AGRICULTURE & FOOD: e-NEWSLETTER

ISSN: 2581 - 8317

Volume 3 - Issue 8
August 2021

Monthly online magazine in agriculture, horticulture, food technology and allied subjects

www.agrifoodmagazine.co.in

EDITORIAL BOARD

INDEX

Agriculture & Food: e-Newsletter Volume 03 – Issue 08 – August 2021
www.agrifoodmagazine.co.in

INDEX

Agriculture & Food: e-Newsletter Volume 03 – Issue 08 – August 2021
www.agrifoodmagazine.co.in

INDEX

Agriculture & Food: e-Newsletter Volume 03 – Issue 08 – August 2021
www.agrifoodmagazine.co.in

INDEX

Agriculture & Food: e-Newsletter Volume 03 – Issue 08 – August 2021
www.agrifoodmagazine.co.in

INDEX

Agriculture & Food: e-Newsletter Volume 03 – Issue 08 – August 2021
www.agrifoodmagazine.co.in

INDEX

Agriculture & Food: e-Newsletter Volume 03 – Issue 08 – August 2021
www.agrifoodmagazine.co.in

INDEX

Agriculture & Food: e-Newsletter Volume 03 – Issue 08 – August 2021
www.agrifoodmagazine.co.in

AGRICULTURE & FOOD: e-Newsletter Volume 3 – Issue 8 – August 2021
www.agrifoodmagazine.co.in
e-ISSN: 2581-8317

Desert Agriculture and Agroforestry

Article id: INV109
Samuel Shay
***Corresponding author's email: gulf@gts-il.com**

INTRODUCTION:

In order to improve food security, arid regions should establish desert agriculture and desert agroforestry as their mainstream agricultural technique. Such regions include Africa, the Middle East, and Australia.

Desert agriculture is the farming of crops well-suited for arid conditions, such as sorghum. Desert agroforestry is the growing of crops with the environmental support of trees in desert or arid areas.

By incorporating these two agricultural techniques, countries should expect two results. One is the increase in food in desert regions due to the successful growth of specific crops that are well-suited to the dry and hot environment. Other crops would require many more resources and much more maintenance in order to just survive in such a climate. The other is the prevention of desertification, which is defined by "Desertification" (2006) as the destruction of animal and plant life in arid areas due to human actions, by the active revegetation of arid lands.

Region-specific Agriculture

According to Markwei, Ndlovu, Robinson, and Shah (2010), "A broader perspective [to reducing hunger in Africa] encompasses an integrated agricultural commodity value chain from production through to processing

e-ISSN: 2581-8317

and marketing with a local and regional perspective. It accounts for the multiple functions of agriculture that include the improvement of livelihoods, the enhancement of environmental services, the conservation of natural resources and biodiversity, and the contribution of agriculture to the maintenance of social and cultural traditions" (p. 7).

The proposed solution goes hand in hand with this quote.

A comparison of corn grown with fertilizer (right) and corn grown without it (left) in Malawi. The fertilizer requires annual reapplication and is still pricey for farmers despite subsidization. Source: Duffell, 2007

Currently, several countries of arid climates support the growth of maize despite its need for water and irrigation. But as realized in Kenya, the increasingly arid land is unable to support maize crops (Mbogo, 2010). This proves that while maize is an internationally important grain, and is successfully grown in many areas, it is not the most suitable crop for Africa. By growing crops suitable for arid climates, not only will more water be available for other purposes, but less intensive and more sustainable and organic farming will be possible. Specific species, particularly those suitable for Africa, for not only agriculture but also agroforestry is described a bit later in the page. Also, growing plants and crops in desert areas will help prevent desertification, which is a problem many countries are facing. According to "Desertification" (2006), one way to prevent desertification is by preventing soil erosion, which planting vegetation will do. Moreover, since plants native to arid climates will be planted, the plants will be low maintenance and will thrive, as proven by their natural existence in the climates today (Mnzava, 1985).

Case Study: Africa

The following is a list of plant species that can play a vital role in the proposed solution for Africa, and other arid regions after taking cultural and environmental factors, as explained later, into account. Several are particularly attractive because of their ability to fix nitrogen, which is the process of putting nitrogen, a valuable element for plant growth, back into the soil. Putting nitrogen and other nutrients back into the soil

e-ISSN: 2581-8317

provides food for growing vegetation and can potentially reverse desertification by reviving the soil ("Desertification," 2006).
Dregne (1976) lists several plants that live in but are not limited to the arid regions if Africa (p.56). The list includes:

- Acacia

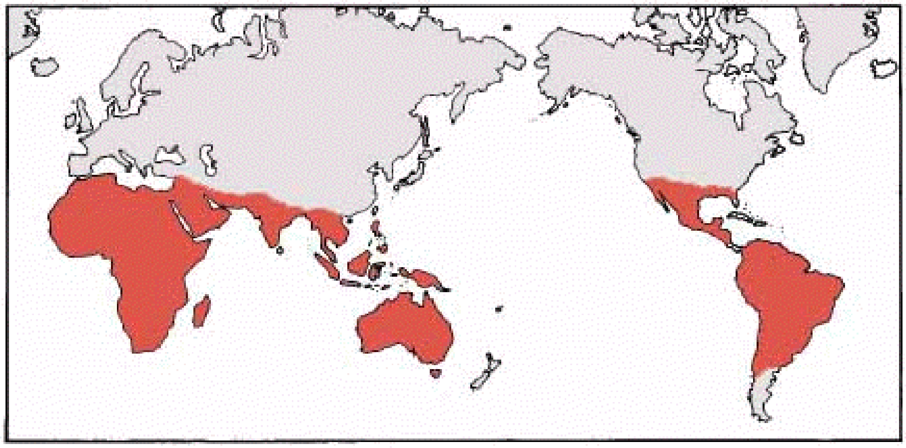
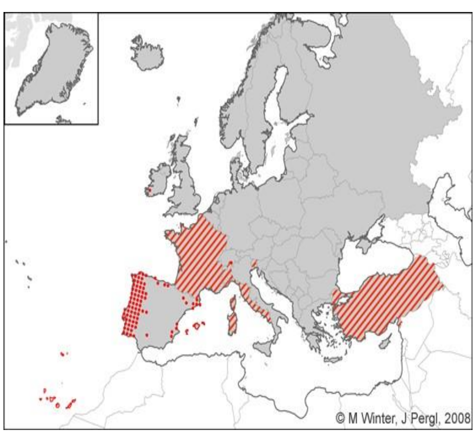


Figure 1. Distribution of acacia in terms of maps. Source: Australian National Botanic Gardens [ANBC], 2010

In addition to having medicinal uses, wood suitable for construction material and fuel, and edible products for humans and animals, widespread (as seen by the above figures) acacia trees provide environmental benefits too (World Agricultural Centre [ICRAF], 2009). It serves as a wind breaker and prevents soil erosion; but most importantly it is a great source of nitrogen (ICRAF, 2009).



(Left) Figure 2. Distribution of *Acacia dealbata* in Europe (as an alien species) Source: Marchante, 2006 (Right) Figure 3. Distribution of acacia aneura in Australia. Source: Nix & Austin, 1973

In a study with *Acacia dealbata,* the trees, planted at 2500 stems per hectare (stems/ha) were able to generate about 50 kilograms of nitrogen per hectare (kg/ha)—40 kg/ha was in the soil, and 10kg/ha was in its vegetation in one year (May & Atwill, 2003). A part of the study was performed in a region that was slashed and burned,

e-ISSN: 2581-8317

so nitrogen fixation was greater there because of the nutrient-rich ash (May & Atwill, 2003). However, it is not advisable to perform such agricultural techniques because it was calculated for the acacia trees to take 9 years to replenish the nitrogen that was lost (May & Atwill). What makes several, if not most species of acacia trees particularly interesting is "reverse leaf phenology" (Heimbuch, 2009). Reverse leaf phenology makes the tree shed its nitrogen-rich acacia leaves at the start of the rainy season, which creates high quality, nutrient-filled soil (Heimbuch, 2009). As recorded by Boffa, reverse leaf phenology and nitrogen fixation of *Faidherbia albida (F.albida)* acacia trees yield about a 30% to 150% increase in nitrogen content depending on the environment (Boffa, 1999).

Planting crops alongside the trees is also attractive because the leaves fall at the same time as when farmers plant seeds, which is at the beginning of the rainy season, and nitrogen and other nutrients are released when the growing crops need them most (Hines & Eckman). The crops and trees also do not compete for sunlight because the trees have shed their leaves, and F. albida trees also provide little competition for water resources, even when planted at 4 by 4 meters away from each other (Boffa, 1999). According to Roupsard, Ferhi, Granier, Pallo, Depommier, Mallet, Joly, and Dreyer (1999), the trees only use less than 5% of annual rainfall. In Malawi, growing maize alongside these trees increased yields by 280% (Heimbuch, 2009). The corn and trees do not compete for sunlight because the corn grows when the leaves of the acacia tree are gone, and the leaves fall coincidentally at the same time as when farmers plant their seeds (Heimbuch, 2009). Yields for other crops grown with F. albida trees are shown on this table (Boffa, 1999).

Table 1. Improvement (%) of soil nutrient content under Faidherbia albida canopies compared to controls

Source	Carbon	Total N	Avg P	Exch. K	Ca	Mg	Na
Charreau & Vidal	62	94	134	43	100	78	33
Dancette & Poulain	37	33	32		43		
Jung 1966	100	100					
Jung 1969		156	57	45	270	53	
Olivier et al 1996	11-86	15-107	18-36	70-115	2-47	0-33	
Seyler 1993	38 (organic matter)	60	60	113	28	36	

Source: Boffa, 1999, Biophysical Factors in Parkland Management: Parkland tree species

Note that key to reverse leaf phenology is letting the acacia trees grow naturally, which includes not pruning them (Boffa, 1999). As cited by Heimbuch (2009), Dennis Garrity, Director General of the World Agroforestry Centre, says, "Growing the right tree in the right place on farms in sub-Saharan Africa-and worldwide- has the potential to slow climate change, feed more people, and protect the environment. This tree, as a source of free, organic nitrogen, is an example of that. There are many other examples of solutions to African farming that exist here already."

e-ISSN: 2581-8317

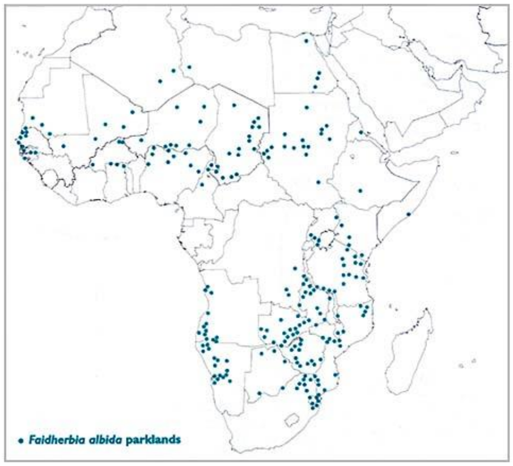


Figure 4. Map of distribution of *Faidherbia albida* in Africa. Source: Boffa, 1999, Agroforestry Parkland Systems

Table 2. Crop yields under and outside *Faidherbia albida* canopies

Crop	Grain yield (kg/ha)			Biomass yield (kg/ha)			Source
	outside	under	difference (%)	outside	under	difference (%)	
Millet	660	1669	153				Charreau & Vidal (1965)
Millet	645	1044	62				Louppe et al (1996)
Millet	1008	1506	49				Maiga, in Kessler (1992)
Sorghum	457	934	104	5480	10490	100	Dancette & Poulain (1969)
Sorghum, fertilizer	1340	1388	3	15870	18140	14	Dancette & Poulain (1969)
Sorghum	1570	2130	36				Poschen (1986)
Sorghum	197	529	169	1538	2607	70	Depommier et al (1992)
Sorghum	889	937	5				Maiga, in Kessler (1992)
Maize (local)			42-272				Saka et al. (1994)
Maize (hybrid)			76-78				Saka et al. (1994)

e-ISSN: 2581-8317

Table 2. Crop yields under and outside *Faidherbia albida* canopies

Crop	Grain yield (kg/ha)			Biomass yield (kg/ha)			Source
Maize	1920	3390	76	53 g/pl.	66 g/pl.	24	Poschen (1986)
Maize			27			22	Depommier et al (1996a)
Groundnut	1181	1052	-11	990	1382	40	Louppe et al (1996)
Groundnut, manure	1289	992	-23	1492	1459	-2	Louppe et al (1996)
Groundnut	810	1108	37	860	1266	47	Dancette & Poulain (1966), in CTFT (1988)
Groundnut, fertilizer	954	1136	19	1091	1386	27	Dancette & Poulain (1996), in CTFT (1988)

Source: Boffa, 1999, Biophysical Factors in Parkland Management: Influence of trees on mineral content of understoery plants

While most scientists are attracted to *F. albida* in sub-Saharan Africa, the same idea is applicable in many other areas with other types of acacia. For example, one study, performed in Blue Nile Sudan, showed that *Acacia senegal* under different climates perform similarly in terms of nitrogen fixing, and that in turn increases with the age of the tree (Raddad, Salih, Fadl, Kaarakka & Luukkanen, 2005). And within the research mentioned up to this point, three different species have been evaluated, and all had nitrogen fixing properties. Boffa (1999) agrees, saying, “Nutrient enrichment under other parkland trees may be less remarkable than for *F. albida* but is also common” (Parkland Tree Species).

Such a project to integrate acacias into agriculture already exists. The Maradi Integrated Development Project (MIDP), having successfully developed sustainable agriculture for twenty years, encourages Niger to use agroforestry (with Australian acacias) as a sustainable farming technique (“Austrailian Acacias,” 2008).

- Adansonia

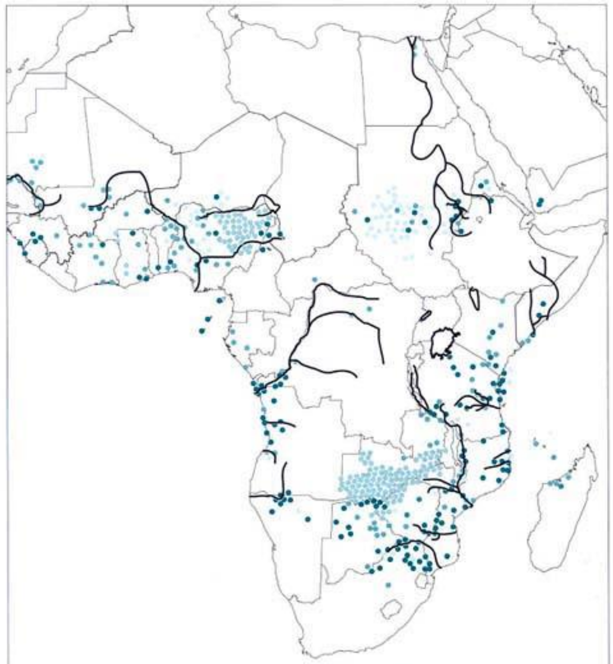


Figure 5. Distribution of *A. digitata.* Varying dot shades are from different sources, documented on the original website. Notice the dots in Yemen. Source: Boffa, 1999, Agroforestry Parkland Systems: Other important parkland species

While *Adansonia,* commonly known as baobabs, do not necessarily have nitrogen fixing properties, African natives are able to utilize almost every part of the tree for food or other commodities (Mnzava, 1985). Most species exist in Madagascar, but the *Adansonia digitata* grows throughout Africa, even though it is only indigenous to the southern area, because it was spread by natives (Le Jardin Naturel, n.d.). Baobabs are able to survive in several areas, particularly arid regions because their massive trunks store a significant amount of water ("*Adansonaia*," n.d.). *A. digitata* even appears to be a halophyte, since it has been seen growing in salt plains (Oxford, n.d.).

- Balanites

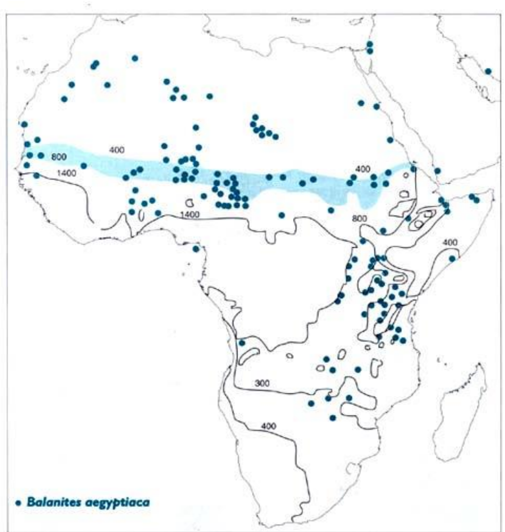


Figure 6. Distribution of *Balanites aegyptiaca.* Source: Boffa, 1999, Agroforestry Parkland Systems: Other Important Parkland Species

Balaniteaegyptica, native to Africa and Middle East, is another species native to Africa that fixes nitrogen (Hines & Eckman, 1993). It also has many uses for feed and fuel, and is an edible, but bitter, vegetable (ICRAF, n.d.c).

- Capparis

Several *Capparis* species, including *C. decidua* and *C. tomentosa*, provide a source of fruit and fodder (ICRAF, n.d.b; ICRAF, n.d.c)

- Sorghum

Sorghum is particularly important for Africa because it is one of the most drought-tolerant grain crops currently being cultivated (U.S. Grain council, 2010). But, sorghum is also able to grow in temperate or tropical regions, in salty or waterlogged soil (NAS, 1996, p. 127). As one of the most efficient plants photosynthetically, sorghum provides the most calories per unit of mechanical energy spent. Internationally, sorghum is already is an important grain that is rich in antioxidants and is gluten-free, and is most likely going to become even more important in the coming years (U.S. Grain Council, 2010). Not only can sorghum be consumed, but it can also be used for forage, construction materials, agricultural purposes, and commercial products (NAS, 1996, p. 128).

- Eragrostis

*Eragrostis tef*is a high quality, drought resistant grain, grown mostly in Ethiopia despite being suitable for many other arid regions and being able to grow under yearly variable conditions (National Academy of Sciences

e-ISSN: 2581-8317

[NAS], 1996, p.218). As shown by Ethiopia's 0.9 million tons of grain grown, or a fourth of the country's cereal production, the crop is quite successful (NAS, 1996, p.215) However, growing *E. tef* requires hard labor; agricultural techniques are not well developed and thus far requires complicated cultural practices (NAS, 1996, p. 218).

Many other species of trees and plants might not provide food, but can be valuable in other respects, such as for medicinal purposes, fodder, and materials that can be used to make other commercial commodities. This list of particular species that can be used in desert agriculture or desert agroforestry does not only pertain to Africa. For example, Australia and Africa have very similar climates and share similar vegetation--Australia has its own native acacias and baobab, and as mentioned above, some of Australia's acacias are being used to help Africa ("Austrailian Acacis," 2008; 20). Astrebla, a drought tolerant grass and important source of feed during dry seasons, is another example, as it is native to Australia, but also suitable for Africa's climate (Cook et al, 2005).

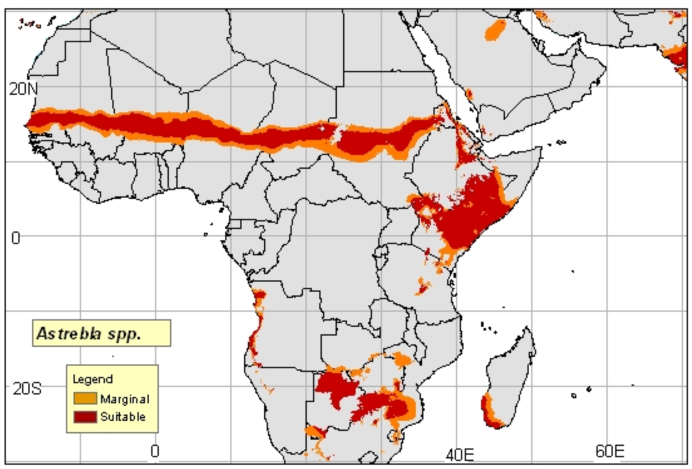


Figure 7. This map shows where *Astrebla spp.* is suitable in Africa. Source: Cook et al, 2005

Implementation

Implementation will come from two directions. One direction starts with convincing participating governments that using region-specific crops for agriculture and incorporating agroforestry will be economically advantageous for the largest number of people. The key is that the plants grown will be agriculturally important and feed people, unlike the plants foresters in Senegal introduced, like the non-native eucalyptus and pine trees, which can only be used as firewood and support no other life (Mnzava, 1985). Eucalyptus trees in particular grow extremely fast, making it advantageous for foresters to grow, but they provide nothing for people other than foresters and their livestock (Mnzava, 1985). To counter situations like this, education of and agreements by the governments and their people, in addition to economic motivation and political coercion, is required in order for regions to implement changes to their agriculture.

e-ISSN: 2581-8317

The government in turn should provide seeds for the native plants, and make it economically advantageous to use native plants as crops.

Farmers who need to change crops will also have to be convinced that the new crops will be profitable due to the fact that they can handle arid conditions better. They will have to phase out their old crops and begin planting the new ones, eventually to produce as much or more than what they originally were. Researchers, teachers, and farmers will need to work together in order to develop and implement the most optimal sustainable methods of growing crops.

The other direction starts at the villages rather than through the government. Often times, more rural communities better understand their own needs and their region's ecosystem because they rely heavily on it. For example, in Senegal, farmers do not cut down baobab trees because they understand its importance in their lives (Mnzava, 1985). They also appreciate nitrogen fixing trees, despite not knowing anything about nitrogen fixation (Mnzava, 1985). By directly giving villagers seeds for their native trees, reforestation would be much more successful, and the villagers would have more sources of food.

According to the International Development Research Centre (IDRC) (1998), a workshop on agroforestry was held at Kenya in 1995 to try to come up with a collaborative model for it. Farmers suggested that the beginnings of agroforestry start as several group nurseries, which could communicate with each other for help, support, and education (IDRC, 1998). The farmers knew that they would need more training and education in order to run the nurseries (IDRC, 1998). Everyone who attended the workshop agreed that there needed to be an "agroforestry forum" that would promote agroforestry techniques, an "agroforestry resource center" to support agroforestry development efforts, which would include native farmer groups, and a tree-seed bank in each district to facilitate agroforestry development (IDRC, 1998).

As a branch off of what the farmers suggested, a "local technology group" will also be developed. The purpose of this group is for farmers and local researchers to develop and provide simple, efficient technologies and techniques that would improve farming efficiencies and production (Gurnitz, 2010). Such techniques could be the optimal spacing of trees that should be used derived by researchers, or the planting of trees in pits to help revive degraded soils as discovered by farmers (Farm Radio International, 2003). The local technology group will disseminate the helpful information and considerably improve crop production.

e-ISSN: 2581-8317

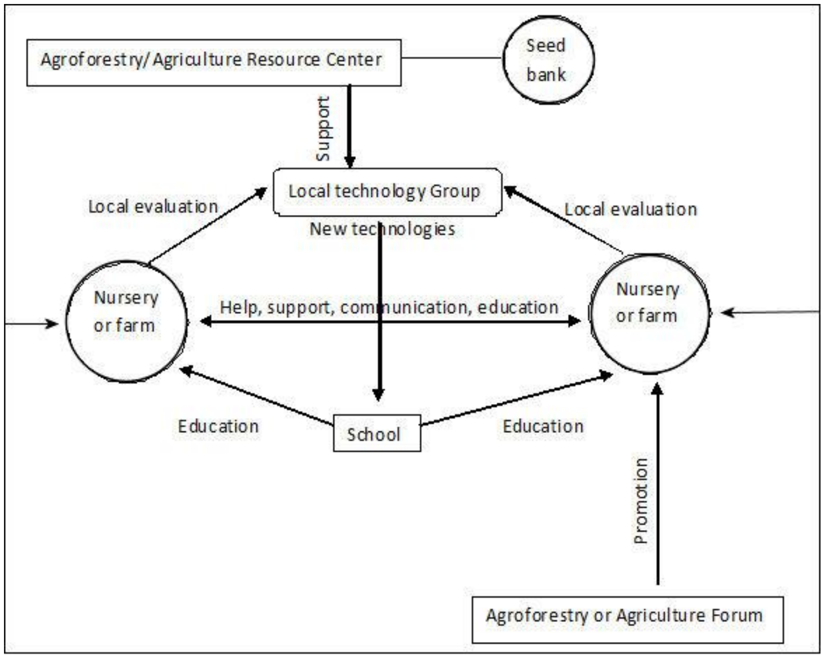


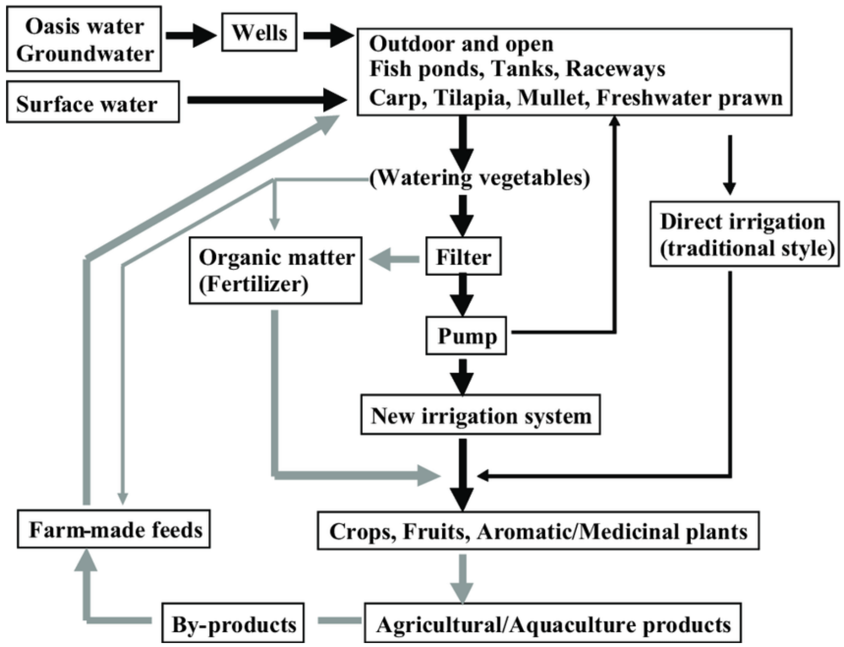
Figure 8: Diagram of suggested organization of groups to implement desert agroforestry and agriculture in villages, adapted from the ideas resulting from the workshop in Kenya in 1998.

There also currently are several projects between banks and non-profit organizations to support farmers. One project, supported by Africa Harvest and Equity Bank, will help 10,000 Kenyan farmers switch from growing corn to growing sorghum (Mbogo, 2010). Equity Bank offers low interest loans for farmers to buy seed and other farming necessities, and Africa Harvest ensures quality yields by offering technical support (Mbogo, 2010). Other projects, like the Coca Cola Project, are investing in 50,000 Kenyan and Ugandan small farmers for their crop yields (Mbogo, 2010).

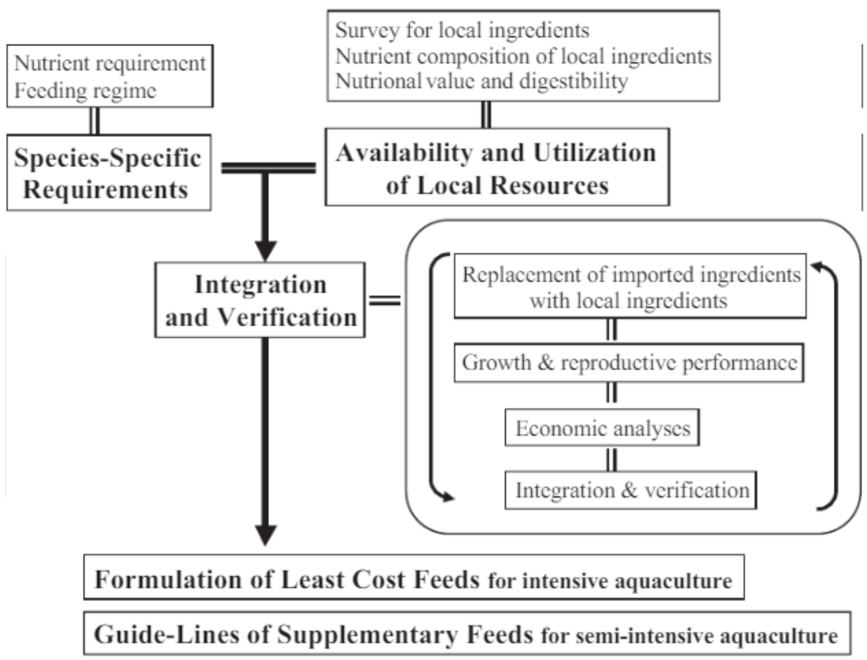
Similar programs focusing more on the spread of desert agroforestry and desert agriculture will help implement the solution to feed people in arid countries.

Similarly, we can look at model of desert aquaculture in Egypt, and possibly in other arid regions in Africa.

e-ISSN: 2581-8317



In the same fashion, we can propose the following method to develop feeds and feeding technologies.



The Limits of Region-Specific Agriculture and Agroforestry

This plan primarily targets regions that suffer from extremely arid, arid, or semi-arid conditions. These regions would be defined by the Thornthwaite moisture index that depends not only on precipitation, but other conditions such as topographical distance from a water source (Dregne, 1976, p.5, 7).

However, the planting of these species should not infringe on other ecosystems that exist with minimal human interaction. For example, savannahs should remain savannahs and support their ecosystems. Where people already are farming, and where civilizations already exist, are suitable places for planting more trees.

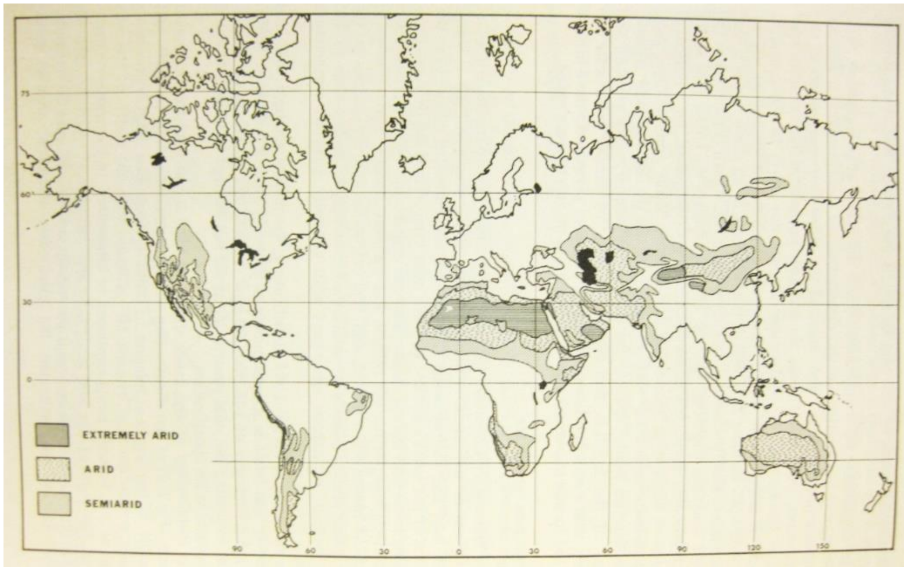


Figure 8: A map of arid regions in the world. Source: modified from Meigs, 1953, by Dregne, 1976, p.6

This plan of implementing agroforestry and more suitable crops for agriculture can also be extended to any place undergoing desertification or soil degradation. However, only certain species should be planted, depending on the region they are being planted in. Most native plants are suitable, while the effects of introduced species need to be analyzed beforehand, or evaluated in a small area where it will not do too much damage. The plants grown should not be high maintenance or require many resources. Instead, they should provide nutrients for the soil, particularly nitrogen, and provide food. At best, they would support biodiversity, fix nitrogen, and provide food.

Economics and Funding

Governments will have an incentive to fund new agriculture and agroforestry since it will increase agricultural production and reduce hunger. The international market for several African crops, like tef, is increasing, too (NAS, 1996, p.217). Aid will come from charities, volunteer groups, and concerned organizations (for instance, the Rockefeller Foundation).

Some organizations we would work with include the aforementioned Rockefeller Foundation, the US Agency for International Development, Winrock International, and the Partnership to Cut Hunger and Poverty in Africa are possible organizations who will help implement this plan. Implementing agroforestry, especially with acacia trees, is supported by the World Agroforestry Center (Heimbuch, 2009). Many other organizations and smaller volunteer groups would be willing to work with the implementation of the plan by helping plant trees or other vegetation, since the work would be a direct help to the environment with tangible results. Overall, the implementation of this project should not be unreasonably expensive, especially if funded by large corporations, as some were in Kenya (Mbogo, 2010). In models where the government or non-profit organizations provide free distribution of seeds, some cost must be anticipated for providing seeds, providing education of optimal agricultural techniques, and starting groups or foundations dedicated to desert agriculture and agroforestry. On the bright side, particularly since native plants are being introduced, many seeds should already be available to the people and fairly inexpensive. Also, many countries already practice seed distribution. Unfortunately, in some cases, like in Tanzania, according to Mnzava (1985), some villagers are given seeds for trees that are not helpful in producing food for them or their animals. So, if they were actually given seeds for desert agriculture, the villagers' situation would have food to eat and to sell.

A eucalyptus forest, which has clearly been planted. While this particular forest might not have been a result of government seed distribution to the villagers, there is a large amount of seeds being bought and planted. Also note how it is a barren forest. Source: Lang, 2004b

In Peshawar, Pakistan, the government gave 1450 farmers a 50kg bag of wheat seeds, a 50kg bag of fertilizer, and a 50kg bag of assorted vegetable seed, funded by the European Union to help them recover from the recent flood that destroyed their crops ("Government distributes," 2010; "EU Firm," 2010). If similar numbers were used for this project, each farmer will receive a bag of roughly 100kg of an assortment of seeds, depending on what they are planning to grow and the mass of each seed. They will need only minimal amounts of fertilizer, if any, because the plants they should be growing are well suited to the current soil and climate. We can project that a 100kg bag of seeds will cost about $100 per farmer. The cost of one kilogram of acacia seeds is 40 US cents ("Australian Acacias," 2003). Moreover, acacia seeds are easy to harvest, nutritious ("Australian Acacias", 2003). One report states that the seeds are produced at about 10kg per tree

(Harwood, Rinaudo, & Adewusi, 1999).
However, scientific research to better understand the impact of a species in a region, and scientific research in the proposed agricultural technology groups to develop and implement better agricultural techniques will require monetary funding.

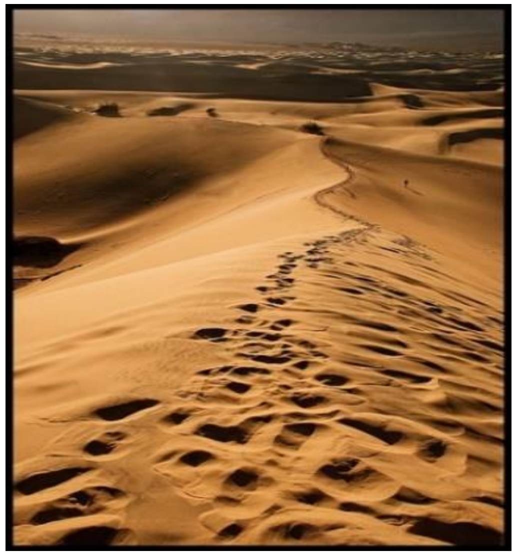
Timescale

Developing agroforestry and agriculture will take about 1 to 5 years to start for each region, but will develop infinitely. The implementation time depends on the education of the farmers and government, the development of groups to promote, develop, and help out with desert agriculture and agroforestry, and the amount of time it will take to phase out old crops and grow trees. After implementation, research will continue to evaluate which plant species should be used in each region's agroforestry and agriculture and develop more efficient and sustainable agricultural techniques. Long term effects, including a better environment overall, most certainly will appear.

Unresolved Issues

While analyzing the traits of certain plants is relatively straight forward, deciding which vegetation should be used to implement desert agriculture and agroforestry and which vegetation should not be is much more difficult.
Some native plants might be more harmful than beneficial to an ecosystem. For example, tamarix trees of North Africa seem detrimental to the environment, since they are salty, water draining trees. However, tamarix are native African trees but only do not compete for water resources with acacia trees because they are distributed so far away from each other (Sher, Wiegand, Ward). In the Americas, tamarix are known weeds that can thrive in a wide range of areas and drain a lot of water ("Non-native", n.d.). A decision about invasive, though perhaps native plant species needs to be made. A one by one analysis on each species is needed, because, despite being generalized under the same category, each species is different. Whether or not to introduce non-native crops is also under debate. As mentioned above, several grains easily found in Africa could be introduced to the Middle East or Australia, or vice versa. But the effects the introduced grains will have on the ecosystems there are unknown. One seemingly positive example is given by "Australian acacias" (2008), where Australian acacias are incorporated into Kenyan crops. However, an example of a debatably negative exotic crop in Africa is the introduced eucalyptus tree. Current research shows that eucalyptus trees, commonly known as "water guzzler," use up a lot of water when planted near water beds, and can severely drain the water table (Okella, 2009; Lang, 2004). In terms of biodiversity, eucalyptus trees support none (Okella, 2009). In the past, when non-native trees overtook the indigenous specious, several crops failed because of the lowered water resources, and ruined food security (Lang, 2004).

e-ISSN: 2581-8317



In the background, there are mesquite bushes growing in the sand dunes, which shows that they could probably survive in the Sahara desert's climate too. However, the environmental impact of introducing mesquite must be evaluated first. Source: Vijayarajan, 2008

From another perspective, eucalyptus trees grow quickly, so they are a good source of wood for foresters, and are extremely helpful in sequestering carbon dioxide (Holman, 2006). Moreover, only one hectare of trees is planted for every ten cut down, so planting fast-growing trees tackles this issue (Okella, 2009). Also, according to Dregne (1976), eucalyptus trees are able to grow on the edges of the Sahara desert (p. 56). In this case, eucalyptus trees do not seem to be water guzzlers, and can be helpful with controlling desertification.

So, as suggested by several supporters of eucalyptus trees, exotic species, even edible desert plants like mesquite, should also be investigated one by one (Okella, 2009). Those that do not devour water sources might be helpful in preventing further desertification, if implemented and planted along the regions becoming uninhabitable by every other plant.

It is also important not to forget the culture of the farmers' and their countries. The seeds and plants provided to the farmers need to match up with the people's lifestyles. If the Masai people survive off their livestock, and need vegetation that would be able to serve as fodder, then they need seeds that will provide them that (Mnzava, 1985).

REFERENCES

[1]. *Adansonia digitatas baobab*. (n.d.). Retrieved November 19, 2010, from http://www.cactus-art.biz/schede/ADANSONIA/Adansonia_digitata/Adansonia_digitata/Adansonia_digitata.htm

[2]. Australian acacias for Africa. (2008, May). *New Agriculturist*. Retrieved November 21, 2010, from http://www.new-ag.info/focus/focusItem.php?a=434

[3]. Boffa, J. M. (1999). *Agroforestry parklands in sub-Saharan Africa*. Retrieved November 24, 2010 from http://www.fao.org/docrep/005/x3940e/X3940E00.htm#TOC

[4]. Cook, B., Pengelly, B., Brown, S., Donnelly, J., Eagles, D., Franco, A., Hanson, J., Mullen, B., Partridge, I., Peters, M., & Schultze-Kraft, R. (2005, June). Astrebla spp. *Tropical Forages: an interactive selection tool* [Online computer software]. Brisbane, Australia: CSIRO, DPI&F (Qld), CIAT, and ILRI. Retrieved November 24, 2010 from http://www.tropicalforages.info/key/Forages/Media/Html/Astrebla_spp.htm

[5]. *Desertification.* (2006). GreenFacts Scientific Board. Retrieved November 24, 2010 from http://www.greenfacts.org/en/desertification/l-2/6-prevention-desertification.htm

[6]. Duffell, J. (2007, December 28). *Fertilizer in Malawi* [picture]. Retrieved November 26, 2010, from http://www.flickr.com/photos/johnduffell/2185913128/in/photostream/

[7]. Dregne, H.E. (1976). *Developments in Soil Science*. New York, NY: Elsevier Scientific Publishing Company.

[8]. EU firm to ensure food security in Pakistan. (2010, November 20). *Daily Times*. Retrieved November 21, 2010, from http://www.dailytimes.com.pk/default.asp?page=2010\11\20\story_20-11-2010_pg5_3

[9]. Farm Radio International. (2003, September). *Rehabilitating degraded land: planting trees in pits.* Retrieved November 21, 2010, from http://www.farmradio.org/english/radio-scripts/68-3script_en.asp

[10]. Government distributes seeds, fertilizers among FATA farmers. (2010, October 15). *Business Recorder*. Retrieved November 21, 2010, from http://www.brecorder.com/section/81/1/1112583:government-distributes-seeds-fertilisers-among-fata-farmers.html

[11]. Harwood, C., Rinaudo, T., Adewusi, S. (1999). Developing Australian acacia seeds as a human food for the Sahel. *Unaslyva—No. 196,* v. 50. Retrieved November 23, 2010, from http://www.fao.org/docrep/x0963e/x0963e0c.htm

[12]. Heimbuch, J. (2009, August 25). Acacia trees could solve Africa's soil problems, be the future for farms [Supplemental material]. Treehugger. Retrieved November 22, 2010, from http://www.treehugger.com/files/2009/08/acacia-trees-could-solve-africas-soil-problems-be-the-future-for-farms.php

[13]. Hines, A.D. & Eckman, K. (1993). Species profiles In *Indigenous multipurpose trees of Tanzania: Uses and economic benefits for people.* Retrieved November 23, 2010, from http://www.fao.org/docrep/x5327e/x5327e00.htm#Contents

[14]. Holman, M. (2006, December). Trees of Africa. *Open Democracy.* Retrieved November 22, 2010 from http://www.opendemocracy.net/democracy-africa_democracy/ugandan_trees_4193.jsp

[15]. International Development Research Centre. (1998). *Agroforestry technologies in semi-arid areas of eastern Kenya*. Retrieved November 23, 2010, from http://www.idrc.ca/en/ev-26976-201-1-DO_TOPIC.html

[16]. Lang, C. (2004a, November). Kenya: biotechnology, eucalyptus but no GM trees. *WRM Bulletin*, 88. Retrieved November 21, 2010, from http://www.africanconservation.org/forum/thread-for-gm-the-environment/11327-kenya-biotechnology-eucalyptus-but-no-gm-trees.html

[17]. Lang, C. (2004b, October 9). *South Africa* [picture]. Retrieved November 27, 2010, from http://www.flickr.com/photos/27886780@N00/84803132/

[18]. Le Jardin Naturel. (n.d). *Baobabs: The species*. Retrieved November 20, 2010, from http://www.baobabs.com/Baobabs_species.htm

[19]. Marchante, H. (2006). *Acacia dealbata* [map]. Delivering Alien Invasive Species Inventories from Europe. Retrieved November 20, 2010, from the DAISIE website http://www.europe-aliens.org/speciesFactsheet.do?speciesId=12749#

[20]. Markwei, C., Ndlovu, L., Robinson, E., & Shah, W. P. (2010). *International assessment of agricultural knowledge, science and technology for development: Summary for decision makers of the Sub-Saharan Africa Report*. FAO. Retrieved November 22, 2010 from http://www.fao.org/docrep/012/al134e/al134e03.pdf

[21]. May, B. M., & Attiwill, P. M. (2003, August 18). Nitrogen fixation by *Acacia dealbata* and changes in soil properties 5 years after mechanical disturbance or slash-burning following timber harvest [Abstract]. *Forest Ecology and Management,* 181, 339-355). doi:10.1016/S0378-1127(03)00006-9

[22]. Mbogo, S. (2010, March 31). *Small scale farmers in Kenya increasingly look to outgrowers' contracts.* Retrieved November 22, 2010, from http://www.africanagricultureblog.com/2010/03/small-scale-farmers-in-kenya.html.

[23]. Mnzava, M. N. (1985). Tanzania tree-planting: A voice from the villages. *Unasylva—No. 150—Forestry and the crisis in Africa,* 37. Retrieved November 21, 2010 from http://www.fao.org/docrep/r5265e/r5265e05.htm

[24]. National Academy of Sciences. (1996). *Lost crops of Africa, Volume I: Grains*. Retrieved November 22, 2010 from http://www.nap.edu/catalog.php?record_id=2305

[25]. Nix & Austin. (1973). *Distribution of mulga (Acacia aneura) in Australia* [map]. Retrieved November 21, 2010 from http://www.fao.org/ag/AGP/AGPC/doc/Publicat/Gutt-shel/x5556e10.gif

[26]. *Non-native Invasive Freshwater Plants: Salt Cedar (Tamarix)*. (n.d.) Washington State Department of Ecology. Retrieved November 21, 2010 from http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua013.html

[27]. Okella, E. (2009, August 27). Eucalyptus trees deadly for Africa—Nobel Laureate. *Climate Change Media Partnership.* Retrieved November 21, 2010, from http://www.climatemediapartnership.org/reporting/stories/eucalyptus-trees-deadly-for-africa-nobel-laureate/

[28]. Pete Oxford. (n.d.). *Baobab (Adansonia digitata)* [picture]. Retrieved November 21, 2010, from http://www.arkive.org/baobab/adansonia-digitata/image-G50349.html

[29]. Raddad, E. A. Y., Salih, A. A., Fadl, M. A. E., Kaarakka, V. & Luukkanen, O. (2005, February 4). Symbiotic nitrogen fixation in eight *Acacia senegal* provenances in dryland clays of the Blue Nile Sudan estimated by N-15 natural abundance method. *Plant and Soil*, 275, 261-269. DOI 10.1007/s11104-005-2152-4

[30]. Roupsard, O., Ferhi, A., Granier, A., Pallo, F., Depommier, D., Mallet, B., Joly, H., & Dreyer, E. (1999). Reverse Phenology and dry-season water uptake by *Faidherbia albida* (Del.) A. Chev. In an agroforestry parkland of Sudanese West Africa. *Functional Ecology*, 13, 460-472. Retrieved November 29, 2010, from http://dx.doi.org/10.1046/j.1365-2435.1999.00345.x

[31]. Sher, A.A., Wiegand, K., & Ward, D. (2010, March). Do *Acacia* and *Tamarix* trees compete for water in the Negev desert? [Abstract]. *Journal of Arid Environments*, 74, 338-343. doi:10.1016/j.jaridenv.2009.09.007

[32]. U.S. Grains Council. (2010). *Sorghum*. Retrieved November 21, 2010, from http://www.grains.org/sorghum

[33]. Vijayarajan, R. (2008, December 21). *Mesquite Dunes, Death Valley, CA* [picture]. Retrieved November 27, 2010, from http://www.flickr.com/photos/rajeshvj/3243367870/in/photostream/

[34]. World Agroforestry Centre (ICRAF) (2009, August 26). Unique Acacia Tree's Promise To Revive African Soils. *ScienceDaily*. Retrieved November 21, 2010, from http://www.sciencedaily.com/releases/2009/08/090824182535.htm

[35]. World Agroforestry Centre. (n.d.a) Balanites aegyptiaca. *Agroforestry Tree Database*. Retrieved November 21, 2010, from http://www.worldagroforestrycentre.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=279#Ecology
[36]. World Agroforestry Centre. (n.d.b). Capparis tomentosa. *Agroforestry Tree Database.* Retrieved November 21, 2010, from http://www.worldagroforestrycentre.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=439
[37]. World Agroforestry Centre. (n.d.c) Capparis decidua. *Agroforestry Tree Database*. Retrieved November 21, 2010, from http://www.worldagroforestrycentre.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=18007

AGRICULTURE & FOOD: e-Newsletter Volume 3 – Issue 8 – August 2021
www.agrifoodmagazine.co.in
e-ISSN: 2581-8317

THE IMPACT OF THE WORLD CLIMATE FOLLOWING THE GROWTH OF THE DESERTS AND THE SOLUTION TO THE EXTERMINATION OF THE DESERT GROWTH

Article id: INV110

Samuel Shay
*Corresponding author's email: gulf@gts-il.com

1. INTRODUCTION

Deserts are areas that receive very little precipitation. People often use the adjectives "hot," "dry," and "empty" to describe deserts, but these words do not tell the whole story. Although some deserts are very hot, with daytime temperatures as high as 54°C (130°F), other deserts have cold winters or are cold year-round. And most deserts, far from being empty and lifeless, are home to a variety of plants, animals, and other organisms. People have adapted to life in the desert for thousands of years.

One thing all deserts have in common is that they are arid, or dry. Most experts agree that a desert is an area of land that receives no more than 25 centimeters (10 inches) of precipitation a year. The amount of evaporation in a desert often greatly exceeds the annual rainfall. In all deserts, there is little water available for plants and other organisms.

Deserts are found on every continent and cover about one-fifth of Earth's land area. They are home to around 1 billion people—one-sixth of the Earth's population.

Although the word "desert" may bring to mind a sea of shifting sand, dunes cover only about 10 percent of the world's deserts. Some deserts are mountainous. Others are dry expanses of rock, sand, or salt flats.

1.1 Desert Characteristics

Humidity water vapor in the air is near zero in most deserts. Light rains often evaporate in the dry air, never reaching the ground. Rainstorms sometimes come as violent cloudbursts. A cloudburst may bring as much as 25 centimeters (10 inches) of rain in a single hour—the only rain the desert gets all year.

Desert humidity is usually so low that not enough water vapor exists to form clouds. The sun's rays beat down through cloudless skies and bake the land. The ground heats the air so much that air rises in waves you can actually see. These shimmering waves confuse the eye, causing travelers to see distorted images called mirages.

Temperature extremes are a characteristic of most deserts. In some deserts, temperatures rise so high that people are at risk of dehydration and even death. At night, these areas cool quickly because they lack the insulation provided by humidity and clouds. Temperatures can drop to 4°C (40°F) or lower.

In the Chihuahua Desert, in the United States and Mexico, temperatures can vary by dozens of degrees in one day. Daytime temperatures in the Chihuahua can climb beyond 37°C (100°F), while nighttime temperatures can dip below freezing (0°C or 32°F).

Winds at speeds of about 100 kilometers per hour (60 miles per hour) sweep through some deserts. With little vegetation to block it, the wind can carry sand and dust across entire continents and even oceans. Windstorms in the Sahara hurl so much material into the air that African dust sometimes crosses the Atlantic Ocean. Sunsets on the Atlantic coast of the U.S. state of Florida, for example, can be tinted yellow.

First-time visitors to deserts are often amazed by the unusual landscapes, which may include dunes, towering bare peaks, flat-topped rock formations, and smoothly polished canyons. These features differ from those of wetter regions, which are often gently rounded by regular rainfall and softened by lush vegetation.

Water helps carve desert lands. During a sudden storm, water scours the dry, hard-baked land, gathering sand, rocks, and other loose material as it flows. As the muddy water roars downhill, it cuts deep channels, called arroyos or wadis. A thunderstorm can send a fast-moving torrent of water—a flash flood—down a dry arroyo. A flash flood like this can sweep away anything and anyone in its path. Many desert regions discourage visitors from hiking or camping in arroyos for this reason.

Even urban areas in deserts can be vulnerable to flash floods. The city of Jeddah, Saudi Arabia, sits in the Arabian Desert. In 2011, Jeddah was struck by a sudden thunderstorm and flash flood. Roads and buildings were washed away, and more than 100 people died.

Even in a desert, water and wind eventually wear away softer rock. Sometimes, rock is carved into table like formations such as mesas and buttes. At the foot of these formations, water drops its burden of gravel, sand, and other sediment, forming deposits called alluvial fans.

Many deserts have no drainage to a river, lake, or ocean. Rainwater, including water from flash floods, collects in large depressions called basins. The shallow lakes that form in basins eventually evaporate, leaving playas, or salt-surfaced lake beds. Playas, also called sinks, pans, or salt flats, can be hundreds of kilometers wide.

The Black Rock Desert in the U.S. state of Nevada, for instance, is all that remains of the prehistoric Lake Lahontan. The hard, flat surface of desert salt flats are often ideal for car racing. In 1997, British pilot Andy Green set the land speed record in Black Rock Desert—1,228 kilometers per hour (763 miles per hour). Green's vehicle, the Thrusts SC, was the first car to break the sound barrier.

e-ISSN: 2581-8317

1.2. Life in the Desert

Plants and animals adapt to desert habitats in many ways. Desert plants grow far apart, allowing them to obtain as much water around them as possible. This spacing gives some desert regions a desolate appearance.

In some deserts, plants have unique leaves to capture sunlight for photosynthesis, the process plants use to make food. Small pores in the leaves, called stomata, take in carbon dioxide. When they open, they also release water vapor. In the desert, all these stomata would quickly dry out a plant. So desert plants typically have tiny, waxy leaves. Cactuses have no leaves at all. They produce food in their green stems.

Some desert plants, such as cactuses, have shallow, wide-spreading root systems. The plants soak up water quickly and store it in their cells. Saguaro cactuses, which live in the Sonoran Desert of Arizona and northern Mexico, expand like accordions to store water in the cells of their trunks and branches. A large saguaro is a living storage tower that can hold hundreds of liters of water.

Other desert plants have very deep roots. The roots of a mesquite tree, for example, can reach water more than 30 meters (100 feet) underground.

Mesquites, saguaros, and many other desert plants also have thorns to protect them from grazing animals.

Many desert plants are annuals, which means they only live for one season. Their seeds may lie dormant for years during long dry spells. When rain finally comes, the seeds sprout rapidly. Plants grow, bloom, produce new seeds, and die, often in a short span of time. A soaking rain can change a desert into a wonderland of flowers almost overnight.

Animals that have adapted to a desert environment are called xerocoles. Xerocoles include species of insects, reptiles, birds, and mammals. Some xerocoles avoid the sun by resting in scarce shade. Many escape the heat in cool burrows they dig in the ground. The fennec fox, for example, is native to the Sahara Desert. Fennec fox communities work together to dig large burrows, some as large as 93 square meters (1,000 square feet). Dew can collect in these burrows, providing the foxes with fresh water. However, fennec foxes have adapted so they do not have to drink water at all: Their kidneys retain enough water from the food they eat.

1.3. Desertification

Desertification is the process of productive cropland turning into non-productive, desert-like environments. Desertification usually happens in semi-arid areas that border deserts.

e-ISSN: 2581-8317

Human activities are a primary cause of desertification. These activities include overgrazing of livestock, deforestation, overcultivation of farmland, and poor irrigation practices. Overgrazing and deforestation remove plants that anchor the soil. As a result, wind and water erode the nutrient-rich topsoil. Hooves from grazing livestock compact the soil, preventing it from absorbing water and fertilizers. Agricultural production is devastated, and the economy of a region suffers.

The deserts of Patagonia, the largest in South America, are expanding due to desertification. Patagonia is a major agricultural region where non-native species such as cattle and sheep graze on grassland. Sheep and cattle have reduced the native vegetation in Patagonia, causing loss of valuable topsoil. More than 30 percent of the grasslands of Argentina, Chile, and Bolivia are faced with desertification.

People often overuse natural resources to survive and profit in the short term, while neglecting long-term sustainability. Madagascar, for instance, is a tropical island in the Indian Ocean. Seeking greater economic opportunities, farmers in Madagascar engaged in slash-and-burn agriculture. This method relies on cutting and burning forests to create fields for crops. Unfortunately, at the time farmers were investing in slash-and-burn agriculture, Madagascar experienced long-term droughts. With little vegetation to anchor it, the thin topsoil quickly eroded. The island's central plateau is now a barren desert.

2. Desertification impacts on natural and socio-economic systems under climate change.

2.1. Impacts On Natural and Managed Ecosystems

2.1.1. Impacts On Ecosystems and Their Services in Drylands

The Millennium Ecosystem Assessment (Assessment, 2005) proposed four classes of ecosystem services: provisioning, regulating, supporting and cultural services (Cross-Chapter Box 8 in Chapter 6). These ecosystem services in drylands are vulnerable to the impacts of climate change due to high variability in temperature, precipitation and soil fertility (Enfors, 2008). There is high confidence that desertification processes such as soil erosion, secondary salinization, and overgrazing have negatively impacted provisioning ecosystem services in drylands, particularly food and fodder production ((Majeed, 2019) (Mirzabaev, 2016a) reported an estimation of NPP losses between 0.8 and 2.0 GtC yr–1 due to desertification, comparing the potential NPP and the NPP calculated for the year 2000. In terms of climatic factors, although climatic changes between 1976 and 2016 were found to be favorable for crop yields overall in Russia (Ivanov, 2018), yield decreases of up to 40–60% in dryland areas were caused by severe and extensive droughts (Ivanov, 2018). Increase in temperature can have a direct impact on animals in the form of increased physiological stress (Rojas-Downing, 2017), increased water requirements for drinking and cooling, a decrease in the production of milk, meat and eggs, increased stress during conception and reproduction (Nardone, 2010) or an increase in seasonal diseases and epidemics (Nardone, 2010). Furthermore, changes in temperature can indirectly impact livestock through reducing the productivity and quality of feed crops and forages. On the other hand, fewer days with extreme cold temperatures during winter in the temperate zones are associated with lower livestock mortality.

Over-extraction is leading to groundwater depletion in many dryland areas (Mudd, 2000) (Mays, 2013)Globally, ground water reserves have been reduced since 1900, with the highest rate of estimated reductions of 145 km3 yr–1 between 2000 and 2008 (Konikow, 2011). Some arid lands are very vulnerable to groundwater reductions, because the current natural recharge rates are lower than during the previous wetter periods (e.g., the Atacama Desert, and Nubian aquifer system in Africa) (Herrera, 2018)

Among regulating services, desertification can influence levels of atmospheric CO2. In drylands, the majority of carbon is stored below ground in the form of biomass and SOC. Land-use changes often lead to reductions in SOC and organic matter inputs into soil (Albaladejo, 2013) increasing soil salinity and soil erosion. In addition to the loss of soil, erosion reduces soil nutrients and organic matter, thereby impacting land's productive capacity. To illustrate, soil erosion by water is estimated to result in the loss of 23–42 Mt of nitrogen and 14.6–26.4 Mt of phosphorus from soils globally each year (Pierzynski, 2017)

Precipitation, by affecting soil moisture content, is considered to be the principal determinant of the capacity of drylands to sequester carbon (Majeed, 2019) (Serrano-Ortiz, 2015). Lower annual rainfall resulted in the release of carbon into the atmosphere for a number of sites located in Mongolia, China and North America (Biederman, 2017) (Chen, 2009). Low soil water availability promotes soil microbial respiration, yet there is insufficient moisture to stimulate plant productivity (Austin, 2004), resulting in net carbon emissions at an ecosystem level. Under even drier conditions, photo degradation of vegetation biomass may often constitute an additional loss of carbon from an ecosystem. In contrast, years of good rainfall in drylands resulted in the sequestration of carbon (Biederman, 2017) (Chen, 2009). In an exceptionally rainy year (2011) in the southern hemisphere, the semi-arid ecosystems of this region contributed 51% of the global net carbon sink. These results suggest that arid ecosystems could be an important global carbon sink, depending on soil water availability (medium evidence, high agreement). However, drylands are generally predicted to become warmer with an increasing frequency of extreme drought and high rainfall events.

When desertification reduces vegetation cover, this alters the soil surface, affecting the albedo and the water balance (Gonzalez-Martin, 2014). In such situations, erosive winds have no more obstacles, which favors the occurrence of wind erosion and dust storms. Mineral aerosols have an important influence on the dispersal of soil nutrients and lead to changes in soil characteristics (Gonzalez-Martin, 2014). Thereby, the soil formation as a supporting ecosystem service is negatively affected. Soil erosion by wind results in a loss of fine soil particles (silt and clay), reducing the ability of soil to sequester carbon. Moreover, dust storms reduce crop yields by loss of plant tissue caused by sandblasting (resulting in loss of plant leaves and hence reduced photosynthetic activity, exposing crop roots, crop seed burial under sand deposits, and leading to losses of nutrients and fertilizer from topsoil (Stefanski, 2009). Dust storms also impact crop yields by reducing the quantity of water available for irrigation; they can decrease the

e-ISSN: 2581-8317

storage capacity of reservoirs by siltation, and block conveyance canals (Stefanski, 2009). Livestock productivity is reduced by injuries caused by dust storms (Stefanski, 2009). Additionally, dust storms favour the dispersion of microbial and plant species, which can make local endemic species vulnerable to extinction and promote the invasion of plant and microbial species Dust storms increase microbial species in remote sites (Konikow, 2011).

2.1.2. Impacts on biodiversity: Plant and wildlife

Plant biodiversity

Over 20% of global plant biodiversity centers are located within drylands (White, 2003). Plant species located within these areas are characterized by high genetic diversity within populations. The plant species within these ecosystems are often highly threatened by climate change and desertification (Assessment, Ecosystems and Human Well-Being: Desertification Synthesis. , 2005). Increasing aridity exacerbates the risk of extinction of some plant species, especially those that are already threatened due to small populations or restricted habitats. Desertification, including through land-use change, already contributed to the loss of biodiversity across drylands. For example, species richness decreased from 234 species in 1978 to 95 in 2011 following long periods of drought and human driven degradation on the steppe land of south-western Algeria (Observatoire du Sahara et du Sahel, 2018). Similarly, drought and overgrazing led to loss of biodiversity in Pakistan to the point that only drought-adapted species can now survive on the arid rangelands. Similar trends were observed in desert steppes of Mongolia. In contrast, the increase in annual moistening of southern European Russia from the late 1980s to the beginning of the 21st century caused the restoration of steppe vegetation, even under conditions of strong anthropogenic pressure (Ivanov, 2018). The seed banks of annual species can often survive over the long term, germinating in wet years, suggesting that these species could be resilient to some aspects of climate change.

Wildlife biodiversity

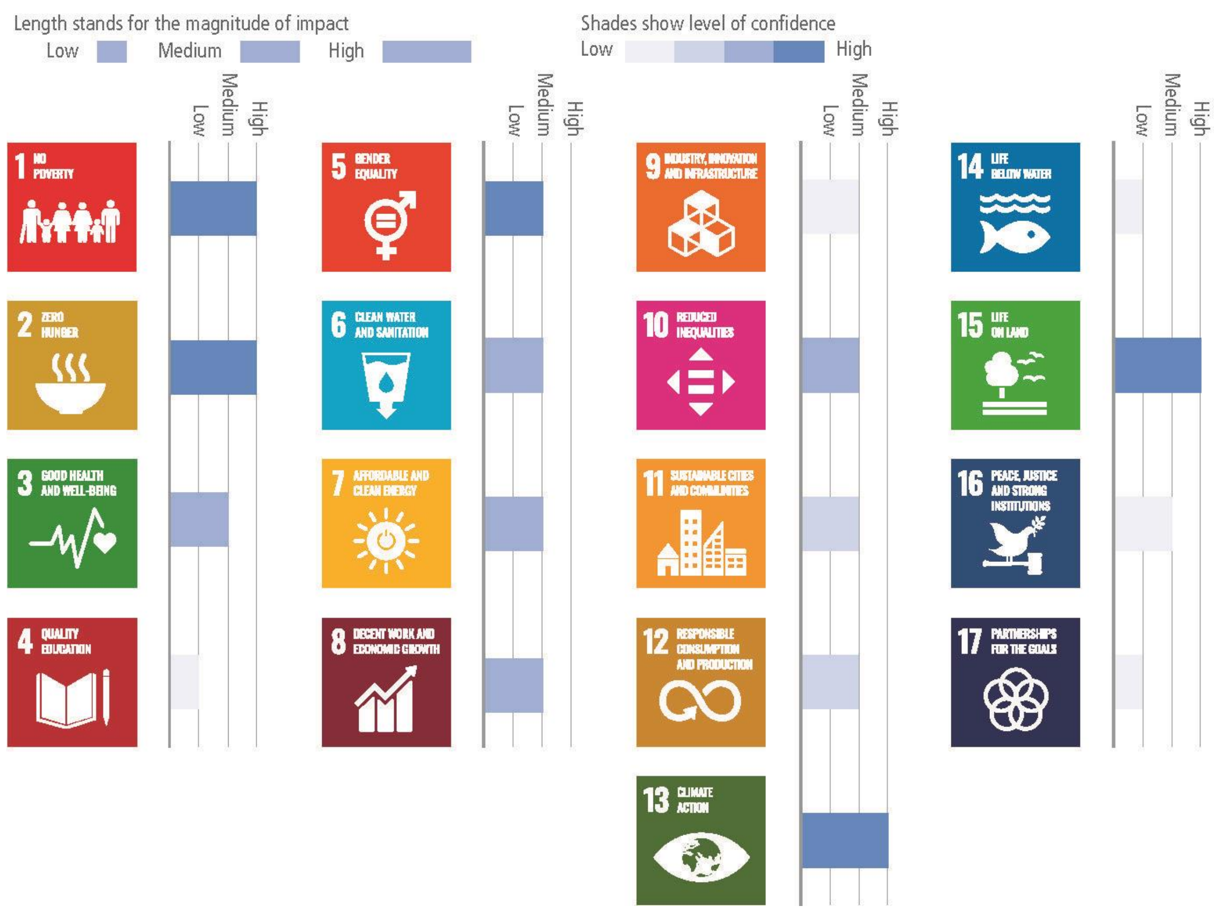
Dryland ecosystems have high levels of faunal diversity and endemism (Whitford, 2002). Over 30% of the endemic bird areas are located within these regions, which is also home to 25% of vertebrate species (Whitford, 2002).Yet, many species within drylands are threatened with extinction. Habitat degradation and desertification are generally associated with biodiversity loss. The 'grazing value' of land declines with both a reduction in vegetation cover and shrub encroachment, with the former being more detrimental to native vertebrates. Conversely, shrub encroachment may buffer desertification by increasing resource and microclimate availability, resulting in an increase in vertebrate species abundance and richness observed in the shrub-encroached arid grasslands of North (Whitford, 2002). However, compared to historically resilient drylands, these encroached habitats and their new species assemblages may be more sensitive to droughts, which may become more prevalent with climate change.

 Volume 3 – Issue 8 – August 2021
www.agrifoodmagazine.co.in
e-ISSN: 2581-8317

2.1.3. Impacts on socio-economic systems

Combined impacts of desertification and climate change on socio-economic development in drylands are complex. Figure 3.9 schematically represents our qualitative assessment of the magnitudes and the uncertainties associated with these impacts on attainment of the SDGs in dryland areas (UN, 2015). The impacts of desertification and climate change are difficult to isolate from the effects of other socio-economic, institutional and political factors (Pradhan, 2017). However, there is high confidence that climate change will exacerbate the vulnerability of dryland populations to desertification, and that the combination of pressures coming from climate change and desertification will diminish opportunities for reducing poverty, enhancing food and nutritional security, empowering women, reducing disease burden, and improving access to water and sanitation. Desertification is embedded in SDG 15 (Target 15.3) and climate change is under SDG 13. The high magnitude impacts depicted for these SDGs (Figure 3.9) indicate that the interactions between desertification and climate change strongly affect the achievement of the targets of SDGs 13 and 15.3, pointing at the need for the coordination of policy actions on land degradation neutrality and mitigation and adaptation to climate change. The following subsections present the literature and assessments which serve as the basis for Figure 3.9.

Socio-economic impacts of desertification and climate change with the SDG framework.



2.1.4. Impacts On Poverty

Climate change has a high potential to contribute to poverty particularly through the risks coming from extreme weather events. However, the evidence rigorously attributing changes in observed poverty to climate change impacts is currently not available. On the other hand, most of the research on links between poverty and desertification (or more broadly, land degradation) focused on whether or not poverty is a cause of land degradation. The literature measuring the extent to which desertification contributed to poverty globally is lacking: the related literature remains qualitative or correlational. At the local level, on the other hand, there is limited evidence high agreement that desertification increased multidimensional poverty. For example (Diao, 2011) estimated that land degradation lowered agricultural incomes in Ghana by 4.2 billion USD between 2006 and 2015, increasing the national poverty rate by 5.4% in 2015. Land degradation increased the probability of households becoming poor by 35% in Malawi and 48% in Tanzania. Desertification in China was found to have resulted in substantial losses in income, food production and jobs. On the other hand, desertification was positively associated with growing incomes in Inner Mongolia in China in the short run since no costs were incurred for SLM, while in the long run higher incomes allowed allocation of more investments to reduce desertification. This relationship corresponds to the Environmental Kuznets Curve, which posits that environmental degradation initially rises and subsequently falls with rising income. There is limited evidence on the validity of this hypothesis regarding desertification.

2.1.5. Impacts On Food and Nutritional Insecurity

About 821 million people globally were food insecure in 2017, of whom 63% in Asia, 31% in Africa and 5% in Latin America and the Caribbean (FAO, 2018).The global number of food insecure people rose by 37 million since 2014. Changing climate variability, combined with a lack of climate resilience, was suggested as a key driver of this increase (FAO, 2018). Sub-Saharan Africa, East Africa and South Asia had the highest share of undernourished populations in the world in 2017, with 28.8%, 31.4% and 33.7% respectively (FAO, 2018). The major mechanism through which climate change and desertification affect food security is through their impacts on agricultural productivity. There is robust evidence pointing to negative impacts of climate change on crop yields in dryland areas. There is also limited evidence high agreement on the losses in agricultural productivity and incomes due to desertification. estimated cultivating wheat, maize, and rice with unsustainable land management practices is currently resulting in global losses of 56.6 billion USD annually, with another 8.7 billion USD of annual losses due to lower livestock productivity caused by rangeland degradation. However, the extent to which these losses affected food insecurity in dryland areas is not known. Lower crop yields and higher agricultural prices worsen existing food insecurity, especially for net food-buying rural households and urban dwellers. Climate change and desertification are not the sole drivers of food insecurity, but especially in the areas with high dependence on agriculture, they are among the main contributors.

2.1.6. Impacts on human health through dust storms

The frequency and intensity of dust storms are increasing due to land-use and land-cover changes and climate-related factors. particularly in some regions of the world such as the Arabian Peninsulas well as Central Asia, with growing negative impacts on human health (high confidence). Dust storms transport particulate matter, pollutants, pathogens and potential allergens that are dangerous for human health over long distances. Particulate matter (PM; that is, the suspended particles in the air of up to 10 micrometers (PM10) or less in size), have damaging effects on human health. The health effects of dust storms are largest in areas in the immediate vicinity of their origin, primarily the Sahara Desert, followed by Central and eastern Asia, the Middle East and Australia, however, there is robust evidence showing that the negative health effects of dust storms reach a much wider area. The primary health effects of dust storms include damage to the respiratory and cardiovascular systems. Dust particles with a diameter smaller than 2.5µm were associated with global cardiopulmonary mortality of about 402,000 people in 2005, with 3.47 million years of life lost in that single year. Although globally only 1.8% of cardiopulmonary deaths were caused by dust storms, in the countries of the Sahara region, Middle East, South and East Asia, dust storms were suggested to be the cause of 15–50% of all cardiopulmonary deaths. A 10 µgm-3 increase in PM10 dust particles was associated with mean increases in non-accidental mortality from 0.33% to 0.51% across different calendar seasons in China, Japan and South Korea. The percentage of all-cause deaths attributed to fine particulate matter in Iranian cities affected by Middle Eastern dust storms (MED) was 0.56–5.02%, while the same percentage for non-affected cities was 0.16–4.13%. Epidemics of meningococcal meningitis occur in the Shelia region during the dry seasons with dusty conditions. Despite a strong concentration of dust storms in the Sahel, North Africa, the Middle East and Central Asia, there is relatively little research on human health impacts of dust storms in these regions. More research on health impacts and related costs of dust storms, as well as on public health response measures, can help in mitigating these health impacts.

2.1.7 Impacts On Water Scarcity and Use

Reduced water retention capacity of degraded soils amplifies floods reinforces degradation processes through soil erosion (De la Paix, 2011), and reduces annual intake of water to aquifers, exacerbating existing water scarcities. Reduced vegetation cover and more intense dust storms were found to intensify droughts. Moreover, secondary salinization in the irrigated drylands often requires leaching with considerable amounts of water. Thus, different types of soil degradation increase water scarcity both through lower water quantity and quality. All these processes reduce water availability for other needs. In this context, climate change will further intensify water scarcity in some dryland areas and increase the frequency of droughts. Higher water scarcity may imply growing use of wastewater effluents for irrigation. The use of untreated wastewater exacerbates soil degradation processes, in addition to negative human health impacts. Climate change will thus amplify the need for integrated land and water management for sustainable development.

3. Responses or Solutions to Desertification Under Climate Change

Achieving sustainable development of dryland livelihoods requires avoiding dryland degradation through SLM and restoring and rehabilitating the degraded drylands due to their potential wealth of ecosystem benefits and importance to human livelihoods and economies. A broad suite of on-the-ground response measures exists to address desertification, be it in the form of improved fire and grazing management, the control of erosion; integrated crop, soil and water management, among others. These actions are part of the broader context of dryland development and long-term SLM within

e-ISSN: 2581-8317

coupled socio-economic systems. Many of these response options correspond to those grouped under 'land transitions' in the IPCC Special Report on Global Warming of 1.5°C (de Coninck, 2018)(Table 6.4). It is therefore recognized that such actions require financial, institutional and policy support for their wide-scale adoption and sustainability over time.

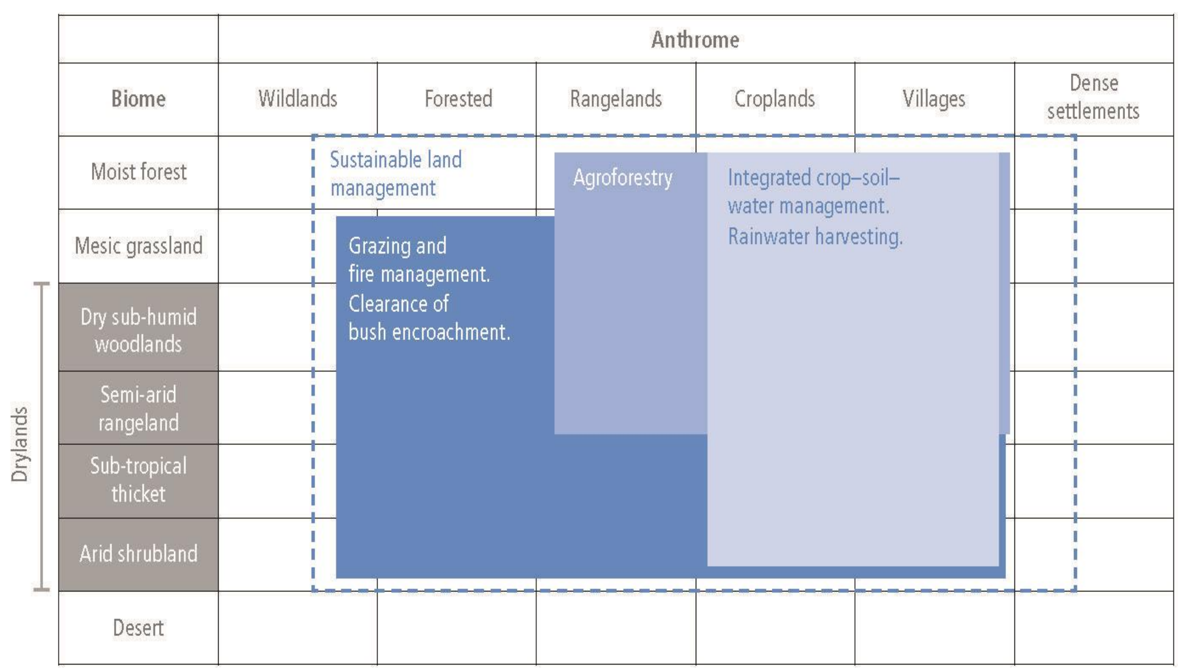
3.1. SLM technologies and practices: On-the-Ground Actions

A broad range of activities and measures can help avoid, reduce and reverse degradation across the dryland areas of the world. Many of these actions also contribute to climate change adaptation and mitigation, with further sustainable development co-benefits for poverty eradication and food security. As preventing desertification is strongly preferable and more cost-effective than allowing land to degrade and then attempting to restore it, there is a growing emphasis on avoiding and reducing land degradation, following the Land Degradation Neutrality framework.

An assessment is made of six activities and measures practicable across the biomes and anthromes of the dryland domain (Figure 3.10). This suite of actions is not exhaustive, but rather a set of activities that are particularly pertinent to global dryland ecosystems. They are not necessarily exclusive to drylands and are often implemented across a range of biomes and anthromes (Figure 3.10; for afforestation, see Section 3.7.2, Cross-Chapter Box 2 in Chapter 1, and Chapter 4 (Section 4.8.3)). The use of anthromes as a structuring element for response options is based on the essential role of interactions between social and ecological systems in driving desertification within coupled socio-ecological systems (Cherlet, 2018). The concept of the anthromes is defined in the Glossary and explored further in Chapters 1, 4 and 6.

The assessment of each action is twofold: firstly, to assess the ability of each action to address desertification and enhance climate change resilience, and secondly, to assess the potential impact of future climate change on the effectiveness of each action.

The typical distribution of on-the-ground actions across global biomes and anthromes.



3.2. Integrated crop–soil–water management

Forms of integrated cropland management have been practiced in drylands for thousands of years.). Actions include planting a diversity of species including drought-resilient ecologically appropriate plants, reducing tillage, applying organic compost and fertilizer, adopting different forms of irrigation and maintaining vegetation and mulch cover. In the contemporary era, several of these actions have been adopted in response to climate change.

In terms of climate change *adaptation*, the resilience of agriculture to the impacts of climate change is strongly influenced by the underlying health and stability of soils as well as improvements in crop varieties, irrigation efficiency and supplemental irrigation, for example, through rainwater harvesting (medium evidence, high agreement) (Lal, 1997). Desertification often leads to a reduction in ground cover that in turn results in accelerated water and wind erosion and an associated loss of fertile topsoil that can greatly reduce the resilience of agriculture to climate change (medium evidence, high agreement) note that even a minimal cover of crop residues (100 kg ha–1) can substantially decrease wind erosion.

Compared to conventional (flood or furrow) irrigation, drip irrigation methods are more efficient in supplying water to the plant root zone, resulting in lower water requirements and enhanced water use efficiency (*robust evidence, high agreement*). For example, in the rainfed area of Fetehjang, Pakistan, the adoption of drip methods reduced water usage by 67–68% during the production of tomato, cucumber and bell peppers, resulting in a 68–79% improvement in water use efficiency compared to previous furrow irrigation. In India, drip irrigation reduced the amount of water consumed in the production of sugarcane by 44%, grapes by 37%, bananas by 29% and cotton by 45%, while enhancing yields by up to 29% . Similarly, in Uzbekistan, drip irrigation increased the yield of cotton by 10–19% while reducing water requirements by 18–42% A prominent response that addresses soil loss, health and cover is altering cropping methods. The adoption of intercropping (inter – and intra-row planting of companion crops) and relay cropping (temporally differentiated planting of companion crops) maintains soil cover over a larger fraction of the year, leading to an increase in production, soil nitrogen, species diversity and a decrease in pest abundance (*robust evidence, medium agreement*) (Diao, 2011) (Tanveer, 2017). For example, intercropping maize and sorghum with *Desmodium* (an insect repellent forage legume) and Brachiaria (an insect trapping grass), which is being promoted in drylands of East Africa, led to a two-to-three-fold increase in maize production and an 80% decrease in stem boring insects. In addition to changes in cropping methods, forms of agroforestry and shelterbelts are often used to reduce erosion and improve soil conditions (Section 3.7.2). For example, the use of tree belts of mixed species in northern China led to a reduction of surface wind speed and an associated reduction in soil temperature of up to 40% and an increase in soil moisture of up to 30%

A further measure that can be of increasing importance under climate change is rainwater harvesting (RWH), including traditional *zai* (small basins used to capture surface runoff), earthen bunds and ridges, contour stone bunds and semi-permeable stone bunds (often referred to by the French term *digue filtrante*). RWH increases the amount of water available for agriculture and livelihoods through the capture and storage of runoff, while at the same time reducing the intensity of peak flows following

e-ISSN: 2581-8317

high-intensity rainfall events. It is therefore often highlighted as a practical response to dryness (i.e., long-term aridity and low seasonal precipitation) and rainfall variability, both of which are projected to become more acute over time in some dryland areas. For example, for drainage in Wadi Al-Lith, Saudi Arabia, the use of rainwater harvesting was suggested as a key climate change adaptation action. There is *robust evidence* and *high agreement* that the implementation of RWH systems leads to an increase in agricultural production in drylands. A global meta-analysis of changes in crop production due to the adoption of RWH techniques noted an average increase in yields of 78%, ranging from –28% to 468%. Of particular relevance to climate change in drylands is that the relative impact of RWH on agricultural production generally increases with increasing dryness. Relative yield improvements due to the adoption of RWH were significantly higher in years with less than 330 mm rainfall, compared to years with more than 330 mm. Despite delivering a clear set of benefits, there are some issues that need to be considered. The impact of RWH may vary at different temporal and spatial scales. At a plot scale, RWH structures may increase available water and enhance agricultural production, SOC and nutrient availability, yet at a catchment scale, they may reduce runoff to downstream uses. Inappropriate storage of water in warm climes can lead to an increase in water related diseases unless managed correctly, for example, schistosomiasis and malaria.

Integrated crop–soil–water management may also deliver climate change *mitigation* benefits through avoiding, reducing and reversing the loss of SOC (Table 6.5). Approximately 20–30 Pg of SOC have been released into the atmosphere through desertification processes, for example, deforestation, overgrazing and conventional tillage. Activities, such as those associated with conservation agriculture (minimising tillage, crop rotation, maintaining organic cover and planting a diversity of species), reduce erosion, improve water use efficiency and primary production, increase inflow of organic material and enhance SOC over time, contributing to climate change mitigation and adaptation. Conservation agriculture practices also lead to increases in SOC (*medium confidence*). However, sustained carbon sequestration is dependent on net primary productivity and on the availability of crop-residues that may be relatively limited and often consumed by livestock or used elsewhere in dryland contexts. For this reason, expected rates of carbon sequestration following changes in agricultural practices in drylands are relatively low (0.04–0.4 tC ha–1) and it may take a protracted period of time, even several decades, for carbon stocks to recover if lost. This long recovery period enforces the rationale for prioritizing the avoidance and reduction of land degradation and loss of C, in addition to restoration activities.

3.3. Grazing and fire management in drylands

Rangeland management systems such as sustainable grazing approaches and re-vegetation increase rangeland productivity (*high confidence*) (Table 6.5). Open grassland, savannah and woodland are home to the majority of world's livestock production (Safriel, 2005). Within these drylands areas, prevailing grazing and fire regimes play an important role in shaping the relative abundance of trees versus grasses, as well as the health of the grass layer in terms of primary production, species richness and basal cover. This in turn influences levels of soil erosion, soil nutrients, secondary production and additional ecosystem services. A further set of drivers, including soil type, annual rainfall and changes in atmospheric CO_2 may also define observed rangeland structure and composition, but the two principal factors that pastoralists can manage are grazing and fire, by altering their frequency, type and intensity.

The impact of grazing and fire regimes on biodiversity, soil nutrients, primary production and further ecosystem services is not constant and varies between locations. Trade-offs may therefore need to be considered to ensure that rangeland diversity and production are resilient to climate change. In certain locations, even light to moderate grazing has led to a significant decrease in the occurrence of particular species, especially forbs. In other locations, species richness is only significantly impacted by heavy grazing and is able to withstand light to moderate grazing. A context specific evaluation of how grazing and fire impact particular species may therefore be required to ensure the persistence of target species over time. A similar trade-off may need to be considered between soil carbon sequestration and livestock production. As noted by increasing grazing pressure has been found to increase SOC stocks in some locations, and decrease them in others. Where it has led to a decrease in soil carbon stocks, for example in Mongolia, trade-offs between carbon sequestration and the value of livestock to local livelihoods need be considered.

Although certain herbaceous species may be unable to tolerate grazing pressure, a complete lack of grazing or fire may not be desired in terms of ecosystems health. It can lead to a decrease in basal cover and the accumulation of moribund, unpalatable biomass that inhibits primary production. The utilization of the grass sward through light to moderate grazing stimulates the growth of biomass and basal cover, and allows water services to be sustained over time. Even moderate to heavy grazing in periods of higher rainfall may be sustainable, but constant heavy grazing during dry periods, and especially droughts, can lead to a reduction in basal cover, SOC, biological soil crusts, ecosystem services and an accelerated erosion. For this reason, the inclusion of drought forecasts and contingency planning in grazing and fire management programmes is crucial to avoid desertification. It is an important component of avoiding and reducing early degradation. Although grasslands systems may be relatively resilient and can often recover from a moderately degraded state, if a tipping point has been exceeded, restoration to a historic state may not be economical or ecologically feasible Together with livestock management (Table 6.5), the use of fire is an integral part of rangeland management, which can be applied to remove moribund and unpalatable forage, exotic weeds and woody species. Fire has less of an effect on SOC and soil nutrients in comparison to grazing, yet elevated fire frequency has been observed to lead to a decrease in soil carbon and nitrogen. Although the impact of climate change on fire frequency and intensity may not be clear due to its differing impact on fuel accumulation, suitable weather conditions and sources of ignition, there is an increasing use of prescribed fire to address several global change phenomena, for example, the spread of invasive species and bush encroachment, as well as the threat of intense runaway fires.

There is often much emphasis on reducing and reversing the degradation of rangelands due to the wealth of benefits they provide, especially in the context of assisting dryland communities to adapt to climate change. The emerging concept of ecosystem-based adaptation has highlighted the broad range of important ecosystem services that healthy rangelands can provide in a resilient manner to local residents and downstream economies. In terms of climate change mitigation, the contribution of

e-ISSN: 2581-8317

rangelands, woodland and sub-humid dry forest (e.g., Miombo woodland in south-central Africa) is often undervalued due to relatively low carbon stocks per hectare. Yet due to their sheer extent, the amount of carbon sequestered in these ecosystems is substantial and can make a valuable contribution to climate change mitigation.

3.4. Clearance of Bush Encroachment

The encroachment of open grassland and savannah ecosystems by woody species has occurred for at least the past 100 years (Archer, 2017). Dependent on the type and intensity of encroachment, it may lead to a net loss of ecosystem services and be viewed as a form of desertification. However, there are circumstances where bush encroachment may lead to a net increase in ecosystem services, especially at intermediate levels of encroachment, where the ability of the landscape to produce fodder for livestock is retained, while the production of wood and associated products increases. This may be particularly important in regions such as southern Africa and India where over 65% of rural households depend on fuelwood from surrounding landscapes as well as livestock production.

This variable relationship between the level of encroachment, carbon stocks, biodiversity, provision of water and pastoral value can present a conundrum to policymakers, especially when considering the goals of three Rio Conventions: UNFCCC, UNCCD and UNCBD. Clearing intense bush encroachment may improve species diversity, rangeland productivity, the provision of water and decrease desertification, thereby contributing to the goals of the UNCBD and UNCCD as well as the adaptation aims of the UNFCCC. However, it would lead to the release of biomass carbon stocks into the atmosphere and potentially conflict with the mitigation aims of the UNFCCC.The benefit of proactive management that prevents land from being degraded (altering grazing systems or treating bush encroachment at early stages before degradation has been initiated) is more cost-effective in the long term and adds more resistance to climate change than treating lands after degradation has occurred (Webb et al. 2013

The challenge is getting producers to alter their management paradigm from short-term objectives to long-term objectives

3.5. Use of Halophytes for The Re-Vegetation of Saline Lands

Soil salinity and sodicity can severely limit the growth and productivity of crops (an, 2017) and lead to a decrease in available arable land. Leaching and drainage provides a possible solution, but can be prohibitively expensive. An alternative, more economical option, is the growth of halophytes (plants that are adapted to grow under highly saline conditions) that allow saline land to be used in a productive manner. The biomass produced can be used as forage, food, feed, essential oils, biofuel, timber, or fuelwood (Chughtai, 2015). A further co-benefit is the opportunity to mitigate climate change through the enhancement of terrestrial carbon stocks as land is re-vegetated. The combined use of salt-tolerant crops, improved irrigation practices, chemical remediation measures and appropriate mulch and compost is effective in reducing the impact of secondary salinisation.

In Pakistan, where about 6.2 Mha of agricultural land is affected by salinity, pioneering work on utilizing salt-tolerant plants for the re-vegetation of saline lands (bio saline agriculture) was done in the early 1970s. A number of local and exotic varieties were initially screened for salt tolerance in lab – and greenhouse-based studies, and then distributed to similar saline areas. These included tree species (Acacia ampliceps, Acacia nilotica, Eucalyptus camaldulensis, Prosopis juliflora, Azadirachta indica) (Awan, 2017).forage plants (Leptochloa fusca, Sporobolus arabicus, Brachiaria mutica, Echinochloa sp., Sesbania and Atriplex spp.) and crop species including varieties of barley (Hordeum vulgare), cotton, wheat (Triticum aestivum) and Brassica as well as fruit crops in the form of date palm (Phoenix dactylifera) that has high salt tolerance with no visible adverse effects on seedlings Pomegranate is another fruit crop of moderate to high salt tolerance. Through regulating growth form and nutrient balancing, it can maintain water content, chlorophyll fluorescence and enzyme activity at normal levels.

In India and elsewhere, tree species including Prosopis juliflora, Dalbergia sissoo, and Eucalyptus tereticornis have been used to re-vegetate saline land. Certain biofuel crops in the form of Ricinus communis, Euphorbia antisyphilitica, Karelinia caspia and Salicornia are grown in saline areas, and Panicum turgidum and Leptochloa fusca have been grown as fodder crop on degraded soils with brackish water. In China, intense efforts are being made on the use of halophytes. These examples reveal that there is great scope for saline areas to be used in a productive manner through the utilisation of halophytes. The most productive species often have yields equivalent to conventional crops, at salinity levels matching even that of seawater.

3.6. Socio-economic responses for combating desertification under climate change

Desertification limits the choice of potential climate change mitigation and adaptation response options by reducing climate change adaptive capacities. Furthermore, many additional factors, for example, a lack of access to markets or insecurity of land tenure, hinder the adoption of SLM. These factors are largely beyond the control of individuals or local communities and require broader policy interventions. Nevertheless, local collective action and ILK are still crucial to the ability of households to respond to the combined challenge of climate change and desertification. Raising awareness, capacity building and development to promote collective action and indigenous and local knowledge contribute to avoiding, reducing and reversing desertification under changing climate. The use of indigenous and local knowledge enhances the success of SLM and its ability to address desertification. Using indigenous and local knowledge for combating desertification could contribute to climate change adaptation strategies. There are abundant examples of how indigenous and local knowledge, which are an important part of broader agro ecological knowledge, have allowed livelihood systems in drylands to be maintained despite environmental constraints. An example is the numerous traditional water harvesting techniques that are used across the drylands to adapt to dry spells and climate change. These include creating planting pits and micro-basins, contouring hill slopes and terracing). Traditional ndiva water harvesting systems in Tanzania enable the capture of runoff water from highland areas to downstream community-managed micro-dams for subsequent farm delivery through small-scale canal networks. A further example are pastoralist communities located in drylands who have developed numerous methods to sustainably manage rangelands. Pastoralist communities in Morocco developed the Agdal system of seasonally alternating use of rangelands to limit overgrazing as well as to manage forests in the Moroccan High Atlas Mountains. Across the Arabian Peninsula and North Africa, a rotational grazing system, hema, was historically practiced by the Bedouin communities. The Beni-Amer herders in the

e-ISSN: 2581-8317

Horn of Africa have developed complex livestock breeding and selection systems. Although well adapted to resource-sparse dryland environments, traditional practices are currently not able to cope with increased demand for food and environmental changes. Moreover, there is robust evidence documenting the marginalization or loss of indigenous and local knowledge. Combined use of indigenous and local knowledge and new SLM technologies can contribute to raising resilience to the challenges of climate change and desertification. Collective action has the potential to contribute to SLM and climate change adaptation. Collective action is a result of social capital. Social capital is divided into structural and cognitive forms: structural corresponding to strong networks (including outside one's immediate community); and cognitive encompassing mutual trust and cooperation within community's Social capital is more important for economic growth in settings with weak formal institutions, and less so in those with strong enforcement of formal institutions. There are cases throughout the drylands showing that community by-laws and collective action successfully limited land degradation and facilitated SLM. However, there are also cases when they did not improve SLM where they were not strictly enforced. Collective action for implementing responses to dryland degradation is often hindered by local asymmetric power relations and 'elite capture' . This illustrates that different levels and types of social capital result in different levels of collective action. In a sample of East, West and southern African countries, structural social capital in the form of access to networks outside one's own community was suggested to stimulate the adoption of agricultural innovations, whereas cognitive social capital, associated with inward-looking community norms of trust and cooperation, was found to have a negative relationship with the adoption of agricultural innovations. The latter is indirectly corroborated by observations of the impact of community-based rangeland management organizations in Mongolia. Although levels of cognitive social capital did not differ between them, communities with strong links to outside networks were able to apply more innovative rangeland management practices in comparison to communities without such links.

Farmer-led innovations. Agricultural households are not just passive adopters of externally developed technologies, but are active experimenters and innovators. SLM technologies co-generated through direct participation of agricultural households have higher chances of being accepted by them. Usually farmer-driven innovations are more frugal and better adapted to their resource scarcities than externally introduced technologies. Farmer-to-farmer sharing of their own innovations and mutual learning positively contribute to higher technology adoption rates. This innovative ability can be given a new dynamism by combining it with emerging external technologies. For example, emerging low-cost phone applications ('apps') that are linked to soil and water monitoring sensors can provide farmers with previously inaccessible information and guidance. Currently, the adoption of SLM practices remains insufficient to address desertification and contribute to climate change adaptation and mitigation more extensively. This is due to the constraints on the use of indigenous and local knowledge and collective action, as well as economic and institutional barriers for SLM adoption. Sustainable development of drylands under these socio-economic and environmental (climate change, desertification) conditions will also depend on the ability of dryland agricultural households to diversify their livelihoods sources.

References

Albaladejo, J. R.-F.-M. (2013). Land use and climate change impacts on soil organic carbon stocks in semi-arid Spain. *J. Soils Sediments*, 13, 265–277, doi:10.1007/s11368-012-0.

an, S. e. (2017). Analysis of salinity tolerance potential in synthetic hexaploid wheat. *Pak. J. Bot*, , 49, 1269–1278.

Archer, S. e. (2017). *Woody plant encroachment: Causes and consequences. In: Rangeland Systems [Briske, D.D. (ed.)]. Springer Series on Environmental Management, .* Cham, Switzerland, pp 25–84.: Springer International Publishing,.

Assessment, M. E. (2005). Ecosystems and Human Well-Being: Desertification Synthesis. . *World Resource Institute, Washington, DC,* .

Assessment, M. E. (2005). Ecosystems and Human Well-Being: Desertification Synthesis. *World Resource Institute, Washington, DC,* .

Austin, A. e. (2004). Water pulses and biogeochemical cycles in arid and semi-arid ecosystems. *Oecologia*, 141, 221–235, doi:10.1007/s00442-004-1519-1.

Awan, A. a. (2017). Tree plantation in problem soils. In: Text Book of Applied Forestry [Tahir Siddiqui, M. and F. Nawaz (ed.)]. *University of Agriculture, Faisalabad, Pakistan, pp. 140–159.*

Biederman, J. e. (2017). CO2 exchange and evapotranspiration across Dryland ecosystems of south-western North America. . *Glob. Chang. Biol*, 23, 4204–4221, doi:10.1111/gcb.13686.

Chen, S. G. (2009). Dependence of carbon sequestration on the differential responses of ecosystem photosynthesis and respiration to rain pulses in a semi-arid steppe. . *Glob. Chang. Biol.*, 15, 2450–2461, doi:10.1111/j.1365-2486.

Cherlet, M. e. (2018). World Atlas of Desertification. Publication Office of the European Union, . *Luxembourg,*, 248 pp.

Chughtai, M. K. (2015). Growth performance of carp species fed on salt-tolerant roughages and formulated feed in brackish water under polyculture system. , . *Pak. J. Zool.*, 47, 775–781.

de Coninck, H. e. (2018). *2018: Chapter 4: Strengthening and Implementing the Global Response. In: Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Con.*

De la Paix, M. L. (2011). Soil degradation and altered flood risk as a consequence of deforestation. . *L. Degrad. Dev., 24, 478-485, doi:10.1002/ldr.1147, pp. 478–485.*

Diao, X. a. (2011). Poverty implications of agricultural land degradation in Ghana:An economy-wide, multimarket model assessment. *African Dev. .*, Rev., 23, 263–275, doi:10.1111/j.1467-8268.2011.00285.x.

Enfors, E. a. (2008). Dealing with drought: The challenge of using water system technologies to break Dryland poverty traps. *Glob. Environ. Chang.*, 18, 607–616, doi:10.1016/J.GLOENVCHA.2008.07.006.

FAO. (2018). *The Impact of Disasters and Crises on Agriculture and Food Security 2017.* Rome, Italy, 143 pp.: Food and Agriculture Organization of the United Nations,.

Gonzalez-Martin, C. N.-P. (2014). The global dispersion of pathogenic microorganisms by dust storms and its relevance to agriculture. *Adv. Agron., ,* 127, 1–41, doi:10.1016/B978-0-12-800131-8.00001-7.

Herrera, C. e. (2018). Science of the total environment groundwater origin and recharge in the hyper-arid Cordillera de la Costa, Atacama Desert, northern Chile. Sci. *Total Environ*, 624, 114–132, doi:10.1016/j.scitotenv.2017.12.134.

Ivanov, A. e. (2018). *National report global climate and soil cover of Russia: Assessment of risks and environmental and economic consequences of land degradation. .* Russia: Adaptive systems and technologies of environmental management (agriculture and forestry).

Konikow, L. (2011). Contribution of global groundwater depletion since 1900 to sea-level rise. *Geophys. Res. Lett*, 38, 1–5, doi:10.1029/2011GL048604.

Lal, R. (1997). Degradation and resilience of soils. Philos. Trans. R. Soc. London. Ser. *B Biol. Sci., 352, 997–1010, doi:10.1098/rstb.1997.007*.

Majeed, A. a. (2019). Salinity: A major agricultural problem – Causes, impacts on crop productivity and management strategies. In: Plant Abiotic Stress Tolerance [Hasanuzzaman, M., K.R. Hakeem, K. Nahar and H. Alharby (eds.)]. Springer Interna.

Mays, L. (2013). Groundwater resources sustainability: Past, present, and future. . *Water Resour. Manag*, 27, 4409–4424, doi:10.1007/s11269-013-0436-7.

Mirzabaev, A. M. (2016a). Rangelands of Central Asia: Challenges and opportunities. J. . *Arid Land,*.

Mortimore, M. (2005). Dryland development: Success stories from West Africa. Environment,.

Mudd, G. (2000). Mound springs of the Great Artesian Basin in South Australia:. *A case study from Olympic Dam*.

Nardone, A. B. (2010). Effects of climate changes on animal production and sustainability of livestock systems. . *Livest. Sci*, 130, 57–69, doi:10.1016/j.livsci.2010.02.011.

Observatoire du Sahara et du Sahel. (2018). La Surveillance environnementale dans le circum-Sahara: Synthèse régionale Ecologie (Algérie, Burkina Faso – Kenya – Mali Niger – Sénégal – Tunisie) 2012, Observatoire du Sahara et du Sahel.

Pierzynski, G. B. (2017). Threats to Soils: Global Trends and Perspectives. . *Global Land Outlook Working Paper 28. UNCCD, Bonn, Germany, 27 pp.*

Pradhan, P. L. (2017). A systematic study of sustainable development goal (SDG) interactions. *Earth's Futur., 5, 1169–1179, doi:10.1002/2017EF000632.*

Rojas-Downing, M. A. (2017). Climate change and livestock: Impacts, adaptation, and mitigation. . *Clim. Risk Manag.*, 145–163, doi:10.1016/j.crm.2017.02.001.

Safriel, U. A. (2005). *Dryland systems. In: Ecosystems and Human Well-Being: Current State and Trends [Hassan, R., R.J. Scholes, and N. Ash, (eds.)].* . Washington, DC, USA, pp. 623–662.: Island Press, .

Serrano-Ortiz, P. e. (2015). Seasonality of net carbon exchanges of Mediterranean ecosystems across an altitudinal gradient. . *J. Arid Environ*, 115, 1–9, doi:10.1016/j.jaridenv.2014.12.003.

Stefanski, R. a. (2009). Impacts of sand and dust storms on agriculture and potential agricultural applications of a SDSWS. IOP Conf. Ser. . *Earth Environ. Sci.,* , 7, 12016, doi:10.1088/1755-1307/7/1/012016.

Tanveer, M. S. (2017). Relay cropping as a sustainable approach: Problems and opportunities for sustainable crop production. Environ. *Sci. Pollut. Res., 24, 6973–6988, doi:10.1007/s11356-017-8371-4.*

UN. (2015). *Outcomes and Policy-Oriented Recommendations from the UNCCD 3rd Scientific Conference. United Nations Convention to Combat Desertification, Twelfth Session, Committee on Science and Technology,* . Ankara, Turkey, 15 pp.

White, R. a. (2003). Drylands, People, and Ecosystem Goods and Services: A Web-Based Geospatial Analysis. . *World Resource Institute, Washington, DC, USA*.

Whitford, W. (2002). *Ecology of Desert Systems.* San Diego, USA, 343 pp.: Academic Press, .

AGRICULTURE & FOOD: e-Newsletter Volume 3 – Issue 8 – August 2021
www.agrifoodmagazine.co.in
e-ISSN: 2581-8317

Use of vertical hydroponics farms in urban agriculture

Article id: INV111

Samuel Shay
***Corresponding author's email: gulf@gts-il.com**

INTRODUCTION

It is predicted that by 2050 the global population will reach approximately 9.8 billion people, of which 70 percent will reside in urban centers, which will result of higher demand for food and water to the expense of 70 percent more than today. The growing demand for water for agricultural needs is already putting pressure on the current food systems, as many countries are facing water crisis due to climate changes (i.e., global warming, droughts) which has yet been resolved by technological means to overcome the water stress, such as seawater desalination, rain harvesting techniques or wastewater purification for irrigation needs.

Despite much progress has been made of efficient utilization of water for agricultural needs, agriculture still is one of the world's main users of freshwater. Irrigated agriculture is responsible for approximately 70 percent of all the freshwater withdrawal in the world, and more water will be used for irrigation in the future to meet world food demand. By 2025, 1.8 billion people are expected to be living in countries or regions with less than 500 cubic-meters of annual water supply per capita (absolute water scarcity), and two-thirds of the world population would be under "stress" conditions defined as "water scarcity" (between 500 and 1000 cubic-meters per year per capita).

Climate changes also cause a destruction of the soil due to prolonged periods of droughts, and as a result reduce the availability of land for agriculture. Moreover, the constant need for land and water in the industry and urban sector due to population growth reduces their already low availability for agricultural needs. At present, over 800 million hectares, or about 38 percent of the world's landmass, are used for agriculture. Under current conventional agriculture practices an estimated 10^9 hectares of new land will be needed to grow enough food to feed the whole world's population by 2050.

Therefore, land, water (and energy) will have to increase in order to cope with the growing demand for food production and supply. This requires immediate actions in order to minimize as much as possible the dependence of agriculture on the above resources and their impacts on food security.

Food security is: "*A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Based on this definition, four food security dimensions can be identified: food availability, economic and physical access to food, food utilization, and stability over time".*

More than 2 billion people suffer from food insecurity, expressed as a consumption of insufficient quantity and/or quality and nutritious food (a deficit in vitamins and minerals such as iron, zinc and vitamin A) required to maintain an active and healthy life. This originates from faults along the food system limit its availability, the access to it, its utilization and stability over time. People may experience moderate to severe hunger, sometimes stay for several days without food. This phenomenon is globally wide, both in low- and high-income countries, but more common in regions of Sub-Saharan Africa (SSA), Southern Asia, Latin America and the Caribbean's, where poverty, poor infrastructure and technology are the main causes to severe food insecurity among smallholder and rural communities. Part of that is

e-ISSN: 2581-8317

because lower-income communities lack of access to healthy fresh food which usually is less available in food stores in their vicinity, leaving them no other choice but purchasing the higher prevalence energy-dense foods which often costs more in these stores compared to large supermarkets. This has been shown to lead to unhealthy diets and increased levels of obesity for people living in these areas.

The situation in the cities is no better. In urban settings lack of income is translated more directly into lack of food than in rural settings. The rapid urbanization in developing countries and SSA in particular, goes together with a rapid increase in urban poverty and urban food insecurity, and it will worsen if preventive measures are not taken. As a large share of the poor household income goes to food (between 54 and 76 percent in SSA capital cities), any spikes in food prices will push tens of millions more into extreme poverty and to severe food insecurity. Food production in the city, i.e., urban agriculture (UA), is in many cases a response of the urban poor to inadequate, unreliable and irregular access to food by rural agriculture (RA), the primary producer of food in cities.

UA and peri-urban agriculture can be defined as the growing, processing and distribution of food crops and other products (seldom raising livestock) through plant cultivation within and around the city. The idea behind UA is that each city will produce its own food for self-consumption, without the need to be dependent on external forces that may interfere with the supply of food, such as poor transport or natural hazards. The lack of free areas for agriculture needs within the city can be partly solved, for instance by utilization of abandoned areas or old buildings.

UA can contribute to food security in each of its four dimensions. The proximity of the consumer to the product shortens the food supply chain, increasing by that the availability and accessibility of fresh and healthy produce in food insecure areas in cities, for individual families, community groups, and urban markets. Moreover, the availability of locally produced foods in cities can possibly encourage the consumption of fruit and vegetables by typical consumers and may help to reduce consumption of less healthy processed foods. Shifting some food production to areas of high demand can reduce energy use and environmental impacts of the food industry associated with food supply chains, for example cutting transportation-related greenhouse gas emissions (the current food system is responsible for up to 30 percent of the world's greenhouse gas emissions), which itself contributes to food production since the global rise of atmospheric CO_2 concentration also affects crop yield as plants response differently to these changes. Lowering transport time and distance can also minimize food spoilage (especially perishable foods), caused by poor storage or transport conditions which may occur along the food supply chain.

The ability to acquire food is determined mainly by its cost, which is affected by value-chain processes such as storage and transport. It is estimated that 13.8 percent of the produced food (worth more that USD 400 billion) is lost every year during its processing, transport and storage. Shifting these processes to minimum through UA by direct supply of the products from the farm to the consumer, is expected to reduce the prices of food, thus providing millions of poor people around the world a better access to food, especially in low-income countries where food insecurity is the highest due to poor production combined with poor storage and transport that cause a high rate of food loss and high prices of food as a result which are above the household's purchasing power.

e-ISSN: 2581-8317

The degree of food security is also determined by actions taken from the consumer side to minimize food waste as a result of over consumption or over purchasing of food which eventually can get spoiled before consumed and thrown away. Synchronizing between the urban farmer as the supplier side and the consumer needs will help to reduce food waste by growing just the amount of food that will suffice the local market demands for self-consumption.

All of these actions can potentially lead to the creation of resilient cities which are dependent on their own in food production and supply for self-consumption, without any interference from external forces that may affect food safety such as environmental or economic crises. Thus, countries should encourage urban and peri-urban agriculture, also because it will upgrade employment and income generating opportunities for the urban poor and improve the supply of local markets with fresh and nutrient-rich foods at competitive prices. However, it is difficult to quantify just how much UA contributes to the global food supply (according to UN Food and Agriculture Organization, UA provides 15 – 20 percent of the world's food), since it can vary extensively among cities based on each one's resources. For example, some cities don't have enough urban area to satisfy the consumption demands of their citizens while other need less than 10 percent of their urban area to do so. On average, UA would require 30 percent of the area of cities globally to provide for the total vegetable consumption of urban dwellers. For cities that lack available urban space, an option could be the use of rooftop gardens, vertical farming, and indoor growing methods, which could still answer the need for large amounts of land area for urban growing.

At present, UA is widespread around the world with more than 800 million people practice it, including the developing countries with over 20 million people in West Africa, where it has been shown to have a positive impact on food security. Many cities across the world have reported high degrees of food self-sufficiency by UA. For example, in Shanghai, China, UA is able to supply 50 percent of its vegetable demands; in Dar-es-Salaam, Tanzania UA produces 90 percent of leafy vegetables and 60 percent of milk consumed.

Many different types of UA exist. Activities range from personal scale in privately owned areas (household gardening), community and public scale (community gardens, vacant lots, parking lots, parks, institutional gardens for example in schools, prisons, churches, community centers or hospitals, rooftop gardens and public food forests) growing food for self-consumption, to commercial scale (for-profit or non-profit urban farms, indoor farms and vertical farms), with farm products are directly supplied to the consumer, distributed through community supported programs or through retailers. The consumer can range from private household to specific business (in a restaurant, as part of a gas station for growing bio-fuel crops, in a ketchup factory for growing tomatoes etc.) to the whole public. In addition, in cases where a farm replaces asphalt or some other hardscape, the urban heat island is reduced. Of the activities above, those executed in open space are categorized under Uncontrolled Environment Agriculture (UEA) or open space agriculture. Controlled Environment Agriculture (CEA) includes any form of agriculture where environmental conditions (such as, light, temperature, humidity and radiation) are controlled in conjunction with urban structure or infrastructure. Among the methods of CEA are greenhouses and vertical farming.

e-ISSN: 2581-8317

To conclude, UA has the potential to contribute to local food security by increasing the availability of and access to fresh and healthy produce. In the future, the ability of cities to produce at least a portion of their own food supply will become important as climate change-driven natural disasters are expected to increase in frequency and severity, thus affecting the global supply chain. Multi-disciplinary research and governmental support are needed for UA to be used effectively as a tool to support the 2nd UN Sustainable Development Goal (SDG 2) to end hunger in all its forms by 2030.

Vertical farming

Vertical farming (VF) is an example of commercial UA in which fruits, vegetables and grains are stacked in layers that may reach several stories tall for instance inside warehouse, buildings or any other urban structure. Its growing method – indoor under full controlled climate and agronomical conditions (precise light, nutrients and temperatures) – seems the most efficient method to provide food security. By almost completely excluding natural interferences (e.g., soil, sunlight, rainfall) from agriculture, high crop yield can be produced all year round, increasing by that the farmer profitability. The use of detached growth substrates (for example coco coir peat or water channel in hydroponic application), combined with big data analytics, internet of things and artificial intelligence for on-line monitoring and operation to provide optimized number of resources the plant requires (i.e., precision agriculture), creates an optimal condition for various types of plants and provides the highest crop productivity, no matter what the climate or environmental conditions are. This, in turn, reduces the need for fertilizers, herbicides, and pesticides. A variety of crops can be grown, including ornamentals, pharmaceuticals, nutritional supplements, flavors, etc.

Although VF can help achieve the three pillars of sustainability (i.e., environmental, economic, and social), it is not enough to solve the global food insecurity or even provide sufficient food supply in city scale, in light of the rapid urbanization, especially not replacing land consumers crops such as cereals (wheat, maize, cassava, sorghum and rice, root vegetables like potato) to produce staple foods. But it

e-ISSN: 2581-8317

could evolve in parallel to the conventional agriculture, in particular growing and supplying fresh fruits and vegetables for city dwellers, beyond its contribution to water and land resources.

Since VF requires a massive capital for the construction of a new building or installation of advanced infrastructure on existing structure, performing a preliminary market survey is essential before any further decisions are taken. This includes identifying the potential customers in terms of type (household, commercial business), income (purchasing power), location (distance from distribution center), food preferences (e.g., organic or other food when deciding which type of crops to be grown) etc.

Structure types

VF systems can be placed in almost any urban structure. Generally, they can be divided into two categories of growing structures: horizontal system with multiple levels of growing platforms in one space or growing in high-rise building, and growing in a vertical surface, for example inside cylindrical units attached to wall. High-rise building can be new or old, for residential or commercial uses, in which few floors are using to grow food for the locals, the workers' cafeteria and even growing lettuce (and other green leaves) destined to feed the zoo animals. Utilization of abandoned warehouse for VF or new farm built on environmentally damaged lands, raising by that the value of these marginal parts of the city.

Other structure in use is used modular shipping containers ocean transports that can be located in places such as parking lots or vacant lots, after being refurbished into self-contained vertical farms, complete with LED lights, drip-irrigation systems, and vertically stacked shelves for growing plants. These units are equipped with computer-controlled growth management systems that allow users to monitor plant growth remotely from a smart phone or computer. An example of VF shipping containers is Crop Box (a product of "Vertical Crop Consultants", North Carolina, USA). Crop Box is equipped with hydroponic growing system and software monitoring system to control environmental conditions inside

e-ISSN: 2581-8317

the container – temperature, lighting, water, pH, CO_2 and humidity levels. Lighting is provided by high-end fluorescent lights while a 200-gallon (757 liter) reservoir and pump system allows water to circulate. Manufacturers say the Crop Box uses 90 percent less water and 80 percent less fertilizer than conventional farms, as well as requiring no pesticides. Another leading manufacturer of VF units based on a platform of shipping container is "Freight Farms" from Boston, USA. Marketed under the name "Greenery S", the unit uses precision growing technology that can be managed through the smartphone, and according to the company is capable of growing lettuce, leafy vegetables, herbs, brassicas, certain root vegetables, edible flowers and many other crops. Also, to date, over 300 different crop varieties have been examined in this system. The Australian "Modular Farms" unit, according to the manufacturer, is able to increase growing capacity by up to 125 percent and use less than 40-liter water a day by capturing up to 190 liters of the water vapors released by the plants via dehumidification process. One last example comes from "Cubic farms" company, Langley, British Columbia. Their system is fully automated and environmentally controlled (temperature, lighting, CO_2 and humidity) through the smartphone. It uses specialized growing trays that are rotated in a "V-shape" motion every 90 minutes to ensure all sides of the plant receive the optimal amount of light to maximize their growth and allows for an easy harvest as it provides an access to the plants at the front.

VF growing systems:

VF uses one of three soil-free systems for providing nutrients to plants: hydroponic, aeroponic, or aquaponic. The following information describes these three growing systems:

1. **Hydroponics**. The predominant growing system used in VF. Plants are usually grown in cylinder-shaped system, placed inside a medium filled with either sand, gravel, perlite, expanded clay, vermiculite, rockwool (the most used medium) etc, or float in nutrient-rich solution medium (also known as Nutrient Film Technique – NFT) as a substitute for soil. The solution can either be recycled in a closed system or used once in an open system and is frequently monitored to ensure that the correct chemical composition is maintained. In a closed system the growing tray is filled with the nutrients solution few times a day, set by a timer based on parameters such as growing stage, water and nutrient level etc. Excess water from the tray is drained back to a reservoir below to be used again in the next cycle. Hydroponic system also needs to be well-ventilated.

Hydroponic is used for both commercial and domestic food production as a hobby. It is recognized as a viable method of growing vegetables (e.g., tomato, lettuce, cucumber and pepper) as well as ornamental crops such as herbs, roses, freesia and foliage plants.

2. **Aeroponics** – NASA is responsible for developing this technique. Plants are grown in an air with no soil or aggregate medium. The seeds are inserted into tiny pots filled with pieces of foam, which are exposed to light (often LED lighting) and sprayed with nutrient-rich water solution. The foam holds the stem and root mass in place as the plant grows. An aeroponic system is by far the most efficient plant-growing system for vertical farms, using up to 90 percent less water than even the most efficient hydroponic systems. And since the nutrients are dissolved in the water, they also get recycled. Plants grown in these systems have also been shown to uptake more minerals and vitamins, making the plants healthier and potentially more nutritious.

www.agrifoodmagazine.co.in
e-ISSN: 2581-8317

One of the world's leading companies in aeroponics VF is Aero farms. It operates in New Jersey one of the largest commercial vertical farm in the world, with 6,500 square-meters and 9 meters high. It is estimated to produce 900 tons of greens per year and have annual yields 390 times higher per land area compared to traditional farming. This company has eight other smaller facilities and plans to build another large 7000 square-meters facility in New Jersey. Company claims their annual production is 75 times more than the field per unit land area, and even 10 times more productive than a hydroponic greenhouse. Also, they use over 95 percent less water than growing out in the field, to grow a seed that would take 30 to 45 days to grow out in the field, with just in 12 to 16 days. The company has grown over 550 different varieties of plants including leafy greens, berries, tomatoes, and more. Focus is made on growing leafy greens in order to maximize the number of trays that can be stacked up inside the vertical farm, as plants like tomatoes and peppers, for example, grow too tall to be efficiently stacked.

3. **Aquaponics** – Plants and fish are grown in an integrated re-circulating closed system. Freshwater fish are grown in indoor tanks or ponds, producing nutrient-rich waste to be used as a feed source for the plants. The plants, in turn, filter and purify the ammonia-rich wastewater, which is recycled back to the fishponds. The most popular fish are tilapia and barramundi because they grow fast and tolerate better changes in water conditions. Trout can also be used, especially for lower water temperatures. The system inputs are fish food and energy for the water pumps and water heaters, but once it is established, only pH and ammonia levels have to be monitored. Wastewater can also be used as a food source for the fish. Currently, aquaponics is used in small-scale VF systems. Most commercial VF systems focus on producing only a few fast-growing vegetable crops and don't include an aquaponics component.

Technologies in use

Typical indoor features related to VF include:
1. Lighting techniques, such as HPS (high-pressure sodium) or LED (more common) that can be adjusted in spectrum and intensity according to the plant development, to achieve optimal photosynthesis for different types of crops.

e-ISSN: 2581-8317

2. Heating, ventilation, air conditioning (HVAC) and humidity control at specific levels that optimize the rate of plant growth.
3. Solar panels for lighting and heating.
4. Recycled water systems enhanced with rainwater or desalinated water. Any nutrients and water not absorbed by the roots can be recycled in the system.

Benefits

There are a number of economic, environmental, social, and political advantages of VF, related to UA in general, and specifically to VF due to its small land requirement that allow to place it near consumers (i.e., in and near cities) and the use of the most recent cost-effective and resources-saving technologies for plants growing and cultivating.

Economic

In a broad scale, economic benefits of growing food in indoor vertical farm include enhanced productivity with minimum requirements of resources and inputs compared to conventional agriculture (land, energy, water, nutrients, fertilizer, herbicides and pesticides and other inputs). Because of the fully controlled environment that ensures an optimal growth for each plant throughout the year, the production is free of extreme-weather related stresses that can cause annual yield variability and significant quality and yield losses. Growing next to the consumers (ideal location is near major retail outlets) reduces costs associated with processes or failures along the food supply chains such as transportation (including packing the crop/food designated for transportation) and storage costs or food loss because of poor storage.

Environment and health

Growing food in an indoor environment allows provision of healthy and affordable food, while minimizing environmental impacts such as reduced greenhouse gas emissions and energy uses, reduced impacts on soils and minimized air and water pollution.

Energy saving – implementing VF on a large scale could result in a significant reduction in energy consumption, greenhouse gas emissions and air pollution in response to the short distance and transportation time from the food produced in the farm to the consumer as they are both located in the same vicinity, and because of other processes associated with the food supply chain that are reduced, for example cold storage. In addition, heavy field machinery such as tractors, trucks, and harvesters used in open field, are unnecessary in indoor agriculture, enhancing by that the workers' protection against injuries from using this machinery. On the other hand, large amounts of electricity are needed to provide light, to pump the water in an enclosed system of nutrients solution recycling, and to heat or cool the plants; although new energy-efficient LEDs are being developed that could reduce lighting costs.

VF can also be integrated with renewable energy, such as solar panels located on the roof of the growing facility or biogas generated in the production of methane in a digestion process of municipal organic waste or the bio-waste produced in the farm itself (e.g., leaves, stems, damaged crops), reducing by that both food waste and energy costs. The by-products of burning methane – CO_2, heat and water – can be added to the farm atmosphere to aid with the plant's growth. The energy generated by solar panels depends on the building's dimensions, and they are more effective in regions with an abundance of sunlight. When a building occupies a larger area, the lighting and water requirements increase, but so does the amount of energy available (via solar panels on the roof and facade). It is estimated that the amount of lighting needed indoors for plant cultivation is around 18 h per day.

Land use – The capacity to grow crops vertically is critical in urban environment where the competition over available land for industry, commercial, residence and other uses is high, leading to a rise in the land value. As a result, the availability of affordable land for urban farming decreases, leading farmers to search for low-cost or free land to farm. Under conventional crop production systems in the field (e.g., row crops) or in greenhouses, crops are grown in a single layer to ensure adequate sunlight and reduce resource competition over the crop canopy as well as in the root zones. Converting forest lands or wetlands is undesirable because it leads to deforestation, soil erosion, increased prevalence of resistant soil-borne pathogens, pests, and weeds, increased greenhouse gas emission, and ultimately the losses of other essential ecosystem services. Much of this can be attributed to the widespread utilization of unsustainable, intensive farming practices, such as the farming of high-yielding crops in monocultures and the use of excessive inputs of synthetic fertilizers and pesticides.

Thus, traditional farming in urban settings is not economically and environmentally feasible. VF can overcome these limitations by allowing the production of more food per land area (up to 30 times more than traditional agriculture, which means 30 times reduction in land use) or water while reducing pressure on current agricultural land. By doing that, forests can re-grow and play again a significant role in carbon sequestration and may help reverse current trends in global climate change.

Since urban land is an expensive commodity, most vertical farms would be located in less-expensive unused urban areas such as deserted industrial structures and vacant lots, raising by that their economic value.

Water use – Unlike outdoor environment where major part of the irrigation water is lost due to evaporation, water usage indoor has greater efficiency, which reduces the allotment of freshwater for irrigation. VF is claimed to have up to 350 percent greater water efficiency and uses as low as 30 and even 5 percent of the water in hydroponics and aeroponics, respectively, as compared to traditional agriculture. The amount of water needed for hydroponic is estimated to be 10.7 liter per each square-meter. This leads to an amount of 200 – 600 liters of water needed to provide 1 kilogram of dry product, depending on the crop type.

Water-saving can also be enhanced through the recycling of urban wastewater (i.e., gray water), which can be purified and converted to drinkable water through evapotranspiration. According to one estimate, it is able to collect 220,000 cubic meters of water every year using this method. Similarly, higher nutrient-use efficiency that can be achieved in a controlled and circular system which minimizes nutrient loss and reduces the contamination of water resources from excess nutrients (e.g., eutrophication). Given this, VF has an extra importance of its implementation particularly in hot and dry regions where water scarcity is high. Water savings has also political benefit in the reduction of water conflicts and downstream water pollution, especially in areas with cross-border water resources.

e-ISSN: 2581-8317

By cooling the air and capturing the condensed water, most of the water can be recovered. However, the costs of cooling air to recover the water can be significantly higher than the costs of using external water. Thus, water recovery is not cost-effective in areas with low water prices.

Elimination of Pesticides and herbicides – The controlled growing conditions allow reducing to minimum the use of chemical pesticides to complete avoidance of these substances, with the exception of use ladybugs and other biological controls to deal with any infestations. From marketing view, avoiding chemical pesticide matches also the "ecological trend" of producing the healthiest food, in case the farm is addressing for a niche market. Excluding hazardous pesticides and herbicides protects farm workers and consumers from possible health effects that are associated with exposure to these chemicals and keeps them out of the water supply. In addition, it brings economic saving of agricultural inputs.

Food security

Food security constitutes issues of food quantity, quality, availability and constant access to food supply. VF can answer these four issues. The unique indoor growing conditions in a controlled environment that can be adjusted to each plant type, shorten the plant's growing cycle and enable getting maximum crop yield per unit land area, leading to increased profits for the farmer. Moreover, using indoor light with the specific spectrum required has the potential to increase even more crop productivity, since the growing in not limited to sunlight hours. Growing under these conditions allows constant supply of food in any time all-year-round without being worried of natural hazards and weather impacts, and at the end point should bring to a fixed price of the food in any season of the year.

It is estimated that a single area of vertical farm may produce yield equivalent to as many as 4 to more than 30 times (for strawberries) the farmland area, depending on crop type. Bowery VF is claimed to have 100 times more yield than traditional farming. As an example, "Sky Greens", a leading vertical farm in Singapore (9 meters-tall, hydraulic water-driven with A-shaped structures, containing 38 tiers of growing troughs based on soil or hydroponic processes, which are vertically rotated throughout the day in a way that plants at the bottom constantly receive water while the ones at the top receive sunlight) claims it can produce 10 times more yield per unit land area than traditional farming: up to 30 kg of vegetables a day, or 6 to 7 kg per each square-meter a month, in comparison to 2 to 3 kg produced in traditional farming. In Israel it is reported that one acre (about 4000 square-meters) of open field and VF could provide food for 12.5 and 97 people per day, respectively. Other estimate claims a container with an area of 30 square-meters could provide a yield equivalent to 1000 square-meters in the open field. In addition, it is estimated that one vertical farm in New York city, covers one square city block and rising up to 30 stories (approximately 900,000 square-meters), would be able to provide enough nutrition (2,000 calories/day/person) for 10,000 people. Similarly, a vertical farm in South Korea stands at three-stories estimates a building with 27 floors could provide food to 15,000 residents.

The most common crops produced in VF are tomatoes, leafy greens (lettuce, basil, Chinese cabbage, kale, spinach), herbs, eggplant, green onion/chives, strawberries and cucumber. Besides plant crops, VF can accommodate small animals such as pigs and poultry that needs the least space but produces the largest amount of meat. Large animals like cattle, sheep and goats seem to be exempted from VF.

e-ISSN: 2581-8317

The shortening of the food supply chain helps keeping the food fresh, healthy and available to city dwellers without the need to transport it over a long distance from the rural farms to city markets. This would also greatly reduce food spoilage since crops would be sold and consumed within short time after harvesting. In addition, consumption of healthy food could also help address chronic diseases (e.g., diabetes, obesity, heart disease), especially in “food desert” regions where there is high prevalence of continual hunger and malnutrition.

Under the right conditions, reduced agricultural inputs as well as other costs of transportation, storage, food loss etc, aside with high crop yields, in the end are expected to reduce food prices to become affordable to all city dwellers disregard of their socio-economic status.

Social

Social benefits include provision of employment and social interactions, community building and personal welfare. More specifically, VF provides new employment and training opportunities in sectors of engineering, biotechnology, construction, and research and development. The location of vertical farm within or near urban gives an access to a large labor market and can boost creation of jobs in the above sectors, and also attracts the creation of indirect jobs like grocery stores, food markets and local distribution centers. While this may have an effect the economic stability of the less-skilled workers occupied in traditional agriculture, with the proper governmental support (e.g., vocational training), reinforced by a pervious rich agronomical experience and knowledge, some of them would be more easily re-integrate in VF.

Another benefit is the protection or workers against injuries from using heavy field machinery, since it is not required in indoor farming. Besides, using empty/abandoned buildings, vacant lots and warehouses for production, can promote the development of the whole surroundings.

Limitations and challenges

For the best outcomes of VM, it is important to consider its benefits aside with the limitations and potentials. The main barriers to the establishment of VF are high start-up and operation cost, especially in low-income countries, and limited amount and variety of crops can be grown, compared to large-scale conventional agriculture.

Start-up costs

Probably the most- and Least-expensive options for VF construction are farms installed from scratch in a new structure or integrated in existing structure such as designating several floors of high-rise building to vertical farms, respectively. In addition, as previously mentioned, since some urban locations can be quite expensive, some vertical farms are based in abandoned warehouses and deserted sites, which can be more economical for construction. Integrating the farm in existing building can lower more initial construction costs in comparing to traditional farming in the open field or in a greenhouse, since electricity and water infrastructure are already implemented in-house. Similarly, when apply precision agriculture, the local network or even wireless detectors in the building itself can use to transmit real-time data from the plant’s sensors to the mobile device and vice versa, in contrast to distance areas where communication network is sometimes out of range, so online monitoring is not possible. Also, it

e-ISSN: 2581-8317

may be more cost-effective to apply VF in one or more lower story or smaller space buildings, instead of a single high-rise building.

Operation costs

High operation costs are derived mainly from high electricity usage to run indoor lighting and heating/cooling (and water to a lesser degree). Lighting is the most intensive input in VF. Highly efficient LEDs are used to mimic photosynthesis processes of natural sunlight. Using only the red and blue light wave lengths, which are optimal for plant growth (for example only red light is used for lettuce), helps reduce electricity costs by as much as 15 percent. LEDs may have a longer life – a lifespan of three years – but this also means they should be replaced in every three years. In addition, disruption of temperatures regime because of heat produced by the intensive lighting, would involve larger energy input for air conditioning, especially in summer. In the opposite direction, plant's evapotranspiration releases the water absorbed to the air and brings down the surrounding temperature.

One way to diminish energy cost is designing the farm structure in such that absorbs as much natural light as possible, for example by using light shelves, tall as the height of the floor to let most of the light in. Another option is setting the structure shape at the right angle to get the maximum sunlight exposure, for example, like the A-shaped structure of "Sky Greens" farm with its unique rotating mechanism that allows regular exposure of the rotated plants tiers to sunlight during the day.

But even that, the total cost can be substantial. For example, apply VF in a 37-story building for 30 years is estimated at a cost of USD 248 million. And as VF is technology-intensive, this means it is extremely dependent on technology and energy for lighting, water re-circulating and maintaining temperature and humidity. So, power outage can cause significant losses to the business.

Other costs are related to the intense use of seeds. As mentioned, VF produces high crop yield than traditional farming. This also results from a short growing cycle of the plant. Thus, instead of harvesting once or twice a year as in traditional agriculture, in VF harvesting is done multiple times a year, so seeding is done more frequently.

New innovations and technology in the future will likely increase energy efficiency, for example by increasing the share of high-efficiency photo-voltaic solar panels in the farm's energy resources. At present, the authorities could facilitate the adoption of VF by strong decrease in electricity prices as well as other inputs such as water and property tax.

Limited plant types

At present, not all plants are suitable for VF due to long growing cycle, small-volume production, the height of the plants, pollination or other issues. Commercial VF usually focuses on high-return and rapid-growing plants such as lettuce, basil, and other salad greens. Slower-growing vegetables, as well as grains and large-scale staple crops, such as wheat, corn, soybean, and rice, are not ideal for indoor production from cost-effectiveness and land considerations. Tree crops such as banana, olive and avocado cannot grow inside due to height constraints but can grow in an outer area of the structure with sufficient space. In addition, the current food volumes produced by VF are not as large as those of large-

e-ISSN: 2581-8317

scale conventional farm, and expanding VF to a large-scale (i.e., multi-story buildings) can be cost-prohibitive. On the other hand, for certain plants potential returns of VF are higher crop yields than conventional agriculture. Also, traditional farming is considered monoculture, meaning a single crop can be produced in each growing cycle, whereas in VF a variety of plants can be grown simultaneously on different floors. However, it is still not clear enough whether this kind of growing is feasible, as every crop requires specific environmental requirements in each floor, which is difficult to get in a single VF facility.

Major incentive to buy VF products is the production of healthy chemicals-free food. However, it is unclear, at least in USA, whether this food can be classified as organic, as many specialists claim that in order for the crop to be organic certified, it has to be grown in an entire natural ecosystem, beyond the lack of pesticides and herbicides.

In relate to pollination, since insects are usually excluded from the indoor growing environment, plants' pollination, if required, has to be done manually, requiring more time, money and labor.

Finally, there are no incentives or policy initiatives to facilitate the development of VF to a large extent that will meet the food demands of the growing population. For that to happen, more skilled workforce has to be trained in the field of VF.

Global trend

VF has major sustainability benefits (i.e., economic, environmental, and social), as well as limitations and challenges. Thanks to its many practical features, VF can be established in any part of the world without any climatic or geographic limitation, and countries that were once major food importers, can become major food producers and food independent.

And indeed, VF is widely adopted around the globe, including in the Antarctic and desert regions (e.g., Middle East, Africa, United Arab Emirates), and in highly urbanized countries with less land availability such as Israel, Japan and South Korea. Japan has heavily invested in commercial vertical farms with almost 200 facilities already operational. VF is also attractive in countries without land constraints such as USA and Canada, because of its economic and environmental advantages, and in countries that suffer from heavy pollution and soil depletion, such as parts of China. It is predicted that VF market in USA will reach USD 3 billion by 2024, representing an annual growth of about 24 percent from 2018 to 2024. In China, there are 80 vertical farms, which are expanding at a faster rate. In Kranji, Singapore, there are about 120 vegetable towers that produce 0.5 ton a day (established by "Sky greens"), and there are plans to build an additional 300 to support daily production of two tons of vegetables. Currently, the world's largest vertical farm is "Crop One", located in Dubai, United Arab Emirates. A 12,000 square-meters facility aims to produce 2,700 kg of herbicide- and pesticide-free leafy greens, harvested daily, for 225,000 in-flight meals every day for Dubai International Airport, using 99 percent less water than conventional agriculture in the open field. Total global number of VF projects estimated at 200 – 300; total occupied area for growing through VF is probably less than 30 hectares.

e-ISSN: 2581-8317

To date, VF is practiced mainly in developed countries. Expanding this technology to other countries is a function of its affordability and accessibility, particularly in low-income countries, where food insecurity is severe. For now, VF cost is not low enough to satisfy these requirements, but like any new technology, it is expected to come down with time, allowing by then its worldwide adoption.

CONCLUSIONS

VF practiced on a large scale has great potential to: (1) provide of healthy and nutritious food (i.e., food security) all year-round for most of the world's population and encourage its consumption; (2) restore large part of landscape and the ecosystem rely on that; (3) conservation of drinking water through recycling of gray water; (4) raise the value of abandoned and unused urban spaces. All together, these benefits contribute to the creation of a sustainable urban environment that encourages good health for all who choose to live in cities. Yet, more research is needed to further confirm these effects at different locations and across different scales. Future technological advancements and governmental support will probably promote the widespread adoption of VF that can complement existing rural agriculture practices. If these conditions are met UA and VF in particular could provide constant food supply and encourage sustainable urban life for the 70 percent of the people that will be living within cities by the year 2050.

REFERENCES

https://www.aerofarms.com

https://cropone.ag

https://cubicfarms.com

https://www.discovery.com/science/vertical-farming--raising-agriculture-s-potential-and-lowering-i

https://www.freightfarms.com

https://interestingengineering.com/13-vertical-farming-innovations-that-could-revolutionize-agriculture

https://www.modularfarms.com.au

https://roboticsandautomationnews.com/2019/05/03/top-25-vertical-farming-companies/22181/

https://www.skygreens.com

http://www.verticalfarm.com/?page_id=36

e-ISSN: 2581-8317

Birkby, J., 2016. Vertical farming. A program of the National Center for Appropriate Technology, ATTAR Sustainable Agriculture. Available at: https://attra.ncat.org/product/vertical-farming

EPA, 2011. Partnership for sustainable communities – Urban Farm Business Plan Handbook. Available at: https://www.epa.gov/sites/production/files/201510/documents/1.urban_farm_business_plan_handbook_091511_508.pdf

Game, I. and Primus, R., 2015. Urban agriculture, GSDR 2015 Brief. Available at: https://sustainabledevelopment.un.org/content/documents/5764Urban%20Agriculture.pdf

Kalantari, F., Mohd Tahir, O., Akbani Joni, R. and Fatemi, E., 2018. Opportunities and challenges in sustainability of vertical farming: a review. Journal of Landscape Ecology, 11 (1). Available at: https://www.researchgate.net/publication/319248372_Opportunities_and_Challenges_in_Sustainability_of_Vertical_Farming_A_Review/fulltext/59a04979aca2726b901138aa/Opportunities-and-Challenges-in-Sustainability-of-Vertical-Farming-A-Review.pdf

Kalantari, F., Mohd Tahir, O., Mahmoudi Lahijani, A. and Kalantari, S., 2017. A Review of vertical farming technology: A guide for implementation of building integrated agriculture in cities. Available at: https://www.researchgate.net/publication/320339851

Kennard, N.J. and Bamford, R.H., 2020. Urban agriculture: Opportunities and challenges for sustainable development. Available at:: https://www.researchgate.net/publication/337719125

Kumar Gupta, M. and and Ganapuram, S., 2020. Vertical farming using information and communication technologies. Available at: https://www.researchgate.net/publication/337972941

Qiu, J., Bayabil, H.K. and Li, Y., 2020. Indoor vertical farming systems for food security and resource sustainability. The Institute of Food and Agricultural Sciences, University of Florida. Available at: https://edis.ifas.ufl.edu/pdf/FR/FR42900.pdf

Rameshkumar, D., Jagathjothi, N., Easwari, S., Rajesh, R., Muthuselvi, R., Naveen Kumar, P., Krishnakumare, B., Minithra, R. and Suresh, R., 2020. Vertical farming – Agriculture of the future. Indian Farmer, 7(11). Available at: https://www.researchgate.net/publication/346097609

Royston, R.M. and Pavithra, M.P., 2018. Vertical farming: A concept. International Journal of Engineering and Techniques, 4 (3). Available at: https://www.researchgate.net/publication/342260487

Vitalyst Health Foundation, 2017. Urban farming workbook – An introduction to urban farming, from types and benefits to strategies and regulations. Available at: http://vitalysthealth.org/wp-content/uploads/2017/07/WrkBk-UrbnAgrcltr-FNL-Edited.pdf

Zeidler, C. and Schubert, D., 2014. From bioregenerative life support systems for space to vertical farming on earth – the 100% spin-off. Available at: https://www.researchgate.net/publication/263747164

Identification of Single Nucleotide Polymorphism (SNP) Markers in Crop Plants

Article ID: 11500

S M Samyuktha[1], S Geethanjali[2]
[1]Assistant Professor (Plant Breeding and Genetics), Imayam Institute of Agriculture and Technology, TNAU, Tamil Nadu – 621 206.
[2]Assistant Professor (Plant Breeding and Genetics), Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu – 641 003.

Introduction

Molecular markers are widely used in plant research and plant breeding. In the plant breeding process, markers are being used for increasing the speed of plant selection mainly through marker-assisted selection (MAS) on the basis of selection of individual genes or chromosomal segments. Molecular markers are also being used for the analysis of population structure, the study of evolutionary relationships, and the study of the genetic structure of individuals at the whole-genome level. In recent years, single nucleotide polymorphism (SNP) markers are increasingly becoming the marker system of choice. SNPs are single base changes that arise due to point mutations. SNPs are the most common and abundant form of genetic variation in organism. On an average, a base pair change can be detected at the rate of one in 500 nucleotides. These genetic polymorphisms have evolved as useful DNA markers finding applications in trait-based association mapping and disease diagnosis. Although SNPs are needed in large numbers, only low numbers of validated SNP markers are available. Identification of SNPs in crop plants is pivotal step to utilise them as valuable markers.

Methods for the Identification of Single Nucleotide Polymorphism (SNP) Markers

1. Identification of SNPs based on sequenced genomes.
2. Identification of SNPs based on EST sequence data.
3. Identification of SNPs based on array analyses.
4. Identification of SNPs based on amplicon resequencing.
5. Identification of SNPs based on RNA seq technology.

Identification of SNPs Based on Sequenced Genomes

Whole genome of many organisms has been sequenced and made publicly available in the recent years. Whole genome sequences are a common choice for SNP identification. Here the SNPs can be directly mined by comparing the genome sequence of a target genotype with the reference genome. Identification of SNPs based on sequenced genomes has been reported in several crops such as Rice, Arabidopsis, Grapes, Populous etc.,

The rapid advancements in next generation sequencing technologies such as 454, Illumina, SOLiD, have made it feasible to sequence either fully or partially the genome sequences of organisms including orphan crops at a relatively lower cost. The availability of genome sequences would permit the identification of SNPs in crops plants at a much faster pace. While a large number of SNPs can be identified through whole genome analysis, most of them lie in the non-coding regions. Their functional role is unknown and makes it difficult to apply them for trait-based mapping.

Identification of SNPs Based on EST Sequences

Compared to a whole genome analysis, targeting specifically the coding regions which are expressed functionally would help in the identification of more informative SNPs. Expressed sequence tags are short DNA sequences generated from cDNA libraries constructed using the traditional cloning and Sanger sequencing technology. Expressed sequence tags (ESTs) have been generated for many crop species. The number of available ESTs in the NCBI EST database (URL: http://www.ncbi.nlm.nih.gov/dbEST) range from less than 10,000 for less investigated crops to more than a million ESTs for major crops. In some cases, ESTs have been specifically generated for SNP identification from different lines as in *Arabidopsis thaliana* and in other cases ESTs from heterozygous highly polymorphic individuals were used for SNP identification using bioinformatic analysis methods. The sequence quality of the ESTs is usually not very high. The number of identified SNPs is relatively low in many species with validation rates usually between 50 and 85%.

Identification of SNPs Based on Array Analyses

The identification of SNPs based on array analyses involves the use of arrays containing oligonucleotides derived from large numbers of genes. Such arrays are not only used for the study of expression levels of individual genes but also for the identification of SNPs when the hybridization patterns generated with cDNA or DNA samples from different individuals are being compared. Compared discovery of SNPs based on ESTs, this approach covers many more (10,000–20,000) genes without an expression level bias.

Identification of SNPs Based on Amplicon Resequencing

Amplicon resequencing involves the development of primers for the amplification of DNA fragments derived from genes, ESTs or other single copy genomic sequences. The amplification products from a number of representative lines are fully sequenced and the obtained sequences are subsequently compared with one another using sequence alignment tools and bioinformatic pipelines. The advantage of this approach is that the sequence from each investigated individual is determined through double-strand sequencing and SNPs can be identified in a very reliable way with a false discovery rate usually below 5%.

Identification of SNPs Based on RNA Seq Technology

Transcriptomics, the study of complete transcripts in a cell is a potential tool to understand the functional elements of a genome. A recent development gaining momentum in transcriptome profiling is the RNA seq technology. High through put RNA sequencing enables to analyse the expression of several thousand transcripts in an organism at a reduced cost. By comparing these sequences with reference sequence, SNPs can be identified from the transcribed or coding regions. Particularly, the SNPs in these regions that cause mis-sense mutations are of great interest, as they result in alteration of protein function and can find immediate application in marker assisted selection. In species where a reference sequence is not available, SNPs can still be called by using pooled samples of individuals for RNA seq. RNA seq has been used for typing SNPs in crops such as Arabidopsis, Red clover, Mandarin and Populus.

Conclusion

The large-scale identification of SNPs in crop plants is still a challenging attempt, whether the entire genome or only the coding regions of genes are surveyed for SNPs. Whole genome sequencing may be still at a far reach for unexplored and orphan crops. Specific sequencing of amplicons and RNA seq are prosmising as the most viable approach for the identification of large numbers of SNPs for most crop plants. In addition to the existing technologies, new approaches are also being explored for SNP identification. At present, high expectations are being placed on one such novel strategy that involves a process called sequence capture which has been successfully used for SNP detection in exons of the human genome. With the accumulating sequence information, it is expected that large numbers of SNPs can be identified in a fast and effective manner.

References

1. Borevitz, J.O., Liang, D., Plouffe, D., Chang, H.S., Zhu, T., Weigel, D., Berry, C.C.,Winzeler, E. and Chory, J. (2003). Large-scale identification of single-feature polymorphisms in complex genomes. Genome Research, 13:513-523.
2. Collard, B.C. and Mackill, D.J. (2008). Marker-assisted selection: an approach for precision plant breeding in the twenty-first century. Philosophical Transactions of the Royal Society B, 363:557-572.
3. Ganal, M.W., Altmann, T. and Roder, M.S. (2009). SNP identification in crop plants. Current Opinion in Plant Biology, 12(2):211-217.
4. Pavy, N., Parsons, L.S., Paule, C., MacKay, J. and Bousquet, J. (2006). Automated SNP detection from a large collection of white spruce expressed sequences: contributing factors and approachesfor the categorization of SNPs. BMC Genomics,7:174.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Biodiversity Of Medicinal and Aromatic Plants

Article ID: 11501

S. Padmapriya[1], M. Kavitha[1]
[1]TNAU, Coimbatore - 641003.

Abstract

The industrial demand for the medicinal plant resources has soared up due to the worldwide resilience in the herbal sector engaged in production of herbal health care formulations, herbal based cosmetic products and herbal nutritional supplements. India houses a rich repository of medicinal and aromatic plants due to favourable geographical position, climatic conditions and varied edaphic factors. The people who have traditionally lived in forests are key to understanding, utilizing and conserving the plant diversity. It is estimated that, 95 % of the medicinal plants used in Indian herbal industry today are collected from wild. About half a million tonnes of dry material is collected through destructive means indiscriminately and 1.65 lakh hectares of forest is cleaned and felled each year. With the increase in population, rapid expansion of area under food and commercial crops, deforestation, extension of urban area, establishment of industries in rural areas, etc., there is considerable depletion of plant genetic resources wealth, many of them being in the process of extinction day by day. Thus, there is an urgent need to understand the current status of biodiversity of medicinal plants and to formulate suitable conservation strategies to preserve the same.

Keywords: Medicinal plants, biodiversity, components, distribution. hotspots of biodiversity.

Introduction

Medicinal plants which constitute a segment of the flora provide raw material for use in all the indigenous systems of medicine in India namely Ayurveda, Unani, Siddha and Tibetan Medicine. An estimate by the World Health Organization (Bannerman 1982) that more than 80 percent of the world's population relies solely or largely on traditional remedies for health care is frequently cited. Additionally, modern medicines contain plant derivatives to the extent of about 25%. The term 'Biodiversity' refers to the total quantity, variety and variability of living organisms in a particular area from all sources including terrestrial, marine and other aquatic ecosystems. It embraces the whole of life, including micro-organisms, plants and animals on earth. Biodiversity also refers to and includes the genes of organisms, the ecosystems they live in and the services they provide to keep the globe healthy. In India, are about 68 million people belonging to 227 ethnic groups and 573 tribal communities derived from six racial stocks in the country (Pushpgandhan, 1994). Medicinal plants are now recognized, throughout the world, as an important component of natural resources of the respective countries. For all practical purposes, medicinal plants are no different from the other economically important species, whether occurring in the wild or cultivated state. They are subjected to the same risks and need the same degree of protection, as the other plant resources. For these reasons, it is essential that the total dimension of biodiversity is understood along with the all the implications, in order to be able to derive the full benefit out of our medicinal plant resources.

Components of Biodiversity

Biodiversity is usually classified into three categories that represent three fundamental and related levels of biological organization: a) ecosystem diversity, b) species diversity and c) genetic diversity.

1. Ecosystem Diversity: An ecosystem is a natural unit consisting of non-living (abiotic) and living (biotic) components occurring together in nature, which interact to produce a stable system. A forest, a grassland, a pond, and a desert, are examples of ecosystems. The abiotic component consists of the soil, the water and the air whose physical and chemical properties sustain and/or affect life. The biotic component of an ecosystem is formed of living organisms. Functionally these may be producers, consumers or decomposers or a combination of these. All the components of an ecosystem are subject to variability and in turn alter the composition and nature of the ecosystem.

2. Species Diversity: Species diversity represents the numbers and the degree of variability of families, genera and species. Species are generally regarded as populations within which gene flow occurs under natural conditions. New species originate due to a variety of causes which determine their structure and reproductive behaviour. (Wilson and Peter, 1988) estimated that the number of species of all organisms falls between 5 and 30 million. A recent estimate puts the known species at a little over 1.4 million. Habitat variability promotes species richness. Wide ranges of distribution result in genetic diversity. In comparison to the temperate parts of the world, the tropical regions harbour a vast range of biodiversity. The global distribution patterns indicate that species richness decreases with latitude. Diversity also decreases with increasing altitude. In the marine habitats, diversity negatively correlates with depth.

3. Genetic Diversity: Genetic diversity is the amount of genetic variability occurring within a species, which is the sum total of genetic information contained in the genes of all individual organisms of that species. This is the most important aspect of biodiversity. Some amount of genetic diversity is readily discernible in the form of visible differences in the expression of a particular character. The genetic variability of cultivated species/varieties and their wild relatives, together forms a source of continued basic supply of traits for breeding new and improved varieties and for the same reason these are called the 'genetic resources' of a country/region.

Biodiversity losses occur due to habitat destruction, over harvesting, pollution, inappropriate and often accidental, introduction of exotic plants and animals, etc. Habitat destruction is often related to development projects like land conversion, construction of dams, etc. Biodiversity is also lost due to sudden natural calamities like floods, cyclones, hurricanes, earth quakes, etc. Conservation of biodiversity is one of the paramounts concerns the world over. Governments, nongovernmental organizations (NGOs), scientists, are all preoccupied with the problem of devising ways and means of conserving biodiversity, or at least retarding the rapid rate of its loss.

Indian Biodiversity

India is a treasure chest of biodiversity which hosts a large variety of plants and has been identified as one of the eight important 'Vavilorian' centres of origin and crop diversity. Although its total land area is only 2.4% of the total geographical area of the world, the country accounts for 8% of the total global biodiversity with an estimated 49,000 species of plants of which 4,900 are endemic (Kumar et al. 2000). The ecosystems of the Himalayas, the Khasi and Mizo hills of northeastern India, the Vindhya and Satpura ranges of northern peninsular India, and the Western Ghats contain nearly 90% of the country's higher plant species and are therefore of special importance to traditional medicine. Although, a good proportion of species of Medicinal Plants do occur throughout the country, peninsular Indian forests and the Western Ghats are highly significant with respect to varietal richness.

Distribution of Medicinal and Aromatic Plants (MAP)

An analysis of distribution of MAP in natural habitat showed that about 70% of India's MAPs are found in tropical forests of Western and Eastern ghats, the Vindhyas, Chotta Nagpur plateau, Aravalis and the Himalayas. Studies also showed that a large percentage of known MAPs occur in the dry and moist deciduous vegetation area compared to evergreen and temperate regions. Habit-wise classification showed that about 33% are trees, 32% herbs, 20% shrubs, 12 % creepers and 3% others.

Medicinal plants: species diversity and representative species of different bio-geographic zones of India (Ved et al. 2005)

Bio-geographic region	Estimated no. of medicinal plants	Examples of some typical medicinal species
Trans Himalayas	700	*Ephedra geradiana* Wall., *Hippopha erhamnoides L., Arnebia euchroma*
Himalayan	2500	*Aconitum heterophyllum* Wall. *Ferula jaeshkeana* Vatke and *Saussurea costus, Nardostachys grandiflora, Taxus wallichiana, Rhododendron anthopogon* and *Ponax pseudoginseng* Wall.

Desert	500	*Convolvulus microphyllus, Tecomella undulate* (Sm.) *Citrulus colocynthis* (L.) and *Cressa crertica* L.
Semi-Arid	1000	*Commiphora wightii* (Arn.) *Caesalpinia bonduc* (L.) *Balanitesa egyptiaca* (L.), and *Tribulus rajasthanensis*
Western Ghats	2000	*Myristica malabarica Lam., Garcinia indica* (Thou.) *Utleria salicifolia Bedd* and *Vateria indica* L.
Deccan Peninsula	3000	*Pterocarpus santalinus* L.f., *Decalepis hamiltonii* Wigh & Arn, *Terminalia pallid Brandis* and *Shorea tumbuggaia Roxb.*
Gangetic Plain	1000	*Holarrhen aqpubescens, Mallotus philippensis* (Lam.) *Pluchea lanceolata* and *Peganum harmala* L.
North-East India	2000	*Aquilaria malaccensis* Lam., *Smilax glabra Roxb., Ambroma augusts* (L.) and *Hydnocarpus hurzii*
Islands	1000	*Claophyllum inophyllum* L. *Adnanthera pavonina* L., *Barringtonia asiatica* (L.) and *Aisandra butyracea (Roxb.)*
Coasts	500	*Rhizophora mucronata* Lam., *Acanthus ilicifolius* L., *Avicennia marina* and *Sonneratia caseolaris* (L.)

Biodiversity in Tamil Nadu

Analysis of habits of medicinal plants indicates that they are distributed across various habitats. One third are trees and an equal portion shrub and the remaining one-third herbs, grasses and climbers. A very small proportion of the medicinal plants are lower plants like lichens, ferns algae, etc. Majority of the medicinal plant are higher flowering plants. The State of Tamil Nadu is endowed with a very rich flora.

Due to the various physiographic features and physiognomic factors, different types of vegetation exist in the state 1. Coastal vegetation 2. Island vegetation 3. Vegetation of hills and mountains comprising of:
1. Dry deciduous forests.
2. Moist deciduous forests.
3. Semi-evergreen forests.
4. Wet evergreen forests.
5. Sholas (Southern montane wet temperate forests).

The altitude varies from sea level to 2637 m including the well-known mountain ranges - the Nilgiri, the Anamalais and the Cardamom hills which harbours different types of ecological niches, ecosystem and innumerable medicinal plants.

Hotspots of Biodiversity

Hotspots are areas featuring exceptional concentrations of endemic species and experiencing exceptional loss of habitat. To qualify to the list of hotspots, an area should have at least 0.5 per cent of all species of plants world-wide, as endemics. Hotspots are also identified, by some other researchers, on the basis of richness of rare or taxonomically unusual species, in the areas under threat. Recognition of hotspots is a pre-requisite to identify areas whose biodiversity needs urgent measures of protection. Among the 25 hotspots of the world, the Western Ghats along with Sri Lanka, and the Eastern Himalayas and the Andaman-Nicobar Islands, along with the Indo-Burma regime, have been recognised, as the two megadiversity hotspots of India. These two areas also figure in the list of eight hottest hotspots (Myers et al., 2000). The following 24 areas, often termed as the micro-hotspots, have also been identified in India: Andamans, Nicobars, Agasthyar hills, Annamalai hills, Nilgiri-Silent valley, Palni hills, Shimoga-Kanara, Mahabaleshwar, Konkan, Satpura ranges, Tirupathi hills, Visakhapatnam hills, Deccan hills, Chotanagpur plateau, Kutch, Aravalli hills, Khasia-Jainitia hills, Patkoi-Lushai hills, Cachar-Mikir hills, Arunachal Pradesh, Sikkim Himalayas, Garhwal Himalayas, Lahul Himalayas and Kashmir Himalayas.

Uncontrolled Exploitation of Medicinal Plants Wealth

The healing plants will continue as the primary means of preventive and curative healthcare in the developing countries. Indeed, rising population growth and falling economic levels will probably make these plants more important than today. Despite all their importance, medicinal plants are seldom handled within an organized, regulated sector, most are still exploited with little or no regard to the future. The escalating consumer demand for pharmaceutically important medicinal plants has resulted in the indiscriminate harvest of wild plants. This is damaging both ecosystems and their precious biodiversity. The damage is especially serious when bark, roots, seeds and flowers all essential for the species survival are removed. Hence there is an urgent need for conservation of the biodiversity.

Conclusion

The present time, therefore, offers a unique opportunity to work with developing countries in implementing policies to regulate medicinal plant conservation, cultivation, processing, and marketing. At this pioneering stage, in which norms and standards for the healthcare of billions of people in the developing nations are going to be rapidly set, a strategy for the future should be developed. This will be far from easy; the medicinal-plant business is fluid, undocumented, and largely unregulated. But, regardless of the difficulties, a beginning must be made to address this important but neglected area.

References

1. Bannerman, R.H. 1982. Traditional Medicine in Modern Health Care Services. International Relations. 6(5): 731-748
2. Kumar, Updesh, and Mahender J. A. 2000. Biodiversity: Principles and Conservation. Agrobios. 8(2).
3. Norman Myers, Russell A. Mittermeier, Cristina G. Mittermeier, Gustavo A. B. da Fonseca & Jennifer Kent. 2000. Biodiversity hotspots for conservation priorities. Nature. Volume 403: 853–858
4. Pushpagandhan P. 1994. Ethnobiology in India. A status report, Ministry of Enviroment and Forest, GOI, New Delhi.
5. Ved, D.K., G.A. Kinhal, K. Ravikumar, R.V. Sankar & K. Haridasan. 2005. Conservation Assessment and Management Prioritization (CAMP) for wild medicinal plants of North-East India. Newsletter of the Medicinal Plant Specialist Group of the IUCN Species Survival Commission. 11:40
6. Wilson, E. O., and Peter, F. M. (Eds.). 1988. Biodiversity. National Academy Press, Washington, D.C.

Nanosensors: A Modern Tool of Agriculture

Article ID: 11502

Deepak Meena[1], Ashish Meena[2]
[1]PhD Research Scholar, Department of Genetics and Plant Breeding, MPUAT Udaipur, Rajasthan.
[2]M.Sc. Research Scholar, Department of Agronomy, MPUAT Udaipur, Rajasthan.

Introduction

In the recent past, development of sensing devices is in boom. When it comes to test a particular analyte from the soil causing disturbance in the field there are assays which give accurate result but it has a drawback of consumption of time and also the high cost for performing. Sensors are those which give better results with the live pictures and conditions of the field. Sensors do monitor changes or the effects caused by various pesticides, fertilisers and herbicide, besides physical conditions of soil like pH, soil moisture and crop growth. When it comes to wireless technology, certain node installation is carried out which makes the person to monitor the happenings in the field. All the nodes can be controlled at the same time through cloud computing or even through air programming.

What is Nanosensors?

Nanosensors are any biological, chemical or surgical sensory points used to convey information about nanoparticles to the macroscopic world. Their use primarily includes different type of medicinal purposes and as open sesame to constructing other nanoproducts, such as computer chips that work at the nanoscale and nanorobots.

Sensors Using Semiconductor Nanowire Detection Elements

These sensors are capable of detecting a range of chemical vapours. When molecules bond to nanowires made from semiconducting materials such as zinc oxide, the conductance of the wire changes. The amount that the conductance changes and in which direction depends on the molecule bonded to the nanowire. For example, nitrogen dioxide gas reduces how much current the wire conducts and carbon monoxide increases the conductivity. Researchers can calibrate a sensor to determine which chemical is present in the air by measuring how the current changes when a voltage is applied across the nanowires.

Semiconducting Carbon Nanotubes

To detect chemical vapours, you can first functionalise carbon nanotubes by bonding them with molecules of a metal, such as gold. Molecules of chemicals then bond to the metal, changing the conductance of the carbon nanotube. As with semiconducting nanowires, the amount that the conductance and its direction changes depend on the molecule that bonds to the nanotube. This type of sensor is now commercially available.

Nanotubes and Nanowires that Detect Bacteria or Viruses

These also utilise changes in electrical conductivity, in this case that of carbon nanotubes to which an antibody is bonded. When a matching bacteria or virus attaches to the antibody a change in conductivity can be measured. In this process you attach nano-tubes to metal contacts in the detector and apply a voltage across the nanotube. When a bacteria or virus bonds to the nanotube, the current changes and generates a detection signal. Researchers believe that this method should provide a fast way to detect bacteria and viruses. One promising application of this technique is checking for bacteria in hospitals. If hospital personnel can spot contaminating bacteria, they may be able to reduce the number of patients who develop complications such as staph infections.

Nanocantilevers

These devices are being used to develop sensors that can detect single molecules. These sensors take advantage of the fact that the nanocantilever oscillates at a resonance frequeney that change if a molecule lands on the cantilever, changing its weight. Coating a cantilever with molecules, such as antibodies, that bond to a particular bacteria or virus determines what bacteria or virus will bond to the cantilever.

One example of nanoparticles used in sensors is a hydrogen sensor that contains a Javer of closely spaced palladium nanoparticles that are formed by a beading action similar to water collecting on a windshield. When hydrogen is absorbed, the palladium nanoparticles swell which causes shorts between nanoparticles and lowers the resistance of the palladium.

Another use of nanoparticles is in the detection of volatile organic compounds (VOCS). Researchers have found that by embedding metal nanoparticles made of substances such as gold in a polymer film, you create a VOC nanosensor. Nanotechnology applications are useful to improve soil fertility and crop production. Nanosensors could also monitor crop and animal health and magnetic nanoparticles could remove soil contaminants. Lab on a chip technology also could have significant impacts on developing nations.

References

Reddy S.R.2020. Principles of Agronomy. Kalyani Publishers, New Delhi.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Weather Forecasting through Synoptic Technique

Article ID: 11503

Vimal Kumar[1], Rajesh Kumar[2], Chandra Praksh[3], Alesh Kumar[4]
[1,2,3,4]Ph.D. Scholar, [1]Division of Agricultural Physics, [2]Division of Agronomy, [3,4]Division of Environmental Sciences, Indian Agricultural Research Institute, Pusa Campus, New Delhi-110012.

Weather plays an important role in the field of domestic and agriculture. Therefore, people have always looked for patterns in the weather, hoping to make accurate forecasts. The accurate weather forecasting information may allow farmers to make good decision on managing their farm. Weather forecasting is the application which combines science and technology to predict the state of atmosphere for future time at a given location. Weather forecasts are based on temperature; wind speed and relative humidity are very important attributes in agriculture sector as well as many industries which largely depend on the weather condition (Meinke and Stone, 2005). There are several methods used in forecast preparation, depending on the time element involved and the weather element for which the forecast is needed like:

1. persistence forecasting.
2. steady-state or trend forecasting.
3. analogue method.
4. Climatological Forecast.
5. Numerical weather prediction.

Dube et al., 2013 assessing the performance of two deterministic forecast models, Global Forecast System (GFS/T574) and Unified Model (NCUM), run at NCMRWF, in predicting the heavy rainfall observed over Uttarakhand region. They confirmed NCUM had the better skill over T574 in terms of forecast peak rainfall amounts, volume and average rain rate.

The high population density along the coastal stretch of India necessitates a real-time storm surge warning system. The Storm Surge Early Warning System (SSEWS) for Indian coasts using the ADCIRC (Advanced Circulation) model. While DSS was initially tested for the very severe cyclonic storm 'Phailin' (October, 2013) in experimental mode, it was used for the first time to provide real-time storm surge and inundation forecasts during cyclone 'Hudhud' in October, 2014 (Murty, et. al., 2017).

Increase of surface and 500hPa air temperature and a deep depression at 500hPa were closely related to increase SST over NIO. The results would be very useful and important findings for the environmental scientists to forecast as well as to study the causes of destructive cyclones (Khan, et. al. 2015). The prediction capability of the WRF modeling system was discussed by analyzing simulation results of four severe cyclones over the Bay of Bengal during 2007–2010.

The prediction parameters such as cyclone track, intensity, and landfall time are analyzed and compared with available observations. The cyclone simulations show that the model could predict the cyclone track, intensity in terms of central pressure, maximum sustained winds, and precipitation reasonably well (Raju, et al. 2012).

Synoptic Weather Forecasting

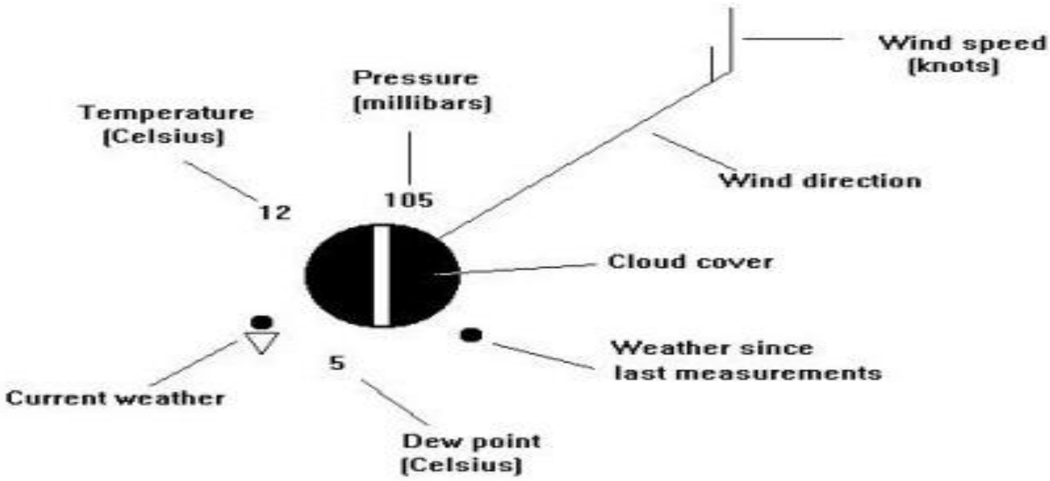
Synoptic weather forecasting technique is the traditional approach in weather prediction. This primary method continued to be in use until the late 1950s. Synoptic" means the representation of observed different weather elements into a specific time of observation.

Weather map is representing atmospheric condition at a given time in a synoptic chart. For study of changing pattern of weather, a modern meteorological center prepares a series of synoptic charts every day. From the study of weather charts over many years, certain empirical rules were formulated. These rules helped the forecaster in estimating the rate and direction of the movement of weather systems.

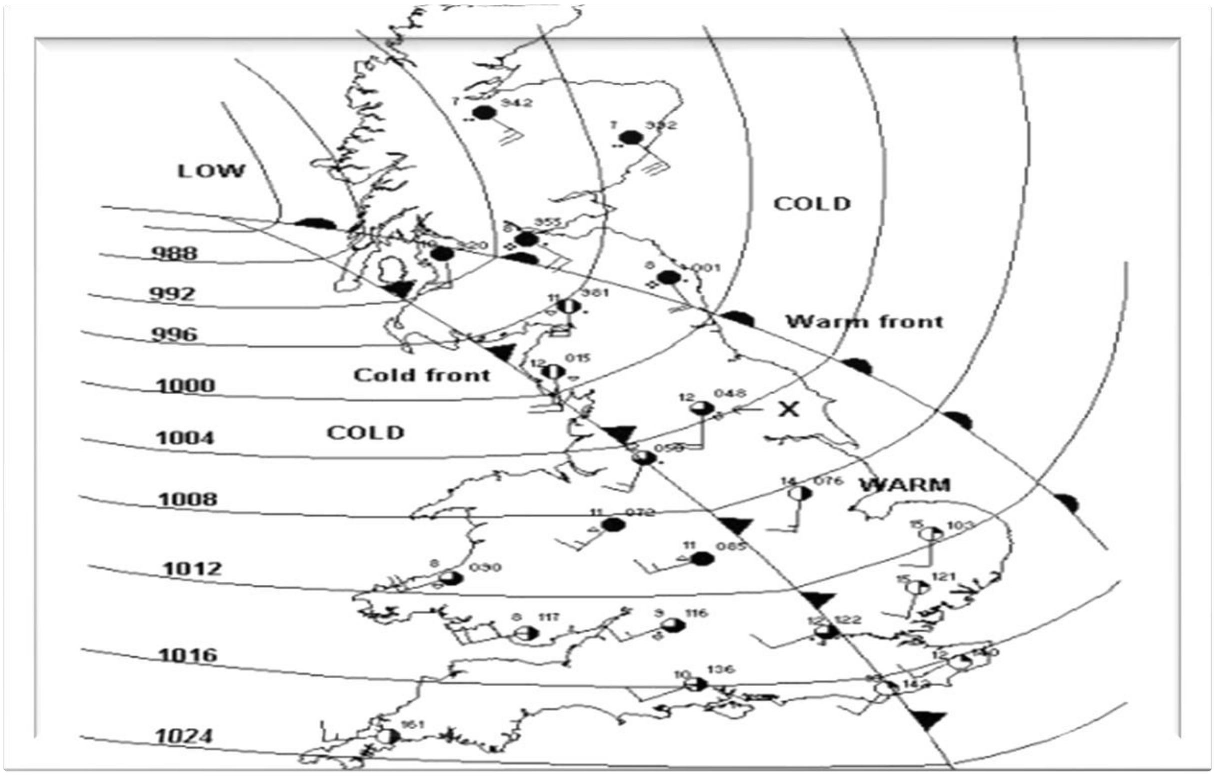
Synoptic Charts

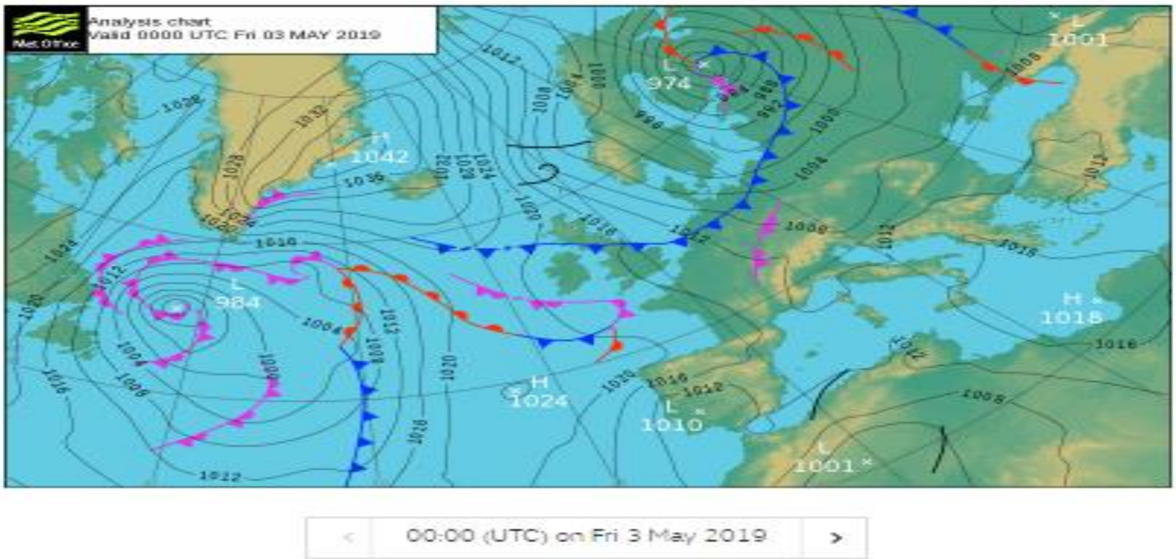
Meteorological symbols used in synoptic chart:

Plotting Weather Observations in Synoptic Chart



The chart on which various weather data and analysis are represented that describes the atmosphere over a large area at a given time. Suitable for short range forecast.





Stapes of Preparation of Synoptic Charts

Taken observed weather data =>Analysis of data =>Prepared weather chart (for today) =>Analysis of past weather chart (same date) =>Compared with present chart =>Forecast based on past and present weather chart.

Synoptic Features of Severe Cyclone Over Bay of Bengal During 2007–2010 (Raju Et Al. 2012)

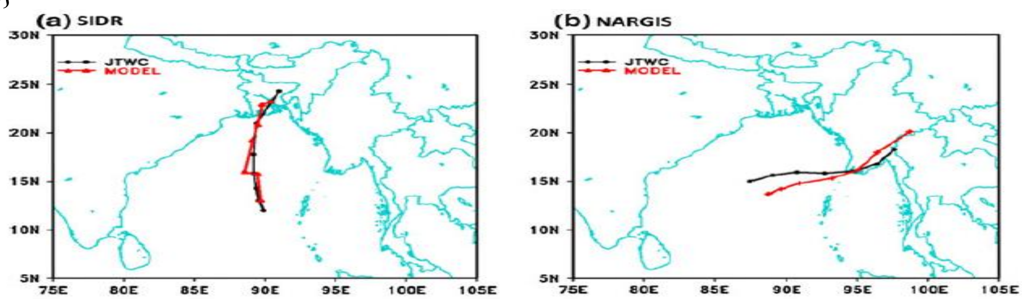
1. Sidr (13–16 November 2007): The depression formed over the south east of the Andaman and Nicobar Islands on 9 November 2007 and intensified as tropical cyclone "Sidr" on 11 November and located south of the Andaman Islands. On 13 November, it became a very severe cyclonic storm. On the morning of 15 November, the cyclone intensified to reach peak winds of 215 km/h and made landfall around 1700 UTC.

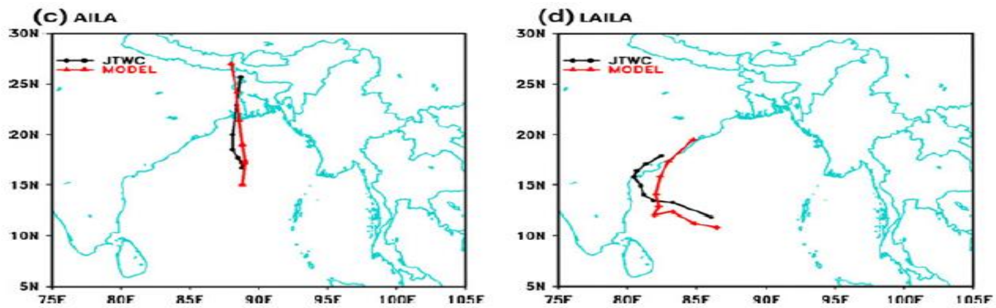
2. Nargis (26 April 2008–02 May 2008): Due to the influence of the Inter-Tropical Convergence Zone (ITCZ), a cyclonic circulation developed over the southeast Bay of Bengal on 27 April 2008 and became a cyclonic storm "Nargis" on 0000 UTC on 28 April 2008 located at 13.0N, 85.5E. The system intensified into a severe cyclonic storm at 0900 UTC on the 28th and into a very severe cyclonic storm at 0300 UTC on 29 April.

3. Aila (23–26 May, 2009): Under favorable conditions of warmer sea surface temperatures, low to moderate vertical wind shear, and upper-level divergence, the depression formed over the southeast Bay of Bengal at 0600 UTC on 23 May 2009. It intensified into cyclonic storm "Aila" at 1200 UTC on 24 May and into a severe cyclonic storm a few hours before landfall at 0600 UTC on 25 May

4. Laila (17–20 May 2010): A depression developed on 0900 UTC on 17 May 2010 in the Bay of Bengal from a persistent area of convection and became a deep depression, indicating sustained winds of at least 34 mph (55 km/h). The system intensified to cyclonic storm "Laila" early on 18 May. Further, strengthening as it tracked north-westward, it became a severe cyclonic storm on 19 May with a maximum wind of 75 mph (120 km/h), the equivalent of a minimal hurricane.

Observed and simulated tracks of tropical cyclone a Sidr, b Nargis, c Aila, d Laila {Joint Typhoon Warning Center (JTWC)}





Application of Synoptic Systems for Forecasting of as following

The synoptic systems is using to prediction of the extreme rainfall with the associated, The predicting the low pressure system and its movement resulted in a better estimation of the rainfall (location and amount) of the analyzed area, Using ensemble forecasting for weather prediction can prove to be very useful in catching an extreme/rare event, Past observation of synoptic chart used for analysis of response to changes in the frequency of synoptic patterns under a changing climate, To identify the path of increased SST over NIO temperature and deep depression by synoptic observations.

References

1. Brooks HE, Lee JW and Craven JP, (2003). The spatial distribution of severe thunderstorm and tornado environments from global reanalysis data. Atmos Res 67–68:73–94.
2. Dube A., Ashrit R., Ashish A., Sharma K., Iyengar G.R., Rajagopal E.N. and Basu S., (2013). Forecasting the heavy rainfall during Himalayan flooding—June 2013. Weather and Climate Extremes, 4: 22-34.
3. Meinke H. and Stone R.C., (2005). Seasonal and inter-annual climate forecasting: the new tool for increasing preparedness to climate variability and change in agricultural planning and operations. Clim. Change, 70:221–253.
4. Murty P.L.N., Padmanabham J., Srinivasa Kumar T., Kiran Kumar N., Ravi Chandra V., Shenoi S.S.C. and Mohapatr M., (2017). Real-time storm surge and inundation forecast for very severe cyclonic storm 'Hudhud'. Ocean Engineering 131, 25–35.
5. Raju P. V. S., Jayaraman Potty and Mohanty U. C., (2012). Prediction of severe tropical cyclones over the Bay of Bengal during 2007–2010 using high-resolution mesoscale model. Nat Hazards, 63:1361–1374.
6. Van Klooster SL and Roebber PJ, (2009). Surface-based convective potential in the contiguous united states in a business-as-usual future climate. J Climate, 22:3317–3330.
7. Khan M N H, Sattar M A and Farukh M A., (2015), Assessment of weather anomalies for severe cyclonic storm Aila in 2009. Bangladesh J. Environ. Sci., Vol. 28, 119-124.

E-ISSN: 2581 - 8317

Ripening Stages and Aging Effect of Banana with Electronic Nose

Article ID: 11504

Meghana S. Kasbe[1]
[1]Vasundhara College, P.A.H. Solapur University, Solapur (M.H.) – 413255.

Introduction

Botanically Banana is a berry type of fruit which is included in the simple and succulent category. It is direct edible fruit as it is or after some cooking processes. Mostly unripe banana is used with recipe, in cooking and preservation like banana chips. Basically, it is a climacteric fruit; the ripening stages of bananas are- under ripe, ripe and over ripe. Hence after harvesting it can change its properties and specifications i.e., colour, smell, taste, weight which is shown in the figure 1 (internal and external structure). The features and characteristics of bananas vary in all stages. Over-ripe banana has ability of enhancing the properties of white blood cells. In case of unripe stage, banana colour is green and is tasteless, tougher than the ripe banana. Weight is more in ripe than the over ripe and unripe banana. Banana is an example of tropical plant and is available in Maharashtra. Plantation of banana depends on the environment and climate conditions, which are mostly observed suitable in equatorial plane, Colombia, Ecuador, China, India, Costa Rica, Philippines, Caribbean, Asian nations and Brazil. The other countries export bananas.

Fig. 1. Ripe and over ripe banana (spoiled) on weighting balance

In our country Banana (Musa sp.) is the most important fruit crop after Mango. Because of availability and agriculture, it has good potential of exportation to other countries.

Banana is the year-round available fruit; also, it is affordable for all classes of people. The taste, nutritive, varietal range and medical value of banana make favorite fruit for children's and for all age people.

Aging Effect Monitoring of Banana

The ripening stages of bananas were studied using the E-Nose system. Emitted gases and odour of all the fruits and vegetables are not similar. All the fruits and also banana mostly emit ethylene gas in the ripening process but the quantity of emission of the ethylene gas is not the same for all the times. The air quality and volatile organic compounds (VOC) also change in the presence of fruits or vegetables during ripening process. An electronic nose (E-Nose) that classifies and distinguish the odour can be done on the basis of this principle. This system was implemented for banana and we have studied the stages of banana: under riped, riped and over riped. Basically, banana is a climacteric fruit hence, the ripening process is continuous after harvesting. Banana odours from harvesting to the spoiled stages were monitored by an E-nose for seven days using a combined hardware and software. Odour variation of banana gives up-and-down responses and shows discrepancy in the pattern.

From harvesting of Banana, it is edible and fresh on third, fourth and fifth day. At the first and second day, it is under ripened stage after harvesting or cutting. And it is in over ripened stage on sixth and seventh day. Unriped bananas are also used for eating with preparation of some recipes and with some cooking methods. But the harvesting of banana for that purpose is slightly different i.e., the time schedule can be different. When the bananas are used for eating without any preparation or recipes and in the ripened stage, the harvesting process or schedule can be different. The harvesting process is very important in the ripening process. If the harvesting or cutting is done without predictions, the process cannot be completed successfully, which can affect the quality and freshness of the banana. Table 1 represents the area of the radar response at various days for banana.

Observations and Analysis with Radar

The responses were recorded from the first day to the seventh day continuously. During this period banana passes through the 3 stages: riped, over riped and under riped. The area of radar is varying with the strength of the odour emitted by the banana. The area of radar plot went on increasing from first day to the seventh day.

Table 1. Radar plots, area of the radar response at various days for banana:

Sr. No.	Day	Area of the radar plot in cm2	Area of radar plot in %
1.	1st day	0.75	8.183
2.	2nd day	0.88	10.275
3.	3rd day	2.08	22.695
4.	4th day	2.27	24.76
5.	5th day	2.86	31.205
6.	6th day	3.07	33.497
7.	7th day	5.05	55.1

On the first day of the experiment, area of radar plot was 0.75 cm^2 and 8.183% with respect to the total area of the pattern. The area of the pattern was slightly increased on the second day, (i.e., 0.88 cm^2 and 10.27 %). On the third day, the area of radar increased to 2.08 cm^2, (i.e., 22.695 %). On the fourth day the area was 2.27 cm^2 with a gas response of 24.76 %. It is observed that area has increased by 0.19 cm2. The area of the responses of the gases on fifth day is 2.86 cm2 (31.205 %) whereas on sixth day it was 3.07 cm^2 and that on the seventh day is 5.05 cm^2 (55.1 %) with gas variation of 0.59 cm^2 and 0.31 cm^2, respectively.

Conclusions

From our experimental results, a number of inferences can be drawn:

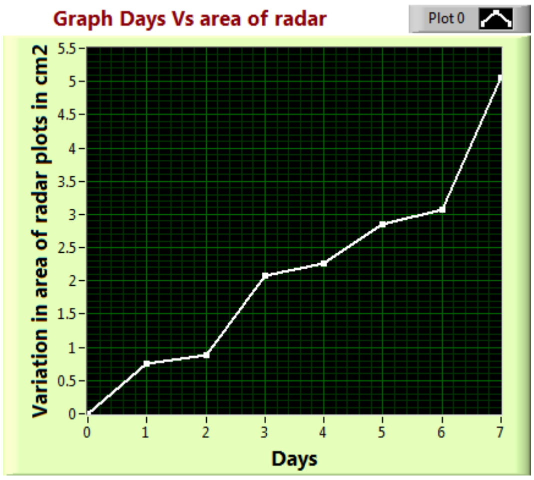


Fig. 2. Graph of variation area of radar plot vs. number of days

1. In cooperation of the planned portable E-Nose system (hardware) and the software (LabVIEW and MATLAB) we accomplished a precision of 93.7 % in case of Banana study.
2. The odour radar patterns at various days for banana were apparent, facilitate the opportunity of recognizing the odour of fruits, vegetables and various ripening stages of the fruits.

The variation in responses of radar plots shows that the ethylene gases, other gases and VOC (odour) are increased from unriped to the overriped stages of the banana. Graphical variation in the odour from under riped to over riped stages of banana, using changing area of radar pattern is shown in the figure 2. Graph shows that the area of the plot is increased from the under riped to over riped stages. Hence, we may say that, when banana is in the under riped stage, the strength of smell or odour is minimum or less than the riped banana. In the ripening process, banana can produce ethylene, other gases and VOC with respect to the time. As the time and the day are increased, strength of the gases also increases. Hence at the end of the experiment (after seventh day), maximum strength is observed. Banana produced maximum gases or ethylene in the over riped stage.

References

1. J. Potts, M. Lynch, A. Wilkings, G. A. Huppe, M. Cunningham, V. Voora, The State of Sustainability Initiatives (SSI) chapter -5 (2014) 97-117.
2. http://nhb.gov.in/report_files/banana/BANANA.htm
3. Meghana S. Kasbe, "Freshness and States of Sapodilla Classification Using Radar Plots: E-Nose Application" Article ID: 11012, Volume 3 - Issue 6 - June 2021, Agriculture & food e-Newsletter, http://www.agrifoodmagazine.co.in/

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Smart Agriculture with IoT

Article ID: 11505

Swayam Sidhi Mishra[1], Manshi Panda[1]
[1]UG Scholarship at School of Agriculture, GIET University, Gunupur.

Agriculture plays vital role in the development of agricultural country. In India about 70% of population depends upon farming and one third of the nation's capital comes from farming. Issues concerning agriculture have been always hindering the development of the country. The only solution to this problem is smart agriculture by modernizing the current traditional methods of agriculture. Hence the project aims at making agriculture smart using automation and IoT technologies. The highlighting features of this project includes smart GPS based remote controlled robot to perform tasks like weeding, spraying, moisture sensing, bird and animal scaring, keeping vigilance, etc. Secondly it includes smart irrigation with smart control and intelligent decision making based on accurate real time field data. Thirdly, smart warehouse management which includes temperature maintenance, humidity maintenance and theft detection in the warehouse. Controlling of all these operations will be through any remote smart device or computer connected to Internet and the operations will be performed by interfacing sensors, Wi-Fi or ZigBee modules, camera and actuators with micro-controller and raspberry pi.

Keywords: IoT, automation, Wi-Fi

Objective

Agriculture is considered as the basis of life for the human species as it is the main source of food grains. But wherever automation had been implemented and human beings had been replaced by automatic machineries, the yield has been improved. The main objective is to making agriculture smart using automation and IoT technologies. The highlighting features of this paper includes smart GPS based remote controlled robot to perform tasks like; weeding, spraying, moisture sensing, bird and animal scaring, keeping vigilance, etc. Secondly, smart warehouse management which includes; temperature maintenance, humidity maintenance and theft detection in the warehouse.

Materials and Method

As the experimental setup for node1 consists of mobile robot with central server, GPS module, camera and other sensors. All sensors are successfully interfaced with microcontroller and the microcontroller is interfaced with the raspberry pi. GPS and camera are also connected to raspberry pi. Test results shows that the robot can be controlled remotely using wireless transmission of PC commands to R-Pi. R-Pi forwards the commands to microcontroller and micocontroller gives signals to motor driver in order to drive the Robot. GPS module provides the co-ordinates for the location of the robot.

The sensors give input to the controller and according to that microcontroller controls the devices in auto mode and also sends the value of sensors to R-Pi and R-Pi forwards it to user's smart device using internet. Test results shows that when temperature level increases above preset threshold level then cooling fan is started automatically in auto mode. The water pump also gets turned ON if moisture level goes below fixed threshold value. In manual mode, microcontroller receives the controlling signals from R-Pi through ZigBee and accordingly takes the control action.

Results and Discussion

1. A remote sensing and control irrigation system using distributed wireless sensor network aiming for variable rate irrigation, real time in field sensing, controlling of a site-specific precision linear move irrigation system to maximize the productivity with minimal use of water
2. With the use of GIS,GPS & Remote sensing make our work easier.
3. Helps in generation of employee.
4. More yield in less time.
5. We can take care of each plant individually.

6. Application of material in right time, right place & right method.
7. The technological development in Wireless Sensor Networks made it possible to use in monitoring and control of greenhouse parameter in precision agriculture.

Conclusions

The sensors and microcontrollers of all three Nodes are successfully interfaced with raspberry pi and wireless communication is achieved between various Nodes.

All observations and experimental tests prove that project is a complete solution to field activities, irrigation problems, and storage problems using remote controlled robot, smart irrigation system and a smart warehouse management system respectively. Implementation of such a system in the field can definitely help to improve the yield of the crops and overall production.

References

1. Google.
2. Wikipedia.
3. Y. Kim, R. Evans "Remote Sensing and Control of an Irrigation System Using a Distributed Wireless Sensor Network", IEEE Transactions on Instrumentation and Measurement.
4. IEEE, Wireless medium access control (MAC) and physical layer (PHY) specifications for lowrate wireless personal area networks (LR-WPANs). In The Institute of Electrical and Electronics Engineer.

Moisture Conservation Techniques for Sustenance of Soil Health and Crop Productivity in Rainfed Area

Article ID: 11506

Ajit Kumar Meena[1], Jaipal Yadav[2], Anshul Mishra[3]
[1,2]Department of Soil Science and Agricultural Chemistry, RCA, MPUAT, Udaipur, Rajasthan.
[3]Department of Genetics and Plant Breeding, RCA, MPUAT, Udaipur, Rajasthan.

Introduction

Rainfed agriculture: The cultivation of crops in areas where rainfall received more than 1150 mm per annum is called as rainfed agriculture." India is a predominantly rainfed country. The total geographical area 328.8 mha, 181.95 mha as devoted to agriculture.

Rainfed agriculture, with nearly 60% of cultivated area, contributes:

a. 40% of country's total food production.
b. Much of the area under coarse cereals 85%, pulses 70%, substantial area under rice 42% and nearly 65% of cotton area is rainfed.
c. It is major in total food production of country that the rainfed farming contributes.

Need of Moisture Conservation:

a. Due to erratic and vulnerable climatic conditions, rainfed agriculture is facing drought in majority of area and farmers are facing complete crop failure.
b. Hence adoption of 'moisture conservation techniques' is at great necessity and importance.

Moisture Conservation Techniques

Agronomic Measures:

a. Intercropping.
b. Mulching.
c. Ridges and Furrows.
d. Broad Bed Furrows.
e. Tied Ridging.
d. Opening of Furrow.
f. Conservation Tillage.

Mechanical Measures:

a. Contour Bunding.
b. Compartmental Bunding.

c. Graded Bunding.
d. Vegetative Barriers.

Mulching:

a. Cheapest moisture conservation practise.
b. Practise that covers ground with crop residue or with other mulching materials like plastic sheets etc.
c. It prevents evaporation losses.
d. Increases infiltration rate.
e. Controls weed growth.
f. Prevents formation of crust.
g. Organic mulches add nutrients to soil upon decomposition.

Broad Bed Furrows:

a. Effective on black soils
b. Beds of 120-180cm separated with furrows.
c. Functions as mini bunds
d. Works well in dry as well as in wet spells.
e. In dry spells- increases infiltration time.
f. In wet spells- protects crops by draining excess water through furrows.

Opening of Furrows:

a. Opening of alternate furrows 30 days after sowing
b. Retain higher moisture during dry spell.
c. It increases infiltration rate, hence gradually moisture content enhanced which helps in better crop growth.
d. Enhances crop productivity.

Cultivation on Ridges and Furrows:

a. Land is laid out into ridges and furrows across the slope.
b. Plants are grown on ridges.
c. Each ridge is acts like miniature terrace.
d. Furrows are let open to conserve rain water into it.

Inter Cropping:

a. Growing of two different crops such as cereals + leguminous crops.
b. It provides an insurance against the vagaries of monsoon.
c. Different root systems favours soil infiltration rate and moisture conservation.

Tied Ridging:

a. Adjacent ridges are joined at regular intervals by barriers.
b. It allows water to infiltrate.
c. Prevents runoff.

Conservation Tillage:

a. Encompassing residue management.
b. Improves soil condition due to decomposition of in situ organic matter.
c. Higher infiltration rate due to vegetation present on soil and channels formed by decomposition roots.
d. Improves soil physical properties.
e. Enhances soil microbial activity.
f. And there by improves crop productivity.

Compartmental Bunding:

a. Practise is suitable in the area having 1% or <1% slope.
b. These are small basin like structures formed on the field
c. Area is converted into small square or rectangular blocks.
d. Useful for impounding of water
e. So, rainwater get conserved.

Contour Bunding:

a. It is constructed in the area where rainfall is less than 600mm.
b. Slope of land is up to 6%
c. Consists of narrow based trapezoidal bunds on contour
d. Impounds runoff behind it
e. Such that it can gradually infiltrate into the soil for crop use.

Graded Bunding:

a. Constructed in the areas where rainfall is more than 600mm.
b. Channel portion of graded bunds is put under cultivation.
c. Graded waterways are permanently kept under grasses.
d. It restricts runoff velocity.
e. Conserve water for crops.

Vegetative Bunds:

a. These are permanent strips of closely spaced grasses on contours.
b. An alternative to bunding
c. Biological control for runoff and for water conservation.
d. Relatively cheaper
e. Farmers friendly- provide direct benefit by fodder and thatching material from these grasses.
f. Suitable grasses are- khus, napier grass etc.

Future Research Thrust

1. One of the major crop production constraints in rainfed areas is short term rainfall with high runoff and moisture deficit.
2. In such areas, moisture conservation techniques are very crucial.
3. As rainfed area contributes majority of food in total food production of country.
4. Here is great opportunity for further research in concern with conservation of moisture for better crop production.

Conclusions

Moisture conservation techniques viz. broad bed furrows, mulching, conservation tillage have found significantly better effect on soil moisture content, soil physico-chemical properties also on soil biological dynamics and crop productivity. Hence considering the scattered rainfall in rainfed area, these moisture conservation practises are need to be adopted for ensuring better soil health and crop productivity.

Crop Diversification: Need of Present Agriculture in India

Article ID: 11507

Rajesh Kumar[1], Vimal Kumar[2], Alesh Kumar[3], Chandra Prakash[4]
[1,2]Ph.D. Scholar, Division of Agronomy, Division of Agricultural Physics, [3&4]Division of Environmental Sciences, Indian Agricultural Research Institute, Pusa Campus, New Delhi-110012.

Introduction

Indian is an agrarian country and it's about 60-65% rural population is dependent on agriculture for their livelihood. Green revolution helped us to bring our status from food deficient country to food sufficient. Associated detrimental effects of green revolution on biodiversity and environment as well as resilience and adaptability of cropping systems to climate change are the growing concern. FAO, 2017 defines crop diversification as "to the addition of new crops or cropping systems to agricultural production on a farm". It could be achieved by two major approaches namely horizontal and vertical. It largely dependent on the technological break-through, consumer demand, trade facilities and governmental policies etc. The small farmers produce much of the developing countries food supply but are pooper that the rest of the population and less food secure. Crop diversification as a strategy to achieve objectives of output growth, employment generation and system sustainability.

Table-1: Status of crop diversification in various states of India:

States	1994-95	2005-06	2010-11	2014-15
Karnataka	0.92	0.93	0.94	0.94
Gujarat	0.91	0.90	0.89	0.90
Andhra Pradesh	0.87	0.87	0.85	0.86
Rajasthan	0.87	0.87	0.89	0.88
Haryana	0.83	0.80	0.79	0.77
Uttar Pradesh	0.81	0.79	0.79	0.78
Punjab	0.71	0.68	0.66	0.66
Bihar	0.70	0.72	0.74	0.73
West Bengal	0.55	0.61	0.66	0.65
National (avg.)	0.90	0.90	0.90	0.89

Source: Economic survey, 2017-18

Why Crop Diversification?

1. Shrinking of natural resources like cultivable land, waster scarcity, land degradation etc.
2. System productivity of rice-wheat has become plateau or reduced.
3. Decreased organic carbon in soils of IGP (Indo-Gangetic Plains).
4. Multi-nutrient deficiencies like nitrogen, phosphorus, potassium, sulphur, Boron, etc. mainly in rice based cropping systems in various part of the country.
5. Development of multiple herbicide resistance in little canary grass in wheat crop.
6. Occurrence of several insect-pests and diseases e.g., fall army worm in maize across the country during 2018-19 growing season and overall reduced economic returns due to increasing cost of cultivation (purchasing of agrochemicals, hiring of farm equipments etc.).

Table-3: Types of crop and non-crop habitats with their functions and specifications:

Crop/Non-crop habitat	Type	Functions for pest control	Specifications	References
Misxing cultivated crops and trees.	Intercropping	Complicating the search of host plant for pests.	Multiple crop species hosting different pests.	Lopes et al., 2015

Mixing cultivated crops and trees.	Agro-forestry	Complicating the search of host plant for pests	Usually not managed for enhancing pest control.	Stamps et al., 2009
Mixing cultivated crops and non-crops.	Cover cops	Complicating the search of host plant for pests.	Non-host species usually not harvested.	Dunbar et al., 2016
Herbaceous patch	Grassland, fallow	Support flower visiting and ground dwelling natural enemies.	Usually not managed for enhancing pest control.	Werling et al., 2014

Table-2: Diversification of agricultural systems:

Diversification types	Description of diversification	Main characteristics
Increased structural diversity	Makes the crops within the field more structurally diverse e.g. strip cropping,	Farm level same land unit
Genetic diversity in monoculture	Growing mixed varieties of a species in a monoculture.	Farm level same land unit
High-value crops	A shift from less profitable and sustainable crop or cropping system to more profitable and sustainable system.	Farm level same land unit
Crop rotations	Temporal diversity through crop rotations.	Farm level different spaces, different times
Polyculture	Growing two or more crop species and wild varieties within the field. Spatial and temporal diversity.	Farm level different spaces, different times
Diversify field with non-crop vegetation.	Growing weed strips or vegetation banks in and alongside crops.	Farm level, different spaces
Mixed farming	Crops and animal husbandry.	Farm level, different spaces, different times
Agroforestry	Growing crops and tree species together.	Farm level, different spaces, different times
Mixed landscapes	Development of diversified landscapes with multiple ecosystems	Larger scale, spatial and temporal.

Source: Modified from Lin, 2011

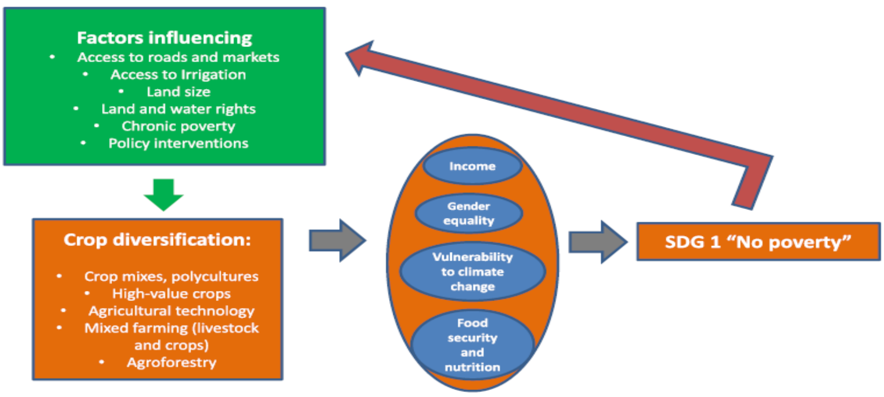


Figure-1: Factors influencing implementation of crop diversification which contribute to the different dimensions of poverty (Feliciano, 2018).

Constraints in Crop Diversification

The major constrains in adaptation of crop diversification in Indian agriculture are primarily due to the following reasons:

1. The water is the basic source of agriculture and without its cultivation of field and horticultural crops are not possible. About 63% of total cropped area under various crops is completely dependent on seasonal rainfall.

2. Over-exploitation of several natural resources such as water, mineral nutrients and indiscriminate use of agrochemicals results in poor sustainability of agriculture as well as health of human, animals and the environment.
3. Inadequate availability and supply of quality seed of various crops that fit regional climatic conditions.
4. Fragmentation of arable land which hinders adoption of farm mechanizatio
5. Very poor reach of agro-industries to the farmers and or local market.
6. In-adequate post-harvest technologies for handling and storage of very perishable vegetables, milk and meat etc.
7. Lack and or timely availability of well-trained human resources.
Weak research-extension-farmer linkages in comparison to western countries.

Governments Support for Crop Diversification

The central and or state governments have been launched or announced several schemes for agricultural development in general and crop diversification in particular. These schemes are as follows:
1. Watershed development fund (was created for the development of rainfed lands at national level in 2002).
2. NMSA (National mission for sustainable agriculture): It has been formulated in 2014-15 for enhancing agricultural productivity especially in rainfed areas focusing on integrated faring, water use efficiency, soil health management and synergizing resource conservation.
3. Seed crop insurance (A pilot scheme on seed crop insurance has been launched which will cover the risk factor involved in production of seeds).
4. PKVY (Paramparagat Krishi Vikas Yojna): A central government scheme was launched in 2015 to promote organic farming in our nation.
5. Gramin bhandaran yojna (It was started in 2001 to create scientific storage capacity with allied facilities in rural India, promotion of grading, standardization and quality control of agricultural produce to improve their marketability).
6. Seed bank scheme (About 7-8% of certified seeds produced in the country will be kept in buffer stock to meet any eventualities arising out of drought, floods, hailstorms etc.).
7. Mera pani meri virasat (An initiative of Haryana government and under this scheme beneficiaries will get Rs 7000 per acre if they will shift from rice to low water requiring field crops and Rs 10000 per acre planting of 400 hundred plants).

Conclusions

Indian is being a vast country which presents wide variations in agro-climatic conditions. Green revolution helped to the India to become a food sufficient nation from a food deficient nation. It was crop (rice and wheat) and region centric which resulted in lowering agricultural sustainability. At present time we have enough food to feed our about human population but now it is time to move from food security to nutritional security. Government (s) have taken several initiatives achieve both food and nutritional securities through adoption of crop diversification wherever is possible.

References

1. Dunbar M.W., O'Neal M.E., Gassmann A.J., (2016). Incresed risk of insect injury to corn following rye cover crop. Journal of Economic Entomology. 109: 1691-1697.
2. Lin B.B., (2011). Resilience in agriculture through crop diversification: Adoptive management for environmental change. Bioscience. 61(3): 183-193. Feliciano D., (2018). A review on the contribution of crop diversification to sustainable development goal 1 (no poverty) in different world regions. Sustainable development. 2019, 1-14.
3. Lopes T., Bodson B., Francis F., (2015). Associations of wheat with pea can reduce aphid infestations. Neotropical Entomology. 44: 286-293.
4. Stampes W.T., McGraw R.L., Godsey L., Woods T.L., (2009). The ecology and economics of insect pest management in nut tree alley cropping systems in the Midwestern United States. Agriculture, Ecosystems and Environment. 131: 4-8.
5. Warling B.P., Dickson T.L., Isaacs R., Gaines H., Gratton C., Gross K.L., Liere H., Malmstrom C.M., Meehan T.D., Ruan L., Robertson B.A., Robertson G.P., Schmidt T.M., Schrotenboer A.C., Teal T.K., WIilson J.K., Landis D.A.A, (2014). Perennial grasslands enhance biodiversity and multiple ecosystem services in bioenergy landscapes. Proceedings of National Academy of Sciences. 1111: 1652-1657.

Agriculture Price Policy

Article ID: 11508

Karthickraja A[1]

[1]UG Scholar, Department of Agricultural Economics and Extension, Pandit Jawaharlal Nehru College of Agriculture Research Institute, Karaikal – 609603.

Introduction

This article consists of Agriculture Price Policy in Pre-Independence, where it covers Zamindari system, Forced Commercialization, Partition; Post-Independence, which has Pre-green revolution Period, which is consist of Fragmented Land ownership, Outdated technology, Low productivity, Absence of rain and Zamindari Abolition act; next is Pre Green Revolution period, Green Revolution Period and recent now. It consists of uses, benefits and impacts.

Pre-Independence

It is known that 2/3 of the national income is based on Agricultural sector in India. But before Independence 90% is based on Agricultural Sector. Most of the Indian Population were resided in villages where agriculture is the primary source of live hood. The pre colonised India produced 2 major crops which is Rice and Paddy where Agriculture sector was sustainable and self-sufficient. But the invasion of British resulted in total commercialisation of India's Agriculture sector. On the eve of independence, this sector was suffered from stagnation and degradation.

Zamaidari system: One of the primary reasons of stagnation is Zamindari system. The farmers were giving most of the benefits to landowners i.e., Zamindar. These zamindars who were vassals of the British, did not help to improve agriculture sector rather enjoyed the benefits.

Forced Commercialization: The British introduced commercialisation in India. This changed the mind-set of farmers from cultivation of self to cultivation of sale. The British forced the farmers to sale the agricultural products rather than for own consumption. So, the majority of the crops were went for the market for sale. On the other hand, British also introduced the cultivation of Indigo which leads harm to India which damaged the fertility of the soil.

Partition: India's partition of Pakistan and Bangladesh leads to food crisis all over India cultivating lands were divided. Various rice producing states of Punjab moves into Pakistan

Post-Independence

Pre-Green Revolution Period (1950-65):

Fragmented land ownership: Most of the national income is based on Agriculture sector, India faced a decline stage in growth. One of the main reasons the agriculture sector that declined was land hold by many individuals which leads to do inability of mind-set to do unique cultivation of crops.

Outdated Technology: Even after India got independence there was lack of technology and outdated technology in agriculture. No fertilizers, no machines were used and also decline in labours for agriculture.

Low productivity: Due to absence of innovative methods, there was little output were gained. This affects overall Indian economy.

Absence of rain: Since there was no hybrids or drought tolerant varieties were not found, sometimes inadequate rainfall leads to low production.

Zamindari Abolition Act (1950): The first major agricultural legislation enacted by the state governments after Independence was the Zamindari Abolition Act.

Objective of Zamindari Abolition Act (1950)

1. To eliminate land intermediaries.
2. To ensure ownership rights to the tillers of land.

3. To ensure a permanent improvement in the quality of the landholding.

The government made additional changes to the land ownership policy to ensure greater equity in the rural society. These decisions involved:

a. Placing a ceiling on the size of holdings.
b. State control on idle or unused lands.
c. The distribution of some of the idle land to the underprivileged rural people.

Provisions were also made to ensure that recipients of this land do not lease out or sell the land. The consolidation of fragmented and scattered landholdings was encouraged so that farmers could have better access to mechanization and land improvements could be made.
Other policy measures during this period included enhancing of farmers access to credit, markets and extension services.

Green Revolution Period (1965-80)

The agricultural and food policy started in the mid-1960s with the advent of green revolution. The adoption of improved crop technologies and seed varieties became the main source of growth during this period.

The Government of India adopted the approach of high-yielding varieties of wheat and rice for cultivation in the irrigated areas of the country. This was accompanied by the extension services and increase in the use of fertilizers, agrochemicals.

A number of important institutions were set up during the 1960s and 1970s, including the Agricultural Prices Commission (now Commission for Agricultural Costs and Prices), the Food Corporation of India, the Central Warehousing Corporation, and State Agricultural Universities.

Another major policy decision was the nationalization of major commercial banks to enhance credit flow to the agricultural sector. Several other financial institutions, for example the National Bank for Agriculture and Rural Development (NABARD) and Regional Rural Banks (RRBs), were also established to achieve this objective. The cooperative credit societies were also strengthened. This strategy produced quick results with a quantum jump in crop yields and consequently, in the food grain production.

The biggest achievement of the green revolution era was the attainment of self-sufficiency in food grains. A significant increase in the funding of agricultural research and extension, marketing of agricultural commodities and provision of credit to farmers was also noted.

Impacts of Green Revolution

1. The impact of the green revolution technology was disturbed wheat and rice, and the irrigated regions. The traditional low-yielding varieties of rice and wheat were replaced by the high-yielding varieties. Today, more than 80 per cent of the area under cereals is sown with high-yielding varieties.

2. The use of fertilizers has risen sharply over the past three decades. In 2011-12, the Indian farmers used almost 144.3 kg of fertilizer per hectare of cultivated land.

3. Another impact is on the agricultural input industry, resulting in a rapid growth in the seed and farm machinery industries.

The Provisions of the Customs Act, 1962

The rules and regulations made there under including those relating to refunds and exemptions from duty, shall, as far as may be, apply in relation to the levy and collection of the duty of customs leviable under sub-section is as the apply in relation to the levy and collection of the duties of customs under that Act or those rules and regulations.

Central Warehousing Corporation

Central Warehousing Corporation was established under 'The Warehousing Corporations Act, 1962. Its aim is to provide reliable, cost-effective, value-added, integrated warehousing and logistics solution in a socially responsible and environment friendly manner. It is a public warehouse operator established by the Government of India in 1957 to provide logistics support to the agricultural sector. It operates 422 warehouses across India with a storage capacity of 10 million tonnes.

Agricultural Refinance Corporation (1963)

The Third Five-Year Plan emphasized the urgent need to create an institution to provide funds for investment in the agricultural sector. This resulted in the establishment of the Agricultural Refinance Corporation (ARC) in 1963.

In 1969, the Lead Bank Scheme was introduced with the primary objective of taking a territorial approach to rural development. The scheme involved commercial banks, cooperative institutions, government, and semi-government agencies in the process of economic development. The nationalisation of 14 scheduled commercial banks in 1969 made this transition easier and influenced further developments in banking for agriculture. However, during 1990s, a cut on bank branch network in the rural areas; fall in the credit-deposit ratios; disproportionate decline in credit to small and marginal farmers.

Food Corporation of India, 1964

Food Corporation of India was enacted by the Parliament under the Food Corporation Act on 10th December 1964. This act was setup on 14th January 1965. The primary purpose of Food Corporation of India (FCI) included the purchase, storage, transportation, distribution and sale of food grains and other food products.

Objectives of FCI

1. To safeguard the interests of farmers.
2. Maintain buffer stocks for food security.
3. To make grains accessible at reasonable prices to the weaker and vulnerable through the public distribution system.

It also recommended that farmers be given direct cash subsidy to plug the diversion of urea. The new FCI should be a market-friendly agency for food management, with a primary focus on creating competition in every segment of food grain supply chain, from procurement to stocking to movement and finally distribution in TPDS, so that overall costs of the system are substantially reduced, leakages plugged, and through it serving farmers and consumers.

It also needs to focus its grain management techniques in areas where farmers have often not been able to receive the minimum support prices.

State Agricultural Universities: For every state there is a State Agriculture Universities were there.

Agricultural Price Policy in India (1965): The government has formulated a price policy for agricultural produce that aims at securing remunerative prices to farmers to encourage them to invest more in agricultural production. The government announces minimum support prices for major agricultural products every year on the recommendations of the Commission for Agricultural Costs and Prices (CACP).

The basic motive behind the Agriculture policy of Government of India is to save the interests of both farmers and consumers. The prices of the food grains should be decided very wisely so that neither farmers nor consumers get suffer.

Agricultural and Processed Food Products Export Cess Act, 1985: A duty of customs at such rate not exceeding 3% valorem as the Central Government may, by notification in the Official Gazette, specify, on all Scheduled products, which are exported. The duties of customs levied under sub-section are on the Scheduled products shall be in addition to any cess or duty leviable on such Scheduled products under any other law for the time being in force.

Eco-friendly farming: The use of pesticides, including herbicides, increased until 1990, but has fallen steadily, away from the heavy use of chemical pesticides to a more environment-friendly integrated pest management system.

Protection of Plant Varieties and Farmers' Rights Act, 2001: India is the first country that passed legislation granting Farmers' Rights in the form of the Protection of Plant Varieties and Farmers' Rights Act, 2001. Farmers' Rights are basically about enabling farmers to continue their work as stewards and innovators of agricultural biodiversity, and about recognizing and rewarding them for their contribution to the global pool of genetic resources.

The Farmers' Rights Project was initiated by the Fridtjof Nansen Institute (FNI) in 2005, with the aim of supporting the implementation of Farmers' Rights as they are recognized in the International Treaty on Plant Genetic Resources for Food and Agriculture.

The Farm Bill (2020): The Farm Bills are three acts initiated by the Parliament of India in September 2020. The Lok Sabha approved the bills on 17 September 2020 and the Rajya Sabha on 20 September 2020. The President of India, Ram Nath Kovind gave his assent on 27 September 2020.

The Farm Acts

1. Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act, 2020.
2. Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act, 2020.
3. Essential Commodities (Amendment) Act, 2020.

Conclusion

As far from the above paragraphs, we can say that National Income of agriculture during British period were decreased. After Independence, before Green Revolution, there is no technology, no hybrids. After Green revolution, introduction of new hybrids, formation of new Acts etc.

References

1. Observer Research Foundation & Chikermane, G. (2018). 70 POLICIES THAT SHAPED INDIA. Mohit Enterprises. https://www.orfonline.org/wp-content/uploads/2018/07/70_Policies.pdf
2. Arora, V.P.S. “Agricultural Policies in India: Retrospect and Prospec.” Agricultural Economics Research Review, vol. 26, 2013, pp. 135 - 153.
3. Dantwala, M. L. (n.d.). Agricultural Policy in India Since Independence
4. ICA Institute, Prasad, A. R., & Tripathi, A. (2009, November). Agricultural Development in India since Independence: A Study on Progress, Performance, and Determinants. Journal of Emerging Knowledge on Emerging Markets, 1, 63 - 91. 10.7885/1946-651X.1007
5. Vedantu. (n.d.). Agriculture setor on the eve of Independence. https://www.vedantu.com/commerce/agriculture-sector-on-the-eve-of-independence
6. Fridtjof Nansen Institute & Andersen, R. (n.d.). Farmer's Rights. http://www.farmersrights.org/contact/index.html

Doubling Farmers Income and Attaining Resilience in Agriculture through Crop Diversification

Article ID: 11509

Rashmi Bhumarkar[1], Gaurav Mahajan[1], Ashish Kumar[2]
[1]AICRP on Maize, Zonal Agricultural Research Station, J.N.K.V.V, Chhindwara, M.P. 480001, India.
[2]College of Agriculture, J.N.K.V.V, Jabalpur, M.P. 482001, India.

The world's largest agricultural production system is rice-wheat cropping system occupying around 12.3 M ha area in India. It has been practiced by farmers in Asia for more than 1000 years. For food security of the country, it has played a significant role. In India, Rice Wheat Cropping System spread over a vast area spanning from Punjab in the North West to east up to west Bengal (Singh, Jat & Sharma, 2005). In spite of, over the past years sustainability of Rice Wheat Cropping System is unsympathetically affected as yields of both rice and wheat are either stagnated or declined due to deterioration of soil health, declining underground water table, unattended intervening periods of rainfall failure, soil degradation, atmospheric pollution, resurgence of diseases, insect and weeds, decrement in factor productivity, reduction in profit margins and increase in cultivation costs.

Precisely, in the rice region where the crop is established by incessantly wet tillage i.e., puddling soil although wheat established by drilling and broadcasting after disking, tilling and planking operations. Seed bed preparation is adversely affecting the soil properties if oxidises the once hidden organic matter, break the macro aggregates into the micro aggregates. Soil perturbation by conventional tillage makes the soil to serve as a source rather than a sink of atmospheric pollutants and thus is not sustainable and environment friendly. Regular increasing population of India it is necessary to keep up and improve productivity of Rice Wheat Cropping System that is predicted to swell from 1012 billion in 2008 to 1.35 billion by 2025 (UNEP, 2008).

As per indigenous knowledge of farmers they have adopted conventional practices for establishing wheat and rice over ages. These are energy, water, capital intensive and lead to many issues which are a serious threat to the sustainable agriculture. Diversification of Rice Wheat Cropping System is a viable option to mitigate all the adverse conditions. In general diversification refers to the shift from the regional or temporal dominance of one crop to a production of number of crops, to meet ever increasing demand for food grains, oilseeds and fodder etc. Crop diversification is not only the shift from traditional and less remunerative crops, but it is demand driven, need based situation specific and national goal seeking continuous and dynamic concept and involves spatial, temporal, value-addition and resource complementary approaches. It implies the use of crops with complementary marketing opportunities and it implies a shifting of resources from low-value crops to high value crops, usually intended for human consumption such as fruits and vegetables.

Issues in RWCS

Continue adoption of green revolution technologies provide lower marginal returns to farmers. Overexploitation of natural resource and inappropriate use of applied inputs leading to emergence of several issues are:

1. Ecological issues.
2. Agricultural issues.
3. Livelihood issues.
4. Climatic issues.

Ecological Issues

1. Declining underground water table: Since last 100 years with development of multi development river project, six head works were framed and water supplied to the agricultural fields for irrigation. Rice and wheat both are high water demanding crops and it is receding water table through continuous cultivation year after year. The gravity mapping satellite of NAAS "GRACE" showed a sharp decline of underground water @ 1 feet per year in northern India in an area of about 4,40,000 km2 which further resulted in the loss 18 km3 year-1 (Soni, 2012). Thus, the water table is some pockets is declining down at alarming rates very fastly. There is a need to address the issues relating rational water use and sustainable crop production.

2. Diverse weed flora: In a sustainable agriculture important issue is diverse weed flora and excessive weed pressure. The weed flora simplified with grass due to intensive cultivation of rice- wheat sequence. Weeds decreases the land productivity of system by compete with the main plants for light, nutrients and water. Some areas it causes complete grain yield losses. When rice is sown as a dry by direct seeded method than it gives higher water productivity through no puddling operations required but causes higher weed flora resultant chances of reduction yield.

An alarming situation in wheat growing areas have come up where *Sphenoclea zeylanica*, this new weed is observed recently in intensive rice- wheat cropping system, which is more difficult to control and also observed in some area and resistant to the available herbicide.

3. Ground water pollution: In rice- wheat cropping system, underground water quality is polluted through excessive use of fertilizer and insecticides. Emergence of several severe disease in animals and decreased the grain quality which ultimately affect the human health by the application of this polluted poor-quality water to the agricultural sector. Excessive use of nitrogenous fertilizers resulting to leaching of nitrates and increase ground water pollution appears to be a serious concern. Where soil is course textured and use of nitrogenous fertilizer is higher so the situation is worse on this wheat field.

4. Growth of insect-pest and diseases: Outbreak of insect- pest and disease is a resultant of wet condition because of irrigations and higher dose of nitrogenous fertilizers. Due to attack of insect- pest and diseases, yields are somehow decreased with increased cost of cultivation which further increased the risk probability. Last few decades, new breeds of insect- pest and diseases which are more resistant to the present insecticides appeared. Another important issues insect- pest under the rice- wheat cropping systems are blast and stem borer, which earlier cause damage to only long stature basmati varieties but from last few years these causing damage to the short basmati varieties too. Earlier sheath blight disease affected only border areas but now it is affected entire rice area. False smut is generally appeared in bumper crop but now causes issue on rice. Decline yields because of bacterial leaf blight in rice and powdery mildew and rust in wheat are noticed. In rice- wheat areas soil borne diseases are also becoming an increasingly important factor in constraining yield growth. Soil pathogens like *Rhizoctonia, Fusarium* and *Sclerotinium* also build up through the continuous growing of rice- wheat cropping system. Previously pink stem borer *(Sesamia inferens)* and shoot fly *(Antherigona oryzea)* attacked only rice but now it attacks both the crops. Thus, keeping these points in view, the emerging disease and insect- pest are really seems to be responsible for the stagnating land productivity and crop productivity.

Agricultural Issues

1. Degrading soil structure: Degradation on upland crops is of concern by the negative effects of tillage under wet conditions in rice field with an aim of reducing percolation losses, ease transplanting and suppers weeds growth. Sub-surface compaction is led out due to repeated puddling of course and medium textured soil, which has been proving detrimental for the upland crops like wheat. Structural deterioration of the soil due to puddle transplanted system of rice. This is water- capital and energy intensive. Wheat crop, conventionally seed bed prepared by disking, tilling and final planking which causes exposure of hidden organic matter to the air leads to the oxidation of organic matter.

2. Problems in residue management: It is major issues in rice wheat cropping system. Among rice and wheat straw residue. Wheat residue is used in animal husbandry sector but due to higher silica content in rice straw make it inappropriate to be used in the dairy sector. Immobilisation of nitrogen causes by incorporation of rice straw which have wider C:N ratio further decreases the grain yields, that why farmers usually burnt the rice residue on to their fields to get rid of it and ensure timely sowing of the wheat crops resulting in increased level of smog and pollutants.

3. Increasing multi-nutrient deficiency: Soil health started to decline due to deficiency of nutrients. Intensive cropping of high yielding varieties of rice and wheat, initially deficiency of zinc (Zn) reported and subsequently deficiency of iron (Fe) in rice and manganese (Mn) in wheat come out as threats to sustainable crop production. Analysis of soil and plant samples has indicated that in 49% of soils in India are potentially deficient Zn, 12% in Fe, 5% in Mn, 3% in copper (Cu), 33% in boron (B) and 11% in molybdenum (Mo) (Singh, 2008). In India, now sulphur (S), zinc (Zn) and boron (B) deficiencies are quite widespread. In rice wheat cropping system, decline of wheat yields due to boron deficiency was found in soils (Sharma, 1987). Improved wheat yields due to soil application of borax. Intensive rice- wheat cropping system, now an emerging issue coming out i.e., selenium toxicity. It could be managed due to crop rotation. Selenium toxicity symptoms in the plants, human, animals being are not an exceptional case. Among wheat, leaves become white which further resultant in decline wheat yield after rice. Therefore, it is necessary to take action against rice- wheat cropping system must be attended to at the priority level by shifting from rice to other low water requiring crops. The emergence of new micro- nutrients deficiencies such as zinc and iron in rice while manganese deficiency and selenium toxicity in wheat are the new hindrance in front of the sustainable rice- wheat cropping system as farmers can neither identify them at exact time nor ameliorate them by applying their correct doses either through sprays or through broadcasting.

Livelihood Issues

1. Poor income: land productivity is decline day by day due to degradation of the soil structure, declining underground water table along with outbreak of insect- pest, diseases and weed pressure and formation of hard pan. Lower land productivity means lower grain yield produced per piece of land. Rice- wheat cropping system lowering the per piece of land income so farmers has need to change their cropping pattern with crop rotation with vegetables, pulses, oilseeds and fodder crops.

2. Deceased land and water productivity: Decreased land productivity is an issue needed urgent attention by using different technologies viz. laser land levelling, bed planting, mechanical transplanting, direct seeded rice, direct drilling of wheat seeds in the untilled soils in standing rice stubbles and implementing some new breeding programme throughout the region to breed some higher yielding, water stress, nutrient and water use efficient and soil tolerant, disease resistant varieties. Water productivity (g/kg) is the quantity of irrigation water used to produce per unit of the grains. Under conventional puddle transplant system of rice (PTR) puddling/ wet tillage require around 4 irrigations, that is a large quantity of water, which is deteriorates the soil structure which finally resulted in lower yields and therefore lower water productivity.

Climatic Issues

1. Increase global warming: Crop residues are burnt on the field for the timely sowing of the wheat crop cause rice wheat cropping systems produce huge crop residues. It generates ample amount of greenhouse gases (CH_4, CO_2, N_2O) and aerosols. To prevent this situation in rice- wheat cropping system should adopted the direct drilling of the wheat seeds in standing rice stubbles using happy seeder and direct seeding etc.

2. Environment pollution: Rice and wheat both are cereal crops and require a greater number of inorganic fertilizers. Combustion of fossil fuels in industries for production of large number of fertilizers causes environmental pollution. For a field preparation and to pump water for irrigation about 150 litres of diesel is consumed per hectare per annum to run a tractor which amounts to emissions of about 400 kg CO2 per hectare per annum. Uses of huge number of inorganic fertilizers causes decline soil health contaminate ground water through leaching and build up to toxic elements in the environment. Many farmers burn the crop residues that causes air pollution and reduced air quality by release of greenhouse gases, aerosols and other hydrocarbons which have adverse imputations on human health by directly causing or worsen a range of health hazards.

Crop diversification in rice- wheat cropping system needed because it increases income on small farm holders, mitigating ill effect of aberrant weather, provide food and nutritional security, conserving natural resources like soil, water etc. improving fodder availability for livestock, decrease environment pollution also insect pest and weed problems too. Farmers should replace wheat by oilseeds like mustard or rapeseed *(Brassica rapes)*, pulses like pea *(Pisum sativum)*, grasspea (*Lathyrus* spp.), chickpea *(Cicer arietinum)*, pigeon pea *(Cajanus cajan)*, lentil *(Lens culinaris)*, maize *(Zea mays)* and potato *(Solanum tuberosum)* in occasional years.

Several oil seeds, pulses, vegetables, fodder and medicinal crops are favourable growing crops for diverse agro ecological condition. Inclusion of these crops in the rice- wheat cropping system successfully gets the increasing demand of pulses, oilseeds and fodder.

In Basmati rice growing areas where long duration basmati rice delays the sowing of wheat, there sunflower is a good alternative of wheat. Water guzzling crop of rice can be replaced with early pigeon pea and soybean where ground water table is decline very fast. Similarly, pulses offer great promise towards diversification of cropping system through short duration and having the ability to thrive better than other crops under harsh climate and to achieve household food and nutritional security on one hand and fragile ecosystem on the other. Pulses are grown as an intercropped, catch cropped or relay cropped in multiple sequences. Insertion of food legumes in rice production system not only brings additional area under the crops but also improves the physical, chemical and biological properties of soil. Exigency of enhancing pulses production and sustainability of the crop production system call for prompt corrective steps in the form of crop diversification.

To fill the increasing empty stomachs, Rice- Wheat cropping system contributed so much but has there upon led to many sustainability issues like degrading soil health and environment degradation, water declining water resources which is further responsible for stagnated land and water productivity. For better land and water productivity, sustainable diversification and intensification of Rice- Wheat cropping system should be adopted.

E-ISSN: 2581 - 8317

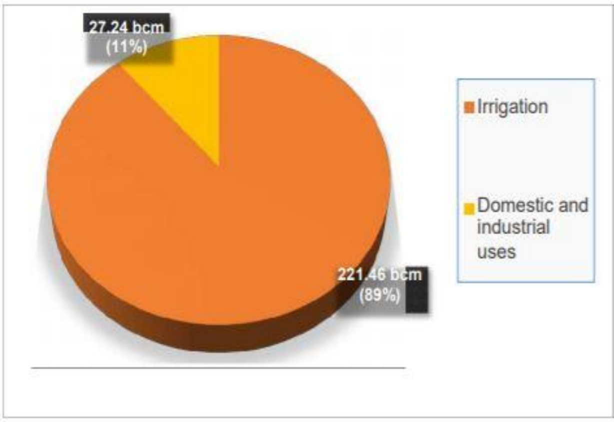
Application of Geospatial Techniques for Groundwater Assessment

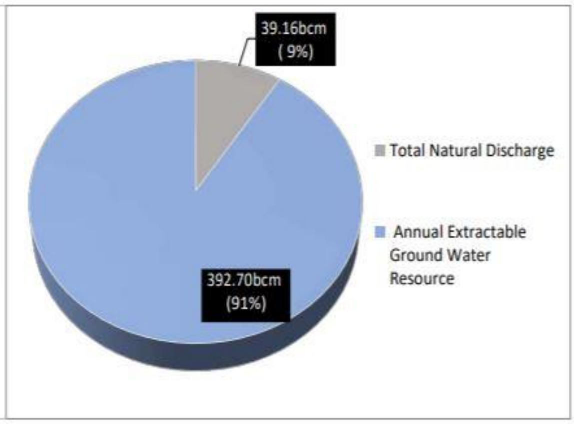
Article ID: 11510

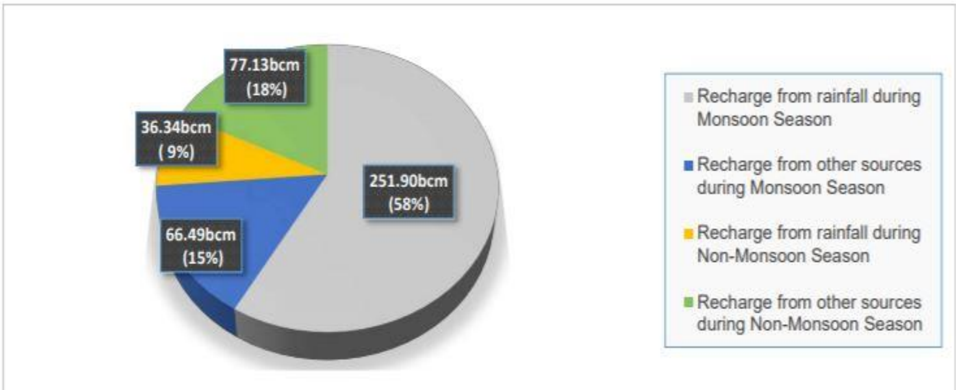
Vimal Kumar[1], Rajesh Kumar[2], Alesh Kumar[3], Vijay Pratap[4]
[1,2,3,4]Ph.D. Scholar, [1]Division of Agricultural Physics, [2,4]Division of Agronomy, [3]Division of Environmental Sciences, Indian Agricultural Research Institute, Pusa Campus, New Delhi-110012.

Population on earth is set to increase to nine billion by 2050. The annual increase in crop yield is only half the required rate to meet projected food needs. Rising population, expanding urbanization and escalating of agriculture leads to water shortages in urban and rural regions prompts a decrease in groundwater resources. To fulfil the need of groundwater resources to plan sustainable development, watershed management and artificial recharge structures that tackle water issues of the area. Artificial groundwater recharge is gradually becoming more necessary as scarcity, rising population and expansion of urbanization which requires more water. So, more groundwater stores are desired to conserve the heavy water usage during the scarcity period.

Ground Water Resources and Extraction Scenario in India, 2017 ((CGWB). (2019).







Remote sensing, geographic information system (GIS) and the analytical hierarchy process (AHP) are useful approaches for distinguishing possible groundwater areas of India (CGWB, 2019; Kumar et al., 2016; Rajasekhar et al., 2019).

Ground water Resource's assessment of West Bengal 2004 to 2017 ((CGWB). (2019)

S. No.	Ground Water Resources Assessment	2004	2009	2011	2013	2017
1	Annual Replenishable Ground Water Resources (bcm)	433	431	433	447	432
2	Net Annual Ground Water Availability (bcm)	399	396	398	411	393

3	Annual Ground Water Draft for Irrigation, Domestic & Industrial uses (bcm)	231	243	245	253	249
4	Stage of Ground Water Development (%)	58	61	62	62	63

Categorization of Assessment Units Based on Quantity

The categorization based on status of ground water quantity is defined by Stage of Ground Water extraction as given below:

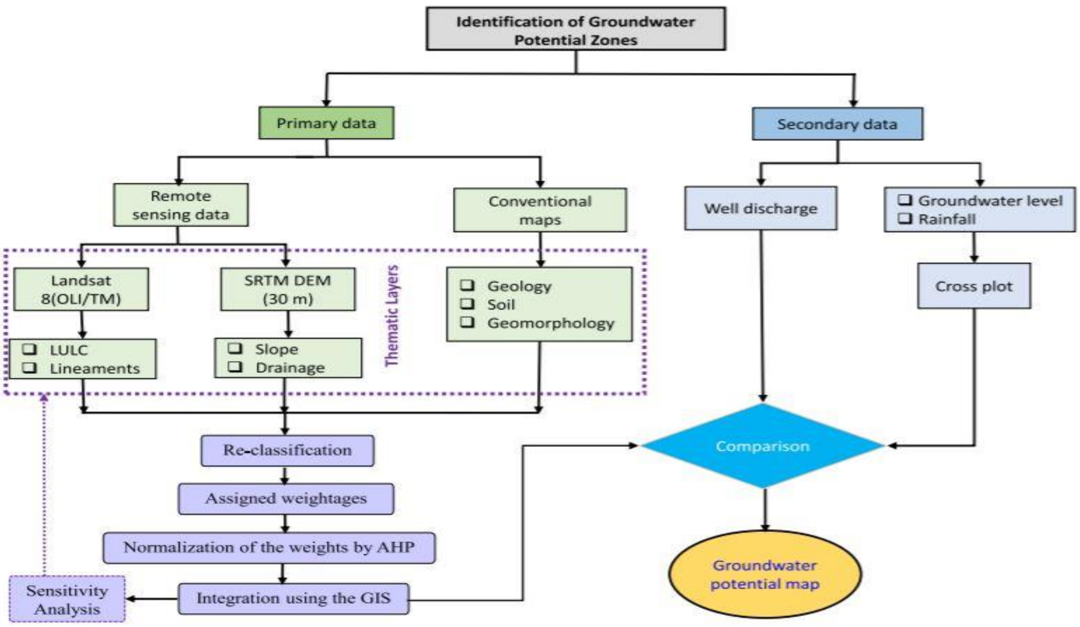
Stage of Ground Water Extraction	Category
≤70%	Safe
>70%and ≤90%	Semi-Critical
>90%and ≤100%	Critical
> 100%	Over Exploited

Norms recommended for the Recharge due to Canals ((CGWB). (2019)

Formation	Canal Seepage factor ham/day/million square meters of wetted Area		
	Recommended	Minimum	Maximum
Unlined canals in normal soils with some clay content along with sand	17.5	15	20
Unlined canals in sandy soil with some silt content	27.5	25	30
Lined canals in normal soils with some clay content along with sand	3.50	3	4
Lined canals in sandy soil with some silt content	5.5	5	6
All canals in hard rock area	3.5	3	4

Raju et al. (2017) delineated groundwater potential zone in Birbhum district, West Bengal. Various thematic layers viz. geology, geomorphology, soil type, elevation, lineament and fault density, slope, drainage density, land use/land cover, soil texture, and rainfall were digitized and transformed into raster data in ArcGIS 10.3 environment as input factors.

Flowchart for the Identification of Groundwater Potential Zones



Thereafter, multi-influencing factor (MIF) technique was employed where ranks and weights, assigned to each factor. It was observed that 18.41% (836.86 km2) and 34.41% (1563.98 km2) of the study area falls under 'low' and 'medium' groundwater potential zone, respectively. Approximately 1601.19 km2 area accounting for 35.23% of the study area falls under 'high' category and 'very high' groundwater potential zone encompasses an area of 542.98 km2 accounting for 11.95% of the total study area. Kumar et al. (2020) studied groundwater potential zones in Deccan Volcanic Province (DVP), Maharashtra. It was found that five groundwater potential zones such as very poor (11.77%), poor (21.73%), moderate (30.13%), good (25.34%), and very good (11.02%). Also, the correlation coefficients between groundwater level and rainfall were well-related to the groundwater potential index (R2 = 0.84). Rajasekhar et al. (2019) assessed groundwater potential zones in Jilledubanderu river basin, Anantapur District, Andhra Pradesh. All the parameters and their sub-parameters were assigned weights to implement FL, AHP and integrated Fuzzy-AHP models based on existing knowledge.

Three results were prepared that integrated all these parameters and their respective weights into the GIS software. Accuracy results showed that the map made with the integrated Fuzzy-AHP model was more efficient (78% validation) than AHP (76% validation) and FL approaches (72% validation). Therefore, RS and GIS based AHP integrated fuzzy logic-based approach is capable of producing accurate and reliable results for better planning and managing the groundwater resources in an effective way.

References

1. Central Ground Water Board (CGWB), (2019). National compilation on dynamic ground water resources of India. 2017.
2. Kumar T., Gautam A. K., and Jhariya D. C. (2016). Multi-criteria decision analysis for planning and management of groundwater resources in Balod District, India. Environmental Earth Sciences, 75(8), 1-16.
3. Kumar V. A., Mondal N. C., & Ahmed S. (2020). Identification of groundwater potential zones using RS, GIS and AHP techniques: a case study in a part of Deccan volcanic province (DVP), Maharashtra, India. Journal of the Indian Society of Remote Sensing, 48(3), 497-511.
4. Rajasekhar M., Raju G. S., Sreenivasulu Y. and Raju, R. S. (2019). Delineation of groundwater potential zones in semi-arid region of Jilledubanderu river basin, Anantapur District, Andhra Pradesh, India using fuzzy logic, AHP and integrated fuzzy-AHP approaches. HydroResearch, 2, 97-108.
5. Raju T., Srimanta G., Shirshendu G., and Harjeet K. (2017). Assessment of groundwater potential zones using multi-influencing factor (MIF) and GIS: a case study from Birbhum district, West Bengal. Applied Water Science, 7(7), 4117-4131.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Commercial Methods of Propagation in Mango

Article ID: 11511

Bhende S. S.[1]
[1]Institute of Agriculture Sciences, Sage University, Indore, Madhya Pradesh.

Propagation is an art of multiplying any particular species or obtaining the new individuals from already existing plant species. There are two major methods of propagation such as sexual or seed propagation and asexual or vegetative propagation. Vegetative methods of propagations are much in use for most of the horticultural crops, because of its own advantages.

Commercial methods are the one which are getting highest rate of survival or low rate of mortality for the newly obtaining propagules in the method of propagation. These methods can be different for different locality. These are mostly based on propagators skills, preference or popularity for particular method, recommendations given by particular research organisation for any particular method for propagation any particular species as well as rate of success received for that particular method at that particular locality.

For e.g., Mango is commercially propagated by soft wood grafting in dry and low rainfall zones of india, stone grafting or epicotyl grafting humid, tropical and costal zones, veener grafting in north India and approach grafting or inarching in South India. In this context, focus is given on different commercial methods of propagation in Mango.

Softwood Grafting

1. Grafting is done with mature, precured scion on the emerging light green shoot of rootstock.
2. Used for in-situ grafting.
3. Especially in the drylands and areas experiencing hot weather with low precipitation where mortality of nursery raised grafts is very high.
4. Success is more during March- September.

Procedure for Softwood Grafting

1. Raising, selection and preparation of rootstock:

a. Raise the rootstock seedlings in suitable containers or preferably in the main field itself.
b. Allow them to grow for a six month to one year.
c. When the seedlings attain a height of 30 – 45 cm.
d. New shoot as well as leaves usually have bronze colour.
e. Make a cleft of 4 – 6 cm deep in the middle of the decapitated stem by giving a downward longitudinal cut.

2. Selection and preparation of scion:

a. Select the tree of scion variety of choice for propagation.
b. Collect healthy, 3-4 months old, matured shoots of 15 – 20 cm length.
c. Precuring of scion will be done by clipping of 3/4th portion of leaves.
d. Scion will be ready for grafting after 7-10 days of leaf removal.
e. Select a matching scion stick of same thickness as that of stock.
f. Give two downward slant cuts (4 – 6 cm long) on opposite sides at the lower end of the scion stick to make it wedge shaped.

3. Grafting:

a. Insert the wedge of the scion into the cleft of the root stock in such way that the cambium of the scion and root stock come in perfect contact with each other.
b. Graft joint is secured firmly by polythene tape.
c. Scion of the graft is to be covered with wet polythene cap.

4. Aftercare:

a. Grafted plant kept under shade for about 15 – 20 days, till the sprouting of the buds on the scion.
b. Regularly water the grafts depending on the weather conditions.

c. Remove the side shoots growing on the rootstock below the graft joint.
d. Remove the polythene strip used for tying the graft joint, after three months to avoid girdling of the stem
e. Protect the grafts from leaf eating insects and shoot borers by spraying the grafts with Nuvacron 2ml / l of water, in the nursery.
f. Grafts will give sprouts within 3-4 week then shifted to open condition.
g. After six months shift the grafts to other place or just lift the grafts and keep them in the place once in a month to prevent them from striking roots in to the ground below.
h. In this method Graft will be ready for planting after 6 months.

		
(a) Rootstock	**(b) Collection of scions**	**(c) Preparation of scions & rootstocks**
		
(d) Grafting	**(e) Successful grafts**	

Epicotyl Grafting or Stone Grafting

1. Germinating seeds of less than 2 weeks old are wedge or splice grafted with mature scion.
2. Rootstock will be of coppery/ brick red colour.
3. Moderate temperature and high relative humidity are major factors related to success.
4. A 2–3cm long slanting cut is made in the epicotyl with a matching cut on the proximal portion of the scion and united together.
5. June to September is the best period.

Procedure for Epicotyl Grafting

1. Raising, selection and preparation of Rootstock:

a. Select very young seedling about 10 days old raised in polythene bags.
b. Cut off the top portion of the chosen seedling leaving 5-6 cm long shoot (epicotyl).
c. With a sharp knife makes a vertical, downward slit (2-3 cm long) at the centre of the remaining portion of the epicotyl.
d. If the stones are raised in sand beds they are uprooted (with stones) 15 to 20 days after sowing (when seedling attain 10-15 cm height).
e. Two rootstocks also can be used in this method.

2. Selection and preparation of Scion:

a. Select a dormant 3 to 4 months old terminal shoot of about 5 to 8 cm long from a proven mother plant as the scion stick.
b. Precuring of the scion will be done as like in the soft wood grafting method.
c. Cut the lower end of the selected scion to a wedge shape by giving, slanting and inward cuts of 2 to 3 cm on opposite side.

3. Grafting:

a. Insert the wedge-shaped scion in the slit made on the seedling and secure firmly with polythene strips or tape.

b. Scion and rootstocks will be covered with polythene cap.

4. After care:

a. Water the graft regularly without wetting the graft region.

b. The grafted seedling is then planted in polythene bags or pots keeping the graft union above the soil level and without damaging the stone.

c. In about 3 weeks, the scion starts sprouting.

d. Aftercare operations will be undertaken as like for the soft wood grafting method.

		
(a) Rootstock	**(b) Grafting and use of two rootstocks**	**(c) Graft Union**

	
(d) Grafting on mass scale	**(e) Successful graft**

Veneer Grafting

1. Mass scale commercial propagation.
2. Popular in North Indian States.
3. Easy to operate, and more economical one.
4. High degree of success.
5. Ideal method for establishing in situ orchards.
6. March –July is the ideal time of veneer grafting.

Procedure of Veener Grafting

1. Raising selection, preparation of rootstock:

a. One year old rootstock having diameter of 1.0 -1.5 cm is suitable can be raised in the field or pot or nursery beds.

b. A downward and inward 30-40 mm long cut is made in the smooth area of the stock at a height of about 20 cm. from ground level.

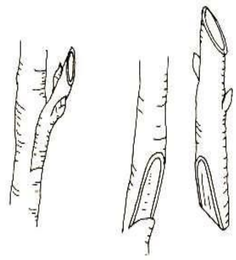
c. At the base of cut, a small shorter cut is given to intersect the first so as to remove the piece of wood and bark.

2. Selection and preparation of scion:

a. The scion should be healthy 3-6 months old, 22-25 cm long.

b. Scion shoot be with lush green leaves and activated buds on it.
c. The scion stick is given a long slanting cut on one side and a small short cut on the other so as to match the cuts of the stock
d. Slanting cut (5 cm long) an oblique cut is then made at the base of the first cut so that a piece of wood along with bark is removed.
e. Terminal and next to terminal shoots of previous season growth are most ideal to use as a scion.
f. Pre curing of scion will be done by defoliating 5-10 days prior to grafting leaving the petiole attached.

3. Grafting:
a. The scion is inserted in the stock so that the cambium layers come on the longer side.
b. The graft union is then tied with polythene strip.
c. Scion, begins its growth after about 3 weeks.
d. After the scion remains green for more than 10 days, the rootstock should be clipped in stages.
e. Polythene wrap will be removed after 2-3 months.

	
Steps in veener grafting	**Cuts on scion & rootstock**

Approach Grafting / Inarching
1. Both rootsstock and scion grown on their own roots (Attached method).
2. Also known as Simple approach grafting or simple inarching or embracing.
3. Best period: Last week of July or the first week of August.

a. Selection and preparation of rootstock:
i. 1-1.5 years old pencil thick stocks are selected.
ii. Strip of bark (about 20 cm from the ground level) of about 6-8 cm in length along with a small portion of wood attached to it will be removed from the rootsctock (inward arch shaped cut along with some portion of wood)
iii. It is better to retain the leaves on the stock.

b. Selection and preparation of scion:
i. From the mother plant an upward branch with same thickness as that of rootstock will be selected.
ii. Scion should be healthy with well-developed foliage.
iii. Similar cut /strip of bark will be removing from the scion.

c. Grafting:
i. These cuts are brought together and tied firmly with the help of a polythene strip
ii. Tie the union perfectly
iii. Union takes place within 1.5-2 months
iv. Half cut should be given 7 days earlier on scion to detach from the mother tree
v. Apixcal portion of the rootstock should also be clipped off.

d. Aftercare:
i. Gratfts should be kept in partical shade in ther nursery.
ii. Irrigation should be provided frequently.
iii. Protection should be given from pest and diseases.

Steps in approach grafting/inarching

Role of Fruits and Herbs in Boosting the Immune System During Pandemic (COVID-19)

Article ID: 11512

Sumit Patel[1]

[1]Institute of Agriculture Sciences, SAGE University, Indore, Madhya Pradesh.

The COVID-19 or Corona Virus is deadly disease. We all have been seriously affected because of current COVID-19 Pandemic. We have lost many lives during this pandemic. In this pandemic situation of COVID-19 the biggest and best medicine is to build our Immunity. Yes Immunity, it is our body's natural defence against disease causing Viruses and Bacteria. The best way to increase the immune system is to take well balance diet. As we all know that, Herbs and Fruits are very essential for improving our body's Immunity. The Fruits and Herbs provide nutrition and antioxidants and having capability to boost immune function. Also, they help reduce oxidative stress. Here are some Fruits and Herbs that can help boost the immune system:

Orange: Orange is a Citrus fruit. Orange gives us Vitamin C and it is thought to increase the WBC in Body. Most people turn straight to Vitamin C after cough and cold because it helps to build up the immune System.

Apple: Apples are the best immunity booster. Apple contains antioxidants, vitamins and Apples are also a rich source of Vitamin C and polyphenols that help to fight with Viruses.

Giloy: Giloy is a medicinal herb which is used to prepare the Ayurvedic Medicines. It helps to purifies the blood, fight against disease and viruses. It contains Antipyretic, anti-inflammatory, antioxidants that can improve the immunity.

Pear: Pear is a fruit and rich in high quantities of antioxidants as well as Vitamin C and copper. Pear also contain anti-inflammatory flavonoids in their peels. Pears are a rich source of antioxidants, which is responsible for improving the immune system.

Turmeric: Turmeric or its powder contain anti-inflammatory, anti-septic and anti-bacterial properties like Curcumin which helps in boosting up the immunity and help to fight against viral replication.

Spinach: It is also known for its immunity-boosting properties. Spanish is rich in Vitamin C, Vitamin E and also packed with antioxidants, beta carotene, zeaxanthin, lutein and chlorophyll. It is also rich in potassium which may increase fighting ability of immune systems.

Garlic: Garlic is one of the best-known herbs around the world. Garlic contain Ajoene, allicin and thiosulfinatus that helps to fights with infections. Garlic is a important herb to boost the immune system.

Blueberries: The Blueberry is a very popular berry. It is rich in high in fiber, vitamin C and vitamin K. Blueberries are the King of antioxidant foods. Antioxidants protect your body from free radicals. The main antioxidant present in Blueberries is flavonoids. This powerful antioxidant is key to a healthy immune system.

Tulsi: Tulsi or Tulsi Leaves is important and essential herb as a immune booster. It protects about all infections like from virus, bacteria and fungi. The Tulsi leaves are rich in Vitamin A, V C and K. Some Important minerals like Iron, Calcium, Magnesium and Phosphorus are also present in Tulsi . Leaves helps to boost the Immune system.

Kiwi: Kiwi is rich and contain Vitamin K, C and dietary fiber and provide a variety of health benefits. Vitamin C rich fruit boosts the white blood cells to fight infection, which can boost Immunity .

Almond: Almond is a rich source of Magnesium and Potassium, healthy fats, fiber, protein, Vitamin E and K, which acts as an antioxidant. It increases the ability to fight against viruses and bacteria. Almond works as immunity booster.

Papaya: Papaya is a fruit which contain high level of antioxidant, Vitamin A, C and E. Papaya is loaded with an enzyme (Papain) that is having anti-inflammatory effect. Vitamin C help to boost the immune system and allowing the body to fight with bacterial and viral illnesses.

Sunflower seed: Sunflower seeds are rich in nutrients and Vitamin E. Its seed contain Selenium which help to build the immunity.

Strawberries: Strawberries are a rich source of Vitamin and fiber. Strawberries contain powerful antioxidant, polyphenols and Vitamin C and it plays an important role to increase immune system.

We can add these types of Fruits and Herbs in our regular diet. This will improve our body's immunity power gradually. All together this will help us in improving our resistance power against any type of disease and disorders. In this way by natural way, we can stay away from harmful infections.

Epidemiology Related to Plant Bacterial Pathogens

Article ID: 11513

Vijaykumar S[1], Sankari Meena K.[2], Chindam Swathi[1]
[1]Professor Jayashankar Telangana State Agricultural University Rajendranagar, Hyderabad, Telangana-500030.
[2]ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad, Telangana-500030.

Epidemiology

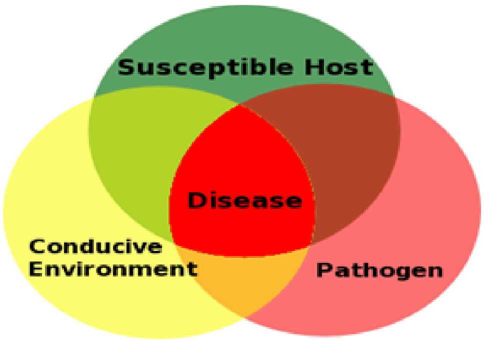
Study of disease in populations or Study of patterns, causes and control of disease in populations or Study of disease in population. Science that deals with the increase or decrease in plant disease in a population in time and space. The massive occurrence of a disease in a limited time period (Agrios, 2005).

Epidemics and Epiphyotics

When a pathogen spreads to and affects many individuals within a population over a relatively large area and within a relatively short time, the phenomenon is called an epidemic. It is the dynamics of change in plant disease in time and space. Plant disease epidemics, sometimes called epiphytotics, occur annually on most crops in many parts of the world.(Epidemics – term for both animal and plant diseases). The study of epidemics and of the factors that influence them is called epidemiology.

Some Important Bacterial Diseases

Elements of epidemics:
1. Susceptible host plants.
2. Virulent pathogen.
3. Favourable environmental conditions.
4. Time.
5. Humans.



An endemic is present in a community at all times but in low frequency.

An epidemic involves more than the expected number of cases of disease occurring in a community or region during a given period of time. An epidemic is typically a sudden severe outbreak within a region or a group.

A pandemic is an epidemic that becomes very widespread and affects a whole region, a continent, or the world.

Sporadic: Occurring upon occasion or in a scattered, isolated or seemingly random way.

Host Factors in Epidemics

Level of genetic resistance or susceptibility of host: Susceptible host plants lacking genes for resistance against the pathogen provide the ideal substrate for establishment and development of new infections. Host plants carrying race-specific (vertical) resistance do not allow a pathogen to become established in them, and thus no epidemic can develop.

Host plants carrying partial (horizontal) resistance will probably become infected, but the rate at which the disease and the epidemic will develop depends on the level of resistance and the environmental conditions.

Degree of genetic uniformity of host plants:

a. When genetically uniform host plants, particularly with regard to the genes associated with disease resistance, are grown over large areas, a greater likelihood exists that a new pathogen race will appear that can attack their genome and result in an epidemic.

b. the highest rates of epidemic development generally occur in vegetatively propagated crops, intermediate rates in self-pollinated crops, and the lowest rates in cross- pollinated crops.

Example: In the early 1960's a dwarf rice cultivar IR8 - high yields, non-lodging and had good response to nitrogen. Planted throughout Southeast and South Asia. Also, very susceptible to bacterial leaf blight caused by *Xanthomonas oryzae* pv. *oryzae.*

Type and Age of Crop

1. In diseases of annual crops, such as corn, vegetables, rice, and cotton, and in foliar, blossom, or fruit diseases of trees and vines, epidemics generally develop much more rapidly (usually in a few weeks) than they do in diseases of branches and stems of perennial woody crops such as fruit and forest trees.

2. Suppression of the blossom-blight phase of fire blight is a key point in the management of this destructive and increasingly important disease of apple and pear.

3. For example blossom infection to occur, the causal bacterium, *Erwinia amylovora*, needs to increase its population size through an epiphytic phase that occurs on stigmatic surfaces.

4. *Xantomonas stewartii* – stewart wilt of corn – mature plants – depends on organic nitrogen which appeared on matured plants only.

Defence Mechanism of the Host

1. Formation of abcission layer – *Xanthomonas pruni* in peach on infection.
2. Deposition of gums in intercellular spaces– stone fruits –*Pseudomonas syringae*.
3. Resistance of tomato to *Psedomonas solanacearum* – tomatin concentration.

Distance of Host from Pathogen

The pathogen in soil move to host through irrigation water. The host plant present near the pathogen is affected early than the farther host. The spread of bacteria is faster in air than in soil.

Pathogen Factors in Epidemics

Quantity of inoculum near hosts:

a. The greater the number of pathogen propagules (bacteria, fungal spores and sclerotia, nematode eggs, virus infected plants, etc.) within or near fields of host plants, the more inoculum reaches the hosts and at an earlier time, thereby increasing the chances of an epidemic greatly

b. Plant debris, seed surface, insects ,air, irrigation, soil

c. Multiplication of *P. lachrymas, X.glycenia, X. versicatoria* in young buds of cucumber, soybean, pepper and bean.

Level of virulence: Virulent pathogens capable of infecting the host rapidly ensure a faster production of larger amounts of inoculum, and, thereby, disease, than pathogens of lesser virulence.

For example, hill potatoes were affected by race 2 and plain grown potatoes were affected by race 1 of *Pseudomonas solanacearum*.

Type of Reproduction of the Pathogen

Bacteria produce many off springs compared to few fungi, all nematodes, and all parasitic plants which produce relatively small numbers of offspring. Some plant pathogenic fungi, bacteria, and viruses have short reproduction cycles and therefore are polycyclic, i.e., they can produce many generations in a single growing season. Polycyclic pathogens include leaf spot causing bacteria. Monocyclic pathogens, the smaller number of offspring and conditions of their dispersal limit their potential to cause sudden and widespread epidemics in a single season Eg. Wilts.

Ecology of the Pathogen

Knowledge of the ecology of the pathogen *(Erwinia amylovora)* on stigmas has been key to the development of predictive models for infection and optimal timing of antibiotic sprays. Vascular bacteria which reproduce inside the plant, spread of the pathogen is rare or impossible without the help of vectors. Therefore, such pathogens can cause epidemics only when vectors are plentiful and active. Still other pathogens, such as soil borne fungi, bacteria, and nematodes, produce their inoculum on infected plant parts in the soil, within which the inoculum disperses slowly and presents little danger for sudden or widespread epidemics.

Mode of Spread of the Pathogen

Fastidious bacteria are transmitted by leafhoppers, plant hoppers, or psyllids.

Bacteria (such as the cause of bacterial wilt of cucurbits) are disseminated primarily by beetles. Pathogens that are transmitted by windblown Rain (most bacteria) are almost annually responsible for severe out breaks. But somewhat localized epidemics within a field, a country, or a valley.

Environmental Factors in Epidemics

Moisture: Abundant, prolonged, or repeated high moisture, whether in the form of rain, dew, or high humidity, is the dominant factor in the development of most epidemics of diseases.

The presence of high levels of moisture allows all these events to take place constantly and repeatedly and leads to epidemics.

In contrast, the absence of moisture for even a few days prevents all of these events from taking place so that epidemics are interrupted or stopped completely.

Rain, flooding: BLB of rice, Black arm of cotton severe when rain followed by bright sunshine during the months of October and November are highly favorable. Splash- fire blight disease Surface irrigation – wilt of banana Relative humidity- Bacterial leaf streak (*Xanthomonas campestris* p.v. *oryzicola*) High relative humidity (83-93%) or dew during morning hours for 2 to 3 hours

Temperature: Epidemics are sometimes favoured by temperatures higher or lower than the optimum for the plant because they reduce the plant's level of partial resistance. At certain levels, temperatures may even reduce or eliminate the race-specific resistance of host plants. Plants growing at such temperatures become "stressed" and predisposed to disease, provided the pathogen remains vigorous. Infections by *Erwinia amylovora* are only found much later in spring or in early summer for the first time. This bacterium has a higher growth temperature optimum (28- 30°C). *C. michiganensis* subsp *sepedonicus* causing bacterial ring rot of potato *(Solanumtuberosum)*. The dispersal linked to occurrence of host and cool climatic area (21ºC) of the bacterium. (Janse, 2005).

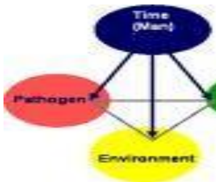
Other Factors in Epidemics

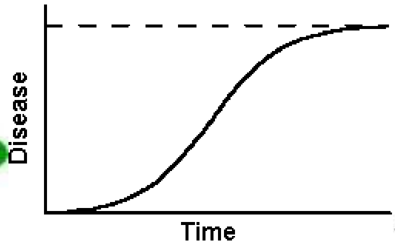
Some plant pathologists have elaborated on the disease triangle by adding one or more parameters. Suggested additional parameters have included time and humans.

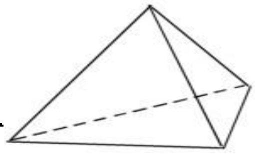
Time in Epidemics

Of these, only time is absolutely required so other elements represent special case applications. The disease onset and intensity are affected by the duration that the three factors are aligned. Naturally, disease may not happen in the first instant the three parameters are aligned favourably but will occur after some duration.

Understanding how disease levels increase or decrease over time is one of the most basic elements of plant disease epidemiology and ecology. Statistical models are often applied in order to summarize and describe this complexity, so that disease processes can be more readily understood (Hirano and Upper,1983: Ronald Gitaitis and Ronald Walcott. 2007). For example, comparisons between patterns of disease progress for different diseases, cultivars, management strategies, or environmental settings can help in determining how plant diseases may best be managed.







Bacteria and viruses are capable of building up enormous populations in a very short time, only days or even hours under the right conditions.

The importance of time is observed in monocyclic, polycyclic and polyetic diseases. The time over epidemic also observed by disease incidence, disease severity and AUDPC models.

Humans in Epidemics

Site selection and preparation: Ex: Bacterial leaf spot and stem canker (Xanthomonas campestris pv. Cajani) disease incidence is generally higher in low-lying waterlogged areas of the field than in well drained areas.

Date of sowing: Sowing date effect on development of Erwinia soft rot in Chinese cabbage in which early sowing (15th of july) was a high risk due to favourable weather conditions for the pathogen. Bacterial blight or Angular leaf spot or Black arm of cotton is severe when early sowing, delayed thinning, poor tillage, late irrigation and potassium deficiency in soil.

Selection of Propagating Material

The use of seed, nursery stock, and other propagative material that carries various pathogens increases the amount of initial inoculum within the crop and favors the development of epidemics greatly. The use of pathogen-free or treated propagative material can reduce the chance of epidemics greatly.

Cultural Practices

Continuous monoculture, large acreages planted to the same variety of crop, high levels of nitrogen fertilization, dense plantings, overhead Irrigation, injury by herbicide application, and poor sanitation all increase the possibility and severity of epidemics.

Pseudomonas solanacearum, persists between crops in moist soil and apparently unable to survive in dry soils. Cultural practices that enhance soil drying help to reduce the pathogen population.

Bacterial stem blight in chrysanthemum, caused by *P. cichorii*, is a big problem under conditions of close planting, high humidity and high N fertilization. Bacterial leaf blight of rice is severe when clipping of tip of the seedling at the time of transplanting, heavy rain, heavy dew, flooding, deep irrigation water, severe wind, temperature of 25-30°C and application of excessive nitrogen, especially late top dressing.

Disease Control Measures

Chemical sprays, cultural practices (such as sanitation and crop rotation), biological controls (such as using resistant varieties), and other control measures reduce or eliminate the possibility of an epidemic. Sometimes, however, certain controls, e.g., the use of a certain chemical or planting of a certain variety, may lead to selection of virulent strains of the pathogen that either are resistant to the chemical or can overcome the resistance of the variety and thus lead to epidemics.

Introduction of New Pathogens

The ease and frequency of worldwide travel have also increased the movement of seeds, tubers, nursery stock, and other agricultural goods. These events increase the possibility of introducing pathogens into areas where the hosts have not had a chance to evolve resistance to these pathogens. Such pathogens frequently lead to severe epidemics. Example: citrus canker caused by the bacterium *Xanthomonas campestris* pv. *citri*.

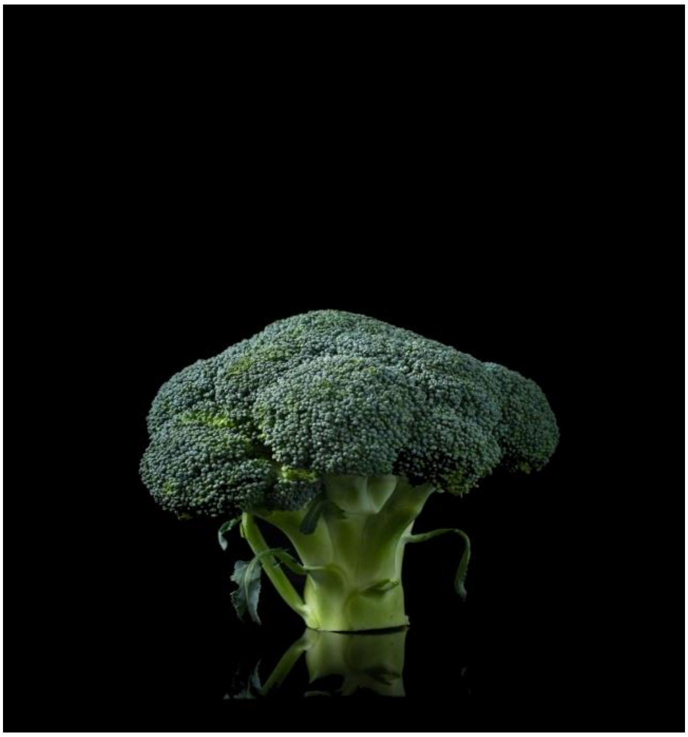
References

1. Agrios, G.N. 2005. Plant Pathology. Fifth ed. Univ. of Florida, Elsevier Academic Press.
2. Andrews J.H. and Tommeruf. 1995.Advances in plant pathology. Academic Press,11.
3. Hirano, S.S. and Upper, C. D.1983. Ecology and Epidemiology of Foliar Bacterial Plant Pathogens. Annual Review of Phytopathology,21: 243-270
4. Janse, J. D.2005 Phytobacteriology principles and practice, CABI Publishing
5. Ronald Gitaitis and Ronald Walcott. 2007.The Epidemiology and Management of Seedborne Bacterial Diseases. Annual Review of Phytopathology 45: 371-397.
6. Vidhyasekaran, P.2004. Concise Encyclopedia of Plant Pathology., PhD, FNA .Food Products Press®

Broccoli

Article ID: 11514

Bhanuja Dwivedi[1]
[1]PhD Research Scholar, Dept. of Horticulture, College of agriculture, Gwalior (M.P.).



Botanical name: *Brassica oleracea* var. *italica.*
Family: Cruciferae
Origin: Mediterranean region
Soil: For the cultivation of broccoli, Fertile soil with good moisture.

Broccoli is an individual from the cabbage family and is firmly identified with cauliflower. Its development started in Italy. Broccolo, which is an Italian name, signifies "cabbage grow." The word "broccoli" comes from the Italian plural of broccolo, which means "the flowering crest of a cabbage", and is the diminutive form of brocco, meaning "small nail" or "sprout." The crop contains 3.3% of protein content and high content of Vitamin A and C. It also contains substantial amount of riboflavin, niacin and thiamine and also contains high concentration of carotenoids.

Health Benefits of Broccoli

1. Broccoli is loaded with potassium which makes it beneficial for those suffering from hypertension.

2. Broccoli is high in essential nutrients including fibre, vitamin C, vitamin K, iron, and potassium.

3. This super green is rich in antioxidants like quercetin that help lower bad cholesterol.

4. This vegetable is also safe for diabetics. As it is loaded with antioxidants and fibre, broccoli may lower blood sugar levels and improve diabetic control.

5. Controlled cholesterol levels also promote better heart health. According to studies, fibre-rich foods like broccoli also help controlling overall heart disease risk.

6. Vitamin K helps your body absorb calcium, and a deficiency increases the risk of bone fractures. Due to the high amount of vitamin K in broccoli, eating more of this vegetable can strengthen your bones. Broccoli also contains calcium, which is another essential nutrient for strong bones and teeth.

7. Glucoraphanin, a sulfur-producing glucosinolate, is the precursor to sulforaphane. Sulforaphane is the most beneficial compound in broccoli microgreens.

8. Several studies have shown that broccoli microgreens high in glucoraphanin decreased oxidative stress and inflammation in kidneys and reduced blood pressure in the cardiovascular system. Sulforaphane has also been shown to reduce inflammation in the respiratory pathways and the symptoms of asthma. The sulforaphane and carotenoids in broccoli contain powerful oxidants that heal the damage to our eyes' retinal cells.

9. Broccoli helps to detoxify your body as it contains Vitamin C, sulphur and certain amino acids. Including broccoli in your diet will help you to remove the free radicals and toxins like uric acid from your body. Health benefits of eating Broccoli includes prevention from problems associated with toxins like boils, itches, rashes, gout, arthritis, rheumatism and even skin diseases like eczema and hardening of the skin.

Replacing Plastics by Bamboo: The Need of the Hour

Article ID: 11515

Shanjeevika. V[1]
[1]Ph.D Scholar, Department of Agricultural Extension and Rural Sociology, Tamil Nadu Agricultural University, Coimbatore.

India is extremely diverse in its bamboo varieties having around 140 species and being second in the world only after China. Bamboo products are appropriately considered eco-friendly due to their intrinsic characteristics of being biodegradable and being derived from a renewable natural resource base. Customized dimension products manufactured on demand expanding the markets for potential in income generation which contributes to achieving better per capita income without spending much more fees on qualification certificates and avoiding exposure to hazardous environment involved in actual collection process of raw material.

Among the various bamboo lifestyle products, bamboo mats, ladders, basketry were said to be the oldest value-added product combining traditional wisdom and utility (Martin et al., 2012). The paper also highlights the potential of value-added products made from bamboo as a commercial green product with multiple applications that may have a significant impact enhancing local economy and upliftment rural communities in the nation. For bio-degradable property its designs, bamboo lifestyle product in high demand with great health concern (Salmiah et al., 2019).

Lifestyle means a style of living that reflects the attitudes and values of a person or group. the totality of the likes and dislikes of a particular section of the market, especially when expressed in terms of the products and services that they would buy; a marketing strategy based on the self-image of such a group.

Globally, more than 1,250 species under 75 genera unevenly distributed in the various agroclimatic zones. Bamboo is vital to India's post COVID 19 – economy and it's been offering an opportunity for the country to strengthen its economy with the support of vast Bamboo resources. Forest & environment ministry policies supporting bamboo industry in this outlook. The Union Government in 2017 amended the Indian Forest Act through which bamboo was classified as a grass and it ceased to be a tree. However, bamboo grown in forest areas continues to be under the provision of forest laws.

Bamboo sourced from 70% adjoining forests land and 30% from the plantation. An average wage paid for the harvesting of each culm costs about 0.21$ per culm. When it's done in bulk charges will be less. Transportation charges vary from the point of raw-material collection to the destination processing unit. Indian craftsmanship already demonstrated implementation modern technologies in bringing out innovative engineered Bamboo lifestyle products (Valsecchi et al., 2012). Bamboo Craftsmanship plays a great role in rural employment creation and poverty alleviation (Khondoker et al., 2011).

Alternative bamboo products: guaranteed to end up in land fill site staking hundreds of years to breakdown Plastics include a wide range of synthetic or semi synthetic organic compounds that are malleable and can be moulded into solid objects. Bamboo waste can also be used in clean energy production (Truong, et al 2015). The properties of plastic include Resistant, Insulator, lightweight, durable, Inexpensive and easy to produce.

The manufacture of plastic, as well as its destruction by incineration, pollutes air, land and water and exposes workers to toxic chemicals, including carcinogens. Synthetic plastic does not biodegrade. It just sits and accumulates in landfills or pollutes the environment. Burning of plastic in the open air, leads to environmental pollution due to the release of toxic chemicals (Desta et al., 2012). Plastic pollution involves the accumulations of the plastic in the environment which adversely affects wildlife, pollutes wild life habitat or human habitations. Bangalore alone generates 50,000 kgs of disposable plastic sanitary pads in a single day. Workshops and webinars from various sources include resources members all over India. Polymer composite alone can be replaced by bamboo in its own ways are creating a public awareness connecting people according to their need to be in a sustainable bamboo matrix.

Background Need of Preventing Plastic Pollution on Our Environment Ocean & Beaches

Light weight, in-destructive plastics garbage discarded into the seas or near waterbodies, resulted in the floating on the marine debris and deposits in the beaches worldwide (Akbar et al., 2018). Aquatic diversity ingests plastic bags mistakenly for foods, die. The ingested plastic bag remains intact even after the death and its decomposition. Landscape: During manufacturing process, some of its constituents (chemicals) are highly toxic (cause cancer) and flammable. Plastic recycling is associated skin and respiratory with problems. May Be our first toothbrush is still alive at the Womb of Nature!!! Yes, our body cleansing process starts with brushing our toothbrush became a part of the plastic crisis. Small acts, when multiplied by millions of people, can transform the world. Next to that water is our basic necessity its again best to prefer handcrafted leak-proof bamboo bottles than water cans.

Humans: Careless disposal of plastic bags chokes drainage block the porosity of soil and causes problem for ground water recharge. “Animals eat plastic bags” brings up hundreds of heart-breaking stories and images from around the world. So many foraging cows in India have died from ingesting plastic bag litter that many of the states in that country have banned the distribution of plastic bags (Valentina et al., 2018). In the United Arab Emirates, a veterinarian has documented images of camels, sheep, goats, and endangered desert animals’ dead from eating plastic bags. Whales wash up on our coasts, their bellies full of plastic. And endangered leatherback sea turtles mistake floating plastic bags for the jellyfish that are their main diet, ingesting the plastic that can then block their digestive tracts. In fact, a recent study of leatherback turtle autopsy records found plastic in one-third of the animals’ GI tracts, plastic bags being the most common item mentioned. plastic bags have been referred to as “urban tumbleweeds”.

In India involvement of non-traditional and non-tribal communities, also indigenous tribal communities are engaged traditional community are provided an opportunity to obtain considerable experience in making a different and traditional high quality of bamboo lifestyle products which is a highly skilled bamboo craftsmanship also education for sustainable development (ESD) (Ying et al., 2019). Specially experience plays an important role in the selection of suitable clumps for harvesting to make quality bamboo products. Using a splitting machine, the bamboo pole is fixed longitudinally in front of the set of splitting knives and a mechanical pushing device pushes the bamboo over the knives to produce splits of a desirable size, the strips are then air-dried either in a shaded area or in artificial ventilation. This process reduces the moisture content in strips to 30 percent. Post drying, bamboo slivers of desired thickness, length, and width (2cm-4cm). Now it is sliced to get bamboo slivers according to desired thickness. The next stage includes Trimming/ Dimensioning/ Cutting to size, sanding and surface coatings or lamination. Meanwhile species selection is also important to shape bamboo in various dimensions to make desired product. Subsequently, depending on storage period appropriate treatments are given as an effective treatment which can be done with a hand sprayer or a knapsack sprayer checked fortnightly for any signs of fungal growth and borer attack. A brief survey on socio-economic factors and their prospects shows artisans are normally engaged based on the supply of raw material and are provided with training and by practice the skill is made perfect. This is considered as a good replacement for wood infrastructure (Rogerson et al.,2016). Socio-economic impacts in providing employment opportunities also innovation and to estimate the impact of social capital on the innovation in the small-medium enterprises (SMEs) (Aloysius et al., 2009) Bamboo lifestyle product- from production to marketing provides equal employment opportunities for all types of categories of the society like i) Scheduled Castes ii) Scheduled Tribes iii) Backward iv) Religion Minorities etc. Socio- economic status of bamboo handicrafts workers are unorganized category (Selvam 2016) There are numerous skilled factory workers/unskilled factory workers required working selected and presently working, on a contractual basis some are working regularly. bamboo cultural events like exhibitions and fairs since decades, thus dissemination indigenous art and skills across the nation. There is vast economic potential in Bamboo lifestyle product, but its contribution to the rural livelihood opportunities of women is often underestimated (Lynser et al., 2014).

Summary and Conclusion

Nature is functioning as its needed to do!!! India already proven its long history of bamboo work, in the process, brilliant craftsmanship. Plastic by itself doesn’t cause much pollution: Used plastic causing the real culprit. The Domestic Plastic Recycling is a global problem (Abhishek et al., 2020). Plastic don’t release any heavy metals above permissible limits for soil. The lead which was present in the plastic bags during the acid digestion and extraction was primarily from the dye and not from the plastic itself (Gabriela et al., 2019). Also have many experienced founders with a demonstrated history of working in the construction industry. To promote the utilization of desirable species by development of stocks of plants for distribution to botanical gardens and introduction to the general public. bamboo planting material as an alternate land use in semi-arid conditions conserving soil carbon stock sequestration as "land quality indicator". To preserve and increase the number of bamboo species in the United States (via various collection trips). Encouraging farmers to plant and maintain bamboo gardens to display the characteristic beauty of mature plants and to provide plant material for research in the taxonomy, propagation and culture of as large a number of species as possible and we have made use of the support more organized study on bamboo. Based on a standard protocol in the field and establishing required facilities are deemed necessary to carry out the research projects. should have experience in sustainability of rural women, materials management, and waste minimization (Datta et al., 2016). Experience with environmental permitting, compliance, source testing and site assessments would be a plus. Excellent presenting skills and technical writing required. It's a greatest challenge to understand and accept the situation. Lots of bamboo biomass is available as green and dry waste generates at various stages in processing from raw material till it becomes an end product. Disposal mechanism differs according to the type of waste generated. twigs shavings and bamboo sawdust.This waste need not necessarily be disposposed in an unscientific hazardous way and instead can be utilized in several innovative ways like in making Bamboo-Polymer Composite or Bamboo Plastic Composite. The recycling of plastic waste and the main issues associated with plastic disposal is also equally important (Vannessa, 2007). Evolving clean solutions from Bamboo lifestyle products Another alternative is the use of certain wastes for Biogas production (Arisutha et al., 2016).

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Advanced Cultivation Practices of Senna

Article ID: 11516

K. Ragu[1], K. Arunkumar[2]
[1]Subject Matter Specialist (Horticulture), Sikkal,
[2]Horticultural College and Research Institute,
[2]Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu.

Senna (*Cassia angustifolia* Vahl.) belonging to the family Caesalpiniaceae, is a perennial shrub, but grown as an annual in the rainfed areas, mainly for its medicinal properties particularly for its laxative principle. This crop is cultivated significantly in Gujarat (Anand), Rajasthan (Jodhpur) and Maharashtra (Pune district) and Tamil Nadu.

It is extensively cultivated as a rainfed crop in wastelands of Tirunelveli district of Tamil Nadu, by which attains the popular name as "TinnevelySenna". The species was reportedly introduced first in Tirunelveli district during the mid-eighteenth century from Europe and hence the Indian produce as a whole is referred as "TinnevelySenna". Nearly 75 % of senna produced in India is exported, especially through Tuticorin port.

The available statistics on area of cultivation of senna is around 6,000 ha located in various regions of India and in southern districts of Tamil Nadu, which dominates in commercial cultivation. Of late, Gujarat and Rajasthan are emerging as potential suppliers of senna in India.

The leaves and pods of senna contain sennosides A, B, C and D, which are well known for the preparation of laxatives and purgatives all over the world. The drug is used as the most reliable and least harmful laxative agent. Senna pods and leaves are also used in the form of decoction, powder and many other herbal preparations. It is popular in European countries for its use along with 'herbal tea'.

Origin and Distribution

There are two sources of senna drug namely, *Cassia angustifolia* Vahl, and *C. acutifolia* Del., *C. angustifolia* commonly called Thirunelvelisenna, is indigenous to Somalia, southern Arabia, part of Sindh and Kutch area of Gujarat. *C. acutifolia* commonly known as Alexandrian senna is indigenous to Sudan and Sinai. It is commonly cultivated in Sudan and Egypt. *C. italica* and *C. obavata* also possess a fair percentage of Anthraquinone compounds.

Description of the Plant

Senna is a small perennial under shrub; leaves are large, compound and pinnate and emit characteristic fetid smell when crushed. The flowers are bright yellow in color and pods are slightly curved, 3.5 to 6.5cm long and 1.5cm broad.

Varieties

1. ALFT-2: The Gujarat Agricultural University, under the All-India Co-ordinated project on Medicinal and Aromatic Plants at Anand, has released a late flowering type 'ALFT-2' through selection, which remains in vegetative stage till 100 days and is suitable for growing as leaf crop.

2. Sona: CIMAP, Lucknow has released a high yielding variety named 'Sona'.

3. KKM Sel 1: It is a selection from Thenkalam local, high yielding recording 38.5 per cent higher leaf yield and 69.88 per cent higher pod yield than local. This is highly suited for all soils of Tirunelveli and Tuticorin districts and ideal for rainfed cultivation.

The plants are spreading and bushy with 7-8 branches attaining a height of 80-100 cm. The plant has good rejuvenation capacity and suitable for stripping at an interval of 30 days with crop duration of 135-140 days. It yields 918 kg/ha of leaves and 352 kg/ha of pods. The total sennoside content is 2.54 per cent. The dried leaves and pods have good export potential and the medicinal property is utilized in the preparation of laxatives.

Cultivation

Soil: Senna is a hardy plant and thrives on a variety of soils ranging from sandy loam to lateritic soils. In southern Tamil Nadu, the crop is grown on poor and marginal lands under rainfed condition. The soil type in this region is sandy to red sandy soil, with a pH of 7-8.5. In areas of Ottapidaram, Vilathikulam, Sattur and Virudunagar, senna is cultivated traditionally under black cotton soils.

Climate: Generally, the crop requires an all-round warm and dry weather conditions. It is very sensitive to heavy rainfall, especially at the time of seed sprouting to young seedling stage. Temporary water logged conditions due to continuous rain and low temperature besides, inclement weather at harvest are unsuitable for its cultivation.

Propagation: Senna can be cultivated both as rainfed and irrigated crop, however, in most parts of southern districts, rainfed cultivation dominates and as such, there are two growing seasons, which coincide with the monsoon rain. The first commences with the onset of south west monsoon in June-July and the second during November-December, receding with North east monsoon rain. Wherever irrigation facilities are available, senna can be raised during January-February as irrigated crop.

Seed treatment and sowing: The crop is raised from seeds. Since the seeds have a hard and tough seed coat, a certain amount of abrasing of its surface is necessary to induce germination. This is achieved by pounding the seeds lightly with coarse sand in a mortar.

A traditional method of seed treatment for removing the hard seed coat is mixing the required quantity of seeds with dry and pure sand in the ratio of 1:3 and is gently beaten. Later the seeds are soaked in water for 10-12 hours and then used for sowing.

This practice gives about 90 % germination. The seeds exhibit dormancy for 2 months. The land should be thoroughly ploughed, at least two times, and properly leveled for ensuring good drainage. The farmers usually divide the land into small fields enabling for draining the excess rain water and then broadcast the seeds for raising the rainfed crop.

Under irrigated condition, a uniform spacing of 45x30 cm is recommended. Small beds are first prepared and shallow straight lines are formed at 45 cm apart and seeds are dibbled at a depth of 1-2 cm. The seeds start germination in 5-7 days and complete germination in 15 days after sowing. The seedlings are thinned to have a spacing of 30 cm in between plants within 20-30 days after sowing.

Manures and fertilizers: A basal dose of 25 tonnes of FYM, 50 kg N, 25 kg P2O5 and 40 kg of K2O/ha can be applied. Top dressing of 25 kg of N can be applied 40 days after sowing and another 25 kg N after 80 days of sowing. 4-6 irrigations can be given during the cropping period. Continuous rain, water stagnation and excess moisture are not suitable for senna growing.

Crop rotation and intercropping: Senna is grown after the paddy and grown as intercrop between rows of cotton, sesamum, chillies, brinjal, okra, mustard and coriander.

Irrigation: Senna can be economically grown under rainfed conditions. However, when it is grown as semi-irrigated crop, the yield increases considerably and excess irrigation is injurious to the crop.

Pest: The leaf eating caterpillar feed on the green senna leaves and spraying of carbaryl (4g/l) controls the infestation. The pod borer is also reported to attack the pods and can be controlled by spraying chlorpyriphos 1000 ml/ha

Harvest, post-harvest handling and storage: The leaves can be harvested in 2 months period. The second harvest is made at 30 days interval and the third harvest 40 days after second harvest. The harvested leaves should be shade dried for 7 to 10 days.

Yield: It has been shown that young leaves and pods contain more sennosides than the mature ones; however, bluish green, matured leaves are preferred in the market and they also fetch better price. Even though, the produce is sold by weight, leaves containing about 2.0-2.5 % and pods having 2.5-3.0 % of total sennosides are acceptable in the industry.

Yield/ha	Leaves (kg)	Pods (kg)
Rainfed	1000	150-200
Irrigated	2000	400

Post-Harvest Handling and Storage

The harvested leaves should be spread in a thin layer under open sun for 6-10 hours to reduce the moisture content. Further drying of the produce is done in well ventilated drying sheds. It takes 3-5 days to dry the produce in the sheds by frequently turning them all over. A well dried produce should have 7-8 percent moisture and should maintain light green to greenish yellow colour.

Production Techniques of Bottle Gourd

Article ID: 11517

Bhag Chand Shivran[1], Harvindra Pal[1], Rajesh Kumar Meena[1], Anuj Pal[2], Vikram Singh[3]
[1]Ph.D. Scholar, Department of Horticulture, Babasaheb Bhimrao Ambedkar University, (A Central University), Lucknow-226 025.
[2]Ph.D. Scholar, Department of Horticulture, S.V.P. University of Agriculture & Technology, Meerut-250110.
[3]Department of Plant Pathology, C.S.A. University of Agriculture & Technology, Kanpur-208002.

Introduction

Bottle gourd is a very important vegetable crop in India and belongs to Cucurbitaceae family. The vegetable in green stage and leaves with stem are used as vegetable. The hard shell of the Bottle Gourd is used for different purpose.

Botanical Name – *Lagenaria siceraria.*
Family – Cucurbitaceae.
Monoecious; Day Neutral Plant.
Isolation distance – Foundation seed – 800 m, Certified seed – 400 m.
Chromosome number: 2n = 22.
Origin – South Africa.
Bottle gourd or calabash is a delicately flavoured, Cucurbita family vegetable. It is one of the chief culinary vegetables in many tropical and temperate regions around the world. Bottle gourd is a fast growing, annual climber (vine) that requires adequate sunlight for flowering and fruiting.

It can be grown under wide range of soils and require trellis to support spread. Its intensely branched stems bear musky, deep green, broad leaves just similar as that in pumpkins, and white, monoecious flowers in the summer. After about 50-55 days from the plantation, young, tender, edible fruits evolve that will be ready for harvesting. Bottle gourds come in wide range of shapes and sizes. The fruit features oval, pear shaped or elongated and smooth skin that is light green in color. Internally, its flesh is white, spongy and embedded with soft, tiny seeds. The fruits are used as a vegetable or making sweets (e.g., halwa, kheer, pedha and barfi) and pickles. As a vegetable, it is easily digestible even by patients. The dry hard shells are used to make musical instruments, pipes, bowls, bottles, containers, floats for fishing nets etc. Kofta is a most popular preparation. Good source of fiber free carbohydrates and fruit pericarp for crude fiber. Oil extracted from kernels of seed is used as hair oil.

Botany

Bottle gourd is a climbing annual with a duration of 3 ½ to 4 months. Flowers are solitary, chalky white in colour and open at night. Fruits are fleshy and vary in shape and size.

Climate and Soil

Soil: Loam or sandy loam soil, too much acidic soil pH is not suitable (less than 5.5).

Seed germination: 25-30ºC, day temperature: 30 -35ºC, Night temperature: 18-22ºC (Higher temperature induces maleness.). It is grown in summer and rainy season. In summer, the crop is sowing: summer-January-February, Rainy –June-July.

Climate: Bottle gourd is a typical warm season vegetable. Though crop tolerates cool climate better than musk melon and water melon, it cannot tolerate frost. Well drained fertile silt loam is ideal for cultivation of bottle gourd. Crop is quite suitable for river bed cultivation because of its deep tap root system. A deep soil supports vines for a long period.

Season: Crop is grown during summer and rainy season. In places where water is not scarce, it is grown throughout the year.

Land Preparation and Sowing

Land preparation and sowing are similar to that of ash gourd. Land is ploughed to a fine tilth and furrows are made at a distance of 2.0-3.0 m. After incorporating farmyard manure, seeds are sown in furrows at a distance of 1.0-1.5 m between plants. When bottle gourd is trained on bower, follow a spacing of 3.0 x 1.0 m. In sloppy land, sowing is done in pits with 2-3 plants/pit. Soaking seeds 12-24 hours in water or in succinic acid (600 ppm) for 12 hours improves germination.

1. Seed rate – 3- 5 kg/ha
2. Seed count ; 450-500 seeds/100 g
3. Spacing – 2 x 1 m
4. FYM: 20 t/ha
5. Training- bower
6. N: P: K = 40-60: 40-60: 60-80 kg/ha.
7. The first half dose of N must be applied as basal while the other half 30DAS.
8. The crop requires frequent irrigation as high humidity is needed for prolific bearing. During hot and humid weather, irrigation after every third or fourth day is needed.

Improved Varieties of Bottle Gourd

1. Arka Bahar
2. Kalyanpur Hari Lambi – fruits slightly dark green in color
3. NDBG 1 – gives early yield in upland conditions; highly preferred for diara cultivation
4. NDBG 4
5. PBOG 1
6. Phule BTG 1 - produces comparatively more female flowers at basal nodes
7. Punjab Komal – variety with shortest duration from fruit set to maturity , 70DAS
8. Punjab Long
9. Punjab Round
10. Pusa Manjari – high yielding hybrid , round fruited
11. Pusa Meghdoot – F1 hybrid between Pusa Summer Prolific Long and Sel. 2.
12. Pusa Naveen – perfectly cylindrical fruit, free from crook neck
13. Pusa Summer Prolific Long – can be grown in rainy season also.
14. Pusa Summer Prolific Round – prolific bearer and heavy yielder.
15. Rajendra Chamatkar
16. Kalyanpur Long Green – developed at CSAUAT Vegetable Research Station, Kalyanpur, Kanpur
17. Samrat – released from Mahatma Phule Krishi Vidyapeeth, Rahuri ; Box packing
18. Pusa Hybrid 3 – for distant market, very early maturing.

Training and Pruning

As bottle gourd puts good vegetative growth, proper training and pruning are advantageous. Training plants to bower helps to trap sunlight more effectively and yield as high as 80 t/ha was obtained. Axillary buds of growing vines should be removed till vines reach the bower height. When vine reaches bower, apical bud is removed at 10-15 cm below bower to allow 2 or 3 branches to spread on bower. After formation of 4-5 fruits, vines are again pruned allowing 2-3 axillary buds only to grow on primary vines.

Harvesting

Fruits are harvested at tender stage when it grows to one third to half. Fruits attain edible maturity 10-12 days after anthesis and are judged by pressing on fruit skin and noting pubescence persisting on skin. At edible maturity seeds are soft. Seeds become hard and flesh turn coarse and dry during aging. Tender fruits with cylindrical shape are preferred in market. Harvesting starts 55-60 days after sowing and is done at 3-4 days intervals. While harvesting, care should be taken to avoid injury to vines as well as to fruits. Plucking of individual fruits is done with sharp knives by keeping a small part of fruit stalk along with fruit. Average yield is 20-25 t/ha for open pollinated varieties and 40-50 t/ha for F1 hybrids. Fruits can be stored for 3-5 days under cool and moist condition. For export purpose, fruits are packed in polythene bags and bags are kept in boxes of 50-100 kg capacity.

Postharvest, Storage and Marketing

1. Improper harvesting, handling, transportation, and distribution results in significant loss.
2. Several post-harvest factors like physical, physiological, mechanical and hygienic conditions.
3. These can be reduced by proper cultural operations, harvesting, transportation, storage and pre- and post-harvest treatments.
4. Processed product is tooty fruity.
5. Fruits can be stored for 3-5 days under cool and shady conditions; in cold storage they can be stored for long periods.
6. Fruits are packed in polythene bag and kept in small boxes and these boxes are transported to market.
7. For export fruits should be picked at edible stage and kept in boxes pf 50-100kg capacity

Important Diseases of Bottle Gourd

Disease	Symptoms	Management
Cucumber Mosaic Virus	Plants are severely stunted • foliage is covered in distinctive yellow mosaic • leaves of plant curl downwards and leaf size is smaller than normal • flowers on infected plants may be deformed with green petals • fruits become distorted and are small in size • fruit is often discolored.	Removing weeds and diseased plants from fields can reduce the chance of infections. Maintaining clean and sanitized tools, machines and hands can help. The use of resistant varieties is another way some farmers control virus spread. Vector control by using systemic insecticides (Metasystox0.1%). Resistant cultivars have been developed recently.
Cucumber green mottle mosaic virus	In severe infections cotyledons may become yellow but more often symptoms are not seen until the 1st or 2nd leaf stage. Leaf: CGMMV symptoms, mottling and mosaic on leaves, fruit mottling and distortion. Early symptoms include vein clearing and crumpling on young leaves while mature leaves become bleached and chlorotic. Fruit: These may be symptomless, at least externally, or can become severely spotted or streaked and distorted, especially during high temperatures. In some cases, fruit that show no external symptoms may be internally discolored or necrotic.	1. Several common seed treatment methods (including thermotherapy at 720C for 3 days, chemotherapy in 10% trisodium phosphate or a combination of both) have some effect on CGMMV infectivity in seeds. 2. The completeness in deactivation of CGMMV infectivity in seeds should be confirmed through bioassay 3. Plant virus-free seed. 4. Rouging of infected plants. 5.Crop rotation may be applied. 6.Resistant varieties have been developed recently.
Zucchini yellow mosaic virus	Foliar symptoms consist of a prominent yellow mosaic, necrosis, green vein banding, chlorotic spots, blistering distortion, leaf deformation and stunting. Fruits remain small, greatly malformed, and green mottled.	Resistant varieties 2. Cropping systems. 3. Deterring aphids. Using reflective mulches or installing yellow sticky traps or pan traps are also methods of interfering with aphid behaviour. 4. Removal of infected plants. 5. Removal of weed hosts.6. Promote natural predators of aphids. Ladybird beetles and hoverflies. 7.Chemical control of aphids.

Bioprinting: Printing A New World of Living Cells

Article ID: 11518

S. Geethanjali[1]

[1]Assistant Professor (PBG), Department of Genetics and Plant Breeding, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University.

"On a moonlit night, a caring mother shows the moon and stars to feed her child. Wrapping the child within her arms, she narrates a thousand bed time stories to put the child to sleep. With all love, she scatters attractive toys to brighten up her child's face with a cute smile".

Well, these narratives would soon become a century old tale, and the day is not far away, where a mother would be gifting her child with 'living cells' as toys to play. Thanks to the world of Bioprinting, a new invention of the 21st century.

What is Bioprinting?

Well, many of us may be aware of how printing is done traditionally. For instance, to print a text or image from a computer, we require some inputs or raw materials. These would include a source file containing the text or image, a machine to print, printer ink and paper on which the text or image should be printed. Once the image is received by the printer, the printer scans the content, pulls the paper from the input tray, delivers the printer ink on the paper, and the replica of the content is exactly produced on the paper, which is then sent out of the printer. This is a traditional 2D Printing.

Now imagine a company wants to produce a toy or jewellery with a unique design in numerous quantities. Here, a prototype or a mould of the unique model of the toy or craft is to be created first. Then instead of ink, polymers of different kinds such as plastics, metals, or ceramics will be deposited in a molten form over the mould layer by layer. On cooling, these polymers solidify to produce a copy of the prototype. Now a days, all these can be done inside a 3D printer. Once the image of the toy is received by the printer, instead of ink, the selected polymer such as thermal plastics is loaded into the printer. Inside the printer, the materials get heated up and begin to flow in a liquid form through the printer nozzle. The deposition of the material takes place layer by layer. On cooling, the layers solidify to produce the three-dimensional object. This process of additive manufacturing to produce a three-dimensional object is known as 3D printing.

Now if one wants to produce a living structure such as a cell, tissue or an organ, it can be done in a similar way as that of 3D printing. But instead of using ink or synthetic polymers, biological materials are to be used for printing. This process is known as bioprinting.

Requirements for Bioprinting

Building a living structure in 3D printers is highly complex compared to building a structure of a lifeless object. The choice of the living structure to be produced and the biomaterials required for the process are to be decided before initiating the bioprinting process.

Prototype: One needs a source of the object to be produced. This is generally a digital file produced from the scanned image of the living object. For example, if a kidney cell of a human being is to be printed, the source image is obtained as a digital file in the form of CT scan or MRI scan.

Living cells: Printing of the desired living structure requires biological materials such as cells. These have to be obtained from living organisms. For example, in humans, a kidney cell can be collected from patients or donors and used as bioink. In case of plants, using tissue culture techniques, cells from different plant parts can be cultured and used as bioink.

Adhesive: While building a living structure, numerous cells (either of the same type or different types) have to be connected and deposited layer by layer. A dissolvable gel like substance such as collagen scaffolds (in case of animals), calcium alginate, agar, starch or polyurethane (in case of plants) is generally added to connect and position the cells precisely and build the frame work.

Steps in Bioprinting

Pre-bioprinting: This is an initial phase or a preparatory phase. It involves generating the digital file from scanned images such as MRI scans and CT scans. The living cells are isolated from organisms and cultivated adequately and the bioink is prepared. Bioink is the combination of living cells, additional materials or scaffolds surrounding the cell and the biopolymer gels used as glue for creating the structure.

Bioprinting: This is the actual printing phase, where the bioink is loaded in 3D printer cartridge with multiple printing heads. The bioink is delivered through the printer nozzle to fabricate the multi- cellular structure with perfect shape and fidelity. The cells are aligned to form the first layer. Additional layers are subsequently deposited and joined by the scaffold and gelling agents. The bioink used can be of three types viz., structural, sacrificial or functional. A structural bioink is used to control the mechanical properties of the living structure. A sacrificial bioink is used during the printing phase and subsequently removed to create channels for nutrient supply, cell movement etc. A functional bioink is used to guide the growth and developmental activities of a cell.

Post bioprinting: This is a post-production phase to ensure stability of the structure. The living structure created is subjected to treatments such as cross linking with ionic solutions or UV light and incubation in an appropriate medium.

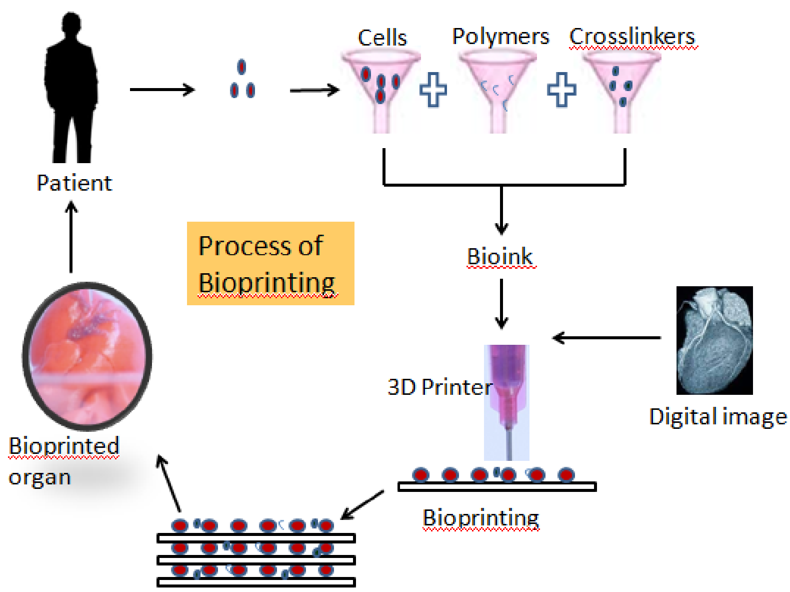
Applications of Bioprinting

Bioprinting has a vast application particularly in the biomedical field. Clinical trials rely mainly on using living organisms as subjects. This has a lot of ethical and legal implications. Now with bioprinted structures such as cells, tissues and organs, efficacy of drugs can be tested. Organ transplantations can be done without a long waiting for donors. Wounded or damaged skins can be easily healed by grafting with the bioprinted structures.

However, in the field of plant science, bioprinting is beginning to mark its existence. With the plant cell-based constructs, scientists can gain an insight into the dynamic changes and physiological responses at cellular and subcellular level during the different phases of growth and development in plants. For instance, it is tedious to study the root architecture and soil penetration ability in response to moisture and nutrient status in the soil under natural conditions.

However, a bioprinted root model, mimicking the natural root functions, can be used to study these parameters without disturbing the biological system. Bioprinting can help in tailor made products such as mass multiplication of plants with desirable traits, plant products such as wooden blocks for industrial applications, healing plant injuries. As a pioneering effort scientist at North Carolina State university are attempting to bioprint the stem cells of the model plant *Arabidopsis thaliana*.

Challenges Ahead



Being in nascent phase, bioprinting has several key issues to be addressed. The organ or tissue to be fabricated should be amenable for a bioprinting process. The choice of cells to be used as printing material, interactions of the cells with the scaffold, the precision and accuracy with which the living structure is created, effective cross-linking techniques, vasculature of the construct to ensure proper nutrient and oxygen supply, mechanical and functional integrity are critical technical challenges in bioprinting. Moreover, unlike a traditional 3D printing which is static, bioprinting is a dynamic and complex process.

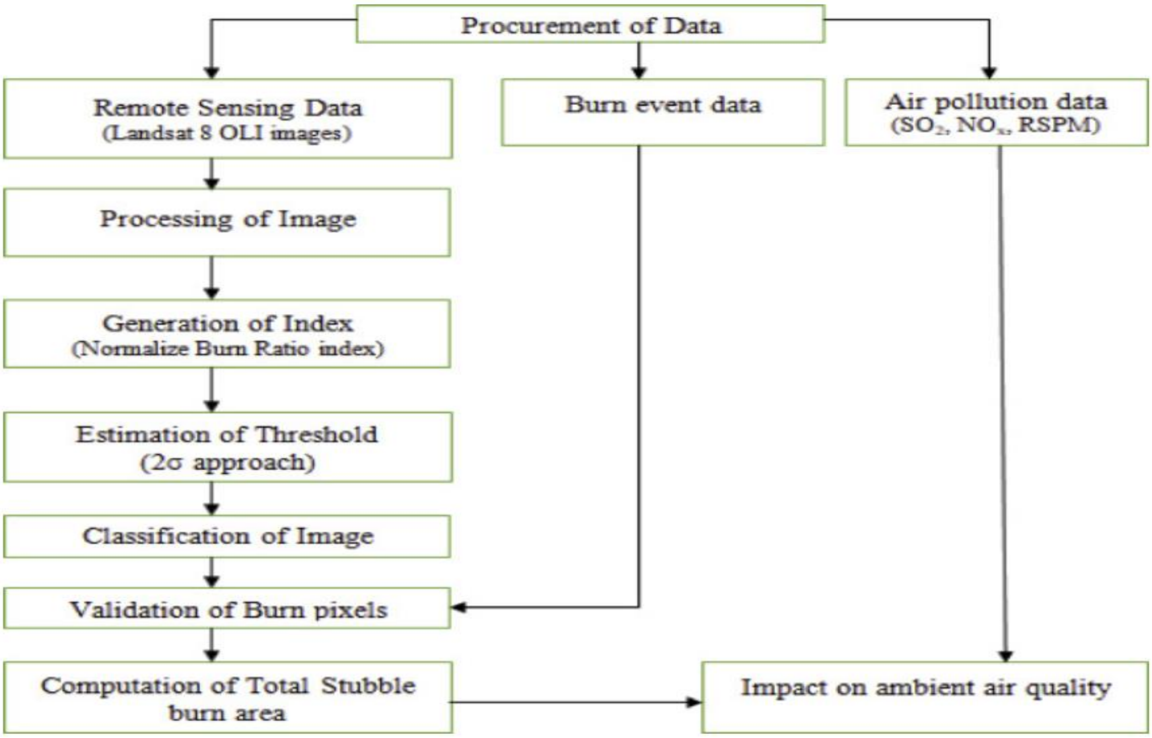
Amidst these challenges, the world of bioprinting is spreading its wings with bioprinted organs such as heart, bones, cartilages, skin tissues, corneas revolutionizing the medical science and benefiting the patients. We need to wait to hear more of bioprinted plants. Keeping away the fascination, a simple question comes to my mind “Are we trying to recreate nature?”

Use of Remote Sensing to Identify Forest Fire and Crop Residue Burning

Article ID: 11519

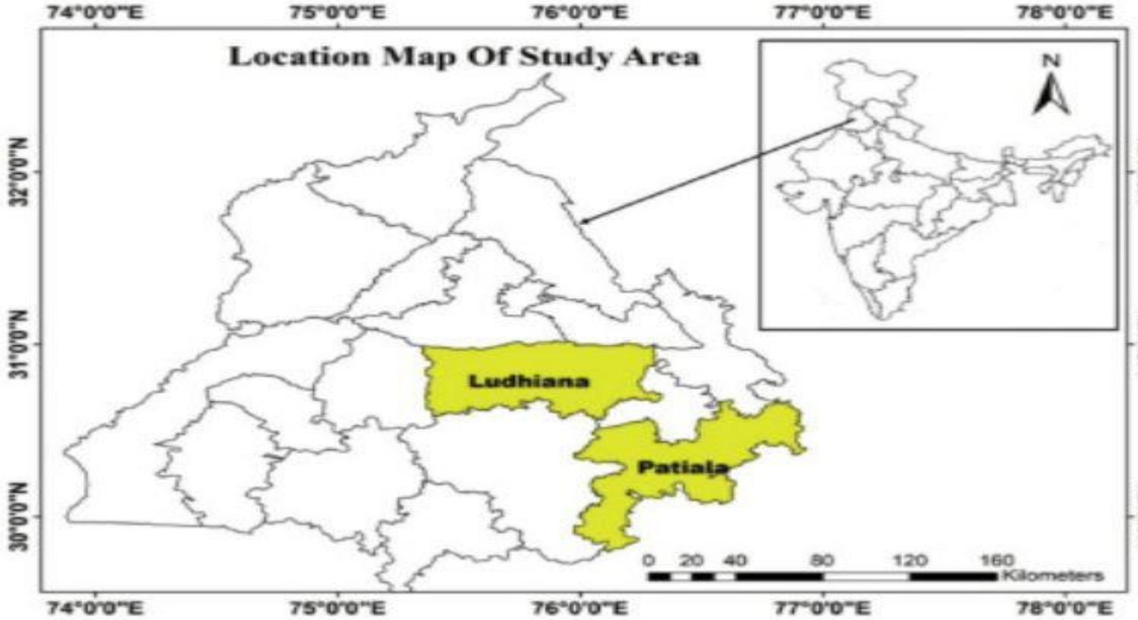
Vimal Kumar[1], Rajesh Kumar[2], Vijay Pratap[3], Chandra Prakash[4], Alesh Kumar[5]
[1,2,3,4,5]Ph.D. Scholar, [1]Division of Agricultural Physics, [2,3]Division of Agronomy and [4,5]Division of Environmental Sciences, Indian Agricultural Research Institute, Pusa Campus, New Delhi-110012.

The characterization of the seasonal and inter-annual variability of agricultural residue burning in tropics is needed to devise strategies to control or minimize substantial amounts of particulate matter and pollutants released to the atmosphere through the burning of agricultural residues. This is quantifying by the spatiotemporal changes in agricultural residue burning. The increased agricultural residue burning activity is needs an immediate attention and develop sustainable alternative methods for crop residue management. It is estimated that the proportion of forest areas prone to forest fires annually ranges from 33% in some states to over 90% also. The understanding of the causes and spatiotemporal patterns of forest fires is key to the development of an effective fire management plan. Earth observation data and models have been widely used for fire monitoring, danger forecasting and risk mapping. Badarinath et al., 2006, state that Agricultural residue burning is a common practice of biomass management used in many parts of the world for preparing the land for the cultivation of next round of crops.



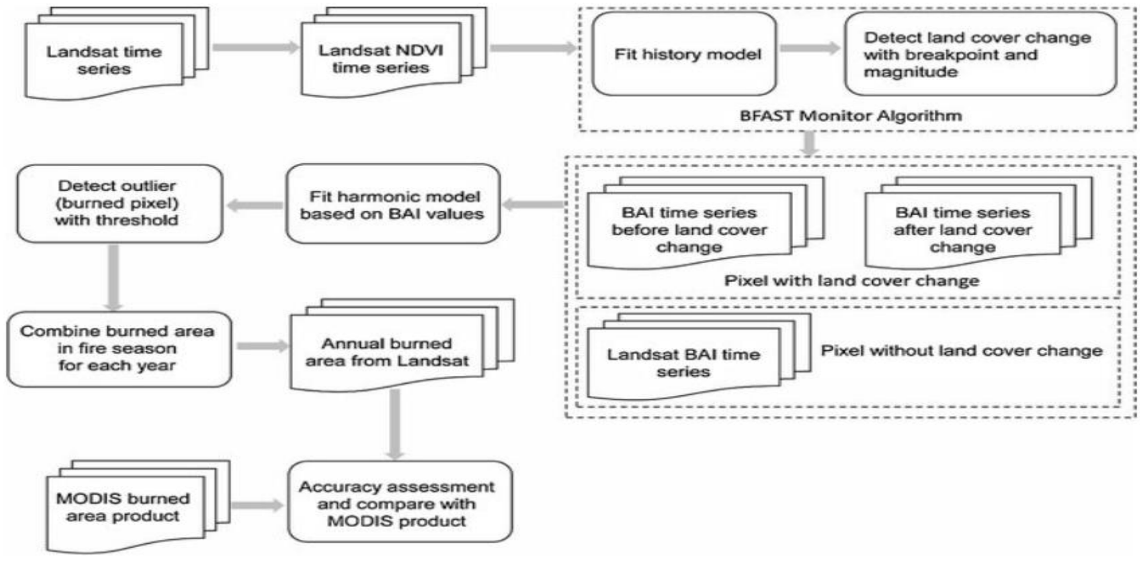
Stubble burn area estimation and its impact on ambient air quality (Pratika Chawala. 2019)

A detailed monitoring of cropland burned area, including information on active fire locations in near real-time is important for accurate estimation of emissions from agricultural residue burning for devising strategies and make policies to mitigate adverse effects of agricultural residue burning (Hall et al., 2016). The burning of biomass, which constitutes forest fires, savanna and grassland fires and crop residue burning. 25% global biomass burning occur in China, India contributes 18% global biomass burning, and Indonesia and Myanmar contribute 13% and 8% respectively (Streets et al., 2003). The Rice-Wheat System (RWS) in India produces large amounts of crop residues, which are generally used as residential cooking and industrial fuel and animal fodder. The satellite-based remote sensing data sets provide opportunities to monitor agricultural residue burning covering large areas in space over an extended period of time. Friedl et al., 2002, The availability of MODIS active fire and land cover classification data offers the opportunity to have a direct high-resolution matching of fire-count and vegetation-cover at an unprecedented resolution of 1 km×1 km pixel level. Wheat and rice residue burning areas for three districts of Haryana namely Kaithal, Kurukshetra and Karnal for the year 2010 using complete enumeration approach of multi-date IRS-P6AWiFS and LISS-III data, showed that highest wheat residue burning was observed in Kaithal (26.83 % of wheat area) followed by Karnal (21.67 %) and Kurukshetra (14.53 %) district. Highest rice residue burning was observed in Kurukshetra (24.51 % of rice area) followed by Karnal (21.22 %) and Kaithal (15.53 %) district.



Identification of location or Location map of the study area

Moderate Resolution Imaging Spectroradiometer (MODIS) data on the occurrence of fire over a period of 15 years (2002–2016) was used to characterize the spatial and temporal patterns of agricultural residue burning in Central India. Agricultural residue burning analyzed during the period from January 2002 to December 2016 in the Madhya Pradesh in India revealed that fire points in croplands have increased from 454 in 2002 to 4359 in 2016 with an average annual rate of 64%. Overall, there was an increasing trend of fire occurrence, which increased from 1268 in 2002 to 7915 in 2016. Most of these fires were in croplands (48.1%) followed by deciduous broadleaf forests (36%).



The main steps of the burned area detection algorithm (Petri K. E. Pellikka. 2018)

Verma et al., 2019, studies Cropland fires were increased almost 10-fold from 454 in 2002 to 4359 in 2016 at an average annual rate of 64%. Yin et al., 2021, Integration of MODIS fire and land-use products to extract CRB spots in China over an extended period (2001-2018) revealed that CRB presents distinctive seasonal patterns for each region of China. Three trend analyses (linear slope, Theil-Sen slope, and Mann-Kendall,) and two geographic distribution analyses (SDE and MEC), showed that annual CRB spots across China increased from 2001 to 2018. CRB spots and FRP peaked in 2014 at 7.33×10^4 and 1.73×10^6MW, respectively. So, based on above study we recommend ploughing of agricultural residues into the soil as a sustainable and eco-friendly alternative to the burning of crop residues.

References

1. Badarinath, K. V. S., Chand, T. K., & Prasad, V. K. (2006). Agriculture crop residue burning in the Indo-Gangetic Plains–a study using IRS-P6 AWiFS satellite data. Current Science, 1085-1089.
2. Friedl, M. A., McIver, D. K., Hodges, J. C., Zhang, X. Y., Muchoney, D., Strahler, A. H., ... & Schaaf, C. (2002). Global land cover mapping from MODIS: algorithms and early results. Remote sensing of Environment, 83(1-2), 287-302.
3. Hall, J. V., Loboda, T. V., Giglio, L., & McCarty, G. W. (2016). A MODIS-based burned area assessment for Russian croplands: Mapping requirements and challenges. Remote Sensing of Environment, 184, 506-521.
4. Streets, D. G., Yarber, K. F., Woo, J. H., & Carmichael, G. R. (2003). Biomass burning in Asia: Annual and seasonal estimates and atmospheric emissions. Global Biogeochemical Cycles, 17(4).
5. Verma, S., Dar, J. A., Malasiya, D., Khare, P. K., Dayanandan, S., & Khan, M. L. (2019). A MODIS-based spatiotemporal assessment of agricultural residue burning in Madhya Pradesh, India. Ecological Indicators, 105, 496-504.
6. Yin, S., Guo, M., Wang, X., Yamamoto, H., & Ou, W. (2021). Spatiotemporal variation and distribution characteristics of crop residue burning in China from 2001 to 2018. Environmental Pollution, 268, 115849.

Remote Sensing of Plant Diseases

Article ID: 11520

Gokarla Vamsi Krishna[1], B. Teja Bhushan[2]

[1]Ph.D (Ag.) Research Scholar, Department of Plant Pathology, Agricultural College, Bapatla-522 101, ANGRAU, Andhra Pradesh.

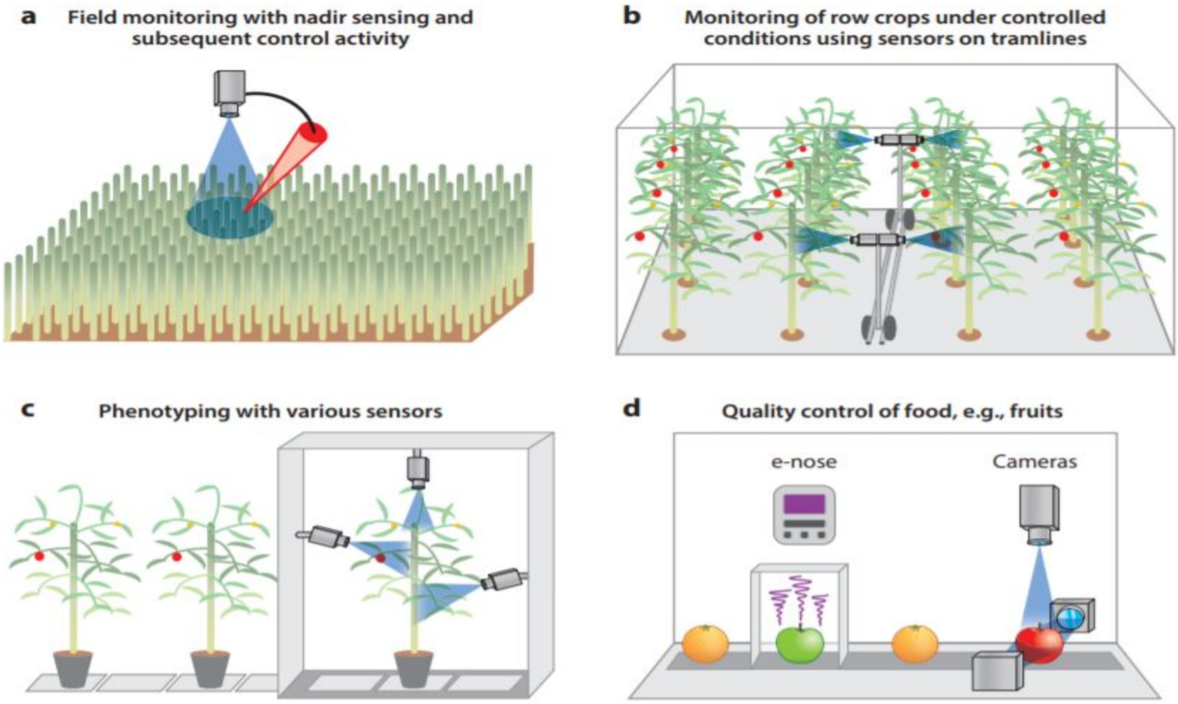
[2]Ph.D (Ag.) Research Scholar, Department of Plant Pathology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, West Bengal.

Detection, identification, and quantification of plant diseases by sensor techniques are expected to enable a more precise disease control, as sensors are sensitive, objective, and highly available for disease assessment. Recent progress in sensor technology and data processing is very promising; nevertheless, technical constraints and issues inherent to variability in host– pathogen interactions currently limit the use of sensors in various fields of application. The information from spectral [e.g., RGB (red, green, blue)], multispectral, and hyperspectral sensors that measure reflectance, fluorescence, and emission of radiation or from electronic noses that detect volatile organic compounds released from plants or pathogens, as well as the potential of sensors to characterize the health status of crops, is evaluated based on the recent literature. Phytopathological aspects of remote sensing of plant diseases across different scales and for various purposes are discussed, including spatial disease patterns, epidemic spread of pathogens, crop characteristics, and links to disease control. Future challenges in sensor use are identified.

Disease management in agricultural crops commonly assumes a homogeneous pattern of disease distribution, so crops are sprayed at uniform application rates. However, the heterogeneity of crops caused by differences in soil conditions, topographical situation, neighbouring fields, microclimatic conditions, and sources of pathogen inoculum often results in a heterogeneous distribution of diseases manifested as patches, gradients, or random patterns. The heterogeneity of disease distribution in a crop may provide an option to minimize the amount of fungicide sprayed during the growing season by applying the fungicide only where it is needed. This reduction can minimize undesirable environmental effects from pesticides as well as decrease selection for fungicide resistance in pathogens. A prerequisite for site-specific disease control is the sensing of diseases, i.e., the monitoring of as many plants as possible, ideally all plants, to determine whether any individual plant is diseased (and to what degree) as well as whether the disease needs to be controlled. Sensors may be used for the detection of diseased plants, to decide whether to control a pathogen, and for the assessment of spatial patterns of plant diseases. Remote sensing is the acquisition of information about an object or phenomenon by a recording device not in physical or intimate contact with the object or phenomenon under study; hence, it is noninvasive and non-destructive. It is suitable for monitoring across various temporal and spatial scales as well as for time-series experiments.

Sensors are expected to be objective, accurate, precise, rapid, and available 24 hours a day. Sensors of plant diseases can be used in quality control (e.g., by the food industry or quarantine authorities) once, or they may be integrated into autonomous systems for the continuous monitoring of crops for plant diseases, i.e., checking and keeping a continuous record of the crop health status. Systematic observation of a crop by technical sensors can allow the operator to intervene when infections are detectable or exceed action threshold levels. Ideally, sensors should be capable of detecting a deviation in the crop's health status brought about by pathogens, identifying the disease, and quantifying the severity of the disease. The identification of a disease requires the ability to differentiate among various/all potential diseases according to disease-specific symptoms. The quantification of typical disease symptoms (disease severity) and assessment of leaves infected by several pathogens are simple for imaging systems but a challenge for nonimaging sensors.

Sensing is a tool for disease assessment, not the prerequisite or the active control mechanism for disease management. Sensors cannot replace the application of fungicides and mechanical devices for disease control, but they may guide (and focus) the actuator(s) to the plants or areas requiring a specific activity and thus help to reduce the amount of chemical applied. Sensing of polycyclic diseases is reasonable only when effective curative control options, i.e., systemic fungicides, are available for control. Sensors may be used for estimating the production losses due to disease, to decide which plants have to be removed from the cultivated area, or to determine which areas of the field must be left uncultivated in the next growing season because of the presence of soil borne pathogens that cannot be controlled by means other than crop rotation.



References

1. Badarinath, K. V. S., Chand, T. K., & Prasad, V. K. (2006). Agriculture crop residue burning in the Indo-Gangetic Plains–a study using IRS-P6 AWiFS satellite data. Current Science, 1085-1089.
2. Friedl, M. A., McIver, D. K., Hodges, J. C., Zhang, X. Y., Muchoney, D., Strahler, A. H., ... & Schaaf, C. (2002). Global land cover mapping from MODIS: algorithms and early results. Remote sensing of Environment, 83(1-2), 287-302.
3. Hall, J. V., Loboda, T. V., Giglio, L., & McCarty, G. W. (2016). A MODIS-based burned area assessment for Russian croplands: Mapping requirements and challenges. Remote Sensing of Environment, 184, 506-521.
4. Streets, D. G., Yarber, K. F., Woo, J. H., & Carmichael, G. R. (2003). Biomass burning in Asia: Annual and seasonal estimates and atmospheric emissions. Global Biogeochemical Cycles, 17(4).
5. Verma, S., Dar, J. A., Malasiya, D., Khare, P. K., Dayanandan, S., & Khan, M. L. (2019). A MODIS-based spatiotemporal assessment of agricultural residue burning in Madhya Pradesh, India. Ecological Indicators, 105, 496-504.
6. Yin, S., Guo, M., Wang, X., Yamamoto, H., & Ou, W. (2021). Spatiotemporal variation and distribution characteristics of crop residue burning in China from 2001 to 2018. Environmental Pollution, 268, 115849.

Role of Endosymbionts in Plant Parasitic Nematodes

Article ID: 11521

Gokarla Vamsi Krishna[1], B. Teja Bhushan[2]
[1]Ph.D (Ag.) Research Scholar, Department of Plant Pathology, Agricultural College, Bapatla-522 101, ANGRAU, Andhra Pradesh.
[2]Ph.D (Ag.) Research Scholar, Department of Plant Pathology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, West Bengal.

An endosymbiont or endobiont is any organism that lives within the body or cells of another organism in a mutualistic (formerly called symbiotic) relationship with the host body or cell, often but not always to mutual benefit. Endosymbionts are critical players in many ecosystems. First, they may provide novel biosynthetic capabilities to help in supplement of nutrients that are limiting to their hosts.

Other endosymbionts may provide defense compounds to help in protecting their hosts from predators or pathogens. Importantly for plant pests, some endosymbionts influence virulence through affecting their host's ability to colonize plants or serve as vectors for other plant pathogens (Amanda, 2018). Major intracellular endosymbiont groups are *Pasteuria* from root knot nematode, cyst nematode and lesion nematode. *Cardinium* from *Globodera* spp., *Heterodera* spp. and lesion (*Pratylenchus* spp.) nematodes. *Xiphinematobacter* from *Xiphinematobacter americani, Xiphinematobacter brevicolli, and Xiphinematobacter rivesi* from dagger nematodes (*Xiphinema* spp.). *Wolbachia* from lesion (*Pratylenchus* spp.) and burrowing (*Radopholus* spp.) nematodes (Ndeme and Gregory, 2008). Light and transmission electron microscopy were used to investigate the life cycle and ultrastructure of an undescribed isolate of *Pasteuria* that parasitizes the soybean cyst nematode, *Heterodera glycines*.

Studies conducted to determine the host specificity of *Pasteuria* revealed that the endospores that attached to the cuticle of second-stage juveniles (J2) of *H. glycines* in soil did not germinate until the encumbered nematodes invaded soybean roots. Thereafter, the bacterium developed and completed its life cycle only in females (Atibalentja *et al*., 2004). *Candidatus Cardinium* is a bacterium from the Bacteriodetes group. It is involved in reproduction alterations of arthropod host organisms including cytoplasmic incompatibility, parthenogenesis and feminization.

They also contained characteristic Microfilament-Like Structures (MLSs) similar to those observed in *Candidatus Cardinium hertigii,* an endosymbiont of *Encarsia spp.* wasps (Gregory and Ndeme, 2006). Nematode species of the *Xiphinema americanum* group (Nematoda, Longidoridae), viz. *Xiphinema americanum*, *Xiphinema rivesi* and *Xiphinema brevicollum*, each harbour their own specific verrucomicrobial endosymbionts. They are exclusively maternally inherited and their hosts reproduce by thelytokous (mother-to-daughter) parthenogenesis, males being extremely rare. A new genus, '*Candidatus* Xiphinematobacter' gen. nov., along with three new candidate verrucomicrobial species, *Candidatus* Xiphinematobacter americani, *Candidatus* Xiphinematobacter rivesi. and *Candidatus* Xiphinematobacter brevicolli, are described on the basis of transmission electron microscopy, scanning electron microscopy, DAPI epifluorescence microscopy and 16S rDNA sequence analysis.

These are the first endosymbiotic species described among the *Verrucomicrobia*. (Vandekerckhove., *2000*). *Wolbachia*, one of the most widespread endosymbionts, is a target for biological control of mosquitoborne diseases (malaria and dengue virus), and antibiotic elimination of infectious filarial nematodes. The genome of a new *Wolbachia* strain (wPpe) in the plant-parasitic nematode *Pratylenchus penetrans was* sequenced and analyzed. Phylogenomic analyses placed wPpe as the earliest diverging *Wolbachia*, suggesting two evolutionary invasions into nematodes. The next branches comprised strains in sap-feeding insects, suggesting *Wolbachia* may have first evolved as a nutritional mutualist**.** (Brown *et al.,* 2016).

Bacterial endosymbionts of plant-parasitic nematodes form a relatively diverse and interesting group of organisms, some of which have shown a great potential as biological control agent. However, much research is needed before the specific interactions between these bacteria and their plant-parasitic nematodes hosts are fully understood and exploited in agriculture to manage nematode pests. The major obstacle to this goal is our current inability to culture these microorganisms *in vitro*.

References

1. Brown, M. V., Sulochana K. W, Dana K. H, Amy B. Peetz, Inga A. Z. and Dee R. Denver. (2016). Genomic evidence for plant-parasitic nematodes as the earliest Wolbachia hosts. nature. 6:34955.
2. Amanda, M.V. B. (2018). Endosymbionts of Plant-Parasitic Nematodes. Annual Review of Phytopathology. 56:225–42.
3. Atibalentja, N., Jakstys, B. P. and Noel, G. R. (2004). Life Cycle, ultrastructure, and host specificity of the North American isolate of Pasteuria that parasitizes the Soybean Cyst Nematode, Heterodera glycines. Journal of Nematology. 36(2):171–180.
4. Gregory, R. N. and Ndeme, A. (2006). 'Candidatus Paenicardinium endonii', an endosymbiont of the plant-parasitic nematode Heterodera glycines, affiliated to the phylum Bacteroidetes. International Journal of Systematics Evolution and Microbiology. 56 :1697–1702.
5. Ndeme, A and Gregory, R. N., (2008). Bacterial endosymbionts of plant-parasitic nematodes. Symbiosis. 46: 87–93.
6. Vandekerckhove. (2000) Occurrence of novel verrucomicrobial species, endosymbiotic and associated with parthenogenesis in Xiphinema americanum group species. Journal of Nematology. 50, 2197–2205.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Production and Export Analysis of Indian Fishery Sector

Article ID: 11522

G. Parthasarathi[1], S. Anandha Krishnaveni[2]
[1]Teaching Assistant (Agricultural Economics), 2Assistant Professor (Agronomy).
[1&2]Institute of Agriculture (TNAU), Kumulur.

Introduction

Fishery is a promising Sector playing an important role for development of economic ambiance in the country. The sector has exhibited string growth of about 8 per cent per year on the average with aquaculture growing at an annual average of more than 10 per cent. The sector has been showing a steady growth in the gross value-added accounts for about 7.28 per cent share of agricultural GDP. The export of marine products stood at 12.9 lakh metric tons and valued at Rs.46,662.85 crores during 2019-20. About 17 per cent of agriculture exports of our country are fish and fish products. The country has a long coastline of about 8,118 km and 2.02 million sq. km. of EEZ. The vast resources both marine and inland are indicative of immerse growth.

Objective

The objective of this study is to find out the trend of Indian fish production and export over the years.

Methodology

The data were collected from the official websites of Food and Agriculture Organization and Marine products export authority of India websites. Simple percentages and averages have been used to analyze the data.

Results

1. Indian Fish Production: India produced 24.42 lakh tonnes of fish during 1980-81, in that, 15.55 lakh tonnes and 8.87 lakh tonnes are through marine and inland production.

Table.1 Fish production in India over the decades:

S. No	Year	Marine	Inland	Total
1	1980-81	15.55	8.87	24.42
2	1989-90	22.75	14.02	36.77
3	1999-00	28.52	28.23	56.75
4	2009-10	31.04	48.94	79.98
5	2019-20	37.27	104.37	141.64

During 2019-20 it is around 141.64 lakh tonnes, in that 37.27 lakh tonnes and 104.37 tonnes through marine and inland production.

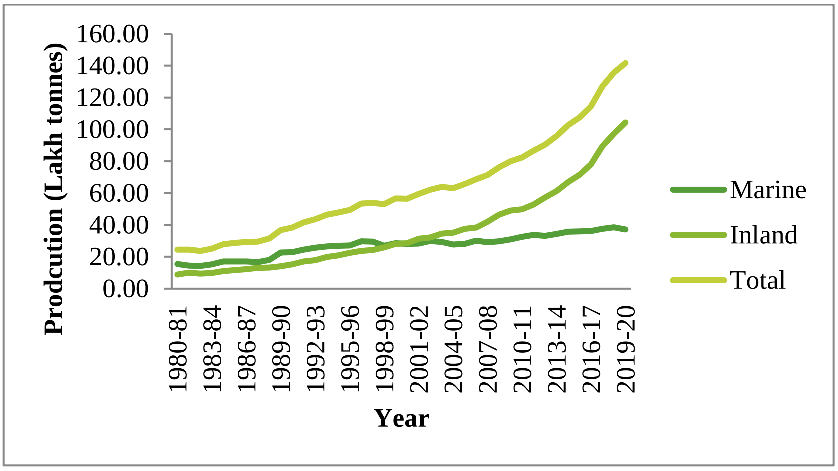


Fig.1 Trend in marine, inland and total fish production

2. Total export of fish and fish products and its value from India over the years: Fig.2 shows the trend in the export quantity of fish and fish products from India and fig.3 shows the trend in the export value of fish and fish products from India.

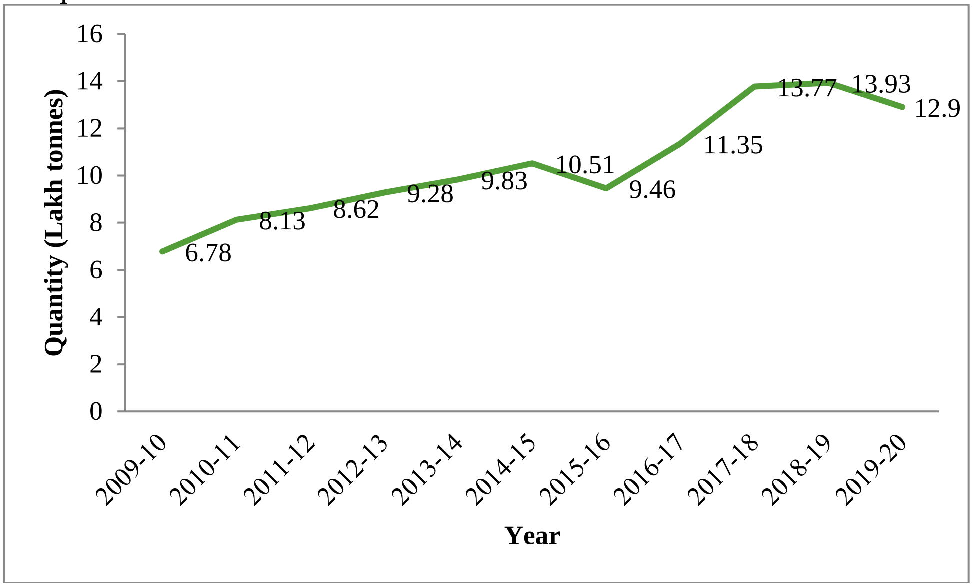


Fig.2 India's trend in export quantity of fish and fish products (lakh tonnes)

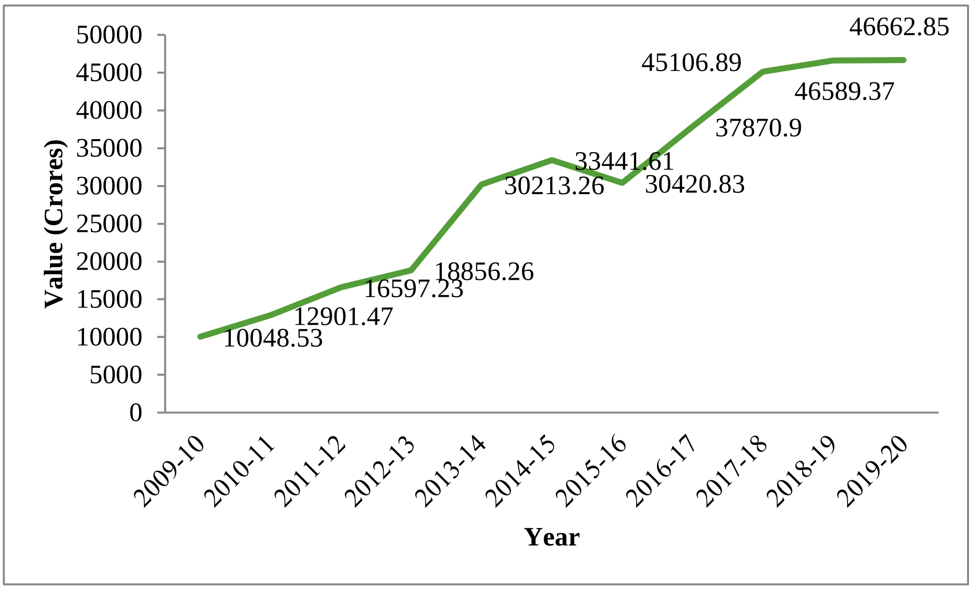


Fig.3 India trend in export of fish and fish products in value (in Crores)

Conclusion

The production and export of the fish and fish products from India is increasing. It is noticed that during the early periods i.e 1980-81 to 1990-91 the marine production was high in India, whereas after year 2000-01 the inland production was high and the marine production was stable. Indian export of fish and fish products from India shows the increasing trend over the years from 2009-10 to 2019-20. This shows that Indian fishery sector having more potential in terms of production and export. Necessary policies will increase the production, export of fish and fish products and thereby the economy will be developed.

References

1. The state of world fisheries and aquaculture sustainability in action, FAO, 2020.
2. Official website of the Marine Products Export Development Authority of India.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Nitrogen Based Nano-Fertilizers Tools for Improving Nitrogen Use Efficiency

Article ID: 11523

Rajesh Kumar[1], Vimal Kumar[2], Alesh Kumar[3], Chandra Prakash[4]
[1,2]Ph.D. Scholar, Division of Agronomy, Division of Agricultural Physics, [3&4]Environmental Sciences, Indian Agricultural Research Institute, Pusa Campus, New Delhi-110012.

World Nitrogen Use Efficiency (NUE)

Nitrogen is one of the major essential plant nutrients for crop production. India produces over 24 million tonnes of urea annually and imports a further 10m tonnes per year. Urea also forms 82 per cent of the total nitrogenous fertilisers consumed in India, with an annual consumption of 33.6 million tonnes in 2019-20. Urea is overused by farmers because of significant subsidies given by the government compared with other fertilizers. Sustained nitrogen (N) availability for low but continuous N feeding of crops is too difficult to manage manually but which is now possible using by using N-based nanofertilizers (NFs). In order to raise nutrient use efficiency (NUE) of crops which normally ranged from 30-50% but use of NFs has increased NUE by 80% (Solanki et al., 2015).

Nano-Fertilizer

They are the nano-formulated particles that can be directly supply essential plant nutrients and can be delivered at time and dose required by the crops to the rhizosphere (Subramanian and Trafdar, 2011).Due to unique physico-chemical properties they can full fill plant nutrients requirements more efficiently and eco-friendly than the conventional chemical fertilizers. During the developing the nanofertilizer (s) the evolution system should include criteria like release kinetics, crop productivity, NUE, environmental compatibility and economic feasibility.

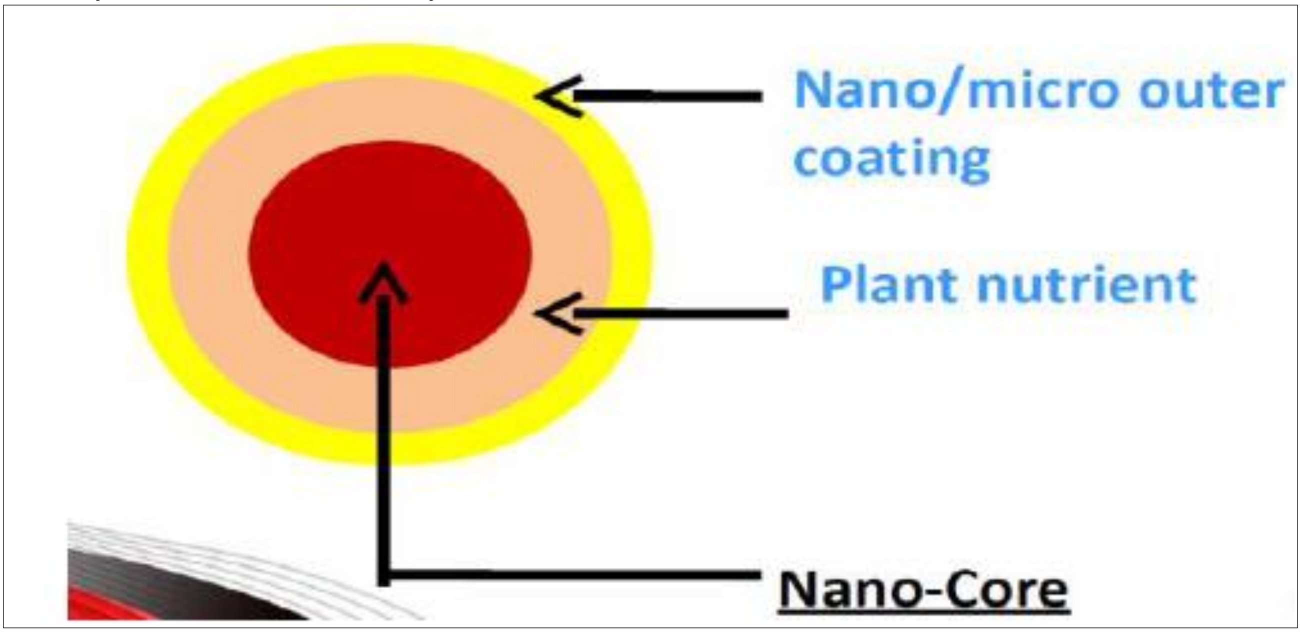


Figure 1: Showing nano-fertilizer coating (Qureshi et al., 2018).

Synthesis of Nano-Fertilizers

Nano-fertilizers are mainly synthesized by two approaches namely top-down (physical approach), bottom-up (chemical approach) and biological. And most commonly used approach is top-down approach (physical approach). In this approach, the adsorbents or substrates such as zeolite, montmorlionite, hydrogels etc. used as carrier for synthesis of nano-fertilizes.

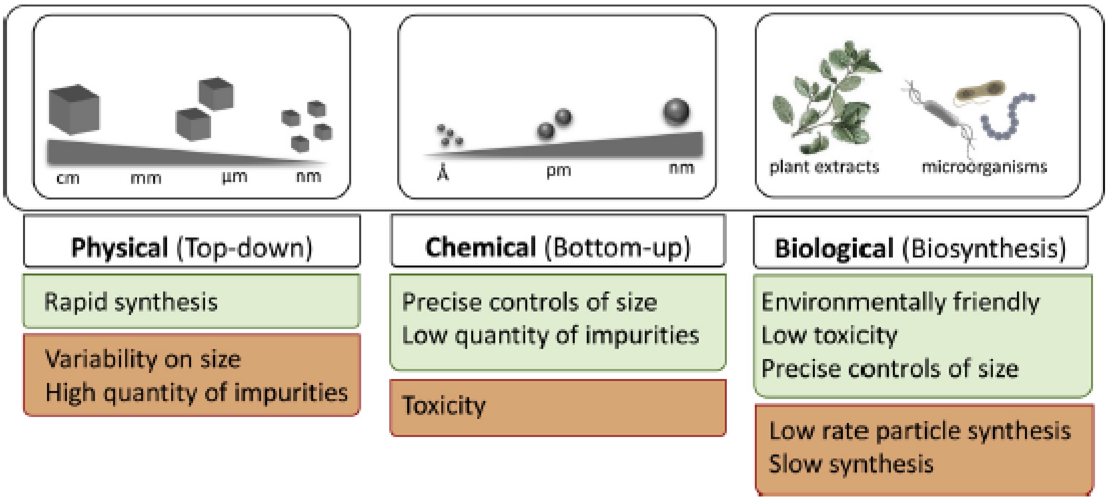


Figure 2: Methods for the synthesis of in order from left to right Physical, Chemical and Biological approached for production of NFs (Zulfiqar et al., 2019).

Type of Nano-Fertilizers

Generally, there are three types of nano-fertilizers namely nano-scale fertilizers, nanoscale additive fertilizers and nanoscale coating fertilizers.

1. Nanoscale fertilizers (They are made of nanoparticles that contain nutrients).
2. Nanoscale additive fertilizers (They are traditional fertilizers with nanoscale additives).
3. Nanoscale coating fertilizers (They are traditional fertilizers coated with nanoparticles).

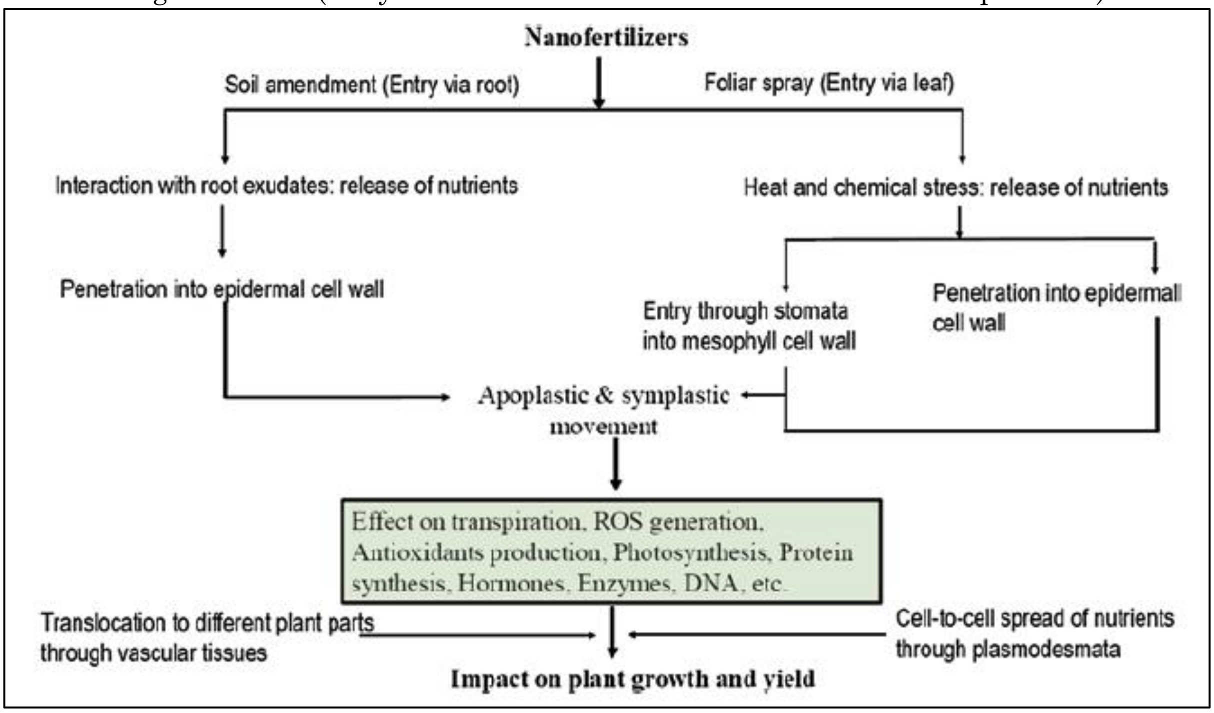


Figure 3: Mechanism of action of nutrients supplied through NFs (Iqbal et al., 2019)

Nitrogen (Urea) Based Liquid Nano-Fertilizer

Indian Farmers Fertiliser Cooperative Limited (IFFCO) has launched world's first a new nano urea (liquid) fertilizer in 2021. This new product is expected to replace the usage of urea granules, one of the most widely used fertilisers in farmlands across the world. The size of one nano urea liquid particle is 30 nanometre (nm) and compared to the conventional granular urea it has about 10,000 times more surface area to volume size. A 500-millilitre bottle of the product would be able to replace at least one 45-kilogram bag of conventional urea, and reduce urea requirements by 50%. A bottle of nano urea is priced at Rs 240 per 500 ml bottle, which is 10% lower than an equivalent bag of conventional urea. The nitrogen present in nano urea effectively meets crop requirements, and could increase yields by 8%. The nano fertilizer would be more sustainable than conventional urea for the environment, and reduce input, logistics and storage costs. Due to the ultra-small size and surface properties, the nano urea liquid gets absorbed by plants more effectively when sprayed on their leaves. In field trials, it was also found that nano urea is further set to replace conventional urea as it can curtail the requirement of the same by at least 50 per cent. According to a release from IFFCO, field trials have shown that a 500 ml bottle of nano urea can replace one bag of conventional urea as it has 40,000 ppm of nitrogen, which equivalent nitrogen nutrient is provided by one bag of conventional urea.

Source: https://www.google.com

Table 1: Synthesis, characteristics and nutrient release from nano-fertilizers/formulations:

Nutrient	Adsorbent and approach	Size (nm)	Nutrient release (hrs.)	References
Nitrogen	Zeolite (Physical)	25-30	1200	Subramanian and Sharmila Rahale (2013)
	Zeolite (Chemical)	7-10	480	Mohanraj (2013)
	Montmorillonite (Physical)	35-40	400	Subramanian and Sharmila Rahale (2013)
	Hydrogels (Chemical)	40-80	672	Liu et al. (2006)
	Hydroxyapatite nano-particles + Gliricidia sepium (Biological)	19-25	1440	Li (2003)
	Urea-liquid (Chemical)	30	-	-
	Conventional fertilizers	-	Less than 500	Rahale (2011)

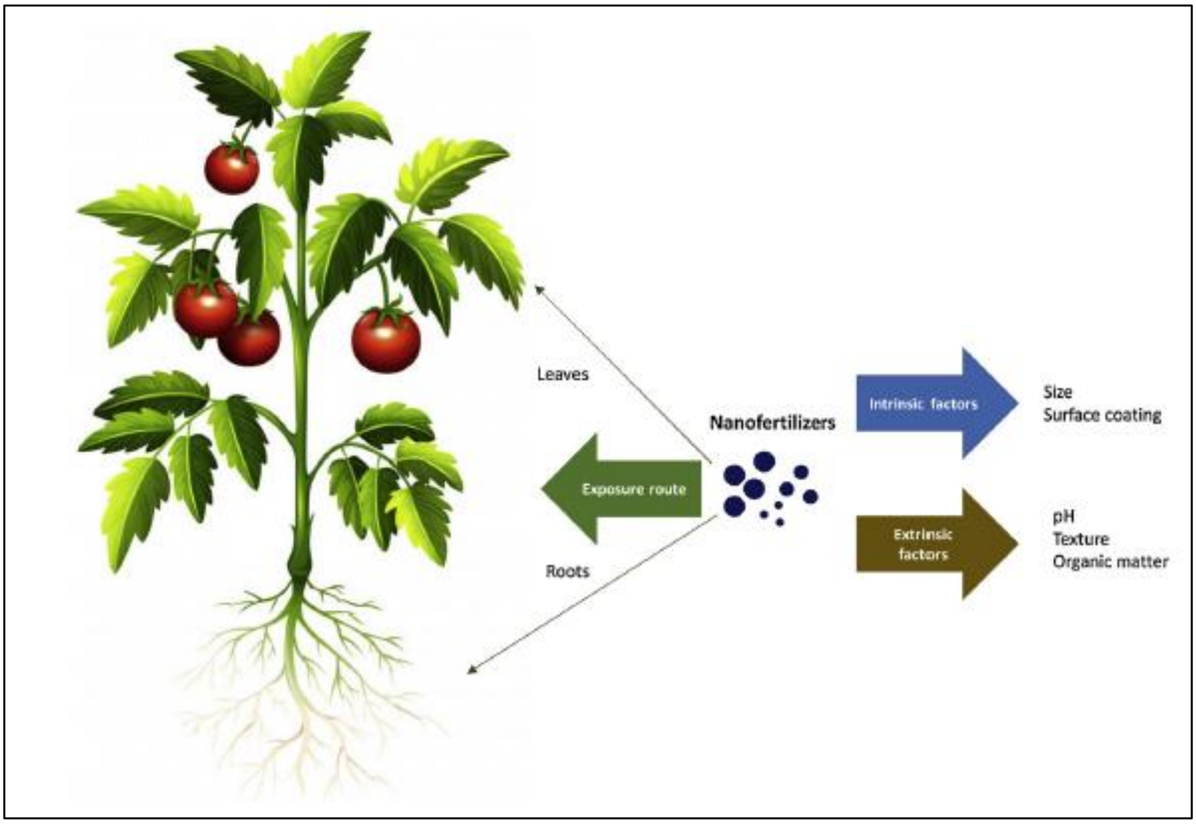


Figure 3: Factors affecting uptake, distribution and accumulation of NFs in crops (Zulfiqar et al., 2019).

Higher NUE through Nano-Fertilizers

The higher NUE could be achieved through the use of nano-fertilizers due to its following physical and chemical properties:

1. They have higher surface area which is due to its smaller particle size (less than 100 nano-meter) and which facilitates more penetration of nano-particles into the plant system. And thus, improves nutrient use efficiency of the fertilizers.
2. They are having higher solubility in various solvents such as water. They are having effective duration of nutrient release into the soil.
3. The reduced particle size results in increased specific surface area and number of particles per unit area of fertilizer which may provide opportunity for contact of nano-fertilizers and it leads to more penetration and uptake.
4. Zeolite based nano-fertilizes act as slow-release fertilizer and which increases availability of the nutrients during the active growing period of the crop plants. And prevents nutrient losses through various mechanisms like denitrification, leaching, ammonia volatilization and fixation of NH_4^+ form of nitrogen etc.

Conclusion

India is able to meet its 80% of nitrogenous fertilizer requirement urea through urea alone and remaining 20% is fulfilled through the import. The application of nitrogen-based nano-fertilizers have greater role in enhancing crop productivity by improving the nitrogen use efficiency. The IFFCO has developed world's first liquid N- based nano-fertilizer that could be a milestone in the history of development of nano-fertilizers and it might be a potential tool for reducing total amount of nitrogenous fertilizer requirement, frequency of fertilizer application and has improved or will improve the NUE in eco-friendly manner.

References

1. https://www.google.com.
2. https://www.icis.com/explore/resources/news/2021/06/01/10647019/india-s-iffco-launches-nano-fertilizer-to-reduce-urea-use-by-50.
3. Iqbal M., Umar S., Mahmooduzzafar (2019). Nanofertilization technique to enhance nutrient use efficiency and crop productivity of crop plants. Springer Nature Switzerland. doi.org/10.1007/978-3-030-05569-1-19

4. Li Z., (2003). Use of surfactant-modified zeolite to carry and slowly release sulphate. Desalin Water Treatment. 21: 73-78.
5. Liu YX., Zhao-bin F., Fu-dao Z., Shu-qing Z., Xu-sheng H.E, (2006). Preparation and testing of cementing and coating/nano-subnanocomposites of slow/controlled release fertilizer. Agriculture Science India 5: 700-706.
6. Mohanraj J., (2013). Effect of nano-zeolite on nitrogen dynamics and greenhouse gas emission in rice soil ecosystem. M. Tech. (Ag.) Thesis, TNAU, Coimbatore, India.
7. Qureshi A., Singh D.K., Dwivedi S., (2018). Nano-fertilizers: A novel way for enhancing nutrient use efficiency and crop productivity. International Journal of Current Microbiology and Applied Sciences. 7(2): 3325-3335.
8. Rahale S., (2011). Nutrient release pattern of nanofertilizer formulation. Ph.D. Thesis, Tamilnadu Agricultural University, Coimbatore.
9. Solanki P., Bhargava A., Chhipa H., Jain N., Panwar J., (2015). Nanofertilizers and their smart delivery system. In: Rai M., Ribeiro C., Mattoso L., Duran N., (Eds.) Nanotechnologies in food and agriculture. Springer, Cham, pp: 81-101.
10. Subramaniam K.S., Sharmila R., (2013). Nano-fertilizers synthesis, characterization and application. In: Adhikari T., Subba Rao (Eds) Nanotechnology in soil science and plant nutrition. New India Publishing Agency, New Delhi, India.
11. Subramanian K.S., Tarafdar J.C., (2011). Prospects of nano-technology in Indian farming. Indian Journal of Agricultural Sciences. 81: 887-893.
12. Zulfiqar F., Navarro M., Ashraf M., Akram N.A., Munne-Bosch S., (2019). Nanofertilizer use for sustainable agriculture: Advantages and limitations. Plant Science. 289: 110-270.

Foreign Direct Investment in India: A General Look

Article ID: 11524

Miss Nikita Inaniya[1]

[1]PhD Research Scholar, Department of Agricultural Economics, Swami Keshwanand Rajasthan agricultural University, Bikaner- 334006, Annual membership number:AM-AFM1609.

Foreign Direct Investment

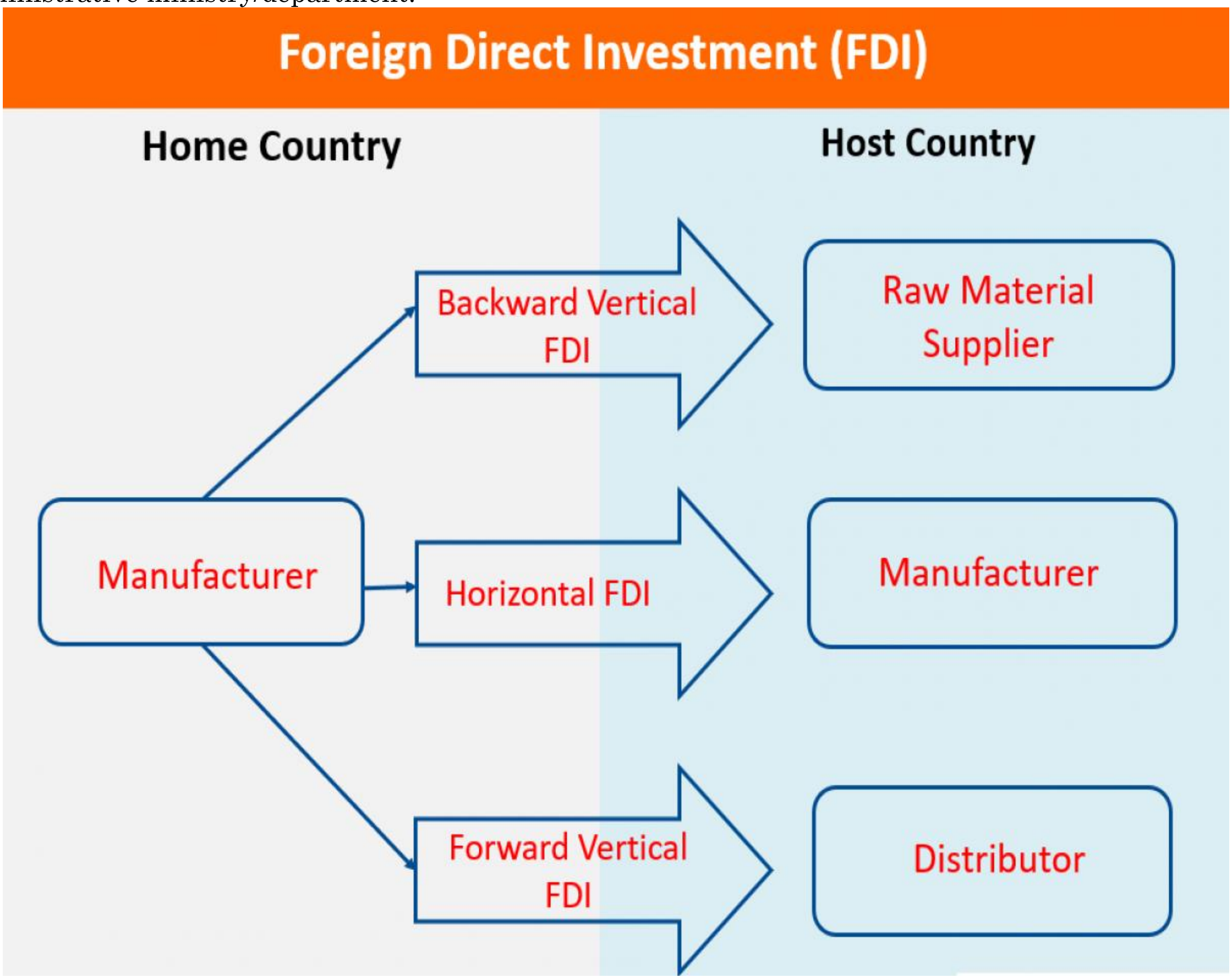
1. A foreign direct investment (FDI) is an investment made by a firm or individual in one country into business interests located in another country.

2. "Foreign investment was introduced in 1991 under Foreign Exchange Management Act (FEMA), driven by then finance minister Manmohan Singh."

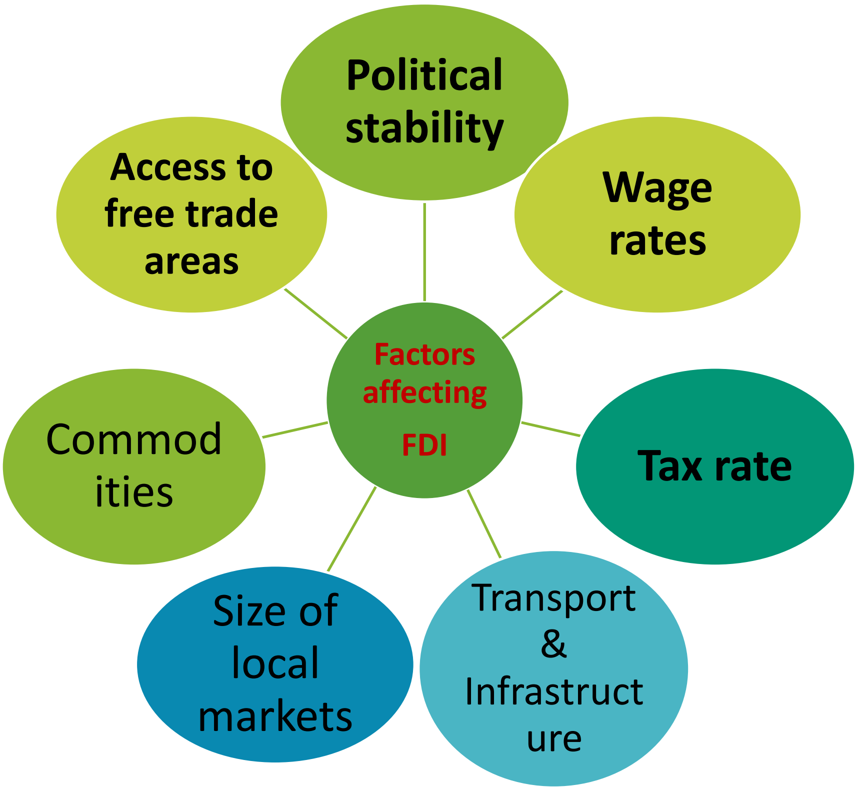
Routes of FDI

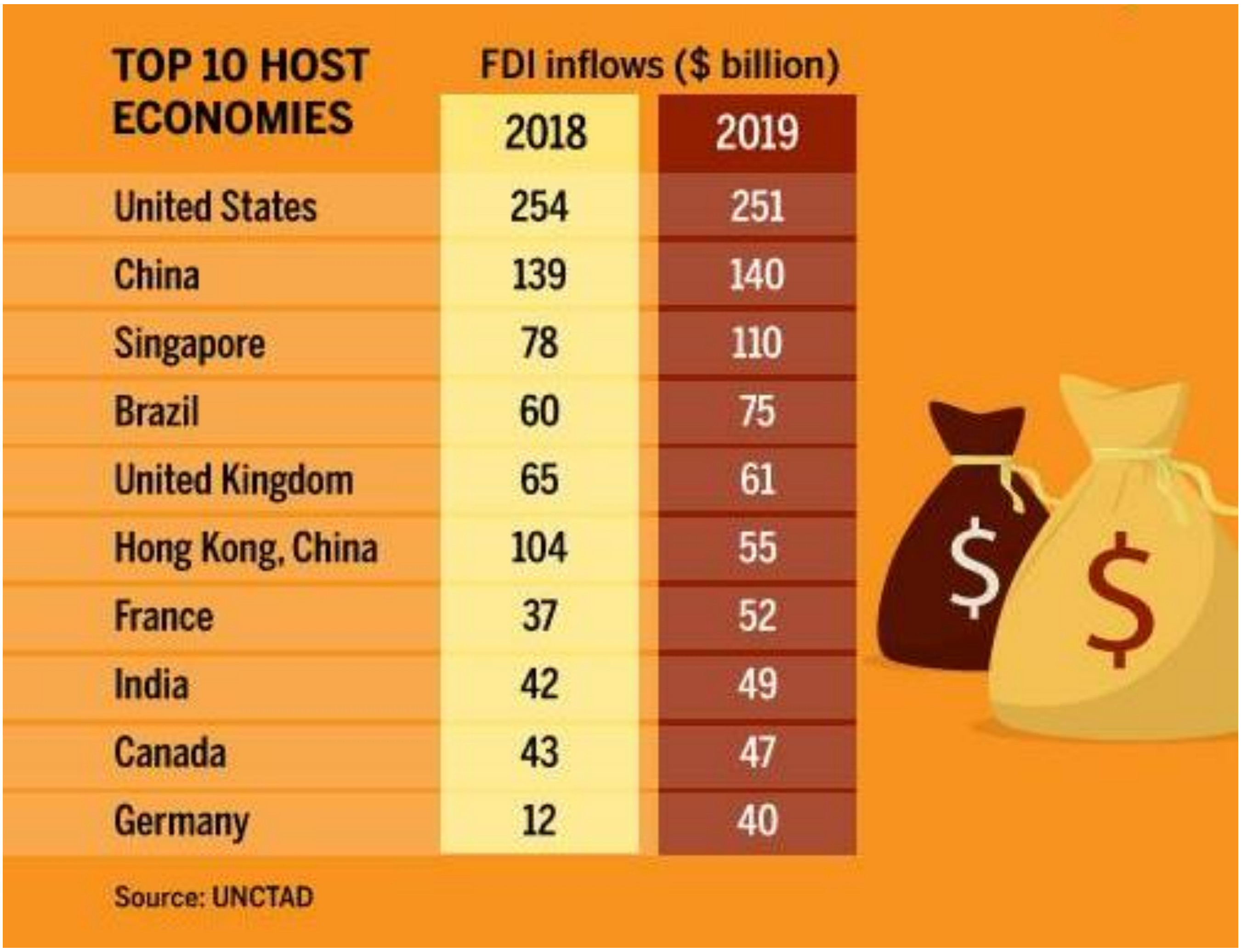
1. Automatic route: Under the automatic route, the non-resident or Indian company does not require any approval from GoI.

2. Government route: Under this route, approval from the GoI is required prior to the investment; proposals for the foreign investment under the government route are considered by the respective administrative ministry/department.



E-ISSN: 2581 - 8317





TOP 10 HOST ECONOMIES	FDI inflows ($ billion) 2018	2019
United States	254	251
China	139	140
Singapore	78	110
Brazil	60	75
United Kingdom	65	61
Hong Kong, China	104	55
France	37	52
India	42	49
Canada	43	47
Germany	12	40

Source: UNCTAD

Top 5 Countries that Making Big in India

S.No.	Country Name	Companies
1.	United States	Amazon, Citibank, Coca-Cola, Ford India, Google, American Express, Pepsico, Hewlett Packard, IBM, JP Morgan Chase, Adobe Systems Incorporated, Apple Inc., Microsoft Corporation, Cognizant, Oracle.
2.	Japan	Suzuki, Honda, Sony and Panasonic, Hitachi, Mitsubishi, Toshiba, Canon, Toyota, Yamaha
3.	UAE	Emaar, DP World, Abu Dhabi's National Petroleum Construction Company, Abu Dhabi National Energy Company, Drake and Scull International
4.	Germany	BMW, Volkswagen, SAP, Siemens AG, and Merck
5.	France	Renault, L'Oreal, Safran, Pernod Ricard.

Mushroom Cultivation: Earn More from Less

Article ID: 11525

K. Srilekha[1], T. Kamalaja[2], Islavath Suresh Naik[3]
[1]Ph.D. scholar, Department of Food Science and Nutrition, University of Agricultural Sciences Dharwad.
[2]Senior Scientist, AICRP, Foods and Nutrition Department, Professor Jayashankar, Telangana State Agricultural University.
[3]Ph.D. scholar, Department of Seed Science and Technology, University of Agricultural Sciences Dharwad.

Introduction

Mushrooms are considered as FOOD OF GODS and are consumed for ages. Mushrooms gained popularity due to their good nutritional profile and potential health benefits. Consumption of mushrooms helps in lowering blood sugar and fat levels. Mushrooms are also valued for their ability to protect against cancer. Apart from being a source of health benefits, mushroom production can become a source of livelihood or strengthen the livelihood of the rural, urban or peri-urban community by providing income in a short period. Undertaking mushroom cultivation at a small-scale level does not require high capital investment as mushrooms can be grown in temporary sheds and substrate can be prepared from agricultural waste, thus in a way mushroom cultivation helps in reusing agricultural waste with a productive outcome. Short-term training, demonstrations on mushroom production would help in acquiring skill, expertise among all sections of the population.

Apart from wild mushrooms, cultivated mushrooms gained popularity in the recent past throughout the world, there are about 200 genera of mushrooms that are useful for mankind out of which 12 varieties are mostly grown either for food or medicinal use. Different mushrooms require different temperatures for growth. Out of all, oyster mushrooms can be grown with minimal changes in the room environment as they have grown well at normal room temperature. Basic steps in the Cultivation of any mushroom include seed material and media preparation, sowing of mushroom, maintenance of crop, and harvesting. As preparation of seed is difficult to farmers usually mushroom seeds are procured from any legal sellers or through government-aided programs.

Steps Involved in the Cultivation of Oyster Mushrooms in Detail

Materials required: Paddy straw, Seeds, Polythene bag, Basins/cooks, water sprinklers, formalin solution, plastic threads, or wires are the material required for mushroom cultivation. Firstly, two days before cultivation, the room needs to be washed with water and cleansed with a solution containing a pinch of formalin solution in a glass of water. Next straw should be chopped into 3-4 inches length and then soaked in water overnight. Then soaked paddy should be boiled in water for half an hour to one hour and water should be completely squeezed out from the straw. Next, a handful of mushroom seeds should be transferred into a polythene bag and needs to be covered with a previously prepared straw up to a length of 3 ½ to 5 ½ inches, the process of putting seed and straw layer by layer is repeated until 3 inches space is free at the top of the polythene bag. Then after the mouth of the bag should be tied with threads or wires and around 5 to 6 small holes are to be made on the bag. Now, these bags should be placed on shelves or ropes tied between two sticks. To maintain humidity water should be sprinkled at regular intervals or wet gunny bags should be hanged over windows. At around twenty days bag should be opened and kept open. Then, after 4-5days mushrooms start growing from the holes. Finally, after 1-2 days the first crop of mushroom can be harvested, packed, and used fresh. After 12- 14 days the second crop can be harvested, final harvest can be made at around 40 to 45 days from sowing. Thus, mushroom cultivation provides returns within a short period. Around 100grams of seed provides half a kilogram of mushroom.

Maintenance

Maintaining hygienic conditions during mushroom cultivation is very much important. Diseases of mushrooms can be controlled by removing infected parts or applying insecticides according to the guidelines given in Integrated Pest Management available from the National Sustainable Agriculture Information Service (ATTRA) and FAO.

Handling and careful packaging of mushrooms play an important role as mushrooms are highly perishable. Harvested mushrooms should be packed in containers, baskets such that air circulation is possible. To prevent wastage, mushrooms can be harvested whenever there is a need and necessity. Orders can be taken by using social media like what's app or SMS such that mushrooms can be harvested and delivered without delay.

A good understanding of the method of cultivation, maintaining good communication with raw material providers, buyers and maintaining transparency in prices play an important role in the successful maintaining of mushroom enterprises. Low capital investment, easy availability of raw material, high market demand, and chances to collaborate with community groups are possible strengths for mushroom cultivation. Selection of suitable mushrooms for cultivation, careful monitoring throughout cultivation, misassumption of poisonous mushrooms in the community may become potential threats if not studied and understood carefully.

Conclusion

Thus, mushroom cultivation could become a potentially sustainable livelihood option, as challenges faced by mushroom cultivation activities are not uncommon to challenges faced by small-scale rural producers. As a strategy to diversify livelihood options mushroom cultivation has huge potential to improve food security and income generation, which in turn can contribute to rural and peri-urban economic growth.

References

1. Valverde M.E., Perez T.H. and Lopez O.P., (2014). Edible Mushrooms: Improving Human Health and Promoting Quality Life. International Journal of Microbiology. 2015: 1-14.
2. Singhal S., Rasane P., Kaur S., Garba U., Singh J., Raj N and Gupta N., (2019). Mushroom Cultivation, Processing and Value-added Products: A Patent Based Review. Recent Patents on Food, Nutrition & Agriculture. 10: 3-19.
3. Jawahar G., (2015). Development and popularization of value-added products from selected medicinal mushrooms. Ph.D. thesis. Karunya University, Coimbatore Tamilnadu.

E-ISSN: 2581 - 8317

Importance of Production of Quality Milk by Our Farmers: Need of Hour

Article ID: 11526

Ishtiyak A Mir[1], Malik Raies Ul Islam[2], Ajaz A Ganie[3], Manzoor Ahmad Yatoo[4]
[1]Scientist, Krishi Vigyan Kendra Anantnag.
[2]Krishi Vigyan Kendra Pulwama 192301 J&K.
[3]Scientist Krishi Vigyan Kendra Srinagar.
[4]Assistant Professor FOA Wadoora SKUAST Kashmir.

The importance of dairy industry in India has become an important segment of food industry with the increasing vegetarian population. The import of milk products due to liberalization of Indian economy has necessitated the production of quality milk by our farmers. The objective of clean milk can be achieved by practical application of science-based system such as Hazard Analysis Critical Control Point (HACCP).

Not only it should produce quantum milk, but must also be free from debris, microbes and must remain so, till it is consumed. Raw milk quickly becomes sour when it is stored for long periods at high ambient temperatures prevalent in tropical and subtropical countries.

This is because; the inherent lactic acid bacteria and contaminating microorganisms from milk vessels or the environment break down the lactose in milk to lactic acid. When sufficient lactic acid has accumulated, the milk becomes sour and coagulates. Raw milk that contains too much lactic acid, even if it does not appear to be curdled, will coagulate when heated. This acidity is known as "developed acidity" and such milk is not acceptable for sale.

Nature of Milk

Normal whole milk contains a balanced proportion of milk fat (4 per cent), lactose (4.8 per cent), proteins (3.5 per cent), minerals (0.7 per cent), vitamins and other minor constituents such as enzymes and hormones. The pH of normal raw milk is about neutral (pH 6.7) with a corresponding titratable acidity of 0.16-0.17 per cent due to the natural buffering capacity of milk proteins and salts. Wholesome milk should contain only a few bacteria and no extraneous matter, if it has been produced hygienically.

Factors Affecting Clean Milk Production

Depending on how milk is handled during and after milking, the natural composition and physico-chemical properties of raw milk may change.

1. Effect of milking practices: Incomplete milking results in low milk yield and low-fat content because the last milk (strippings) contains more fat than the foremilk.

2. Stage of lactation: Immediately after calving, a cow produces colostrum during the first four days, after which the milk reverts to its normal composition. Colostrum is also more alkaline (pH 6.8–6.9) than normal milk.

3. Effect of mastitis: On farms practicing good husbandry, 20 to 30 per cent of lactating cows have one or more quarters infected with sub-clinical mastitis. With poor hygiene, up to 70–80 per cent of the cows may be affected. The composition of mastitis milk approaches that of blood. It has more whey proteins, less casein and less water-soluble vitamins. It also tends to be more alkaline, has a higher chloride content than normal milk, and tastes salty like the milk of very old cows (more than six lactations) or milk of cows in late lactation (near drying off).

4. Effect of feeding: Cows have to be fed properly. If cows are fed a diet low in forages and high in starch, the butterfat content of the milk may fall below 2.5 per cent. A good forage-to-concentrate ratio is important to enable cows produce good quality milk to their potential.

5. Effect of cold storage: On cooling milk, the multiplication of bacteria delays, except for a few cold-tolerant bacteria (psychrotrophs) which can even grow at refrigeration temperatures. If milk is kept chilled at 4°C for more than 72 hours, the cold-tolerant bacteria will multiply and produce lipase and protease enzymes that, respectively, break down milk fat and proteins. These enzymes are also heat resistant, and can cause spoilage of pasteurised milk and other processed dairy products. Extended cooling also makes calcium in the milk less soluble and unavailable during coagulation of milk by rennet in cheese making.

6. Effect of heating: Pasteurisation of milk involves heating it to 63°C for 30 minutes or 72°C for 15 seconds in order to destroy harmful microorganisms. Pasteurisation kills more than 90 per cent of bacteria and causes minor denaturation of proteins and loss of some water-soluble vitamins.

7. Effect of treatment of cows with antibiotics: When cows suffer from mastitis, they are treated with antibiotics by intramammary or intramuscular injection. The antibiotics circulate in the blood and are secreted in the milk for up to 72 hours. Longer acting (slow release) antibiotics, such as are used in dry cow therapy against mastitis, remain in the blood longer. Drug residues in milk are undesirable because they can trigger allergies and drug resistance in humans, and inhibit the lactic acid starter cultures used in the manufacture of fermented milk products. For this reason, milk processors routinely screen raw milk for antibiotic.

Strategies for Clean Milk Production

The first step to clean milk production should be education and training of milk producers on hygiene, housekeeping, sanitation, milking methods and good animal husbandry practices.

1. Awareness and training: Educational aids and programmes should be organized for the farmers for making them aware of the importance of clean milk production. This should be in the form of charts/posters displayed at village, society and milk collection centres. Make them aware of the correct handling of the milk from udder to reception dock, maintenance of hygienic environment, clean utensils to availability of milk cooling bulk tanks and coolers.

2. Feeding practices: The feeds and fodder of the animals should not introduce directly or indirectly microbiological or chemical contaminants in the milk in amounts that is unacceptable to health. Feed fodder and silage should be procured from a reliable source and should be stored properly.

3. Housing management: The shed should be comfortable and clean with suitable arrangement to dispose dung, urine, feed and fodder residues. There should be proper supply of clean drinking water and electricity. The shed should be washed before milking. Sanitation and Disinfection of the Animal Houses:

a. Cleaning and sanitation are complementary. By sanitation we adopt hygienic measures aiming at creating conducive to health of animals and assuring product quality.
b. The measures include proper cleaning of habituation, adequate drainage system, adequate lighting of building and sheds, proper ventilation and proper disinfection measures.
c. It involves cleaning of bedding material like sawdust, paddy, straw etc. once daily.
d. Watering and feeding material to be thoroughly cleaned.
e. In case of mud floor, a top of 12-15 cm soil is removed and replaced with clean soil.
f. Cleaning and washing of milk parlors.
g. Sloped drains having width of 6-12 inches and 2-inch depth. It should maintain a proper gradient of 1 in 60 for easy flow of drain water.
h. Provide adequate lighting
i. Provide proper ventilation
j. Disinfect the houses by washing the houses with boiling water, flame blower or by using suitable disinfectants such as formaldehyde, phenols, cresols, washing soda, quick lime, bleaching powder etc.
k. The hygiene and sanitation process practiced in a dairy herd can not only keep the animal and surrounding healthy but will also find its way for export of milk and milk products thereby, enhancing the efficiency of livestock and its productivity, survivability and longevity.

4. Handling of milking vessels: The milking vessel should be made of stainless steel. It should be cleaned before and after milking with hot water and certified detergents/chemicals. It should have small mouth. The milker should wear clean clothes and maintain personal hygiene. He should wash his hands before milking and should not spit or smoke. Shaving the hair of the hind legs and tail should be carried out routinely. Also, the fore milk should be discarded in a proper place.

5. Udder Hygiene:

a. Effective milking practice is one important criterion in order to produce safe and suitable milk; failure of which may introduce contamination of milk. From an ethological perspective, the cow rests in a lying position, which inevitably leads to contact of the udder skin with filth on the bedding surface. As much as 1 x 1010 of total microorganisms can be found in one gram of filth from the udder surface.

b. With unsuitable udder hygiene, the microorganisms present on the teat skin can contaminate the milk during milking or through the teat tip will penetrate the teat canal increasing the possibility of mastitis. Hence it is necessary to implement hygienic-prophylactic measures in maintaining cleanliness and udder health before and after milking of dairy herds, with the aid of disinfecting agents.

c. There are many procedures for udder hygiene prior to milking such as:

d. Washing by spraying water and wiping of teats

f. Washing of teats with a cloth immersed in warm disinfectant solution and drying with a dry cloth

g. Immersing of teats in disinfectant and wiping with a paper cloth.

h. Appropriate hygiene, such as dry cleaning, is necessary for lowering teat contamination whereas only the substantially soiled udders require washing with water. Therefore, if the udder is not substantially soiled, the teats should be immersed in active foam disinfectant and wiped with disposable paper cloths after 1-2 minutes.

i. Disinfection prior to milking by immersing teats in a special cup, containing active foam based on surface active compounds, organic acids and hydrogen peroxide, and disinfection after milking by immersing teats in the agent containing 1.94% linear dodecyl-benzene sulphonic acid (LDBS) and skin care substances.

j. The implementation of udder hygiene after milking is a very rational method for maintaining acceptable udder health status, and is conducted by immersing teats in a disinfecting agent. This procedure removes the milk droplets that are left behind which can serve as a breeding ground for surrounding pathogenic microorganisms. Subsequent drying of the disinfectant creates a thin layer over the teat orifice, mechanically preventing the incursion of microorganisms through the teat canal.

k. The benefits are manifested through a decrease in post secretory milk contamination, reduction of udder infections by so-called environmental microbes, and by a decrease in the number of subclinical mastitis.

l. Nowadays, the priority in conducting udder hygiene is given to ecologically acceptable disinfecting agents that are not harmful to animals and the environment.

6. Health management: Good animal husbandry practices including regular monitoring of disease such as mastitis should be a part of the routine work. During milking, using teat dips, and washing of udder should be an ongoing activity of the dairy farm. Sick animal shed should be far away from the milking barn and separated from the healthy ones. The healthy animals must be milked first. Improper use of veterinary drugs should be avoided.

7. Milk collection and transportation: There should be a provision of bulk cooling tanks in order to reduce the bacteriological load in the milk immediately after collection. Introducing differential pricing system based on bacteriological quality of milk will help in overall improvement of milk quality reaching the dairy dock. Other prerequisites for clean milk production include hygienic norms, good animal husbandry practices and proper handling, storage and transportation of milk are important elements to produce quality milk. The lids of the milk cans should fit tightly preventing from entry of rain and dust. The cans should be stored in an inverted condition on stand. Excessive agitation while transportation should be avoided. When milk is agitated, the milk fat is destabilised which becomes easily oxidised. The milk tanker should have proper insulation. The number of spoilage bacteria in raw milk depends on the level of hygiene during milking and the cleanliness of the vessels used for storing and transporting the milk. During the first 2–3 hours after milking, raw milk is protected from spoilage by inherent natural antibacterial substances that inhibit the growth of spoilage bacteria. However, if the milk is not cooled, these antibacterial substances break down causing bacteria to multiply rapidly. Cooling milk to less than

10°C may prevent spoilage for up to three days. High storage temperatures result in faster microbial growth and hence faster milk spoilage.

Milk Borne Infections: An Emerging Public Health Issue

It is important the way milk is handled subsequently after milking which affects the quality of raw milk reaching the dairy dock. Milk has the potential to cause food borne illness. Raw milk is also known to be associated with pathogenic bacteria which cause milk-borne diseases such as tuberculosis, brucellosis or typhoid fever, etc. Hygienic milk production, proper handling and storage of milk, and appropriate heat treatment can reduce or eliminate pathogens in milk. In many countries, milk processing factories are required by law to pasteurize milk before selling it to the public. Many consumers also routinely boil milk before drinking it to protect themselves from milk-borne diseases. Processed milk must be handled hygienically to avoid post-processing contamination. So, whether one is selling milk directly to consumers or to a processing factory, it must be handled hygienically so that it remains fresh and capable of being heated without curdling. Hygienic milk handling includes using clean equipment, maintaining a clean milking environment, observing good personal hygiene and preserving the quality of milk during storage and transportation to the consumer or processing plant.

Conclusion

Village entrepreneurship is the main stay for bringing India as number one milk producer in the world. As a result, there is limited scope for mechanizing milking procedures but does not mean that India cannot produce clean milk. By launching vigorous campaign, clean milk can be produced by good animal Husbandry practices in villages, small farms with the help of Dairy Development Boards, different Cooperative Dairy Federations etc.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Major Insects of Banana and their Management

Article ID: 11527

Ram Prawesh Prasad[1]
[1]Scientist Plant Protection, KVK Jale, Darbhnga (Dr.RPCAU, Pusa, Samastipur) Bihar-847302.

Introduction

Banana (*Musa* sp.) is the second most important fruit crop in India next to mango. Banana is a rich source of carbohydrate and is rich in vitamins particularly vitamin B. It is also a good source of potassium, phosphorus, calcium and magnesium. The fruit is easy to digest, free from fat and cholesterol. Banana powder is used as the first baby food. It helps in reducing risk of heart diseases when used regularly and is recommended for patients suffering from high blood pressure, arthritis, ulcer, gastroenteritis and kidney disorders Its year-round availability, affordability, varietal range, taste, nutritive and medicinal value makes it the favourite fruit among all classes of people. It has also good export potential .Banana is a very popular fruit due to its low price and high nutritive value. It is consumed in fresh or cooked form both as ripe and raw fruit. Processed products, such as chips, banana puree, jam, jelly, juice, wine and halwa can be made from the fruit. The tender stem, which bears the inflorescence is extracted by removing the leaf sheaths of the harvested pseudo stem and used as vegetable. Plantains or cooking bananas are rich in starch and have a chemical composition similar to that of potato. Banana fibre is used to make items like bags, pots and wall hangers. Rope and good quality paper can be prepared from banana waste. Banana leaves are used as healthy and hygienic eating plates. Banana has occupied a top position in India's booming fruit industry with an annual production of 13.5 MT from an area of 4.0 lakh ha (Sathiamoorthy et al., 2000).

Rhizome or Corm Weevil

Adult is a stout, reddish brown weevil. Eggs are elongated oval in shape, laid singly in small burrows. Weevils scrape out on the root stock or within leaf sheaths just above the ground level. Grub is stout, fleshy, highly wrinkled, apodous and creamy white with reddish head. It pupates within a chamber made near the outer surface of rhizome. Pupa is whitish in colour. Grub bores into rhizome and tunnels within it. Adult also tunnels within stem feeding on its internal tissues. Central shoot is killed. Plants show pre-mature withering, leaves become scarce, fruits become undersized and suckers are killed outright.

IPM Practices

1. Use insect free planting material and get it from reliable source. For healthy sucker and plant use tissue culture pant and do clean cultivation.
2. Cover the exposed portion of the cut rhizome by a layer of earth to prevent entry of weevils. Dried old leaves must be removed to allow the detection of early symptoms of weevil infestation and to increase the efficacy of chemical application.
3. Do not take regular crop in the same field to avoid initial infestation.
4. Removal of pseudo stems below ground level. Banana stumps kept in the field after harvest must be removed and destroyed as they serve as weevil refuges and breeding sites.
5. Avoid Robusta, Karpooruvally, Malbhog, Champa and Adukkar. Grow less susceptible varieties like Poovan, Kadali, Kunnan, and Poomkalli.
6. Mass trapping of adult weevil can be done using pheromone trapping system in which cosmolure and metalure @5/ha are be used.
7. Cut banana plant at the ground level and cover the cut portion with soil.
8. Dry the suckers under direct sun light before planting for 3 to 4 days and dip it in cow dung and ash.
9. Hot water treatment of banana rhizomes at 550 C for 5 to 10 minutes.
10. At the time of planting in incorporate the carbofuran 3 G 10 gm or Phorate 10G 5 gm per pit and mix thoroughly or clean and trim suckers before planting. In case of severe infestation spray 0.03% or dimethoate 30% EC or 0.06% fenitrothion.

Pseudostem Weevil

Infestation normally starts in 5-month-old plants which lay eggs in the slits cut on the leaf sheath. Immediate after hatching the grubs feed on leaf sheath and then bore inside the pseudo stem. Early symptoms of the infestation are the presence of small pinhead-sized holes on the stem, fibrous extrusions from bases of leaf petioles, adult weevils and exudation of a gummy substance from the holes on the pseudo stem. Rotting occurs due to secondary infection of pathogens and a foul odour is emitted and in the true stem. The pest breeds throughout the year but it is more active during summer and monsoon seasons.

IPM Pactices

1. Select healthy rhizomes for planting and monitor the field.
2. Proper disposal off the banana plant after harvesting.
3. Prepare trap for attracting adult by making 10 cm round pieces from the pseudo stem of banana. Use two pieces and put small stones between two pieces so that adult can easily enter in between them, 8 to 10 traps are recommended per hectare.
4. Spray chlorpyriphos @ 0.05 per cent for killing attracted adults.
5. For chemical control, inject chlorpyriphos @ 0.05 per cent in the stem with the help of syringe or spraying of chlorpyriphos @ 0.05 % or spark 0.036 % or Neemazal 1 % at monthly interval starting from the age of 6 months.
6. Remove dried leaves periodically and keep the field clean.
7. Prune the side suckers every month.
8. Do not dump infested materials into manure pit.
9. Uproot infested trees, chop into pieces and burn.
10. Application of Phorate or carbofuran @ 5 to 10 gram per plant in the pit prepared for planting.

Burrowing Nematode

Nematode cause extensive root necrosis resulting in serious economic consequences viz. fertilizers are not effectively utilized; the period from planting to harvesting is lengthened; maximum bunch weight is not attained; the quality of fruit is impoverished and fields have to be replanted every 2 to 3 years because of drastic reduction in plant numbers. The burrowing nematode, Radopholus similes is the most important pest. The disease of bananas caused by the burrowing nematode is known by different names, the most common of which are rhizome root, root rot, black head, toppling disease and decline.

IPM Practices

1. To avoid introducing inoculums of nematode into a new plantation, banana sets may be disinfected.
2. The removal of infected tissue along with some of the surroundings healthy tissue would normally disinfect sets. Dip the sets in mud slurry (made by mixing 40 litres of clay in 50 litres of water) and sprinkle with 1.2 g a.i. carbofuran per set. The sets can be dried in shade and used for planting. The pared sets can also be disinfected by dipping them in a hot water bath at 550 C for 10 min.

Thrips

Flower Thrips: Thrips hawaiiensis Morgan and Banana rust thrips *Chaetanaphothrips signipennis* Bagnall (Thripidae: Thysanoptera). Adults and nymphs are found on lower surface of leaves. Eggs are laid in leaf tissues. They also damage peels of fruits forming greyish powdery blotches and brown eruptions. Circular rusty-red patches appear on affected fruits. Cracking of the skin or sometimes splitting of the fruit. Leaves develop yellow patches and wither if infestation is severe.

IPM Practices

1. Destroy all volunteer plants and old neglected plantations and use healthy and pest free suckers for planting.
2. Bunch covers –protects at early stage. Checking of fruit under the bunch covers is essential to ensure that damage is not started.
3. Bunches, pseudostem and the suckers should be sprayed with Chlorpyriphos and if need be soil application fipronil or bifenthrin may be done.
4. Field release of predators like lacewings, ladybird beetles may be done.

5. For controlling thrips infesting flowers and small fruits, spraying of Imidachlopyride 17.8 SL 0.03 % or quinalphos @ 0.05 %. After spraying of insecticide cover polyethylene bag on the bunch and removal of unfertile flowers.

Banana Aphid

The banana aphid is a significant pest of banana and acts as vector for virus causing banana bunchy top virus (Hu et al., 1996; Elayabalan et al., 2015) and cucumber mosaic virus. Aphid excretion of 'honeydew' provides a nutritional and physical substrate for sooty mold fungi, which may diminish Integrated Pest Management in Banana 335 fruit quality and physically block photosynthesis. Banana aphid populations are often tended by ant species.

IPM Practices

1. Rouge out virus affected plants before spraying.
2. Use disease free, healthy, suckers or rhizomes or planting materials for commercial production. Follow clean cultural practices and maintain sanitation in the orchard. In case of post planting infestation, spray 0.06 per cent dimethoate or 0.05 per cent methyloxydemeton on seedling.

Conclusion

The suitable Pest management options that could be Integrated to improve the productivity and reduce the present gap between potential and realized yield of banana crop.

References

1. Sathiamoorthy, S., Uma, S. and Selvarajan, R. 2000. Banana research and development programme in India and highlights of NRCB-INIBAP collaborative projects. Pp. 67-76. In: Advancing banana and plantain R & D in Asia and the Pacific - Vol. 10, Proceedings of the 10th INIBAPASPNET Regional Advisory Committee meeting held at Bangkok, Thailand, 10-11 November, 2000.
2. Witzgall, P., Kirsch, P. and Cork, A. 2010. Sex pheromones and their impact on pest management. Journal of Chemical Ecology, 36: 80-100.
3. Hu, J. S., M. Wang, D. Sether, W. Xie and K. W. Leonhardt. 1996. Use of polymerase chain reaction (PCR) to study transmission of banana bunchy top virus by the banana aphid (Pentalonia nigronervosa). Ann. Appl. Biol. 128:55-64.

Role of miRNA and siRNA in Abiotic Stress

Article ID: 11528

Ritika Yadav[1]

[1]Ph.D. Scholar, Department of Plant Physiology, Govind Ballabh Pant University of Agriculture and Technology Pantnagar.

Summary

Short interfering RNAs (miRNA and siRNA) are the non-coding sequences of RNA which can help plants in mitigating abiotic stress as well as pathogen attack. Plants use RNA silencing machinery to promote ETI (effector triggered immunity) and PTI (pathogen associated triggered immunity) in order to combat microorganism invasion and increase resistance.

Small RNA machinery makes use of protein complexes like DICER which is an endonuclease that act as a portal for gene silencing, AGO (ARGONAUT) that is helicase with RNA motif and HEN (HUA ENHANCER) for stabilizing the processed small dsRNAs and ultimately associates with RISC (RNA inducing silencing complex) for repressing or silencing the expression of gene.

Hence understanding the regulation of gene expression by short interfering RNAs will enable researchers to investigate the role of small RNA in abiotic stress tolerance, as well as the possibility of molding small RNAs to promote plant growth and development.

Introduction

For plants to complete their life cycle, several environmental conditions such as CO2, light, water availability, temperature, and nutrients are critical. A minor rise or decrease in the threshold value of these elements, on the other hand, will cause stress and have an impact on the production of a commercially important crop.

Plants remodulate their expression of genes for osmotic adjustment, up regulate antioxidant pathways for ROS (reactive oxygen species) production, and limit or restore damage to cellular constituents such as DNA, proteins, and membranes in response to abiotic stress.

Moreover, gene expression and proteomic analyses specified dramatic changes in expression of several hundreds or even thousands of genes during stress and such alterations were thought to be reliant on transcriptional (induction or suppression of genes) or post-translational regulation (protein stability and degradation). miRNA expression profiling also reveals that miRNAs which are involved in the progression of plant growth and development are differentially expressed during abiotic stress responses.

Drought Stress

Rain-fed Agriculture is the most widely practiced form of agriculture in the world, and recurrent dry spells are usual in such situations. Numerous genes that are expressed during drought stress have been identified using high-throughput technologies such as proteomics and genomics. It was recently shown that miRNA expression is also expressed in responses to drought stress.

In Arabidopsis, the up-regulation of miR393, miR319 and miR397 in response to dehydration has been reported. Similarly, miR393 expression has also been found to be up-regulated during drought stress in rice. More comprehensive array-based analysis indicated that several other miRNAs (miR157, miR167, miR168, miR171, miR408, miR393 and miR396) were also up-regulated in drought-stressed Arabidopsis. During drought stress, the expression levels of miR1446a-e, miR1444a, miR1447, and miR1450 were dramatically reduced, and the expression levels of miR1711-a, miR482.2, miR530a, miR827, miR1445, and miR1448 were modestly down-regulated in *Populus trichocarpa*.

In *Medicago truncatula*, miR398 and miR408 were up-regulated during water stress. miR2118 in Phaseolus vulgaris was highly induced under drought, NaCl and ABA treatments whereas miR159.2, miR393 and miR1514 were moderately up-regulated in response to drought and ABA.

Salt Stress

About 6% of the total cultivated land is affected by excess salt concentration in the soil. Limited salt stress condition decreases crop yield while severe salt stress threatens the survival of crop plants. Various pathways and genes in plants are regulated differently under increased salt concentration.

Expression of various micro-RNA in Arabidopsis such as miR165, miR167, miR168, miR319, miR159, miR394 was up regulated under salt stress. In *P trichocarpa*, miR530a, miR1445, miR1446a-e, miR1447 and miR171l-n were down-regulated, whereas miR482.2 and miR1450 were up-regulated during salt stress.

Interestingly, two members of the miR169 family, miR169 g and miR169n, were strongly up-regulated in rice. Similarly, Arabidopsis miR169 was also up-regulated in response to salt stress. Salt stress decreased the expression of miR398 and this negatively correlated with the expression of its target genes, Cu/Zn superoxide dismutase 1 (CSD1) and CSD2 in Arabidopsis.

Oxidative Stress: Suppresses miR398 Expression

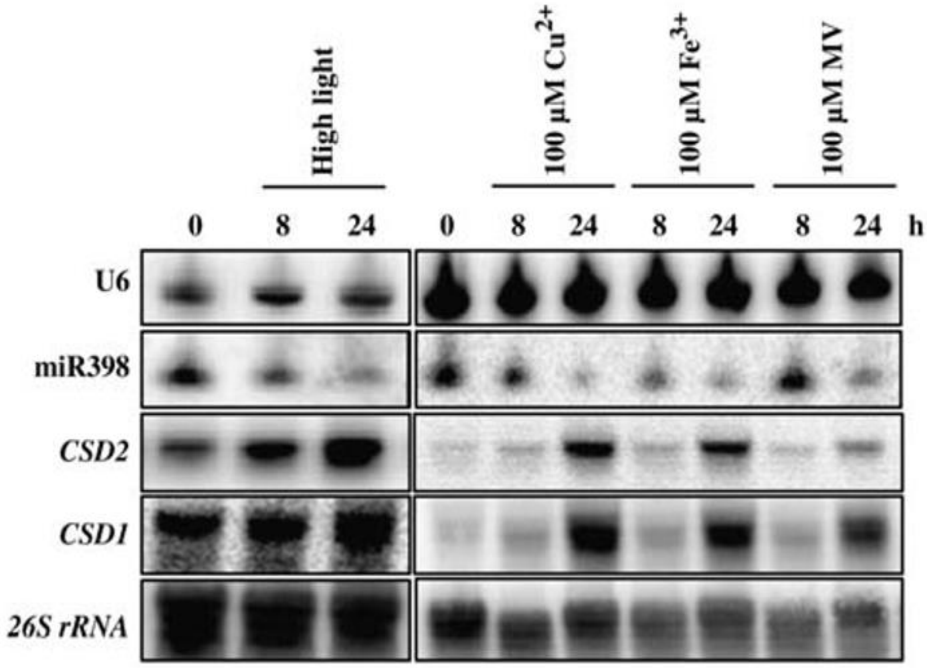


Fig.1. miR398, CSD1, andCSD2 in response to high light, Cu^{2+}, Fe^{3+}, and MV treatment

Each lane contained 10 mg (miR398 analysis or CSD1 and CSD2 analysis) of total RNA isolated from 15-d-old wild-type seedlings either transferred to high light (800 mmol m^{-2} s^{-1}) or sprayed with 100 mM Cu^{2+} or 100 mM Fe^{3+}, and seedlings were harvested after 8 and 24 h of treatment.

The CSD1 and CSD2 transcripts are known to be induced by oxidative stress although the mechanism of this induction is unknown. Two-week-old wild-type seedlings grown under regular intensity light were exposed to high light for 8 or 24 h. The miR398 level was down regulated at 8 h, and the signal decreased further with longer treatment. To further test miR398 regulation by oxidative stress, miR398 expression was studied in seedlings exposed to Cu^{2+}, Fe^{3+} and methyl viologen (MV).

Heavy metals, such as Cu^{2+} and Fe3+, are involved in Fenton-type reactions and have a potential to generate hydroxyl radicals. RNA gel blot analysis showed that miR398 expression was decreased after 8 h of the stress treatment, and the levels were greatly reduced after 24 h of treatment (Figure 1).

Oxidative Stress–Induced CSD1 and CSD2 Expression is Posttranscriptional

The results indicate that the stress induced CSD1 and CSD2 mRNA is possibly caused by the suppression of miR398 expression and hence a decrease in miR398-guided CSD1 and CSD2 mRNA cleavage. Results also showed that CSD1 and CSD2 mRNA accumulation in response to oxidative stresses is a result of decreased miR398-guided posttranscriptional regulation rather than increased transcription.

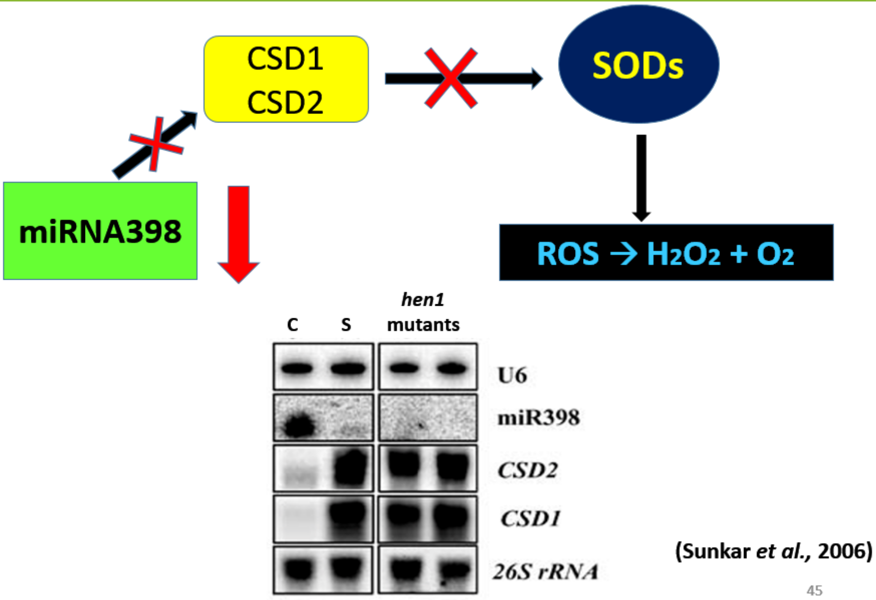


Figure 2. Downregulation of miRNA398 during oxidative stress hence scavenging ROS

Water Stress

Loss of water as well as excess of water causes stress on plants. The loss of water or drought stress induces morphological and physiological changes in plants. At the same time submergence or water excess causes anaerobic conditions around plants. Plants regulate the expression of various genes at transcriptional and post-transcriptional level in response to such stress however plants undergo various morphological, physiological and metabolic alterations to adapt against water stress. Recently, genome profiling of drought stressed rice revealed drought-responsive miRNAs. It has led to the identification of 30 miRNA families, either up-regulated or down-regulated significantly during drought. Detailed analysis has revealed that eight miRNAs from 30 families were up-regulated (miR395, miR474, miR845, miR851, miR854, miR901, miR903 and miR1125) and 11 miRNAs were down-regulated (miR170, miR172, miR397, miR408, miR529, miR896, miR1030, miR1035, miR1050, miR1088 and miR1126).

Conclusion

Current agricultural technology needs more and more molecular tools to reduce current crop loss and feed extra mouths, which according to a recent estimate by the FAO (Food and Agriculture Organization) will increase by two billion over the next 30 years. The RNAi technology, described in this article, describes one such powerful innovation. If judiciously used, this technology may go a long way to narrow the gap through production of disease-, insect- and virus resistant, nutritionally rich and toxic-free crops. The cost effectiveness is always a big question, whenever a new technology is developed. In fact, it becomes a stumbing block for a resource-poor developing country to adopt a new technology, if it is to buy the patent from a multinational company at prohibitive price.

Fortunately, the situation in case of RNAi technology is different. Hopefully, the technology that has been developed by the scientists from developed countries will be available to any lab including those in the developing countries, where work utilizing RNAi technology is either in progress or going to be launched shortly. The technology is well developed and can be applied directly to evolve a crop resistant to stresses caused by virus, bacteria, fungi, insects or natural disasters.

References

1. Sunkar R., Kapoor A. and Zhu J. K. 2006. Posttranscriptional Induction of Two Cu/Zn Superoxide Dismutase Genes in Arabidopsis Is Mediated by Downregulation of miR398 and Important for Oxidative Stress Tolerance. The Plant Cell 18: 2050-2065.
2. Guleria P., Mahajan M., Bhardwaj J. and Yadav S. K. 2011. Plant small RNAs: biogenesis, mode of action and their roles in abiotic stresses. Genomics Proteomics and Bioinformatics 9: 183-199
3. Arenas H. C., Perez B., Rabanal F., Blanco M. D., De la Rosa C., Estrada N. G. 2009. Conserved and novel miRNAs in the legume Phaseolus vulgaris in response to stress. Plant Molecular Biology 70: 385-401.

Medicinal Significance of Insects

Article ID: 11529

Sharayu Prakash Patil[1]
[1]Ph.D. Agril. Entomology, MPKV, Rahuri (M.S.).

Abstract

Insects and insect secretions have been used in the treatment of certain diseases of human beings from a very long time. Insect derived medicinal products are used in many parts of the world. Scientist are trying to rediscover more natural products which has medicinal significance. Some natural products have tendency to cure major diseases such as bacterial infections, HIV and cancer.

Introduction

Insects and insect products have been used to produce folk medicine around the world since the beginning of human civilization. The use of insect derived products as an alternative medicinal source is an exciting and rapidly expanding new field since insects are hugely variable and have a high biodiversity index. Insect products such as silk and honey have already been utilized for a thousand years in folk medicines, but nowadays with the development of modern molecular bio-techniques has it become possible to manipulate and use of insect natural products into medicine. The immunological, antibacterial, anti- inflammatory and anti-cancer properties in the body of insect are now well recognized. On that basis scientists are doing research on insect derived medicinal substances for their further uses.

Medicinal Uses of Different Insects

1. Honeybee: Honey bee products such as honey, bee wax, propolis, royal jelly, bee venom and bee pollen have long been used in traditional medicines.

a. Honey: Honey is derived from honey bee that has been used to treat excessive scar tissue, rashes and burns. It is also consumed to treat cold, cough, throat infections, tuberculosis and lung diseases.

b. Bee wax: When honey is mixed with bee wax and olive oil makes an antibacterial combination. It has been now used in several skin disorders.

c. Propolis: Propolis is a resinous mixture that honey bees produce by mixing plant sap with their own discharge and bee wax . It is often consumed by menopausal women because of its high hormone content, and it is said to have antibiotic, anaesthetic and anti-inflammatory properties.

d. Royal jelly: Royal jelly is a honey bee secretion that is used in the nutrition of larvae and adult queen. It is used to treat anaemia, gastrointestinal ulcers and hypertension.

e. Bee venom: Bee venom can be applied via direct stings to relieve arthritis, rheumatism, polyneuritis and asthma. Also, it destroys HIV virus.

f. Bee pollen: Bee pollen is eaten as a generally health restorative and is said to treat both internal and external infections.

Bee venom used in medicinal capsules

2. Maggot therapy: Maggot therapy is the intentional introduction of live, disinfected blow fly maggots into soft tissue wounds to selectively clean out the necrotic tissue. This help to prevent infection; it also speeds healing of chronically infected wounds and ulcers. Maggot therapy includes three processes which are as follows:

a. Debridement or wound healing.
b. Wound disinfection.
c. Wound healing.

3. Blister beetle: Blister beetle secrets a defensive substance known as cantharidin. Due to anticancer properties of cantharidin and its derivatives are used for the treatment of a range of cancers including hepatic, colorectal, bladder, breast, melanomas, pancreatic, and leukemia. Also, it is a strong urinogenital irritant and is used as an aphrodisiac.

4. Termite: Different species of termites are used to treat various diseases that affect human's health. For e.g., Microkeratomes exiguous used for asthma, bronchitis, influenza, whooping cough, flu. Nasturtiums macrocephalus is used to treat asthma, leakage, bronchitis, 'catarrh in the chest' coughs, influenza, sore throat, sinusitis and tonsillitis.

5. Silk worm: Silkworm used as a bioreactor for production of low-cost vaccine against infectious diseases of human beings. Silkworm larval dry powder can also be used for control of diabetes.

6. Grasshopper: Dried powder of grasshopper is mixed with water and ash, that paste is applied on forehead to treat headache.

7. Blood feeding insects: Many blood feeding insects like ticks, houseflies and mosquitoes inject multiple bioactive compounds into their prey. These insects have been used by practitioners to prevent blood clot formation or thrombosis.

Table1: Some other insects as a medicine in human culture:

Common name	Scientific name	Disease treated
House fly	*Musca domestica*	Eye cysts, baldness
Cicada	*Huechys sanguinea*	Migrane headache, ear infection
Red velvet mite	*Trobidium grandissium*	Malaria, paralysis
Mud wasp	*Synagris spp.*	provide lime to fetus
Stingless bee	*Trigona spinipes*	Cough, achne

Conclusion

Some natural products which are derived from insects and their chemical secretions can be used in medical drugs with enormous potential. The emergence of this new aspect will open up new views in the study of development of medical drugs for human disease.

References

1. Chakravorty, J.; Ghosh, S.; Meyer-Rochow, V.B. (2011). Practices of entomophagy and entomotherapy by members of the Nyishi and Galo tribes, two ethnic groups of the state of Arunachal Pradesh (North-East India). Journal of Ethnobiology and Ethnomedicine. 7: 5.
2. Feng, Y.; Zhao, M.; He, Z.; Chen, Z.; Sun, L. (2009).Research and utilization of medicinal insects in China. Entomological Research. 39 (5):313–316.
3. Ramos-Elorduy; de Concini, J.; Moreno, J.M. Pino (1988). The utilization of insects in the empirical medicine of ancient Mexicans. Journal of Ethnobiology. 8 (2): 195–202.
4. Shriram H. Bairagi (2019). Insect with potential significance: Review. Biomedical journal of scientific and technical research. 16 (3).
5. Srivastava, S.K.; Babu, N.; Pandey, H. (2009). Traditional insect bioprospecting--As human food and medicine. Indian Journal of Traditional Knowledge. 8 (4): 485–494.
6. Sun, Xinjuan; Jiang, Kechun; Chen, Jingan; Wu, Liang; Lu, Hui; Wang, Aiping; Wang, Jianming (2014). A systematic review of maggot debridement therapy for chronically infected wounds and ulcers. International Journal of Infectious Diseases. 25: 32–7.
7. Yang, X., Hu, K., Yan, G., et al., 2000. Fibrinogenolytic components in Tabanid, an ingredient in traditional Chinese medicine and their properties. J. Southwest Agric. Univ. 22, 173-176 (Chinese).

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Phosphorus as an Important Nutrient for Crops

Article ID: 11530

Sanjay Kumar Singh[1]

[1]Tirhut College of Agriculture, Dholi, Muzaffarpur, Dr. Rajendra Prasad Central, Agricultural University, Pusa, Samastipur.

Introduction

Phosphorus is the second fertilizer element which is an essential constituent of every living cell and for the nutrition of plant and animals. It found is less abundant in soils than N and K however, it has a significant role in sustaining and building up agriculture.

Phosphorus is indispensable plant nutrient and no plant on this planet earth can complete life cycle without adequate supply of P. The total P-content in Indian soils ranges from 100 to 2000 ppm. The total P in soil consists of inorganic P and organic P-forms. The inorganic phosphorus bound to aluminium (Al-P), iron (Fe-P) and calcium (Ca-P) constitutes the active form of inorganic phosphorus.

Among these forms, Al-P and Fe-P are more abundant in acid soils and Ca-P dominants in neutral-alkaline soils. The Al-P and Fe-P fractions are the major contributors to plant available P under most situations. Soils are known to vary widely in their capacities to supply Phosphorus to crops because only a small fraction (<1- 3%) of the total Phosphorus in any soil is in a form that is available to plants.

When water soluble fertilizer P applied to soil readily dissolves and increases P in soil solution, it maintaining solution P concentration for adequate P nutrition depends on the ability of labile P to replace soil solution P taken up by the plant.

Table 1. Phosphorus scenario in Indian soil:

Form of phosphorus	All India (%)	Arid Region (%)
Plant available form	>1 – 3	0.8 – 1.6
Unavailable inorganic form	15 – 79	75 – 79
Organic form	18 – 90	18 – 22

Function of Phosphorus in Plant

1. The most essential function of phosphorus is in energy storage and transfer.
2. Adenosine di-and triphosphates (ADP and ATP) act as "energy currency" within plants.
3. Phosphorus is an essential element of deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).
4. Phosphorus stimulates root development and growth in seedling stage to establish the seedling quickly.
5. It encourages the better growth of shoots and roots.
6. It also stimulates the flowering, fruit setting and seed formation and developments of roots.

Phosphorus Deficiency in Plant

1. The most common visual symptoms include overall stunted of the plant and darker coloration of leaves.
2. Purple leaf coloration is commonly associated with phosphorus deficiency in corn and other grasses.
3. Root and shoot growth is restricted and plant become thin and spindly.
4. Potato tubers show rusty brown lession.

		
P-deficiency in maize	**P-deficiency in cauliflower**	**P-deficiency in tomato**

Table 2: Phosphorus content in selected animal wastes:

Animal	Total P	Inorganic P
............% dry matter		
Swine	1.5-2.5	0.8-2.0
Beef cattle	0.7-1.2	0.5-0.8
Dairy cattle	0.5-1.2	0.3-1.0
Poultry	0.9-2.2	0.3-1.2
Horses	0.4-1.4	0.2-0.8

Table 3: Phosphatic fertilizers: Source of Phosphorus:

Name of fertilizer	Chemical composition	Percentage of P_2O_5	Acidity or Alkalinity
Single superphosphate	$Ca (H_2PO_4). 2H_2O$	16.0-20.0	Neutral
Double superphosphate	$2Ca (H_2PO_4). 2 H_2O$	30.0-35.0	Neutral
Triple superphosphate	$3Ca (H_2PO_4). 2 H_2O$	45.0-50.0	Neutral or acidic
Basic slag	$(CaO)_3P_2O_5SiO_2$	3.0-8.-	Alkalinity
Dicalcium Phosphate	$CaHPO_4$	35.0-40.0	Acidic
Rock Phosphate	$Ca3(PO_4)_2CaF_2$	23.0-24.0	
Boanmeal	$Ca(PO_4)_3CaF_2$	20.0-25.0	Alkalinity

How to Exploit Native Unavailable Phosphorus

The advantage of phosphorus is may not loss from the system; therefore, it has every possibility for exploitation. Native P can be mobilized:

1. To increase the activity of phosphatase and phytase in the soil through efficient microorganisms or plant species.
2. To inoculate P mobilizing bacteria.
3. To increase organic acid concentration in the soil through efficient plant and microorganisms.
4. To take help of mycorrhizal fungi.
5. To introduce nano-nutrients.

Mobilization of Organic Phosphorus

The soils having high organic matter content generally have high Phosphorus. The organic phosphorus compounds can be generally classified into three groups, namely,(i) the inositol phosphates, the major constituent with inositol and pentasphophates, primarily of plant origin, comprising up to 60% of soil organic P; (ii) the nucleic acids; and (iii) the phospholipids.

In general, 18-90% of total P in all agricultural soils is present in organic form. Organic P is generally higher in clay soils than in course-textured soils, but lower than in humus soils (Dalal, 1978). Plants may utilize organic P after the hydrolysis of C-O-P bond by phosphatses and phytase. The efficiency of hydrolysis of different organic P compounds of different fungi varied from 2.12-4.85 mg min^{-1} g^{-1} for glycerophosphate to 0.92-2.10 mg $min^{-1}g^{-1}$ fungal mat for phytin (Yadav and Tarafdar, 2003). Phosphate dissolving microorganisms play an important role to release plant available inorganic phosphate into soil from unavailable inorganic P (Ca-P, Fe-P, AI-P) through secretion of organic acids.

Many fungi and bacteria *viz.* Aspergillus, Penicillium, Bacillus, Pseudomonas are potential solubulizer to bound phosphorus (Subba Rao, 1977). The influence of inoculation of phosphate solubilizing bacteria (*Pseudomonus striata and Bacillus Polymyxa*) was studied under arid field condition. The establishment of phosphobacteria varied among the genotypes. In general, 64% increase in the population of P. *striata* and 71 % increase in population of B. *ploymyxa* was observed in the rhizosphere at critical growth stages of pearl millet. The organic acids (lactic, formic, citric, malic) also involved on the mobilization of native phosphorus in plant available form (Gharu and Tarafdar, 2004). Arbuscular mycorrhizal fungi can transport inorganic phosphorus to plants both from organic and inorganic sources. It has been found that under field condition with the application of P mobilizers including AM fungi the available P status in the bulk soil never exceeds 5% of the total P as well as the applied P use efficiency does not exceed 20%.

Nanotechnology intervention may enhance the P use efficiency, more enzyme release for P mobilization 80-100 times less requirement for the crop and possible to mobilize > 10% phosphours in plant available form. Nano-particles can enter through different plant parts *viz.,* cuticle, stomata, hydathodes, stigma, root tips, cortex, lateral root junctions, *etc.* and traverse the cell wall before entering the intact plant cell protoplast. During their movement they may trigger many enzyme systems for higher secretion through roots and insisting plants to be more active to nutrient mobilization in the rhizosphere. Application of 10 ppm nano-Zn and 30 ppm nano – Fe can enhance the phosphatases and phytase release by plants up to 70%.They also enhance the release of P mobilizing enzymes up to 2.5-fold.

Conclusion

It is important to utilize and recycled native P for plant nutrition both to reduce the cost of production and sustain the mineral reserves for longer period.

References

1. Dala, R.C (1978). Organic phosphorus, Advances in Agronomy, 27, 83-117.
2. Gharu, A. And Tarafdar, J. C. (2004). Influence of organic acids on mobilization of organic and inorganic phosphorus in soil. Journal of Indian Society of Soil Science, 52, 248-253.
3. Subba Rao, N. S. (1977). Soil micro-organisms & plant growth. Oxford & IBH Publishing CO; New Delhi.
4. Yadav, R.S. and Tarfdar, J. C. (2003). Phytase nad Phosphatase producing fungi in arid & semi-arid soils & their efficiency in hydrolyzing different organic P. Soil Biology and Biochemistry, 35, 745-751.

Rural Development through Agro-Based Entrepreneurship: A Study of Farmers in Uttar Pradesh

Article ID: 11531

Shailendra Kumar Singh[1], Anand Singh[1], Sachin Pratap Tomar[1]
[1]Krishi Vigyan Kendra-II, Sitapur, Uttar Pradesh-261145.

Abstract

Rural entrepreneurs are a key figure in the economic progress of a developing country like India. Rural entrepreneurship is the way to transform a developing country into a developed nation. Rural entrepreneurship is the answer to alleviating rural poverty in India. Therefore, more emphasis should be given on integrated rural development programmes.

Indian economy is basically an agrarian economy; it can serve as a platform for agricultural entrepreneurship, food processing and other allied activities. At the time of independence in 1947, agriculture contributed more than half of the national income. In the first five-year plan, emphasis has been laid on agricultural development.

Also, the strategies of Green Revolution adopted during 1960s have contributed a lot in making India self-reliant in food production. With the advent of the New Economic Policy adopted since 1991, the scenario has changed significantly.

Agriculture is the main driver of economic development in Uttar Pradesh. The state has a paramount role in the food production, processing and food security of the country. The state ranks number 1 in terms of production of wheat, sugarcane, maize, vegetables, potatoes and livestock products including milk, sugar and rice.

There are some potential areas for agro-processing in the state such as:
1. Jute production in Sitapur, which has also been included in the ODOP scheme by the Government of Uttar Pradesh.
2. Lac at Firozabad. Manufacture of bangles from production.
3. Fruits and vegetables in the western region.
4. Perfume business from flowers in Kannauj.
5. Carpet manufacturing in Bhadohi region.

Thus, rural entrepreneurship has been recognized as an important factor for the survival of industries in a changing global economy. Farmers need knowledge about primary agricultural techniques and methods of production, harvesting, processing, wholesale and retail sales, financial services, transportation, packaging, promotional and advisory services. The research paper identifies and analyzes the economic and social perspective which works as a barrier in the development of entrepreneurial skills in the farming sector of Uttar Pradesh and studying the implications of the Pieter de Wolf and Hermann model.

Keywords: Agripreneurship skills, management skills, farmers and socio-economic aspect.

Introduction

An agricultural entrepreneur can start agribusiness, change the direction of business, get business or indulge in innovative activity of value addition. Poor farmers have failed in agriculture, but agricultural entrepreneurs are becoming very successful by doing business in agriculture export sectors due to:
1. Agriculture is selective, whereas the art of agricultural entrepreneurship is productive.
2. Agriculture is gradual, whereas the art of agricultural entrepreneurship can leapfrog.
3. Agriculture works only when there is a direction in which to proceed, whereas the art of agricultural entrepreneurship moves to generate direction.
4. Agriculture requires every step to be perfect, whereas this need not be the case with the art of agriculture.
5. Agriculture has definite categories, classifications and labels whereas Art of Agriculture Entrepreneurship there are no such constraints.

Objectives of the Study

1. Understanding the challenges that act as a hindrance in the development of entrepreneurial skills in the agricultural entrepreneurship sector.
2. To study the agricultural entrepreneurship model of rural development and its importance.
3. To develop an alternative model for promoting agricultural entrepreneurship among farmers.

Scope and Challenges of Entrepreneurship in Uttar Pradesh (India)

The benefits of entrepreneurship for the society and economy as a whole are immense. They help in making the exports competitive in the Indian market and at the same time, they make the 'Made in India' brand more acceptable. The Government of Uttar Pradesh has formulated its policies to nurture and promote budding agricultural entrepreneurs. Uttar Pradesh, the land of opportunities is widely acknowledged for its multicolored culture, religion, diversity of natural resources and geographical land. Uttar Pradesh is a continuously growing state at the rate of about 6% during the last decade. Large-scale agriculture with fertile planes and diverse agro-climatic conditions, agriculture is one of the most important and important sectors of the economy of Uttar Pradesh. Uttar Pradesh is the largest producer of food grains and sugarcane in India. The major crops grown in the state are paddy, wheat, sugarcane, potato, mustard, groundnut, gram, peas and lentils. The state has immense potential for food processing industries, which have been started profitably in the state.

Significant Step in the Development of Agro-Based EDP Programme

1. Organizational support in setting up the enterprise.
2. Perspectives Identification and Placement of Self-Employees.
3. Agro Based Entrepreneurship Development Training.
4. Mobilizing various resources.
5. Follow up.
6. Selection of potential self-employed/entrepreneurs from the prospective candidates.
7. Providing assistance/guidance in preparation of project reports in the selection of product advertisements.

Why India is Promoting Agri-Entrepreneurs?

Agriculture contributes 24.2% to GDP, 15.2% of total exports and provides employment to 58.4% of country‘s work force.(Source- Economy of Uttar Pradesh).
1. Agriculture remains a major sector of the Indian economy accounting for 25 per cent of the gross domestic product (GDP) and about 13 per cent of the total export earnings.
2. The share of agriculture in the total value added to the economy, about 25 per cent, is still quite high. This implies that agriculture is likely to remain a priority for both policy makers as well as businesses in the foreseeable future, and any move to advance this sector requires a multi-pronged strategy.

Challenges/ Barriers Faced by the Agripreneurs

Lack of funds, Lack of infrastructure, Risk, Marketing problems and competition, Lack of technological dissemination, Legal formalities and regulations, Availability of resources, Lack of technical knowledge, Quality Control and low skill level among farmers etc.

Remedies to Solve these Problems

Various organizations like IFCI, ICICI, SIDBI, NABARD etc are trying to solve these problems. Marketing problems are related to distribution channels, pricing, product promotion etc. In order to inform the rural entrepreneurs about the business venture, the following measures can be adopted:
1. Establishment of finance cells.
2. Concessional rates of interest.
3. A suitable supply of raw materials.
4. Offering training facilities.
5. Setting up marketing co-operatives.

Development of an Alternative Model for Promotion Agripreneurship Among Farmers

In view of the above problems, the agribusiness sector needs customized financial services so that the service providers as well as the beneficiaries are benefitted. Some of the possible solutions that need to be explored and empirically tested are:

1. New financing instruments.
2. Bundling financial services with nonfinancial services.
3. Supportive infrastructure.
4. Issue of financial literacy.
5. Facilitating electronic payment systems.
6. Branchless banking.
7. Portable smart technology.
8. Sustainable models of providing financial service to Agripreneurs.

References

1. Chengappa, P. G., Achoth, L., Mukherjee, A., Reddy, B. M. R., Ravi, P. C. and Dega, V.,(2007) ―Evolution of food retail chains in India, in Agricultural Diversification and Smallholders in South Asia", edited by P. K. Joshi, Ashok Gulati and R. Cummings (Jr), Academic Foundation, New Delhi, pp. 385-404.
2. Harron, M. H., Shamsudin, M. N., & Latif, I. A. (2001). ―Challenges for Agribusiness: a Case for Malaysia. International Symposium on Agribusiness Management towards Strengthening Agricultural Development and Trade", 388-400. doi: ISBN 974-657-555-4
3. Punjabi, M. (2007). ―Emerging Environment for Agribusiness and Agro-industry Development in India: Key issues in the way forward‖, New Delhi: Food and Agricultural Organization of the United Nations.
4. Mehra Kavita(2002), ―Entrepreneurial spirit of the Indian farmer- National Institute of Science Technology and Development studies‖, New Delhi India-Ownership and copyright Springer –Verlag Limited, AI & Soc.(2002)16:112-118.(AI& Society).

Weed Management Approaches in Sugarcane

Article ID: 11532

Dr. Tulasi Lakshmi Thentu[1], Dr. A B M Sirisha[1], Mrs. Sk Haseena Banu[1]
[1]Agriculture Research Station - Yellamanchili, Acharya N. G. Ranga Agricultural University, AP-531005.

Weeds compete for moisture, nutrients, space and light during growing period of ratoon crop, which reduces the yield. Although weeds reduce the crop yields and they also indirectly elevate farm production costs through energy spent in controlling them. According to an estimate, collective crop losses due to weeds, insect pests and plant pathogens in 2006-07 in India is to the tune of Rs. 14 lakh million. The weeds are notorious in being responsible for major part of the losses (about 40% or so). In India, the reported cane yield losses range from 12 to 72 per cent. If weeds are not properly controlled in the initial stages, the yield loss could go upto 17.5 t/ha. Twining weeds which sprout at later stages and twine around clumps affect cane growth and cause around 25 per cent loss in yield. Bermuda grass (Cynodon dactylon) the cogan grass (Imperata cylindrica) and other graminacious weeds are known to be alternate hosts to Ratoon Stunting Disease (RSD) of sugarcane. Twining weeds like Ipomoea spp. are becoming a problem in many sugarcanes growing areas, escalating cost of cultivation besides decreasing cane yields. The twining weeds also cause serious harvesting problem. Providing a weed-free environment in sugarcane is absolutely essential to realize the full potential of a variety.

Critical Period of Crop-Weed Competition

Weeds interfere with crops at any time they are present in the crop. The period at which maximum crop weed competition occurs is called as critical period which is the shortest time span in the ontogeny of crop when weeding results in highest economic returns. As a thumb rule, first ¼ - 1/3 of the growing period in many crops is critical period. The duration of a sugarcane crop is 12-16 months. So, in cane, the initial 120 days can be considered as critical period for crop-weed competition.

Weed Management Approaches

Tillage: tillage operation is quite effective in controlling weeds through the means of ploughing, discing, harrowing and leveling which enhances the germination of weeds through soil tilling and exposure to sunlight. Tillage operations control annual as well as perennial weeds by physically damaging them on both above ground part and below ground. Blind hoeing before the sprouting of sugarcane followed by 2 to 3 manual or mechanical inter-row cultivation during tillering stage of crop growth is essential. Afterwards, the grand growth stage of the cane takes care of the weeds by smothering effect. Double pass of rotary weeder/tiller was found effective in managing the weeds in sugarcane.

Intercropping: Intercropping plays significant role in covering soil quickly and efficient utilization of resurces/input and minimize the crop-weed competition. Among intercropping systems, sugarcane + cowpea/ greengram/ blackgram can effectively reduce the weed density and dry weight of weeds as compared to sole crop up to 120 days after planting, with corresponding weed control efficiency ranges from 37 to 42%.

Trash mulching: it is highly useful in sugarcane for moisture conservation and suppression of weeds. Mulching the inter-row spaces with 5 to 10 cm thick-layer of dry leaves of sugarcane (trash) or any other organic source is quite effective. About 10 to 12 tonne of sugarcane trash per hectare is enough to provide the desired thickness of mulching. To increase the efficiency of mulching, a thorough hoeing and weeding in the field before spreading the trash on decomposition release nutrients which improve the soil health. Due to in-situ availability of trashes, mulching in ratoon is more convenient than in the plant crop. Bagasse, paddy husk, hay, straw etc. can also be used as mulching material.

Chemical method: several herbicides were found effective in controlling weeds. Pre-emergance application of atrazine, metribuzin, ametryn, sulfentrazone, flumioxazin either alone or in tank mix can effectively control the weeds for initial 35 to 45 days.

Integrated weed management: It is the integration of two or more weed control methods at low input levels for reducing weed competition below an economical threshold level in the crop. It is basically a combination of effective, dependable and workable weed management practices that can be used economically by the producers as a part of sound farm management system. Hence, to get effective control of composite weed flora in sugarcane, a logical combination of several weed control methods will certainly prove the most effective approach for season long weed management. Pre-emergence application of atrazine @ 2.0 kg/ha followed by 2, 4 D @ 1.0 kg/ha at 60 days after planting added with one hoeing at 90 days after planting provided season long weed control and highest productivity of sugarcane and monetary returns. Post-emergence application of glyphosate @ 1.0 kg a.i. at 25 days after planting + one hoeing at 60 days after planting proved to be economical compared to 3 manual hoeing at 30, 60 and 90 days after planting.

The herbicides recommended for plant cane and ratoon cane may not be suitable under sugarcane based intercropping systems. Pre-emergence application of oxyfluorfen @ 0.23 kg/ha or pendimethalin @ 0.75-1.0 kg/ha proved effective in reducing weed growth and provided highest monetary net returns in sugarcane. Similarly, pre- emergence or early post-emergence application of metribuzin @ 0.75-1.25 kg/ha could be used in sugarcane + potato inter-cropping. Post emergence application of metsulfuron @ 4-6 g/ha can be used for effectively control of weeds in sugarcane + wheat intercropping system.

Commercially Available Synthetic Growth Regulator and their Role

Article ID: 11533

Kanhaiya Lal[1], Jyostnarani Pradhan[2]

[1]Ph.D. Scholar, Department of Agronomy, PG College of Agriculture, Dr. Rajendra Prasad Central Agriculture University, Pusa, Samastipur -848125.

[2]Assistant Professor, Department of Botany, Plant Physiology and Biochemistry, Dr. Rajendra Prasad Central Agriculture University, Pusa, Samastipur -848125.

Summary

In text books there are topics related to plant growth regulators, which explains a number of physiological roles of these bio-chemicals. This article is briefly explaining mechanisms of some of the plant bio-regulators which are extensively used by our farming communities. These synthetic chemicals include several products mimicking natural hormones, for example, NAA, GA3, BAP, and CPPU. Some of them are used to improve the growth of plants in direct or indirect way, to put up with good yield and some are used to improve the quality of fruits. This article shows a clear picture of mode of action of these bio-regulators.

Introduction

Plant growth regulators (PGRs) or bio-regulators are widely used in modern-day agriculture to encourage plant growth, yield, and grain quality. These externally applied growth regulators are having both valuable as well as undesirable effects of plant growth regulators on growth and development in addition to plant metabolism has been documented here. Growers or farming communities try hard to find more effective ways to manage crop plants so that they can produce greater than before yield and quality produce. They use many methods and technologies, which include the use of synthetic chemicals to regulate plants. These man-made chemicals include several products mimicking PGRs. Some of them are used to improve the growth of plants to put up with good yield and some are used to improve characteristics of fruits mainly to improve its quality and to prevent storage disorders.

Of the many currents uses of PGRs, their effects on yield may be direct or indirect. Some of the indirect effects include:

1. In cereals they check lodging.
2. Put off pre-harvest fruit drop in many perennial fruit crops.
3. Bring maturity into line to facilitate mechanical harvest.
4. Speed up maturity to lessen turnover period.
5. Cut labour needs.

Experiments conducted on foremost grain crops, such as maize, soybean, wheat, and paddy with these PGRs have identified mechanisms capable of shifting individual agronomic characteristics like lodging, plant height, seed number, and maturity. Even so, these modifications have not constantly resulted in increased yields. In this paper, commercially available synthetic PGRs have been discussed.

Auxin as Herbicide

Common name	Trade Name
2,4-D	2,4-D, LV-4, LV6, Salvo, Savage, Weedone
Dicamba	Banvel, Clarity, Sterling Blue, Oracle, Rifle, Distinct, Status, Diablo, Vanquish
MCPA	MCPA Amine, MCPA Ester, Rhomene
Mecoprop	MCPP
Picloram	Tordon, Tordon 22K, Trooper
Fluroxypyr	Starane, Vista, Spotlight, Obtain

Auxinic herbicides, forming a large and well-known group of chemicals, targeting diverse weed spectra and wide-ranging selectivity, have been synthesized, formulated, and commercially launched. Presently, these classes consist of phenoxy carboxylic acids, benzoic acids, pyridine carboxylic acids, aromatic carboxymethyl derivatives, and quinoline carboxylic acids. Auxinic herbicides imitate the foremost auxin indole-3-acetic acid (IAA) in higher plants. However, they are abiding, particularly due to their higher constancy in the plant, and, therefore, additionally proficient than IAA. Auxinic herbicides excite a range of growth and developmental courses, while available at small concentrations at the cellular sites of action. However, through increasing concentration, auxin activity in the tissue may be assorted, growth may be disturbed and the plant can be mortally injured.

If we divide the whole instance, beginning from the application of herbicide up to the death of the weed, it can be divided into three phases. The first is named as stimulation phase, which occurs within the early hours following treatment. This very phase comprises the commencement of the metabolic course of action such as stimulation of ethylene biosynthesis through induction of 1-aminocyclopropane1-carboxylic acid (ACC) synthase in the shoot tissue (1-2 hours), subsequently symptoms of abnormal (deregulated) growth (3-4 hours), including leaf epinasty, tissue inflammation and instigation of stem curling. Here, activation within minutes of membrane ion channels and plasmalemma H+-ATPases are known to be involved in the cell elongation response. Subsequently, abscisic acid (ABA) starts accumulation, initially noticeable in the shoot tissue after 5-8 hours. The next segment, which occurs within 24 hours, consists of reserved growth of the root and shoot, with the diminished rate of internode elongation and leaf area, and deepened green leaf pigmentation. Concurrently, stomatal closure comes about collaterally by bargained transpiration, carbon assimilation and starch formation, and over-production of reactive oxygen species (ROS) are observed. The third and last segment is the senescence phase and tissue decay, which is characterized by hastened foliar senescence with faster chloroplast degradation and progressive chlorosis, and by the damage of membrane and vascular system integrity, leading to wilting, necrosis and finally to plant death.

Thidiazuron

Thidiazuron is a type of diphenyl urea cytokininthat can non-competingly hold back cytokinin oxidase activity. It supports cytokinin effects while externally treated to plants. Plants, in addition, produce inactive conjugates of kinin such as ribosides, ribotides, and glucose derivatives. It has the exceptional property of coping not only cytokinin but also properties on the development and differentiation of cultured explants, even though structurally it is diverse from both auxins and purine-based cytokinin.

It is commercially well known as a cotton defoliant and was found both to have elevated cytokinin activity in the callus of Phaseolus bioassay and also to stimulate ethylene production as the same as auxin in addition to inhibit stomatal closure. Moreover, it can be used in tissue culture plus can support or speed up organogenesis as well as plant regeneration.

N-(2-Chloro-4-pyridyl)-N′-Phenylurea (CPPU)

CPPU is well recognized as an extremely active synthetic cytokinin that enhances chlorophyll biosynthesis, reduces its degradation, augments cell division, and cell elongation. This compound also increases fruit set and accelerates fruit enlargement, and has been experienced extensively in fruit crops including apple, blueberry, citrus, kiwifruit, persimmon and pear. There is evidence that CPPU promotes fruit growth and development in kiwifruit by rising internal cytokinins, gibberellins, and auxins biosynthesis, which results in a greater sink strength in the fruit. The treatment of CPPU along with the foliar application of micronutrients, in addition considerably increases fruit set and maturity in macadamia nuts. CPPU appreciably compacts young fruit drop in Macadamia nutsand delays the wave of fruit drop by 1-2 weeks. The treatment significantly lessens the total soluble sugars and starch content in the leaves but amplifies them in the bearing shoots and the same with total soluble sugars in the husk (pericarp) and seeds. CPPU encourages carbohydrate mobilization from the leaves (source) to the fruit (sink). Though, there is no information regarding the consequence of CPPU treatment alone on fruit retention in macadamia. But the outcome of CPPU treatment with foliar spray or raceme soaking on fruit abscission during early fruit development influences carbohydrate availability and endogenous hormone secretion.

6-Benzylaminopurine/ Benzyl Adenine (BA)

Trade name: Cylex

This adenine-based Kinin is one of the most widely used Cytokinins as a supplement in plant growth media such as MS media (Murashige and Skoog medium) or Gamborg's medium.BA is a first-generation cytokinin plant growth regulator affecting plant growth and developing processes together with auxin. It interferes plant growth by influencing initiation of reproductive organs and positively modifying fruit richness by stimulating cell division. It is an inhibitor of respiration by interfering activities of kinases in plants and increases the post-harvest life of green vegetables. Many reports are sharing that external spraying 6-BA on the leaves at the late growth period or near senescence period of the late-season rice can increase seed setting rate and grain yield by checking chloroplast degradation resulting in delay of leaves senescence. BA thins mostly when applied only to the leaves, which indicates that it may cut the supply of sugars to the fruit. It was firstly recognized as a promising chemical thinner as it reduces crop load in the plant, increased fruit size, and enhanced return bloom. The effective thinning concentration is between 50 and 150 ppm. BA can increase fruit size beyond the attribution to a discount in crop load.

Ethephon

Trade name: Ethrel (Bayer), Ruspon (Jai Shree Rasayan Udyog Ltd), Highgrow (HPM).

Ethephon ($C_2H_6ClO_3P$) is extensively applied as an ethylene-releasing controller of plant growth in agriculture. The mode of action of Ethephon works via the discharge of ethylene, which is diffuse into the plant and gets in the way of growth processes. It has been reported that Ethephon has a role in inhibiting rate of plant growth, promoting stomatal opening and affecting flowering, stirring up pollen sterility, influencing biosynthesis of secondary metabolites and boosting fruit ripening process, improving fruit quality, such as fruit colour, firmness, aroma etc., enhancing herbicide efficacy pre-treatment, eradicating pests, discouraging vesicular-arbuscular mycorrhiza formation and nodulation and smoothing the harvest of fruits by contributing to the abscission layer. High concentrations of Ethephon can cause harm to plants and its products. Ethephon is an important artificial inducers of pineapple flowering. It decomposes inside the plant tissue, releasing ethylene, which persuades flowering. Ethylene assistances in breaking alternate bearing of mango.

Chlorocholine Chloride (CCC)

Trade name: Cycocel Chlormequat E-Pro, Citadel, Cycocel.

Chlorocholine Chloride (CCC) (2-chloroethyl) trimethyl-ammonium chloride) is a gibberellin biosynthesis inhibitor involved in the hang-up of cyclization of geranylgeranyl pyrophosphate to copyallyl pyrophosphate. But the studies in progress, indicate that chlorocholine chloride is a quaternary ammonium compound acting as growth retardant involved in a diverse array of cellular, developmental, and stress-related processes in plants. Numerous instances of the benefits of CCC in the growth and development of plants are described by many researchers in many direct or indirect growth parameters such as plant height, number of leaves, area of leaf, dry matter accumulation, chlorophyll and other photosynthetic parameters, nutrient uptake, economic yield, biological yield, oil production, harvest index, amino acid, and protein content etc. Foliar spraying of CCC could distinctly decreases Gibberellins and abscisic acid contents in potato leaves, which in turn helps diverting energy towards increasing chlorophyll contents and stimulated photosynthetic rate led to enhanced sucrose contents in leaves.

Mepiquat Chloride (MC)

Trade name: Pix.

N,N-dimethyl piperidinium chloride (synonym) is the most widely used growth regulator worldwide to control plant growth and stature. It can be absorbed by the green leaves and distributed throughout the plant. It reduces GA concentration and disturbs cellular movements because of reduced cell wall expansion, flexibility, and improved wall rigidity. Furthermore, decreased GA concentration reduces the cell elongation which in turn limits the vertical growth of the stem. The visual effect of this chemical includes the reduction of the rate of leaf expansion and stem but picks up ripeness of the cotton crop, hence useful against adverse weather conditions, which can cause loss to farmers by yield and quality. This comes about by a change in cotton canopy structure as well as darkens and broadens the leaves as compared with control by restricting the vegetative growth resulting in smaller leaves with improved reproductive organs thereby increased cotton boll production. To restrict plant height and lodging, MC is used, which in result increases the utilization of solar radiation and changed the assimilate distribution. It has been elucidated that better those alterations in cotton canopy structure by MC application results in increased penetration of sun light, improved light use efficiency. MC inhibits excessive vegetative growth and increases the differentiation of reproductive organs by translocating energy with complimentary benefits of improved flowering as well as crop earliness.

Paclobutrazol

Paclobutrazol (PBZ) is a triazole derived bio-regulator that obstructs natural synthesis of sterol and gibberellin. This compound can markedly affect plant growth and development by fluctuating the photosynthetic rate and modifying the phytohormone levels. Paclobutrazol hinders the activity of ent-kaurene oxidase, which is an enzyme in the GA biosynthetic pathway that catalyses the oxidation of ent-kaurene to ent-kaurenoic acid. PBZ application has impact to reduce plant height, improve stem diameter and leaf number, alter root arrangement straight contributing to yield increase, and circuitously reduce the event of lodging. It has also been conveyed that the application of paclobutrazol efficiently reduces the vegetative growth of rice plants and augments chlorophyll content. Rice seedlings externally treated with paclobutrazol allocates fewer photosynthates for vegetative growth and diverts more photosynthates for seed development compared to non-treated plants or plants treated with gibberellin. In orchard practices, paclobutrazol has been widely used as growth retardants and to induce flowering in fruit plants.

Aminoethoxyvinylglycine (AVG)

Trade name: ReTain.

One of the most well-known synthetic growth inhibitors of ethylene biosynthesis is AVG. ‘ReTain’ enables a grower to spread the harvest period of high-volume cultivars without risking a loss in harvest quality, and to slow ripening during subsequent storage. Beneficial for fruit store houses, hole sellers, retailers and consumers may embrace earlier availability of fresh fruit, superior condition of cold-stored fruit, slower fruit ripening, less scald, and firmer fruit.

Future Line of Work

Publicities and promotions assure a variety of benefits of treating synthetic plant growth chemicals. In research the effects of plant bio-regulators are often observed on excised plant parts and in controlled environment growth and chambers for very short periods. To know the effect PGR on overall plant growth and development, it must:

1. Act over a comparatively longer period.
2. Overcome the effects of the environments.
3. Affect through many varieties or hybrids of a particular crop.
4. Be readily engrossed into the plant and able to signalise through cell membranes to blowout signals through cell protoplasm to the nucleus.
5. Be stable on the plant surfaces or in the soil for adequate time for proper absorption of the chemicals.

These problems are needed to be resolved; because of which, bio-regulators uses in field crop production is strictly limited presently. The human community wants safe, healthy and eco-friendly food products.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Floral Biology of Banana

Article ID: 11534

Purnita Raturi[1], Vipin Chandra Garwa1[2]
[1]Research Scholar, Department of Horticulture, G.B. Pant university of Agriculture and Technology, Pantnagar, Uttarakhand-263145 (India).
[2]ADO Horticulture, Uttarakhand Government.

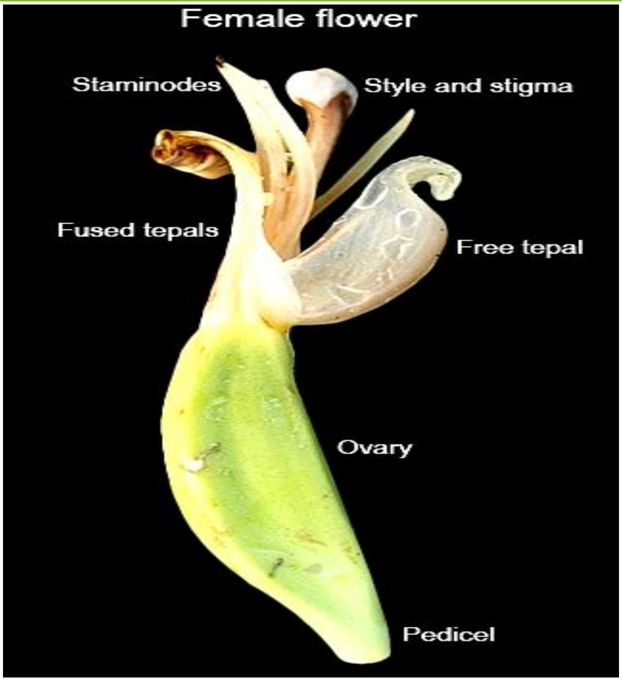
Introduction

Most flowering plants have hermaphrodite blooms, which means that each flower has both female and male parts that are functioning. While a banana flower has both female and male organs, the relative development of these organs determines whether the bloom is female and develops into fruit or male and generates pollen. This is true of both wild banana species and cultivars that have been domesticated for edibility, albeit the latter's fruit grows parthenocarpically (in the absence of pollination) and is seedless. Pollination is necessary for wild species for ovules to grow into seeds, which drives pulp development. Flowers that do not receive pollen have scrawny fruits. Banana flowers grow in clusters (called hands) on the peduncle, which is the stalk that supports the inflorescence. Female flowers are found towards the base of the peduncle, whereas male flowers are found at the distal end. Each hand of flowers is enfolded by a bract that lifts at anthesis when the flowers have finished developing.

Basal female flowers becoming fruits (top right) and distal male flowers in the male bud revealed by an opened bract (bottom)

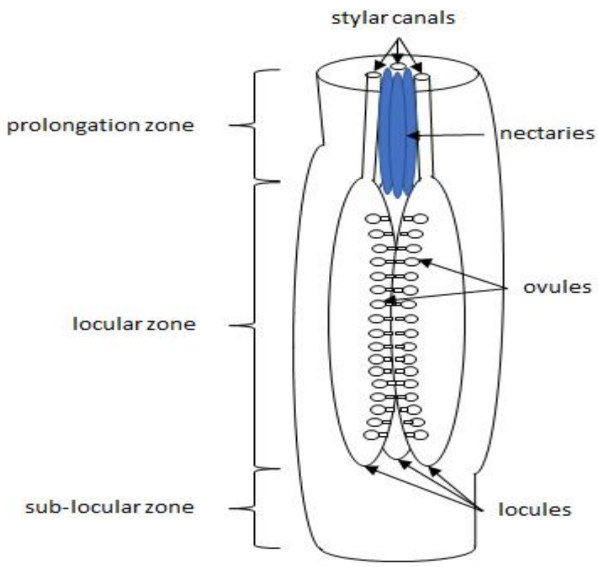
Types of Flowers

Female flowers: Female banana flowers contain a large style and stigma, as well as stamens that are often reduced to staminodes that do not release pollen. Male organs are sometimes missing. The ovary is the enlarged basal portion that contains the ovules. The ovary, style, and stigma make up the pistil together, also called a carpel. Three pistils merge in a banana blossom to form a tri-pistillate ovary, style, and stigma. The stigma is the receptive tip of the carpel that accepts pollen and germinates pollen grains. The stigma has been designed to capture and trap pollen. The term gynoecium refers to the portions of the flower that generate ovules and eventually mature into fruit and seeds. The pedicel connects each flower to a cushion of tissue on the peduncle. Female flowers arrive at anthesis (the moment when a flower is completely open and functioning) before male flowers.

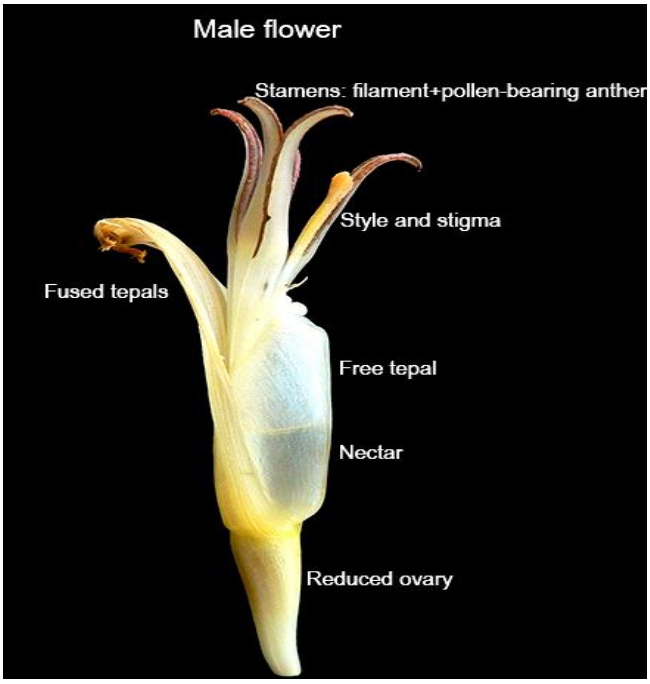


Female flowers' ovaries are split into three parts along their length: the sublocular, locular, and prolongation zones. Externally, these three zones are indistinguishable. The sub-locular segment is generally tiny and links the ovary to the pedicel, which attaches to the cushion on the peduncle. The locular portion is split into three chambers or locules, each of which contains ovules embedded in a mucilaginous gel. An ovary can hold 200 to 300 ovules, which can mature into that many seeds in wild species. The prolongation zone comprises the nectar-secreting nectary tissues and ducts, as well as the stylar canals, which each emerge from a locule. When these stylar canals enter the style, they join together. Each ovule is connected to the central placenta contains an egg cell as well as a micropyle through which the pollen tube enters to fertilize the ovule. If the flower was pollinated, the fruit will contain seeds in wild species. In edible bananas, the ovary develops into a seedless fruit by parthenocarpy (without being pollinated).

Female ovary



Male flowers: Male banana flowers feature a thin style and stigma, as well as well-developed anthers that typically carry pollen in wild species. The pollen content of edible bananas is low or non-existent. The anther and filament combine to create a stamen. Male banana flowers usually have five stamens. The banana flower's style, stigma, and male organs are enclosed within a tubular structure created by the fusion of five petal-like tepals, with a sixth tepal remaining free. Male flowers lack ovules but do have nectaries. The amount of nectar and its sugar content is lower in male flowers than in female blooms. The nectar of wild banana species attracts pollinators, mainly bats and birds. Although edible bananas do not require pollination, because their flowers continue to generate nectar they are visited by animals and insects. The male flowers are enclosed within the male bud, which is grouped in clusters known as hands. A bract encircles each hand and rises after the blooms have completed growing. Male flowers generally fall to the ground shortly after they bloom.



Hermaphrodite flowers: The basal fruit-forming flowers of some wild species, such as *Musa acuminata* ssp. *banksii, Musa acuminata* var. *Chinensis, Musa hillii, Musa schizocarpa, Musa ingens,* and *Musa yunnanensis*, contain a functioning gynoecium and androecium and can self-fertilize before bract opening if the stigma and anthers are aligned. The capacity to self-fertilize is important because it minimizes hybridization and therefore contributes to genetic isolation.

Other Types of Flowers

Some edible bananas may have flowers at the point of transition from the basal female to the distal male section of the inflorescence that does not yield fruit and have a tiny ovary, albeit it is bigger than in male flowers. These blooms may maintain certain characteristics of fruit-forming flowers, such as remaining connected to the peduncle. These blooms are referred to as neuter or intermediate. They are also described in certain wild species, where they might be neuter or functionally male.

Pollination

The blooms of wild banana species offer the structure for sexual reproduction, which happens when pollen generated by the anther of a male flower fertilizes the ovule of a female flower, resulting in the formation of a viable embryo. To begin, pollen must be transported to the stigma. Because female flowers open before male flowers on the same inflorescence, several inflorescences, and a pollinator to gather and distribute pollen are required. Second, to germinate, pollen grains must be 'recognized' after they have landed on the stigma. The tube that emerges from a germinated pollen grain reacts to chemical signals that guide it down the canal in the center of the style to reach one of the three locules containing ovules. To create a viable embryo, a pollen tube must be guided to an accessible ovule. The fertilized ovule, which contains a viable embryo, develops into a seed. This encourages the formation of pulp surrounding the seeds in the ovary, resulting in seed-bearing banana fruit. A fruit from a wild species may contain up to 300 seeds.

Pollinators

Female flowers are isolated from male blooms in space and time by the nature of the banana inflorescence. Pollinators are critical for seed production in this scenario. Because the tepals are not colorful and nectar is abundant, bats and birds are the primary pollinators. Numerous insect and animal species visit banana blooms; however, they are not engaged in pollination.

Parthenocarpic Bananas

Sexual reproduction is seldom effective in edible bananas, with very few, if any, seeds generated as a result of pollination. This failure is complex, owing to a lack of viable pollen, interruption of the pollen route via the gynoecium in the female flower, and a lack of viable ovules to varying degrees.

Instead, the fruit of edible bananas develops by vegetative parthenocarpy, with the pulp growing autonomously from tissues on the ovary wall of the female flower without the requirement for pollination.

References

1. Buddenhagen, I. (2008). Bats and Disappearing Wild Bananas. Bats Magazine, 26(4): 1-6.
2. Kirchoff, B.K. (2017). Inflorescence and Flower Development in Musa velutina H. Wendl. and Drude (Musaceae), with a Consideration of Developmental Variability, Restricted Phyllotactic Direction, and Hand Initiation. International Journal of Plant Sciences 178(4):259-272.
3. Kirchoff, B.K. (1992). Ovary structure and anatomy in the Heliconiaceae and Musaceae (Zingiberales). Canadian Journal of Botany 70(12):2490-2508.
4. Simmonds, N.W. (1960). Notes on banana taxonomy. Kew Bulletin 14(2):198-212.
5. https://www.promusa.org/Banana+flowers.

Impact of Covid-19 Lockdown on the Fisheries Sector of India

Article ID: 11535

Naznin Firdousie[1], Imtiaz Ahmed[1], Rinku Gogoi[1], Imran Hussain[1], Sagarika Nath[1], Rinchen Nopu Bhutia[2]

[1]College of Fisheries, Assam Agricultural University, Raha, Nagaon, Assam-782103.

[2]Scientist (Fisheries Resource Management), ICAR-Central Soil Salinity Research Institute, RRS, Canning Town, West Bengal-743329.

Abstract

Fisheries have been identified as an important source of income and rural employment, as well as a catalyst for the development of a variety of ancillary industries. The COVID-19 epidemic has not only hampered aquaculture operations but it also had a financial impact on the farmers. Because of the extended lockdown, stocking as well as the pre and post harvesting operations of fish were severely affected. The overall nationwide lockdown enforced to halt the spread of COVID-19 had taken a toll on aqua farmers' confidence while also impacting the Indian economy.

Keywords: COVID-19, Lockdown, Fisheries, Food security, Livelihood.

Introduction

COVID-19 is the disease which has created havoc around the globe, caused by the novel Coronavirus SARS-CoV-2. The World Health Organization had first learnt about it after a cluster of cases appeared in Wuhan, China on 31st December, 2019. Later, after observing the terrible extent upto which it could devastate the lives of innocent people, the WHO declared it as a global pandemic on 30th January, 2020. This deadly virus has affected the lives of all the people living on the planet. However, the impact has been felt differently by different class and sections of the society.

Fisheries has already assumed the status of a fast-expanding industry in India as it generates livelihood and employment opportunities to millons of people associated with it. Percentage contribution of Fisheries sector in Indian economy in the year 2018-19 is 1.24% (Handbook on Fisheries Statistics, 2020). With the growing food demands from increasing urban and rural populations, fisheries play an important role in food security and nutrition. However, due to the sudden annihilating outbreak of Covid-19 and subsequent complete lockdown has affected the livelihood and economic stability of fishing communities across several parts of India.

Impact on Fisheries Sector

Fish is an important source of low-fat high-quality protein essential for human diet due to its nutritional and health promoting qualities. The nutritional benefits of fish have a positive link to the food security, decreased poverty and employment generation owing to the better and brighter future of our country. Fish and fish-related products assist in food security by providing income for fishers and fish farmers; earns a livelihood for workers in fisheries, aquaculture, fish processing plants, hatcheries, marketing and allied supply, extension etc. Moreover, in many rural populations, aquaculture is taken as a secondary source of income by the people.

But due to the outbreak of covid-19 pandemic, the fisheries sector of our country had undergone a massive pitfall. The small-scale fishers in many coastal areas were facing challenges in selling their catch and earning their daily wages due to the norms set by the government to avert the rapid spread of the disease. The demand of fish had also dribbled in many parts of our country. Export of fish to the foreign markets such as US, Japan, Europe etc had also reduced due to the border restrictions resulting in decreased revenue generation. During the adverse period, breeding of fish was put on halt and therefore seed production in the hatcheries has also not gained momentum. Due to social distancing and allied norms, only few fishers were able to buy and sell their fish in the markets during the specific limited time allotted to them. Therefore, this resulted in selling of fish at lower prices by the poor fishermen. The unavailability of fish seed, fertilizers, labours, ice and other inputs had led to the decline in production. The suppliers and producers had also undergone a tremendous downfall as they were unable to sell their goods in the markets due to restrictions in marketing and supply, transportation issues, closure of restaurants and hotels, drop in demand etc. Frozen shrimp followed by frozen fish have remained the major exported items in terms of quantity and value. Unfortunately, due to the imposition of lockdown worldwide, it led to the cancellation of several orders of frozen shrimp and other processed fish-based products as the export of these items to the foreign countries became difficult.

Assam, the land of blue rivers and red hills is one of the leading states in fish production in India. Since the onset of the pandemic, a total of INR 185 crore (Zaman, 2020) of fish has been sold which helped to provide protein to the mass and aided the fish farmers in booming their economy. However, in 2020 the pandemic has affected the hatcheries and feed manufacturers to some extent. No hatcheries operated in February and very few (7%) opened in March (Shieh et al., 2020). The number of operational hatcheries increased gradually to 64% percent in April, and to 91% in July (Shieh et al., 2020). Farmgate prices of fish remained fairly stable from February to June, 2020 at around INR 240/kg, though dipping slightly to INR 220/kg in May, 2020 when sales were highest (Shieh et al., 2020).

Andhra Pradesh, the highest inland fish producing state in India; has also suffered tremendously during this pandemic. Usually, an average of 2,000 tonnes fish daily was transported from Andhra Pradesh to various parts in India (Seshagiri et al., 2020). Only 250 to 300 tonnes fish was transported daily during lockdown period which computed to be 15.2% of fish transport from Andhra Pradesh (Seshagiri et al., 2020). Fish prices dropped by 15-20% (Sally, 2020). The lack of retail marketplaces caused a sharp drop in fish prices.

West Bengal had also undergone a serious breakdown in fish and seed production during 2020. Interstate transport of fish seed from West Bengal to other states such as Andhra Pradesh, Bihar, Jharkhand, Madhya Pradesh and Uttar Pradesh had been put on halt. Although few hatcheries in West Bengal had completed summer breeding of Pangasius, only 10-15% of seed could be stocked by seed growers before imposing lockdown (Seshagiri et al., 2020). Few hatcheries which bred Indian Major Carps had no takers for fish seed due to lockdown (Ghosal, 2020).

Odisha's fishery industry is dominated by both domestic and export markets. Prohibitions were set on all types of trawlers and mechanised vessels and stretched upto 12 nautical miles off the coast of Odisha. As per the Directorate of Fisheries, the loss to the sector is INR 615 crores during the stringent period of lockdown.

Conclusion

COVID- 19 has severely disrupted food systems, harming many lives and livelihoods; major effects can also be seen in the fisheries sector. This is one of the most serious fisheries crisis the world has ever seen. The nationwide lockdown has not only predicted that the aquaculture sector relies heavily on migrant labour, but it has also highlighted the need for capacity growth of local human capital. Some governments have recognised the importance of developing rural markets and have begun selling fish in rural areas through official vehicles in order to increase fish consumption and improve market flow. The country's current state of emergency has also highlighted the urgent need to increase fish consumption.

With its effective governance, India has taken the situation as a threat and is doing everything possible to fight the pandemic. Simultaneously, the government and policymakers must be prepared to mitigate the effect of the shock and growth of the economy in the post-COVID era.

References

1. Shieh, J., Rajendran, S., Beypi, N., Gogoi, K., Parvin, B. R., Pegu, R., Ghazali, S., Dhar,G. and Belton B., 2020. Impacts of COVID-19 on Aquatic Food Supply Chains in Assam, India. Penang, Malaysia: CGIAR Research Program on Fish Agri-Food Systems. Program Report.
2. Zaman, R., 2020. Fish production in Assam has gone up by 27% in 4 years. The Times of India, 20 November. https://timesofindia.indiatimes.com/city/guwahati/fish-production-in-assam-has-gone-up-by-27-in-4-years/articleshow/79484644.cms

3. Sally, M., 2020. Lockdown blues: Meat na mila re mann ka. The Economic Times, 11 April. 75:81-86. https://economictimes.indiatimes.com/industry/cons-products/food/lockdown-blues-meat-na-mila-re-mann-ka/articleshow/75088164.cms?from=mdr
4. Seshagiri, B., Nagireddy, M. V. S., Raju V. R., Nagireddy, S., Rangacharyulu, P.V., Rathod, R. and Ratnaprakash, V., 2020. Impact of nationwide lockdown on freshwater aquaculture in Andhra Pradesh, India. International Journal of Fisheries and Aquatic Studies, 8(4): 377-384.
5. Ghosal, S., 2020. Slow movement of fish seeds from Bengal due to lockdown to impact fish production in the country. The Economic Times, 15 April. 15:20. https://economictimes.indiatimes.com/news/economy/agriculture/slow-movement-of-fish-seeds-from-bengal-due-to-lockdown-to-impact-fish-production-in-the-country/articleshow/75152516.cms?from=mdr
6. Anon, 2018. Handbook of Fisheries Statistics. Government of India. Ministry of Fisheries, Animal Husbandry and Dairying, Department of Fisheries, New Delhi.

Successful Farming of Mushroom in Bihar with Proximate Composition

Article ID: 11536

Satya Prakash[1], A. K. Paswan[2], M. N. Ansari[3]
[1]Assistant Professor, Department of Extension Education, RPCAU, Pusa, Samastipur Bihar.
[2&3]Assistant Professor, Department of Extension Education, TCA, Dholi.

Mushroom is a fungus but every fungus is not a mushroom. Mushroom is a group of macroscopic fungi, which are distributed throughout world. It is fleshy, spore bearing body of fungus, typically produced above ground on soil or on its food source. They are very unlike green plants because they lack chlorophyll and therefore depend on performed food for their nutrition. They are known as “meat” of vegetable world (Has and James, 2009).

No leaves, no buds, no flowers yet fruits, this miracle played only by mushroom. This unique fruit is basically a gift of nature to poor as evident from its appearance on thatched house and rotten woods just after first shower. But its taste and flavor soon introduced its delicious dish in the kitchen of aristocrats and elites of the society. Mushroom have prized as the food of God on an account of their special flavor, nutritive value and medicinal property. It can be grown on all types of plants and agricultural waste and thus constitute highly nutritive source of food at low cost (Tewari and Pandey, 2002). Mushroom is an indoor crop, grown independent of sunlight and do not require fertile land (Chadda and Sharma, 1995).

The early man by trial and error became familiar with the type of wild mushroom worth collecting for eating purpose (Arti et.al., 1997). More than 2000 species of mushrooms are reported to be edible throughout the world and about 283 of these are reported to be available in India (Purkayastha and Chandra, 1985). Large number of wild mushrooms are collected and consumed as vegetables or as staple food and especially by tribal communities and poor villagers. However, civilized society neglected the use of mushroom because of the ignorance of the food values and taste and panic of poisoning effect of some wild varieties. It is thus essential to create awareness among all sections of people to popularize the wild mushrooms in the country with a view to attain proper utilization of natural wealth.

The history of use of mushroom stretches beyond the history of men, as there are grounds to believe that prehistoric men and women made various uses of mushroom. Button mushroom have grown wild since prehistoric times, having being consumed as food by early hunters. Their edibility is known since time immemorial, but technology of its cultivation is comparatively of late origin. It was attempted around AD 600 in China by growing *Auricularia auricular* on logs. But possibilities of mushroom cultivation on commercial scale in India were realized after lapse of more than half century (Bose, 1921). It was followed by successful farming of mushroom at Coimbatore (Thomas, 1943). Since then, commendable progress has been made in its technology know how and it has been now successfully transferred to farmers.

Kezeli and Dzabaridze (1994) reported the presence of appreciable amount of Thiamin, Folic acid and Ascorbic acid. Folic acid prevents and cure anemia. Vit. A is not found but all other vitamins (B, C, D, K) are available in mushroom and do not get lost in cooking, drying and freezing.

Proximate Composition of Mushroom (Dry wt. Basis)

Nutrient	
Proteins	25
Carbohydrate	48
Fats	1.0 – 3.2 %
Crude fibre	11
Ash	5 – 9 %
Vitamins	B1 and B2
Minerals	K, Ca, P, Fe
Calories	261 – 385 kcal

Button Mushroom

Oyster Mushroom

Button Mushroom

Milky White Mushroom

Most of the commercial and export-oriented unit grow white button mushroom for sale in domestic and distant markets both in fresh and canned form because of having maximum acceptability. Oyster mushroom cultivation is confined to small and marginal mushroom grower and the produce is sold fresh and dry in the local market. This mushroom is gaining popularity because of;-

1. Wider range of growing temperature.
2. Easy method of cultivation
3. Low technology infrastructure.

Grows on wide variety of waste material/agro waste with good productivity. In spite of its lesser acceptability, third most commonly grown mushroom in hot/humid areas of peninsular India is *Volvariella* spp.

It is reported that India has pushed back Taiwan to gain position of top exporter of whole button mushroom. World mushroom production at present is estimated to be around 10-12 million tone/annum. Mushroom cultivation in India is about 4 decades old with a rapid increase in production over last 10-12 years. From a meager production of about 4,000 tonnes in 1985, India now produces 1,20,000 tonnes (Kapoor and Khanna) of mushroom annually of which about 90 per cent are of the buttom mushroom.

The remaining 10 per cent production is accounted for by Oysters and Chinese mushroom. The major chunk of national mushroom production, primarily button mushroom, comes from a number of industrial units located in different parts of states. India has gained second position in the export of cut mushrooms. Haryana, Punjab, Himachal Pradesh, Uttar Pradesh and Tamil Nadu are the main mushroom producing states in India.

Of late mushroom production has caught the attention of farmers in Bihar. Out of which various districts producing mushroom in Bihar, Samastipur occupies a place of pride with respect to mushroom production. Annual production of mushroom in Bihar is approx 2000 tonnes and Samastipur produces approx 12-15 tonnes per annum. Mushroom cultivation is a potential biotechnological process where in the waste plant material or negative value crop residues may be converted into valuable food. There are about 200 kinds of waste in which edible mushroom can be produced (Pope, 2000).

There are about 12000 species of fungi that can considered to be mushroom, with at least 2000 species showing various degree of edibility (Chang, 1999). Above 35 mushroom species have been cultivated commercially and of these around 20 are cultivated on industrial scale. Among these major contributions in production are *Agaricus bisporus* (White button mushroom), *Pleurotus* spp. (Oyster mushroom) and *Volvariella* spp. (Paddy straw mushroom).

The Important Verities Which are Grown in Bihar on Large Scale

Sl. No.	Species	Common name	Temperature	Growing season
1	*Agaricus bisporus*	Button	15– 20^{0}c	October – February
2	*Pleurotus* spp.	Oyster	25- 30^{0}c	Round the year
3	*Volvariella* spp.	Paddy straw	30- 40^{0}c	April - September
4	*Calocybe indica*	Milky white	30-35^{0}c	April - October

Vegetable Grafting - A New Concept

Article ID: 11537

Smt. D. Rajani[1], Dr. A. Nirmala[2]
[1]Department of Horticulture, College of Agriculture, Palem.
[2]Department of Horticulture, College of Agriculture, Hyderabad.
Professor Jayasankar Telangana State Agricultural University, Rajendranagar, Hyderabad.

Plant grafting is a propagation technique where two portions of plant with similar organic texture are joined to continue their development as a single plant. The production of grafted plant first began in japan and korea in the late 1920s when watermelon *(Citrullus lanatus)* was grafted on bottle gourd rootstock, later on the scions of eggplant were grafted in large scale on rootstocks of scarlet eggplant *(Solanum integrifolium)* to avoid injury caused by soil-borne diseases such as verticillium wilt, fusarium will, bacterial wilt and nematodes. Grafting is now commercially practiced especially in greenhouse grown crops viz., watermelon, cucumber, muskmelon, bitter gourd, tomato and eggplant in Japan, Korea and other European countries.

Objectives

The main objective of grafting is to avoid soil-borne diseases viz., fusarium wilt, bacterial wilt and nematodes. Currently grafting is used for induction of disease resistance especially caused by soil pathogens, low temperature tolerance, salt tolerance, flood tolerance, drought tolerance, enhancing nutrient and water uptake and high temperature tolerance. It is also used for cultivar change and repair or invigoration of older established plant, studying the transmission of signals affecting vernalization and photoperiod, transmission of virus into indicator plants and elimination of viruses.

Different Grafting Methods

1. Hole insertion grafting (HIG).
2. Tounge approach grafting (TAG).
3. Splice grafting (SG).
4. Cleft grafting (CG).
5. Pin grafting (PG).
6. Tube grafting (TG).
7. Slant cut grafting.
8. Flat grafting.
9. Saddle grafting.
10. Mechanized grafting (Robots).

Requirements for Vegetable Grafting

Selected rootstock and scion should have same diameter for successful union and to overcome graft incompatibility problem. Grafting should be done at 2-3 leaf stage. The seed of scion cultivar should be selected based on purity, viability, yield, fruit quality and market demand. Similarly, rootstock cultivars should be selected based on purity, viability, resistance to diseases, compatibility with the scion cultivar and adaptability to local soil and other environmental conditions. Grafting blade, pins should be contamination free. Temperature of 25-30˚c, relative humidity of 85-90 % and low light intensity is maintained for healing process. Grafting seedlings are kept for 7-10 days for acclimatization as hardening treatment.

Applications of Vegetable Grafting

The effectiveness of grafting in imparting tolerance to vegetable crops against abiotic and biotic stresses has been attributed to several improved traits of grafted plants:
1. More vigorous root system apparatus.
2. Improved water and nutrient uptake.
3. Enhanced photosynthetic efficiency and water relations.
4. Stronger antioxidative defense system.

5. Heightened hormonal signaling.
6. Large and long-distance movement of mRNAs, small RNAs and proteins.
7. To impart insect – pest and disease resistance.
8. To enhance nutrient and water uptake.
9. To avoid nematode infestation.
10. To minimize the autotoxic effect.
11. To provide cold hardiness.
12. To impart flood tolerance.
13. To impart drought tolerance.
14. To impart salt tolerance.
15. Impact on quantitative and qualitative traits.
16. Manipulation in flowering and harvesting period.
17. Influence on sex expression.

Suitable Rootstocks for Vegetable Grafting

Scion	Rootstock
Cucumber	*Cucurbita moschata, Cucurbita ficifolia* (fig-leaf gourd), *Cucurbita maxima, Sicyos angulatus* (bur cucumber)
Muskmelon (for open field)	*Cucurbita,* spp., *C. Moschata* x *C. Maxima, cucumis melo*
Muskmelons (for greenhouse)	*Cucumis melo, Benincasa hispida, cucurbita* spp., *C.moschata* x *C. Maxima*
Watermelon	*Lagenaria siceraria, cucurbita., Beincasa hispida*
Bitter gourd	*Cucurbita moschata, Lagernaria siceraria, Luffa cylindrical*
Tomato	*Lycopersicon pimpinellifolium, Lycopersicon esculentum, Solanum, nigrum*
Brinjal	*Solanum torvum, Solanum interifolium, solanum melongena solanum nigrum*

Healing and Acclimatization

Acclimatization is essential for healing and survival of grafted plants. Acclimatization involves healing of the cut surface and hardening for field or greenhouse survival. Maintenance of proper moisture content before and after grafting is critical for the production of uniform grafted seedlings. After grafting, keeping the grafted plants in dark for seven days at about 28-30°C and with more than 95% relative humidity promotes the survival ratio. Gradually, the relative humidity is then lowered and the light intensity is increased. During healing and acclimatization, it is important to keep a constant air temperature in the tunnel, in order to maintain high humidity. Grafted plants are usually healed and acclimated in a plastic tunnel which is covered with materials which provide shade and maintain inside humidity. After healing maintain the light level to 3000-5000 Lux. Before grafting the scion and rootstock should be exposed to sunshine for two to three days and water should be withheld from plant to avoid spindly growth. All these improves the survival rate of grafted plants.

Time Requirement

The total time requirement for production of grafted plants of vegetables depends upon the species and methods employed. However, in general 5-to-6-week time is sufficient for successful graft union.

Limitations

Beside several beneficial manifestations, there are certain limitations associated with grafting technology such as:
1. Additional seeds for rootstocks.
2. Experienced labour needed.
3. Wise selection of scion/rootstock combinations.
4. Different combinations for cropping season.
5. Different combinations for cropping methods.
6. High price of seedlings.
7. Increased infection of seed-borne diseases.

8. Excessive vegetative growth.
9. Fruit harvesting may be delayed.
10. Inferior fruit quality (taste, colour and sugar contents).
11. Increased incidence of physiological disorders.
12. Symptoms of incompatibility at later stages.
13. Different cultural practices should be applied.
14. Higher prices of grafted seedlings.

References

1. Current Journal of Applied Science and Technology 33(3): 1-10, 2019; Article no.CJAST.46422 ISSN: 2457-1024.
2. OLERICULTURE; Fundamentals of Vegetable Production; Volume – 1.
3. J. K. Ranjan, Rajesh Kumar, Pradip Karmakar and Pragya.2015. ICAR-Indian Institute of Vegetable Research, Varanasi.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Fruit Cracking: A Challenging Problem of Fruit Crops

Article ID: 11538

Purnita Raturi[1], Vipin Chandra Garwa1[2]
[1]Research Scholar, Department of Horticulture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand-263145 (India).
[2]ADO Horticulture, Uttarakhand Government.

Fruit cracking is a serious physiological condition that harms fruit quality. Cracks on the fruit surface allow the fungus to infect it while also promoting fast moisture loss and shriveling, reducing market quality and storage life. Fruit cracking occurs when the plants have lots of water after a prolonged drought, as well as when the temperature and humidity are high in the summer. Drip irrigation, mulching, fertilizer management, resistant cultivars, bagging, alternative packing materials, and timely harvesting are all utilized to control fruit cracking in different fruit crops, as well as spraying micronutrients and growth regulators.

Introduction

Fruit cracking is a physiological issue that affects many subtropical fruit crops across the world. The pericarp, or membrane, of the fruit, splits mostly because the fruit's contents absorb water quicker than the fruit wall expands. Varietal traits, environmental variables, orchard floor management, uneven water delivery at maturity level, and nutritional deficiencies can all be issues. Litchi, pomegranate, lemon, grape, bael, and fig are a few examples. It happens throughout fruit growth, development, and ripening. Cracked fruits are prone to storage disease, do not achieve commercial-grade, and are unable to generate economic gain from the market. Cracked fruits are prone to storage disease, do not achieve commercial-grade, and cannot generate economic benefit in the market. Depending on the fruit crop, fruit cracking losses range from 50 to 85 percent.

Forms of Cracking on Fruits

There are three distinct forms of cracking:

1. Circular or semicircular cracking in the cavity and around the stem end.
2. Fruits have a fine crack at the apical end that is identical to the one described above.
3. Lateral cracking is defined as deep fractures on the fruit's side.

Nature of Cracking in Important Fruit Crops

There are three types of cracking that occur in most fruit crops: (1) Peel cracking (2) Star cracking and (3) Splitting. Fruit cracking generally occurs in three ways: It may be Radial (longitudinal), Transverse or Concentric cracking. Fruit cracking generally occurs in three ways: It may be Radial (longitudinal), Transverse or Concentric cracking. Where radical cracking occurs from the radical portion of the stem to the fruit center. Nectarine fruit is harmed by radiation or sun rays, resulting in breaking. This splitting is found in nectarine, lemon, mango, and litchi. Whereas, concentric cracking occurs when two or more concentric rings are seen on fruit, which causes breaking; they may also be found in a single fruit, which is known as concentric, for example, in cherry.

Radical cracking

Concentric cracking

There are two types of cracking in lemon: radical cracking and transverse cracking. The radical form is more prevalent, with 90 percent of damaged fruit exhibiting this kind of cracking and only 10% exhibiting transverse. However, in Pant Lemon 1, four kinds of cracking were observed: Radical, Transverse, Oblique (/), and Mixed. Cracks in litchi can be either radical or transverse. Mango, on the other hand, exhibits four forms of splitting: radical, transverse, oblique, and mixed.

Factors Influencing the Fruit Cracking

1. Environmental factors: High temperature and low humidity, Rainfall (low), and hot wind.
2. Fruit Characteristics: Maturity, fruit size, fruit firmness, and osmotic concentration.
3. Lack of orchard management: Moisture stress, nutrient, insect-pest, and disease.

Nature of Cracking of Some Fruits

1. Pomegranate: This disorder is caused by boron shortage in immature fruits, but it is caused by a moisture imbalance situation caused by irregular irrigation or rainfall in fully established trees. The major reasons for pomegranate fruit cracking are long periods of dryness followed by strong rainfall or irrigation. A prolonged dry spell increased peel hardening. When dryness is followed by heavy rainfall or irrigation, the pulp expands and the peel splits. Fruits grown during Mrig Bahar are more susceptible to breaking. It is caused by changes in humidity throughout the growth and development of the fruit. There is imbalanced fertilization and nutritional shortages, such as boron, calcium, and potash, during fruit growth and development. Fruit rind thickness and texture are connected to cracking susceptibility depending on varietal characteristics.

2. Litchi: Litchi fruit cracking is closely related to variety, watering interval owing to hot wind, endogenous growth regulators, and greater amounts of gibberellins and abscisic acid in the skin, aril, and seed. High temperatures, low humidity, and low soil moisture levels all contribute to fruit cracking during development. Furthermore, a temperature of more than 38 degrees Celsius mixed with a relative humidity of less than 60% is excellent for fruit cracking. Inadequate moisture during the early stages of skin development results in rigid, non-elastic skin that cracks when subjected to increasing internal pressure caused by rapid aril growth after irrigation or rain.

3. Citrus: It is prevalent in acid limes and oranges and begins at the fruit's blossom end. When the temperature rises during a drought, the rinds of fruits stiffen and become less elastic. Growth processes are accelerated during the wet season, and the tissue within the fruit expands. Cracking happens because the peel does not appear to grow as rapidly as the pulp. Gummy substances can grow on the surface and throughout the body when infected with Alternaria citri and exanthema. The fruit cracks because the tissues holding these sticky compounds retain too much water. Hot winds and inadequate watering techniques induce fruit splitting. There are two types of splitting: radial (longitudinal) and transverse splitting, with radial being the more prevalent. It changes periodically and is often highest when crop burden is high.

4. Grape: Water on the stalk and berry's surface is absorbed by the berry cells, resulting in a large increase in water moving through the fruit, raising the chances of breaking. The increased water content results in necessary turgor strain, which leads to berry breaking. As the temperature rises from 10 to 40 ^{o}C, the rate of fruit cracking increases. Since high relative humidity lowers leaf transpiration, fruit water supply and turgor pressure might rise. Some grape disease retards the berry development and causes berry cracking, for example, Powdery mildew.

Measures to Control Fruit Cracking

1. Selection of location: The most effective method for reducing rain runoff in a fruit orchard is site selection. The optimum site should have little or no rain approaching harvesting season. To select cultivars that are resistant to rain-induced fruit crack.

2. Rain cover protection: To avoid cracking at maturity, fruit trees were simply covered on top, allowing unrestricted airflow through the sides, for example, litchi netting and individual bunch bagging.

3. Moisture conservation: Moisture conservation is important during the hot, dry months of May and June since constant moisture and enough humidity prevent fruits from breaking throughout their maturity period.

4. Regular irrigation: Watering the orchard regularly is the most important component in maintaining moisture percent in fruit. These are quite sensitive to high and stressed water conditions. In hot and dry climates, drip irrigation and fertigation can be employed.

5. Planting windbreak: A suitable wind barrier should be planted around the orchard's periphery, at a right angle to the direction of the prevailing wind. Windbreaks can be created by planting a row of tall trees, such as mango and jamun.

6. Mulching: Organic mulches like as leaves and straw are excellent sources of moisture conservation by lowering evaporation, limiting weed emergence, and adding humus to the soil as they decompose. Maintaining soil moisture reduces the percentage of fruit trees that crack.

7. Resistant varieties: The most effective approach to avoid fruit cracking is to grow highly resistant cultivars. Pomegranate cultivars such as Bedana Bosec, Khogand, and Jalore Seedless have better crack tolerance. Litchi cultivars with thin skin, few tubercles per unit area, and a rounded to flat shape is more resistant to breaking. Swarna Roopa, a litchi cultivar, is resistant to this disease.

8. Hormonal spraying: Spraying 2, 4-D, and NAA at 20 ppm or 20 mg/liter doses reduce the cracking of litchi fruit. Fruit cracking in pomegranates can be minimized by spraying GA3 (120 ppm) during maturity.

9. Chemical Spraying: Spraying with ZnSO4 (1.5 percent) weekly or CaNO3 (1.5 percent) fortnightly is an effective approach to prevent cracking in litchi from pea-size to fruit harvesting. Pomegranate fruit cracking can be minimized by spraying calcium hydroxide (0.1%) and borax (0.1%) at 15-day intervals after the fruit has achieved maturity. When potassium is used to limes and lemons, it reduces fruit splitting.

10. Anti-transparent application: Anti-transparent application that inhibits water from passing through stomata on the leaf or plant surface. Spraying pomegranate fruit with anti-transpirants such as phenol (5%) and liquid paraffin (1%) four to five weeks before harvesting reduces fruit cracking.

Conclusion

It has been concluded that timely orchard management, as well as preharvest treatments of mineral nutrients, plant growth regulators, and anti-transpirants throughout the early phases of fruit growth, may help prevent fruit cracking.

References

1. Abd El-Rhman, I. E. (2010). Physiological studies on cracking phenomena of Pomegranates. J. Appl. Sci. Res., 6: 696-703.
2. Bullock, R.M. (1952). A study of some in organic compounds and growth promoting chemicals in relation to fruit cracking of cherries at maturity. Proceeding of the American Society for Horticulture Science 59: 243-253.
3. Huang, X. M. (2005). Fruit disorders. (In) Litchi and Longan - Botany, Production and Uses, pp 41–152. Menzel C and Waite G K (Eds). CABI Pub., Wallingford, Oxford, UK.
4. Khadivi-Khub, A. (2014). Physiological and genetic factors influencing fruit cracking. Acta Physiol. Plant, 37:1–14.
5. Srivastava, R.P. and Singh, L. (1969). Effect of growth substances on the quality of litchi. Horticulture Science 1: 1-6.
6. Veera, S and Das, R.C. (1971). Effect of 2,4-D, NAA, GA and 2,4,5-T on fruit weight and fruit cracking in litchi (Litchi chinensis Sonn) var. Muzaffarpur. Plant Science 3: 126-128.

Adding Colour to Your Front Approach

Article ID: 11539

Dr. G. Sathish[1]

[1]Assistant Professor (Horticulture), Regional Research Station, TNAU, VRIDHACHALAM , Cuddalore Dt.

We have looked at types of enclosure and suggested varieties of ground surfacing to guide you in planning and structuring your front garden area. Now we give you a selection of suitable plants and shrubs to help you to determine its final appearance.

The plantings of the leftovers, the bits between the hard surfacing and against the house and garage should be fairly tough, with a good proporting of evergreen for an all-year-round effect. Evergreen conjures up ideas of laurel and privet (which incidentally are both effective when used well), but there are many other suitable plants, such as cotoneasters, certain viburnums, hebes, fatsia, senecio and choisya which are all attractive evergreens that flower, and some have berries too. These can also survive in an area with not too much sun. the ever-popular conifer, however, being by its shape a point-of-emphasis plant, is not suitable for most frontages.

In your layout, try to avoid little pieces of lawn which are tedious to cut, and consider instead areas of low ground cover. Here you will want something flat. Ivy is suitable in this situation, and hypericum (St John's wort or rose of Sharon), or low juniper would be admirable. Plant boldly and simply for the positive effect that is needed.

Before making your final selection of plants, do some homework on their ultimate size. A weeping willow in the middle of the front garden may look charming for a year or two, but very quickly grows to 10m (30 ft) across. And there is no point in planting shrubs on either side of a path if they need cutting back each year to allow you to walk there.

You could choose a particularly handsome sculptural plant adjacent to the front door, marking its importance. Tubs with bay trees have traditionally been used here, or, more recently, conifers again. But what about mahonia bealei, or its near relation M. Charity? The leaves are an attractive, waxy evergreen, and the yellow flowers smell delicious in the early spring. Euphorbias (or spurges) make another good sculptural plant, or for a sunny situation try the upright-growing rosemary Miss Jessup. A good herbaceous plant in the sun is the beautiful leafed acanthus.

Scent on entering a garden is always appreciated. Mahonia again is good, as is the evergreen daphne odora marginata. Choisya ternata, the Mexican orange blossom, has scented white flowers and glossy foliage for cutting all year round.

If you are thinking of a climber up the front of the house or on the garage wall, consider a honeysuckle, for its scent. But whichever climber you settle on, remember that it is the plant you have put there for display, not its means of support. Use simple wires running along the brick courses rather than complicated patterns of trellis that are liable to rot.

For points of coloured emphasis use window boxes, or pots filled with bulbs and annuals.

Highlighting your Home

Lastly, if you provide a serviceable and welcoming frontage to your house, do help your visitors to find it. Put a name or number in a position not only visible to pedestrians but also to car drivers. It helps, too, if the lettering is legible and not too much in the mock tudor rustic style. Let the name and number be illuminated at night, as well as any change of level at the entrance. With luck this may deter the night intruder, as well as guide the more welcome guest.

Design for a Country Garden Site

Article ID: 11540

Dr. G. Sathish[1]
[1]Assistant Professor (Horticulture), Regional Research Station, TNAU, VRIDHACHALAM , Cuddalore.

An irregular -shaped country garden can present just as many problems as the town gardens described over-leaf. Here we look at some possible solutions that would blend in with a less formal rural setting.

This site seemed to be the leftover bit between fields, surrounded by thorn hedges and very boggy at its farthest corner. The back of the period house was sited against the road, with the front door and main living room facing south onto the garden.

The plan shows clearly how the lines of the pattern should first start off with some regard to the shade of the house, usually with straight lines. These can then be continued on in curves to sweep about and encompass existing features and altogether be gentler than a formal layout that in any case would not sit well within the boundary lines here.

The house is surrounded by a York stone paved terrace, so that the area outside the living room gets a long view down into the curving wild garden under a few old fruit trees. At the rear of the house the formal pattern has been broken down to form a small box-hedged herb garden conveniently near to the kitchen door. The existing hedge on this boundary has been replaced by a white picket fence along the roadside.

Planting in the garden is mixed and colourful outside the front door, becoming wilder and more rampant as you progress down the length of the garden towards the pretty summerhouse.

At the side of the house facing west the grass is left rough, and bulbs are naturalized in it. The hedge has also been reduced in height so that the feeling of a neighbouring field rolling right in is encouraged and continues right up to the house. This rough grass motif is repeated in circular form to surround an old ash tree nearby. The internal pattern of this garden again pays little service to the existing boundary line, and thick intervening planting screens the discrepancy between the two.

In an old garden you tend to have old existing tress to work to work around. A feature has been made of the existing ash in this garden by surrounding it with a circle of rough grass containing massed spring and autumn bulbs.

Communication Channels for Transfer of TNAU Technologies

Article ID: 11541

P. Radhakrishnan[1]
[1]Teaching Assistant, Institute of Agriculture, National Pulses Research Centre (NPRC) Campus, Vamban. Pudukkottai. 622 303, Tamil Nadu, India.

Introduction

A technology is said to be successful when it is transferred to farmers in efficient manner. TNAU technologies were disseminated through different channels. Many of the directorates and departments were involved in transferring of technologies successfully to the reach of end users 'Farmers'.

The following are the list of departments and directorates:
1. Directorate of extension education.
2. Krishi Vigyan Kendra.
3. Department of agricultural extension and rural sociology.
4. Department of agricultural entomology.
5. Department of plant pathology.
6. Department of environmental sciences.
7. ATIC.
8. Others.

Directorate of Extension Education

1. Dynamic Market Information:

a. It is the channel through which the daily market price of all perishable commodities in different markets in Tamil Nadu and also prices in cochin market.

b. It helps the farmers to know the daily rate of the perishables, so that they can be benefited by selling their products in market having better price.

c. It also display a simple technology in its home page as tip of the day.

2. DEMIC (Domestic Market Export Intelligent Cell):

a. Dissemination of the market intelligence through different mass media like news papers in regional languages, English, Television, Radio, Agricultural Journals etc., so as to reach the maximum number of farmers.

b. Providing price forecasts well in advance of sowing of major commodities and during harvesting thus helping the farmers in taking better sowing and selling decisions;

c. Studying the different market intelligence aspects being made available to farmers in different countries and explore possibilities of replicating the same in India;

d. Training the farmers and officials of agricultural departments in various States in use of the above intelligence.

e. Providing other market intelligent such as product qualities, high price markets for the different commodities etc.

3. Community e - Radio Broadcasting Centre:

a. It is located in 'Ulavaragam' Building of Tamil Nadu Agricultural University.

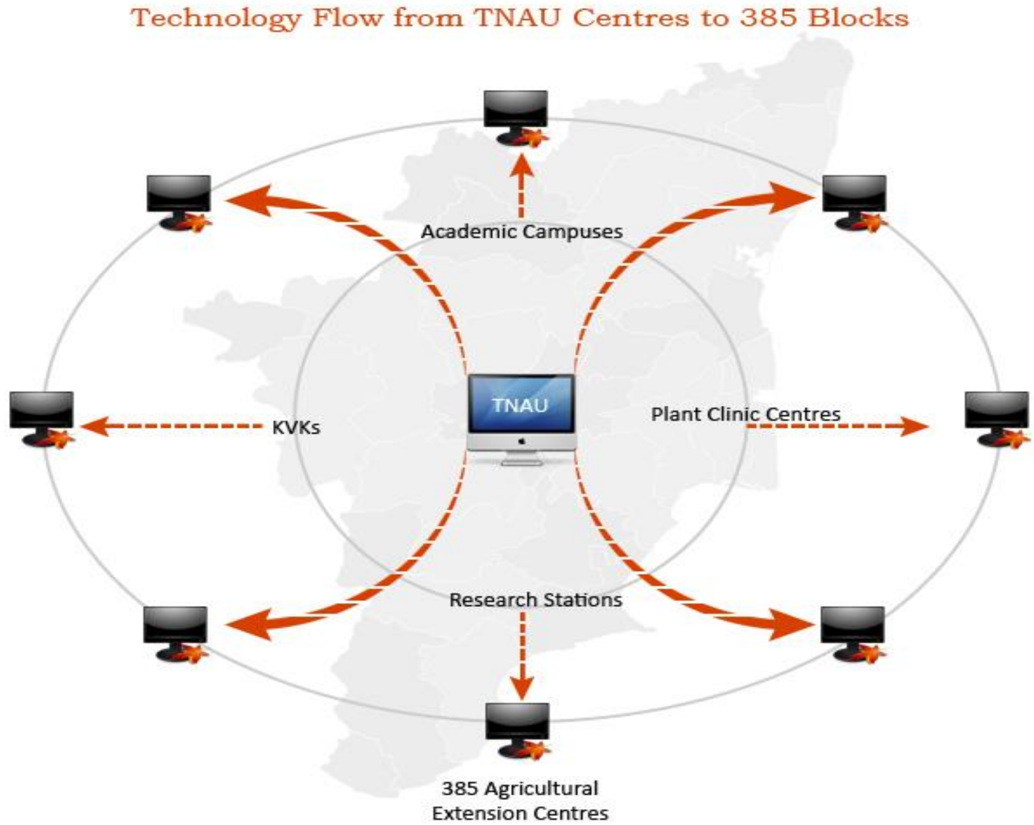
b. Its frequency is 107.4 MHz.

c. Community Radio means radio broadcasting with the objective of serving the cause of the Community in the service area by involving members of the community in the broadcast of their programmes.

d. The TNAU, Community Radio Station which has the coverage of 15 to 20 km, has the feature of 'e' component in it and hence the broadcast programme is integrated into the e – Extension network.

e. Handling Community e – Radio is an interesting and creative task. All the three types of intelligence viz., abstract, mechanical and social, are judiciously utilized in this ICT tool for making the programmes informative as well as interesting.

4. e-Extension center:



Projects Going on in this Center

1. NADP precision farming.
2. NADP e-extension.
3. Expert system.
4. Mobile technology.
5. NAIP agro diversity.
6. Dynamic market information.
7. NAIP mass media.

Market Extension

1. Mandate of the Department:

a. To promote commodity-based farmers groups.
b. To promote institutional linkages for the commodity groups for better marketing.
c. Conduct workshops on linking markets and farmers and organize buyer sellers meet.
d. To scout the market information and share it with all KVKs and line departments.
e. To offer Master training to developmental workers on market forces, intelligence and information systems.
f. To provide training on marketing management to line department officials.

2. Institutional Linkages:

a. Development of effective linkages with Department of Agricultural Marketing and Agri - Business, Directorate and other related institutions like APEDA (Agricultural and Processed Food Products Export Development Authority).
b. Linkages with unorganized and organized markets of different sizes and commodities.
c. Buyer and Seller Linkages.

Agritech Portal

1. It is developed by e-extension center.
2. It is uploaded with all the latest technologies and information about TNAU.
3. In simple words it is 'e-book' of TNAU.
4. Internet based information center
5. Provide all the information related to agriculture & horticulture production & protection technology.

Kisan Call Center (KCC)

1. Conducting "On-Farm Testing" (OFT) for identifying technologies in terms of location specific sustainable land use systems (Technology Assessment and Refinement).
2. Organise training programmes to update the extension personnel with emerging advances in agricultural research on regular basis (In-service training).
3. Organise short and long-term vocational training courses in agriculture and allied vocations for the farmers and rural youth with emphasis on "learning by doing" for higher production on farms and generating self-employment (Vocational training).
4. Organise Front Line Demonstration (FLD) on various crops to generate production data and feedback information.

TV & Radio programs		
Channel Name	**Timings**	**Programmes**
Podhigai TV	Morning 6.00-6.30 am Evening 6.00-6.30 pm	Pon Vilayum Bhoomi
Makkal TV	Morning 6.30-7.00 am, Evening 6.30-7.00 pm	Malarum Bhoomi
Tirunelveli 1197 kHz	6.30-6.45 am, 7.25-8.00 pm	Farm announcement, Uzhavarulagam
Madurai 1269kHz 103.3 MHz	6.30-6.45 am, 7.25-8.00 pm, Saturday : 6.45-7.00 am	Oru sol kelir, intha oor seithi,Mannum maniyum Poonthottam(programme for rural Women)
Trichy 936kHz 102.1 MHz	6.30-6.45 am, 3.00 pm, 7.25-8.00 pm	Farm announcement, Velaan Arangam, Uzhavar ulakam
Coimbatore 999kHz 103.0 MHz	6.35am to 6.45pm, 3.00 pm, 6.45-7.25 pm, 7.25-8.00 pm	Farm announcement, Uzhavaruku oru sol, Oorpurathille & Erum oorum

Other Activities

1. Formation of Farmers Commodity based Groups.
2. Conducting Monthly Zonal Workshop with extension functionaries.
3. Rendering need-based farm advisory services.
4. Implementing State and Central Governments sponsored agriculture related development programmes.
5. Developing location specific technologies.
6. Conducting skill demonstrations.
7. Dissemination of technologies through AIR, Doordharsan, Websites and Newspapers.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Buckwheat- A Gluten Free Underutilized Crop Having Huge Processing Potential

Article ID: 11542

Towseef A. Wani[1], Quraazah Akeemu Amin[2]
[1]Subject Matter Specialist, Food Science and Technology. KVK/ETC, Malangpora Pulwama, SKUAST Kashmir, India.
[2]AssitantProfessor, Food Science and Technology. SKUAST Kashmir, India.

Summary
Buckwheat , a gluten free pseudo cereal that has a huge potential in processing, which is yet to be explored completely. However, its procured products can help the people suffering from celiac disease. Its high in protein, fiber, minerals and contains almost all essential amino acids.

Introduction
There are three known species of buckwheat: common buckwheat (*Fagropyrum esculentum* Moench) tartary buckwheat (*Fagropyrum tartaricum* Gaertn) and perennial buckwheat (*Fagropyrum cymosum* L.). *Fagropyrum esculentum* is a pseudocereal food crop in the dicot family Polygonacea (Fig. 1). It's seeds have a triangular shape and are covered with a dark brown or black hull (Fig 2.). They are mainly consumed in a dehulled form It has a variety of healthful properties. It is an excellent plant source of easily digestible protein, contains all eight essential amino acids, so it's close to being a "complete" protein (Gallagher, 2009).

Figure 1 : Buckwheat inflorescence

Figure 2: Seeds of buckwheat

Nutritional Properties
Buckwheat seeds show a significant percentage of carbohydrates (73.3%), with starch being the main component. This pseudocereal is recognized as a good source of nutritionally valuable protein, lipid, dietary fiber and minerals. Buckwheat protein is rich in albumin and globulin, but very poor in prolamin and glutein. Both common and tartary buckwheat grains are a good source of unsaturated fatty acids, mainly oleic and linoleic acids Buckwheat seeds contain very rare D-chiro-inositol, which is mainly found in the form of fagopyritols.Along with rutin, a high content of epicatechin in flowers and leaves make these parts of buckwheat good antioxidant sources in human diet . The C-glucoflavones present mainly in buckwheat seeds are vitexin, isovitexin, orientin and homoorientin, which exert have high antioxidant activity. Quercetin, the aglycone of rutin, is a flavonoid with a potent antioxidant activity that is present in buckwheat groats in a lower concentration. Tannins isolated from buckwheat showed a relatively high level of activity against Listeria monocytogenes. Recently, GABA and 2"-hydroxynicotianamine (2HN) have been found to serve as functional compounds in buckwheat. Seeds and sprouts contain GABA, while 2HN has been recently identified in buckwheat flour. In vitro and in vivo studies have shown that the consumption of buckwheat and buckwheat enriched foods is related to a wide range of biological and pharmacological activities: hypocholesterolemic, hypoglycemic, anticancer and anti-inflammatory (Malobika et al., 2009).

The gluten is a protein that is normaly digested and absorbed by humans except for those who are diagnosed with celiac disease (CD). CD is a genetic auto immune disease where the immune system perceives gluten as harmful. Some of the symptoms of celiac disease include weight loss, diarrhea, fatigue, vitamin and mineral deficiencies and osteoporosis (Alaedini and Green, 2005). Buckwheat is a gluten free pseudocereal.

Table 1 shows the physico-chemical observations recorded in buckwheat flour:

S. No.	Parameter	Mean
1.	Moisture (%)	11.12
2.	Ash (%)	1.80
3.	Crude fibre (%)	2.36
4.	Crude protein (%)	11.97
5.	Crude fat (%)	1.95
6.	% Water absorption	30.4
7.	Peak viscosity (cp)*	1080
8.	Dough development time (min)	2.5

***Peak viscosity conversion 1 rapid visco units (RVU) = 12 centipoise (cp)**
(Source: Quraazah (2014).)

Scope in Food Processing Sector

Groats: The primary type in which buckwheat is eaten as grain. In the processing of various products as refined flour, dehulled seeds (raw groats) are primarily used as breakfast cereals for human consumption. Roasted groats are used for cooking and are usually served as a "kasha" as potato and rice alternatives. The dehulling method is used to obtain good quality roasted groats (Baljeet et al., 2010).

Bakery: There is a trend in the bakery industry to develop innovative products. The bioactive components in our buckwheat flour show numerous beneficial effects on health, therefore, there is a significant interest in buckwheat for development of various bakery items (bread, noodles, biscuits), with potential functional components. Buckwheat-enriched wheat bread with more sugars has a stronger umami taste and a more characteristic aroma. Buckwheat-enriched wheat bread had the highest phenolic content and antioxidant activity. Proposing corn-buckwheat snacks as an attractive type of appetizer with increased nutritional properties (Mohamed et al., 2009). The biscuits enriched with buckwheat had increased spread, hardness and fracturability. Buckwheat sourdough, obtained through long fermentation of buckwheat flour carried out with naturally occurring Lactobacilli and yeasts, gained attention for wheat bread production. Therefore, appropriate starter cultures and process parameters have started to be exploited in buckwheat sourdough. Buckwheat noodles, also known as soba noodles, are normally made from a blend of common wheat flour and buckwheat flour.

Buckwheat honey: It's is a reddish-brown product with a strong animal aroma. Comparative studies described that it has higher antioxidant capacity, as well as flavonoid and total phenolic content compared to other honeys. It has been used as a protective agent against lipid oxidation in ground turkey and an inhibitor of heterocyclic aromatic amine formation in fried ground patties.

Buckwheat tea: It can be made of common or tartary buckwheat. Furthermore, buckwheat hulls, a by-product derived from the production of buckwheat products, has been also used for elaborating infusions. Although it has been described that the buckwheat tea shows lower antioxidant capacity and lower content of total phenolic compounds than the green tea, this product may be offered to the consumers as a new type of tea enriched in flavonoids, especially rutin and other compounds, such as quercetin and flavone C-glucosides.

Buckwheat tarhana: A traditional fermented cereal food, tarhana is prepared by mixing wheat products, yoghurt, some vegetables and spices. In terms of fat, ash, protein, mineral content (K, Mg, P) and lysine content, the addition of buckwheat improved the nutritional content of this soup.

Buckwheat sprouts: Sprouting is a simple way to obtain a commodity with a highly improved antioxidant potential, most likely derived from low molecular antioxidants and phytochemicals that are easily biosynthesized. Rutin and quercetrin concentrations notably increase after 7 days of seedling and chlorogenic acid moderately enhances.

Conclusion

The tremendous nutritional profile of buckwheat makes it a necessary crop in value addition of cereal based and other products. These new products prove to be health beneficial and safe. However, they are unfamiliar to consumers so, a proper knowledge regarding gluten free based products is to be popularized viz-a viz.

References

1. Alaedini, A. and Green, P.H.R. 2005. Natrative review: Celaic disease. Ann. International Medicine 142: 289-298.
2. Baljeet, S.Y., Ritika, B.Y. and Roshan, L.Y. 2010. Studies on functional properties and incorporation of buckwheat flour for biscuit making. International Food Research Journal 17: 1067-1076.
3. Gallagher, E. 2009. Gluten Free Food Science and Technology. Wily Blackwell Publishers, United Kingdom.
4. Malobika, B., Dubey, A.P., and Mathur, N.B. 2009. Prevalence of Celiac Disease in North Indian Children. Indian Pediatrics 46(17): 415-417.
5. Mohamed, A.E., Abd-Elmotaleb, N.M. and Baumy, H.A. 2009. Bioavailability of calcium from different sources for balady bread fortification. Egypt. J. Food Sci. 37(1): 26-38.
6. Quraazah . A. Amin. (2014). Safety and Quality Studies of various low gluten bakery products. PhD Thesis Division of FST. SKUAST Kashmir. India.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Molecular Breeding for Low Phytic Acid in Maize

Article ID: 11543

Gaurav Mahajan[1], Rashmi Bhumarkar[1], Ashish Kumar[2], Sharad Bisen[3]
[1]AICRP on Maize, Zonal Agricultural Research Station, J.N.K.V.V, Chhindwara, M.P. 480001, India.
[2]College of Agriculture, J.N.K.V.V, Jabalpur, M.P. 482001, India.
[3]College of Agriculture, Balaghat, J.N.K.V.V, Jabalpur, M.P. 482001, India.

Inositol hexakis - phosphate having empirical formula $C_6H_{18}O_{24}P_6$ is the salt form of phytic acid. It is primarily present as a salt of the mono- and divalent cations K^+, Mg^{2+}, and Ca^{2+} and accumulates in the seeds during the ripening period. Phytic acid is ubiquitous in eukaryotes and found in plants, animals and soil. Phytic acid regulates many cellular functions inside human body like responses to stress, development, homeostasis and phosphate sensing, repairing of DNA and editing of RNA and export mRNA through membranes. The biosynthesis of phytic acid is largely cytoplasmic and begins with the synthesis of phytic acid's backbone myo-inositol and its phosphorylation.

In maize grain approximately 75-80% is represented by phytic acid. For use by the growing seedling, during seed germination, the phytate salts are broken down by the activity of phystases releasing their phosphorous mineral and myo-inositol content for better growth. Presence of phytic acid in diet has a negative impact on the bioavailability of divalent, and trivalent mineral ions such as Zn^{2+}, Fe^{2+},Ca^{2+}, Mg^{2+}, Mn^{2+}, and Cu^{2+} as Phytate, behaving as negatively charged ion, works in a broad pH-region. Concerning to it, the result is negative effect on mineral uptake. Depending on the dietary habits of a person, amount of plant origin foods consumed, and food processing grade, high intake of phytic acid up to the range of 4500 mg on daily basis could prove fatal. Inhabitants of rural areas in developing and under developed countries having vegetarian diets, vegans and others who eat food of plant origin have estimated to consume 2000–2600 mg phytate per day.

Phytic acid chelates mineral nutrients (Manganese, Calcium, Iron, Zinc, Magnesium, etc.) and provides minerals in phytate which is non- bioavailable to humans and monogastric animals such as poultry, swine and fish, it is considered as an anti-nutritional. Any animal that does not belong to ruminant could not typically bio-available the phosphorus bound to phytic acid. As the ruminant animals having compound stomach can regurgitate their food. The rumen, first stomach chamber, contains enzymes and microbes that aid digestion there by separating phosphorus in phytates. Humans and other non-ruminant are devoid of such process.

Besides human consumption 60% of maize is used as poultry feed. The distribution of phytate in maize seeds, where 80% of phytate accumulates in the embryo and scutellum. Beyond it role in phosphorus storage phytic acid is a very important signaling molecule involved in different regulatory processes during plant development and responses to different stimuli. Consequently, many *lpa* mutants show different negative pleitotropic effects. Presence of phytic acid in the seed, which binds with phosphorus and other minerals like iron, zinc and magnesium, make it not available to the monogastric animals. In order to overcome this issue, fungal phytases were supplemented to break down phytic acid, but it adds on to the cost of feed. phytic acid is an environmental pollutant the phosphorus unleashed from undigested phytic acid is excreted by monogastric animals can cause phosphorus pollution. Development of varieties with low phytic acid levels therefore is important from nutrition as well as environmental perspectives. Thus the wise approach to address this issue is by utilsing the genetic resources and formulating breeding strategies for the development of pre-breeding lines with low phytate further these lines can be utilized in hybrid development programmes.

Potential of breeding programme targets for reducing phytic acid levels during seed development. phytic acid synthesized primarily in the cytoplasm and is stored in protein storage vacuoles (PSV). Many scientists have achieved the target of reducing phytic- acid content of seeds by transgene- mediated silencing expression of an ABC transporter encoded by the maize *lpa1* locus. So far, in maize, three low phytic acid (*lpa*) mutants have been isolated, viz. *lpa1, lpa2* and *lpa3*. These mutant lines are important genetic resources to develop low phytic acid maize crops. The *lpa1* mutation is caused by a mutation in a gene that encodes trans membrane transporter protein (ZmMRP4), which is hypothesized to load phytic acid into protein storage vacuoles of maize seed. The *lpa2* mutation is caused by a mutation in inosotol phosphate kinase gene (ZmIpk4), which along with other kinases leads to phytic acid synthesis. The *lpa2-1* mutation is caused by genomic sequence rearrangement in the ZmIpk. The *lpa2-2* mutation, caused by a single nucleotide change (i.e. C to T at nucleotide position 158), generates a stop codon in the N-terminal region of the ZmIpk open reading frame. The *lpa3* mutation is caused by a mutation in a gene that encodes *myo* -Ins kinase, which catalyzes the production of Ins(3)P 1 in maize seed. Compared with wild-type kernels, the *lpa 1, lpa2-1, lpa3* mutations achieved 66%, 50% and 50% reduction in phytic acid content, respectively. The *lpa2-2* mutation achieved a 30% reduction in phytic acid content and a three-fold increase in inorganic phosphate. The mutant lines are temperate maize lines that are not adapted to local tropical and subtropical conditions. Therefore, there is a need to have the *lpa* locus introgressed into locally adapted agronomically superior lines to improve their nutritional benefit.

Also, PA reduces the phosphorous availability required for growth in mono-gastric animals, which digest PA poorly. Moreover, undigested PA eliminated by the monogastric animals into the environment leads to an increase in phosphorous level in the environment and contributes to water pollution. Also, PA reduces the phosphorous availability required for growth in mono-gastric animals, which digest PA poorly. Moreover, undigested PA eliminated by the monogastric animals into the environment leads to an increase in phosphorous level in the environment and contributes to water pollution.

Marker assisted backcross breeding (MABB) provides a great opportunity for transfer of desirable trait of interest into the genetic background of a recipient genotype by recurrent backcrossing and also to recover the recurrent parent genome as rapidly and completely as possible. Therefore, MABB that involves introgression of *lpa2-2* recessive allele for low phytate trait from the donor *lpa2-2* mutant into a locally well-adapted agronomically superior line using a series of backcrosses and selection of lines possessing *lpa2-2* trait from each backcross progenies, with the help of markers, is an effective strategy for developing low phytate maize. The selection of lines possessing *lpa2-2* trait from each backcross progenies is a challenging task because it requires destructive sampling to measure the amount of phytic acid in maize grain. Also, the selection takes time and therefore the selection has to be deferred until when adequate seed can be produced to allow destructive sampling. Therefore, the development of a co-dominant molecular marker will enable quicker selection and make maize breeding for Low Phytic Acid efficient and fast, and it will enable the earlier release of *lpa2-2* varieties.

E-ISSN: 2581 - 8317

Integrated Farming System-Eco-Friendly Approach for Doubling the Farmer's Income

Article ID: 11544

N. M. Vasava[1], M. P. Dohat[2]
[1]Agriculture Officer, Department of Agronomy College of Agriculture, AAU, Vaso.
[2]Assistant Professor, Department of Agronomy, College of Agriculture, AAU, Vaso.

Problems of Present-Day Agriculture

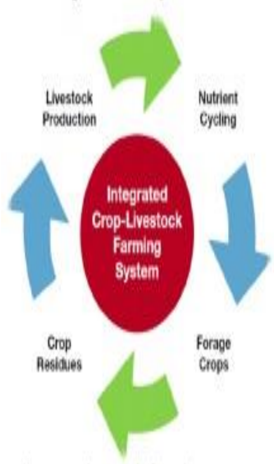
1. Decline in agriculture growth rate.
2. Decline in factor productivity.
3. Static or decline in food production.
4. Increase in malnutrition.
5. Shrinkage in net cultivable area.
6. Increasing environmental pollution.
7. Depleting ground water table.
8. Increasing cost of production.
9. Low farm income.
10. Increasing unemployment.

What is the solution ?

" Integrated Farming Systems "

Integrated Farming System

Integrated Farming as a farming system where high quality food, feed, fibre and renewable energy are produced by using resources such as soil, water, air and nature as well as regulating factors to farm sustainably and with as little polluting inputs as possible.



Key Principles

Cyclic: Farming system is essentially cyclic. Therefore, management decision related to one component may affect to others.

Rational: Rational use of crop resource is major route to get out of poverty. For resource poor farmers the correct management of crop residues, together with an optional allocation of scare resources, leads to sustainable production.

Ecologically sustainable: Combining ecological sustainability and economic viability, the integrated livestock-farming system maintains and improves agricultural productivity while also reducing negative environmental impacts.

Concept

1. An arrangement of recycling products/by-products of one component as input to another linked component.
2. Reduction in cost of production.
3. Increase in productivity per unit area.
4. Increase in total income of farm.
5. Effective utilization of family labours around the year.

Why IFS is Needed?

1. For reducing the risks due to biotic and abiotic stresses.
2. High input costs.
3. For meeting the rising need of food, feed, fibre, fuel and fertilizer.
4. Nutritional requirement of family.
5. Increased demand of soil nutrients.
6. For increasing the income and Employment.
7. Standard of living.
8. Sustainability.

Objectives

1. Maximization of yield of all component enterprises to provide steady and stable income at higher levels.
2. Rejuvenation of system's productivity and achieve agro-ecological equilibrium.
3. Control the buildup of insect-pests, diseases and weed population through natural cropping system management and keep them at low level of intensity.
4. Reducing the use of chemical fertilizers and other harmful agro-chemicals and pesticides to provide pollution free, healthy produce and environment to the society at large.

Ideal Situations for Introduction of IFS

1. The farmer wishes to improve the soil quality.
2. The farm household is struggling to buy food or below the poverty line.
3. Water is stored on-farm in ponds or river-charged overflow areas.
4. Soil salinity has increased as a result of inorganic fertilizer use.
5. The farmer is seeking to maximize profits on existing holding.
6. The farm is being eroded by wind or water.
7. The farmer is looking to reduce chemical control methods.

Components in IFS

Agriculture	Apiary	Poultry	Sheep rearing	Mushroom culti.	Kitchen gardening
Horticulture	Sericulture	Goat rearing	Fish farming	Azolla farming	Fodder production
Forestry	Dairy	Vermiculture	Pigeon	Nursery	Value addition

Factors Determining Integration of Farm Enterprises

1. Soil and climate feature of selected area.
2. Availability of the resources, land labor and capital.
3. Present level of utilization of resources.
4. Economics of proposed integrated farming system.
5. Managerial skill of farmer.

Factor Deciding Nature and Size of Enterprises

1. Farm size.
2. Marketing facilities.
3. Climate.
4. Technologies available.
5. Soil type and condition.
6. Credit facility.

7. Skill/Knowledge.

IFS Concerns of Eco-Friendly Sustainable Agriculture

Water concern	Landscape concern
Air quality concern	Soil erosion concern
Biodiversity concern	Food safety and animal welfare concern

Integrated-Farming Systems for Different Agro Eco-System

The improved cropping systems which form the major component of farming system were evaluated. Depending upon the ecosystem, the enterprise mix will vary. Generally, there are three different farming situations are:

1. Irrigated low and uplands.
2. Rainfed and dryland areas.
3. Hill regions.

Irrigated Upland

Components like Dairy, Poultry, Goat, Sheep, Piggery, Sericulture, Mushroom, Apiary, Pigeon and Rabbit etc. can be easily integrated in an irrigated upland farm. Perennial trees like coconut and other fodder and multipurpose farm forestry trees can be grown along the borders of the fields and boundary of the farm.

Special Features of Irrigated Upland

Wide range of crops and varieties can be grown, Effective resource utilization and management is possible due to controlled irrigation system. The control and management of available resources in more effective manner paves the way to integrate two are more components with cropping. The choice of components is many in irrigated upland compared to lowlands and rainfed lands.

Irrigated Upland

The following are some of the examples of Integrated Farming System for irrigated uplands:

1. Crop + Dairy + Biogas unit.
2. Crop + Poultry + Biogas unit.
3. Crop + Sheep / Goat rearing + Biogas unit.
4. Crop + Sericulture.
5. Crop + Piggery.

Lowland Integrated Farming System

Mostly rice is the principal crop in our low lands. Crops like Banana, Sugarcane and Coconut are also grown in this ecosystem. Diversified farming (IFS) can be adopted in the low lands with the components like Fish, Poultry, Duck and Mushroom. Cropping in low land (Wetland) is considered to be less risky due to abundant availability of water. In addition, most of the low land soils are heavy type of soils, which are fairly fertile soil.

Lowland Integrated Farming System

The following are some of the examples of Integrated Farming System for wetland situation:

1. Rice + Fish + Azolla.
2. Rice + Fish + Poultry.
3. Rice + Fish + Poultry -Mushroom.
4. Crop + Pigeon + Goat.
5. Crop + Piggery + Duck.

Rainfed and Dryland Areas

The dryland ecosystem is characterized by:

1. Inadequate and uneven distribution of rainfall.
2. Poor and marginal soils.
3. Low cropping intensity.

4. Limited crop diversification.
5. Low value crop.

The cropping season is restricted to 4-5 months and people remain without employment for rest of the year. Diversification of cropping by integrating with components like livestock (Sheep/Goat rearing), silviculture, horticulture tree crops and pastures would improve the standard of living and employment opportunities of the dryland farmers.

Rainfed and Dryland Areas Integrated Farming System

The following are some of the examples of Integrated Farming System for dryland situation:
1. Crop + Goat
2. Crop + Goat + Agro forestry
3. Crop + Goat + Agro forestry +Horticulture
4. Crop + Goat + Agro forestry +Horticulture + Farm Pond
5. Crop + Goat + Buffalo + Agro forestry + Farm Pond

Hilly Regions

This system refers to combination of forest, agriculture, livestock and fisheries with well-founded soil and water conservation base. The rain water is collected from catchment of protected hill tops of above 100 % slops in pond with seepage control. Silt retention tanks are constructed at several points before the runoff water enters in the pond. The cultivation fully depends on the amount of water stored in the pond. This system is generally practiced in high altitude hilly areas, where it is not possible to construct terraces and or irrigation channels across the slope.

Hilly Regions Integrated Farming System

The following are some of the examples of Integrated Farming System for hilly region situation
1. Agriculture + Horticulture.
2. Agriculture + Horticulture + Livestock.
3. Agriculture + Horticulture + Fisheries +Livestock.
4. Agriculture + Horticulture + Silviculture.
5. Agriculture + Horticulture + Livestock.
6. Agriculture + Livestock.

Limitations of IFS

1. Lack of awareness about sustainable farming systems.
2. Unavailability of varied farming system models.
3. Lack of credit facilities at easy and reasonable interest rate.
4. Non-availability of ensured marketing facilities specially for perishable commodities.
5. Lack of deep freezing and storage facilities.
6. Lack of timely availability of inputs.
7. Lack of knowledge/education among farming community specially of rural youth.

Conclusion

1. In conclusion IFS enhances productivity, profitability and nutritional security of the farmer and sustains soil productivity through recycling of organic resources.

2. In a well-organized IFS, labour intensive enterprises like dairy, poultry, fruits, vegetables, sericulture, mushrooms etc. can be significantly increase the man days of employment and income to the farm families in particular to small and marginal farmers, where the surplus of farm labour is available, especially women in the rural India.

3. IFS helps in conservation of resources by efficient recycling of crop and animal waste that generated within the system in the form of composts helps in reducing the usage of inorganic fertilizers and agrochemicals, thereby minimizing the environmental hazards.

4. The loss of biodiversity due to monocropping will be considerable retrieved by IFS. Increased biodiversity and enzymatic activities in the IFS encourage the mineralization of nutrients and quick decomposition of organic residues.

5. IFS is a promising strategy for the small and marginal farmers of India to accelerate the farm income and agricultural growth, this transforms the rural farmers life to prosperous.

References

1. Ansri,M.A., Prakash, N., Baishya, L.K., Punitha, P., Sharma, P.K., Yadav. J.S., Kabuei, G.P., Levis,K .L.(2014). Indian journal of Agricultural Sciences.84(3);356-62
2. Bahera, U.K., Giri, A., Mishra, A.,& Pal, G. (2017). Indian Journal of Hill Farming. 30(2);295-306.
3. Basavanneppa, M.A., & Gaddi, A.K. (2020). International journal of chemical studies.8(2);955-958.
4. Channabasavanna, A.S., & Biradar, D.P. (2007). Karnataka J.Agric. Sci. 20(4);706-709.
5. Kumar, R., Patra, M.K., Thiruganavel, A., Deka, B.C., Chatterjee,D., Borah,T.R., Rajesha,G.,Talang,H.D.Kumar,M. & Upadhyay,P., K.(2018). Indian Journal of Agric.Sci.88(11);1722-29.
6. Netam,A.K., Sahu, B., & Netam, C.R. (2019). Int. Curr.Microbiol.App.Sci. 8(4);822-829.
7. Panwar,A.S., Syiemlieh,H.,Kalitha, L.,Tahshildar,M.,Bhujel,S.,Das,A., Ramkrushna,G.I., & Layek, J. National seminar on sustaining hill agriculture in changing climate:5-7 dec.,2015, Agrtala, Tripura.
8. Patel A.M. (2019) AICRP on IFS Annual_Report 2018-19. Page no.1-30.
9. Rajappa, J.J.,Venkatesh,A., Puran chandra & Mohapatra, K.P.(2015). Conservation Agriculture for Advancing Food Security in Changing Climate 1 : 301-31.
10. Ramarao, W.T., Tiwari,S.P., Singh, P. (2019). Livestock research for rural development.18(7);1-4.
11. Zaman,A. (2019). New India publishing agency, New Delhi, 53-73.

E-ISSN: 2581 - 8317

Nutritional Management for Sheep and Goat

Article ID: 11545

Mir Nadeem Hassan[1], Iqra Hussain Shah[2], Ajaz A. Ganie[3], Manzoor A. Yatoo[4]
[1]Scientist Krishi Vigyan Kendra Budgam, [2]Ph D Scholar Vety. Public Health SKUAST-K, [3]Scientist KVK Srinager, [4]Assistant Professor FAO Wadura SKUAST-K.

Introduction

Proper nutritional management is essential to exploit the full genetic potential of the cross bred sheep. Feed accounts for 55-60% in the total cost of rearing the sheep. The right kind of nutrition provided at the right stage is essential to the profitable production of sheep and goats. It is required to produce a high-percentage crop, to wean heavy animals, and to develop satisfactory flock replacements. The ideal program also is efficient and economical, and minimizes nutrition-related problems. To succeed, sheep and goat reares should have the basic knowledge of animal nutrition, be familiar with common nutrition terms, and understand nutritional requirements at different stages of animal life. This begins with knowledge of the essential nutrients these small ruminants need; energy (fat and carbohydrates), protein, vitamins, minerals, water, and fiber, and their roles in growth, production, and reproduction of the animal. Nutritional requirement of sheep at different ages is given below.

Feeding of Preweaned Lambs from Birth to 90 Days of Age

The most critical peroid in the life of the lam is first 48 hours. If a lamb is unable to nurse within half an hour after birth, it should be assisted to suckle to get the advantage of colostrum @ 1/10th of the body weight normally at three times a day. The normal birth weight of lamb/kid is 2-3 kg and from 3 days onwards milk at the same rate as mentioned above. The feeding schedule for lambs and kids is given in table 1 and table 2 respectively.

Advantages of Colostrums Feeding

1. Immunity
2. It is good source of vitamin A and Vitamin D along with minerals like copper, iron, manganese, magnesium etc.
3. Laxative in nature and help in easy passage of meconium (first faeces).

Table 1:Feeding schedule for lambs:

Age	Milk (ml/day)	Creep mixture (g)	Green fodder (g)
0- 3 days	1/10th of B.Wt (3 times /day)	---	---
4-30 days	1/10th of B.Wt (3 times /day)	Small quantity	Small quantity (started at 15 days)
31-60 days	1/10th of B.Wt (2 times /day)	50 – 150	Ad lib
61-90 days	1/10th of B.Wt (2 times /day)	150 – 200	Ad lib

Table 2: Feeding schedule for kids:

Age	Live wt. (kg)	Milk (ml/day)	Creep mixture (g)	Green fodder (g)
0- 3 days	2- 2.5	400 ml	---	---
3-15 days	2.5- 3.5	400 ml	---	---
16-30 days	3.5 – 4	500 ml	Small quantity	Small quantity
31-60 days	4 – 6	600 ml	50 – 150	50 – 100
60-75 days	6 – 7	400 ml	100 - 150	250 – 300
75-90 days	7 – 8	200 ml	150 - 200	250 – 300

Creep Feeding

The creep is small enclosure in a sheep pen having opening wide enough for lambs to pass in while ewes are kept back. The practice of providing supplement feed to nursing lambs is called creep feeding. The creep feeding is done from 10 days of age to 90 days to promote growth during early age feeding and rumen development (Table 3):

Table 3: Composition of creep feed:

Composition	Percentage
Maize	40%
Groundnut Cake	30%
Wheat Bran	10%
De-oiled Rice Bran	13%
Molasses	5%
Mineral Mixture	2%
Salt	1%

(Fortified with vitamin B1, B, D and antibiotic feed supplement)

The creep feed should have DCP = 17.4% and TDN = 73%.
The weaning should be done at 90 days of age and average body weight attained at this age should be around 14 kg.

Feeding of Growing (Finishing Lambs/Kids from Growing to Slaughter)

Extensive system will not meet the requirement of growing finishing lambs. Hence should be given concentrate mixture to supplement the nutrients obtained through grazing (Table 4 and 5).

Table 4: Composition of concentrate mixture:

Ingredients	Percentage	OR	Ingredients	Percentage
Maize	25%		Maize / Jowar	30%
Wheat bran	32%		Groundnut cake	20%
Gram waste	26%		De-oiled rice bran	40%
Groundnut cake	15%		Molasses	8%
Mineral mixture	1%		Mineral mixture	1%
Salt	1%		Salt	1%

The concentrate mixture should contain DCP = 13% and TDN =65%-70%

Table 5: Feeding schedule for finishing Lambs/Kids:

Body weight	Concentrate mixture (g)	Roughage (g/day)
12-15 kg	200	400
16- 25 kg	250	600
25 – 35 kg	300	700

Note: - 8-hour grazing can be substituted in place of roughage.

Cross bred sheep should attain more than 30 kg of body weight by 6 months of age.

Feeding of Lactating/Suckling Ewe

After lambing proper care should be taken while feeding mother ewes, only little grain mixture should be fed during first 2-3 days and ewe should be given good quality forage. Dry matter consumption may go upto 4% of body weight. Lactating sheep require twice the maintenance requirement during first two months of lactation followed by 1.5 times the maintenance during remaining period if twins are born or additional 200g concentrate is given per kg milk produced. The maintenance requirement of concentrate diet for sheep is 250g/day. Feeding of supplemental concentrate mixture can gradually be diminished after 8-10 weeks of lambing and can be stopped after 12-13 weeks of lambing, as lambs are weaned from mother the ewes may be maintained on grazing alone and continue until the next breeding season (Table 6).

Table 5: Feeding Schedule for Lactating/Suckling Ewes:

S. No	Stage of lactation	Concentrate diet (g/day)	Roughage
	0-2 months of lactation	400-500 g (250g Maintenance + 200-250 lactation)	8-hour grazing
	2-3 months of lactation	375g	8-hour grazing

Feeding of Pregnant Ewes During Last Six Weeks of Gestation

During this stage the ewes need more energy, protein, minerals & vitamins to meet the increased requirements for feotal growth and development of the potential for high milk production. Pregnant ewe cannot consume sufficient bulk roughage as the space in the abdomen is reduced due to growth of feotus & its membranes; it has to be fed with good quality forage (cereal fodder 6% DCP and 60% TDN) & a concentrate mixture supplement @ 500g/day. Before 5-7 days before kidding, number of concentrates should be reduced to about 100-150g/day and laxative diets comprising of soaked bran, leguminous green fodder, hay etc should be given in ample quantity.

Practical way to find out whether the ewe in advanced pregnancy is receiving their quota is to check the average daily gain of 100g for smaller breed & 150g for larger breeds is a fair measure of nutrient intake status.

Feeding Requirement for Breeding Rams

Sufficient green fodder (more than 8 hr grazing) and concentrate mixture @ 500g/day must be given during breeding season.

Conclusion

Nutrition constitutes nearly 60-70% of input cost in sheep and goat rearing. Proper nutritional management of sheep and goat is essential for utilization of full genetic potential of the animal. Colostrum supplementation within first eight hours is essential, as it provides nutrients and immunity to the newborn lamb/kid besides helping in passing out the meconium. Proper care must be taken to ensure feeding of sheep and goat especially during the extreme winter months when the animals are stall fed and there is scarcity of lush green fodder.

Bottom Line

A veterinarian should be contacted for devising the best formulation based on locally available feed & fodder sources.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Identification of Single Nucleotide Polymorphism (SNP) Markers in Crop Plants

Article ID: 11546

S M Samyuktha[1], S Geethanjali[2]
[1]Assistant Professor (Plant Breeding and Genetics), Imayam Institute of Agriculture and Technology, TNAU, Tamil Nadu – 621 206.
[2]Assistant Professor (Plant Breeding and Genetics), Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu – 641 003.

Introduction

Molecular markers are widely used in plant research and plant breeding. In the plant breeding process, markers are being used for increasing the speed of plant selection mainly through marker-assisted selection (MAS) on the basis of selection of individual genes or chromosomal segments. Molecular markers are also being used for the analysis of population structure, the study of evolutionary relationships, and the study of the genetic structure of individuals at the whole-genome level. In recent years, single nucleotide polymorphism (SNP) markers are increasingly becoming the marker system of choice. SNPs are single base changes that arise due to point mutations. SNPs are the most common and abundant form of genetic variation in organism. On an average, a base pair change can be detected at the rate of one in 500 nucleotides. These genetic polymorphisms have evolved as useful DNA markers finding applications in trait-based association mapping and disease diagnosis. Although SNPs are needed in large numbers, only low numbers of validated SNP markers are available. Identification of SNPs in crop plants is pivotal step to utilise them as valuable markers.

Methods for the Identification of Single Nucleotide Polymorphism (SNP) Markers

1. Identification of SNPs based on sequenced genomes.
2. Identification of SNPs based on EST sequence data.
3. Identification of SNPs based on array analyses.
4. Identification of SNPs based on amplicon resequencing.
5. Identification of SNPs based on RNA seq technology.

Identification of SNPs Based on Sequenced Genomes

Whole genome of many organisms has been sequenced and made publicly available in the recent years. Whole genome sequences are a common choice for SNP identification. Here the SNPs can be directly mined by comparing the genome sequence of a target genotype with the reference genome. Identification of SNPs based on sequenced genomes has been reported in several crops such as Rice, Arabidopsis, Grapes, Populous etc.,

The rapid advancements in next generation sequencing technologies such as 454, Illumina, SOLiD, have made it feasible to sequence either fully or partially the genome sequences of organisms including orphan crops at a relatively lower cost. The availability of genome sequences would permit the identification of SNPs in crops plants at a much faster pace. While a large number of SNPs can be identified through whole genome analysis, most of them lie in the non-coding regions. Their functional role is unknown and makes it difficult to apply them for trait-based mapping.

Identification of SNPs Based on EST Sequences

Compared to a whole genome analysis, targeting specifically the coding regions which are expressed functionally would help in the identification of more informative SNPs. Expressed sequence tags are short DNA sequences generated from cDNA libraries constructed using the traditional cloning and Sanger sequencing technology. Expressed sequence tags (ESTs) have been generated for many crop species. The number of available ESTs in the NCBI EST database (URL: http://www.ncbi.nlm.nih.gov/dbEST) range from less than 10,000 for less investigated crops to more than a million ESTs for major crops. In some cases, ESTs have been specifically generated for SNP identification from different lines as in *Arabidopsis thaliana* and in other cases ESTs from heterozygous highly polymorphic individuals were used for SNP identification using bioinformatic analysis methods. The sequence quality of the ESTs is usually not very high. The number of identified SNPs is relatively low in many species with validation rates usually between 50 and 85%.

Identification of SNPs Based on Array Analyses

The identification of SNPs based on array analyses involves the use of arrays containing oligonucleotides derived from large numbers of genes. Such arrays are not only used for the study of expression levels of individual genes but also for the identification of SNPs when the hybridization patterns generated with cDNA or DNA samples from different individuals are being compared. Compared discovery of SNPs based on ESTs, this approach covers many more (10,000–20,000) genes without an expression level bias.

Identification of SNPs Based on Amplicon Resequencing

Amplicon resequencing involves the development of primers for the amplification of DNA fragments derived from genes, ESTs or other single copy genomic sequences. The amplification products from a number of representative lines are fully sequenced and the obtained sequences are subsequently compared with one another using sequence alignment tools and bioinformatic pipelines. The advantage of this approach is that the sequence from each investigated individual is determined through double-strand sequencing and SNPs can be identified in a very reliable way with a false discovery rate usually below 5%.

Identification of SNPs Based on RNA Seq Technology

Transcriptomics, the study of complete transcripts in a cell is a potential tool to understand the functional elements of a genome. A recent development gaining momentum in transcriptome profiling is the RNA seq technology. High through put RNA sequencing enables to analyse the expression of several thousand transcripts in an organism at a reduced cost. By comparing these sequences with reference sequence, SNPs can be identified from the transcribed or coding regions. Particularly, the SNPs in these regions that cause mis-sense mutations are of great interest, as they result in alteration of protein function and can find immediate application in marker assisted selection. In species where a reference sequence is not available, SNPs can still be called by using pooled samples of individuals for RNA seq. RNA seq has been used for typing SNPs in crops such as Arabidopsis, Red clover, Mandarin and Populus.

Conclusion

The large-scale identification of SNPs in crop plants is still a challenging attempt, whether the entire genome or only the coding regions of genes are surveyed for SNPs. Whole genome sequencing may be still at a far reach for unexplored and orphan crops. Specific sequencing of amplicons and RNA seq are prosmising as the most viable approach for the identification of large numbers of SNPs for most crop plants. In addition to the existing technologies, new approaches are also being explored for SNP identification. At present, high expectations are being placed on one such novel strategy that involves a process called sequence capture which has been successfully used for SNP detection in exons of the human genome. With the accumulating sequence information, it is expected that large numbers of SNPs can be identified in a fast and effective manner.

References

1. Borevitz, J.O., Liang, D., Plouffe, D., Chang, H.S., Zhu, T., Weigel, D., Berry, C.C.,Winzeler, E. and Chory, J. (2003). Large-scale identification of single-feature polymorphisms in complex genomes. Genome Research, 13:513-523.
2. Collard, B.C. and Mackill, D.J. (2008). Marker-assisted selection: an approach for precision plant breeding in the twenty-first century. Philosophical Transactions of the Royal Society B, 363:557-572.
3. Ganal, M.W., Altmann, T. and Roder, M.S. (2009). SNP identification in crop plants. Current Opinion in Plant Biology, 12(2):211-217.
4. Pavy, N., Parsons, L.S., Paule, C., MacKay, J. and Bousquet, J. (2006). Automated SNP detection from a large collection of white spruce expressed sequences: contributing factors and approachesfor the categorization of SNPs. BMC Genomics,7:174.

Nutritional Attributes of Pleurotus Spp. – An overview

Article ID: 11547

Gurvinder Kaur[1]
[1]School of Agricultural Sciences and Technology, RIMT University, Mandi Gobingarh- 147301, Punjab, India.

Introduction

Pleurotus mushrooms are considered healthy because of richness in proteins, fiber, vitamins, and minerals (Jegadeesh, 2021). *Pleurotus* species are commercially essential mushrooms and widely cultivated throughout the world. The production of *Pleurotus* mushrooms alone accounts for around 25% of that total cultivated mushroom globally (Feeney *et al.,* 2014). *Pleurotus* mushrooms are rich in proteins, dietary fiber, essential amino acids, carbohydrates, water-soluble vitamins, and minerals. These mushrooms are abundant in functional bioactive molecules, though to influence health. *Pleurotus* mushrooms are finding unique applications as flavoring, aroma, and excellent preservation quality. Apart from its unique applications, *Pleurotus* mushrooms have a unique status delicacy with high nutritional and medicinal values.

	
Pinhead formation	**Fruiting Body**

Health Benefits

Mushrooms have been attracting attention of mankind since ancient times and use of mushroom as food is as old as human civilization. They have considerable importance in the human diet as they are rich in protein, non-starchy carbohydrates, dietary fiber, minerals, and vitamin-B and have no cholesterol, and negligible amount of fat. Mushroom proteins are of high quality and they contain an abundance of essential amino acids.

The active constituents found in *Pleurotus* mushrooms are polysaccharides, dietary fibers, oligosaccharides, triterpenoids, peptides, proteins, alcohols and phenols, and mineral elements such as zinc, copper, iodine, selenium and iron, vitamins, and amino acids. These have been found to boost the immune system, have anti-cancerous properties, and act as anti-hypercholesterolaemic and hepato-protective properties. Pleurotus species are excellent food for the people suffering from hypertension and cardiovascular diseases due to high potassium and sodium content.

The chemical composition of the fresh fruiting bodies of Pleurotus species constitutes of a large quantity of moisture (90.8%). Mushrooms are rich in proteins (30.4 %), fat (2.2 %), carbohydrates (57.6 %), fiber (8.7 %) and ash (9.8 %) with 345 K (cal) energy value on 100 g dry weight basis and vitamins such as thiamin (4.8 mg), riboflavin (4.7 mg) and niacin (108.7 mg), minerals like calcium (98 mg), phosphorus (476 mg), ferrous (8.5 mg) and sodium (61 mg) on 100g dry weight basis (Sadler, 2003). Oyster mushrooms are highly edible and has considerable amount of human dietary and nutritional value.

Conclusion

Mushrooms have been associated with humankind and provide profound biological and economic impact. From ancient times, man has consumed wild mushrooms with delicacy probably, for their taste and pleasing flavour. Edible mushrooms provide high quality of protein that can be produced with greater biological efficiency than animal protein, rich in fibre, minerals and different types of vitamins especially, vitamin B Complex and Vitamin C and have low fat content, with high proportion of polyunsaturated fatty acids relative to total content of fatty acids. Fresh mushrooms contain relatively large amount of carbohydrate (4-5%) and fibre but, in mushrooms, starch is absent. Mushrooms also contain significant amount of phosphorous, sodium and potassium with lesser amount of calcium and iron. Mushrooms have many potential medicinal uses. Specially, *Pleurotus* spp. has naturally produces isomers of lovastatin, which are well-known blood cholesterol reducing compounds (Ganesan and Xu B, 2018).

References

1. Feeney M. J., Dwyer J., Hasler-Lewis C. M., (2014). Mushrooms and health summit proceedings. J Nutr.144(7):1128S–1136S
2. Ganesan K., Xu B., (2018). Anti-Obesity Effects of Medicinal and Edible Mushrooms. Molecules. 5: 23(11)
3. Golak-Siwulska I., Kaluzewicz A., Spizewski T., (2018). Bioactive compounds and medicinal properties of Oyster mushrooms (Pleurotus sp). Folia Hortic. 2018; 30(2):191–201.
4. Jegadeesh R., Kab-Yeul J., Youn-Lee Oh., Minji Oh., Ji-Hoon Im, Hariprasath Lakshmanan & Vikineswary S., (2021). Cultivation and Nutritional Value of Prominent Pleurotus spp.: An Overview. Mycobiology, 49:1, 1-14,
5. Sadler M., (2003). Nutritional properties of edible fungi. Nutrition Bulletin, 28, 305–308.
6. Singh M.P., Singh V. K., (2011). Yield performance and nutritional analysis of Pleurotus citrinopileatus on different agro wastes and vegetable wastes. Paper presented at: The 7th International Conference on Mushroom Biology and Mushroom Products; Arcachon, France.
7. Suguimoto H. H, Barbosa A. M., Dekker R.F., (2001) Veratryl alcohol stimulates fruiting body formation in the oyster mushroom, Pleurotus ostreatus. FEMS Microbiol Lett. 194 (2):235–238.

Fungal Diseases of Gladiolus- An Overview

Article ID: 11548
Gurvinder Kaur[1]
[1]School of Agricultural Sciences and Technology, RIMT University, Mandi Gobingarh- 147301, Punjab, India.

Introduction

Gladiolus *(Gladiolus grandiflorus)* are belonging to Iridaceae family and are native to South Africa. It is cultivated throughout the world. It comprises over 180 species with more than 30,000 cultivars, out of which above 20 are grown for commercial flower production (Mishra et. al., 1989). Gladiolus have become a major crop in the florist industry in India. Although the crop can be propagated sexually from seeds, most of the industry is based on movement of corms and cormels, which leads to many diseases being disseminated with the crops like Botrytis grey mold, corm rot, blight, wilt and curvularia leaf spot are the most limiting fungal diseases.

Fungal Diseases

1. *Botrytis* grey mold: *Botrytis cinerea* causes blossom blight, bud rot, stem canker, stem and crown rot, cutting rot, leaf blight and damping-off or seedling blight. *Botrytis* disease of gladiolus has two distinct phases: corm rot in storage and a leaf and flower spot and collar rot in the field. The leaf spot phase of *Botrytis* blight often appears when infected flower petals or other plant parts fall on the leaves and the pathogen invades healthy tissue. The resulting lesion often assumes the outline of the fallen, infected tissue. If the leaves are wet or high humidity conditions prevail, the spots enlarge, merge and become irregular, brown, and water-soaked. If high humidity continues, the lesions become covered with coarse, tan to gray masses of *Botrytis* spores. Lesions commonly develop at the leaf margins as a result of entry through a guttation droplet, resulting in a V-shaped blotch. On corms slightly sunken, round, straw colored or greenish brown to dark brown spots developed.

Botrytis grey mould

2. Wilt: *ĐFusarium* wilt or yellows of gladiolus is a common problem which is caused by *Fusarium oxysporum* f. sp. *gladioli*. The infected plants show symptoms of yellowing, bending of spikes, and inability to bloom, production of small sized florets, drying and eventual death of plants. *Fusarium* corm rot can be observed both in field and during storage (Riaz et. al., 2010).The infected corms in storage develop brown to black lesions and eventually become mummified. Conventional management practices for Fusarium wilt disease include corm treatment with fungicides and soil fumigation. These measures are time consuming and labour intensive which also increase the cost of cultivation.

Fusarium wilt

3. Curvularia leaf spot: The disease curvularia leaf spot causes severe spotting of the stems, leaves, spikes, flowers and even the corms. In starting spots are white eventually turned brown. The lesions on leaf developed into oval to circular spots, which were surrounded with an obvious yellow halo. The spots expanded and coalesced, causing leaf blight.

Conclusion

Good sanitation practices, including grooming the plants and removing spent or senescing flowers, can minimize the potential for infection. These affected tissues should be carefully removed and discarded when they are dry. It is also important to avoid wetting the flowers when watering, and crowding plants. Adequate spacing between the plants can promote good air circulation. Any corms with symptoms of infection should be rogued and destroyed. It is also important to dig the corms during dry weather and to cure them properly.

References

1. Elmer W.H., Kamo K.K., (2018). Diseases of Gladiolus. In: McGovern R., Elmer W. (eds) Handbook of Florists' Crops Diseases. Handbook of Plant Disease Management. Springer, Cham
2. Misra RL, Singh B., (1989). Gladiolus. Commercial flowers. In: Bose TK, Yadav LP, editors. Calcutta: Naya Prokash. 874 p.
3. Riaz T., Khan S. N., Javaid A., (2010). Screening of Gladiolus germplasm for agronomic performance and resistance against corm rot disease. African J Biotechnology. 9(40):6701–6707.
4. www.stoopflowerbulb.nl

E-ISSN: 2581 - 8317

Centauri Honey: A Costliest Honey in the World

Article ID: 11549

Arunkumara C. G.[1], Achanta Sravika[2], Aravinda[3], Manjuprakash[1]
[1]Senior Research Fellow, Department of Apiculture, UAS, Bangalore.
[2]Assistant Professor, Sri Krishna Devaraya College of Horticultural Sciences.
[3]Ph. D Scholar, Department of Entomology, UAS, Bangalore.

A special brand of honey created by a colony of bees given access to medicinal endemic plants to improve phenol, flavonoid, and antioxidant levels, and cultivated high up in the hills of Turkey. Ahmet Eren Cakir, a 44-year-old Turkish citizen, entrepreneur, and researcher, produces this unique honey at a height of 2,500 metres above sea level in the Black Sea region of Turkey. The honey has powerful medical effects and is sought after by a wide range of people, including CEOs, celebrities, politicians, and doctors from London to Los Angeles and Milan to Japan. It's no surprise that this honey is in high demand, especially because buyers claim to experience incredible health and wellness advantages.

Method of Production

The honey is meticulously cultivated and gathered at an altitude of 2,500 metres above sea level, according to brand owners Ahmet Eren Cakir. Honey is produced by Caucasian honey bees, which can withstand low temperatures and high altitudes. The three-year-old firm adheres to a strict set of guidelines in order to assure the highest quality of production, which is somewhat different from different from conventional honey harvesting methods.

To keep the bee colony free of the varroa mite, which affects most honey-bee colonies, it is kept away from human houses and other bee colonies. Only natural plants and herbs are employed as a deterrent to keep mites at bay once more. There are no chemicals or pesticides utilised in any way. The bee colony has year-round access to endemic herbs and plants, which could aid in the fight against disease. Furthermore, the honey is gathered late in the season in mid-November to give the bees a complete season to produce naturally.

Healthy Honey for Healthy Living

Centauri cave honey – extracted from 2500 meters from mean sea level

This rare and high-end honey has many established health benefits thanks to the rigorous production procedures and natural cultivation. "Since Centauri Honey contains high phenol, flavonoid, and antioxidant levels, which fight diseases, and because I utilise rare indigenous herbs, Centauri Honey has remarkable benefits on general health and ageing, as well as preventative properties," producer Ahmet explained. Honey has long been recognised as beneficial to one's health and well-being, with ancient Greeks, Chinese, and Egyptians ingesting it for both nutritional and medical purposes. Honey was not only used as a sacrifice to the gods, but also as an embalming fluid and a wound dressing by the ancient Egyptians, and this tradition continues today with honey, particularly manuka honey, being utilised in therapeutic contexts. Honey's antioxidant, antibacterial, and anti-inflammatory effects have attracted a large number of individuals in recent years. It is regarded as one of nature's best all-around medicines by holistic practitioners.

High in Polyphenols

Centauri honey is rich and natural; it has one the highest percentage of polyphenols at 77.65mg. The beneficial effect of honey on human health derives mainly from its content in phenolic compounds. Polyphenols are one of the most important groups of compounds occurring in plants. They are associated with many health benefits. Centauri honey is also rich in salicylic acid which is a beta hydroxy acid well-known for reducing acne and improving skin condition. Used often to exfoliate the skin and keep pores clear.

Guinness World Record as a Costliest Honey

Produced in an isolated cave in Turkey's mountains, Centauri Honey has been named the world's most expensive by Guinness World Records. According to the official website of Guinness World Records, this is unlike the conventional honey that is available in the market and achieved a price tag of over $11,000 per kilogram to break the world record. Apparently, the brand uses an undisclosed formula to increase the quality of the honey, which is kept secret even from close family members. Furthermore, only the best quality material is harvested, with samples sent to the Turkish Scientific Council/Food Institute to authenticate the value and quality of the honey.

Conclusion

Sufficient evidence exists recommending the use of honey in the management of disease conditions. Evidence confirming the use of honey in all areas of clinical practice is needed. Studies revealed that the medicinal effect of honey may be due to of its antibacterial, anti-inflammatory, apoptotic, and antioxidant properties. Centurion honey is rich in antioxidant and polyphenols, so even though it is costly the people like celebrities, politicians and doctors usually prefer.

References

1. https://thrive-magazine.co.uk/centaurihoney/
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5424551/
3. https://www.medicalnewstoday.com/articles/324997#antioxidants
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6225430/
5. https://dlmag.com/turkeys-centauri-honey-is-most-expensive-in-the-world
6. https://www.guinnessworldrecords.com/news/commercial/2021/3/exclusive-turkish-cave-honey-confirmed-as-worlds-most-expensive-652034
7. https://odishaexpo.com/this-is-the-most-expensive-honey-in-the-world-and-heres-why/
8. https://timesofindia.indiatimes.com/life-style/food-news/this-is-the-most-expensive-honey-in-the-world-and-heres-why/articleshow/81672061.cms
9. https://www.upi.com/Odd_News/2021/03/16/turkey-Guinness-World-Records-most-expensive-honey-Turkey-Centauri-Honey/8331615927546/

Biosecurity Measures of a Poultry Farm

Article ID: 11550

Iqra Hussain Shah[1], Mir Nadeem Hassan[2], Ajaz A. Ganie[3]
[1]Ph D Scholar Vety. Public Health SKUAST-K.
[2]Scientist Krishi Vigyan Kendra Budgam.
[3]Scientist KVK Srinager.

Introduction

Biosecurity refers to procedures used to prevent the introduction and spread of disease-causing organisms in poultry flocks. Because of the concentration in size and location of poultry flocks in current commercial production operations and the inherent disease risks associated with this type of production, it is imperative that poultry producers practice daily biosecurity measures. Developing and practicing daily biosecurity procedures as best management practices on poultry farms will reduce the possibility of introducing infectious diseases such as Avian Influenza and Exotic Newcastle as well as many others. Contract poultry growers should be familiar with the specifics of their company's biosecurity protocols and work closely with company representatives to implement those programs. Before implementing biosecurity programs, contract producers should check with poultry company personnel to be sure the measures taken are consistent and compatible with their company's policies.

How Microorganisms Spread?

The primary method of spreading disease causing microorganisms between poultry flocks is the use of contaminated equipment or exposure to contaminated clothing and footwear of humans. Infected animals, such as wild birds and rodents, can also be a source of disease for poultry flocks. Disease causing viruses and bacteria can be transported from one flock to another on bird transporting equipment, trucks, tractors and other farm equipment as well as egg flats and cases. Humans and animals are also important ways of transporting disease causing organisms. Disease causing microbes have been found on human's clothes, shoes, skin, and hair. As a result, many hatcheries and breeder facilities utilize shower in and shower out protocols as part of their biosecurity programs. Animals such as dogs, cats, mice, rats and free flying birds are also known to be carriers of disease organisms. Insects such as flies, beetles, and mosquitoes are well known to be carriers of disease microbes as well. Another, but less risky form of transmission is through the air. The following steps are a summarization of standard measures that poultry producers may use on their farms to increase the biosecurity of their flocks.

Keep Visitors to a Minimum

Human transportation of microorganisms is one of the more serious threats to biosecurity. Restriction of unnecessary human traffic is a major component of a sound program. Growers should restrict visitors and make sure that any visitor to their farm has a good reason to be there. Growers should provide protective covering such as boots, coveralls, and headgear to any visitors that work with, or have had recent contact with poultry.

This would include friends, neighbors, relatives, equipment and utility service personnel. Visitors should never enter poultry houses unless approved by the grower or company personnel. Traffic through poultry houses should always flow from younger to older birds. One useful measure is keeping records of visitors that have been on the farm. If a problem arises, knowing who was there will help in limiting additional flock infections.

Growers may post signs at the entrance to the farm indicating that entry to the farm and facilities is restricted. Poultry producers work to educate members of the local community of the risks to their flocks and the need to restrict traffic on their farms. This can be done by attending local community meetings or social events and speaking to groups and individuals about this subject. Print an article in the local newspaper about the importance of biosecurity for your farm and others. This can also help educate people regarding the seriousness of this issue.

Limit Poultry Growers Visit to Other Poultry Farms

Poultry growers should refrain from visiting other poultry operations unless absolutely necessary. Whenever it is necessary to visit another farm, growers should be sure to exercise additional precautions such as showering and changing clothes before arriving and washing any vehicle before entering a farm. It will be very important for growers to wear protective clothing including boots, coveralls and headgear and to clean and disinfect all clothing and equipment before returning to their facilities. Showering and changing into clean clothes will also be necessary.

Keep All Animals Out of Poultry Houses

Animals can be carriers of poultry disease causing organisms. Growers should not allow pets such as dogs, cats or other animals in their houses. Some growers will allow their dogs to walk the houses with them, but this is risky because the dogs may have been exposed to other animals or birds that have been contaminated with disease organisms. Poultry houses should be kept as closed as possible to prevent wild birds from getting inside. Wild birds utilizing the feeders and defecating in the houses can be a source of disease.

Practice Sound Rodent and Pest Control Programs

Rats, mice, and insects such as flies and darkling beetles can carry and spread microorganisms. Growers should consult with their poultry company and practice effective rodent and insect control programs. Eliminating or reducing as many of these pests as possible will reduce the risk of contracting or spreading a disease.

Avoid Contact with Non-Commercial Poultry or Wild Birds

Poultry growers should avoid all contact with non-commercial sources of poultry including backyard flocks, fanciers, fairs, poultry shows, and markets. These types of poultry are seldom fully vaccinated for the major poultry diseases and they are often exposed to many types and flocks of birds. Non-commercial birds represent extremely high-risk contacts. Employees should not be allowed to own their own poultry and neighbors with backyard flocks should be informed of the importance of getting sick or unhealthy birds to a diagnostic lab as soon as possible.

Growers should also avoid wild birds such as ducks, geese and turkeys. Growers with farm ponds should be particularly concerned with the potential of carrying droppings from wild birds around ponds into their poultry houses. Wild birds are well known to be carriers of the avian influenza virus as well as other poultry diseases. Hunters should be sure they take the same biosecurity precautions as if they were visiting another poultry farm (i.e., showering, changing clothes, sanitizing vehicles, etc.).

Inspect Flocks Daily

Growers are required by their contract to inspect their flocks every day. Mortality should be picked up daily and disposed of in a timely and approved method. Stock-piling mortality and allowing carcasses to decompose before disposal increases the risk of spreading disease via rodents and insects. Growers should report increases in mortality or signs of health problems to their service representative immediately. This is required by contract and will ensure a rapid detection and response should a disease be present. Growers should check with the ir poultry company before using any vaccines, medications or drug treatments for a flock health problem. Timely reporting of health issues on a farm will not only help restrict additional infections, but will minimize losses to both the grower and the company.

Maximize the Environment

Maintaining litter in a relatively dry condition (i.e., 20%-30%) and providing good ventilation will help control microorganism numbers. Wet conditions combined with warm in-house temperatures provide a good growth environment for most disease-causing organisms. Good ventilation also helps reduce microorganisms as fresh air entering and leaving the house dilutes microbe populations and removes them from the house. Poor ventilation can result in irritation of the respiratory tract of birds making them more susceptible to bacterial and viral infections.

Keep Areas around Houses and Feed Bins Clean

Keeping grass and weeds cut around poultry houses and removing used equipment or trash is beneficial in keeping rodent and insect populations under control. Thick grass or weeds and old equipment provide refuge and habitat for rats, mice and insect pests that can spread disease. Spilled feed should be cleaned up regularly and not allowed to collect for long periods of time. Spilled feed around the feed bins will attract birds, rats, mice and insects.

Recognizing Disease Symptoms

It is important for poultry growers to be aware of signs of disease in their flocks. Early detection of contagious diseases can greatly reduce the impact and spread of that disease to other flocks. Clinical signs associated with the possibility of a disease in a poultry flock are:

1. Lack of energy and appetite.
2. Decreased egg production.
3. Soft-shelled eggs or misshapen eggs.
4. Swelling of the head, eyes, comb, wattles and hocks.
5. Purple discoloration of the wattles, combs and legs.
6. Nasal discharge.
7. Coughing, wheezing and sneezing.
8. Lack of coordination in mobility.
9. Diarrhoea.
10. Sudden or excessive mortality without clinical signs.

Conclusion

Biosecurity is taking measures to protect your birds from harmful biological agents, like viruses, bacteria, parasites, etc. Biosecurity is the cheapest and most effective means of disease control available. No single disease prevention program will be effective without taking proper biosecurity measures. It is a proven method that can help to promote the health of your flock. However, there are steps that should be taken to help promote biosecurity and safety for small production flocks.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Gall Midge, *Clinodiplosis ultracrepidata* - The Putative Jackfruit Pollinator

Article ID: 11551

K. A. Sindhura[1], S. B. Sawant[2]
[1]Department of Entomology, University of agricultural Sciences, GKVK, Bangalore.
[2]Department of Plant Pathology, Anand Agricultural University, Anand.

Introduction

The jackfruit (*Artocarpus heterophyllus* Lam.) hails from the rain forests of the Western Ghats of India which is today cultivated throughout the tropical lowlands in South and Southeast Asia, parts of central and eastern Africa and Brazil. India ranks the second in the production, hence crowned as the motherland of jackfruit. Jackfruit is entitled as "poor man's fruit" in the eastern and southern parts of India. The jackfruit is a multi-purpose species providing food, timber, fuel, fodder, and medicinal and industrial products. The presence of vitamins, isoflavones, antioxidants, and phytonutrients in the fruits indicate that jackfruit has cancer-fighting properties. It is also known to help cure ulcers and indigestion.

Floral Biology

Jackfruit trees are monoecious. The inflorescence is racemoid known as 'spike', which is enclosed in a pair of protective stipules. Male inflorescence is borne on short shoots on main and lateral branches. Male spikes are dense, fleshy, cylindrical to club-shaped, and up to 10 cm (4 in) in length. Male spikes are found on younger branches above female spikes. Flowers are tiny, pale green when young, turning darker with age. At anthesis, the male flowers emit a sweet aroma of overripe fruit. Female inflorescence is found only on the trunk and main branches. Flowers are larger, elliptic or rounded, with a tubular calyx. The inflorescence eventually rots before abscission as depicted in the figure above.

Anemophily or Ambophily

Jackfruit is an underutilised crop whose pollination side is the least studied. However, efforts were and are being made to resolve the ambiguity with jackfruit pollinators. Jackfruit has been described as a wind-pollinated species (of more male than female flowers), but pollen is sticky and not shed readily by light physical disturbance as would be expected from a wind-pollinated tree. Insect activity on the male inflorescence may promote the release of pollen, which may then be carried by wind. Such behaviour may be an evolutionary transition between insect and wind pollination. Further several studies were carried out and affirmed that jackfruit involves with the insect mediated wind pollination.

Pollinators Reported

Pollinators reported to be contributing in jackfruit seed set are, *Euphoria sepulchralis*, the flower beetle; *Carpophilus dimidiatus* and *Carpophilus tempestivus*, nitidulid beetles; Trigona species, stingless bees;

several gall midge species. Major reports support gall midge, a putative pollinator, *Clinodiplosis ultracrepidata* Gagne new species (Diptera: Cecidomyiidae), as major pollinator.

		
The flower beetle	**Nitidulid beetle**	***Clinodiplosis ultracrepidata***

Tripartite Mutualistic Association

The female gall midges pay visits to both male and female jackfruit inflorescences but oviposit in only fungus-infected male inflorescences, and their larvae feed on the fungus, *Rhizopus artocarpi* Racib. (Mucoraceae) making it clear that female inflorescences provide no apparent reward. While male inflorescences provide a brood site and nutritional resources, attraction of gall midges to female inflorescences is the result of deceit by scent. When midges with pollen on their body visit these female inflorescences, pollination is aided by deceit due to the scent. However, they lay eggs in male inflorescent after which the newly hatched larvae feed on the fungus and pupate in the litter under the tree; adults emerge from the litter and mate. This was coated as a tripartite pollination mutualism involving fungus and gall midges in an understudied crop. Therefore, proper pollinator management is called for in jackfruit, as farmers dump fungicides misinterpreting the gall midge-fungus-jackfruit mutualism as fungal rot infection.

Equipment and Techniques

Ruling out the potential pollinator is a skilful task that needs sophisticated techniques and equipment in jackfruit tree. In several pollination studies, Y choice tubes, A battery-powered flashlight was used with a red filter to observe inflorescences in the dark, IOx-hand lens to examine insect visitors, electroantennography, Gas chromatography–mass spectrometry to examine the jackfruit plant and floral volatiles that attract the pollinators; to test wind pollination - Kramer-Collins 7-Day Drum Spore, Sampler, Cascade Impactor, Rotorod samplers, wind -borne pollen trapping methods.

Future Prospects

Research can be carried out regarding the evolutionary relation between gall midges and jackfruit in mutualism with the Rhizopus fungi. This would help in not misinterpreting the fungal rot in male jackfruits that are managed using fungicides harming the fruit set further. As other species like Morus, Ficus from the same family as Artocarpus have similar behaviour of volatiles, research on floral and plant volatiles can help to rule out the non-pollinator visitors. Ancestral state reconstructions to study Artocarpus pollination in a better way.

References

1. El-Sawa, S., 1998. Pollination and breeding of jackfruit (Artocarpus heterophyllus Lam.) in south Florida. MS thesis. Florida International University, Miami. doi:10.1108/eb050773.
2. Elliot, M., Gardner., Raymond, J., Gagne., Paul, E., Kendra., Wayne, S., Montgomery., Robert, A., Raguso., Tashina, T., McNeil., Nyree, J. C., Zerega., (2018). A Flower in Fruit's Clothing: Pollination of Jackfruit (Artocarpus heterophyllus, Moraceae) by a New Species of Gall Midge, Clinodiplosis ultracrepidata sp. nov. (Diptera: Cecidomyiidae). International Journal of Plant Sciences, Volume 179, Number 5.
3. Elevitch, C. R., Manner, H. I., (2006). Artocarpus heterophyllus (jackfruit), ver. 1.1v. In CR Elevitch, ed. Species profiles for Pacific Island agroforestry. Permanent Agriculture Resources, Hōlualoa, HI.
4. Haque, M. A., Majumder, S., (2006). Studies on floral biology of jackfruit. Journal of Bangladesh Agricultural University, 4(1): 9-16.

List of Bacterial Disease Major Bacterial Disease, Symptoms and its Management

Article ID: 11552

Kiran Choudhary[1], Suresh Choudhary[2], Pappu Lal Dalal[3]
[1]Ph.D Scholar Department of Plant Pathology Rajasthan Agriculture Research Institute (RARI) Jaipur - 302018, Rajasthan.
[2]Ph.D Scholar Department of Entomology Rajasthan Agriculture Research Institute (RARI) Jaipur - 302018, Rajasthan.
[3]Ph.D Scholar, Department of Entomology, SKNAU Jobner-303328, Jaipur , Rajasthan.

1. Citrus canker- *Xanthomonas campestris pv.citri*
2. Black rot crucifer- *Xanthomonas campestris pv.campestris*
3. Angular leaf spot of cotton- *Xanthomonas campestris pv.Malvacearum*
4. Bacterial blight of rice –*Xanthomonas oryzae pv.oryzae*
5. Common blight of beans – *Xanthomonas campestris pv. phaseoli*
6. Bacterial pustule in soybean- *Xanthomonas campestris pv.glycines*
7. Bacterial blight or stripe of cereals- *xanthomonas campestris pv.translucens*
7. Bacterial blight of cassava- *xanthomonas campestris pv.manihotis*
8. Bacterial spots of stone fruit- *xanthomonas arboricola pv.pruni*
9. Bacterial streak of tomato- *Pseudomans Syringae pv.Tomato*
10. Angular leaf spot of cucumber- *P. Syringae pv.lacrymans*
11. Wild fire of tobacco- *P. Syringae pv. Tabaci*
12. Halo blight of beans- *P. Syringae pv. Phaseolicola*
13. Citrus blast,pear blast,bean leaf spot,liliac blight- *P. Syringae pv. Syringae*
14. Fire blight of apple- *Erwinia ammlovora*

Major Bacterial Disease

1. Citrus canker.
2. Black rot of cabbage.
3. Angular leaf spot of cotton.

Citrus Canker

Causal organism: *Xanthomonas axonopodis* pv. Citri.

Economic Importance: The Asian, or A-strain, of CC is thought to have originated in southeastern Asia or India (Civerolo 1984) and spread through much of Asia, to Japan, southern and central Africa, the Middle East, Australia, New Zealand, Pacific Islands, South America and the southeastern United States (CABI/CMI 1996; Schubert et al. 2001; Gottwald et al. 2002b). CC has been eradicated from South Africa, Australia, the Fiji Islands, Mozambique, New Zealand and the United States (Koizumi 1985). Active eradication/containment programs are continuing in Uruguay and Brazil.

In India, citrus canker is endemic and occurs in all the citrus growing areas. It is reported from Punjab, Tamil Nadu, Andhra Pradesh, Karnataka, Rajasthan, Madhya Pradesh, Assam, and Uttar Pradesh. Acid lime is highly susceptible to canker.

Symptoms:

a. Canker appears on leaves, twigs, petioles, branches, fruit stalks, fruits and thorns.
b. When it is severe, trunk and roots are also affected. But the symptoms are most conspicuous on leaves, twigs and fruits. The lesions appear as minute water soaked round, yellow spots which enlarge slightly and turn brown, eruptive and corky.
c. On acid lime and sweet orange they are about 2 to 3 mm in diameter.

d. Several lesions on fruit may coalesce to form a patch. The crater-like appearance is more marked on fruits than on leaves.
e. The market value of the fruits is considerably reduced by the canker spots, though such infections are mostly confined to the fruit skin.
f. Favourable conditions:- Free moisture for 20 minutes at 20-30°C initiates the disease.

	
Infected leaf	**Infected fruit**

Management:

a. Prune out and burn all canker infected twigs before monsoon Periodical spraying of bactericides along with an insecticide.
b. Use canker tolerant varieties like "Tenali selection" and "Balaji".
c. Select seedlings free from canker for planting in main field.
d. Spray Streptocycline (1g) + Copper oxy chloride (30g) in 10 litres of water at fortnightly intervals for effective management of canker in citrus nurseries.
e. Three sprayings of Streptocycline (1g) + Copper oxy chloride (30g) in 10 litres of water at an interval of 20 days during rainy season is effective for leaf canker.
f. Fruit infection can be prevented by two sprays of Streptocycline (1g) + Copper oxy chloride (30g) in 10 litres of water at marble stage followed by another spray 30 days later.
g. Control leaf miner when young flush is produced.

Black Rot of Cabbage

Causal organism: *Xanthomonas campestris* pv. *campestris*. Serious on cabbage, cauliflower, knol-khol, mustard, radish.

Economic Importance: Black rot, caused by Xanthomonas campestris pv. campestris (Xcc), is a destructive disease of a wide range of crucifer plants; cabbage (Brassica oleracea pv. capitata L.) being one of the main hosts. Black rot has been a major disease constraint of cabbage production to smallholder farmers in Africa where substantial crops losses are experienced, especially during the warm and wet seasons (Day et al., 1992; Onsando, 1992; Mguni, 1996; Massomo, 2002). Also, in Mozambique, black rot is considered to be one of the most important diseases of crucifers (Sageren et al., 1994). Cabbage production can be affected by biotic and abiotic factors, including disease and pests, climatic and soil conditions, crop management, etc.

Symptoms:

	
Infected plant	**Infected leaf**

a. 1st appears near the leaf margins as chlorotic or yellow (angular) areas.
b. The yellow area extends to veins & mid rib forming characteristic 'v' shaped chlorotic spots.
c. Veins and veinlets turn brown and finally black.
d. The vascular blackening extends beyond affected veins to midrib, petiole and stem.
e. In advanced stages, infection may reach the roots system and blackening of vascular bundles occur.
f. Bacterial ooze can also be seen on affected parts.
g. If the infection is early, the plants wilt and die.
h. Bacterium is internally seed and soil borne. It also survives on plant debris.

Management:

a. Hot water treatment at 50 0c for 30min, for killing seed borne inoculum followed by a 30min dip in streptocycline 100ppm.
b. Spray Agrimycin-100 or Streptocycline-50ppm at transplanting, curd formation and pod formation .
c. Crop rotation for 2-3 yrs with non-cruciferous crop .
d. Drenching seed bed with 5% formalin or any antibiotic solution in nursery beds .
e. Resistant Varieties:- Cabbage: Cabaret, Defender, Gladiator, Pusa Muktha. Cauliflower: -Pusa ice, Pusa snow ball-K-I-F, Sel-12.

Angular Leaf Spot of Cotton

Other name: Bacterial blight or Angular leaf spot or Black arm.

Causal organism: *Xanthomonas campestris* pv. *malvacearum*.

Economic Importance: Cotton (*Gossypium* spp.) is an important natural fibre for textile industry. The cotton crop is affected by several diseases from seedling to maturity by various agents like fungi, bacteria and virus. The favourable weather conditions play a major role in disease occurrence among various cotton growing zones of India. Bacterial blight caused by *X. citri* pv. *malvacearum* (Xcm) is the major disease occurring in entire cotton growing regions of India. The disease was considered as one of the world's most widely distributed cotton diseases. Five stages of the disease are recognized based on the symptoms and area of infection in the plant namely seedling blight, angular leaf spot, vein blight, black arm and boll rot. Typical symptoms of the disease on susceptible cotton genotypes are water-soaked lesions, angular leaf spots, black arm and boll rot (Madani et al., 2010). Under favourable conditions, yield loss can exceed 50 per cent. Cotton fields infected with bacterial blight have been found to show as much as 80 per cent yield loss in certain areas (Jalloul et al., 2015). Reports of the occurrence of bacterial blight disease in natural field conditions ranged from 19 to 38 per cent in different cotton growing areas of India. This difference in the intensity of bacterial blight disease in various cotton growing areas necessitated to undertake an extensive survey to assess the bacterial blight incidence in three major cotton growing zones of India and to observe the severity of the disease with different types of symptoms

Economic importance: This disease was first observed in Tamil Nadu in 1918. It is an important disease in Maharashtra, Karnataka, A.P., Tamil Nadu and Madhya Pradesh.

Symptoms: Bacterium attacks all stages from seed to harvest. Usually, five common phases of symptoms are noticed.

a. Seedling blight: Small, water-soaked, circular or irregular lesions develop on the cotyledons. Later, the infection spreads to stem through petiole and cause withering and death of seedlings.
b. Angular leaf spot: Small, dark green, water-soaked areas develop on lower surface of leaves, enlarge gradually and become angular when restricted by veins and veinlets and spots are visible on both the surface of leaves. As the lesions become older, they turn to reddish brown colour and infection spreads to veins and veinlets.
c. Vein blight or vein necrosis or black vein: The infection of veins causes blackening of the veins and veinlets, gives a typical 'blighting' appearance. On the lower surface of the leaf, bacterial oozes are formed as crusts or scales.
d. Black arm: On the stem and fruiting branches, dark brown to black lesions are formed, which may girdle the stem and branches to cause premature drooping off of the leaves, cracking of stem

and gummosis, resulting in breaking of the stem which hang typically as dry black twig to give a characteristic "black arm" symptom.

e. Square rot / Boll rot: On the bolls, water soaked lesions appear and turn into dark black and sunken irregular spots. The infection slowly spreads to entire boll and shedding occurs. The infections on mature bolls lead to premature bursting of bolls.

Infected leaf

boll rot

Pathogen

The bacterium is a short rod with a single polar flagellum. It is gram negative, non-spore forming.

Disease cycle:

a. The bacterium survives on infected dried plant debris in soil for several years.
b. The bacterium is also seed-borne and remains in the form of slimy mass on the fuzz of seed coat.
c. It multiplies soon after the seed is sown and infects the seedling through the micropyle.
d. Volunteer plants that arise from the bolls falling off prematurely also provide a source of primary infection.
e. The primary infection starts mainly from the seed-borne bacterium.
f. The secondary spread of the bacteria may be through wind, windblown rain splash, irrigation water, insects and other implements. The bacterium enters through natural openings or insect caused wounds.
g. Favourable Conditions Optimum soil temperature , high atmospheric temperature, poor tillage, late irrigation and potassium deficiency in soil.
h. Rain followed by bright sunshine during the months of October and November are highly favourable.

Management:

a. Remove and destroy the infected plant debris.
b. Rogue out the volunteer cotton plants and weed hosts.
c. Follow crop rotation with non-host crops.
d. Early thinning, good tillage, early irrigation, early earthing up and addition of potash to the soil reduces disease incidence.
e. Grow resistant varieties like HG-9, BJA 592, G-27, Sujatha, 1412 and CRH 71. Suvin is tolerant.
f. *Gossypium herbaceum* and *G. arboreum* are almost immune. *G. barbadense*, *G. hirsutum*, *G. herbaceum* var *typicum* and *G. herbaceum* var *acerifolium* have considerable resistance.
g. Delint the cotton seeds with concentrated sulphuric acid at 125ml/kg of seed.
h. Treat the delinted seeds with Carboxin at 2 g/kg seed or soak the seeds in 1000 ppm Streptomycin sulphate overnight or treat the seed with hot water at 52-560C for 10-15 minutes.

Literature Cited

1. Civerolo, E. L. 1984. Bacterial canker disease of citrus. Journal of the Rio Grande Valley Horticultural Society 37: 127-146
2. Commonwealth Agricultural Bureaux International - International Mycological Institute. 1996. Distribution maps of plant diseases, Xanthomonas campestris pv. citri. Map No. 11. Edition 6. 2 p.
3. Day, L.A., Feldman, S., Minja, R. & Wien, C. 1992. Vegetable production in Tanzania, a case study in Arumeru District. Special Survey Report, Cornell University, United States of America and Sokoine University of Agriculture, Tanzania. 46pp.
4. Gottwald, T.R., X. Sun, T. Riley, J.H. Graham, F. Ferrandino and E.L. Taylor. 2002a. Geo-referenced spatiotemporal analysis of the urban citrus canker epidemic in Florida. Phytopathology 92: 362-377.

5. Jalloul, A., Sayegh, M., Champion, A. and Nicole, M. 2015. Bacterial blight of cotton. Phytopathol. Mediterr. 54 : 3-20.
6. Koizumi, M. 1985. Citrus canker: the world situation. Pp. 2-7. In Timmer, L.W. (ed.). Citrus canker: An international perspective. University of Florida, Lake Alfred.
7. Madani, A. S., Marefat, A., Behboudi, K. and Ghasemi, A. 2010. Phenotypic and genetic characteristics of Xanthomonas citri subsp. malvacearum, causal agent of cotton blight, and identification of races in Iran. Australas. Pl. Pathol. 39: 440-45.
8. Massomo, S.M.S. 2002. Black rot of cabbage in Tanzania: characterisation of Xanthomonas campestris pv. campestris and Disease Management Strategies. PhD Thesis. The Royal Veterinary and Agricultural University, Copenhagen, Denmark. 215 pp.
9. Mguni, C.M. 1996. Bacterial Black Rot (Xanthomonas campestris pv. campestris) of vegetable brassicas in Zimbabwe. The Royal Veterinary and Agricultural University, Copenhagen, Denmark. PhD. Thesis.144pp.
10. Schubert, T.S., S.A. Rizvi, X. Sun, T.R. Gottwald, J.H. Graham and W.N. Dixon. 2001. Meeting the challenge of eradicating citrus canker in Florida - Again. Plant Disease 85: 340-356.
11. Segeren, P., Van den Oever, R. & Campton, J. 1994. Pragas, Doenças e ervas daninhas nas culturas alimentares em Moçambique. INIA, Moçambique. 258pp.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Role of Mulching in Vegetable Crop Production

Article ID: 11553

Dr. Pankaj Kumar Ray[1]

[1]Subject Matter Specialist (Horticulture), Krishi Vigyan Kendra, Agwanpur, Saharsa, Bihar, (Bihar Agricultural University, Sabour, Bhagalpur, Bihar).

Summary of Article

Mulch is a general term for a protective ground cover that can include manure, wood chips, seaweed, leaves, straw, grasses, sands, stones (boulders), synthetic plastics, and other natural products. While the term mulching may be defined as a practice of covering the surface of soil with these materials to reduce evaporation, and also to moderate wide fluctuations in diurnal soil temperatures, especially in the root zone environment. It controls external evaporability and also reduces energy supply to the evaporating site by cutting off solar radiation falling on the ground. Its main function is limited to controlling first stage of drying which helps in improved moisture status, reduced soil temperature (Loy and Wells, 1975), besides checking seedling mortality and improving crop stand. It also suppresses weed flora and reduces weed competition with crop for water and nutrients making them available in greater quantities for crop plants. Besides the above, mulching helps in increasing downward movement of water.

Mulch is Used for Various Purposes

1. To accent landscape plantings.
2. To provide a “finished” look to the garden.
3. To help in production of clean and quality products.
4. To protect the plant and their produce from attack of insect-pest and diseases.
5. To moderate the soil thermal regime throughout the cropping season.
6. To prevent weed growth.
7. Increasing overall crop production.
8. To improve the fertility of soil.

Types of Mulches

There are of two basic types viz., organic and non-organic mulches. The examples of only those mulch materials have been explained below which are mostly used in vegetable productions.

Organic Mulches

Compost/Manure/peat: These materials can be used for mulching and can be of quite an attractive appearance. They need to be laid in a 2”-3” thick layer. Manure should be well rotted before laying or damage can occur to plants. These materials will benefit the soil fertility. It is generally considered as the best mulching material for the home garden. It is usually free of weed seeds and is inexpensive. It may be highly satisfactory where available from commercial producers or homeowners. One can prepare compost from materials present in his yard. It is not necessary to purchase expensive materials for mulching.

Peat moss: This mulch is attractive and easy to handle but somewhat expensive. Dry peat moss requires considerable time and water to become moist, so it should be applied only to a 3-inch or less depth and avoided in areas subject to drought. Its acidic pH makes it especially desirable for acid-loving plants.

Sawdust: Aged partially rotted sawdust makes satisfactory mulch that lasts a long time. Since it is prone to caking and has a high carbon to nitrogen ratio. It contains only half the nutrients of straw, is slow to break down and causes nitrogen robbery, so should not be incorporated into the soil unless and until it has broken down to a brown ‘soil’ and worms are found in it. Softwood sawdust takes longer than hardwoods to decompose.

Straw: Straw has similar qualities to grass clippings provided that that it should be put down in a thick layer (5-10 cm).

Newspaper: Apply sheets of newspaper and cover lightly with grass clippings or other mulch material to anchor. They are impractical on their own, as they are too prone to blow away and once, we are soon broken up or penetrated by weeds. Newspaper is mostly chlorine-free and there is no danger to lead from the ink anyone. If other mulch materials are not available, cover edges of paper with soil. Applying on a windy day can be a problem. This is certainly readily available and economical but somewhat difficult to apply. A good use for newspaper is as an under mulch; that is, place two to three sheets under a thin layer of an attractive, more expensive mulch. They can be useful underneath loose mulches, as they stop the soil being mixed commercial papers are available.

Non-Organic Mulches

Polyethylene mulches: non-organic mulches generally lack the soil improving properties particularly to improvement in soil particle aggregation, structure formation and regulation of soil reactions. Among the different inorganic mulches, the use of plastic mulches is most common owing to its properties of moderating the hydrothermal regimes of microclimate of crops, show positive effects on weed control, prevention of soil dryness and crusting, water saving by preventing evaporation from surface, prevention of soil erosion and reduction of nutrient loss by leaching.

Types of plastic materials: The plastic materials may be either PVC or polyethylene. Owing to its greater permeability to long wave radiation which can increase the temperature around the plants during the night times, polyethylene is preferred.

Aluminum-coated plastic and foil: Use is limited primarily to vegetable plants where research findings have indicated a significant reduction in insect pests, such as aphids, and viruses carried by insects. One layer of either one of these materials provides excellent weed control. These materials decompose very slowly, but they are very expensive and quite unattractive mulches.

When to Apply Mulch?

Time of application depends on what we want to achieve by mulching. Mulches, by providing an insulating barrier between the soil and the air, moderate the soil temperature. If you are using mulches in vegetable garden or flower garden, it is best to apply them after the soil has warmed up in the spring. Cool, wet soils tend to slow seed germination and increase the decay of seeds and seedlings.

Role of Organic Mulching in Vegetable Production

Crop nutrition/fruit quality: Mulches of organic origin have been reported to be effective in increasing the leaf and fruit nutrient concentrations of vegetable crops due to better moisture regime and optimum soil temperature in the root zone of plant. Pertaining to the higher availability of phosphorus concentration in the plant leaves under organic mulches it is observed that because of increment of soil solution phosphorus on partial decomposition of organic mulches inter-alia better surface rooting of the crops and keeping the surface soil moist for a longer time. The concentrations of ascorbic acid, B-carotene and vitamin- A are also recorded to be appreciably higher in the fruit of brinjal plants growing with Cordia leaf mulch as compared to the bare field.

Role of Plastic Mulching (Non-Organic Mulching) in Vegetable Production

Soil fertility: The use of black polyethylene mulch in vegetable production has been reported to control the weed incidence, reduces nutrient losses and improves the hydrothermal regimes of soil. Polyethylene mulches also buffer soil pH and exchangeable Mg and Ca more efficiently than the uncovered soil. Many researchers have revealed that yield of tomato was significantly higher in polyethylene mulched soil as compared to uncovered soil probably as a result of slowing soil-water percolation and restricting removal of nutrients from the top 15-cm of soil.

Soil water conservation: Covering the soil surface with plastic film reduces the irrigation requirement in bell pepper (Capsicum sp) by 14-29% due to elimination of soil evaporation. Tomato plants growing in polyethylene mulched soil have shown improved water use efficiency and yield potential under all (surface and drip) levels of irrigation. Mulching experiment conducted on brinjal crop with black polyethylene revealed that it conserved 29-56 and 22-107% more moisture as compared to straw mulches and control, respectively (Singh et al. 2006).

Plant growth and yield: It has been demonstrated that black polyethylene mulch is found to be beneficial in promoting early harvest, higher plant biomass and yield of muskmelon relative to plants grown without mulch. The yield of brinjal plants mulched with white and black polyethylene is recorded to be increased by 344 to 520% over control probably as a result of slowing the soil-water percolation and restricting removal of nutrients from the top 15cm of soil (Singh et al. 2006). Red and black plastic mulches which induce higher soil temperature have been found to be more effective in increasing the early yields of tomatoes than the white and reflective plastics (Decoteau et al., 1989).

Advantages of Mulching

The introduction of mulching into your garden will provide the following rewards:
1. Prevention of weed growth.
2. Soil will retain more moisture.
3. Prevention of erosion.
4. Improved soil conditions and healthier plants.
5. Will encourage beneficial organisms such as earthworms to the soil.
6. The mulch acts as a fertilizer.
7. Less weeding and watering necessary.

Disadvantages of Mulching

Mulches do have a few drawbacks, which are as follows:
1. The cost of some materials can be a drawback to large-scale mulching.
2. Some mulch is not readily available.
3. In case of sawdust or straw mulch, nitrogen starvation sometimes occurs.
4. Heavy mulching over a period of years may result in buildup of soil over the crown area of the plants.

References

1. Aggarwal, Sonia, Korla, BN and Raina, JN (2003). Effects of mulches on soil hydrothermal regimes, weed incidence, yield and quality of ginger. J. Indian Soc. Soil Sci; 51: 65-67.
2. Allmaras, RR and Nelson, WW (1971). (Zea mais L.) root configuration as influenced by some inter-row variants of tillage and straw mulch management. Soil Sci. Soc. America Proc; 35: 974-980.
3. Gupta, JP (1986). Moisture and thermal regimes of the desert soils of Rajasthan, India and their management for higher plant production. Hydrol. Sci. J; 31: 347.
4. Gupta, JP and Gupta, GN (1983). Effect of grass mulching on growth and yield of legumes. Agric. Wat. Mgmt; 6: 375.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Nanoparticles as a New Tool for Pest Management

Article ID: 11554

K. Murugasridevi[1], S. Lekha Priyanka[2]
[1]Assistant Professor, Dhanalakshmi Srinivasan Agriculture College, affiliated to Tamil Nadu, Agricultural University, Perambalur-621212, Tamil Nadu, India.
[2]Ph.D., Scholar, Tamil Nadu Agricultural University, Coimbatore – 641 003, Tamil Nadu, India.

Abstract

Insecticide resistance has increased as a result of the widespread usage of pesticides for insect control. It has now evolved into a global issue and a source of great concern. As a result, more efficient and innovative technologies for insect/pest control are desperately needed. By incorporating nanoparticles, nanotechnology, an interdisciplinary field, has transformed various fields of science and technology. Nanoparticles can be used to improve the efficacy of insecticides and herbicides in low-dose applications. Nanotechnology is used less frequently in agriculture than in other fields such as medicine and pharmacy. We review classic insect/pest control tactics in this chapter and examine nanotechnology's potential as a novel tool for insect management.

Introduction

The word nano is derived from the Greek word nano, which means "dwarf," which explains the term nanotechnology, which arose from the use of nanometer-sized particles (sizes of 1–100 nm) (Bhattacharyya et al. 2010). Nanotechnology is one of the most trustworthy and rapidly developing technologies in the twenty-first century. It offers numerous benefits, particularly in agriculture, such as insect pest management via nanomaterials-based pesticides and insecticides, development of insect pest-resistant crop varieties, and increased agricultural output via bio-conjugated nanoparticles.

Nanoparticles Present in Insects

There are several naturally occurring nanostructures that fit certain criteria, but they have been underestimated up until now. Cicada wings, such as *Psaltoda claripennis* Ashton and termites, family Rhinotermitidae, have an organized hexagonal array of features (Zhang et al. 2006). Nanoparticles range in size from 200 to 1000 nanometers, according to numerous studies. The top of these wing structures is rounded, and the outer side has a protrusion of around 150–350 nm. These characteristics improve the insect's aerodynamic efficiency. Some insects' compound eyes have nanostructures that are similar to these. The brightly coloured components found in butterfly wings are, interestingly enough, nanoparticles. Plant-insect interactions are thought to be mediated by these naturally occurring nanoparticles. Some insects have ferromagnetic material in their body parts, which are magnetic nanoparticles that operate as geomagnetic sensors, especially in social insects (Esquivel 2007).

Nanoparticles Used in Biopesticides Controlled Release Formulations

The different types of nanomaterials used are:

1. **Nanospheres:** Active compound is dispersed into the polymeric matrix.
2. **Nanocapsules:** Active compound is lined by matrix polymer and centered in the core.
3. **Nanogels:** These are cross-linked polymers which are hydrophilic in nature and can absorb large amounts of water.
4. **Micelles:** These are aqueous collection formed by hydrophilic and hydrophobic molecules.

Classes of Nanoparticles

There are many ways to classify nanoparticles based on their chemical composition and their properties. They can also be classified based on their morphology, structure, dimension, and composition. The major classes of nanoparticles are carbon-based nanoparticles (carbon nanotubes and fullerenes) and metal or metal-oxide nanoparticles (Ag NPs, CuO NPs, TiO_2).

Nanopesticides

Nanopesticides are biologically generated nanoparticle complexes that are intended for use as pesticides. Nanopesticides are made up of both organic and inorganic components, such as polymers and metal oxides. Nanoformulation is important in the creation of nanopesticides because it increases the apparent solubility of poorly soluble active components, allows for controlled release of the active ingredient, and protects it against premature degradation. The advantages of nanoparticle-based pesticide formulations include increased formulation stability, which prevents early degradation, more toxic substance elimination compared to conventional pesticides, improved mobility and higher insecticidal activity due to smaller particle size, and larger surface area, which extends their shelf life (Shah and Wani 2016). The benefits of nanoparticles include better and accurate delivery of products as they are designed to transfer particular molecules to a cell or tissue according to requirement. These nanoparticles enter the plant cell through ion channels or by binding to a carrier protein. This uptake is also influenced by the permeability of the plant cell wall. These nanoparticles are being evaluated for phytotoxicity, despite their beneficial effect on plants. The effects of these nanoparticles on seed germination and plant development have been described in many research. Nano-ZnO particles, for example, have been demonstrated to boost seedling growth of mung and grams beans at a certain concentration, whereas treating castor seeds with silver nanoparticles had no effect on seed germination or lepidopteran insect growth on the seeds. By using scanning electron microscopy to locate nanoparticles in the nucleolus or mitochondria, researchers were able to demonstrate their penetration into cell organelles, implying that they may be used for pesticide administration.

Methods to Develop Nanoparticles for Pest Control

Pesticide encapsulation is essential for its controlled release as well as to minimize its toxic properties. Some of the uses of nanoparticles for pest management are described below:

1. Pesticide-loaded nanoparticles: Some nanoparticles have the ability to load a variety of pesticides, including insecticides, herbicides, fungicides, and nematicides. An aqueous suspension of nanoparticles containing an organic active agent, such as insecticides and pesticide-coated metal oxide nanoparticles with a UV photoprotective filter were effective in preventing the plant from dangerous insects.

2. Insecticide-loaded nanoparticles: Imidacloprid is a new pesticide that is encapsulated with chitosan and sodium alginate and is present in soybean plants in small amounts. Deltamethrin, a silver nanoparticle conjugated to a pyrethroid pesticide, has been found to be efficient against arthropod vectors like mosquitoes. Pyrifluquinazon, a nanoparticle with a controlled release characteristic, was proven to be efficient against *Myzus persicae.*

Mechanisms of Action of Nanoparticles

Understanding the mechanisms of action of nanoparticles against insects is critical for predicting the pesticide effects of these nanoparticles. Because toxicity is heavily influenced by nanoparticle size, shape, and charge, the majority of toxicity research have been conducted on silver nanoparticles (Foldbjerg et al. 2015). One of the most widely accepted theories concerning nanoparticles' mode of action is that they pierce the exoskeleton and bind to DNA and proteins, causing organelles and enzymes to denature quickly. In the end, a disruption in proton motive force and a decrease in membrane permeability leads to the loss of cellular activities and cell death.

Conclusion

Traditional pest management tactics are insufficient for large-scale pest control. Chemical pesticides are incredibly effective, but they have a lot of negative side effects on other organisms and humans. Furthermore, the emergence of pesticide resistance among insects/pests is always a risk. Nanopesticides could be a viable alternative for managing insect pests in agriculture without harming the environment. Pesticides combined with nanoparticles will also have more particular and focused impacts on pest populations. Although the hazardous effects of nanoparticles on aquatic species have been researched, there is little information on the toxicity of nanoparticles on helpful insects. This allows the scientific community to do additional study and validation in order to fully realize the promise of nanoparticles and nanotechnology in agriculture.

References

1. Bhattacharyya A., Bhaumik A., Rani P.U., Mandal S. and Epidi T.T., (2010). Nano-particles - A recent approach to insect pest control. African Journal of Biotechnology. 9(24):3489–3493
2. Esquivel D.M.S., (2007). Magnetic nanoparticles in social insects: are they the geomagnetic sensors? Entomological Society of America. Annual Meeting. Monday, December 10, NO-0574
3. Zhang G., Zhang J., Xie G., Liu Z. and Shao H., (2006). Cicada wings: a stamp from nature for nanoimprint lithography. Small. 2(12):1440–1443
4. Shah MA., and Wani S.H., (2016). Nanotechnology and insecticidal formulations. Journal of Food Bioengineering and Nanoprocessing. 1(3):285–310
5. Foldbjerg R., Jiang X., Micləuş T., Chen C., Autrup H. and Beer C., (2015). Silver nanoparticles – wolves in sheep's clothing? Toxicology Research. 4(3):563–575.

Molecular Markers and their Applications in Plant Breeding

Article ID: 11555

Dr. Rani Jadhav[1]

[1]Junior Research Fellow, DBT-NBPGR Network Project on Linseed, AICRP on Linseed and Mustard, College of Agriculture, Nagpur (MS).

Summary

DNA markers are the utmost extensively used marker predominantly due to their abundance. They arise from various classes of DNA mutations like substitution mutations (point mutations), movements (insertions or deletions) or errors in replication of tandemly repeated DNA (Paterson, 1996). These markers are selectively neutral because they are generally located in non-coding regions of DNA. Dissimilar to morphological and biochemical markers, DNA markers are practically unlimited in number and are not affected by environmental factors and the developmental stage of the plant (Winter & Kahl, 1995).

Introduction

DNA marker is a fragment of DNA revealing mutations/variations, which can be used to detect polymorphism between different genotypes or alleles of a gene for a particular sequence of DNA in a population or gene pool". Such fragments are associated with a certain locus within the genome and may be detected by some molecular technology. In simple words, DNA marker is a small region of DNA sequence showing polymorphism (base deletion, insertion and substitution) between different individuals. DNA markers that are tightly linked to candidate genes may be used as molecular tools for marker-assisted selection (MAS) in plant breeding (Ribaut and Hoisington, 1998).

What are Genetic Markers?

Genetic markers represent genetic differences between individual organisms or species. Generally, they do not represent the target genes themselves but act as 'signs' or 'flags. Genetic markers that are located in close proximity to genes (i.e., tightly linked) may be referred to as gene 'tags'. Such markers themselves do not affect the phenotype of the trait of interest because they are located only near or 'linked' to genes controlling the trait. All genetic markers occupy specific genomic positions within chromosomes (like genes) called 'loci' (singular 'locus'). There are three major types of genetic markers: (1) morphological (also 'classical' or 'visible') markers which themselves are phenotypic traits or characters; (2) biochemical markers, which include allelic variants of enzymes called isozymes; and (3) DNA (or molecular) markers, which reveal sites of variation in DNA (Jones et al., 1997; Winter & Kahl, 1995)

Isozyme markers are differences in enzymes that are detected by electrophoresis and specific staining. The major disadvantages of morphological and biochemical markers are that they may be limited in number and are influenced by environmental factors or the developmental stage of the plant (Winter & Kahl, 1995). DNA markers may be broadly divided into three classes based on the method of their detection: (1) hybridization-based; (2) polymerase chain reaction (PCR)based and (3) DNA sequence-based (Gupta et al., 1999; Jones et al., 1997)

RFLP Markers

RFLP markers are the first generation of DNA markers and one of the important tools for plant genome mapping. They are a type of Southern-Bolting-based markers. In living organisms, mutation events (deletion and insertion) may occur at restriction sites or between adjacent restriction sites in the genome. Gain or loss of restriction sites resulting from base pair changes and insertions or deletions at restriction sites within the restriction fragments may cause differences in size of restriction fragments. These variations may cause alternation or elimination of the recognition sites for restriction enzymes. They are powerful tools for comparative and synteny mapping. Most RFLP markers are co-dominant and locus-specific. RFLP genotyping is highly reproducible, and the methodology is simple and no special equipment is required. By using an improved RFLP technique, i.e., cleaved amplified polymorphism sequence (CAPS), also known as PCR-RFLP, high-throughput markers can be developed from RFLP probe sequences, whereas it requires large amounts of high-quality DNA, has low genotyping throughput, and is very difficult to automate. Radio- active autography involving in genotyping and physical maintenance of RFLP probes limit its use and share between laboratories.

RAPD Markers

RAPD is a PCR-based marker system. In this system, the total genomic DNA of an individual is amplified by PCR using a single, short (usually about 10 bases) and random primer. It is predominantly dominant marker which yields high levels of polymorphism and is simple and easy to be conducted. 1) neither DNA probes nor sequence information is required for the design of specific primers. 2) the procedure does not involve blotting or hybridization steps, and thus it is a quick, simple and efficient technique. 3) Relatively small amounts of DNA (about 10 ng per reaction) are required and the procedure can be automated, and higher levels of polymorphism also can be detected compared with RFLP. 4) No marker development is required, and the primers are non-species specific and can be universal. 5) The RAPD products of interest can be cloned, sequenced and then converted into or used to develop other types of PCR-based markers, such as sequence characterized amplified region (SCAR), single nucleotide polymorphism (SNP), etc. Low reproducibility and incapability to detect allelic differences in heterozygotes.

AFLP Markers

AFLPs are PCR-based markers. Technically, AFLP is based on the selective PCR amplification of restriction fragments from a total double-digest of genomic DNA under high stringency conditions, i.e. the combination of polymorphism at restriction sites and hybridization of arbitrary primers. The first step in AFLP involves restriction digestion of genomic DNA (about 500 ng) with two restriction enzymes, a rare cutter (6-bp recognition site, EcoRI, PtsI or HindIII) and a frequent cutter (4- bp recognition site, MseI or TaqI). The adaptors are then ligated to both ends of the fragments to provide known sequences for PCR amplification. The double-stranded oligonucleotide adaptors are designed in such a way that the initial restriction site is not restored after ligation. Therefore, only the fragments which have been cut by the frequent cutter and rare cutter will be amplified. This property of AFLP makes it very reliable, robust and immune to small variations in PCR amplification parameters (e.g., thermal cycles, template concentration), and it also can produce a high marker density. A typical AFLP fingerprint (restriction fragment patterns generated by the technique) contains 50-100 amplified fragments, of which up to 80% may serve as genetic markers. In general, AFLP assays can be conducted using relatively small DNA samples (1-100 ng per individual). AFLP has a very high multiplex ratio and genotyping throughput, and is relatively reproducible across laboratories. It does not require sequence information or probe collection prior to generating the fingerprints, and a set of primers can be used for different species. This is especially useful when DNA markers are rare. Polymorphic information content for bi-allelic markers is low. High quality DNA is required for complete restriction enzyme digestion. AFLP markers usually cluster densely in centromeric regions in some species with large genomes (e.g., barley and sunflower). The applications of AFLP markers include biodiversity studies, analysis of germplasm collections, genotyping of individuals, identification of closely linked DNA markers, construction of genetic DNA marker maps, construction of physical maps, gene mapping, and transcript profiling.

SSR Markers

SSRs, also called microsatellites, short tandem repeats (STRs) or sequence-tagged microsatellite sites (STMS), are PCR-based markers. They are randomly tandem repeats of short nucleotide motifs (2-6 bp/nucleotides long). Di-, tri- and tetra-nucleotide repeats, e.g. (GT)n, (AAT)n and (GATA)n, are widely distributed throughout the genomes of plants and animals. The copy number of these repeats varies among individuals and is a source of polymorphism in plants. Because the DNA sequences flanking microsatellite regions are usually conserved, primers specific for these regions are designed for use in the PCR reaction. One of the most important attributes of microsatellite loci is their high level of allelic variation, thus making them valuable genetic markers. SSR markers are characterized by their hyper-variability, reproducibility, co-dominant nature, locus-specificity and random genome-wide distribution in most cases. They can be readily analysed by PCR and easily detected by PAGE. SSR markers can be multiplexed, have high throughput genotyping and can be automated. Require only very small DNA samples (~100 ng per individual) and low start-up costs for manual assay methods. However, SSR technique requires nucleotide information for primer design, labor intensive marker development process and high start-up costs for automated detections.

SNP Markers

An SNP is a single nucleotide base difference between two DNA sequences or individuals. SNPs can be categorized according to nucleotide substitutions either as transi- tions or transversions. SNPs provide the simplest form of molecular markers as a single nucleotide base is the smallest unit of inheritance and thus, they can provide maximum markers. Typically, SNP frequencies are in a range of one SNP every 100-300 bp in plants SNPs may present within coding sequences of genes, non-coding regions of genes or in the intergenic regions. Advantages: SNPs are co-dominant markers, often linked to genes. High costs for marker development, high-quality DNA required and high technical/equipment demands limit, to some extent, the application of SNPs in some laboratories and practical breeding programs.

Conclusion

The choice and use of DNA markers in research and breeding is still a challenge for plant breeders. A number of factors need to be considered when a breeder chooses one or more molecular marker types. A breeder should make an appropriate choice that best meets the requirements according to the conditions and resources available for the breeding program.

Health Benefits of *(Ziziphus jujube)*

Article ID: 11556

Vipin Chandra Garwal[1], Purnita Raturi[2]
[1]ADO Horticulture, Uttarakhand Government.
[2]Research Scholar, Department of Horticulture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand-263145 (India).

Introduction

The use of ethnomedicinal plants to cure various illnesses has been practiced since ancient times. *Ziziphus jujube* is a Rhamnaceae family herb that is used in traditional medicine. It is one of the most significant *Ziziphus* species. *Ziziphus jujube*, also known as Jujube, Korean date, or red date is a tiny shrub or tree with small yellowish-green flowers and fruit type is a drupe, the size of a date that ranges in color from brown to purplish black. Jujube fruit is consumed as dried candies or fresh, and it is also occasionally processed into juice. The pits are sometimes removed, and the flesh is pounded with sugar and other fruits to make a cake that can dry in the sun. Whatever method you use to consume jujubes, the powerful antioxidants and organic compounds found in this impressive fruit will provide a wide range of health benefits. It has a high concentration of bioactive chemicals that are beneficial to human health.

Nutrients Present in Jujube

Jujube is a traditional and useful fruit that includes 23 different types of amino acids that are not present in most other fruits and has various health advantages. Phosphorus, calcium, potassium, and manganese are the most abundant minerals in jujube. It is also high in sodium, zinc, iron, and copper, and is a good source of vitamin C, thiamine, and riboflavin.

Health Benefits of Jujube

1. Anticancer activities: In traditional Chinese medicine, jujube extract is used to treat breast cancer; the extract contains bioactive triterpenic acid molecules such as ZE2 and ZE4. These chemicals are efficient at inhibiting cell development and inducing apoptosis in cells. The bioactive chemicals found in jujube fruit, such as triterpenic acids and polysaccharides, exhibit antiproliferative and anticancer properties in a variety of cancer cell lines.

2. Fight anemia: Jujube fruits are high in iron (1.9 mg/100g) and phosphorous, both of which are essential components of red blood cells. Anemia is defined as a low iron concentration in the blood, which is accompanied by symptoms such as tiredness, weakness, dizziness, pale complexion, mild headache, indigestion, tingling or crawling sensation in the legs, rapid or irregular heartbeat, cold hands and feet, and so on. As a result, increasing your consumption of iron-rich jujube fruits might help us battle anemia.

3. Strengthening of bones: To keep our bones tough, healthy, and strong, we need minerals like calcium (79 mg or 8% of RDI present in jujube), phosphorus, and iron, all of which are abundant in jujube fruits. We are all aware that as we get older, we are more likely to develop osteoporosis and other bone-degrading disorders, therefore adding this fruit can help to halt or reverse the trend.

4. Improve immunity: Jujube has a high anti-oxidant content, Vitamin C (69 mg/100gm), Vitamin A, and numerous organic compounds and acids that are useful to the immune system. Antioxidants can neutralize free radicals, which are harmful byproducts of cellular respiration and are responsible for a wide range of severe diseases and illnesses in the body. Vitamin C also stimulates the formation of white blood cells, which serve as our immune system's first line of defense.

5. Control stress and anxiety: Jujube has been shown to have anxiolytic and calming effects on the body, as well as an impact on hormone levels, resulting in a peaceful and soothing experience throughout the body and mind. Snacking on dried jujube can assist to relax those who suffer from chronic tension or anxiety daily. It includes flavonoids, which are antioxidants that help to decrease stress.

6. Weight loss: Eating fruits and vegetables is a popular recommendation for those seeking to reduce weight and jujube is another that can easily be added to the list. Because of its low-calorie count and high protein and fiber content, jujube can meet nutritional needs and full stomach up, preventing us from nibbling in between meals. Skin health: As the fruit is rich in antioxidants and thus help to prevent the appearance of wrinkle and scars, as well as keeping the skin tight and energized with oxygenated blood. Jujube extract and juice have been tropically used to treat various irritation and inflammations on the skin like psoriasis, eczema, acne.

7. Blood Purification: The saponins and alkaloids present in jujube fruits have been linked to blood purification and the removal of harmful poisons from the body. The antioxidant impact can assist to prevent a wide range of disorders and illnesses, as well as reduce stress on the immunological and lymphatic systems.

8. Improve digestion: Jujube's high fiber content aids in the prevention of constipation, bloating, cramps, excess flatulence, and severe gastrointestinal problems.

9. Sleeping aids: For people who suffer from insomnia or restlessness, eating the seed extract is a useful treatment.

10. Heal burn: Jujube fruit (*Zizyphus vulgaris* L.) has been reported to have anti-inflammatory effects as a traditional therapeutic agent. It contains agents such as 9 fatty acids, 2 saponins, a lot of vitamin C, and 7 phenolic compounds including caffeine, epicatechin, caffeine acid, ferulic acid, pins acid, rutin, hydroxybenzoic, and chromogenic acid that reduce inflammation and because disinfection affects the burn healing.

Conclusion

Ziziphus jujube is an important medicinal plant that has been used to cure many diseases since antiquity. Almost all components and extracts of the plant have shown substantial pharmacological activity and are often used as an alternative medicine to treat a variety of ailments and disorders. The plant's roots are used to cure coughs, nausea, and headaches. Chronic dysentery and diarrhea are treated with the bark. Boiling the leaves in water is also used to clean corpses before burial. Furthermore, the leaves can be utilized to lose weight and fight obesity. The major element is the fruits, which have traditionally been used as a digestible, tonic, and laxative to cure nausea, burn, feelings, thirst, TB, and blood bone disorders. The extracts from the seeds can be used to treat eye irritation and leucorrhoea. Traditionally, powdered leaves and bark have been used to heal wounds. Furthermore, fresh leaves can be utilized to heal wounds and urinary infections. As a result, jujube can be utilized as a natural option to cure a variety of illnesses.

References

1. Hossain, M. A, (2019). A phytopharmacological review on the Omani medicinal plant: Ziziphus jujube. Journal of King saud University - science. 31(4):1352-1357.
2. Shahrajabian, M.H. and Khoshkharam, M. (2019). Jujube, a super-fruit in traditional Chinese medicine, heading for modern pharmacological science. Journal of Medicinal Plants Studies.7(4):173-178.
3. Vafaei, F. and Abdollahzadeh, F.(2015). Investigating the effects of Hydroalcoholic extract of jujube fruit (Zizyphus vulgaris L.) on second degree burn wound healing in Balb/c mice. Journal of medicine and life. 8(2):117–120.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Health Benefits of *(Ziziphus jujube)*

Article ID: 11557

Vipin Chandra Garwal[1], Purnita Raturi[2]
[1]ADO Horticulture, Uttarakhand Government.
[2]Research Scholar, Department of Horticulture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand-263145 (India).

Introduction

The use of ethnomedicinal plants to cure various illnesses has been practiced since ancient times. *Ziziphus jujube* is a Rhamnaceae family herb that is used in traditional medicine. It is one of the most significant *Ziziphus* species. *Ziziphus jujube*, also known as Jujube, Korean date, or red date is a tiny shrub or tree with small yellowish-green flowers and fruit type is a drupe, the size of a date that ranges in color from brown to purplish black. Jujube fruit is consumed as dried candies or fresh, and it is also occasionally processed into juice. The pits are sometimes removed, and the flesh is pounded with sugar and other fruits to make a cake that can dry in the sun. Whatever method you use to consume jujubes, the powerful antioxidants and organic compounds found in this impressive fruit will provide a wide range of health benefits. It has a high concentration of bioactive chemicals that are beneficial to human health.

Nutrients Present in Jujube

Jujube is a traditional and useful fruit that includes 23 different types of amino acids that are not present in most other fruits and has various health advantages. Phosphorus, calcium, potassium, and manganese are the most abundant minerals in jujube. It is also high in sodium, zinc, iron, and copper, and is a good source of vitamin C, thiamine, and riboflavin.

Health Benefits of Jujube

1. Anticancer activities: In traditional Chinese medicine, jujube extract is used to treat breast cancer; the extract contains bioactive triterpenic acid molecules such as ZE2 and ZE4. These chemicals are efficient at inhibiting cell development and inducing apoptosis in cells. The bioactive chemicals found in jujube fruit, such as triterpenic acids and polysaccharides, exhibit antiproliferative and anticancer properties in a variety of cancer cell lines.

2. Fight anemia: Jujube fruits are high in iron (1.9 mg/100g) and phosphorous, both of which are essential components of red blood cells. Anemia is defined as a low iron concentration in the blood, which is accompanied by symptoms such as tiredness, weakness, dizziness, pale complexion, mild headache, indigestion, tingling or crawling sensation in the legs, rapid or irregular heartbeat, cold hands and feet, and so on. As a result, increasing your consumption of iron-rich jujube fruits might help us battle anemia.

3. Strengthening of bones: To keep our bones tough, healthy, and strong, we need minerals like calcium (79 mg or 8% of RDI present in jujube), phosphorus, and iron, all of which are abundant in jujube fruits. We are all aware that as we get older, we are more likely to develop osteoporosis and other bone-degrading disorders, therefore adding this fruit can help to halt or reverse the trend.

4. Improve immunity: Jujube has a high anti-oxidant content, Vitamin C (69 mg/100gm), Vitamin A, and numerous organic compounds and acids that are useful to the immune system. Antioxidants can neutralize free radicals, which are harmful byproducts of cellular respiration and are responsible for a wide range of severe diseases and illnesses in the body. Vitamin C also stimulates the formation of white blood cells, which serve as our immune system's first line of defense.

5. Control stress and anxiety: Jujube has been shown to have anxiolytic and calming effects on the body, as well as an impact on hormone levels, resulting in a peaceful and soothing experience throughout the body and mind. Snacking on dried jujube can assist to relax those who suffer from chronic tension or anxiety daily. It includes flavonoids, which are antioxidants that help to decrease stress.

6. Weight loss: Eating fruits and vegetables is a popular recommendation for those seeking to reduce weight and jujube is another that can easily be added to the list. Because of its low-calorie count and high protein and fiber content, jujube can meet nutritional needs and full stomach up, preventing us from nibbling in between meals. Skin health: As the fruit is rich in antioxidants and thus help to prevent the appearance of wrinkle and scars, as well as keeping the skin tight and energized with oxygenated blood. Jujube extract and juice have been tropically used to treat various irritation and inflammations on the skin like psoriasis, eczema, acne.

7. Blood Purification: The saponins and alkaloids present in jujube fruits have been linked to blood purification and the removal of harmful poisons from the body. The antioxidant impact can assist to prevent a wide range of disorders and illnesses, as well as reduce stress on the immunological and lymphatic systems.

8. Improve digestion: Jujube's high fiber content aids in the prevention of constipation, bloating, cramps, excess flatulence, and severe gastrointestinal problems.

9. Sleeping aids: For people who suffer from insomnia or restlessness, eating the seed extract is a useful treatment.

10. Heal burn: Jujube fruit (*Zizyphus vulgaris* L.) has been reported to have anti-inflammatory effects as a traditional therapeutic agent. It contains agents such as 9 fatty acids, 2 saponins, a lot of vitamin C, and 7 phenolic compounds including caffeine, epicatechin, caffeine acid, ferulic acid, pins acid, rutin, hydroxybenzoic, and chromogenic acid that reduce inflammation and because disinfection affects the burn healing.

Conclusion

Ziziphus jujube is an important medicinal plant that has been used to cure many diseases since antiquity. Almost all components and extracts of the plant have shown substantial pharmacological activity and are often used as an alternative medicine to treat a variety of ailments and disorders. The plant's roots are used to cure coughs, nausea, and headaches. Chronic dysentery and diarrhea are treated with the bark. Boiling the leaves in water is also used to clean corpses before burial. Furthermore, the leaves can be utilized to lose weight and fight obesity. The major element is the fruits, which have traditionally been used as a digestible, tonic, and laxative to cure nausea, burn, feelings, thirst, TB, and blood bone disorders. The extracts from the seeds can be used to treat eye irritation and leucorrhoea. Traditionally, powdered leaves and bark have been used to heal wounds. Furthermore, fresh leaves can be utilized to heal wounds and urinary infections. As a result, jujube can be utilized as a natural option to cure a variety of illnesses.

References

4. Hossain, M. A, (2019). A phytopharmacological review on the Omani medicinal plant: Ziziphus jujube. Journal of King saud University - science. 31(4):1352-1357.
5. Shahrajabian, M.H. and Khoshkharam, M. (2019). Jujube, a super-fruit in traditional Chinese medicine, heading for modern pharmacological science. Journal of Medicinal Plants Studies.7(4):173-178.
6. Vafaei, F. and Abdollahzadeh, F.(2015). Investigating the effects of Hydroalcoholic extract of jujube fruit (Zizyphus vulgaris L.) on second degree burn wound healing in Balb/c mice. Journal of medicine and life. 8(2):117–120.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

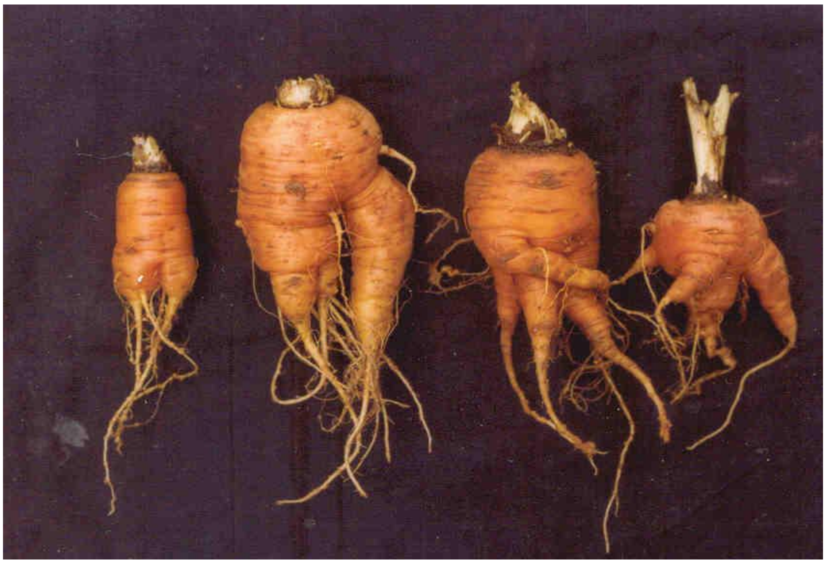
Techniques to Control the Galling or Forking Menace of Carrot

Article ID: 11558

Seenivasan Nagachandrabose[1]
[1]Department of Nematology, Tamil Nadu Agricultural University, Coimbatore 641003, Tamil Nadu, India.

Summary
Carrot is an important vegetable crop grown in hilly regions in India. The economic part of this crop is root tubers that are highly prone to infestation by the root-knot nematode, *Meloidogyne hapla*. Severely infected carrot plants often failed to produce root tubers and caused yield reduction of up to 36-51%. Since nematode infection leads to 'malformation of carrot' or 'forking of root tubers', the farmers facing a marketable yield loss of up to 86%. This forking menace of carrot can be managed by following summer ploughing or application of organic amendments or biocontrol agents or chemical methods. Recent studies conducted at Horticultural Research Station, Kodaikanal, Tamil Nadu, India demonstrated that seed treatment with liquid Pseudomonas fluorescens (plant growth-promoting rhizobacterium) at 100 ml/kg seeds and soil drenching with *Purpureocillium lilacinum* (nematode egg parasitic fungi) at 5 l/ha can give 70-74% control of M. hapla and improve carrot yield by 29%. Hence, this biocontrol technology needs to be promoted for the production of quality carrots.

Introduction
Carrot is an important root vegetable crop grown globally for its rich nutritional contents of vitamin A and carotenes. In India, it is cultivated in 23 states with a total area of 6.8 million ha and produced 10.93 million tonnes annually. Tamil Nadu states is the second-largest producer of carrots in India that growing carrots in 1.3 million ha with 3900 tonnes of production. Galling or forking of carrots is a serious constraint for successful carrot farming. This kind of root galls, malformation and forking of carrots is occurring due to root-knot nematode, *Meloidogyne hapla* infection. The eggs of *M. hapla* are found in soils and hatches in presence of water and host crops. The hatched juveniles of *M. hapla* penetrate roots and forms several multinucleate giant cells in root vascular tissues. It leads to the formation of galls, digitation and constriction on taproots. In addition, it causes seedling death, stunting of young plants, branching of taproots which reduces quality and yield. Even at low soil densities, it has been reported to reduce marketable carrot yields. On mature carrots, infection by *M. hapla* causes small galls on secondary roots. If galling occurs during the seedling stages, the carrot roots can become severely stunted or forked and therefore unmarketable.



Malformed carrots due to Meloidogyne hapla infection

Nematode infection affects the germination of seeds by 15% and carrot yield by 36-51%. Apart from direct yield loss in quantity, root malformation due to M. hapla also leads to a marketable yield loss of up to 86%. The M. hapla infection also reduces the carotenoid contents in carrot root tubers. Additionally, root damage caused by M. hapla provides an avenue for entry of soft-rot bacterium, *Pectobacterium carotovorum* subsp. carotovorum and can result in a huge crop loss due to the synergistic disease complex. The carrots growers at the Nilgiris and Kodaikanal hills are frequently facing the menace due to root-knot nematode infection.

Nematode Management Technologies

Summer ploughing: The conventional cultural practice of 'summer ploughing' can help to reduce the population load of root-knot nematodes. Summer ploughing should be done just after a receipt of summer rain or the field should be irrigated before doing summer ploughing. The disc plough is better to expose the soil to the desired depth. The mechanism behind this technology is (i) rainwater or irrigated water makes the eggs of the root-knot nematode hatch, (ii) the hatched juveniles cannot survive without host or killed by heat and desiccation (stress to juveniles) induced by direct exposure to sunlight on the soil. Adoption of summer ploughing before carrot crop can reduce 35-55% of the root-knot nematode inoculums.

Organic manures: The other conventional agro practice 'application of organic manures' also harms root-knot nematodes. However, the extent of nematode control differs according to the type of organic manure. Farmyard manure, vermicompost, farm wastes, chicken manure and oil cakes like neem cake, castor cake, pungam cake etc are some of the commonly used organic manure. The organic manures reduce root-knot nematodes by:

a. Release of substances such as organic acids (formic, acetic, propionic and butyric acids), ammonia and hydrogen sulphide gases which are toxic to juveniles of root-knot nematodes.

b. Promoting the populations of predatory nematodes such as *mononchus* spp. and other nematode antagonistic microbes in the soil. Application of neem cake @ 400-500 kg/ha can give 40-60% nematode control.

Biological control: Effective use of nematode antagonistic bio-agents is an important component of eco-friendly agro-farming. To the tune, a technology of "seed treatment (ST) with liquid *Pseudomonas fluorescens* at 100 ml/kg seeds + soil drenching (SD) with *Purpureocillium lilacinum* at 5 lit/ha" has been developed at Horticultural Research Station, Kodaikanal. Adoption of this technology can control 70-74% of *M. hapla* infections and can increase carrot yield by 29%. The *P. fluorescens* is a plant growth-promoting bacteria that colonizes the carrot roots when applied as a seed treatment. It reduces *M. hapla* infection by altering the root exudates which affect the nematode egg hatching, juvenile attraction towards the root and root penetration potential. The bacterium colonized roots induce systemic resistance against nematodes in carrot plants by producing peroxidases, polyphenol oxidases, phenylalanine ammonia-lyase and 1-aminocyclopropane-1-carboxylic acid deaminase enzymes. Simultaneously, *P. lilacinum* applied as soil drenching can parasitize egg-mass, eggs, juveniles and adult females of *Meloidogyne hapla* by direct hyphal penetration. The acetic acid and some metabolites like paecilotoxins and eucinostatins produced by *P. lilacinum* can also kill *M. hapla* juveniles. The economic returns per investment were also higher in the concomitant application of ST with liquid *P. fluorescens* @ 100 ml/kg seed + SD with liquid *P. lilacinum* @ 5 lit/ha (1:8.4 incremental cost-benefit ratio).

Chemical control: If the field population of *M. hapla* is heavy (Economic threshold level - more than 2 eggs or juveniles/g soil), the farmers can go for soil application of Carbofuran 3G @ 30 kg/ha. However, the nematodes that escape from carbofuran treatment may serve as inoculums for the next crop. Hence, farmers should follow other eco-friendly methods like summer ploughing, organic manure and biological control for the ensuing carrot crop.

Conclusion

Combined application of Seed treatment with liquid Pseudomonas fluorescens @ 100 ml/kg seed + Soil drenching with liquid *Purpureocillium lilacinum* @ 5 lit/ha is recommended for management of root-knot nematodes in carrot cultivation. This technology has the following advantages;

1. The technology can reduce *M. hapla* population in soil by 74%.
2. It can reduce *M. hapla* infection on roots by 70%.
3. It can improve the yield of carrots by 29%.

4. This technology has the highest incremental cost-benefit ratio of 1:8.4.

References

1. Devrajan, K., Seenivasan, N., & Selvaraj, N. (2003). Bio-management of root-knot nematode, Meloidogyne hapla, in carrot (Daucus carota L.). Indian Journal of Nematology, 33(1), 6-8.
2. Nagachandrabose, S. (2018). Liquid bio formulations for the management of root-knot nematode, Meloidogyne hapla that infects carrot. Crop Protection, 114, 155-161.
3. Seenivasan, N. (2017). Status of root-knot nematode, Meloidogyne hapla infection on carrot at Kodaikanal hills of Tamil Nadu, India and its yield loss estimation. International Journal of Current Microbiology and Applied Sciences, 6, 1-7.
4. Seenivasan, N. (2018). Effect of concomitant application of Pseudomonas fluorescens and Purpureocillium lilacinum in carrot fields infested with Meloidogyne hapla. Archives of Phytopathology and Plant Protection, 51(1-2), 30-40.

E-ISSN: 2581 - 8317

Customized Fertilizers: A New Approach to Increase FUE

Article ID: 11559

Rutul S. Patel[1]

[1]Ph. D. Scholar, Department of Agronomy, N. M. College of Agriculture, Navsari Agricultural University, Navsari – 396450 (Gujarat).

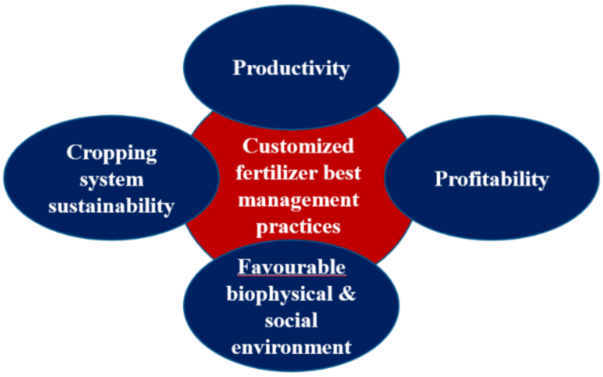
Introduction

Fertilizer is an essential component of modern agriculture. To meet the growing food grains, need of population, the only option available is increasing productivity through proper planning & optimum utilization of resources such as fertilizers, seeds, water etc. In India, among the nutrients, NPK remain the major ones for increased and sustained productivity. However, the development of high yielding systems will like exacerbate the problem of secondary & micronutrient deficiencies, not only because larger amounts are removed, but also because of the inadequate & imbalance use of N, P & K to achieve higher yield. As a result, in the intensive systems there is every possibility to build up of negative balance & deficiency of secondary nutrients & micronutrients. To attain high future targets, balance fertilization, site specific nutrient management and customized fertilizers will play a very important role. The development of site and crop specific readymade customized fertilizers based on scientific principles may prove to be more effective to meet the plant requirement and enhance the nutrient use efficiency. This approach is also likely to boost crop yield & arrest soil fertility decline in a long run in an eco-friendly manner.

Customized Fertilizer

Customized fertilizers are multi-nutrient carriers design to contain macro- and/or micro- nutrient forms, manufactured through a systematic process, satisfying the crop's nutritional needs, specific to its site, soil and stage, validated by a scientific crop model developed by an accredited fertilizer manufacturing/marketing company. [Source: Fertilizer (Control) Order, 1985].

Objectives of Customized Fertilizers



1. To provide site specific nutrient management for achieving maximum fertilizer use efficiency for the applied nutrient in a cost-effective manner.
2. The customized fertilizer includes the combination of nutrients on the basis of:
    a. Site.
    b. Soil testing.
    c. Crop need.
    d. Stage of crop.

Characteristics/Quality of Customized Fertilizers

1. Granular in size.
2. Minimum 90% b/w 1-4 mm IS sieve & below 1 mm should not exceed 5%.
3. 100% water soluble grade.

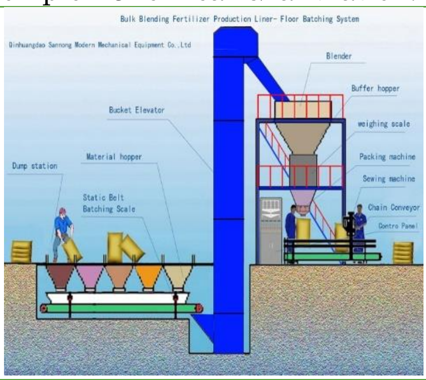
4. Minimum nutrient content in specific grade should contain >30 units of all nutrient.

Need of Customized Fertilizers

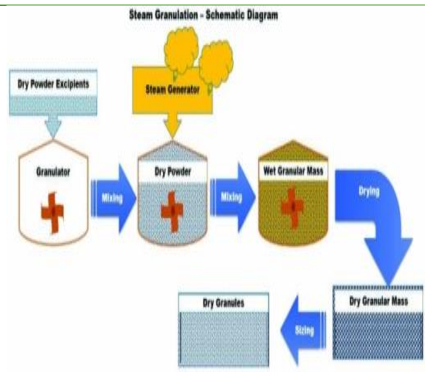
1. Imbalance use of fertilizers.
2. Continuous increase of secondary and micronutrient deficiency.
3. Stagnant of crop productivity.
4. Emergence of multi-fertilizer responsive genotypes.
5. Need of increasing FUE.
6. Improve soil health.
7. Need to reduce fertilizer-based input cost.
8. Environmental Pollution.

Farmer's Preference of Customized Fertilizers Due to

1. Better crop quality & productivity
2. Maximum nutrient use efficiency
3. Specific to crop and area based on soil fertility
4. Available in ready to use form in balance way
5. Improve soil fertility
6. Environment friendly
7. Adoptable to varies field application
8. Method of customized fertilizer manufacturing: There are basically three method of customized fertilizer production:
   a. Bulk Blending.
   b. Compound Granulation/Steam Granulation.
   c. Complex/Chemical Granulation.



Bulk blending



Stem granulation

How to Arrive at Customized Fertilizer?

1. Geo-referencing of chosen area.
2. Selecting sampling points on appropriate statistical procedure.
3. Actual sampling of sites.
4. Analysing sampling of sites.
5. Analysing soil, plant and water samples for nutrients and some soil characteristics.
6. Defining management zones.
7. Yield targeting in major management zones.
8. Computing crop removal of nutrients.
9. Calculating nutrient requirement.
10. Blending of nutrients based on generated information.

Journey of Customized Fertilizers in India

2005	Concept paper in IJF & presented in FAI seminar
2006	FAI working Group
2007	FAI & DAC proposal on CF

2007	CF formulation & field validation trial by Tata, Nagarjuna & Deepak
2007	Series of CF workshops conducted
2008	CF guideline issued by GoI on 11th March, 2008
2008	DAC approved 12 CF grades
2009	Tata initiates setting up of HI tech CF plant
2010	GoI support for availability of raw material
2010	Tata's CF Plant starts production on 22nd Nov., 2010

Customized Formulation in India

1. Fertilizer Control Order (FCO) approved about 36 formulations of customized fertilizers. At present nearly 1lakh tonne of customized fertilizer is being marketed by four companies in India.
2. The important companies in the market, producing customized fertilizers are:
    a. Tata chemical Ltd.
    b. Deepak Fertilizers
    c. Nagarjuna fertilizers
    d. Coromandal industries Ltd. Etc.

Different Customized Fertilizer Formulations Available in India

Sr. No.	Crops	Formulations (N:P:K:S:Zn:B)	Geography/area
1.	Wheat	10:18:25:3:0.5:0	Muzaffarnagar, Bareilly, Bijnor, Hathras, Pilibhit, Mathura, Meerut
2.	Sugarcane	7:20:18:6:0.5:0	Moradabad, KR Nagar, Farrukhabad
3.	Rice	8:15:15:0.5:0.15:0	Ghaziabad, Rampur, Shahjahanpur, Manipuri and US
4.	Groundnut	15:15:15:9:0.5:0.2	Andhra Pradesh
5.	Maize	20:0:15:0:0:0.2	Andhra Pradesh
6.	Potato	8:16:24:6:0.5:0.15	Agra, Aligarh, Budan, Bulandshahar
7.	Paddy	15:32:8:0.5 18:33:7:0.5 18:27:14:0.5	Andhra Pradesh
8.	Mentha	8:20:20:4:0.3:0.2	JP Nagar, Lakhimpur Kheri
9.	Grape, Sugarcane	10:20:10:5:2:0.5:0.3:0.2	Aurangabad, Nasik, Pune Ahmednagar
10.	Paddy (basal)	16:22:14;4:1:0	East & West Godavari, Krishna, Guntur
11.	Maize (basal)	14:20:15:4;0.6:0	Karimnagar, Warangal, Nizamabad
12.	Groundnut (basal)	17:17:17:4:0.5:0.2	Anantapur, Chittor, Kadapa, Kurnool, Mahbubnagar

Advantages of Customized Fertilizers

1. Customized fertilizers are use of the Fertilizers Best Management Practices and are generally assumed to maximize crop yields while minimizing unwanted impacts on the environment and human health.

2. Application of customized fertilizer is compatible with existing farmers system and hence it will be comfortably accepted by the farmers.

3. Customized fertilizer satisfies crop's nutritional demand, specific to area, soil, and growth stage of plant.

4. Mixed fertilizers with micronutrients provide recommended micronutrient rates for the agricultural field at the usual fertilizer application.

5. As the micro-nutrients are also added with the granulated NPK fertilizer the plants can absorb the micro-nutrient along with macro-nutrient which prevents nutrient deficiency in plant.

6. Micro-nutrient with the mixed fertilizer is one of the most convenient methods of fertilizer application and helps in more uniform distribution of nutrient with conventional application equipment's. It is a very unique method developed in agriculture industry and has tremendous crop for future.

Conclusion

1. Customized fertilizer is no doubt a ready to use form innovative product for site and crop specific nutrient management at particular agroclimatic conditions.
2. Customized fertilizer not only enhance the yield and quality of crops but also achieve the maximum fertilizer use efficiency of applied nutrient in a cost-effective manner.
3. Customized fertilizer also sustains the post-harvest soil fertility due to utilization of site-specific balance proportion of macro as well as micro nutrients.

References

1. http://www.iiss.nic.in/eMagazine/v2i1/7.pdf.
2. https://agricoop.nic.in/sites/default/files/Guideline2013.pdf.
3. https://www.soilmanagementindia.com/fertilizers/short-notes-o-customized-fertilizer/3086.
4. Rakshit, R.; Rakshit, A. & Das, A. (2012). Customized fertilizers: Marker in fertilizer revolution. International journal of agriculture, environment and biotechnology, 5(1): 67-75.
5. Fertilizer (Control) Order, 1985.

Advanced Package of Practices in Sarpagandha

Article ID: 11560

I. Geethalakshmi[1], K. Arunkumar[2]
[1]Assistant Professor, Horticultural College and Research Institute,
[2]Ph.D. Scholar, Horticultural College and Research Institute,
Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

Rauvolfia serponitina (2n – 22) (Family: Apocynaceae) commonly referred to as sarpagandha is one of the most important native medicinal plants of India. Apart from *R. serpentina* there is another species, *R. tetrophylla* which is also cultivated on a commercial scale. In India, the root of sarpagandha has a 400-year history of use in treatment of snakebite. Insect stings, nervous disorders, mania and epilepsy, intractable skin disorders, such as psoriasis, excessive sweating and itching. Gynecological ointments for menopause, toxic goiter and conditions such as angina pectoris and to promote uterine contraction in childbirth. The importance of the drug and the alkaloids obtained from it has been recognized by the allopathic system in the treatment of hypertension and as a sedative or tranquillizing agent.

The hypotensive properties of rauvolfia were first discovered by Chopra in 1953, but the attention of the Western countries was drawn to it only after the isolation and identification of its most active alkaloid 'Reserpine' by the Swiss scientists, Schiller and Mueller, of CIBA Pharmaceuticals in Switzerland, in 1952. After that, there was a great demand for its roots, leading to its indiscriminate uprooting from wild sources where it grew luxuriantly. Intense collection brought the plant to the verge of extension. So, in 1955, the Government of India put a ban on the export of the raw drug and attempts to cultivate the plant were taken up at a number of places. About 30 alkaloids are known to exist in this plant. The most important among these are rescinamine, doserpidine, reserpinine, serpentine, serpentinine, ajnklfing, ajmalicine, ajmalinine, rauvolfinine and yohimbine. The total alkaloid content varies from 1.7 to 3% of the dried roots detailed studies have been carried out on the chemistry of these alkaloids, their pharmacodynmaics and their varying roles in essential hypertension and neuropsychiatic conditions.

Origin and Distribution

R. serpentine is indigenous to the moist, deciduous forests of South East Asia including Burma, Bangladesh, Sri Lanka, Malaysia the Andaman Islands and Indonesia, most of the drug is obtained from wild sources in the countries. It is cultivated on a small scale in India and Bangladesh.

In India, it is found in the central region, i.e., between Sirmor and the Gorakhpur district of Utter Pradesh, in shady, moist sometime swampy localities. In the east in Bihar, North Bengal and Assam as well as in Khasi, Jaintia and Gharo Hills the plant is encountered more commonly on the forest margin of mixed deciduous forests. In the Western Ghats, R.serpetina occurs more frequently in Goa, Coorg the North Kanara and Shimoga districts of Karnataka and Palghat, Calicut and Trichur in Kerala. In Orissa, Andhra Pradesh and Himachal Pradesh the areas comprising the catchment of the river Godavari are the richest. The plant is chiefly associated with Sal (Shorea robusta) forests as well as bamboo brakes.

A major part of the commercial supply of this drug used in the USA and European countries originates from India, Pakistan, Sri Lanka, Myanmar (Burma) and Thailand, with India being the major supplier. The present-day commercial supplies of the roots of rauvolfia are mostly from Uttar Pradesh, Bihar, Orissa, West Bengal, Assam, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka and Maharashtra, Rauvolfia roots exhibit more or less the same morphological features but they differ in their alkaloid content, not only in geographically distinct areas but also within the same geographical area. The annual requirement of roots in the country for the manufactured rauvolfia extracts, simple and total alkaloids, have been estimated at about 650 t against the present annual supply of 30 t from all the sources. There is also a great demand for demand for the alkoids as well as the raw drug in the international market. The world requirement of dried rauvolfia roots is around 20 000 t/annum. The consumption of the raw drug is substantial in the indigenous drug market. Steps, therefore, will have to be taken to increase the present production to about

100-150 t/annum of dry roots. This is possible only if the plant is brought under large-scale cultivation in agro climatically suitable areas.

Soil

The plant grows in a wide variety of soils, from sandy alluvial loam to red lateritic loam or stiff dark loam. In its natural habitat, it prefers clay or clayey loan with a large percentage of humus, and it does not grow well in soil having pH 8 or above. The ideal pH for this crop is from 4.6-6.2: generally, the plant produces thicker roots in black. Stiff loan soils than in heavy clayey or sandy soil. Soils containing large quantities of sand. Retard the growth of the plants and male is the more susceptible to root and leaf diseases.

Climate

Seed rate 4 kg/ha.
Spacing: 60x30cm.

Manuring

The use of organic manure, leaf-mould and compost has been recommended to increase the quantity of nutrients in the soil and improve the drainage. The plants respond better to chemical fertilizers than to organic manures. Nitrogenous fertilizers induce more vegetative growth, followed by organic manure. Nitrogen seems to have a stunting effect on the root. But the combination of nitrogen either FYM or phosphates results in better root growth than nitrogen alone. Application of phosphates induces more growth of thick as well as thin roots. Since good manure is in short supply and uneconomical, artificial fertilizers should, therefore, be preferably used.

It is better to apply 25-30 t of well-rotted FYM at the time of land preparation and 10 kg N, 60 kg P_2O_5 and 30 kg K_2 O/ha as a basal dose. Later, two equal doses of N, each of 10 kg/ha in moist soil is given at 50 days and 170 days after planting.

Irrigation

The crop may be irrigated fortnightly in the hot dry season and about once a month in winter. The crop can be cultivated under rainfed conditions also, but the yield is considerably poorer.

Weeding and Interculture

In order to maintain the satisfactory development of roots about 2 weedings are necessary during the monsoon and one hoeing at the end of the growing season (December). This may be done in large plantations using a tractor-drawn cultivator which is cheaper than manual labour. Hoeing by means of a tractor-drawn wheel-hoe, is the most economical.

Intercropping

It is possible to grow crops in rauvolfia plantations particularly where good irrigation facilities are available it is reported that although the yield of roots was higher under monoculture, the net returns were highest when rauvolfia was intercropped with soyabeans and onions of soybeans and garlic.

Though *R. serpentine* can be propagated by various methods, the optimum yield of roots (including thick, thin and fibrous) is obtained when the propagation is done by seeds. The yield of fresh roots per plant varies widely from 0.1-4 kg. With a spacing of 60 X 30 cm, the total yield of roots in the case of plants raised from seeds works out to about 1175 kg/ha on an air-dried basis, as compared with 175 kg/ha in the case of plants raised from stem-cuttings, and 345 kg/ha in the case of plants raised from root-cuttings. A yield of 2200 kg/ha of air-dried roots has been obtained from a 2-year-old plantation and 3300 kg/ha from a 3-year-old plantation, under irrigated conditions on sandy, day loam soil.

Indian Systems of Medicine

Article ID: 11561

S. Padmapriya[1], M. Kavitha[1]
[1]TNAU, Coimbatore -3.

Abstract

Traditional systems of medicines based on the usage of medicinal plants are playing significant role in providing health care to large segment of population, especially in developing countries. The Indian System of Medicine is the culmination of Indian thought of medicine which represents a way of healthy living valued with a long and unique cultural history, as also amalgamating the best of influences that came in from contact with other civilizations like Greece (resulting in Unani Medicine) or Germany (Homeopathy) or our scriptures/sages which gave us the science of Ayurveda, Siddha along with Yoga & Naturopathy. It is increasingly understood that no single health care system can provide satisfactory answers to all the health needs of modern society. Evidently there is a need for a new inclusive and integrated health care regime that should guide health policies and programs in future. To have a basic understanding about the functioning of these systems, it is inevitable to know the scientific basis of different aspects of Indian System of Medicine which is well known among the well-known global traditional systems of medicine.

Keywords: Indian System of Medicine, Ayurveda, Unani, Siddha, Homeopathy, Yoga, Naturopathy.

Introduction

Indian Traditional Medicine, the foundation of age-old practice of medicine in the world, has played an essential role in human health care service and welfare since its inception. India has an advantage in this global resurgence of interest in holistic therapies as it has a rich heritage of indigenous medical knowledge coupled with strong infrastructure and skilled manpower in modern medicine. The system of medicines which are considered to be Indian in origin or the systems of medicine, which have come to India from outside and got assimilated into Indian culture are known as Indian Systems of Medicine. India has the unique distinction of having six recognized systems of medicine in this category. They are- Ayurveda, Siddha, Unani and Yoga, Naturopathy and Homoeopathy. Though Homoeopathy came to India in 18th Century, it completely assimilated in to the Indian culture and got enriched like any other traditional system hence it is considered as part of Indian Systems of Medicine (Prasad, 2002). Apart from these systems- there are large number of healers in the folklore stream who have not been organized under any category.

A separate Department of Indian Systems of Medicine and Homoeopathy (ISM&H) was set up in 1995 to ensure the optimal development and propagation of AYUSH systems of health care. The Department of ISM&H was re-named as the Department of AYUSH (an acronym for - Ayurveda, Yoga and Naturopathy, Unani, Siddha, Homoeopathy) in November 2003. Medical pluralism is here to stay and the AYUSH sector has a critical role to play in the new and emerging situation. The Department of AYUSH under Ministry of Health and Family Welfare, promotes and propagates Indian systems of Medicine and Homoeopathy, and is committed to infuse the wisdom of traditional medicine with the methodologies of modern science, scientifically validating the systems and presenting them in the scientific idiom, relating their efficacy to modern life styles. Hence attempts are being made to provide brief profile of the Indian Systems of Medicine to familiarize the readers about them so as to facilitate acquisition of further information.

India has the exclusive distinction of its own recognized traditional medicine; Ayurveda, Siddha, Unani, Yoga and Naturopathy, and Homoeopathy. Despite the fact that Homoeopathy came to India in the 18th century, it is totally absorbed into the Indian culture and got improved like another traditional system consequently it is enriched and became a part of Indian traditional medicine (Kumar et al, 2007). Indian traditional medicine has its origin in India that evolved through a continuous process of transformation from its Vedic period and a single drug or blends in crude shape are favoured over many fold formulations. Though the starting points and advancement times of these traditional medication process are different, however, there is a common background through this foundation, is in their basic standards and practices by utilizing the plants and plant-based preparations in the medicinal services. The extent of utilization of plants in a different system of medications appears in Fig. 1. Moreover, around 85–90% Indian population depends on the traditional system for essential medicinal services.

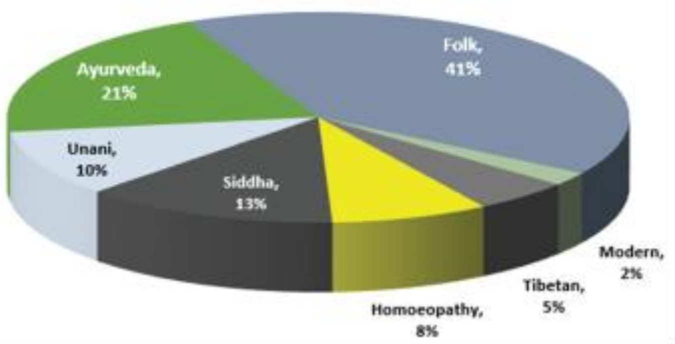


Fig. 1: Percentage of plants used in different systems of medicines in India

Ayurveda

Ayurveda is a classical system of healthcare originating from the Vedas documented around 5000 years ago. Around 1000 B.C. the knowledge of Ayurveda was first comprehensively documented in the compendia called Charak Samhita and Sushruta Samhita. The literal meaning of Ayurveda is "The Science of Life;" the combination of two Sanskrit words "ayur" (life) and "veda" (science or knowledge). It is a holistic arrangement of medical services with the idea, that the human body is a network of seven fundamental tissues ("Rasa," "Rakta," "Mansa," "Meda," "Asthi," "Majja," and "Shukra") and the waste results of the body, for example, excretion, urine, and sweat, which are derived by the five fundamental components fire, water, air, ether, and earth and three dynamic energies or functional philosophies "vata, pitta, and kapha" (Tridosha). Any unevenness or unsettling influence in these fundamental standards of the body causes disease (Lad, 2002).

Ayurveda is proven to be effective in the treatment of chronic, metabolic and life style diseases for which satisfactory solutions are not available in conventional medicine:
1. The preventive aspect of Ayurveda is called Svasth- Vritta and includes personal hygiene, daily and seasonal regimens.
2. Over the years, Kshar Sutra an Panchakarma therapies of Ayurveda have become very popular among the public.
3. Panchakarma is a unique therapeutic procedure for the radical elimination of disease-causing factors and to maintain the equilibrium of humors.

Research on Ayurveda, over the past few decades, through multi-disciplinary platforms, has given rise to higher undertakings in this field. Various drug lead compounds are developing. Due to traditional acceptance, useful assistance, socioeconomic benefit, and easy acceptability ayurvedic medicines are popularizing throughout the globe. Quality, safety, stability, and efficiency for ayurvedic medicines are now being assured through extensive research. The increasing search for newer medicinal plants derived agents, most importantly the bioactive compounds are taking a major role in the development and management of health-care issues in India.

Unani

As the name indicates, Unani system originated in Greece. The foundation of Unani system was laid by Hippocrates. It was introduced in India by the Arabs and Persians sometime around the eleventh century During 13th and 17th century A.D. Unani Medicine had its hey-day in India. Unani system of Medicine has been found to be efficacious in conditions like rheumatoid arthritis, jaundice, nervous Debility, skin Diseases like vitiligo & eczema, sinusitis and bronchial asthma.

Unani practice of medicine is built on the four conditions of living such as hot, sodden, frosty, and dry and four humors of Hippocratic hypothesis, namely, blood, yellow bile, dark bile, and mucus. Unani solution of medicine was mixed with the Indian culture in Mughal Emperors and is utilized by an extensive segment of the population in India. Unani views the human body as made up of seven standards; Mizaj (temperaments), Anza (organs), Quo (resources), Arkan (components), Arawh (spirits), Aklath (humors), and Afal (capacities). These standards oversee prosperity and additionally disease condition (Kalim et al, 2010).

Types of medications recommended in the Unani system of medicine includes:
1. Diet treatment goes for treating certain illnesses, by the organization of particular diet control plans or by controlling the amount and nature of diet in a routine basis.
2. Regimental treatment incorporates diaphoresis, diuresis, Turkish shower, knead cleansing, etc.
3. Pharmaco - treatment manages the utilization of NPs.

Unani system of medicine is a comprehensive medication where single or in the formulation, in crude form is preferred, which miraculously deals with numerous states of health and disease. This system extends great solutions for gastrointestinal, nervous disorders, and cardiovascular disease.

Siddha

Siddha system of medicine is settled since the ancient human civilization in India, around 10,000 BCE–4000 BCE. Like Ayurveda, it is developed through everyday skills of utilizing natural resources for maintaining good health and remains as an oldest medicinal practice in South India. The word "Siddha" indicates "holy harmony" or "attaining excellence" or "recognized fact" and the "Siddhars" were supernatural beings who obtain intellectual powers by constant practice of such type of medicine. This medicinal practice believes preserving the human well-being is crucial to succeeding the eternal bliss and the philosophical idea includes "food is medicine, medicine is food" and "sound mind makes a sound body (Thas, 2008).

Siddha medicines are less known toward the western world in light of the fact that a large portion of the literature is not interpreted from the Tamil language, but rather well recognized as an alternative biomedicine inside Tamil communities. Siddha philosophy is created in the therapeutic, profound, and scholarly perspectives, it gives equal importance to the inward soul and outer body, especially identifying methods of alchemy (converting base metals into gold), urine examination, and practice Materia Medica are the uniqueness in comparison to ayurvedic medicines. Likewise, herbo metal or herbo mineral preparations which certainly contain nanoparticles are more effective in treatment of chronic disorders.

Yoga and Naturopathy

Yoga is a Sanskrit word, composed and spoken limitedly in India. Sanskrit is popular fundamentally in mainstream Indian ceremonial settings, for example, Hinduism, Jainism, and Buddhism. The word yoga has changing interpretations yet is most usually comprehended as significance union. Yoga explores preventive and curative aptitudes as a training exercise for people to improve mindfulness. Dialectical behavior therapy has its underlying foundations in cognitive behavior therapy, a different model of mindfulness happens for cognitive therapy practices, known as care based subjective treatment (Gordon, 2016).

Naturopathy is a particular type of essential drugs that balances age-old healing traditions with logical progress and current research. Naturopathy is guided by an interesting arrangement of the rule that perceives the body's inborn healing capacity, emphasizes disease prevention, and urges singular responsibility to get ideal well-being. Naturopathic hypothesis, the disease is seen as a procedure of disturbance to well-being and consequent recovery with regard to natural healing systems.

Homoeopathy

The principle of Homoeopathy stays one of the most debatable therapeutic practice and been known Hippocrates from Greece around 450 BCE. The present-day practice of Homoeopathy is better recognized by a German doctor, Dr. Samuel Hahnemann (1755 CE–1843 CE). The word "Homoeopathy" has been derived from Greek words, "Homois" which means similar and "pathos" which means suffering. Homeopathy is a therapeutic technique utilizing arrangements of substances whose impacts when regulated to healthy individuals match to the appearances of the illness in the individual patient (Ernst, 2003). The methodology is believed to work on two main principles:
1. "Like cures like;" a healthy individual would manifest the same symptom with the drug, that particular drug is the cure for the same illness.

2. "Infinite dilution;" therapeutic activity is enhanced by repeated dilution and succession even when diluted beyond Avogadro's number.

Homeopathy essentially implies treating illnesses with cures, which are equipped for producing symptoms identical to the disease when administered.

Conclusion

Therapeutic knowledge of Indian traditional medicine has propelled various traditional approaches with similar or different theories and methodologies, which are of regional significance. Due to mastery of current pharmaceuticals notwithstanding open confidence and trust, Indian traditional medicines are in inimical hindrances. A need has developed to join the entire whole traditional medicinal system and systematize it with an extremely strong optimistic approach in spreading our own medical tradition is the need of great importance. Consequently, phytochemical and biochemical research with a continuous endeavour for the revival and spreading of Indian medical inheritance for the welfare of the society at large is needed.

References

1. Ernst E. Homoeopathy: Past, present and future. 2003. Br. J. Clin. Pharmacol; 44: 435-7.
2. Gordon T. 2013. Theorizing Yoga as a Mindfulness Skill. Procedia Soc. Behav. Sci.; 84:1224-7.
3. Kalim MD, Bhattacharyya D, Banerjee A, Chattopadhyay S. 2010. Oxidative DNA damage preventive activity and antioxidant potential of plants used in Unani system of medicine. BMC Complement Altern Med; 10: 77.
4. Kumar B, Vijayakumar M, Govindarajan R, Pushpangadan P. 2007. Ethno pharmacological approaches to wound healing - Exploring medicinal plants of India. J Ethnopharmacol.; 114:103-13.
5. Lad VS. 2002. Fundamental Principles of Ayurveda. Albuquerque, New Mexico: The Ayurvedic Press;25-9.
6. Prasad LV. Indian system of medicine and homoeopathy. 2002. In: Chaudhury RR, Rafei UM, editors. Traditional Medicine in Asia. New Delhi: WHO-Regional Office for South East Asia; 283-6.
7. Thas JJ. 2008. Siddha medicine - Background and principles and the application for skin diseases. Clin Dermatol. 26:62-78.

Mother Palm Selections and Nursery Management in Coconut

Article ID: 11562

K. Ragu[1], K. Arunkumar[2]
[1]Subject Matter Specialist (Horticulture), Krishi Vigyan Kendra, Tamil Nadu Dr. J. Jayalalithaa Fisheries University, Sikkal, Nagapattinam, Tamil Nadu.
[2]Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu.

Selection of high yielding mother palm has proved to increase the productivity. Mother palms should be carefully marked out for seed nut collection, based on certain visible phenotypic and easily discernible character. The middle-aged palms should be preferred as mother palms so as to make sure their yielding ability.

Basic Traits of a Mother Palm should be

1. Heavy yielders giving good over 100 nuts per palm per year. More number of nuts per bunch and consistent yield.
2. Regular bearers, yielding food crop every year; having 12 to 14 bunches at various stages of development on the crown.
3. Production of large number of spikes lets per inflorescence and high percentage fruit set.
4. Thick set crowns, spherical or semi-spherical in outline, having at least 30-35 fully opened leaves closely spread well oriented and borne on thick stalk.
5. High copra content per nut (over 180 g) or over 350 g of kernel, good size and shape of nuts.
6. Production of uniform seedlings with high mean values for desirable characters. (Early germination, more leaf and good girth at collar).

Collection of Seed Nuts

Besides selection of mother palms, collection of seed nuts from selected palms is also very important. The seed nuts collected from consistently high setting mother palms germinate early.

The best period for seed nut collection would be from January to April on the west coast and February to May – June on the east coast of India, as those nuts are big in size with maximum copra content and give high percentage of early germination and good vigour of seedlings.

Nuts those are light, under sized cracked and not uniform, have to be rejected. Bunches can be harvested by plucking from the mother palm and lowering them by using ropes.

Freshly harvested nuts can be stored in a well-ventilated shed, giving protection from the sun and rain.

Soaking of seed nuts in water for about a fortnight helps to promote quicker and better germination.

Nursery Technique

The nursery soil should have loose, permeable, preferably sandy loam, rich in humus and have good drainage facility. The nursery bed is 2 metre width with convenient length. The nuts are buried in the seed bed in a horizontal, oblique or vertical position, keeping the stalk end up first above the soil surface.

Horizontal planting is advantageous as it gives highest percentage of early germination produces vigorous seedlings with good girth at the collar region, because the nut water remains close to the embryo. The advantage of vertical planting is the economy of space and to transport the seedlings to a long distance. The normal spacing is about 45cm from nut to nut.

Management of nursery beds involves the creation of optimum condition. Keeping the soil free from weeds, giving regular irrigation each morning and evening, mulching, providing adequate shade during sanitation and covering seed nuts with a thin layer of river sand are measures for reducing termite infestation. Since there are ample food reserves in the nut itself to sustain germination, on fertilizer is normally given in the nursery.

Seed nuts start to germinate twelve weeks after sowing and reached maximum by 18 weeks. First leaf appears in the second month after germination and the root emerges in the first month after sowing, there would be gradually fall in the thickness of the kernel and will full the whole cavity of the nut in the fifth month.

E-ISSN: 2581 - 8317

Maintenance of Seed Purity – Nucleus and Breeder Seed Production

Article ID: 11563

Vipin Chandra Garwal[1], Purnita Raturi[2]
[1]ADO Horticulture, Uttarakhand Government.
[2]Research Scholar, Department of Horticulture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand-263145 (India).

Maintaining Genetic Purity During Seed Production

1. Ensuring enough isolation to avoid contamination from natural crossing or mechanical mixing.
2. Routing of seed fields before they may contaminate the seed crop
3. Genetic purity of cultivars is tested regularly.
4. Avoiding genetic shift by exclusively cultivating crops in regions where they are adapted.
5. Seed crop certification to insure genetic purity and high-quality seed.
6. Adopting a generation system (The seeds produced are limited to four generations, beginning with the breeder's seeds.) and the seeds can be reproduced up to three additional generations, i.e., foundations, registered, and certified.

Control Over Seed Source

Seeds from an authorized source and an acceptable class are required for raising a seed crop. Seed certification typically recognizes four types of seeds: breeder seed, foundation, registered and certified. AOSCA, or the Association of Official Seed Certifying Agencies, recognizes these classes.

1. Breeder's seed: A seed or vegetative propagation material that is directly managed by the institution's sponsoring breeder and offers increases of foundation seeds.

2. Foundation seed: is a seed stock that is recognized or disrupted by an agriculture experiment station to retain unique genetic identity and purity. The production must be closely monitored by station officials. All other certified seed classes are derived from foundation seed, either directly or indirectly via registered seed.

3. Registered seed: The registered seed is the progenies of a foundation seed that has been recognized and certified by certifying bodies.

4. Certified seed: Is the progeny of foundation, registered, or certified seed that has been recognized and certified by certifying authorities and has been treated to retain genetic uniqueness and purity.

Preceding Crop Requirements

Preceding Crop Requirements have been established to minimize contamination from volunteer plants as well as soil-borne diseases. (Volunteer plants are plants that were grown in the field from earlier crops.)

Isolation: Isolation is necessary throughout seed crop development to minimize contamination due to natural crossing and disease infection by wind and insects from neighboring fields, as well as during planting, harvesting, threshing, and seed handling to avoid mechanical mixing. The isolation distance varies from crop to crop and from seed class to seed class. For example, certified seeds and foundation seedbeds.

Rouging: Off-season plants, which differ in their traits from the seed variety, are another kind of genetic contamination. Their continuous presence would undoubtedly damage the variety's genetic integrity. Rouging is the process of removing such plants. The three primary origins of off-type are outlined below.
1. The existence of recessive genes in a heterozygous state at the time of variety release may result in the emergence of an off-type plant. (Recessive genes can also be caused through mutation.)
2. Off-type plants are caused by volunteer plants or seeds generated by an earlier crop.
3. Mechanical mixes are also a significant source of off-type plants.

Seed certification: A seed certification system ensures the genetic integrity of commercial seed production. The goal of seed certification is to maintain and make available crop seeds, tubers, bulbs, and so on that are of good seeding value and true to variety. For seed certification, well-experienced and qualified personnel are required from the seed certification agency, and they conduct field inspections at appropriate stages of crop growth. They also do seed inspection to ensure that the seed crop/seed lot has the required genetic purity and quality. After harvesting the crop, the quality is varied, and samples are taken at the processing factories for seed testing as well as grow-out testing.

Grow-out – test: Varieties cultivated for seed production should be checked for genetic purity regularly by growing – out – test to ensure that seed is kept in its genuine form.

Seed Purity: When a farmer purchases a seed from a reputable university or firm, he expects to receive a high-quality seed rather than a mix of other crop seeds, weed seeds, straw, and so on. It is not feasible to eliminate all of these admixtures with the use of a cleaning machine, and some seeds will always be present, necessitating the use of a purity test or analysis to establish how much admixture is present in the seed.

Nucleus and Breeders seed production: The initial handful of seeds obtained from selected individual plants of a particular variety by the originating plant breeder to purify and maintain that variety, and its further multiplication under his supervision, or the supervision of a qualified plant breeder, to provide Breeder's Seed, constitutes the basis for all further seed production. The quality of the nucleus/breeder's seed has a major impact on the varietal purity of subsequently multiplied foundation, registered, and certified seed. Unless and until the nucleus/breeder's seed is of the utmost purity and quality, the seed multiplied from it cannot be said to be of sufficient genetic purity. Unsatisfactory genetic purity, particularly in cross-pollinated crops, can harm a variety's performance. It is consequently critical that the nucleus/ breeder's seed be generated in such a way that adequate genetic purity, identity, and other excellent seed characteristics are preserved.

Methods for Maintaining the Nucleus and Breeder's Seed in Self-Fertilized Crops

The methods of maintaining nucleus seed/breeders can be simply categorized into two types.

1. Maintenance of Pre-released or Newly Released Varieties' Nucleus Seed: The following is a description of the process given by Harrington (1952) for the preservation of nucleus seed of pre-released or freshly released varieties:

- **a. Variety sampling to acquire nucleus seed:** New numbers, lines, or selections that show great promise in breeding nurseries and yield experiments should be tested for seed purification. These samples serve as a starting point for purifying new varieties, as well as for future expansion and distribution to farmers. In any one crop, no more than fifteen new varieties should be sampled at a station in a single year.
- **b. Table inspection of samples:** Each sample's two hundred plants should be threshed individually, and the seed inspected in heaps on the table. Remove any piles that look to be plainly out of type, diseased, or otherwise undesirable. The seeds of each 200 plant samples or less are now ready to be sown in a variety purification nursery known as a nucleus.
- **c. Nucleus seeding and location:** Each nucleus seed should be cultivated on clean fertile ground at an experiment station in the region or area where this new variety may be developed if it is released. The land must not have grown the same kind of crop in the previous year.
- **d. Examining nucleus two-row plots and removing off-types:** The nucleus plot should be closely inspected throughout the growing season, from seedling to maturity. Differences in early plant development habits, rate of growth, leaf color, time of heading, height head features, and disease responses should be observed. If a plot deviates significantly from the average during the pre-heading stages of development, it should be eliminated before heading.
- **e. Harvesting and threshing of nucleus seed:** each remaining plot (at least 180 of the original 200) should be harvested separately with a sickle and wrapped in a bundle. The total bundles of each nucleus should be labeled and preserved until the current year's yield rests for trials are received. If the nucleus bundles of any new variety are determined to be unfit for continuation, they should be eliminated.

Later, the seed should be cleaned in a fanning mill or by hand, with grain from each nucleus plot piled on the seed table. 180 or more heaps of seed from a single nucleus must be inspected for relative consistency of seed appearance, and any pile that looks to be of type must be removed. All of the leftover seed heaps should be masked together in one lot. This should be treated with fungicide and pesticide before being bagged, labeled, and kept as "Breeder's Stock Seed" for the following year. The initial pure seed stock of a new variety in the hands of plant breeders is known as breeder's stock seed.

2. Maintenance of Pre-released or Newly Released Varieties Breeder's Seed: The following procedures are involved in the maintenance of the breeder's seed.

a. Breeder's stock seed from the nucleus should be planted on clean, productive soil that did not produce a crop of the same type in the previous year. The space needed to seed the breeder's stock is around 1.2 ha in the case of wheat and up to 3 ha in the case of transplanted rice.

b. The field must be appropriately isolated.

c. The best farm practices should be utilized in the sowing, raising, and harvesting of breeder's stock.

d. It should be produced in the experiment station in the region where the novel variety was developed.

e. Seeding should be done in such a way that it makes the greatest use of the limited amount of seed available and facilitates roguing. Row spacing should be sufficient to allow for inspection of plants in rows for probable mixtures or off kinds.

f. Roguing: Remove any plants that are have not the characteristic of the variety. If the previous year's nucleus breeder's stock seed was adequately protected from natural crossing, careful roguing was done, and there were no contaminants during cleaning, etc., there should be relatively few plants to rogue out. Rouging should be done before blooming, just as it did with the nucleus/ breeder's stock seed.

g. Harvesting the breeder's stock: When harvesting and threshing the breeder's stock, the equipment utilized must be spotlessly clean and devoid of seeds from other kinds. This hygiene should be extended to cards, bags, and the threshing machine itself. The seed should now be 99.9% pure in terms of variety. These breeder's seeds are now ready for foundation seed production.

Breeder's seed preservation for established varieties: Any of the following approaches might be used to keep the breeder's seed of established types in good condition:

a. By raising the crop in isolation: The breeder's seed of local varieties might be preserved by cultivating them in separate plots and subjecting them to rigorous roguing at various phases of crop growth when the numerous plant characteristics are visible.

b. By bulk selection: Bulk selection might significantly enhance the genetic purity of existing cultivars. 2,000 to 2,500 plants suitable for the variety are picked, harvested, and threshed individually using this procedure.

Carry-Over Seed

If there is a total failure during the foundation seed multiplication phase, the breeder must carry over at least enough seed to protect against the loss of variety. Furthermore, the breeder should ensure diversity by arranging for a portion of the seed initially dispersed to be kept under ideal conditions.

Artificial Ripening of Fruit Crops

Article ID: 11564

Vipin Chandra Garwal[1], Purnita Raturi[2]
[1]ADO Horticulture, Uttarakhand Government.
[2]Research Scholar, Department of Horticulture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand-263145 (India).

Introduction

Fruit ripening is a natural process that causes fruit to become less green, soft, and sweeter. Ripening, in other words, is the physiological process through which fruits acquire acceptable flavor, color, quality, pleasant character, and other textural features. Many composition changes occur during ripening, for example, immature fruit has a high acid content, which decreases with ripening. Amylases convert starch to sugars during ripening, whereas pectinase converts hard pectin to soft pectin. Fruits are divided into two classes based on their ripening state, they are:

1. Climacteric fruits: These fruits continue to ripen after harvesting, releasing ethylene, and increasing respiration rate. As a result, the crop was firm and green. Mango, banana, apple, plum, pear, sapota, guava, kiwi, and more fruits fall under this category.

2. Non-Climacteric fruits: Once picked, these fruits do not mature further. These fruits generate very little ethylene, do not respond to ethylene treatment, have no distinctive enhanced rate of respiration, and are picked when completely ripened. Fruits in this category include orange, grapes, watermelon, pomegranate, strawberry, litchi, and blackberry.

Ripening via Artificial Means

Artificial ripening is the process by which fruits get ripe under controlled conditions, and the result may be obtained as desired by regulating various factors. It is done to achieve a speedier and more uniform ripening. However, while the cosmetic quality of ripened fruits improves during this procedure but organoleptic characteristics, nutrition value, and shelf life are degraded when fruits are exposed to treatment without reaching maturity.

Artificial Ripeners

Many chemicals and agents are employed by farmers, transporters, and merchants to cause color changes and speed ripening during pre-harvest, post-harvest, transportation, and storage. Acetylene gas, ethephon, ethylene, calcium carbide, and ethylene glycol are some of the most widely used artificial ripening agents.

Calcium Chloride

It is a chemical substance (CaC_2) that is used in the manufacture of acetylene and calcium cyanamide, as well as in gas welding. It reacts with water or moisture to generate acetylene gas, which acts as a ripening agent and produces effects comparable to ethylene. Fruits produce nice peel color when exposed to CaC_2, and the intensity of the color developed is proportional to the concentration of CaC_2 used. It is commonly referred to as 'Masala' in the local language. Carbide is used to ripen fruits such as mango, banana, apples, papaya, and sapota.

Effects on Health

Vomiting, diarrhea with or without blood, thirst, weakness, a burning sensation in the chest and abdomen, difficulty in swallowing, irritation or burning in the eyes and skin, permanent eye damage, ulcers on the skin, cough, sore throat, and shortness of breath are early symptoms of arsenic or phosphorus poisoning. Higher levels of exposure may result in a buildup of fluid in the lungs. It is carcinogenic and has the potential to induce neurological disorders. In India, the use of calcium carbide is prohibited, and artificial ripening is prohibited by the PFA act of 1954. The use of carbide gas for ripening is forbidden under the Prevention of Food Adulteration Rules, 1955, Rule 44A. The sale of hazardous food is punishable under the Food Safety and Standards Act of 2006. The food safety and standards legislation of 2011 expressly forbids the sale of fruits that have been artificially ripened with carbide gas. Although ethylene-like chemicals are very expensive in India, traders are relying on low-cost calcium carbide.

Table 1: Identification of calcium carbide ripened fruits:

Quality criteria	Calcium carbide ripened fruits	Fruit that has ripened naturally
Weight per fruit	Fair	Good
Texture	Less appealing, but uniformly colored	Attractive but not evenly colored
Aroma	Mild	Good
Firmness	Fair	Fair
Taste	Taste Extremely sour, yet somewhat pleasant	Sweeter, Longer
Shelf –Life	Shorter, black blotches appear on the skin in 2 and 3 days.	Longer

Ethephon/Ethrel

Ethephon [2 – chloroethyl phosphonic acid ($C_2H_6ClO_3P$), also known as Floral and Cepa in India] is a plant growth regulator that produces ethylene comparable to that generated during the ripening process. The Indian government has approved the use of ethephon for fruit ripening since it is less hazardous. Fruit treated with ethrel had a higher acceptance rate and a longer shelf life than fruits ripened with CaC_2. It is commonly used in mango, papaya, banana among other climacteric fruits.

Ethylene (C_2H_4)

Ethylene is the daughter of ethyl (C_2H_4). It is a natural gaseous plant growth regulator that functions as a stimulating or regulating enzyme for fruit ripening. The ethylene concentration necessary for the beginning of ripening in commodities is typically in the range of 0.1 to 1 ppm. The time of exposure to initiate ripening may vary, although, for climacteric fruits, 24 hours is generally sufficient. The only safe and widely acknowledged way is to use ethylene, which has been approved as a safe artificial ripener by the FDA. Because it is a natural hormone, it poses no health risk to fruit eaters. It is often used as a de-greening agent in citrus, bananas, and climacteric fruits. In a confined chamber with regulated temperature and relative humidity, ethylene is distributed via catalytic generators.

Effects on Health

When breathed in large quantities, it induces sleepiness and unconsciousness. According to the Ministry of Agriculture, exposing fruits to ethylene gas at low concentrations of 10-100 ppm exogenously to promote fruit ripening is safe. Ethylene accelerates respiration, chlorophyll breakdown, carotene production, starch-to-sugar conversion, and the activity of cell-wall disintegrating enzymes.

Table 2: Optimal ripening conditions for various fruits.

Parameters	Value
Temperature	18 to 25°C
RH	90 to 95 %
Ethylene concentration	10 to 100 ppm
Duration of treatment	24 to 72 hours depending on fruit kind and maturity stage.
Air circulation	Enough to enable consistent ethylene dispersion.
Carbon dioxide	< 1%

Table 3: Differences between the calcium carbide and ethylene-based artificial ripening of fruit crops:

Aspect	Calcium carbide	Ethylene
Legal	Prohibited, punishable by law	Permitted by WHO and FDA
Health	Hazardous and carcinogenic has affected all essential organs.	Completely safe and natural
Quality of produce	Dry skin, Less/ worse aroma, green patches	Uniform appearance, soft and smooth skin, natural Aroma

Weight Loss	>13 %	<7 %
Transport losses	More	Comparatively low
Shelf-Life	<5 Days, more prone to rot (12%)	>10 days, less prone to rot (3%)
Market demand	Decreasing	Increasing as people become more conscious
Ripening costs	Rs. 8.50/ kg	Approximately Rs.5/ kg (40% lesser), more economical.

Ethylene Glycol

The chemical structure of ethylene glycol ($C_2H_6O_2$) comprises the gas ethylene. The agent ethylene glycol is formed when ethylene interacts with hydrogen peroxide. It is significantly less costly than ethylene gas. Another advantage of its low cost is it may be diluted with water and is used for fruit ripening in chilly climates. The major drawback of ethylene glycol is that it is toxic if swallowed and large doses can induce kidney failure.

Regulations to Prevent Artificial Ripening

Ripening food adulteration and illicit activities have grown common as a result of inefficiencies in government-regulated quality assurance processes. As a result, the Government of India must enact stringent regulations. Restrictions on the purchase and sale of such prohibited compounds for this purpose, such as carbide imported from China, South Africa, and Taiwan, should be severely enforced. Fruit dealers must be aware of the hazard and imbued with a sense of moral duty to society. The wholesale market should be more vigilant to put an end to this practice.

Consumer Preventive Measures

Selecting homogeneously ripened fruits with eye-catching brighter hues is not recommended, because naturally ripened fruits are not evenly ripened. Natural matured fruits feature green and yellow patches. Fruit washing with running water for a few minutes may reduce chemical compounds adhering to the fruits. When eating mangoes and apples, it is preferable to chop the fruit into pieces rather than consume it whole.

Conclusion

Artificial ripeners are used to accelerate the ripening of fruits. Because of the dangers associated with its usage, ripeners such as calcium carbide and ethephon must be properly monitored and regulated. It is not entirely the duty of the government; citizens must also become informed and avoid eating contaminated fruits.

Aprientrepreneurship - A Way Forward in Cold Arid Kargil

Article ID: 11565

Syed Mohmad Shah[1], Mohd Mehdi Aakhone[1]
[1]Krishi Vigyan Kendra Kargil-I, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir.

Introduction

Kargil, in the union territory of Ladakh, inhabits more than 90% tribal farmers in its total population, who own no or small patches of land, mostly devoid of the quality soil. The scarcity of water further adds to the miseries of these farmers and obstructs their economically impactful ventures into vegetable and fruit production. As if to compensate for the less benevolence, Nature has gifted this otherwise barren and dry land with the ability to grow apricots, and the region has arguably not a single household which does not own at least a dozen apricot trees. The region is known in the world for its bumper apricot produce (~10000 MT), and the apricots of the region are presumed to be the sweetest in the world. People rely on the produce for their domestic uses up to the extent that the fruit is next only in importance to their stable diet. Every part of the fruit, be it pulp, kernel or seed, is put to some use by the family, perhaps as a survival way-out inherited from the past; when the region used to be virtually cut-off from the rest of the world in the severe winter period which lasts for about six to eight months. Under the extant scenario, in addition to its domestic use, surplus apricots are sun dried and taken to local market for sale to the visitors who throng to this beautiful place in the summer months. The fruit, owing to its organic way of production and natural processing, fetches a good market price. Despite of its potential of vehement customer attraction, there is nothing like apricot industry or apricot entrepreneurism in the region.

The main reason for lack of entrepreneurship for this fruit is the traditional and non-scientific way of fruit drying, storage and packaging which does not attract the modern customer despite the top-class taste and quality of the original product. This keeps the development of apricot entrepreneurship at bay and compels the farmers to sell the otherwise precious fruit at throwaway prices. The author (s) are of firm belief that development and promotion of the scientific and modern ways of apricot drying and packaging, which are currently in use in the major apricot producing countries like Iran, Turkey and Egypt, would prove very beneficial to these tribal farmers' vis-à-vis- prompting a two-fold increase in their income, and at the same time not harming the ecological sensitivity of this bio-diverse Himalayan region.

The Concept and the Target

Nature does provide conditions for bumper apricot growth in the region but the farmer is not enough geared-up to reap the proportionate benefit from the produce. The main reason is the lack of scientific know-how and unavailability of the techniques and tools for proper and scientific drying and packaging of the fruit. Being produced organically and having a tremendous taste, the fruit has a market too wide-and-long which is yet unexploited due to lack of proper drying, storage and packaging techniques. Almost all the fruit is harvested at the same time in the region, of which about 90% is sundried in the open and taken for sale to the local market either open or in manually packaged polythene bags (Figure 1). A good proportion of the fruit is lost during the drying process due to injury, fungal/ bacterial attack and sticking of the dust and dirt. A good portion of the fruit is sulphur treated so as to improve its colour and texture which has led to marginal increase in its market sales (Figure 2 and 3).

Modern methods of drying and packaging, as currently in use in Egypt and Iran, if made available in the region would help to a very great extent in ensuring sustainable livelihood to these tribal farmers. A Livelihood Business Incubation (LBI) Centre for apricot drying and packaging would prove to be of immense for the poor tribals of the area, where the facility for scientific drying and packaging of the produce would enable longer storage and subsequently longer time slot for sale as per the market demand so as to get a fair price.

Expected Outcome

The development and inculcation of scientific management of apricot orchards, harvesting and post-harvest management would not only increase the quantity and quality of the produce per se but would lead to change of perception towards this naturally growing fruit tree from being a useless entity to a money-minting machine which would further compel the farmers to preserve and propagate their germplasm. The region in due course of time will become apricot exporter in the country which would lead to increase in farmer's income and livelihood security. Under the current market conditions, a small proportion of apricot produce is sold by some individuals or self-help groups or local organizations in well-labelled polythene bags/ packets which fetch a good market price and are sought after by the tourists who visit the region.

Figure 1 A & B: Traditional apricot sun-drying in a Kargil Village

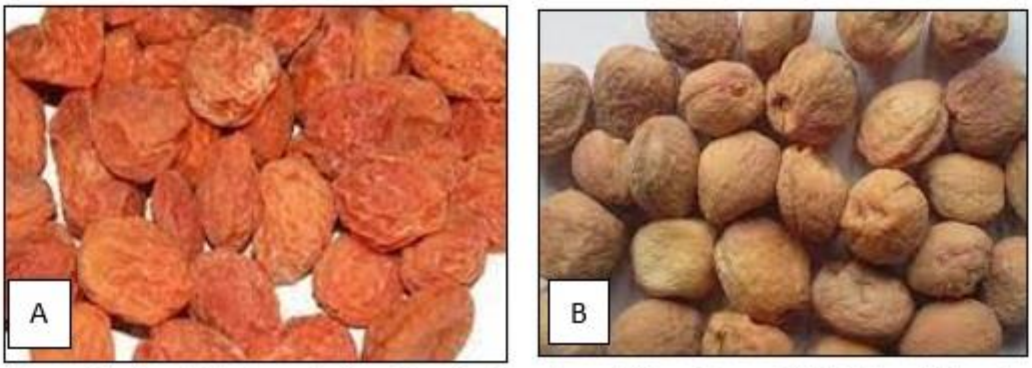


Figure 2: A – Dried apricots after Sulphuric acid treatment & B: Traditional sun-dried apricots

Figure 3: Sun-dried apricots for sale in local market in Kargil

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Water Management Practices for Fruit Cultivation in Problematic Soils

Article ID: 11566

Bharti Choudhary[1]
[1]AICRP on Potato, ZARS, Chhindwara, JNKVV, Jabalpur (M.P.).

India has an important place in the production of many horticultural crops and is currently the second largest producer of fruits in the world. In comparison to majority of the field crops, fruit cultivation can generate higher incomes and employment opportunities while ensuring nutritional security of the farm families.

Problem Soils

The soils which possess characteristics that make them uneconomical for the cultivation of crops without adopting proper reclamation measures are known as problem soils.

Irrigation System for Different Fruit Crops in Problematic Soils

Proportional mixing of good quality (if available) water with saline water and then using for irrigation reduces the effect of salinity. Alternate furrow irrigation favours growth of plant than flooding. Drip, sprinkler and pitcher irrigation have been found to be more efficient than the conventional flood irrigation method since relatively lesser amount of water is used under these improved methods.

1. Supplemental irrigation using rainwater: Supplemental irrigation with harvested rainwater can stabilize fruit production in rainfed saline areas. A variety of structures like field bunds, trenches, terraces and micro catchments have been found suitable for in situ rainwater harvesting while farm ponds and tanks can be used to store rainwater ex situ. Harvested water can be directly used either in irrigation or for groundwater recharge for improving groundwater quantity and quality. In situ water harvesting in continuous trenches has been found an efficient technique for preventing decline and improving fruit yields in Nagpur mandarin orchards in Vertisols of Central India (Panigrahi et al., 2015). Shallow conical micro-catchments (1.0 m radius) should be constructed for improving soil moisture availability in ber orchards in arid areas (Ojasvi et al., 1999). Rainwater harvesting in farm ponds is a viable solution for mitigating the growing water scarcity; especially in areas frequently impacted by droughts resulting in crop failures. Rainwater stored in farm ponds is used for assured irrigation of pomegranate and grapes in many areas of Maharashtra (SANDRP, 2017). A rooftop rainwater harvesting structure (557.7 m2) has been developed for providing supplemental irrigation to crops like guava and pomegranate in arid areas (Kumar et al., 2006).

2. Conjunctive use of fresh and saline groundwater: High salinity in groundwater often renders it unsuitable for irrigation. Nonetheless, growers facing fresh water supply constraints have no other option but to irrigate their lands with low quality water. Field trials conducted in north-west India have indicated the possibility of irrigation with saline and canal (fresh) water in cyclic and/or blending modes provided there is sufficient rainfall to leach a major part of salts accumulated during the irrigation season. Conjunctive irrigation can partly reduce the dependence on fresh water while preventing the further rise in water table. However, little is known about the viability of this practice in perennial fruit crops. Storage of canal water in an auxiliary reservoir of 1500 m3 capacity was used to drip irrigate pomegranate, Kinnow and guava crops in a salt-affected soil at Abohar, Punjab. Drip irrigation resulted in up to 30% saving in water use than surface irrigation (Kumar et al. 2013). In some saline areas of Haryana, canal water stored in farm ponds is mixed with saline groundwater for irrigating fruit crops like Kinnow and ber. However, storage and blending practices come at an additional expenditure raising the cost of production. Evidently, rainwater harvesting can minimize such expenses.

3. Pitcher irrigation: In this method, porous clay pots placed in the soil provide controlled irrigation to plants with rate of water diffusion being governed by factors like crop ET and soil water tension. Crop water use efficiency in pitcher irrigation is several times higher than surface methods of irrigation and sometimes even higher than drip irrigation. Unlike drip irrigation, however, there is less clogging problem and no power requirement in pitcher method (Bainbridge, 2002). It is due to these benefits that pitcher irrigation offers an easy means of getting stable crop yields in salt-affected soils, and has been successfully used for establishing fruit plantations in arid saline regions. Singh et al. (2011) reported that rainwater collected in underground water tanks was applied through pitchers to raise ber and lasora trees in an area where saline groundwater was the only source of irrigation. Pareek et al. (2003) observed that planting of cactus cladodes at 5 cm depth in east-west direction and provision of slow water releasing pitchers ensured the highest biomass production than planting in north-south direction and irrigation by basin method.

4. Drip irrigation: Leaching of salts beyond the root zone is necessary for the sustained application of saline irrigation waters. Application of excess water than actually required for crop ET needs is termed as the 'leaching requirement'. Depending on factors like climatic conditions, root zone salinity and crop salt tolerance, either occasional or seasonal or regular leaching may be necessary. Although surface methods of irrigation leach a considerable portion of salts, they require the heavy use of water. Again, in many situations, development of shallow water tables restricts the downward movement of salts. Owing to these constraints, drip and sprinkler methods of irrigation are suggested for curtailing water wastages, ensuring high WUE and achieving leaching in salt-affected soils. Depending on crop, drip irrigation can result in up to 50% reduction in irrigation water use without any adverse effects on soil properties and crop yield (Stevens et al., 2012). Drip irrigation has been successfully used to grow fruit crops in many salinities affected areas of India; guava at Abohar, Punjab (Mandal et al., 2007), mango at Jamnagar, Gujarat (Gunjate et al., 2009) and in sapota, ber and pomegranate at Indore, Madhya Pradesh (Meena et al., 2011). In spite of potential benefits and an enabling policy environment, slow penetration of drip technology in India remains a concern. Furthermore, in states like Maharashtra where drip technology has gained farmers' acceptance, recommended irrigation scheduling is often ignored resulting in the excess application of water and the consequent problems of water logging and salt accumulation (Marathe & Babu, 2017). Fruit trees adapted to dry saline areas often have sparse foliage; at least during a part of the year probably to lessen the harmful impacts of heat, water and salinity stresses. For example, better adaptation of aonla and ber to rainfed saline soils than other fruit trees can be ascribed partly to a thin foliage and partly to a deep root system arresting the transpiration rate and facilitating water absorption from lower depths, respectively. Aonla trees exhibit 'fruitlet dormancy' with fruitlets (fertilized ovaries) remaining dormant during hot summer months and resuming active growth in the rainy season. Ber trees also shed the leaves and enter into dormancy during summer months. These morphological adaptations mean that virtually no water is required for supporting growth in the summer season; a period witnessing heat stress and evaporation induced salt accumulation in the upper soil surface.

5. Windbreaks: Planting of windbreaks improves water availability in crop fields by regulating the microclimate and reducing the evapotranspiration (Campi et al., 2012). Windbreaks modify the orchard microclimate by decoupling it from atmospheric influences, reducing the wind speed and evaporation. Because rate of water removal from the sheltered area is generally lower than open fields, humidity increases and evaporation decreases. Sheltered fields also experience lesser advective influence on evaporation resulting in more efficient water use by the fruit trees and vines. Increase in humidity may also partly nullify adverse effects of low temperature and unseasonal frost (Norton, 1988). Biofencing with casuarina reduces the impact of hot winds on mango trees in salt-affected soils (Gunjate et al., 2009).

6. Anti-transpirants: Plants utilize only a fraction of absorbed water in metabolism while the rest (~99%) is lost to the atmosphere through transpiration. Obviously, reduced transpiration can minimize water stress. Foliar spray of some chemicals called anti-transpirants can reduce the transpiration rate in three ways: by reducing the absorption of radiant energy and thus lowering the leaf temperature; forming a thin transparent film on leaves hindering water loss, and by preventing full stomatal opening decreasing the loss of water vapor (Davenport et al., 1969). Kaolin, a silicate mineral, prevents water loss from leaves by partially reflecting photosynthetically active radiation and reducing stomatal conductance. Kaolin application reduced crop ET losses while improving photosynthetic water productivity in well-watered bean and Clementine tangor, and in salt stressed tomato plants (Boari et al., 2015). Kaolin application alleviated drought stress in olive cv. Chondrolia Chalkidikis by increasing the leaf water content, succulence and CO_2 assimilation rate (Denaxa et al., 2012). Supplemental irrigation and anti-transpirant (folicote and vapor-guard) sprays improved plant growth and fruit yield of fig (Ficus carica) in an arid rainfed area (Al-Desouki et al., 2009).

Water Management Practices for Physical Problem of Soil

1. In light soils shallow depth of water with more frequency should be adopted.
2. To increase the infiltration rate of clay type soil, breeding of soil by mixing with coarse textured soil or tank silt at the rate of 50 tonnes per hectare is advocated.
3. Organic wastes like crop residue, farm waste, coir pith, filter cake, etc., at the rate of 20 tonnes per hectare once in every year can be applied.
4. Poorly drained clay soils can be improved by providing tile drains and trenches intermittently.
5. To make the soil more permeable and to overcome poor drainage, addition of organic wastes or sandy soil at the rate of 20 tonnes per ha or 50 tonnes per ha respectively is advocated.
6. Tank silt or heavy soil application is the only way to increase soil depth and water holding capacity. Besides growth shallow rooted crop is advisable.
7. The encrustation problem could be alleviated by incorporating organic matter and adding montmorilonite clay containing silt.

Irrigation Management in Saline Soils

The salt concentration in the water extracted from a saturated soil (called saturation extract) defines the salinity of the soil. If this water contains less than 3 grams of salt per litre, the soil is said to be non-saline. If the salt concentration of the saturation extract contains more than 12 g/l, the soil is said to be highly saline. Improvement of saline soils implies the reduction of the salt concentration of the soil to a level that is not harmful to the crops. More water is applied to the field than is required for crop growth. This additional water infiltrates into the soil and percolates through the root zone. During percolation, it takes up part of the salts in the soil and takes these along to deeper soil layers; the water washes the salts out of the root zone. This washing process is called leaching. The additional water required for leaching must be removed from the root zone by means of a subsurface drainage system.

Irrigation Management in Water logged Soils

Water logging condition and presence of excess water in soil have various harmful effects on crops, soils and farm animals. The first and foremost effect is on the aeration of soil, which is essential for plants to carry on various vital activities. Root growth, availability of nutrients and their uptake, escape of carbon dioxide and other harmful gases produced in the soil, optimal activity of useful bacteria do not take place properly.

Methods of Drainage

Surface drainage: Surface drainage consists of disposal of surplus water by gravity flow from accumulating on the land surface and getting into the soil profile raising the ground water table to a problematic level.

Subsurface Drains: These drains are laid below the soil surface and are covered. They do not interfere with normal movement of farm implements and cultivation practices and no area are wasted for constructing drains.

Various other types of drainage devices: Setting up various other drainage devices can lower water table in an area. They may be mole drain bamboo or wooden pole drain, stone drain and drainage wells.

References

1. Soil and Water Management Practices for Fruit Cultivation in Salt Affected Soils Anshuman Singh ICAR-Central Soil Salinity Research Institute, Karnal – 132 001, India E-mail: anshumaniari@gmail.com
2. Dhakar, Mahesh Kumar & Santosh S Mali, Irrigation Management in Fruit Crops. Indian Council of Agricultural Research, Chapter · September 2016
3. International Archive of Applied Sciences and Technology Int. Arch. App. Sci. Technol; Vol 8 [3] September 2017: 18-24 © 2017 Society of Education, India [ISO9001: 2008 Certified Organization]
4. Books: 1. Fundamental of Soil science ICAR Publication 2. D.K. Das Kalyani publications 3. Problematic Soils by P. R. Fleming, E. J. Murray, I. Jefferson, E. Faragher.

Prominent Agro-Technology for Rose-Scented Geranium *(Pelargonium graveolens)* Cultivation

Article ID: 11567

Sonveer Singh[1], Dipender Kumar[1], Amit Kr. Tiwari[1]
[1]CSIR-Central Institute of Medicinal and Aromatic Plants, Research Center, Pantnagar-263149 (Uttarakahnd).

Picture 1. Rose-scented Geranium *(Pelargonium graveolens)* Plant

Introduction

Rose-scented geranium (*Pelargonium graveolens*) is one of the most profitable aromatic crops for Indian farming system. It is known as rose-scented geranium due to its very strong rose like aroma. *Pelargonium* genus consists of about more than 600 species present in the world, but good quality of geranium essential oil is obtained only from *Pelargonium graveolens* (L.) *Herit.* Geranium crop is native of southern part of Africa. The first time in world, planting of Geranium was introduced from Reunion Island. In India, it was commenced first time in the twentieth century, but geranium cultivation and oil production got confined to the hilly region of southern India. At global level, Geranium is commercially cultivated in France, Belgium, Spain, Egypt, China and so on. In India, it is cultivated mainly inside the Nilgiris and Kodaikanal hills of Tamil Nadu and in & around Bangalore in about 2000 hectare. Globally, total geranium oil production is estimated about 350-400 tonnes per annum and demand for geranium essential oil is more than 600 tonnes in international market. Rose-scented geranium oil is a high valued commodity and enormously demanded in country wide and global market. The main chemical components of geranium essential oil are geraniol, citronellol. The geranium oil actually may be used as antibacterial, insecticidal, and for wound healing and skin disorders. Geranium leaves may also be used in herbal tea making. The geranium oil also used in flavor making and perfumery industries, aromatherapy, cosmetic industries, and food industries.

Plant Description

Rose-scented geranium belongs to Geraniaceae family (2n=88). It is a bushy fragrant plant that can reach as much as to a height of 60 cm and laterally 90cm. Younger stems have hair on them which turn rough and brown in coloration with age.Leaves are gentle, sharp in margin and have strong rose like aroma. The geranium flower is bisexual hypognous with a pink corolla; the two posterior petals are massive with radish purple marking (Picture 1).

Geranium Cultivation Technology

Varieties: Some genetically improved varieties developed by CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow (UP), cultivated by Indian farmers are given below:

1. BIO-G-171: Developed through clonal selection, upright robust growth ability, oil yield (50-55 kg/ha), oil content (0.24%) and Geraniol content (21%).

2. CIM-Pawan: Developed through extensive in-vitro selections in soma-clonal variants of Bourbon type, herb yield (297 q/ha), oil yield (59.6 kg/ha), oil content (0.2%) and Geraniol content (21%).

Soil and Climate

Rose-scented geranium is not a deep-rooted crop, so geranium crops require well sandy loam and dry soil. Crop performs well in loamy soils with a pH of 5.0 to 8.0, rich in organic matter. The alkaline or saline soil with and poor drainage are unsuitable for geranium cultivation.

Geranium may be grown in tropical, subtropical and dry climate and 100-150cm annual rainfall is considered good for its growth. For proper growth of geranium, cardinal temperature range is 25^0C to 30 ^{0}C. Additionally, heavy rainfall and water-logging causes root-rot and stunted crop growth.

Nursery Preparation for Planting Material Production

Rose-scented geranium is especially propagated with the help of cutting, so vegetative propagation is must. Geranium cuttings of about 12 to 15 cm long, containing 4-5 nodes and insect& pest free with three-four leaves present in the top are the good planting material for propagation (Picture 2).They provide 80% rooting without any treatment, but middle portion and basal cuttings require treatment as few earlier observations have reported to give bad rooting, which may be improved after treating with growth regulators like; IAA (Indole acetic acid), IBA (Indole butyric acid) of 200 ppm solution upto 25-30 minutes.

Farm yard manure (FYM) should be properly blended in the soil. Those cuttings are then planted in ridges bed of 3-meter length and 1 meter width at 8-10 cm spacing, beds should have proper shade and watered at an interval of about 4-5 days. Period from November to January months is the best time for geranium cutting and nursery preparation. Rooting begins 20 days after plantation in nursery and cuttings becomes ready for transplanting for main field in about 45-50 days.

Picture 2: Geranium plant cuttings and planted cuttings in polybags for rooting

Field Preparation and Plantation

The field should be properly ploughed and have fine tilth. After field preparation, as per comfort, field is divided in ridges and furrow beds. The fertilizer and irrigation should be applied just after planting on the same day. Approximately, 30,000 rooted geranium cuttings are required for 1hectare area plantation.

The geranium cuttings are canniness dug out from the nursery and planted at 60 cm plant to plant and 60cm row to row distance (Picture 3).

Picture 3: Field view of rose-scented geranium crop and leaves

Irrigation

Geranium crops require 5-7 times irrigation during the crop growth depending on climatic conditions and field situations. However, geranium can tolerate short-period of drought and water-logging should be totally avoided.

Weed Management

In geranium crop, particularly 2-3 times weeding is required. The vegetative growth of crop is slow, so weed should be removed time to time.

Manure and Fertilizers

Geranium crop requires NPK in the ration of 150:60:40 kg per hectare. Therefore, 60 kg Phosphorus and 40 kg Potash is broadcasted in the field before transplanting the geranium cuttings and 150 kg nitrogen is divided in three splits and applied at 25 to 30 days interval.

Other additional (Micro-nutrients) fertilizer application of 20 kg/hectare Zinc sulphate and 10 kg/hectare boron has been reported in enhancing the herbage yield.

Plant Protection

Diseases: Geranium crop is mainly affected by fungal diseases like: wilt, root-rot and leaf rust. The most effective preventions for such type of affected plants are: destroy the leaves and use fungicides like; carbendazime (Bavistin) or mancozeb (Ridomil) @ 2 gram per liter.

Insect: Termites mainly attack the geranium crop so termites can be simply controlled by 25 kg /hectare Heptachlor mixed with the soil in irrigated area.

Harvesting

Geranium crop gives three harvests per year. Geranium crop is ready for first harvesting after 100-120 days of transplanting when geranium leaves are light green in color having rose like aroma.

Second and third harvests are done at 50-60 days interval after first harvest. After harvesting, any copper-based fungicides should be sprayed to control any fungal infection in the crop.

E-ISSN: 2581 - 8317

Picture 4: Post distillation rose-scented geranium essential oil

Distillation and Yield

The herb part of mature geranium crop is harvested during the daytime. The herb part is hydro-distilled for 3-4 hours for oil extraction and the isolated oil is dried over anhydrous Na_2SO_4 in sealed container in cold condition for purification (Picture 4). Geranium crop yields about 25-30 tonnes fresh herbage yield in per hectare area in a year in three harvestings. Geranium oil recovery ranges from 0.10 to 0.20 percent depending upon climatic conditions, harvesting time and material type and 25-30 kg oil is obtained in a hectare area.

Oil Storage

After distilling the oil, it must be stored in air tight Galvanized iron (GI), Aluminium/ Stainless steel (SS) container for long time storage in dark room condition.

Income and Expenditure

Cultivation cost (per hectare): Rs. 90,000/-
Income (per hectare): Rs. 2,50,000 to 3,00,000/-
Net profit (per hectare): Rs. 1,60,000 to 2,10,000/-
*In 2021, current oil price per kilogram in Indian market: Rs.10,000 to 12,000/-

Conclusion

Rose scented geranium *(Pelargonium graveolens)* is important profitable aromatic crop and its oil is highly valued and very demanded in national and international market due to presence of marker compounds like geraniol and citronellol. For more production of its oil, advanced, better and right agro-technology should be adopted at the right time by the Indian farmers. So, that quality essential oil of rose-scented geranium can be produced to fulfill the demand of the emerging population, flavor and perfumery industries, aromatherapy, cosmetic industries, and food industries which will help in boosting up the Indian economy.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

What is Bio Fertilizer (Bio Fertilizer) - Types, Uses and Benefits!

Article ID: 11568

V. M. Dalavi[1]
[1]Ph.D. Scholar, Department of SSAC, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.).

Biofertilizer is also called Biofertilizer because bio fertilizer is a living fertilizer, in which microorganisms are present. By using Biofertilizer in crops, nitrogen present in the atmosphere is easily available to the plants in the form of ammonia. And the insoluble phosphorus and nutrients already present in the soil are converted into soluble state and are easily available to the plants or crops. And the insoluble phosphorus and nutrients already present in the soil are converted into soluble state and are easily available to the plants or crops. Because the bacteria are natural, their use increases the fertility of the soil, and there is no adverse effect on the health of the organisms and the environment. Biofertilizer is a supplement to chemical fertilizers, not a substitute.

Continuous and unbalanced use of chemical fertilizers has adversely affected our agricultural land and environment. Due to the decrease in the amount of organic matter in the soil, its fertility decreases. The water in our reservoirs and on the ground gets polluted. It can be controlled to a great extent with Bio Fertilizer.

Types of Bio Fertilizer

Rhizobium: Rhizobium biofertilizer mainly in all oilseeds and pulses crops as a symbiotic and supplies nitrogen to the plants. After mixing Rhizobium with seeds, after sowing, the bacteria enter the roots and form small nodules. In these nodules, bacteria live in large quantities, taking natural nitrogen from the atmosphere and converting it into nutrients and making it available to the plants. The more knots the plants have, the healthier the plant is. It is used as in pulses and oilseed crops like gram, mung, urad, tur, peas, soybean, beans, lentils and groundnut etc.

Azotobacter, residing freely in the soil and the surface of the roots, converts atmospheric nitrogen into nutrients and makes it available to plants. Azotobacter is used in all non-pulse crops.

Azospirillum: Certain micro-organisms such as bacteria and blue-green algae have the ability to utilize atmospheric nitrogen and provide this nutrient to crop plants. This manure is a staple for fodder crops like maize, barley, oats and sorghum. It increases the efficiency of crop production by 5 to 20 percent. The production efficiency of millet can be increased by 30 percent and that of fodder crops by up to 50 percent.

Blue-Green Algae: The use of blue green shellac as a Biofertilizer for rice is very beneficial. It is a storehouse of nitrogen and nutrients for rice, and it also helps to reduce the alkalinity of the soil.

Mycorrhizae: It is a possible combination of fungi with the roots of vascular plants, it is useful in increasing phosphorus rapidly. It is very beneficial in yield for fruit crops like papaya.

Phosphorus Solvent Bacteria: PSB converts the insoluble phosphorus inside the soil into soluble phosphorus available to the plants, it can be used in all crops, it fulfils the deficiency of phosphorus.

Method of Uses of Bio Fertilizer

Seeds Treatment Method: This is the best method of using Bio Fertilizer. Mix 100 to 110 grams of jaggery in 1 liter of water and mix well with organic fertilizers, sprinkle it well on 20 kg of seeds and make a layer on the seeds, then dry it in a shady place, when the seeds are well Sow it immediately after it dries up.

Tuber Treatment Method: In crops like sugarcane, potato, arbi and ginger, the shoulders are treated for the use of biofertilizers. Prepare a solution of 1 kg of Azotovector and 1 kg of phosphorus solvent bacteria in 25 to 30 liters of water, after that soak the tubers in the solution for 10 to 15 minutes and then transplant the seedlings.

Plant Root Treatment Method: The roots of the plants are treated with bio-fertilizers in crops like paddy and vegetable crops that are planted like tomato, cauliflower, cabbage and onion etc. For this, take a wide and open vessel, now take 6 to 8 liters of water in it, make a solution by mixing 1 kg of Azotobacter and 1 kg of phosphorus solvent bacteria and 250 to 300 grams of jaggery. After this, uproot the plant and clean its roots and make bundles of 70 to 100 plants and now immerse them in the solution of organic fertilizers for 10 to 15 minutes and remove them and transplant them immediately.

Soil Treatment Method: 5 to 10 kg of Biofertilizer according to the crop, mix 80 to 100 kg of soil or compost and leave it for 10 to 12 hours, after that add it to the field in the last ploughing.

Benefits of Bio Fertilizer

1. Bio Fertilizer (Bio-Fertilizer) Increases the fertility of the soil.
2. By their use, the germination is quick and the number of twigs of the plant increases or there is more division.
3. It supplies about 15 to 25 percent of chemical fertilizers especially nitrogen and phosphorus.
4. Increase in humus, the organic matter in the soil, improves the physical and chemical condition of the soil.
5. Their use increases the production of crops by 10 to 15 percent.
6. Bio-Fertilizer also increases the oil of oilseed crops.
7. Improvement is also seen in the alkaline condition of the soil.

Precautions in the Use of Biofertilizer or Biofertilizer

Rose-scented geranium is especially propagated with the help of cutting, so vegetative propagation is must. Geranium cuttings of about 12 to 15 cm long, containing 4-5 nodes and insect& pest free with three-four leaves present in the top are the good planting material for propagation (Picture 2).They provide 80% rooting without any treatment, but middle portion and basal cuttings require treatment as few earlier observations have reported to give bad rooting, which may be improved after treating with growth regulators like; IAA (Indole acetic acid), IBA (Indole butyric acid) of 200 ppm solution upto 25-30 minutes.

Farm yard manure (FYM) should be properly blended in the soil. Those cuttings are then planted in ridges bed of 3-meter length and 1 meter width at 8-10 cm spacing, beds should have proper shade and watered at an interval of about 4-5 days. Period from November to January months is the best time for geranium cutting and nursery preparation. Rooting begins 20 days after plantation in nursery and cuttings becomes ready for transplanting for main field in about 45-50 days.

Field Preparation and Plantation

1. While buying organic fertilizers, the name of the fertilizer, the crop to be used and the last date must be checked.
2. Always keep Bio Fertilizer in a shady place.
3. Do not use organic fertilizer after the expiry of the date at all.
4. Choose bio-fertilizer according to the crop, otherwise the production may be affected.
5. According to the crop and the parameters of the company, use manure in proper quantity.

In this way you can save your farm, water, environment and health by using organic manure and can take more production of your crop at less cost.

References

1. Bhattacharjee R. and Dey U. (2014) Biofertilizer a way towards organic agricultural : A review 8(24): 2332-2342.
2. Raja N. (2013).Biopesticides and bio fertilizers: ecofriendly sources for sustainable agriculture. J Biofertil Biopestici, vol.4 (1).

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Micronutrients Functions and Deficiency Symptoms

Article ID: 11569

V. M. Dalavi[1]
[1]Ph.D. Scholar, Department of SSAC, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.).

The functions of micronutrient nutrients are important in biochemical activity. Their main functions are as follows.

Iron Function

1. Iron is useful for enhancing photosynthesis.
2. The various biochemical processes that take place in plant life require disorders.
3. Iron is primarily involved in the action of disorders. Iron also stimulates protein production.

Symptoms:

a. Symptoms of iron deficiency are similar to those of magnesium deficiency.
b. Due to iron deficiency, not enough chlorophyll is produced in the leaves, so the new shoots turn yellow and then the leaves fall off.
c. The leaf veins, however, remain green.
d. As the amount of protein decreases, the amount of soluble bio-nitrogen increases.

Manganese Function

Manganese leaves contain chlorophyll components and therefore affect the photosynthesis.

Symptoms:

a. The leaf veins of the crop are green and the veins are yellow, followed by whitish and gray.
b. Leaves are low in chlorophyll and chlorophyll.
c. Kovali leaves look creamy yellow.

Zinc Function

1. Zinc is very important for various biochemical activities of crops.
2. Zinc is very important in the production of herbs as well as in the production of hormones and proteinaceous substances.

Symptoms:

a. The leaves of the plant turn yellow and become weak.
b. The size of the leaves decreases.
c. The tissues in the middle of the leaf veins die.
d. The leaves at the apex are scaly.
e. The shape of the fruit deteriorates.
f. The edges of the leaves look crazy.
g. Affects the length of the apex and trunk.
h. The buds are wrinkled.
i. Pere falls short.

Copper Function

1. Many of the biochemical processes that take place in plant growth require radiation.
2. Copper is a major component of many such disorders.
3. Such actions are due to the supply of copper to copper.
4. In particular, it increases the production of proteins as well as `non-vitamins.
5. Copper acts as a regulator in crop respiration.

Symptoms:

a. The chlorophyll in the veins of the leaves is reduced.
b. Crop growth is stunted and leaves fall off. Leaves feel narrow.

c. The petals and edges appear creamy yellow.
d. Stunts new growth in citrus fruit trees. The fruits have reddish gray spots.
e. Slows down the formation of nodules on the roots.

Field Preparation and Plantation

1. While buying organic fertilizers, the name of the fertilizer, the crop to be used and the last date must be checked.
2. Always keep Bio Fertilizer in a shady place.
3. Do not use organic fertilizer after the expiry of the date at all.
4. Choose bio-fertilizer according to the crop, otherwise the production may be affected.
5. According to the crop and the parameters of the company, use manure in proper quantity.

In this way you can save your farm, water, environment and health by using organic manure and can take more production of your crop at less cost.

Boron Function

1. Plants need a variety of biological substances for growth, flowering, and fruiting.
2. Boron is useful in the production of fatty substances, their metabolism and their transport from one place to another.
3. Boron increases the protein content of dicotyledonous crops as well as the oil content of grains.

Symptoms:

a. The colour of the new leaves on the tips starts to fade from the stalk.
b. If there is a severe deficiency of boron, the growing bud dies.
c. Decreased pollen production and fruiting results in less fruit.
d. The leaves at the top of the crop die.
e. The core of the tuber turns black.

Molybdenum Function

1. This nutrient converts nitrate to nitrogen into protein.
2. This nutrient promotes biological nitrogen-fixation in dicotyledonous plants.
3. Adequate supply of these nutrients therefore increases nitrogen-fixation as well as protein production.

Symptoms:

a. Symptoms of molybdenum deficiency look similar to nitrogen deficiency.
b. The leaves look creamy green, secreting brown dinka-like fluid from the underside of the leaves.
c. The growth of the plant is stunted, the leaves appear pale yellow.
d. The first yellowish quinthodasa orange color appears in the space between the veins of the leaves and it spreads on all the leaves.
e. If there is a severe shortage, there is a shortage.

Chlorine Function

Chlorine plays an important role in photosynthesis.

Symptoms:

a. Growth is stunted and lateral roots have footways.
b. Yellowing appears on new leaves, leaves turn yellow, wilted.
c. Coconut trees are prone to fungal diseases.

Reference Book

C. P. Sharma (2006) : Plant Micronutrient.

Importance and Utility of Organic Farming

Article ID: 11570

V. M. Dalavi[1]
[1]Ph.D. Scholar, Department of SSAC, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.).

Increasing population is a serious problem all over the world, with the increasing population, the use of various chemical fertilizers, toxic pesticides, and use of different types of chemical fertilizers, toxic pesticides, to get more and more production in the competition of food production by humans for the supply of food. Affects the cycle of exchange between biotic and inorganic substances (e.g., system), due to which the fertility of the land deteriorates, as well as the environment is polluted and human health deteriorates. In ancient times, farming was done according to human health and in accordance with the natural environment, due to which the cycle of exchange between organic and inorganic substances continued continuously, as a result of which water, land, air and environment were not polluted. In India, cow rearing was done along with agriculture since ancient times, the evidence of which is Lord Krishna and Balarama in our texts, whom we address by the name of Gopal and Haldhar, that is, agriculture and cattle farming combined was very beneficial, which that was very useful for the animal and the environment.

But in the changing environment, the animal husbandry has gradually decreased and various types of chemical fertilizers and pesticides are being used in agriculture, due to which the balance of the cycle of organic and inorganic substances is getting disturbed, and by polluting the environment, there is a danger to mankind. Affecting health. Now instead of using chemical fertilizers, toxic pesticides, we can get more and more production by using organic fertilizers and medicines, so that the land, water and environment will be pure and humans and every living being will be healthy.

Agriculture is the mainstay of the rural economy in India and agriculture is the main source of income for the farmers. In view of the increasing population since the time of Green Revolution and increasing production in terms of income, it is necessary to use chemical fertilizers and pesticides in more quantity in agriculture for more production, due to which the ordinary and small farmers have a lot in less holding. Costs are being incurred and water, land, air and environment are also getting polluted, as well as food items are also becoming poisonous.

Therefore, to deal with all the above problems of this type, it was recommended to do farming on the principle of sustainable farming since last years, which was promoted by the Agriculture Department of the state to adopt this special type of farming, which we call organic farming. Know by name.

Benefits of Organic Farming

Benefits from the point of view of farmers:

a. The fertile capacity of the land increases.
b. Irrigation interval is increased.
c. Reduced dependence on chemical fertilizers reduces cost.
d. Increase in productivity of crops.

Benefits of Soil:

a. The use of organic manure improves the quality of the land.
b. Increases the water holding capacity of the land.
c. There will be less evaporation of water from the land.
d. Benefit from environmental point of view is increase in the water level of the land.
e. There is a reduction in pollution through water in the soil, food and land.
f. The use of waste, in making manure, reduces diseases.
g. Reduction in the cost of production of crops and increase in income.
h. To meet the quality of organic products in the competition of the international market.

The method of organic farming gives equal or more production than the method of chemical farming, that is, organic farming is fully helpful in increasing the fertility of the soil and the productivity of farmers. The method of organic farming is even more profitable in rainfed areas.

By doing farming by organic method, the cost of production is reduced, along with this, the farmers get more income and organic products meet more in the competition of international market. As a result of which farmers can get more profit than normal production.

In modern times, the path of organic farming is very beneficial for the ever-increasing population, environmental pollution, conservation of soil fertility and human health. For the all-round development of human life, it is absolutely necessary that the natural resources should not be polluted, there should be a pure environment and nutritious food should be available, for this we have to adopt the agricultural methods of organic farming, which is all without polluting our natural resources and human environment. public opinion Will be able to provide food to the people and show us the way to live happily.

Major Organic Manure Preparation Methods for Organic Farming

By adding chemicals to the fields, this biological system is going to be destroyed and land and water pollution is increasing. With the help of organic means available in the fields, we have to use them by making fertilizers, insecticides, medicines for rat control, etc.

By using these methods, we will get more yield and grains, fruits and vegetables will also be toxic and good. Nature's system of micro-organisms and organisms will again be able to do cooperative work in our farming.

How to Make Organic Fertilizer

Now we will take help of these micro-organisms in agriculture for making fertilizers and supplying the elements. These micro-organisms have been damaged by chemicals in the fields, so we have to use their culture in every crop, so that the nutrients can be available to the crops. In pulse crops, 4 to 5 packets of Rhizobium culture will have to be applied per acre.

Apply the same amount of Ejectobacter culture in one parti crop. Also, PSP is used to dissolve the phosphorus which is in the soil. Culture has to be applied at 5 packets per acre. Some methods are being given below to make manure, make manure with these methods and apply it in the fields.

This manure will improve the composition of the soil, the number of micro-organisms will also increase and the air circulation will increase, the ability to absorb and hold water will also increase and the production of the crop will also increase. The residues of crops and shrubs contain all the elements they need.

Sulphur Oxidizing Bacteria

Article ID: 11571

V. M. Dalavi[1]
[1]Ph.D. Scholar, Department of SSAC, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.).

Thiobacilli play an important role in sulphur oxidation in soil. Sulphur oxidation is the most important step of sulphur cycle, which improves soil fertility. It results in the formation of sulphate, which can be used by the plants, while the acidity produced by oxidation helps to solubilize plant nutrients and improves alkali soils.

Several Thiobacillus species are able to utilize mixtures of inorganic and organic compounds simultaneously, often referred to as mixotrophic growth depending on the ratio of inorganic and organic substrates, CO may serve as an additional carbon source. Of the 13 species of the genus Thiobacillus recognized, occurring in diverse habitats, only five species are important in sulphur oxidation in soil. Four of these *Thiobacillus thiooxidans, T. ferrooxidans, T. thioparus and T. denitrificans* are obligate chemoautotrophs while *T. novellus* is considered a facultative chemoautotroph.

Sulfur-oxidizing bacteria including *Acidithiobacillus thiooxidans* and *Thiobacillus denitrificans* use sulphides as the efficient electron donors for autotrophic denitrification treating nitrate in wastewater

Sulfur-oxidizing bacteria are often considered one of the most dangerous groups for the conservation of stonework (chemolithotrophic) as they produce sulfuric acid, an inorganic acid that has a strong degrading action through the oxidation of hydrogen sulfide, elemental sulfur, and thiosulfates. Indeed, the most dangerous for artifacts are the thiobacilli (Thiobacillus and Thiomicrospira) as they directly oxidize sulfides to sulfates and their ecological characteristics favor a greater production of sulfuric acid.

Nitrifying bacteria include ammonia-oxidizing bacteria (Nitrosomonas and Nitrosococcus) that oxidize ammonia to nitrous acid and nitrite-oxidizing bacteria that oxidize nitrous acid to nitric acid (Nitrobacter and Nitrococcus). The metabolic process is called nitrification. Nitrifying bacteria play an important role in stone weathering because of nitric acid production.

Hydrogen bacteria use molecular hydrogen as a source of energy, converting CO_2 to organic carbon. Their importance lies in the fact that they remain active under limited environmental conditions and even in the temporary absence of the primary energy source. Almost all are facultative chemolithotropic organisms, having the capacity to use organic compounds as the energy source (chemoorganotrophs). Hydrogen bacteria are active in both the presence and the absence of organic substances, as long as the hydrogen concentration is high. Both Gram-positive (Bacillus) and Gram-negative organisms are found, the most common and well known being the Pseudomonas, Paracoccus, and Alcaligenes.

Ferrobacteria are microorganisms that obtain their energy from the aerobic oxidation of iron: from ferrous (Fe^{2+}) to ferric (Fe^{3+}). Ferrobacteria are found on stone containing pyrites (ferric sulfide), frescos and wall paintings, and so on, where reduced iron compounds were employed, and on iron artifacts. In acid environments, *Thiobacillus ferrooxidans* is the most frequently found, growing autotrophically by utilizing both ferrous ions and compounds reduced from sulfur as electron donors.

Based on Colourless Sulphur Bacteria

Chemolithotrophic sulfide- and sulfur-oxidizing bacteria (colourless sulfur bacteria) are ubiquitous in aquatic sediments. Under some circumstances they form macroscopically visible cohesive white patches or extensive white areas on the sediment surface. These mats appear white due to the intracellular accumulation of elemental sulfur. To form mats, colourless sulfur bacteria depend on the simultaneous presence of oxygen (or nitrate) and sulfide, but since they are microaerophiles, they prefer O_2-tensions around 5% of atmospheric saturation; they also do not tolerate very high sulfide concentrations. They are therefore "gradient organisms", and their habitat is the narrow 0.1 to one mm thick zone where low concentrations of HS^- and O_2 coexist. More recent studies have shown that the filamentous forms of colourless sulfur oxidizers can and to large extent do use nitrate instead of oxygen to oxidize sulfide. They migrate between the surface, where they obtain nitrate and store it in vacuoles, and the sulfidic zone where they obtain sulphide.

The chemosensory motile behaviour of these organisms is an important property for understanding the characteristics of the mats they form. In particular these sulfur oxidizers seek zones with very low values of pO_2, which leads them to the narrow zone where O_2 and HS^- overlap. The filamentous *Beggiatoa* continuously glide up and down between zones of excess and limiting O_2-tensions, turning each time they encounter unfavourable oxygen levels. Other types of unicellular bacteria similarly swim back and forth between high and low values of oxygen tension, so that they remain within some species-specific pO_2 range. By simultaneously consuming O_2 and HS^{-1} they maintain steep concentration gradients with elevated transport for both substrates. Simultaneous consumption of sulfide and oxygen in combination with chemosensory motility creates their desired niche. In one case, the colourless sulfur bacterium, *Thiovulum*, even creates water currents so that vertical solute transport is enhanced through advection generated by the bacteria themselves (Fenchel, Glud, 1998).

Mats of colourless sulfur bacteria can also form under somewhat different circumstances. Transient mats appear above accumulations of degrading organic material (seaweed tissue, dead animals) buried in or lying on the sediment, because this creates high local sulfide production. Such white patches are often seen on shallow water sediments that are protected from wave action.

The microbiota of such mats undergoes a characteristic succession during the first few days of activity. Following initially high sulfide production, the patches are first colonized by unicellular colourless sulfur bacteria, e.g., *Macromonas*, *Thiospira* and later the large and rapidly swimming *Thiovulum* that forms characteristic about 0.1 mm thick white veils on the top of sulfidic sediments. Next, the unicellular forms are to a large extent replaced by gliding *Beggiatoa* filaments with different diameters. This succession is driven at least in part by dense populations of bacterivorous ciliates that decimate the unicellular sulfur bacteria.

Symbion-S *(Thiobacillus thiooxidants)*

What is Symbion-S? A liquid form of Bio-fertilizer based on selective strain of sulphur solubilizing bacteria, Thiobacillus thiooxidants. This beneficial bacterium is suspended liquid carrier @ 1x109bacterial cells / ml of the product.

Mode of Action

The bacteria used for the production of this product, namely *Thiobacillus thiooxidants* strain are known for its sulphur solubilizing characters. This bacterial cell converts the non-available sulphur and sulphur related compounds to easily assailable form of sulphur salts through a process of oxidation. During this process, it brings down the high pH of the soil (alkasol soil). Hence, Symbion-S can be utilized in reclaiming the alkaline and saline soil for normal cultivation.

Dose and Method of Application

For Soil Reclamation: Soil with high pH, acts as an impediment in making available sulphur to the plants and also preventing proper establishment of root system. Addition of elemental sulphur varying from 200 kgs to 500 kgs and application of Symbion-S *(Thiobacillus thiooxidants)* at the recommended rate liquid (3 lit/ha) will facilitate availability of sulphur related compound salts to the plants as nutrients. Also, in the process of oxidation it produces acid which bring down the pH to the optimal level.

In places where application of Gypsum is practiced for reclamation of the soil with high pH, addition of Symbion-S *(Thiobacillus thiooxidants)* will have added advantage in the process of reducing the pH/soil reclamation.

In Soil with High sulphur Content: There are soils recorded to have high sulphur either in the form of elemental sulphur or complex compound, which are not available to the plant system. Addition of Symbion-S at appropriate ratios as per the dosage indicated, will be converting the elemental sulphur through the process of oxidation and produce simple sulfate or complex sulfate compound, which are water soluble and that the plant can easily absorb and utilize.

Features

Symbion-S, which contains acidophilic *Thiobacillus thiooxidans* is capable of oxidising elemental sulphur which results in the production of water soluble sulfate salts which facilitates reduction of soil pH also.

Benefits

1. It converts non-available sulphur and sulphur related compounds in to an easily available simpler fertilizer form to the plants.
2. It helps to improve the plant immune system.
3. It is environment friendly and self-perpetuating, which facilitates proliferation of soil micro-flora.
4. Cumulatively, it improves the general health of the soil, leading to better plant growth and ultimately results in higher yields.
5. Application of sulphur along with Symbion-S *(Thiobacillus thiooxidants)* will protect the crop from sulphur deficiencies.

References

1. Rajagopal vidyalakshmi and R. Sridar (2007) Isolation and characterization of sulphur oxidizing bacteria journal of culture collections. Vol 5: 73-77.
2. Rangasamy Anandham (2014) Early plant growth promotion of maize by various sulfur oxidizing bacteria that uses different thiosulfate oxidation pathway. African Journal of Microbiology Research Vol.8 (1):19-27.
3. Sulphur Oxidizing Bacteria and Pulse Nutrition - A Review (2009) World Journal of Agricultural Sciences 5 (3): 270-278.

E-ISSN: 2581 - 8317

AI Enabled Next Generation Pest Detection System

Article ID: 11572

Akash V. Kachot[1], Dharmrajsinh M. Jethva[2], Pankaj S Wadaskar[3]
[1]Senior Research Fellow, Biocontrol Research Laboratory, Department of Entomology, Junagadh Agricultural University, Junagadh.
[2]Associate Research Scientist, Biocontrol Research Laboratory, Department of Entomology, Junagadh Agricultural University, Junagadh.
[3]Research Associate, Biocontrol Research Laboratory, Department of Entomology, Junagadh Agricultural University, Junagadh.

What is Artificial Intelligence?

For those who are not familiar with artificial intelligence (AI), imagine that some tasks that are done by humans, such as object detection, visual interpretation, and speech recognition, can be done by computers without human interference. Artificial intelligence is based on the principle that human intelligence can be denied in a way that a machine can easily mimic it and execute tasks, from the simplest to those that are even more complex. The goals of AI include learning, reasoning, and perception.

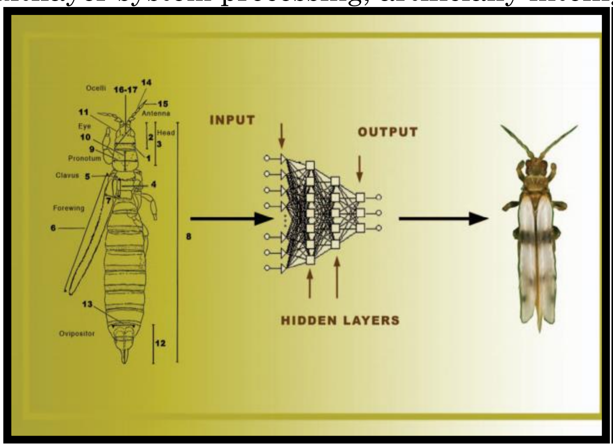
"We are at beginning of a golden age of AI. Recent advancements have already led to invention that previously lived in the realm of science fiction- and we have only scratched the surface of what's possible." Jeff Bezos, Amazon CEO

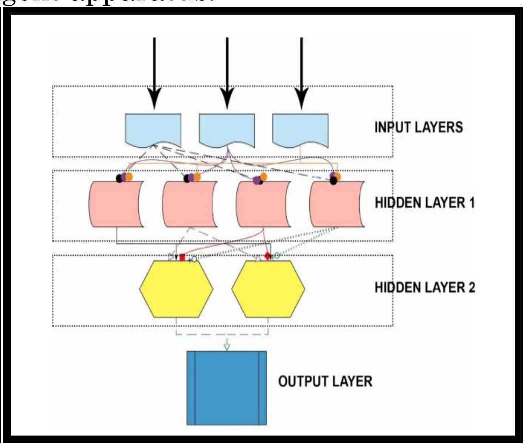
AI is growing in fields that require algorithms (mathematical instructions for computers) and machines to solve problems that are intellectually difficult for human beings but relatively easy for programmable computers. The true challenge of AI is to solve tasks that are easy for people to perform, but hard to be described, once it requires intuition.

AI-Enabled Systems to Detect Pests

Pests are one of the worst enemies of the farmers which damages crops. AI systems use satellite images and compare them with historical data using AI algorithms and detect that if any insect has landed and which type of insect has landed like the locust, grasshopper, etc. and send alerts to farmers to their smartphones so that farmers can take required precautions and use required pest control thus AI helps farmers to fight against pests.

Artificial neural networks (ANN), defined under artificial intelligence, suggested possible practical methods for semi-automated identification of biological objects (MacLeod, 2008). Together with other statistical tools, such as principal component analysis or classification trees, such networks meet digital age science. An optimum architecture, established and supervised by experts, transforms metadata through multilayer system processing, artificially intelligent apparatus.





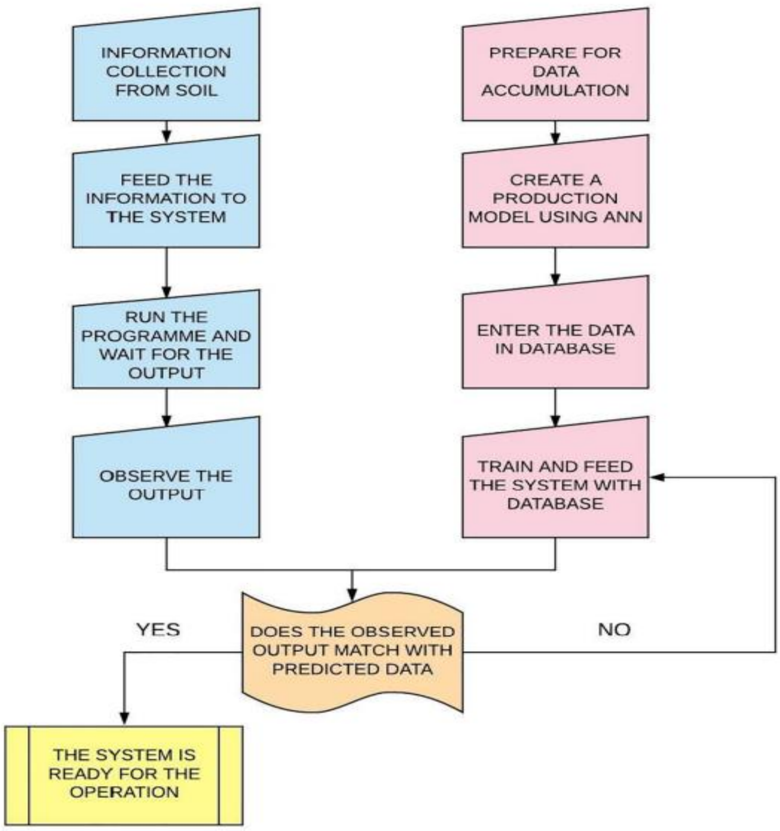
Fedor and his co-worker gave an operating Artificial Neural Network system for pest identification. They showed the process of pest identification in ways of input to output by process through multiple hidden layers by creating solid image of pest for their identification.

Experiments with several ANN types (radial basis function, linear, probabilistic and multilayer perceptron networks) suggested multilayer perceptron as efficient for such a purpose generally. Its architecture was constructed conventionally with three or more feed-forward layers, i.e., input, output and one or several hidden layers. More than 3000 specimens, both males and females, were analyzed in accordance with standard preparatory techniques.

For instance, 17 quantitative morphometric characters (measured as linear distances on digital images), such as head, clavus, wing, ovipositor length and width, two qualitative two-state characters (presence/absence) and sex formed the input variable computation set in a Trajan neural network simulator (Trajan Software, Ltd, 1996–1998) for cereal damaging and grain damage causing thrips of the Limothrips genus. (Fedor et al., 2008) The experimental uncertainty for the digital images was 0.03 □m.

The practical use of ANNs for pest identification has several limitations (Gaston & O'Neill, 2004). For thrips, problems may originate in intraspecific variation (e.g., wing and sex polymorphism). However, enough evidence exists that precise and effective pest monitoring could have far reaching implications for farmers and food policy without harming biodiversity, expensive inputs, or plaguing human dignity. The use of ANNs corresponds with more effective control of harmful pests and thus with prevention of serious crop damage.

Following is a working flowchart of process run throughout in Artificial Neural Network based predictor model with help of smartphones. In these two different processes runs simultaneously. One in which that collect the information from soil sample and feed that into system and give output after processing. Simultaneously, after data accumulation it creates a production model based on data using Artificial Neural Network. By combining these if the data is matched with predicted data, then this system is ready for the operation but if it does not match then it is again train and feed the system with different modified database.



Flowchart of ANN-based crop predictor using smartphones

Conclusion

As the agriculture is a vast field, the use of Artificial Intelligence is needful for the smart agriculture solutions like management of various insect pests in different crops has become serious issue. For efficient management of particular pest identification of the pest plays a vital role. AI enabled systems includes Artificial Neural Network (ANN) which can be used for the pest identification. It will play vital role not only in management of insect pest but also for entomological research.

References

1. Fedor, P., Vanhara, J., Havel, J., Malenovsky, I. and Spellerberg, I. (2008). Thrips (Thysanoptera) identification using artificial neural networks. Bulletin of Entomological Research, 98: 437-447.
2. MacLeod, N. (2008). Automated Taxon Identification in Systematics. Theory, Approaches and Applications. CRC Press, Boca Raton.
3. Gaston, K. J. & O'Neill, M. A. (2004). Use of Artificial Neural Network for pest identification. Philosophical Transactions of the Royal Society of London, Series. 359: 655–667.

Vitamins – An Important Immune Booster

Article ID: 11573

Bharathi. S[1], Meenakshi. V[2]
[1]Student, Community Science College and Research Institute, TNAU, Madurai -625 104.
[2]Assistant Professor (FSN), Department of Food Science and Nutrition, Community Science, College and Research Institute, TNAU, Madurai -625 104.

Abstract

Good Nutrition is fundamental to improving immunity. Immunity provides protection to life by its three main such as skin, cellular response, and humoral immune response. Innate immunity is the first line defense against infection. It is rapid response. It is not specific to particular pathogen. It is found in all classes of plant and animal life. Adaptive immunity provides a specific immune response directed at an invading pathogen. Various micronutrients are essential for immunocompetence, particularly vitamin A, C, D, E, B2, and B12, folic acid, iron, selenium and zinc. Micronutrient deficiencies are a recognized global public health issues, and poor nutritional status predisposes to certain infections. Immune function may be improved by restoring deficient micronutrients to recommended levels, thereby increasing resistance to infection and supporting faster recovery when infected.

Introduction

Adequate nutritional status is crucial for the development, maintenance, and expression of the immune response. Micronutrients (i.e., vitamins and nutritionally essential minerals) influence and support every stage of the immune response. Deficiencies of micronutrients can affect both innate and adaptive immunity, causing immunosuppression and thus increasing the susceptibility to infections. In addition, mucosal-associated invariant T cells (MAIT), which are innate-like T cells expressing a semi-invariant T cell receptor, play a role in polarizing adaptive lymphocyte function, and contribute to metabolic dysfunction. Furthermore, infections and an inadequate nutritional status have a synergistic relationship.

The immune system, which is integrated into all physiological systems, protects the body against infections and other external and internal insults by utilizing three distinct layers, depending on the nature of the threat: a. physical (e.g.,skin, epithelial lining of the gastrointestinal and respiratory tracts), b. biochemical barriers (e.g., secretions, mucus, and gastric acid), c. numerous different immune cells (e.g., granulocytes, CD4 or CD8 T and B calls), and antibodies (immnunoglobulins).

Nonspecific, innate or natural immunity is present from birth and comprises components that serve as defense barriers. The innate immune system can play an important role as the first line defense or barrier against foreign organism and substances. It also plays a role in acute and chronic inflammation and in select disease states. One type of barrier that functions to prevent entry of pathogens is structural. Examples include the skin and mucous membranes; these are effective in preventing the entry of most pathogens. Another component of innate immunity consists of physiological barriers and includes parameters such as temperature, pH, and oxygen levels. An example is the low pH of the stomach, which provides an innate barrier to infection, as few ingested microorganisms can survive that environment.(Kent L. Erickan et.al, 2000).

Adaptive immunity is defined by the presence of lymphocytes, either T or B cells, and includes both CD8+ cytotoxic T cells that are the effector cells that directly destroy tumor cells, CD4+ helper T cells that regulate CD8+ T cell and B cell function, and B cells that present antigen and produce antibodies. (Luigina Romani et.al, 2018).

Viral infections are a leading cause of morbidity and mortality worldwide, as is shown by both seasonal influenzas, and the recent outbreak of coronavirus disease 2019 (COVID-19), caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Many people of all ages have single or multiple micronutrient deficiencies. Supplementation of micronutrients may play an important role in enhancing the resistance to infections, restoring the immune function. (Sidra Aslam et.al, 2017).

Life Style and Immunity

Nutrition and other lifestyle measures influence immune strength and susceptibility to infectious diseases. Immune system responds to regular physical activity, moderate – and vigorous – intensity aerobic exercise of less than 60 min duration, there is an activation of the antipathogen activity of tissue macrophages together with enhanced recirculation of immunogloblins, anti-inflammatory cytokines, neutrophils, NK cells, cytotoxic T cells, CD8+ T lymphocytes, and immature B cells, all of which play critical roles in immune defense activity and healthy metabolic health.

Several in vitro studies have shown signs of reduced immunity in individuals during acute and chronic stress. Some studies have also indicated that chronic stress may increase the risk of infections and cancer. Sleep is an essential physiological process that has been found to have significant restorative and regulatory properties on many systems of the body, including the immune system. Both short term and long-term sleep loss have been found to correlate with increased production of many proinflammatory markers such as IL – 6, CRP (C-Reactive protein). (Abiodun Bamidele Adelowo, 2020).

Research has shown that being happier may help keep immune system strong. This may help to reduce the risk of developing colds and chest infections. (Daisy Coyle, 2017). A more negative affective style mounts a weaker immune response and therefore may be at greater risk for illness than those with a more positive affective style. (Peter scepanovic et.al,2018).

Micronutrients – An Importance Immune Booster

The immune system is a multifaceted and sophisticated network of specialized organs, tissues, cells, proteins, and chemicals, which has evolved in order to protect the host from a range of pathogens, such as bacteria, viruses, fungi, and parasites, as well as cancer cells. The body may lose micronutrients when exposed to pathogens, which causes the immune system to become increasingly active. The loss is exacerbated during an active infection (including vitamins A, C, and E, calcium, zinc, and iron), and plasma levels return to normal once symptoms improve. An adequate micronutrient intake is essential to aid recovery from infection, made more difficult by the fact that food intake may decrease during illness, and that antibiotic use can also deplete certain micronutrients. (Gombart, Pierre, et al., 2020).

A strong immune system which may offer protection from seasonal illness and other health problems requires good nutrition. Dietary sources of essential elements are important for correcting physiological functions of the human body. Healthy foods constituting well-balanced diet with large quantities of fruits and vegetables are essential to meet the essential nutrient to boost the body's immune system.

Eating a low-fat, plant-based diet may help give the immune system a boost. The immune system relies on white blood cells that produce antibodies to combat bacteria, viruses, and other invaders. Fruits and vegetables provide nutrients like beta-carotene, vitamin C, and vitamin E which can boost immune function. Vegetables especially green leafy vegetables are the most sustainable and affordable source of vitamin A, C, riboflavin, folic acid, micronutrients iron, calcium, phosphorus, sodium, potassium, and dietary fibre (soluble) and fatty acid (α-linolenic acid) in diet.

Vitamin A and Immunity

Vitamin A is referred as Anti-inflammatory vitamin. Vitamin A and related retinoids modulate many different immune response elements, including expression of keratins and mucins, lymphopoiesis, apoptosis, cytokine production, function of neutrophils, natural killer cells, monocytes or macrophages , T lymphocytes and B lymphocytes, and production of immunoglobin. (Semba, 2012). Vitamin A increases cellular and Humoral immune response. Plant and animal sources provide B-carotene and pre formed vitamin A. The rich sources are liver egg yolk butter whole milk and cheese . The affordable plant sources of β carotene are sweet potato, melons, mango, green leafy vegetables , carrot , pumpkin and red palm oil. β carotene function as an antioxidant when it comes to the enhancement of immune response.

Vitamin D and Immunity

Vitamin D regulates mineral metabolism and maintains a healthy mineralized bone structure, but it also plays important immunomodulatory. Vitamin D is composed of two main groups that contain vitamin D2 and vitamin D3. Vitamin D2 is commonly known as ergocalciferol and D3 as cholecalciferol. In humans both types of vitamins (D2 and D3) are utilized but vitamin D3 is naturally produced by the human cells in the presence of ultraviolet radiation from the sunlight. Vitamin D3 plays an important part in regulating human immune response. Exposure to adequate sunlight will determine vitamin D content in our body. Natural food sources are oily fishes and fortified breakfast foods.

Vitamin E and Immunity

Vitamin E is acting as a potent antioxidant and helps in the prevention of free radicals' formation and plays an important role in enhancing immune response by inactivating and inhibiting the free radicals as a result of antioxidant activity.

When the diet is supplemented with vitamin E intake, it results in the mitogen stimulated increased T lymphocyte multiplication, increased cytotoxic cell activity and maximize the action of macrophages against the intruders thus providing the strong basis of action against infections. (Jazib Ali Irfan and Sidra Aslam. 2017). Rich source of immunoregulator vitamin E are Edible vegetable oil such as wheat germ oil, sunflower oil rape seed oil, green leafy vegetables like spinach, nuts (almond and peanut).

B Complex Vitamin and Immunity

Several members of vitamin B complex are used in our body to promote the defensive role for better health and prevention of diseases by boosting up the immune system. The body needs vitamin B6 in order to absorb vitamin B12 and to make red blood cells and B cell synthesis and T cell multiplication of the immune system.

Vitamin B6 helps to improve immune response to the increase in production of antibodies and also helps in communicative interaction between cytokines and chemokines. (Jazib Ali Irfan and Sidra Aslam. 2017). The important Vitamin B6 sources are Chicken, liver , fish, nuts (walnut and peanut), chick pea, whole grain cereals, maize and vegetables. Vitamin B12 are present in animal foods such as shell fish, liver, game meat and milk and milk products. Folate deficiency can lead to decreased responses of T-cells to phytohemagglutinin (PHA) as well as to decreased cytotoxic T-cell functioned.

Vitamin C and Immunity

Vitamin C regulates the immune system because of its antioxidant properties and its role in collagen synthesis required for stabilization of epithelial barriers. It plays a role in phagocytic function and has an immunostimulatory effect on lymphocyte cells. Vitamin C is highly concentrated in leucocytes and is used rapidly during infection.

In fact, it has been defined as a stimulant of leucocyte functions, especially of neutrophil and monocyte movement. Administration of vitamin C results in improvement in several components of the human immune response, such as antimicrobicidal and natural killer (NK) cell activities, lymphocyte proliferation, chemotaxis and delayed-type hypersensitivity response. (S. Maggini et.al, 2015).
Rich sources of vitamin C are fruits especially citrus fruits, west Indian cherries, amla etc.

Conclusion

Vitamins and other micronutrients are understood to work together to support an effective immune system, based on a variety of mechanistic and clinical data. However, further studies are needed to evaluate nutrients' synergistic effects in the immune response against viral infections. We can obtain them from fruits, vegetables, beans, lentils, whole grains and fortified dairy foods. Plant and Animal foods contain vitamins that promote, enhance and regulate the immune system. Some vitamins have more immune protection power than others. Comprehensively, inadequate intake and lowered nutritional status of these vitamins and minerals may lead to suppressed immunity, which predisposes to infections and aggravates malnutrition. Therefore, a healthy life style along with healthy balanced diet can support the body's natural defense system.

References

1. Abiodum Bamidele Adelowo. Strengthening immunity through healthy lifestyle practices. Published . life style medicine. Volume1, Issue1. July 2020.
2. Adrian F Gombart , Adeline Pierre , Silvia Maggini. 2020. A Review of Micronutrients and the Immune System-Working in Harmony to Reduce the Risk of Infection. Nutrients. 2020 Jan 16;12(1):236. doi: 10.3390/nu12010236.

3. Adrian F. Gombart, Adeline Pierre, 2 and Silvia Maggini. 2020. A Review of Micronutrients and the Immune System–Working in Harmony to Reduce the Risk of Infection. Nutrients. Jan; 12(1): 236.
4. Jazib Ali Irfan and Sidra Aslam. 2017. Vitamins: Key Role Players in Boosting Up Immune Response-A Mini Review. Vitamins & Minerals. 2017, 6:1 DOI: 10.4172/2376-1318.1000153.
5. Kent L. Erickson, Edward A. Medina, Neil E. Hubbard. Micronutrients and Innate Immunity. The Journal of Infectious Diseases, Volume 182, Issue Supplement_1, September 2000. https://doi.org/10.1086/315922.
6. Luigina Romani . 2004.Immunity to fungal infections. Nature Reviews Immunology volume 4. pages11–24 .
7. Scepanovic, P. et al. Human genetic variants and age are the strongest predictors of humoral immune responses to common pathogens and vaccines. Genome Med. 10, 1–13 (2018).
8. Semba R.D. The historical evolution of thought regarding multiple micronutrient nutrition. J. Nutr. 2012;142:143s–156s. doi: 10.3945/jn.110.137745
9. Silvia Maggini, Adeline Pierre. Immune function and micronutrient requirements changes over the life course. Published on 17 October, 2018.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Deterioration of Ground Water Quality and its Amelioration

Article ID: 11574

Rashmi Bhumarkar[1], Ashish Kumar[2], Gaurav Mahajan[1], Sharad Bisen[3]
[1]AICRP on Maize, Zonal Agricultural Research Station, J.N.K.V.V, Chhindwara, M.P. 480001, India.
[2]College of Agriculture, J.N.K.V.V, Jabalpur, M.P. 482001, India.
[3]College of Agriculture, Balaghat, J.N.K.V.V, Jabalpur, M.P. 482001, India.

In the most productive areas of world ground water resources are shrinking at an alarming rate and these may not be adequate to meet the ever-increasing demands from agriculture and allied industries in near future. The studies done by scientists had shown that in most of the Rice–wheat (RW) cropping systems area of North West India, there has been a steadily increase in the depth of ground water. The increase in depth has accelerated alarmingly in some areas in the recent years. The rate of increased has been varied from about 0.2 m/year during 1973-2001 to about 1m/year during 2000-2006 in parts of Punjab. These alarming situations are indicative of that agriculture sector consumes maximum of the ground water and ≥ 80% of actual water resources are utilized for irrigation purpose in agriculture. With developing scenarios of severe water scarcity and competition from other sectors of economy, it is axiomatic that agriculture is going to lose its first use right for better quality waters and it would have to increasingly depend upon marginal waters only.

In water some salts are always dissolved, no matter what ever may be the source of irrigation water be it canal, tank or well. Calcium, magnesium, sodium and potassium are the positively charged ions or main soluble cations constituents. Whereas, sulphates, chlorides, carbonates, bicarbonates and nitrates are the main soluble anions. Other cations and anions may also be present in minor quantities. Some of the ions like boron, selenium, molybdenum and fluorine if taken up by plants in excessive amounts will be harmful for animals feeding on such fodder or drinking such water in plenty. For determining the quality of irrigation water and its suitability for irrigation calcium, boron, bicarbonates, sodium, magnesium, chloride and sulphate plays a pivot role.

The total salt concentration as measured by electrical conductivity, relative proportion of sodium to other cations as expressed by sodium absorption ratio, bicarbonate content, boron concentration and soluble sodium percentage are the chief criteria for judging the quality of irrigation water.

Total concentration of soluble salts is the most important single criterion of irrigation water quality. The harmful effects increase with increase in total salt concentration. Increased concentration of sodium in the solution increases sodium hazard. Any increase in the sodium adsorption ratio (SAR) of irrigation water increases the SAR of soil solution. This ultimately increases the exchangeable sodium of soil. There is a linear relationship between SAR and exchangeable sodium percentage (ESP) of soil.

Calcium and magnesium react with bicarbonates in irrigation water and precipitates as in soluble carbonates. As calcium and magnesium are lost from water, the relative proportion of sodium increases causing sodium hazard. Some salts even in very small quantity when present or absent in the water makes a huge difference. Presence of boron beyond 2ppm in irrigation water is toxic for most of the field crops due to affecting metabolic activity of plants.

On the basis of quality, ground water is broadly grouped in three groups (a) the areas in arid regions where annual rainfall is 450 mm (b) the areas where water influenced by high water table (c) water in coastal areas of the country influenced by backward flow of sea water and inundation. Arid environments are extremely diverse in terms of their land forms, soils, fauna, flora, water balances, and human activities. It is the main cause for a very high degree of salinity in ground water. In the arid parts of the country like Rajasthan aridity has resulted in water accumulation and problems of soil salinity. Estimated amounts of 57% of the area irrigated by wells in the state are affected by alkalinity and salinity.

Scientists surveyed the waste sewage water of Haryana and documented that total concentration of lead (Pb), nickel (Ni) and cadmium (Cd) varied from 1.10 to 3.0, 0.67 to 2.67 and 0.12 to 0.48 mg liter-1, respectively. The maximum concentration of these metals was found in the sewage water, where a number of industries disposed of their effluents in sewage water resulting in tremendous increase of these metals beyond permissible limits

The quality of water is poor not only in northern part of the country but similar situation also persists in eastern area. It is evidenced from the fact that Kolkata sewage effluent was not suitable from different discharge points in terms of sodicity, salinity, micronutrients, heavy metals toxicity and bicarbonate content. Although the concentration of iron (Fe), copper (Cu), zinc (Zn), manganese (Mn) and lead (Pb) were within acceptable limits for plants, yet their continuous use may establish alarming situations. It has been reported that the concentration of cadmium (Cd), nickel (Ni) and cobalt (Co) were higher in sewage water of industrial area where the manufacturing of metallic products was done in comparison to those where textile and wool industries were located. High cadmium (Cd) concentration was observed in sewage water of electroplating industries and tanneries chiefly dealing in leather work showed higher chromium (Cr) content in the sewage water.

Amelioration measures include curtailing the inputs, growing nonfood crops, removing the polluted soils or covering it with a thick layer of unpolluted soil ensuring that roots do not reach the under lying polluted soil. Waste water may also be used for cultivation of forest trees for timber purposes (non-edible purposes). It is desirable that the waste water particularly industrial effluent be made to undergo suitable treatment in waste water treatment plants before it is declared environmentally safe for discharge in to water bodies. Soil remediation is defined here as set of techniques for reducing the mobile and in consequence, bio available fraction of contaminant in soil with the object of minimizing their transfer to food chain and ground water.

Technologies based on physical, chemical and biological processes to ameliorate polluted soils had been developed and deployed in a particular situation depending on the easy availability and the cost effectiveness of the method/s to be employed.

Among the physical measures adopted for amelioration of soil, excavation of contaminated soil is chiefly adopted. It chiefly involves digging of affected soil and lifting it up for “ex-situ” (above-ground) treatment or for disposal in a landfill. Excavation is commonly used where in situ cleanup methods will not work quickly enough or will be too expensive. Offsite disposal and ex situ treatment are often the fastest ways to deal with high levels of contamination that pose an immediate risk to people or the environment. Excavation is cost-effective approach only for small amounts of contaminated soil. With land space becoming costly, this strategy is becoming less acceptable to industry, regulatory bodies and public.

The phytotoxicity of different heavy metals can also be decreased by the use of organic amendments like farmyard manure and poultry manure. Reactions of organic constituents with metals provide fixation sink leaving lesser number of metals immediately available for plants. Efficiency of cattle waste compost in reducing cadmium uptake by spinach has been reported. In comparison to the chemical fertilized plots/soil, cadmium concentration was 34-38% lower in spinach harvested from cattle waste compost supplied plots/soil.

Raising the pH leads to higher affinity between soil and metals. By addition of lime and other alkaline amendments pH of the soil can be raised and its affinity for toxic metals increases thereby decreasing its availability to plants, some time it also leads to formation of precipitates and secondary minerals that decreases the solubility of metals.

Addition of calcium carbonate to soil not only increases the dry matter yield of the crop and but also mitigate the effect of nickel toxicity to crop plants. Application of calcium carbonate @ 2.5% to the soil leads to reduced extractable DTPA and plant nickel.

Phytoremediation is another and a new approach that uses selected metal accumulators’ plants to ameliorate the soils polluted with heavy metals. The basic strategy behind it is use of green plant to remove pollutants from the environment or to render them harmless. This approach takes advantage of the ability of plants to concentrate elements and compounds from the environment and to metabolize various molecules in their tissues. It is a cost-effective plant-based approach. Another sub process of phytoremediation is ‘Phytoextraction’ and in this remedial process use of pollutant-accumulating plants is done so as to remove metals or organics from soil by concentrating them in the harvestable plant parts.

The heavy metals that plants extract is toxic to the plants as well, and the plants used for phytoextraction are known hyper accumulators that sequester extremely large amounts of heavy metals in their tissues. Another way to make remediation more effective is by involving microorganisms along with plants to degrade or decompose heavy metals in to less toxic and simpler metal ions. This process is known as Phytodegradation. It is the ability of plants to take up and degrade the contaminants. Contaminants are degraded through internal enzymatic activity and photosynthetic oxidation/reduction.

As many microorganisms have developed various strategies and survival mechanisms for their survival in heavy metal polluted soils and some organisms are known to develop and adopt different detoxifying mechanism such as biosorption, biotransformation, biomineralization and bioremediation. All these processes refer to biological methods for cleanup of contaminated soils. It involves establishing the conditions in contaminated environment so that appropriate microorganisms flourish and carry out the metabolic activities to detoxify the contaminants. Different types of bacteria, fungi and other microorganisms are used for treating polluted soils. White rot fungi (*Pleurotus tuberegium* or *Pleurotus ostreatus*) secretes wood-rotting enzymes which degrade a variety of pollutants. Treatment involves mixing soil with fungus and a suitable substrate such as wood chips. White rot fungus has the ability to degrade a number of pollutants in soil and sediment, including the predominant conventional explosives, DDT (dichlorodiphenyltrichloroethane), poly nuclear aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs).

The use of genetic engineering to create organisms specifically designed for bio-remediation has great potential. The bacteria *(Deinococcus radiodurans)* have been tested to consume ionic mercury from highly radioactive nuclear waste. *Deinococcus radiodurans* is an extremophilic bacterium, one of the most radio resistant organisms known. It can survive under cold, dehydration, vacuum and acid.

The major environmental concern in modern urbanizing country like ours is related to access to safe water due to poor waste disposal, inadequate sewerage and drainage and improper disposal of industrial effluents. Sewerage water of many cities where industrial waste is mixed in the sewerage system adds up to toxic metals. This warrants the potential hazard to soil and plant health suggesting necessity of their safe use after pretreatment to safe guard soil health and reduces the risk of animal and human health hazards.

Heat Pump Dryer- An Application in Food Industries

Article ID: 11575

V. P. Sangani[1], P. R. Davara[1]
[1]Assistant Professor, Dept. of Processing and Food Engineering, College of Agril. Engg. & Technology, Junagadh Agricultural University, Junagadh – 362001.

Introduction

Heat pump dryer is the most recent innovation technology in drying of materials at low temperature and in an oxygen-free atmosphere. It adds a second heat exchanger i.e., evaporator that cools the heated air, allowing a greater separation of moisture and air and again, recirculates the hot air.

The heat pump works on the principle of refrigeration system that cools an air stream and condenses the vapour contained in it. Heat pump assisted drying provides a controllable drying environment (temperature and humidity) for better products quality consuming less energy.

The different heat sources are available for drying. However, due to the increasing prices of fossil fuel and electricity and the production of CO_2 in conventional drying methods, it is important to save green energy and other heat recovery methods for drying of agricultural produce. Heat pump drying has been successfully used for drying of agricultural products and for other domestic dehumidification/heating applications.

The economic consideration, environmental changes and product quality parameters are the main goal of drying process research in food industry (Okos et al. 1992).

Working Operation of Heat Pump

There are many possible methods of applying heat pump drying. According to Mujumdar and Jangam (2011) these possibilities include varying the following: mode of operation, HPD cycle, drying media, supplementary heating, heat pump dryer operation, number of heat pump stages, and temperature for drying.

The heat pump system consists of an expansion valve, evaporator, condenser and a compressor, which are connected by using copper tubes. Heat pump dryer consists of a refrigeration cycle which recovers heat from dryer exit air and reheats it to the required temperature before it enters back into the dryer.

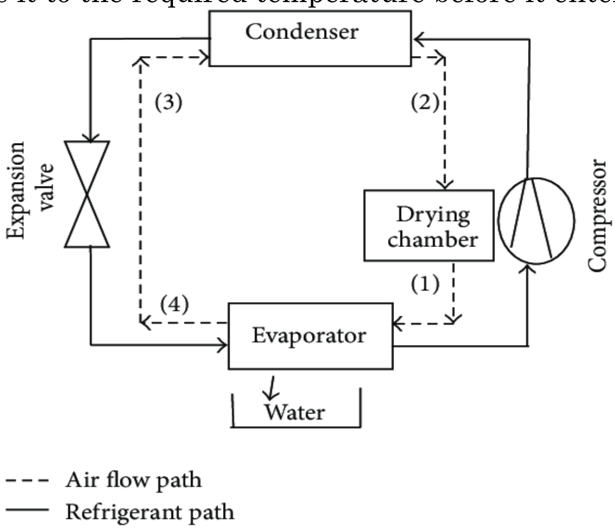


Fig.1: Working of Heat pump dryer

The work cycle starts with the air being heated at the condenser after being blown towards the product (From 3 to 2 in Fig.1). When the warm air passes through the product, it removes moisture from the material. Downstream, the air captured the moisture from the food (From 2 to 1 in Fig. 1) and proceeds to the evaporator, to partially condense some of its vapour. This (From 1 to 4 in Fig. 1) is achieved by promoting the heat transfer of the air with the surfaces of the evaporator colder than the dew-point of the air. For a real machine, a percentage of outside air replaces with part of the circulating air at each pass to allow the cooling section to condense more moisture from the air and to avoid the increase in circulating air temperature.

Advantages of Heat Pump Drying

1. High energy efficiency (reduced energy consumption).
2. Controlled temperature profile to meet product requirements.
3. More environmentally friendly.
4. Consistent output of products.
5. A wide range of drying conditions (from -20 °C to 80 °C).
6. Better product quality.
7. Business opportunities for both farmers and industry.

Limitations of Heat Pump Dryer

1. Higher initial costs.
2. Refrigerant leakage.
3. The compressor, condensers, evaporator and refrigerant filters required regular maintenance to keep the dryers operating efficiently.

Application of Heat Pump Drying

Any dryer that uses convection as the primary mode of heat input can be fitted with a suitably designed heat pump, but dryers that require large amounts of drying air, for example, flash or spray dryers, are not suited for HP operation (Islam and Mujumdar , 2008).

Heat pump drying technology has been combined with other drying techniques to overcome some problems encountered in those techniques and to achieve improved product quality, reduced energy consumption, high coefficient of performance, and high thermal efficiency (Jangam and Mujumda, 2011).

Heat pump assisted drying include heat pump assisted solar drying, microwave drying, infrared drying, fluidized bed drying, radiofrequency drying, and chemical heat pump assisted drying (Islam and Mujumdar, 2008, Patel and Kar, 2012).

This dryer particularly used for heat sensitive materials like fruits and vegetables that required only low temperature. For example, combining Heat pump dryer with solar drying enhances the drying rate and reduces cost. A heat pump is attractive because it can be delivered more energy as heat than the consumption of electrical energy. Also, it can use modified atmospheres to dry sensitive food materials like fruits and vegetables.

Comparison of Heat Pump Drying with Vacuum and Hot Air Drying

Item	HPD drying	Hot-air drying	Vacuum drying
SMER (kg water / W h)	1.0-4.0	0.12-1.3	0.7-1.2
Operating temperature range (°C)	10 - 65	40- 90	30-60
Operating % RH range	10-65	Varies depending on temperature	low
Drying efficiency (%)	Up to 95	35-40	Up to 70
Drying rate	Faster	Average	Very slow
Capital cost	moderate	low	high
Running cost	low	high	Very high
control	Very good	moderate	good

Source: Perera, and Rahman (1997)

Conclusion

Heat pump drying systems are appropriate for the drying of heat-sensitive products. Also, the quality of heat pump dried products is superior to those of conventional drying systems. Heat pump dryer combination with solar drying enhances the drying rate and reduces cost of drying.

References

1. Islam, M. R and Mujumdar, A. S. (2008) "Heat pump-assisted drying," in Drying Technologies in Food Processing, Blackwell Publishing, Oxford, UK pp.190–224,
2. Jangam, S. V. and Mujumdar, A. S. (2010) "Classification and selection of dryers for foods," in Drying of Foods, Vegetables and Fruits, Singapore, 1: 59–82.
3. Jangam, S. V. and Mujumdar, A. S. (2011) "Heat pump assisted drying technology—overview with focus on energy, environment and product quality," in Modern Drying Technology: Energy Savings, Wiley-VCH, 4:121–162.
4. Mujumdar, A. S. and Jangam, S. V. (2011) "Energy issues and use of renewable source of energy for drying of foods," in Proceedings of the International Workshop on Drying of Food and Biomaterials, Bangkok, Thailand,
5. Okos, M.R., Narsimhan, G, Singh, R.K. and Weitnauer, A.C. (1992) Food dehydration. Handbook of food engineering. New York: Marcel Dekker; pp. 437–562.
6. Perera, C.O. and Rahman, M.S. (1997) Heat pump dehumidifier drying of food. Trends Food Science Technology. 8(3):75–79.
7. Patel, K. K. and Kar, A. (2012)"Heat pump assisted drying of agricultural produce—an overview," Journal of Food Science and Technology, 49(2): 142–160.

Seed Treatment Techniques in Organic Farming

Article ID: 11576

G. Senthil Kumar[1]
[1]Assistant Professor (Agronomy), Department of Rice, Tamil Nadu Agricultural University, Coimbatore – 641 003, Tamil Nadu, India.

Seed Treatment

It is the process of treating the seeds with organic materials to augment the germination, to make it free from pest and diseases; to harden the seeds to withstand drought. Seed borne infestation of insects and diseases pose devastating consequences to crop production.

The concept of seed treatment is the use and application of biological agents that basically can control or contain primary soil and seed borne infestation. This helps to improve crop safety, which in turn leads to good establishment of healthy and vigorous plants thus results in better yield. Treating seeds with micro-organisms also enhances the nutrient availability in soil by fixing or solubilizing in various crops.

The benefit of seed treatment leads to increased germination and ensures uniform seedling emergence. Seed treatment break seed dormancy, induce drought tolerance and augment germination. Seed treatment also gives protection to the emerged seedlings from sucking insect pests.

Seed Treatment Techniques

Smear all types of seeds with a paste of ash and water and dry it under the sun before sowing. This will control the seed borne diseases and enhance seed vigour and germination percentage. Treat the seeds with butter milk (125 ml / kg of seeds) to prevent fungal diseases in crops.

Mix the seeds of cereals, legumes and cotton in cactus *(Euphorbia neriifolia)* milk solution (100 ml in 1 litre of water) and dry in darkness for 8 hours before sowing. This will enhance the protection from stem borer larvae, termites and other pests.

Seed Treatment Techniques in Paddy

Seed treatment with bio fertilizers: Five packets (1kg/ha) each of *Azospirillum* and *Phosphobacteria* or five packets (1kg/ha) of Azophos bioinoculants are mixed with sufficient water wherein the seeds are soaked overnight before sowing in the nursery bed. The bacterial suspension after decanting may be poured over the nursery area itself.

Seed treatment for improved germination and healthy seedlings: Dry seeds in bright sun light (between 12.00 p.m. to 1.00 p.m.) for half an hour before sowing to improve the germination and seedling vigour. Soak the paddy seeds along with a gunny bag in water for 12 hours and then soak in biogas slurry for 12 hours before sowing. Soak paddy seeds in *Panchagavya* (35 ml per litre of water) for 30 hours before sowing.

Seed treatment for the prevention of pest and disease attack: Soak seeds in water for 12 hours and then mix it with 10% cow's urine (10 ml cow's urine + 90 ml water) or 5% *prosophis kashaayam* (5 ml *kashaayam* + 95 ml water) and dry it for 30 minutes. Use the seeds for sowing within 24 hours. This will enhance the resistance of the paddy against bacterial leaf blight disease. Soak paddy seeds tied into small bundles using kada cloth in cow's urine solution (500 ml of cow's urine with 2.5 litres of water) for 30 minutes and shade dry before sowing. This method of seed treatment prevents the crop from seed borne fungal and bacterial diseases.

Seed treatment techniques for Pulses: Treat the seeds with talc formulation of *Trichoderma viride* @ 4g/kg of seed (or) *Pseudomonas fluorescens* @ 10 g/kg seed. Bio control agents treated seeds should be again treated with bacterial culture after 24 hours. Treat the seeds required for sowing 1 ha with Rhizobial culture CRR 6 / CPR 9, phosphobacteria *(Bacillus megaterium)* and PGPR (*Pseudomonas* sp.) developed at TNAU, with one packet each (200g). For red lateritic soil, Rhizobial culture VPR 1 is effective.

Chickpea

Soak seeds in water before sowing to enhance the germination percentage of the seeds. Smear seeds (1 kg) with a mixture of turmeric and sweet flag powder (50 gms turmeric powder and 15 gms sweet flag powder with 10 ml of water) and sow after 10 minutes. This will enhance the disease resistance of the crop.

Bengalgram

Mix seeds with well fermented (sour) butter milk and shade dry before sowing. The acidic nature of the butter milk reduces the incidence of wilt and dry root rot diseases.

Greengram

Take the seeds in a plastic tray and add a small quantity of adhesive (10% maida solution) to the seeds. Shake this gently to enable the seeds to spread evenly on all parts of each of the seed. Add *Arappu* powder *(Albizia amara)* as filler material evenly over the seeds and continue shaking until the uniform coating is ensured. Remove the seed clumps manually and also the excess filler material by sieving. Shade dries it before sowing. This process helps to handle small and irregular shape seeds. It also enables precision sowing of seeds and physiological characters of seeds are strengthened.

Millets

Treat the seeds with three packets (600g) of the *Azospirillum* inoculant and 3 packets (600g) of *phosphobacteria* or 6 packets (1200g) of *Azophos*.

Maize/ Pearl Millet / Finger Millet

Soak seeds in 2% *Panchagavya* (20 ml of *Panchagavya* in 980 ml of water) for 2 hours before sowing for the production of healthy seedlings.

Sorghum (Jowar)

Treat the seeds with asafoetida solution (75 - 100 gms in 1 litre of water) and shade dry before sowing. This seed treatment method prevents ergot disease in sorghum. Mix the seeds with the extract *of Ashwagandha* and *Datura* (for 1 kg seeds, pound 250 gms of *Ashwagandha / Amukura (Withania somnifera)* roots and 50 gms *of Datura / Oomathai (Datura metel)* leaves by adding water and shade dry before sowing. This will help in the production of healthy and disease-free seedlings.

Seed Treatment Techniques for Oilseeds

Treat the seeds with *Trichoderma viride* (4 gms/kg of seeds) or *Pseudomonas fluorescens* (10 gms/kg of seeds) and sow after 24 hours. In ground nut treat the seeds with 3 packets (600 g)/ha of Rhizobial culture TNAU14 + 3 packets of Azospirillum (600 g/ha) and 3 packets (600 g/ha) of Phosphobacteria or 6 packets of Azophos (1200 g/ha) developed at TNAU using rice kanji as binder. If the seed treatment is not carried out apply 10 packets of Rhizobium (2000g/ha) + 10 packets of Azospirillum (2000 g/ha) and 10 packets (2000 g) of Phosphobacteria with 25 kg of FYM and 25 kg of soil before sowing.

Groundnut

In Groundnut, the pre germinated seeds are used for sowing to get good yield by maintaining optimum plant population in the field. Soak the seeds tied in a gunny bag in water for 4 - 6 hours. Then untie the gunny bag and cover it with another wet gunny bag for 12 - 14 hours. Shade dries the germinated seeds for 3 - 4 hours and treat with Rhizobium (@ 600 gms / 110 - 120 kg of seeds) and sow within 1 or 2 days. Soak the seeds in Jeevamirtham / Amirthakaraisal / Panchagavya for 4-6 hours and shade dry before sowing.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Vertical Farming: The Future of Agriculture

Article ID: 11577

Nitesh Kumar Tanwar[1], Lokesh Kumar[1]
[1]Ph.D. Scholar, Department of Extension Education, Rajasthan College of Agriculture, Udaipur.

Introduction

By 2050, the world's population is expected to grow to 9.7 billion people, and feeding them will be a major challenge. We are all aware of the growing population and its negative effects. The time is not far off when the Earth will see a clear reduction of arable land and wish for food demand due to the land crisis and the increase in space. Urban sprawl is particularly evident in India's cities, which are experiencing a massive influx of migrant-seeking rural settlers. The UN estimates that by the year 2050, about 70% of the world's population will live in urban areas and that the world's population will increase by 3 billion. Is vertical farming being the solution of all these problems? Let's check it.

What is Vertical Farming?

Vertical farming is the practice of producing food on vertically inclined surfaces. Instead of farming vegetables and other foods on a single level, such as in a field or a greenhouse, this method produces foods in vertically stacked layers commonly integrated into other structures like a skyscraper, shipping container or repurposed warehouse, whereby plants, animals, fungi and other life forms are cultivated and used for food, fiber and fuel by using artificially stacking them vertically above each other.

In India Vertical Farming has been introduced in 2019. ICAR is working on techniques and adaptations to introduce in the market. However, it has still not found its application at wider level. The concept of vertical farming was proposed in 1999 by Dickson Despommier, a professor of Public and Environmental Health at Columbia University.

The most special feature of Vertical Farming is that its goal is to provide optimal growing conditions throughout the development of the plants, conditions that are almost optimal for each individual plant. The closed environment gives protection from outdoor influences and gives more ways to control the many uncertainties that cannot be controlled when growing crops outdoor. Modern vertical farming facilities can regulate lighting, humidity, temperature and nutrients with sophisticated sensors and climate control systems.

The main aims of the verticals farming are to optimize the plant growth and soilless farming techniques such as hydroponics, aquaponics and aeroponics. Some common choices of structures to house vertical farming systems include buildings, shipping containers, tunnels, and abandoned my shafts. Instead of farming vegetables and other foods on a single level, such as in a field or a greenhouse, this method produces foods in vertically stacked layers commonly integrated into other structures like a skyscraper.

Techniques of Vertical Farming

1. Hydroponics: This is the technique of growing crop plants without soil. In this system, the roots of the crop plants are submerged in the nutrient solutions that contains macronutrients as well as micro nutrients in trace amount. Some other materials are also used to provide support for the roots of the plants. The nutrient solution is supplied and recycled frequently at prescheduled time by electric pumping system to maintain nutrient level in running liquid solution. This technique is widely used in high-tech research-based organizations. It insures the produce free from diseases, insect pests or other weed plants.

2. Aquaponics: The term aquaponics is made of two words: aquaculture, which refers to fish farming and hydroponics- growing technique of crop plants without soil. It means growing of plants and aquatic organisms (fish) in the same ecosystem. Although aquaponics is used in smaller-scale vertical farming systems, most commercial vertical farm systems focus on producing only a few fast-growing vegetable crops and don't include an aquaponics component.

3. Aeroponics: Aeroponics does not require any solid or liquid medium for growing of the plants, while, a nutrients rich liquid solution misted in an air chambers where plant roots are suspended. Aeroponics is the most sustainable technique uses up to 90% less water than the other vertical farming techniques. There is no requirement of growing medium replacement. It is an energy saving system saves energy as gravity force drains away the excess water.

Advantages of Vertical Farming

1. Preparation for future: By 2050, around 68% of the world population is expected to live in urban areas, and the growing population will lead to an increased demand for food. The efficient use of vertical farming may perhaps play a significant role in preparing for such a challenge.

2. Increased and year-round crop production: Vertical farming allows us to produce more crops from the same square footage of growing area. In fact, 1 acre of an indoor area offers equivalent production to at least 4-6 acres of outdoor capacity. According to an independent estimate, a 30-story building with a basal area of 5 acres can potentially produce an equivalent of 2,400 acres of conventional horizontal farming.

3. Less use of water in cultivation: Vertical farming allows us to produce crops with 70% to 95% less water than required for normal cultivation.

4. Not affected by unfavorable weather conditions: Crops in a field can be adversely affected by natural calamities such as torrential rains, cyclones, flooding or severe droughts events which are becoming increasingly common as a result of global warming. Indoor vertical farms are less likely to feel the brunt of the unfavorable weather, providing greater certainty of harvest output throughout the year.

5. Increased production of organic crops: As crops are produced in a well-controlled indoor environment without the use of chemical pesticides, vertical farming allows us to grow pesticide-free and organic crops.

6. Human and environmentally friendly: Indoor vertical farming can significantly lessen the occupational hazards associated with traditional farming. Farmers are not exposed to hazards related to heavy farming equipment, diseases like malaria, poisonous chemicals and so on. As it does not disturb animals and trees inland areas, it is good for biodiversity as well.

Disadvantages of Vertical Farming

1. No established economics: The financial feasibility of this new farming method remains uncertain. The financial situation is changing, however, as the industry matures and technologies improve.

2. Difficulties with pollination: Vertical farming takes place in a controlled environment without the presence of insects. As such, the pollination process needs to be done manually, which will be labor intensive and costly.

3. Labor costs: As high as energy costs are in vertical farming, labor costs can be even higher due to their concentration in urban centers where wages are higher, as well as the need for more skilled labor. Automation in vertical farms, however, may lead to the need for fewer workers. Manual pollination may become one of the more labor-intensive functions in vertical farms.

4. Too much dependency on technology: The development of better technologies can always increase efficiency and lessen costs. But the entire vertical farming is extremely dependent on various technologies for lighting, maintaining temperature, and humidity. Losing power for just a single day can prove very costly for a vertical farm. Many believe the technologies in use today are not ready for mass adoption.

Challenges of Vertical Farming

1. Challenges of lighting: Over two-thirds of the global energy is consumed in cities. A critical point and disadvantage often highlighted by the adversaries of VF is, how will plants growing inside a building be provided with sufficient amount of energy needed for plant growth. The system makes use of both natural light as well as artificial light as the main source of energy within the building for photosynthesis as well as the structure of plants. Since vertical farms within buildings have less access to natural light, there is a need for artificial lighting which is often provided by LEDs, which is comparable to greenhouse farming.

2. Challenges of Heating: An issue closely linked to lighting is, the temperature it produces. More than the brightness, lighting devices produce heat, which especially in summer would disrupt or interfere with the air conditioning system. Two other crucial requirements for healthy plant growth indoors, are humidity as well as air conditioning which require meticulous control and monitoring and involves high energy costs. Still another major prerequisite and cost is in the building of the towers.

3. Challenges of Water Demand: It is estimated that approximately, 3000 liters/person/day of water is regularly used just for producing food. Out of the total water consumption of human beings, 24-30 % of it is used for watering and producing rice. The fluid provision system needs to be standardized both in the growing floors as well as the others, exactly like an industrial unit.

4. Challenges of Food Nutrition: Foods are rich in vitamins, proteins and minerals are increasingly in demand nowadays, as more countries are moving towards the trend of their developed counterparts.

Conclusion

Vertical farming technologies are still relatively new. Companies are yet to successfully produce crops at scale and make it economically feasible to meet the growing food demand. The performance of farms like Aero Farms will determine how important a role vertical farming will play in the future to face the challenge of growing food demand. It is worth noting, however, that technologies developed for vertical farms are also being adopted by other segments of the indoor farming sector, such as greenhouses, which can utilize natural sunlight, albeit requiring much more real estate and longer routes to market.

References

1. Birkby, J. (2016). Vertical Farming. ATTRA Sustainable Agriculture Program. Retrieved October 28, 2019. (https://attra.ncat.org/attra-pub/download.php?id=512)
2. Despommier, D. D. (2011). The vertical farm: feeding the world in the 21st century. Picador. ISBN 9780312610692. OCLC 827058703. (https://www.worldcat.org/oclc/827058703)
3. Resh, H. M. (2016). Hydroponic food production: a definitive guidebook for the advanced home-gardener and the commercial hydroponic grower (Seventh ed.). Boca Raton, FL. ISBN 9781439878699.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Recycling of Kitchen Waste for a Healthy Environment

Article ID: 11578

Dr. Y. Jamuna Devi[1], Dr. Y. Prabhabati Devi[2]
[1]Zoology Department, Standard College, Kongba, Imphal East, Manipur.
[2]ICAR-KVK, Chandel, ICAR-RC for NEH Region, Manipur Centre.

Introduction

Every day we throw away kitchen waste such as banana peels, potato peels, carrot stems and leftover vegetable foods which pollute the environment. Kitchen wastes are full of nutrients but they usually end up in landfills so they do not get reused. The most practical way to combat this problem is to compost vegetables and other food matter and use the rich compound which is formed to boost the flower or garden plot soil. This is a simple recycling effort which pays off in the form of better garden harvest. These methods are of great green initiatives that have large environmental benefits. Therefore, recycling of kitchen waste is a simple way to help save money and to ensure a healthier and more manageable garden that also happens to be good for the environment. Natural way of recycling is the biological process of breaking up of organic waste such as food waste manure, leaves, grass, etc. into extremely useful humus like substances by various microorganisms including bacteria and fungi in the presence of oxygen. Therefore, the use of composting to turn organic waste into a valuable resource is expanding rapidly in many countries as landfill spaces. The main reason behind this rapid expansion is the ability of composting to turn kitchen waste which is full of nutrients into organic manure in the yard to boost flowers or home garden plot soil. It also ensures a greater and greener environment and is also beneficial to plants and gardens at home. Kitchen waste is defined as the leftover organic matter from the households, restaurants and hotels. Kitchen waste is a nutrient rich or eutrophic environment containing high levels of carbohydrates, proteins, lipids and other organic molecules which can support abundant population. Kitchen waste is usually acidic due to the presence of bacteria such as lactic acid bacteria. In every kitchen there is waste that must be recycled, waste that can be hazardous and waste that must be stored in a certain way to maintain the environment in a eco-friendly way. Recycling is necessary to reduce wastes in homes and workplaces. Composting is one of the easiest methods to convert otherwise useless food waste into organic compounds which makes the fertility of the soil increase. Since it requires little time, effort or space depending on which system we use, it is one of the most popular and widely used method. One of its plus point is that it turns any type of kitchen waste into organic compounds. Most of the kitchen waste such as uncooked vegetable, banana peels, potato peels, and carrot stems can pollute the environment. Kitchens produce a lot of waste which is full of nutrients and composting is the most sustainable option for managing such type of organic waste. Composting food waste and other acceptable organic waste at a licensed composting facility produces a beneficial product. The compost is valuable for the soil of our garden or potted plants. It is a complete natural food for the soil, helping to improve its structure, water relating activities and overall health. Recycling of kitchen waste also helps in reducing the total amount of waste that a person generates.

Objectives of Recycling

1. To raise the personal and public awareness of environment issues including the benefit of reducing, reusing and recycling of materials that otherwise be sent to landfill sites.
2. To increase the number of students involves in recycling.
3. To protect the environment and for the health and safety of the population.
4. To save energy.

How to Recycle Kitchen Waste at Home

1. Use a 5-lt. capacity container for food scrapes and ingredients for your compost.
2. Fill the food container.
3. Once the container is full get it outside.
4. Separate on the garden.
5. Organise the materials in layers with soil.

6. After some days it is converted as organic manure.

We should not add plastic products, wooden products, dog or cat litters, cardboard products, medicines, liquid, oils and fats.

Composting Process

Three types of organisms are involved in the process of composting. They are:
1. Fungi.
2. Bacteria.
3. Actinomycetes.

The process of composting commences when all these three types of organisms begin to grow all over the material and breakdown the waste. This produces heat further increasing the activity of the bacteria. Composting kitchen waste can take a week or even a month time.

Benefits of Recycling of Kitchen Waste

1. Turning waste into a value-added resource by providing valuable footstock for the regions.
2. Extending the life of the region's only landfill.
3. Producing valuable products such as compost and fertilizer that enhances soil and aids in plant growth.
4. Preventing greenhouse emissions and leachate caused by decomposing organic landfill waste.
5. Improves your garden health.

Future Aspects

1. To increase the knowledge of environmental conservation and protection.
2. To increase the knowledge of global warming mitigation.
3. Limit waste in landfill area.

Conclusion

Kitchen waste management is simple to implement and could save your business time, money and resources whilst also benefitting the environment from eco-friendly recycling. It is an easy way for us as individuals to reduce waste and have a positive environmental impact in our communities. Kitchen waste is considered mostly green. When composted, it turns into a value-added resource which enhances the fertility of the soil in a sustainable way which is healthy to the environment. It also prevents the greenhouse emission to the environment which helps tremendously in reducing a person's carbon footprint.

References

1. Domestic recycling of Kitchen wastes an additional health hazards for households.
2. Journal of public health, volume 29,(1) March 2007, 95-96.
3. Food waste composting Institutional and industrial application.
4. Extension Publication Bulletin, 1189 University of Georgia extension.
5. Transforming of food waste making something out of rubbish.
6. Australian Academy of Science.
7. Current situation and development of Kitchen waste treatment in China.
8. Yangyang Li, Yoying Jin et.al Science direct, Elsevier volume (31) 2016, 40-49.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Use of Bioinformatics Approaches in Agriculture

Article ID: 11579

Ashish Kumar[1], Rashmi Bhumarkar[2], Gaurav Mahajan[2], Sharad Bisen[3]
[1]College of Agriculture, JNKVV, Jabalpur, M.P., 482 004, India.
[2]AICRP on Maize, Zonal Agriculture Research Station, JNKVV, Chhindwara, M.P., 482 001, India.
[3]College of Agriculture, Balaghat, JNKVV, Jabalpur, M.P. 482 001, India.

Omics, bioinformatics and computational approaches are indispensable tools to unravel genomics and the molecular systems which lie beneath several plant functions. Advances in technology have emerged out new omic layers in the context of genome analysis, hormonome, metabalome, interactome, and epigenome. In ancient time the biological research was mainly focused on laboratory/field experiments only. However, the present era of scientific research, revolutionized the data interpretation and inference by utilizing the complex alogorithms, computational analysis under in-silco conditions.

Bioinformatics tools are playing pivotal role in elucidating the information about different genes present in the genome of an organism. Prediction of functions of different genes and factors affecting their expression was only made possible using the computational in-silco analysis using bioinformatics software. The gene level information made it possible for scientist to utilize these sequence data for developing different varieties resistant to abiotic and biotic stresses with improved yield, quality and other attributes contributing towards the varietal improvement.

Sequence Database: Gene and Genome

A biological sequence is primary biological system object at the molecular level like DNA, RNA, and protein. Recent approaches of sequencing technology have revolutionized the gene/genome sequencing not only with high throughput data generation, but also with its much-reduced rates. The core matrix of bioinformatics system lies in DNA sequence data and several tools have been designed for the maintenance, annotation and interrogation of sequence information. The largest of the DNA sequence repositories is the International Nucleotide Sequence Database Collaboration (INSDC; http://www.insdc.org)), made up of joint efforts of the DNA Data Bank of Japan (DDBJ) at the National Institute for Genetics in Mishima, Japan, GenBank at the National Center of Biotechnology Information (NCBI) (NCBI; http://www.ncbi.nlm.nih.gov/genbank/) in Bethesda, MD, USA, and the European Molecular Biology Laboratory (EMBL) Nucleotide Sequence Database at European Bioinformatics Institute (EMBL-EBI; http://www.ebi.ac.uk/ena) in Hinxton, UK.

Sequence Analysis Tools

Basic Local Alignment Search Tool (BLAST) is one of the most popular software for performing database search by using either nucleic acids or protein sequences as a query. It can be freely obtained from NCBI (National Centre for Biotechnology Information) to search GenBank Database on the world wide web (http://www.ncbi.nlm.nih.gov/BLAST). Based on the type of query sequence whether it is protein or DNA, a specific program is selected for performing BLAST search.

The Basic Local Alignment Search Tool (BLAST) finds regions of local similarity between sequences. The program compares nucleotide or protein sequences to sequence databases and calculates the statistical significance of matches. BLAST can be used to identify functional and evolutionary relationships between sequences as well as help in identification of members of gene families (NCBI). BLAST search can be easily performed on NCBI website from the web address: http://www.ncbi.nlm.nih.gov/. Various BLAST options are available on this home page. One can perform BLAST against the full genome sequences of human, mouse, rat, Arabidopsis thaliana, Oryza sativa etc. Besides, one can also perform specialized BLAST against different databases.

For performing BLAST, one of the important steps is to select appropriate database against which the query sequence has to be searched for possible matches. One can make species specific BLAST search by selecting the database from a drop-down box. Different types of databases are available in the GenBank. A variety of tools/software are now available for different purposes like multiple sequence alignment (MSA), phylogenetic analysis, Genetic map constructions, quantitative trait loci identification etc.

Computational Analysis of Molecular Data

The molecular data obtained on the gels or autoradiographs is in the form of banding patterns. These bands are of different molecular weight sizes. Based on the size and migration of bands on a gel, the data recorded in the form of statistical values. The presence '1'or absence '0' of a band of a particular molecular weight is scored as two alleles at a single locus. This data is used to construct a binary matrix on an excel sheet. The DNA marker data are analyzed on the basis of similarity co-efficient (F) of strains x and y and calculated according to the relation given by Nei and Li, 1979.

$$F=2Nxy/(Nx+Ny)$$

Where, Nx and Ny are number of RAPD/RFLP bands obtained from strains x and y, respectively and Nxy is the number of bands shared by the two strains. Various DNA data analysis softwares are now available for phylogeny studies (www:ucmp.Berkeley.edu./ subway/ phylo/phylosoft) and commonly used in population studies of fungi

NTSYS-pc is a collection of programs developed by Rohlf (1992) that is used to find and display structure in multivariate data. NTSYS (Numerical Taxonomy and multivariate analysis System) can perform many types of analysis.

With plant genes evolutionarily conserved, the science of bioinformatics in agriculture has caught interest with myriad of applications taken from bench side to in silico studies. Bioinformatics plays an essential role in today's plant breeding with regards to the development of new plant diagnostic tools. Bioinformatics helps scientists to apply different tools and technology to facilitate and analyse the research work. This would allow us to identify candidate genes and understand the molecular basis/phenotypic variation of traits. Application of various bioinformatics tools in biological research enables storage, retrieval, analysis, annotation and visualization of results and promotes better understanding of biological system in fullness.

Role of MGNREGA in Rural Employment after the Outbreak of Covid-19

Article ID: 11580

Nitin Saratkar[1], Dr. Deepak Kher[2], Mamta Vyas[3]
[1]Assistant Professor, [2]Director, [3]Assistant professor Faculty of Agric. Sciences, Department of Agriculture, Mandsaur University, Mandasaur (M.P), 458001.

Introduction

MGNREGA being a public works programme, has the capability to effectively harness the productive power of rural unemployed towards their socio-economic development.

It is also capable of not only supplementing the income of jobseekers; the whole process would actually roll out an excellent social security and insurance mechanism by stabilizing employment during off-peak agriculture season in the rural areas.

The covid-19 or corona virus pandemic and prolonged lockdown economic activities have caused health and income security amongst the socio-economically weak and vulnerable, especially the migrants, the daily wage earners and the casual labours.

Considering the intensity of this unusual situation on livlihoods of millons of citizens, Indian PM gave a ringing call for initiation of the Atmnirbhar Bharat [Self-reliant India movement] on May 12, 2020.

Since poverty alleviation and employment generation have been the major objectives in India from 1950s, the government rested its renewed focus on reviving rural economic growth through broadening wage employment opportunities to jobseekers.

Rural Employment and MGNREGA

Farm risk and uncertainties population pressure on the cultivable land, lake of other occupational choices, rural –urban income differentials and rising rural economic distress had, earlier promoted massive rural urban migration in india. But the nation with a migrant workforce of more than 423 million [census 2011 GOI] in cities and metros from states other than the origin is now witnessing unrelenting reverse migration due to covid-19 impact. It is important to ensure adequate livelihoods through broadened occupational choice to the millions of workforces of the countryside. The permanent concern on productive absorption of rural surplus workforce besides building quality and productive community assets and enterprises, had pressed for enactment of demand driven wage guarantee programme. MGNREGA in Sep. 2005.

MGNREGA is the largest work guarantee programme in the world with the primary objective of guarantee 100 days of wage employment per year to rural households. The programme emphasizes on strengthening the process of decentralization by giving a significant role to Panchayti Raj Institutions in planning and implementing these works.

MGNREGA Role in Self-Reliant Rural India

MGNREGA being a public works programme, has the capability to effectively harness the productive power of rural unemployed towards their socio-economic development. It is also capable not only supplementing the income of jobseekers; the whole process would actually roll out an excellent social security and insurance mechanism by stabilising employment during the off-peak agriculture seasons in the rural areas.

Considering its employment generation potential and productive absorption capacity of surplus workforce during and after pandemic the government revised its earlier earmarked allocation to RS 1,01,500 crore for 2020-21 by additionally allocating Rs 60,000 crore under the package of Atamnirbhar Bharat.

MGNREGA: The Game Changer

Low level of education and limited skills –set of the country's rural labour force have always impacted the labour productivity and the resultant income growth.

In this situation, MGNREA accords an opportunity to broaden the occupational choices and wage income for the willing less educated, unskilled-job seekers by tapping their productivity through execution of quality community asset crating projects.

MGNREGA has the capability to empower poor rural households to withstand economic shocks. It can manage and deal with situations to address effects of business cycles in a large rural economy like India. The recent pandemic has promoted national lockdown and has given an early signal of a prolonged depressed business-like environment.

MGNREGA can effectively give a stimulus to the rural economic activities via wage income disburses resulting in rising purchasing power of rural population. Increment in individual income in turn will transform into higher expenditure on food and essential items, thereby lubricating and stimulating a depressed economy in the post pandemic era.

However, the big challenge for the implementing states is now how to elevate the absorption capacity of implementing machineries without diluting the legal provision of Act.in this regarding states take must immediate to ensure social protection and productive absorption of surplus rural workforce.

Looking at degree and intensity of the on-going reverse migration the approved list of MGNREGA projects for 2020-21 may not be sufficient to meet the potential work demand in the post-Covid situation in rural areas. Hence on-going works must be assessed and an additional labour budget exercise initiated to ensure adequate block or Gram Panchayat wise additional shelf of projects along with their timely technical and financial approvals.

Effective implementation of public works programme depends upon largely how the community will participate in work from identification of works to their planning and well execution.

Contribution of MGNREGA During Covid-19 Pandemic

The nationwide lockdown which lasted more than two months resulted in millions of workers losing their jobs all over the country. Manual labours in urban and rural areas which worked in informal and casual employment were the worst hit an important feature of this casual workforce is that they originate from less developed rural locations to cities and urban mass as seasonal or circulatory migrants.

The two major saviour in the phase were agriculture and the MGNREGA agriculture provided work in harvesting and post-harvest activities of the rabi crops during month of April-May the over flow of workers in these activities however brought wage down.

As per revised guidelines of the lockdown MGNREGA work was allowed from April 2020 the number of households who got work in the same month was the lowest in several years at 95 lakhs once the work started the number went up to 3.05 crore in May. The scheme turned out to be the main livelihoods source of millions of migrant and other workers in rural India providing much needed daily wage and subsistence.

Until the end of the July when agriculture operations again picked up during the sowing of kharif crops, there was an unusual surge in MGNREGA beneficiaries. Data on the scheme portal show that up to 72% more households demanded work in July 2020 than in July 2019 in the same month and up to 66% more households demanded works in August this year in comparison to Aug. 2019.

Available data also suggest that many states recorded a sharp increase in demand for work under the scheme. Some even meeting annual quota of number of days within six months.

Shortcoming and Scope for the Improvement

When the person days generated during the months from May to August previous year stood much higher than last year of the similar period, there was also a demand and supply mismatch the scheme.

In June alone, while 4.1 crore households were in need of jobs under the scheme, work was supplied to only 2.8 corers households. Issues of it falling short of the demand remained from the supply side. Ground level reports and independent surveys reveal that finding work under MGNREGA was becoming difficult and households seeking from village panchyats acroos many states reported having no work under the scheme.

Given that a large section of the worker households has already spent their days of quota there is an urgent need to increase the cap of the 100 days to 200 by making additional resource available for this.

Unpaid wages in some states are another issue which need to be make good.

An employment scheme which has helped in curbing distress out migration in many states by making hundred days of work a legal claim at the source can be significantly add to assets creation and infrastructure development in rural areas if used innovatively and strategically. This can help creating sustainable livelihoods in these areas.

Given the current economic slowdown in most sectors of the economy wages earned by the workers by working under the scheme can help in reviving the manufacturing and service sectors as the demand and spending on consumption will increase.

This provides all the reasons to not only continue but also further nourish the scheme in the times to come.

Reference

1. K. K Tripathy and A.K Singla: MGNREGA- A Social Security Net, Kuruksherta A Journal on Rural Development, Vol. 68 No. 9.
2. Prof. Shamsher Singh, Assistant Professor – Sociology, Covid -19 pandemic and role of the rural employment guarantee scheme Flame University.

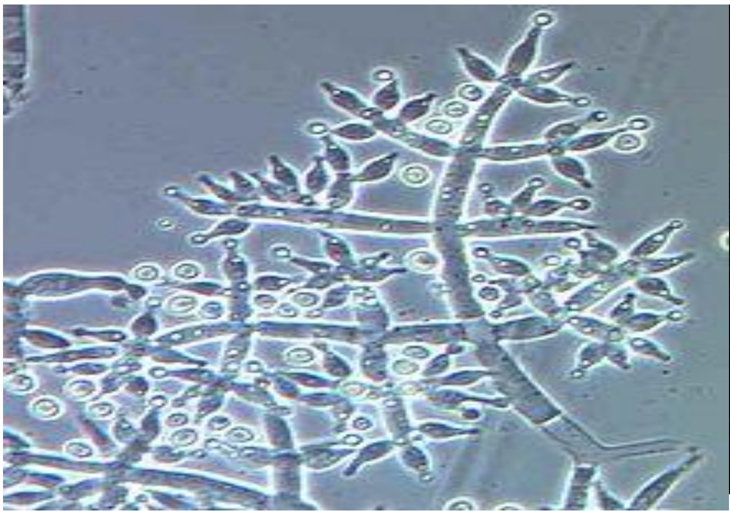
E-ISSN: 2581 - 8317

Trichoderma Spp. as a Biocontrol Agent

Article ID: 11581

Payal V. Kose[1]
[1]Ph.D scholar, Department of Plant Pathology, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola - 444 104 Maharashtra INDIA.

Introduction



Some of the most widely used biocontrol agents in the world belong to the fungal genus *Trichoderma*. *Trichoderma* spp. are found in almost all types of soils and diverse habitats and contribute to control of many soils borne plant diseases caused by fungi (Mishra *et al*. 2011).

Trichoderma is a ubiquitous, easy to isolate and cultured, grown rapidly on many substrates and affect wide range of pathogens. One of the popular species *Trichoderma viride* is effective against all soil borne fungal pathogen.

It has been exploited on about 87 different crops and about 70 soils borne and 18 foliar pathogens (Sharma *et. al*. 2014). More than 50% crop losses are due to soil inhabiting microorganisms, such as *Fusarium, Sclerotium, Rhizoctonia, Verticillium, Phytophthora, Pythium (*Elad *et al*.1982).

In particular isolates of *T. harzianum, T. viride* and *T. hamatum* are used against diseases in wide variety of economically important crops. They have been used with successes against soilborne, seedborne and phyllosphere diseases and against storage rots (Chet 1987, Papavizas1985.) Biological control of plant diseases appears to be an effective and ecofriendly approach being practiced world over.

Further biological control strategy has a major role to play as a component of integrated pest management (IPM). Large scale production, along with shelf life and establishment of bioagent in targeted niche, determine the success of biological control (Tewari and Bhanu 2004).

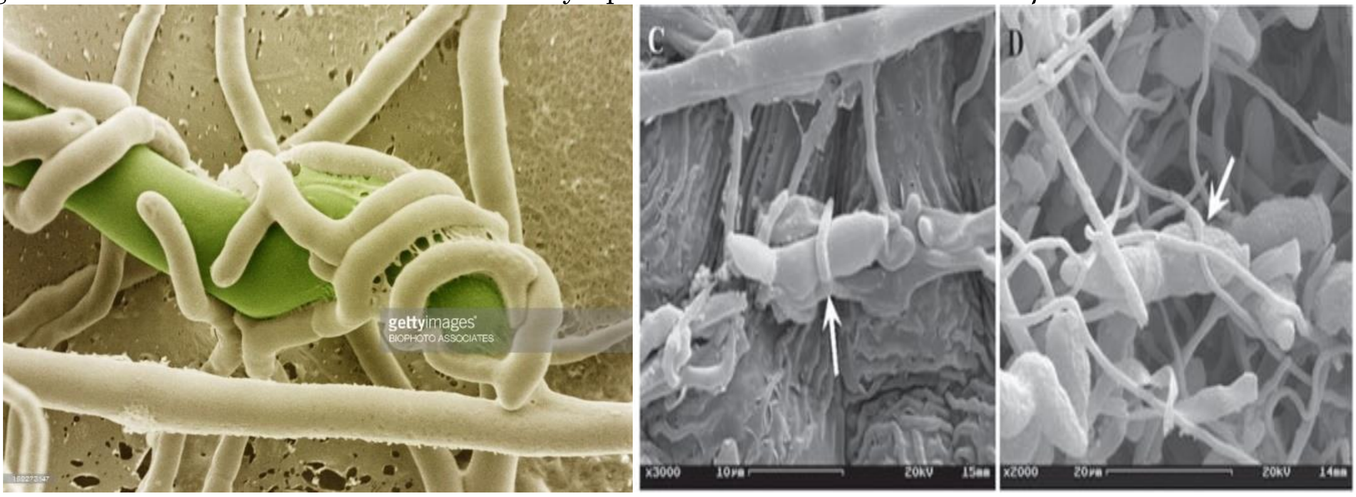
How Biological Control Agents Work?

The most common mechanisms for microbial antagonism of plant pathogens are parasitism, predation, competition, induced resistance and the production of antimicrobial substances. Often, several mechanisms act together.

1. Competition: It exists between organisms that require the same resource for growth and survival. Use of the resource by one organism reduces its availability for the other organism. Competition for space or nutrients usually takes place between closely related species.

2. Parasitism: Antagonist fungi parasitize other pathogenic fungi. Hyphae of Trichoderma either grow along the host hyphae or coil around it. Trichoderma coils around, penetrates, and kills other fungi that are pathogenic (i.e., cause disease) to crops. It can digest their cell walls.

E.g.: *T. harzianum* and *T. hamatum* were mycoparasite of both *Scelerotium rolfsii* and *R. solani*.



3. Antibiosis: It is the condition in which one or more metabolites excreted by an organism have harmful effect on one or more other organisms. In such antagonistic relationship spp. A produces a chemical substance that is harmful to Spp.

E.g: *Trichoderma* secreted - Trichodermin, viridine, Trichothecin, Sesqiterpine etc.

4. Plant growth promoter: *Trichoderma* strains solubilize phosphates and micronutrients. The application of Trichoderma strains in rhizosphere of plants increases the number of deep roots, thereby increasing the plants' ability to resist drought.

Taxonomic Position of *Trichoderma* Spp.

Position	Asexual stage (Conidia)	Sexual stage (Ascospore)
Kingdom	Fungi	Fungi
Phylum	Deuteromycota	Ascomycota
Sub-Division	Deuteromycotina	Ascomycotina
Class	Hyphomycetes	Pyrenomycetes
Order	Monilliales	Sphariales
Family	Monilliaceae	Hypocreaceae
Genus	*Trichoderma*	*Hypocrea*

Species

There are 89 species in the *Trichoderma* genus. *Hypocrea* are teleomorphs of *Trichoderma* which themselves have *Hypocrea* as anamorphs. (Samuels et al.,2006).

The most important Trichoderma species in industrial, medical and biocontrol uses include:
1. *Trichoderma hamatum.*
2. *Trichoderma harzianum.*
3. *Trichoderma koningii.*
4. *Trichoderma longibrachiatum.*
5. *Trichoderma reesei.*
6. *Trichoderma virens.*
7. *Trichoderma viride.*

Isolation, Identification and Quantification of *Trichoderma* Spp.

Fungal species *Trichoderma viride* was isolated from soil samples by using potato dextrose agar (PDA) medium. Samples were inoculated over plates by multiple tube dilution technique (MTDT) and the plates were incubated at 26˚C for 4 days.

The fungal colonies which were picked up and purified by streaking and incubated at 26˚C for 7-8 days. Green conidia forming fungal bodies were selected and microscopic observation was identified to be *Trichoderma viride*. The culture was maintained on PDA slants.

Treatments

1. Seed treatment:

Dose: 5 g /kg of seed or as prescribed on container.

Method: Make a paste or slurry adding 5 g in 10-20 ml of water or rice gruel. Pour 1 kg of seed on to the paste or slurry and mixed properly to coat the seeds uniformly. Shade dries the coated seeds for 20-30 minutes before sowing.


Trichoderma viride mixing with Talcum powder

2. Tuber/Rhizome/Cutting treatment:

Dose: As prescribed in the treatment / recommendation.

Method: Dip the tuber / rhizome/cuttings in the suspension prepare @ 10 g /litre of water. Shade dries for 15 minutes before planting.

3. Seedling Treatment:

Dose: 300 g. To treat seedling roots to cover one bigha.

Method: Prepare a suspension @ 5-10 g/litre of water. Dip the roots of seedling or 15 minutes and shade dry for 15 minutes before transplanting.

4. Nursery bed treatment:

Dose: 250 g for 400 sq.m nursery bed.

Method:

i. Prepare a suspension by adding 250 g in 50 litres of water and drench the nursery bed soil.

ii. Mixed 250 g in 2 kg cow dung / compost/FYM and spread over 400 sq.m. nursery bed and irrigate the bed.

5. Soil treatment:

a. Direct broadcasting:

Dose: 300 g for one bigha of land.

Method: Mix 300 g in 6 kg of FYM. Broadcast in one bigha of land and irrigate the field.

b. Awaited broadcasting:

Dose: 30 g for one bigha of land

Method: Mixed 30 g in 6 kg of FYM. Cover the mixture with polythene sheet for 7-15 days and broadcast in the field.

c. Furrow application:

Dose: Any one of E (i) or E(ii) as above.

Method: It is highly effective in root crops like potato, ginger, turmeric etc. and sugarcane. The mixture is applied in furrows at the time of earthing up or after 30 days of planting.

6. Foliar application:

Dose: 500 g/ha.

Method: Make a paste by adding 10 g in 15 ml water and then add the paste to 1.5 litre of water. Mixed properly before spraying on the plant parts.

Precautions

1. Don't use chemical fungicide after application of *Trichoderma* for 4-5 days.

2. Don't use *Trichoderma* in dry soil. Moisture is an essential factor for its growth and survivability.
3. Don't put the treated seeds in direct sun rays.
4. Don't keep the treated FYM for longer duration.

Compatibility

Trichoderma is compatible with Organic manure. *Trichoderma* is compatible with biofertilizers like *Rhizobium, Azospirillum, Bacillus Subtilis* and Phosphobacteria.

Trichoderma can be applied to seeds treated with metalaxyl or thiram but not mercurials. It can be mixed with chemical fungicides as tank mix.

Available Biopesticides in Markets

Organism	Trade Name	Target	Crops
Trichoderm harzianum Rifai strain KRL-AG2	Plant Shield® HC Biological Foliar and Root Fungicide	Fusarium, Pythium, and Rhizoctonia	Cucurbit vegetables, flowers, bedding plants, ornamentals, fruiting and leafy vegetables, Cole crops, hydroponic crops, pome fruits, shade house, outdoor nursery, stone fruit, and tree nuts
Trichoderma harzianum Rifai strain KRL-AG2	RootShield® Granules	Fusarium, Pythium, and Rhizoctonia	Flowers, bedding plants, ornamentals, fruiting vegetables, herbs and spices, hydroponic crops, leafy vegetables, cole crops, pome fruits, stone fruits, and tree nuts.
Trichoderma virens (Formerly *Gliocladium virens*)	SoilGard 12G3	*Pythium, Rhizoctonia*, and Root rots	row crops, alfalfa, hay and forage crops, bulb crops, cucurbits, fruiting vegetables, herbs, spices, leafy vegetables, cole crops, legumes.
Trichoderma harzianum Rifai strain KRL-AG2	T-22™ HC	Fusarium, Pythium, and Rhizoctonia	fruiting vegetables, herbs, spices, leafy vegetables, cole crops, legumes, root crops, small grains and tuber crops.

Reference

1. Papavizas G. C. 1985. Trichoderma and Gliocladium: Biology and potential for biological control.Annu. Rev. Phytopathol. 23:23-54.
2. The Plant Cell, Vol. 8, 1855-1869, October 1996. American Society of Plant Physiologists Biocontrol of Soilborne Plant Pathogens. Jo Handelsman' and Eric V. Stabb.
3. Current Microbiology Vol. 37 (1998), pp.6-11 Target Range of Zwittermicin A and Aminopolyol antibiotic from B. cereus.
4. Naseby, D. C., J. A. Pascual, and J. M. Lynch. 2000. Effect of biocontrol strains of Trichoderma on plant growth, Pythiumultimum populations, soil microbial communities and soil enzyme activities. J. Appl. Microbiol. 88:161-169.
5. Harman, G.E. (2004). "Overview of mechanisms and uses of Trichoderma spp.".Phytopathology96 (2): 190-194. doi:10.1094/PHYTO-96-0190. PMID18943924
6. Singh, U.S., Zaidi, N.W., Joshi, Deeksha, Varshney, Shekhar and Khan, T. 2006. Current status of Trichoderma as a biocontrol agent. In: Current Status of Biological Control of Plant.
7. Diseases using Antagonistic Organisms (Ramanujam, B &Rabindra, R. J., eds.).

8. Technical Document No.57. Project Directorate of Biological Control, Banglore, India.pp. 13-48.
9. Trichoderma for Biocontrol of Plant Pathogens: From Basic Research to Commercialized Products Gary E. Harman Departments of Horticultural Science and of Plant Pathology ,Cornell University.
10. Plant Biocontrol by Trichoderma spp. Ilan Chet, Ada Viterbo and Yariv Brotman. Department of Biological Chemistry.
11. Trichoderma spp., including T. harzianum, T. viride, T. koningii, T. hamatum and other spp. by G. E. Harman, Cornell University, Geneva, NY 14456.
12. LUMSDEN RD, LEWIS JA, FRAVEL DR 1993. Formulation and delivery of biocontrol agents for use against soilborne plant pathogens. In Hall FR and Barry JW (eds). Biorational Pest Control Agents: Formulation and Delivery. American Chemical Society, Washington, pp. 166-188.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Molecular Markers and their Applications in Agriculture

Article ID: 11582

Ashish Kumar[1], Rashmi Bhumarkar[2], Gaurav Mahajan[2], Sharad Bisen[3]
[1]College of Agriculture, JNKVV, Jabalpur, M.P., 482 004, India.
[2]AICRP on Maize, Zonal Agriculture Research Station, JNKVV, Chhindwara, M.P., 482 001, India.
[3]College of Agriculture, Balaghat, JNKVV, Jabalpur, M.P. 482 001, India.

Marker may be defined as "Mark of identification". Molecular markers have several advantages over the traditional phenotypic and biochemical markers in plant. The main uses of DNA markers in agricultural research such as Cultivar identity/assessment of 'purity'/ Hybrid Testing, Genetic Diversity Analysis, Genetic Linkage Map Construction, Mapping of quantitative trait loci (QTLs), Map based cloning of genes, Mapping of mutations, Marker-assisted selection (MAS), Marker assisted backcross breeding (MAB), Marker-assisted pyramiding, Mapping major genes, Characterization of transformants etc. DNA markers are widely accepted as potentially valuable tools for crop improvement in plant. Variation at genetic level can be detected in the form of phenotypic expression of different characters (traits) under varied environment. These identifiable traits are called markers. Transmission of characters from parents to progenies, through genetic material and expression of those differentiating characters in the progenies are known as genetic markers, before we use DNA markers data analysis tools, it is imperative to understand different types of markers. It is also important to know the basis of different marker system and how molecular marker data are generated by the biologists.

Different Types of Genetic Markers

1. Morphological markers: Different plant characters like plant height, leaf shape and pathogen characteristics like culture growth, pigmentation, pathogenecity and other visual identifiable characters are known as morphological markers.

2. Biochemical markers: These include analysis of proteins and enzymes like isozymes or allozymes extracted from the tissues. Proteins and isozymes are used as a marker after distinguishing the polymorphisms in the elecrophoretically separated and specifically stained protein bands.

3. DNA markers: Analysis of DNA in the form of individual bands or restriction fragments is the direct method of estimating large number of differences at genetic level.

Morphological and biochemical markers are the ultimate result of gene expression, which are influenced by the environment, as well as developmental stages of the organism under study. Besides, these markers are few in number and do not represent the whole genome of an organism, hence cannot be used for the construction of a saturated genetic map. However, DNA markers are enormous in number and stably inherited in Mendelian fashion. These are also not affected by environment or developmental stages of the plants. Variation at DNA level is detected by DNA polymorphism survey by various molecular techniques. Polymorphism at the DNA level is the result of simple point mutation, insertion or deletion of DNA segments etc.

Types of DNA Markers

Natural variation at DNA level can be detected by a range of molecular biology techniques developed in the recent past. The choice of their use solely depends on nature of the study and species in question. Different DNA markers have been classified into three categories on the basis of molecular biology techniques used.

Hybridization-Based Markers

The most important hybridization-based technique is Restriction Fragment Length Polymorphism (RFLP). In this technique, DNA is first digested with restriction enzymes, separated on an agarose gel and Southern transferred to membrane filter. DNA fixed on the filters is then hybridized with locus specific DNA probes labelled with radioactive or non-radioactive substance and DNA fingerprints are obtained by autoradiography. Alternatively, hybridization can be performed with microsatellite specific DNA probes.

Such type of DNA markers is then known as Variable Number Tandem Repeats (VNTR) and oligonucleotide fingerprinting. Anonymous cloned or PCR amplified DNA sequences may also be used as probes to detect variation.

Sequence Targeted and Single-Locus PCR-Based Markers

Though DNA sequence information can be rapidly detected by the use of DNA markers, it provides incomplete information. Moreover, some of the PCR-based DNA markers do not provide allelic information. Such problems can be overcome by the use of PCR primers flanking to a specific locus. Most ecological and evolutionary studies are based on DNA markers derived from the sequences of DNA. However, it is a labour intensive and expensive technique and sometimes difficult to use in the detection of polymorphism at species or race level. For the specific and sensitive detection of locus, PCR techniques like, allele specific Oligonucleotide Ligation Assay (OLA) and after cloning and sequencing of simple sequence repeats, PCR primers flanking to the region can be designed. These are known as Sequence Tagged Microsatellite Site (STMS) markers.

PCR-Based Markers

Amplification based DNA markers have been proved versatile and easy because there is no need of difficult and lengthy steps of Southern blotting. All the genetic markers based on PCR are generated by the modification of original method of PCR. The technique is very sensitive and allows specific amplification of DNA fragments from the genomic DNA of all the organisms. PCR is a simple chemical synthesis of DNA molecule with the help of DNA polymerase and primers by using genomic DNA as template. The technique can be automated for large-scale applications and devoid of radioactivity used for labelling DNA probes. The application of PCR technology is almost countless. Brief description of important PCR-based markers is given below:

PCR-RFLP markers: The basic principle of PCR-RFLP technique is exactly similar to normal RFLP analysis with a distinction that no prove is used here for hybridization. In this technique, two primers are used to amplify a specific region of the genome. The amplified fragment is then digested with restriction endonucleases, separated on agarose/polyacrylamide gel to detect polymorphic DNA profiles. The obvious advantages of PCR-RFLP are its speed and sensitivity to detect variation. The whole experiment can be performed within 24 hr, with small amount of genomic DNA compared to RFLP analysis, which takes about 24 hrs and require 4-5 µg DNA per sample.

Random amplified polymorphic DNA markers: One of the important molecular markers developed by the use of PCR technique is Random amplified polymorphic DNA (RAPD). This technique is a variant of PCR, where a single primer developed from randomly chosen ten nucleotides, is used for amplification of the template. After DNA denaturation in PCR, primers randomly join with the homologous DNA sequences at the template. Since, primers are short in length and having random homologous DNA sequences, low primer annealing temperature (35-37°C) is used to ensure perfect primer annealing to the template. DNA fragments are amplified randomly wherever primers anneal to the opposite strand facing their 3-end. PCR products are separated on an agarose gel, stained with ethidium bromide and visualized under UV light. RAPD are being used in various molecular biology studies. It has several advantages over the existing RFLP technique. It is very rapid and easy technique where no sequence information is required for generating primes. This involves no radioactivity, is less expensive and does not require rightly skilled manpower.

DNA amplification fingerprinting markers: DNA amplification fingerprinting (DAF) is another PCR technique in which a short arbitrary primer (5-6 nucleotide in length) is used for PCR to obtain reproducible banding patterns on agarose or acrylamide gels. Like RAPD, DAF does not rely on previous knowledge of genome variation. It is a simple, fast and sensitive method that may be used in a wide variety of organisms.

Amplified fragment length polymorphism markers: Amplified fragment length polymorphism (AFLP) is a good combination of RFLP and PCR. In this technique, genomic DNA is first cut with two restriction enzymes simultaneously one of which is a rare cutter (EcoRI) and another one is a frequent cutter (MSeI). At both the cut ends, DNA adapters with known DNA sequences are ligated. The base sequences of these adaptors are used for designing primers for the PCR amplification. Besides, while synthesizing primers, 1-3 additional known base pairs are added at the ends of the primers. Hence, PCR amplifications obtained where the primers anneal to fragments, have the adaptor sequences plus the complementary base pairs to the additional nucleotides. These additional base pairs are thus known as selective nucleotides. The purpose of adding selective bases is that only fewer restriction fragments ranging from 50-100 bp are amplified wherever the complementary primers are annealed to the adaptors at the cut ends. After PCR, the amplified fragments are separated by electrophoresis on a polyacrylamide sequencing gel. Fingerprints are normally obtained after exposing an x-ray film on the gel, if on the PCR primers is radio-labelled with P32. However, non-radioactive detection by silver staining of the polyacrylamide gel is also done to get AFLP fingerprints.

Microsatellite Markers or Simple Sequence Repeats (SSRs)

Microsatellites are the simple sequence tandem short oligonucleotide repeats distributed throughout the genome. The PCR based method, can be used to detect co-dominant polymorphism at simple sequence repeats (SSR) loci. Microsatellite loci are highly reproducible and generate large number of polymorphic banding patterns upon electrophoresis. Amount of genetic variation in a particular species is mainly dependent on differences in the number of randomly repeating units at a locus. Short oligonucleotides SSR are used as hybridization probes in Southern blotting to generate highly variable DNA fingerprints of the species. Alternatively, PCR primers flanking to the SSR can be developed and variation can be detected on the basis of PCR amplification, separating amplified products on Poly Acrylamide gel Electrophoresis (PAGE) and fingerprints can be obtained by silver staining of the gel. However, SSR-primer development cost is quite high, since it requires determination of base sequences of the DNA regions flanking to the SSR. Besides, synthesis of oligonucleotide primers is expensive, though running cost of assay is less and is very simple to perform.

E-ISSN: 2581 - 8317

Array of Growth Regulators in Plant Tissue Culture

Article ID: 11583

Rashmi Bhumarkar[1], Ashish Kumar[2], Gaurav Mahajan[1]
[1]AICRP on Maize, Zonal Agricultural Research Station, J.N.K.V.V, Chhindwara, M.P. 480001, India.
[2]College of Agriculture, J.N.K.V.V, Jabalpur, M.P. 482001, India.

Change in temperature and precipitation profiles is due to change in the current climate, leading to intense drought condition. These fluctuations in ecological condition resulted an increase in global warming. On the other hand, rise in population resulted severe devastation of prime cropland due to increase in urbanization and soil erosion. Therefore, there is an inordinate need to utilize soils with minimal ability for crop growth and production. The fertility status and yield capabilities of soils can be improved with the application of manure, compost, leaf mould or by the application of plant growth regulators.

Some chemicals occurring naturally within plant tissues (i.e., endogenously), have a regulatory, rather than a nutritional role in growth and development. These compounds, which are generally active at very low concentrations, are known as plant hormones (or plant growth substances).

Synthetic chemicals with similar physiological activities to plant growth substances, or compounds having an ability to modify plant growth by some other means, for example polyamines, are usually termed plant growth regulators.

Some of the natural growth substances are prepared synthetically or through fermentation processes. When these chemicals have been added to plant tissue culture media, they are termed plant growth regulator, to indicate the fact that they have been applied from outside the tissues (i.e., exogenously).

Many years have passed since F. W. Went's pioneering work on plant growth regulators had surfaced in the scientific as well as in common day to day agriculture. Auxins, abscisic acid, cytokinins, ethylene, and gibberellins are commonly recognized as the five main classes of naturally occurring plant hormones.

Auxins, cytokinins, and auxin-cytokinin interactions are usually considered to be the most important for regulating growth and organized development in plant tissue and organ cultures, as these two classes of hormones are generally required. Some compounds have been also described as oligosaccharins, salicylates, brassinosteroids, jasmonates and polyamines.

Classes of Plant Growth Regulators

Growth promoters: The plant-bio regulators or hormones which have catalytical effect, i.e., take a vital role in plant growth are called growth promoter e.g., Auxins, Gibberellins and Cytokinins.

Auxins: Auxins are a group of phytohormones produced in the shoot and root apices and they migrate from the apex to the zone of elongation. Auxins promote the growth along the longitudinal axis of the plant and hence the name (auxeing: to grow or to increase). The term, auxin was introduced by Kogl and Haagen-Smit (1931) designating those plant hormones which are especially concerned with cell enlargement or the growth of the shoots. Went (1926 and 1928) isolated auxin from the Avena coleoptile tips by a method called Avena coleoptile or curvature test and concluded that no growth can occur without auxin. Auxins are widely distributed throughout the plant however, abundant in the growing tips such as coleoptile tip, buds, root tips and leaves. Indole Acetic Acid (IAA) is the only naturally occurring auxin in plants. At low concentration, auxin stimulate growth while at high concentration they retard growth. They are characterized by causing cell enlargement and stem elongation in plants. They are also active in development of branches in plants and are associated with apical dominance.

Gibberellin: They named this disease as bakanae, meaning foolish seedlings. Sawada (1912) suggested that the disease is due to a substance secreted by a parasitic as comycetous fungus, *Gibberella fujikuroi* (the perfect form, occurring only occasionally; the imperfect form is *Fusarium moniliforme*, in infecting the diseased plants. This suggestion was experimentally supported by Kurosawa (1926) who demonstrated that sterile filtrates of the fungus could initiate symptoms of bakanae disease in healthy rice seedlings. Later in Yabuta (1935) and Yabuta and Hayashi (1939) isolated this growth promoting substance in crystalline form and named it as gibberellin A, which has now been shown as a mixture of many growth promoters, collectively known as gibberellins. The best known of gibberellins is Gibberellic acid (i.e. GA3). The best known of gibberellins is Gibberellic acid (i.e., GA3).

Cytokinins: The word for cytokinins is a generic name for all naturally occurring substances that are known to promote cell division. The term, cytokinin was proposed by Letham (1963). They are also known to delay senescence. The first naturally occurring cytokinin was found in corn and is referred as zeatin. The most widely distributed cytokinins are the synthetic benzyladenine and kinetin. Kinetin was discovered from the tobacco pith callus and the chemical substance was identified as 6-furfuryl aminopurine. The natural cytokinin appears to be made principally in apical root meristem, inflorescences and developing fruits.

Growth inhibitors: The plant bio-regulators which selectively interfere with normal hormonal promotion of growth are called Growth Inhibitor e.g., Abscisic acid and Ethylene.

Abscisic acid (ABA): These were previously called Dormin or Abscisin mainly because of their regulatory effect on abscission and dormancy. This hormone is widespread in higher plants and is found in many different organs and tissues (both old and young) of plants. ABA induces abscission of the leaves of a wide variety of plants and fruits of some plant species. ABA also prevents or delays the germination of seeds. ABA retards the growth of a large variety of plant tissues and organs including leaves, coleoptiles, stems, hypocotyls and roots. It promotes senescence through leaf abscission, degeneration of excised leaves and acceleration of decomposition of chlorophyll.

Ethylene: This is a simple gas that is produced in small quantities by many plant tissues and they serve as a very powerful regulator of growth and development. They are found very prominently in physiologically matured fruits undergoing ripening.

Other Growth Hormones

Oligosaccharins: Oligosaccharins (OS), in low concentration, that is complex carbohydrates that have the capability of modulating plant growth and development. The first evidence that oligosaccharins could serve as biological signals came forth from the studies on interaction of plant and microorganisms. It occurs due to the synthesis and accumulation of phytoalexins, an antimicrobial, in response to attack of microbes. The synthesis and accumulation were observed not only on attack but after treatment of plant tissue with cell free extracts of micro-organic origin which were termed as 'elicitors' referred as molecules that stimulate any plant defense mechanism. Some of the important physiological role played by oligosaccharins in plants is growth in excised stem segments, morphogenesis in tissue culture and induction of root nodules in legumes.

Jasmonates: The term jasmonates is widely used as synonym with the jasmonic acid (JA) and its methyl ester which were for the first time isolated from oil of jasmine. The biosynthesis of jasmonates in plants is from linoeic acid through the action of lipoxygenase. jasmonates is detected within the plant shoot apex, root tips, immature fruits and young leaves in the highest concentration. Certain mechanical perturbations in plants such as tendril coiling, water deficit induced turgor reductions, wounds etc leads to rapid and transient increase in the levels of jasmonates in plants.

Brassinosteroids: Brassinosteroids (BPs) are basically steroidal lactone, a novel plant growth promoter which was for the first time isolated from the pollens of *Brassica napus*. In plants the physiological effect of brassinosteroids is similar to that of other plant hormones such as auxins, GA3 and ethylene but variation exists in mechanism of its action. It has been found that brassinosteroids interact synergistically with auxins and it has both independent and additive response with GA3. Whereas, brassinosteroids interact strongly with abscisic acid and prevent the induced effects by it.

Salicylate: It belongs to a diverse group of plant phenolics mainly comprising of ortho-hydroxy benzoic acid, simple phenols to polymeric tannins. The coumarins, the flavonoids and cinnamic acids are also included in this group. It is the second largest group after carbohydrates. In plants these compounds occur as glycosides. In plants it stimulates flowering and it inhibits biosynthesis of ethylene, ion uptake and stomatal closure. Disease resistance is major significant role of salicylate.

Polyamines: On 1982 during the international conference on plant growth substances, polyamines were accepted as plant hormones. Polyamines inducing flowering in crop plants. At the time of flowering these amides are either translocated from apical leaves to floral buds or are metabolically converted when the floral apex synthesis large quantities of polyamines. They also play role in embryogenesis.

Growth retardants: These are the synthetic organic compounds causing retardation of cell division by inhibiting biosynthesis of plant hormones without evocating substantial growth distortions e.g., onium compounds, pyrimidines, trizoles, tetcyclacis, morphactins, maleic hydrazide etc.

Role of Growth Retardants in Growth Promotion and Inhibition

1. Inhibit excessive vegetative growth and promote reproductive growth.
2. Enhance flowering and fruiting.
3. Control irregular or alternate bearing.
4. Induce early maturity.
5. Promote ripening.
6. Inhibit biosynthesis of plant hormones.

PGR Uses in Tree Fruit Production

PBRs are used more extensively in tree fruit production than in any other horticultural or agricultural commodity, and they are essential for effective and profitable production. Several commercial uses have been selected to illustrate the evolution of the involvement of PBRs from infancy to the present and progress made in the fundamental understanding of how regulation by PBRs is achieved.

Fruit abscission is considered as most important physiological response that is regulated by PBRs. This regulation of abscission occurs at two very different times in the life and development of a fruit. The first occurs early in or at the start of fruit development and this will be referred to as the flower abscission or chemical thinning period and second period when fruit drop prematurely or drop just as they are entering the development period when they can be harvested.

Naphthalene acetic acid (NAA) and naphthalene acetamide (NAAm) could reduce preharvest drop. The most recent candidate as a drop control PBR is 1-methylcyclopropene (1-MCP). This is a compound that is released as a gas which then binds irreversibly to ethylene binding sites within the plant.

Role of PGRs in Flower Abscission - Chemical Thinning Period

The inherent characteristic of pome fruit to undergo biennial bearing has been recognized for centuries but practical and meaningful solutions emerged starting in the 1930s. Two separate approaches have been taken in crop load reduction; one is use of hormonal sprays and the second is application of caustic sprays. The compound sodium dinitro-ortho cresylate (DNOC) is used as a caustic spray.

Role of PGRs in Vegetative Growth

Appropriate regulation of vegetative growth is important in fruit production since there is an inverse relationship between growth and flowering and excessive vegetative growth negatively impacts fruit quality, postharvest life, and development of an efficient and productive tree structure.

Paclobutrazol was registered for use as a growth retardant in several countries, but its use has been limited due to long persistence in the tree, concerns about ground water contamination and a negative influence on fruit size.

Role of PGRs in Enhancing Flower Bud Formation

Harley et al., (1958) showed that NAA had the intrinsic ability to promote flower bud formation distinct from effects related to thinning. Early the focus on NAA was to enhance flower bud formation by chemical thinning to reduce crop load. In the mid-1960s when daminozide came into general use, it was found that daminozide could enhance flowering when applied after bloom.

High rates reduced fruit size so lower rates were used to reduce the impact on fruit size. Ethephon proved to be the most effective promoter of flower bud formation. However, its use on bearing trees was limited because ethephon also caused thinning.

Many hormone-like growth regulators have now been identified, but despite the long list of their effects and the progress that has been made in elucidating some of the pathways of signal transduction, we have still a long way to go before we fully understand the complex interaction between plant hormones. The growth and development processes in vivo and in vitro are excessively complex and composed of interdependent physiological phases which have different requirements.

In these processes a single phytohormone can, over time, more than once play the role of inducer/stimulator or inhibitor as tissues move through phases of changing sensitivity to specific hormones. Phytohormone may alter the overall growth rate or change the direction of development, which in the long-term feedback and adjusts the balance of all other phytohormones. In essence, because the tissues are now growing at a different rate or are in a different developmental state, the cells are required to modify the manufacture of all phytohormones.

Real-Time PCR: Principle, Procedure, Advantages, Limitations and Applications

Article ID: 11584

K. A. Sindhura[1], S. B. Sawant[2]
[1]Department of Entomology, University of agricultural Sciences, GKVK, Bangalore.
[2]Department of Plant Pathology, Orissa University of Agriculture and technology, Bhubaneswar, Odisha.

What is Real-time PCR?

A technique used to quantify the nucleic acid (DNA/RNA) present in a sample, during the PCR reaction is known as a real-time PCR or quantitative (q) PCR."

Why is Real-Time PCR More Advanced Compared to the Traditional Conventional PCR?

We can calculate or measure the amount of the amplification which is not possible in the conventional PCR; hence, real-time PCR is also referred as "quantitative PCR." The need of performing agarose gel electrophoresis in the conventional PCR is avoided in case of the real-time PCR. One can acquire results by carrying out the melting curve analysis. Quantitative analysis of gene expression is not possible in conventional PCR. By monitoring the reaction in real-time (number of templates amplified during each reaction) the amount of gene expression can be measured; proving real -time advantageous and advanced over the conventional PCR.

The Principle

Real-time PCR relies on the use of fluorescent dye. The amount of the nucleic acid present into the sample is quantified using the fluorescent dye or using the fluorescent labelled oligos."

Two Types of Chemistry are Available for the Real-Time Quantitative PCR

1. DNA binding dye (Intercalating dye-based method).
2. Sequence-specific probe (Hydrolysis Probe-based detection method).

DNA Binding Dye

The dye has its own fluorescence. When the dye binds to the double-stranded DNA, the fluorescence emitted by the dye increases 100 to 1000-fold than the original signal. However, the original dye fluorescence is taken as the baseline for the detection.

SYBR green dye-based method: The SYBR green is one of the most popular dyes used in real-time PCR. We can identify the on-specific bindings into the reaction by doing the melting curve analysis.

Melting curve analysis: Larger sequences require more time and higher temperatures for melting whereas the non-specific bands melt at a comparatively lower temperature and has different melting temperature curves.

Probe-Based Detection Method

This method uses two types of single short sequence-specific probes viz., Linear probe and Molecular beacons.

Linear probe: Linear probes are the TaqMan probe which rely on the activity of Taq DNA polymerase. These probes are the labelled short single-stranded sequence-specific DNA molecules which are radio or fluorescent labelled. TAMRA and Black Hole Quencher are two widely used quencher dyes; while FAM is the most popular reporter dye.

Molecular beacons: The molecular beacons operate on the mechanism of the thermodynamics in which a molecule remains in an energy-optimized (saving) condition. Instead of binding non-specifically, the molecular beacon remains in a hairpin structure in this case. Beacons are the hairpin loop-like structure of the oligonucleotides with complementary sequences on both the ends.

Scorpion probes: Scorpion probes are other types of a probe or we say it is a type of molecular beacons in which instead of two different probes and primer, the hairpin loop is incorporated at the 5′ end of the primer directly.

Steps and Procedure of Real-Time PCR

Quantification is achieved by amplifying and monitoring DNA or RNA present in the sample. The three main steps in real-time PCR are viz., Denaturation and Extension. Denaturation occurs at 94°C- the double-stranded DNA is denatured and two single-stranded DNA is generated. The DNA is melted followed by annealing at 55°C - 66°C. Lastly, extension occurs at 72°C where the Taq DNA polymerase is activated to the highest.

Components Used into the Real-Time PCR

1. dNTPs.
2. Primers.
3. MgCl2.
4. Template.
5. Taq DNA polymerase.

The real-time or quantitative analysis is divided into two other methods viz., Standard curve analysis and Relative quantification.

Standard Curve Analysis

In the standard curve analysis method, the serially diluted sample or template is quantified against the known template. In simple words, we can say that each unknown sample dilution is compared with each known standard dilution. The method is also called as absolute quantification.

Relative Quantification

Another method is for those types of the template which does not have reference value. Or it is totally unknown the Ct value of the template sample, the amount of the expression of the gene into the unknown sample can be determined.

Advantages of Real-Time PCR

1. Cost-effective.
2. Takes less time.
3. Enhanced sensitivity and specificity.
4. Requires fewer templates.
5. Melting curve analysis.
6. Only Real-time is sufficient.

Limitation of Real-Time qPCR

Expensive instrumentation when compared to the conventional PCR. Kits are not available for all kind of genes and disorders. The technical and standardized protocols are limited.

Applications of Quantitative PCR

1. Disease diagnosis: The real-time PCR is used in the diagnosis of a monogenic and multigenic diseases; to quantify the mutated gene in the disease patient.

2. MicroRNA analysis: Micro RNAs are the smaller RNA molecules of 20 to 25 nucleotides in length. It plays an important role in the gene regulation pathway. The qPCR assay used to quantify the microRNA from different tissues.

3. Cancer detection: Circulating tumour cells contains the mutant mRNA which transports to different tissues if it is malignant.

4. Microbial load testing: The accurate microbial load testing from any biological sample is nearly impossible without the qPCR i.e., microbial load in the fermented sample, soil sample, water sample, food.

5. GMOs detection: Genetically modified organisms are the organism whose genetic makeup is altered using the genetic engineering or transgenic technique specifically into plant, animal and microorganism.

6. Genotyping and quantification of pathogens: Conventional PCR can help in genotyping of the contagious disease-causing pathogen (it can only detect the strains and species of the pathogen). Nevertheless, quantification is essential for estimating the severity of the infection.

7. Identification and quantification of circulating nucleic acid: Cell-free fatal DNA and circulating micro-RNA are two types of the circulating nucleic acid present into the bloodstream.

8. Detection of pathogenic SNPs: Melting curve analysis helps in the identification of many pathogenic SNPs claiming it to be the most recommended method for characterization and identification of some of the disease.

References

1. Kubista, M., Andrade, J. M., Bengtsson, M., Forootan, A., Jonak, J., Lind, K., Sindelka, R., Sjoback, R., Sjogreen, B., Strombom., (2006). The real-time polymerase chain reaction. Mol Aspects Med., 27(2–3): 95–125.
2. Radonic, A., Thulke, S., Mackay, I. M., Landt, O., Siegert, W., Nitsche, A., (2006). Guideline to reference gene selection for quantitative real-time PCR. Biochem. Biophys. Res. Commun.,313 (4):856–62.
3. Vandesompele, J., Preter, K., Pattyn, F., Poppe, B., Van, R. N., De, P. A., Speleman, F., (2003). Accurate normalization of real-time quantitative RT-PCR data by geometric averaging of multiple internal control genes. Genome Biol.,3(7):34.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Insect Pests of Cole Crops and their Management

Article ID: 11585
Suresh Choudhary[1], Pappu lal Dalal[1], Kiran Choudhary[2]
[1]Ph.D. Scholar, Department of Entomology, Sri Karan Narendra Agriculture University, Jobner (Jaipur) 303329.
[2]Ph.D. Scholar, Department of Plant Pathology, Sri Karan Narendra Agriculture University, Jobner (Jaipur) 303329.

Introduction

Cabbage, cauliflower, knol khol, broccoli etc are major cole crops. Many insect pests like the diamondback moth (DBM) (*Plutella xylostella*), leaf webber (*Crocidolomia binotalis*), Cabbage webworm (*Hellula undalis*), Cabbage butterfly (*Pieris brassicae*), aphids (*Brevicoryne brassicae*) and painted bug (*Bagrada hilaris*) infect the cole crops reducing the productivity and quality of product. The present article emphasis on the identification, life cycle, nature of damage and management of major insect pests of the cole crops.

Diamond Back Moth, *Plutella xylostella* (L.) (Plutellidae: Lepidoptera)

It is a serious pest of cauliflower & cabbage, but also feeds on many other cruciferous crops throughout the world.

Identification and life cycle: The moth is grayish brown with narrow wings having pale white markings anteriorly which form diamond-like white patches dorsally when wings are folded back at rest. The adult female moth lays eggs 5-57 singly or in groups on the undersurface of the leaves along the veins. Egg period is 2-7 days. The larvae are greenish with short hair on the body and the larval period is varies from 13-21 days. It pupates in thin loose barrel- shaped silken cocoon and the pupal period is 7-9 days. The life-cycle is completed in 24-35 days and there are several generations in a year.

	
Adult Diamond back moth	**Damaged cabbage**

Damage: The larvae feed on the leaf epidermis and later make holes in the leaves. Severely affected leaves are completely skeletonized.

Management:

a. Mustard is used as a trap crop in cabbage fields to attract diamond back moth in the ratio of 2:25.
b. Spray application of bacillus thuringiensis var. kurstaki @ 1 kg/ha.
c. Use the natural enemies Diadegma semiclausm, Cotesia plutellae as effective parasitoid.
d. Need based spray of NSKE 5%.
e. Spray cartap hydrochloride @ 175 g a.i/ha once at primordial stage and repeated twice at 10 days interval.Spray flufenoxuron 10% DC @ 0.8 ml per liter of water or flubendiamide 20% WG @ 0.1 ml per liter of water or emamectin benzoate 5% SG @ 0.4 gm per liter of water.

Cabbage Butterfly, *Pieris brassicae* (L.) (Pieridae: Lepidoptera)

It is serious pest of cabbage, cauliflower, knol khol & also attack turnip, radish, mustard and other cruciferous crops. The pest passes winter in the plains and migrates to hilly regions during summer.

Identification and life cycle: The young larvae are pale yellow and become greenish yellow later on. The butterflies' wings are pale white, with a black patch on the apical angle of each forewing and black spot on the costal margin of each hind wing. The female lays on an average 150 eggs in clusters of 40-50 eggs on the both side of a leaf. The eggs hatch in 3-14 days in winter. The caterpillars feed gregariously passes through five stages and are full-fed in 16-24 days. Pupation takes place in cocoon on fences or trees. The pupal stage ranges from 7-28 days. The butterflies live for 3-12 days.

	
Cabbage butterfly caterpillar	**Adult Cabbage butterfly**

Damage: On hatching, the first instar caterpillars only scrape the leaf surface but in later stages eat away the leaves at the margin's inwards, leaving intact the major veins only. Sometimes the caterpillars bore into the heads cabbage and cauliflower.

Management:

a. Hand picking and mechanical destruction of caterpillars during early stage of attack are quite beneficial when caterpillars feed gregariously.
b. Release of parasitoids like Apanteles glomeratus.
c. Spray application of Bacillus thuringiensis @1-2 g/liter of water.
d. In severe infestation dusting with carbaryl 0.15%.

Leaf Webber, *Crocidolomia binotalis* Z. (Pyralidae: Lepidoptera)

Present in all areas where cabbage and cauliflower are grown.

Identification and life cycle: The moth is 2 cm in length with light brownish forewings having distinct wavy lines and hind wings with semi translucent colour. The larva with red head has brown longitudinal strips on its body. The female moth lays eggs in masses, each mass containing 45-100 flat eggs. Egg period is ranges from 5-15 days. The larvae become full grown in 24-28 days during in summer and 50 days during in winter. It pupates in the soil after making an earthen cocoon and emerges as adult in 13-20 days.

	
Leaf Webber Caterpillar	**Damaged cabbage**

Damage: The leaves are skeletonized by the larvae which remain on the under surface of leaves in webs and feed on them. They also attack flower buds and pods.

Management:

a. The adult moth can be control through light traps.
b. Remove and destroy the webbed leaves from the field.
c. Use the parasitoid like Cotesia crocidolomiae.
d. Spray with chlorfluazuron 5.4% EC @ 0.1 ml per litre of water or indoxacarb 14.5% SC @ 0.5 ml per liter of water for effective control.

Cabbage Head Borer, *Hellula undalis* (F.) (Crambidae: Lepidoptera)

It is widely spread from Europe across Asia to Pacific region. It is a serious pest of cole crop.

Identification and life cycle: The Adult moth have 17-18 mm wingspan with grey wavy lines on the fore wings and pale dusky colouration on hind wings. The caterpillar is 12–15 mm long and is Creamy yellow with purplish brown longitudinal stripes. The adult female lays eggs on the older leaves that hatch within 2-3 days. The caterpillar full-grown in 6-18 days and Pupation occurs within silken shelter. The pupal period varies from 4-19 days. Adult lives for 2-8 days and it have many generations from April to November.

	
Cabbage head borer caterpillar	**Adult Cabbage head borer**

Damage: The larvae in early stage bore into the stem of growing shoots and the later instars the leaves. It makes a silken web around the feeding area and as they grow bigger, they bore into the heads of cabbage and cauliflower.

Management:

a. Collection and destruction of early-stage caterpillars helps to check the infestation.
b. Dusting with 4% carbaryl is effective for the control of the larvae.
c. Spray of Bacillus thuringiensis @ 2g/lit is also useful for the control of pest.

References

1. Kumaranag, K. M., Kedar, S. C., Thodsare, N. H and Bawaskar, D. M. 2014. Insect Pests of Cruciferous Vegetables and Their Management, Pop. Kheti, 2(1):80-86
2. Agriculture Pests of South Asia and Their Management by A. S. Atwal and G. S. Dhaliwal, 456.

Prognosis of Seed Maturity and its Impact on Seed Quality

Article ID: 11586

Priyanka. M.[1], Islavath Suresh Naik[2]
[1]Assistant Prof. (Contractual) College of Horticulture, Mudigere. Karnataka (Department of Seed Science and Technology).
[2]Ph. D Scholar, UAS, College of Agriculture, Dharwad. Karnataka (Department of Seed Science and Technology).

Seed development and maturity are more important as seeds may be harvested at proper time to ensure their quality. The process of seed development or maturation is controlled genetically and involves an organized sequence of changes from ovule fertilization to the point in which the seed becomes independent from the parent plant. Harvesting seeds of crop plants at their physiological mature stage is recommended to reduce the risk of various environmental hazards and it is one of the important factors that affect the production of quality seeds. Seed moisture content and morphological characteristics are the prime criteria to identify seed maturity.

1. Harvesting is the process of gathering mature crops from the fields.
2. Harvest marks the end of growing season/ growing cycle of a particular crop.
3. Harvesting time is a critical decision that balances the likely weather conditions with the degree of crop maturity.
4. Weather conditions such as frost and unseasonably warm or cold periods can affect yield and quality.
5. Timing of the harvest often involves a significant degree of gambling.

What is Seed Maturation?

1. Seed maturation is defined as the sum total of all morphological, physiochemical and physiological changes which occur in the ovule from the stage of fertilization to harvest. (Delouche, 1971)
2. Seed develops from a fertilized ovule.
3. The process of seed development is influenced by both environment and variety which could lead to various kinds of changes within the ovule.

Two Types of Maturity

1. Physiological maturity: Physiological maturity of the seed is the stage at which seed attains its maximum dry weight and it represents the stage of the seed marked with maximum viability and vigour. The translocation of the food from the plant completely stops and seed becomes independent. The changes that occur in the seed beyond physiological maturity is mainly dehydration without accumulation of reserves allowing the seeds to dehydrate on the mother plant till harvest.

2. Harvest maturity: Stage at which moisture content of the grain is in equilibrium with the atmospheric moisture. "That grain moisture content where harvest can occur with minimal kernel damage and mechanical harvest loss". Harvest maturity is usually considered to be near 25 % seed moisture.

Maturity Indices

1. Morphological indices:
- a. Change of colour in reproductive parts.
- b. Formation of black layer at maturity.
- c. Change of colour in leaves.

2. Chemical indices: During maturation some compounds like soluble and insoluble carbohydrates, soluble amino acid, protein, DNA and RNA level changes.

3. Physiological indices:
- a. Seed dry weight and seedling vigour.
- b. Decrease in moisture content.

Physiological Maturity Indices of Some Cereal Crops

1. Paddy: Green caryopsis turn to straw yellow color.
2. Maize: Darkening of silk, drying up of husk and black layer point seed.
3. Sorghum: Formation of black layer on seed, grain dry weight.
4. Bajra: Formation of black layer at the point of attachment, seed colour changes from green to yellow.
5. Oat: change in the glume colour green to light yellow.

Physiological Maturity Indices of Some Pulse and Oilseed Crops

1. Arhar: Change in colour of pod, seed and shrinkage of seed.
2. Vigna sp.: Change in colour of pod and seed dry weight.
3. Sunflower: Change of head colour and floret abscission.
4. Soybean: 50% of pods and leaves turn yellow, seed colour change, first appearance of brown coloured pods and yellowing of pod.

Determination of Physiological Maturity

1. Concepts proposed by Shaw and Loomis in 1950:
    a. The maximum dry matter accumulation.
    b. Reached when there are no significant increases in seed dry weight.
    c. When seeds reach maximum dry weight, germination and vigor.
2. Determination of physiological maturity in individuals or in plant communities:
    a. It can be determined on individual seed or plant community basis. Individual seeds in plant community usually reach PM at different times making community basis is less precise.
    b. Difficult to identify the exact point of seed physiological maturity (maximum dry weight).

Need to Increase Precision

1. Number of statistical replicates.
2. Reduce harvesting intervals.
3. Additional care in weighing.

Why to Study Seed Maturation?

1. Helps in prevention of seed deterioration by timely harvesting of seed.
2. Plant breeders can shorten the time required for growing by knowing indices of physiological maturity.
3. It contributes to saving time and money by unnecessary delay in harvesting
4. It helps in reducing seed loss due to pests, rodents, birds & animals.
5. It helps in escaping from the various types of diseases.
6. It helps in reducing seed losses due to shattering.

Factors Affecting Seed Maturity

1. Environmental factors like Temperature, Rainfall, Relative Humidity etc.
2. Moisture content of the seed.
3. Availability of water.
4. Mother plant nutrition.
5. Chemical composition of seed.

Conclusion

The stage of physiological maturity varies with crop to crop and also variety and it is governed by genotypic character which is influenced by environment factors. The indeterminate flowering nature of some crop plants renders the seed development studies difficult. However limited systematic studies on morphological indices of physiological maturity suggested that still there is need to work on prediction of seed maturity.

References

1. Delouche, J. C., 1971, Seed Maturation, Seed Sci, Technol., 1: 671-700.
2. Shaw and Loomis, 1950, Bases for the prediction of corn yields. Plant Physio., 25(2): 225-244.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Caregiving Responsibilities for Dependent Elderly: A Period of Extreme Caregivers' Stress

Article ID: 11587

Parul Kalia[1]

[1]Ph.D, Dept. of Human Development & Family Studies, College of Community Science, Punjab Agricultural University, Ludhiana.

Summary

Caregivers plays a pivotal duty in the long-term care of the dependent elderly in the family. Caregiving responsibilities are immensely packed with stress and storm and usually caregivers could not extract time for their leisure activities. Additionally, most of the families preferred to care for their elderly person at all stages of their life. However, larger societal changes and changes into the patterns and structure of family system in the country have now placed a significant demand and importance on the family caregivers.

Introduction

In Indian culture, from ancient times family members used to play the roles of caregivers for taking care of the elderly persons in the family. Caregiver could be a family member, relative or acquaintance who takes care of the dependent elderly in the family. Dependent elderly needs assistance due to their unavoidable limitations.

Undoubtedly, caregiving is tumultuous job and it takes a great toll on the daily lives of the caregivers. Fulfilling caregiving duties gets even worse when the care recipient is completely dependent upon the others. The dependency of the care recipient leads to inability to perform the daily basic activities of living such as bathing, toileting etc. Despite the fact of being an additional support to caregivers, due to their limited mobilization dependent elderly need assistance from caregivers. Therefore, the caregiver perform instrumental activities For example: financial transactions, shopping, help in household chores etc. for the dependent elderly.

Along with other household work, childcare etc. caregivers usually help the elderly with feeding, bathing, toileting, transferring etc. which ultimately kills the leisure time of caregivers. Researchers reported that a majority of the caregivers admitted a shortage of time for themselves and almost 95 per cent among them reported to have the feeling of left out. The social relationships often get affected due to continuous checking on the care recipients. Caregivers generally avoid gatherings and stop enjoying public ceremonies. A habit of recurring stress and anxiety is developed with due time.

The initial phase of caregiving process often appears rewarding but if the caregiving responsibilities are not thoroughly managed and proper assistance will not be received this rewarding experience slowly transferred into burdensome experience with the passage of time. The reason behind this burdensome experience is the ignorance and avoidance of the personal time and space of the caregivers. The caregiver should be considerate about their own health and well-being because studies have shown negative consequences on the personal health of the caregivers due to continuous caregiving demands and challenges.

Typically, family members are focused on the health and well-being and improvement of the elderly conditions rather than considering caregivers' assistance needs, whereas, the energy and efforts of caregivers are totally unrecognized and unasked. Therefore, the phase of endless stress and storm, sleep deprived nights and even ups and downs in caregivers' own life etc. aggregately puts enormous pressure upon caregivers.

Another aspect towards extreme burden of caregivers may be lack of training and improper knowledge about the health condition of the dependent elderly. Therefore, to provide their best efforts towards wellness of the care recipient, caregivers devoted their time and energy in fulfilling responsibilities.

Generally, due to inadequate knowledge and skill, family caregivers may be unfamiliar with the type of care they must provide or the amount of care needed. Studies documented by Family Caregiver Alliance (2007) states that majority of caregivers (81%) feel inadequately trained for the skills that they perform and they further mentioned that they have never received any kind of formal education in caregiving. In another study, Borghi et al (2013) quoted that majority of time primary caregivers do not receive any training for daily care of the dependent elderly rather they are told about the medical condition of the disease which triggered negative thoughts and stress which ultimately affect their quality of life.

As a result of mentioned issues, caregivers often reported stress and anxiety issues, loss of energy, lethargy, loneliness, isolation, feelings of negative emotions such as anger, sadness, irritation, frustration, despair etc. which they usually developed due to excess stress and strain of caregiving. Caregivers are potentially at increased risk for adverse effects on their well-being in virtually every aspect of their lives, ranging from their health and quality of life to their relationships and economic security. Study shows that impairments in the health status of caregivers are led by the factors that make up the context of care. The dependence in daily activities, time spent in giving care and the severity of disorders of the elder members pose marked influences on the understanding of wellbeing and its bad impact on primary caregivers (Schulz & Eden 2016).

Conclusion

Taking care of someone when the person is partially or completely dependent on the others is extremely tiresome. Dependency leads to a physical decline that brings need for psychosocial and health care services and this dependency leads to seek assistance for basic and instrumental activities of daily living. Thus, a kind of stress is always at backstage in the mind of the caregiver. Whereas, taking care is an imposition of the circumstances, however, not an option. Therefore, caregivers burdened themselves with multiple responsibilities which ultimately affect their health and well-being as well as personal and social life.

References

1. Borghi, A. C., Castro de V, C., Marcon, S. S. and Carreira, L. (2013). Overload of families taking care of elderly people with Alzheimer's Disease: a comparative study. Rev. Latino-Am Enfermagem, 21: 876-83. https://dx.doi.org/10.1590/S0104-11692013000400007
2. Family Caregiver Alliance (2007). Family caregiving: state of the art, future trends. Report from a national conference. San Francisco, Calif.: Family Caregiver Alliance.
3. Schulz R and Eden J (2006) Families Caring for an Aging America. Committee on Family Caregiving for Older Adults; Board on Health Care Services; Health and Medicine Division; National Academies of Sciences, Engineering, and Medicine, Washington (DC), National Academies Press (US); 2016 Nov 8. Available from: https://www.ncbi.nlm.nih.gov/books/NBK396401/ doi: 10.17226/23606.

Biorefinery: A Sustainable Solution to Lower the Burden on the Environment

Article ID: 11588

Somdatta Achar[1], Sourajit Dey[1]
[1]PG Scholars, Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal-741252.

Summary of the Article

The environmental capacity of earth is determined by three interrelated factors- the human population size, activities of human on earth and the impact of those activities on environment. With the continuous and exponential growth of human population, the extent of use of environmental resources is increasing, creating huge impact of individual human activity on earth. The aim of human being in making more and more wealth will not set bounds, even after knowing the consequences of that on environmental deterioration. The main sources for worldwide energy production are fossil fuels, mainly oil and natural gas. Due to the extreme increase in price of fossil resources and their adverse environmental impact, the concept of using renewable resources is coming forward. Harmful gases like greenhouse gases, carbon dioxide, methane, nitrous oxide etc. arouse from combustion of fossil fuels, which is a matter of concern to save our earth. After keeping both supply and demand prospect, we can observe that there is increasing need in energy use as population is increasing in faster rate. So, using renewable sources to produce energy would be a sustainable and affordable way out to the problem. The one and only renewable carbon source is biomass. Here, through this article we want to set your sight on the concept of biorefinery, as a sustainable solution towards lowering the loads on environment.

Introduction

A straight forward solution to the whole problem is reducing harmful human activities on earth. But restricting human activities is near impossible to execute. Enough knowledge and awareness about environmental issues are not there within individuals. If we think about adopting dematerialization i.e., limiting the use of resources in technological processes, that is one way out to bring down the environmental load. And another way would be trans-materialization i.e., replacing non-renewable natural resources with other renewable resources, by-products or wastes of other processes. But adopting any one of these individually will not be feasible enough. Parallel use of both the abovementioned proceedings might provide tangible effect on reducing the impact of human activities. Biorefinery system can work efficiently as an alternate way of energy production, which does not use conventional non- renewable resources and thus it can be identified as a sustainable processing of biomass into bioenergy and bio-based products.

What is Biorefinery?

Biorefinery is a complex technological system, which converts biomass to energy and other beneficial byproducts. It is the sustainable processing of biomass into biobased products (like food, feed, polymers, chemicals) and bioenergy (like biofuel, alcohol fuel, liquid fuel, power and heat). Using biomass as feedstock is beneficial to reduce the bad impacts on environment, with additional benefit of less pollutant emission. All kinds of necessity will be fulfilled by production of transportation biofuels, biochemical, bioenergy, food and feed by replacing fossil-based carbon with renewable carbon of biomass. Biorefinery is an open system, where input part is biomass and the output products are both highly valuable, obtained in small amount and of low value, obtained in large amount. Energy produced in cogeneration and trigeneration through biorefinery (electricity, heat, cooling) is a sustainable substitute to energy produced by conventional petroleum refinery.

Biorefinery system

Diverse renewable raw materials like any agricultural crop (corn, wheat, barley grains, oilseeds, etc.), agro-food and forestry industry wastes, wood chips, energy crops, deforestation forest products, municipal waste and any other kind of waste biomass can be used for biorefinery process. These substrates can be converted into the outputs through different version of technologies/processes like fermentation, gasification, trans-esterification, etc. Pretreatment of the biomass materials includes enzymatic hydrolysis, fast pyrolysis, fermentation, hydrothermal conversion, alkaline pretreatment, pretreatment with hot water or dilute acid. The raw materials are first decomposed to get simple compounds like sugars, proteins fats and carbohydrates, thus preparing them to go through subsequent thermochemical and fermentation processes. Considering availability of raw materials and technological possibilities, there can be some basic biorefinery systems:

1. Biorefinery with the feed of the whole plant/ Agro-refineries: In this system, the whole plant is assumed to be in two parts- edible parts and straw. From the edible parts, by biotechnology, chemical or physicochemical methods starch derivatives and flour are obtained, which in turn used for production of fuels, chemicals and other materials. From straw, lignocellulosic material is obtained by biotechnology and chemical procedures and finally those lignocellulosic materials are used for energy production in cogeneration with production of final waste.

2. Biorefinery with the feed of non-edible parts of plants/ Green refinery: Wet biomass like green grasses, alfalfa, clover, immature corn, non-edible green parts of plants are converted into liquid part through extrusion and solid part is separated. Biogas, fuel, polymers are produced from both the liquid and solid substances by biochemical/ physicochemical processes.

3. Biorefinery with lignocellulosic feedstock/ Lignorefineries: Lignocellulosic substrates like dry biomass, wood, straw, fodder, forest industry wastes, wastes from paper and furniture industry, etc. are treated with auxiliary substances such as yeast and enzymes. Then through biotechnology and chemical processes lignin and cellulose are converted into sugar raw material, which eventually produces biofuel, chemicals, polymers, etc.

4. "Two platform" biorefinery: Wastes from different industries (agriculture, forestry, marine, food) are divided in two platforms- sugar and syngas platform. Sugar raw materials through chemical reactions and syngas raw materials through thermal/ chemical methods produce fuel, chemicals other biorefinery outputs.

5. Oleorefinery: Oilseeds from degraded areas, which cannot be used as food, can be used to produce energy, biodiesel and oleochemical products like phytosterols/ sphingomyelin.

Environmental Impact of Biorefinery System

Biorefinery not only manages economics by replacing petrochemical industry, but also lower the overall harmful environmental effect. It helps to reduce greenhouse gas emission. The whole process is expected to produce no or very less waste (waste, which indeed is used as substrate of other industries, if any). Compared to conventional fossil fuel, bioenergy produced by biorefinery process has obvious advantage of renewability and ability to defend energy security in future. Carbon dioxide produced during biorefinery process will be utilized by plants during photosynthesis and plants will produce more biomass, which eventually will supply more raw materials for biorefinery. Utilizing conventional energy resources for energy production may cause serious problems like global warming, climate change, acid rain, etc. Fossil fuel combustion deteriorates the air quality and harms human health. In this situation, biorefinery process is providing so many advantages over the conventional energy resources. Thus bioenergy is gaining more attention in world.

Personal Opinion

Though in recent years people are gaining knowledge about biorefinery process and its advantages, the total replacement of conventional energy source with biorefinery has not taken place yet. Bioenergy accounts only 14 percent of global energy consumption (world energy resources, 2016). As the sustainable bioenergy can reduce the risk of energy poverty and contribute to economic development, it has the potential to get huge popularity in near future, especially in developing countries. Government should imply laws and necessary policies to promote bioenergy production. If biorefinery comes more in use, then people will think of their profit by producing more energy crops instead of other crops. Then crop diversity in certain land type will change. So, we can say that bioenergy usage has to some extend negative impacts too. So, we have to choose cleverly, where to use biorefinery and to how much extent should we use it. As the good impacts of biorefinery are more than its negative impacts, biorefinery can act as a reliable zone. Moreover, it will save the earth from ongoing problems created due to conventional energy usage. More research work should be done on this field and the countries which are lagged behind should gain knowledge about it from leading countries.

Conclusion

The sustainability goal depends on the effective biomass deconstruction technologies through which the biorefinery system liberates biomass polymers and other active compounds effectively in lowest loss of resources. This biomass deconstruction technology is one of the important cost deterrents in biorefinery system. So, developing a cost effective, profitable and sustainable biorefinery is a challenging aspect. Complimentary scientific innovations introduced synergistic design of biorefinery that will lead the production of integrated solution packages (concept of novel feedstock, cross-disciplinary synergies). It will add ubiquitous knowledge in academics, implementation and commercialization of biorefinery technology.

References

1. Berntsson T., Sanden B., Olsson L. and Asblad A.; What is a Biorefinery: page16-25.
2. Biernat K., Grzelak P. L.; Biorefinery Systems as an Element of Sustainable Development, http://dx.doi.org/10.5772/60448, Biofuels- Status and Perspective; chapter 20; 427-455.
3. Cherubini F., Jungmeier G., Wellisch M., et al, Towards a common classification approach for biorefinery systems, Wiley InterScience (www.interscience.wiley.com); DOI: 10.1002/bbb.172; Biofuels, Bioprod. Bioref. (2009).
4. Torres A. F., Xu X., Nikiforidis C. V., Bitter J. H. and Trindade L. M. (2019); Exploring the Treasure of Plant Molecules With Integrated Biorefineries, Front. Plant Sci. 10:478. DOI: 10.3389/fpls.2019.00478.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Insect Pests of Cocoa and its Management

Article ID: 11589

K. Murugasridevi[1], S. Lekha Priyanka[2]
[1]Assistant Professor, Dhanalakshmi Srinivasan Agriculture College, affiliated to Tamil Nadu Agricultural University, Perambalur-621212, Tamil Nadu, India.
[2]Ph.D., Scholar, Tamil Nadu Agricultural University, Coimbatore – 641 003, Tamil Nadu, India.

Introduction

Cocoa is an important commercial plantation crop of the world. Cocoa is a crop of humid tropics and so it was introduced as a mixed crop in India in areas where the environments suit the crop. It is cultivated in coconut and arecanut plantations in large scale from 1970 onwards. It is grown as an under- storey intercrop with sufficient shade in southern states of India. In India, the current production is about 12,000 Metric Tonnes and Tamil Nadu produces about 400 Metric Tonnes. In this article, the insect pests ravaging cocoa and their management have been discussed.

Insect Pests of Cocoa and its Management

Pest management is one of the critical components in health management of cocoa. More than 50 insect pests infesting cocoa are recorded in India (Daniel,1994). Pest occurrence is widely observed during summer and post monsoon seasons. The major insects' pests infesting cocoa are described below.

Mealy Bugs (*Planococcus lilacinus, Planococcus citri, Paracoccus marginatus* and *Rastrococcus iceryoides*)

It colonizes on the tender parts of the plant such as growing tips of the shoots, the terminal buds, the flower cushions, the young cherelles and mature pods. Feeding of mealy bugs induces cherelle wilt.

Management: When the infestation is lesser: Spraying of Neem Oil 3% or fish oil rosin soap 25g/litre

a. In case of severe incidence, spraying of any one of the following chemicals is recommended: Dimethoate (2 ml/litre), Profenophos (2 ml/litre), Chlorpyriphos (5 ml/litre), Buprofezin (2 ml/litre), Imidacloprid (0.6 ml/lit), Thiamethoxam (0.6g/litre)

b. In the area where *P. marginatus* alone occurs, field release of *Acerophagus papayae*, the encyrtid parasitoid @ 100 per hamlet is recommended as the best management strategy.

Tea Mosquito Bugs *(Helopeltis antonii, H. bradyii)*

Infested pods develop circular water-soaked spots around the feeding punctures. These punctures subsequently turn pitch black in colour. Deformation of pods occurs because of multiple feeding injuries (Thube et al., 2016)

Management:

a. When the infestation is lesser: Spraying of Neem Oil 3% is recommended.

b. In case of severe incidence, spraying of any one of the following chemicals is recommended: Imidacloprid (0.6 ml/lit), Thiamethoxam (0.6g/litre), Profenophos (2 ml/litre), Carbaryl (2g/lit).

	
Cocoa pod infested with mealybugs	**Tea mosquito bug**

Flatid Plant Hoppers

Nymphs and adults suck the sap from flowers, tender shoots and pods. They excrete honey dew resulting in the development of sooty mould fungus on the leaves and pods.

Management: Foliar application of a newer molecule Thiacloprid @ 2 ml/litre twice at 5 days interval is recommended for the management of these flatid plant hoppers.

Cocoa pod infested with flatid hopper Nymphs and Adults

Aphids (*Toxoptera aurantii* and *Aphis gossypii*)

They colonize on the underside of tender leaves, succulent stem, flower buds and small cherelles. Heavy infestation may occur during hot summer and after rainy season which brings about premature shedding of flowers and curling of leaves.

Management: Spraying of dimethoate @ 2 ml per litre.

Hairy Caterpillars (*Lymantriya* sp., *Euproctis* sp., *Dasychira* sp.,)

They cause serious leaf damage on seedlings and young trees.

Management: Foliar spray of acephate @ 2g/litre of water.

Stem Girdler, *(Sthenias grisator)*

Damage was done by female beetle which girdles the branches and inserts whitish spindle shaped eggs singly into the tissue in a slanting manner. Due to mechanical injury caused by girdling and oviposition, the branches above the girdle wither and dry.

Management:

a. Swab Coal tar + Kerosene @ 1:2 or carbaryl 50 WP 20 g / litre (basal portion of the trunk - 3 feet height) after scraping the loose bark to prevent oviposition by adults.

b. Hook out the grub from the bore hole and apply monocrotophos 36 WSC 5 to 10 ml/ bore hole (or) one celphos tablet (3 g aluminum phosphide)/bore hole (or) apply carbofuran 3G 5 g/bore hole and plug with mud.

c. Injection of dichlorvas (DDVP) + monocrotophos solution into bore holes after removing the webs and subsequently sealing of the holes with clay gives satisfactory control of the pest.

Cocoa Fruit Borer *(Conogethes punctiferalis)*

Though considered as a minor pest, nowadays it is recorded as an emerging pest. Caterpillar after emerging from eggs feed on rind/husk of cocoa pods later bore and feed on the internal contents of the pods extruding the granular faecal pellets which are seen outside the pods.

Management:

a. Field sanitation and collection, destruction of infested cherelles and pods from the plantations

b. Flubendiamide and Spinosad are effective against this pest.

References

1. Daniel M., (1994). Pests of cocoa. In advances in horticulture. Vol 10. Plantation and spice crops. Part 2. Edited by Chadha K.L. and Rethinam. P. Malhothra Publishing house, New Delhi, pp.743-758.
2. Thube S., Saneera E. and Prathibha P.S., (2016). Pests of Cocoa and Their Management. The Cashew and Cocoa Journal.

Organic Farming: The Future of Indian Agriculture

Article ID: 11590

Bimolkishor Wahengbam[1], Rubina Gill[2]

[1]Ph.D scholar, Department of Agronomy, School of Agriculture, Lovely Professional University, Phagwara, Jalandhar, Punjab, India, 144411 and [2]Associate Professor Agronomy, LPU, Phagwara, Jalandhar, Punjab, India, 144411, Corresponding Author: Rubina Gill.

Abstract

Organic farming is a technique, which involves the cultivation of plants and rearing of animals in natural ways. Organic farming which is a holistic production management system that promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. Indian farmers apply heavy doses of chemical fertilizers in their field, to get maximum production because of which the soil is becoming unhealthy day-by-day. Excess use of chemical fertilizers and pesticides effect the eco-system and polluting the environment. So, the Indian farmers should move to organic farming gradually to keep everyone healthy.

Keywords: Organic Farming, Biodiversity, Ecosystem, Biological Cycles, Biological Activity.

Introduction

Organic Farming is a system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives etc.) and to the maximum extent feasible rely upon crop rotations, crop residues, animal manures, off-farm organic waste. Organic farming is a technique, which involves the cultivation of plants and rearing of animals in natural ways. This process involves the use of biological materials, avoiding synthetic substances to maintain soil fertility and ecological balance thereby minimizing pollution and wastage. "It is a holistic production management system that promotes and enhances health of agro-ecosystem, including biodiversity, biological cycles and soil biological activity".

Fig: Organic field

Organic Farming in India

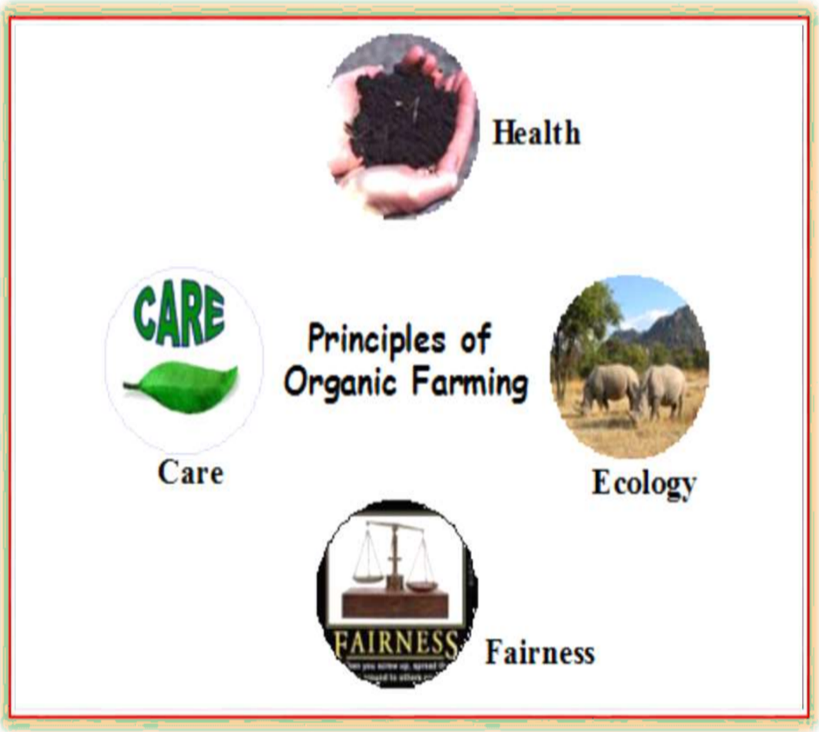
The tradition of organic farming is not new in India. Organic agriculture in India started long back 1900 by Sir Albert Howard a British agronomist, in local village of Madhya Pradesh, India. The state of Sikkim declared fully organic state in the year 2003. Much more use of these chemicals in agriculture not alert the ecosystem but it claims with death to many lives every year due to their hazardous nature. About 2.78 million hectares of farmland was under organic cultivation as of March 2020, according to the Union Ministry of Agriculture and Farmers' Welfare. This is 2% of the 140.1 million ha net sown area in the country. The top 10 states with most organic practice according to 2019-2020 data are:

Sl.no.	State	Area (ha) 2019-2020
1	Madhya Pradesh	1161015.03
2	Rajasthan	539245.81
3	Maharashtra	293135.19
4	Jammu & Kashmir	215275.95
5	Chhattisgarh	208392.80
6	Himachal Pradesh	204836.35
7	Karnataka	170418.49
8	Uttar Pradesh	132031.67
9	Odisha	115676.68
10	Gujarat	95207.58

Why is Organic Farming Necessary?

1. Organic farming which is a holistic production management system that promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity is hence important.
2. Many studies have shown that organic farming methods can produce even higher yields than conventional methods.
3. Organic farming improves quality, shelf and nutritive value of the farm produce.
4. It encourages sustainable livelihood of the producers as well as safeguards consumers health.
5. It improves the physical, chemical and biological health of the soil.
6. Promotes healthy use of the natural resources and minimizes all forms of the pollution.
7. It enhances and sustains biological diversity within the system.

Principles of Organic Farming



1. Principle of health.
2. Principle of ecology.
3. Principle of care.
4. Principle of fairness.

Objectives of Organic Farming

1. Produce food with higher nutritional quality.
2. Work with natural system.
3. Maintain and increase soil fertility.
4. Use renewable resources as far as possible.
5. Avoid pollution.
6. Wider social and ecological impact of farming system.
7. Allow satisfaction to agricultural producer.

Limitation of Organic Farming in India

1. Small land holding.
2. Poor infrastructure facilities.
3. Lack of technology knowledge.
4. Convert organic farm.
5. Neighbouring farmer well co-operate.
6. Organic material such as animal dung and other crop waste used for fuel purpose.
7. Organic material is bulky in nature very difficult store and high price.
8. City garbage contain heavy metal, plastic bags, stones and needles.
9. Bio control agent are available only few selected insect pests.
10. Complicated organic certification process and high fees cost.
11. Higher human population of India.

Components of Organic Farming

1. Vermicompost.
2. Green leaf manures.
3. Crop rotation.
4. Biological management.
5. Animal husbandry.
6. Biofertilizers.
7. Manures.

Conclusion

With the excess use of chemical fertilizers in India in an alarming rate, the agricultural producers must be concerned about the pollution of soil, and the disturbing eco-system. The best way to stop this is to encourage the use of organic practices in large scale. This will control the environment condition of this country in an unknowingly way. Not only for the environment it will be a great improvement in the health of the consumers also.

References

1. P. Saravana Pandian*, S. Subramanian, P. Paramasivam and K. Kumaraswamy; ORGANIC FARMING IN SUSTAINING SOIL HEALTH - A REVIEW.Agricultural Reviews.2005.
2. S. Roy and K.N. Dhumal; ORGANIC AGRICULTURE: THE INDIAN SCENARIO.Agricultural Reviews.2011.
3. Sandeep Kaswan, Vineet Kaswan and Rajesh Kumar; ORGANIC FARMING AS A BASIS FOR SUSTAINABLE AGRICULTURE - A REVIEW.Agricultural Reviews.2012.
4. V. Kavitha and K. Chandran; Organic farming in conserving bio diversity in India-A review.Agricultural Reviews.2017.
5. Vijay Kumar, Veer Sain and D.P. Malik; Eco - Friendly System of Cropping.Bhartiya Krishi Anusandhan Patrika.2019.
6. Chanchal Yadav, Sonali Pandey; Status of the use of Organic Fertilizers in India: A Review.Agricultural Reviews.2020.
7. Union Ministry of Agriculture and Farmers' Welfare, 2020.
8. Agricultural & Processed Food Products Export Development Authority, 2020.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

The Role of Nanotechnology in Postharvest Management of Horticultural Crops

Article ID: 11591

Maraboina Sandhyarani[1], Malikireddy Jasmitha[2]
[1]Ph.D. Scholar (Fruit Science), Dr. Y. S. R Horticultural university, College of Horticulture, Venkatramannagudem.
[2]Ph.D. Scholar (Vegetable Science), Dr. Y. S. R Horticultural university, College of Horticulture, Venkatramannagudem.

Abstract

The postharvest losses of horticultural products are major problem in getting maximum profit from the crop production. Postharvest activities include crop harvesting, handling, processing, packaging, storage, transportation and marketing. They may be due to several factors and includes growing conditions to handling and marketing.

However, such losses of fruits and vegetables are difficult to measure but can be prevented by adopting good management practices. such as pre-cooling, temporary storage, transport, and market distribution. The application of novel sciences like biotechnology and nanotechnology can be highly effective in decreasing postharvest wastage and can be considered as the best method to control this problem. Now a days, nanoparticle science is becoming one of the most imperative tools in modern agro-horticulture pre harvest and post-harvest production sectors.

Various biological agents such as microbes (*Bacillus* spp. *Pseudomonas* spp. *Fusarium* spp. *Chlorella* spp. etc.) and plants/plant extracts (Neem, garlic, aloe, tea etc.) have emerged as economical and efficient candidates for the synthesis of nanoparticles by green synthesis approaches. Due to higher solubility, stability and eco-friendly biodegradable nature of nanoparticles, it finds immense application in sustainable agro-horticulture food chain.

Nanoparticles having particular characteristics are useful in postharvest technologies. It can improve the post-harvest shelf life by controlling the growth, development and spread of disease-causing microorganisms. With the development of new generation of packaging coverage's (Films), increasing strength, quality and packaging beauty and using the nanobiosensors for labelling the food products has proved beneficial for controlling postharvest losses.

Introduction

Horticultural products waste is estimated around 42% in developing countries, so even if we manage to reduce this amount for 5-10%, huge saves will be obtained. Now, increasing production efficiency and decreasing post-harvest wastage with using novel sciences such as biotechnology and nanotechnology in products, could be counted as the best solution to this problem. Generally, conventional preservation methods for fruits and vegetables mainly include physical-related preservation, chemical-related preservation and biological-related preservation.

Though every preservation method has different emphasis, they all regulate three major factors that play a pivotal role in preservation of quality:
1. Controlling the senescence process, which generally through the control of respiration.
2. Controlling microorganisms, that mainly through the control of spoilage bacteria.
3. Controlling the internal water evaporation, which mainly realized by controlling relative humidity of the environment.

What is Nano Technology?

Nanotechnology is the understanding and control of matter at dimensions of roughly 1 to 100 nanometers, the size-scale between individual atoms and bulk materials, where unique phenomena enable novel applications. At the nanoscale, the physical, chemical, and biological properties of materials can differ in fundamental and useful ways from the properties of bulk matter thereby ensuring new uses for existing materials.

Highly Efficient Applications of Nanotechnology Related Strategies

1. Nanotechnology-related intelligent label system.
2. Nanotechnology-related detection methods:
    a. Microbial detection.
    b. Detection of structure.
3. Nanotechnology-related active packaging:
    a. Antioxidant film.
    b. Antimicrobial film.
    c. Controlling ripening by absorption of ethylene.
4. Nanotechnology-related combined preservation strategies.

Role of Nanotechnology in Postharvest Management

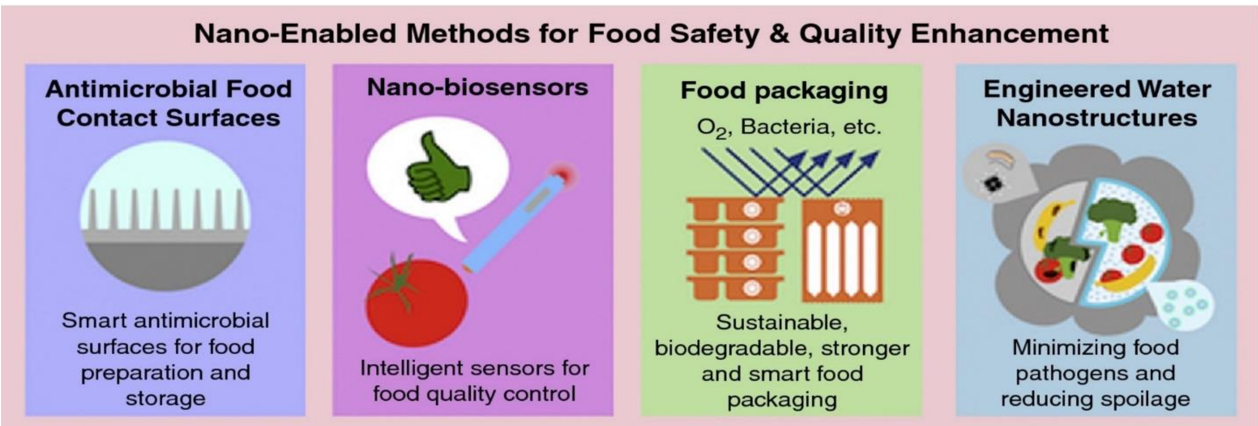
1. Coatings has proved to be effective in reducing losses in storage as it acts as carriers of useful ingredients like antioxidants, antimicrobial compounds, anti-ripening compounds, colour or aroma additives. It has many advantages such as retardation of ripening, reduction of water loss, chilling, mechanical injury and decay. It also adds shine to the coated products. Different coating materials can be used like lipids, polysaccharides, proteins or a combination of these materials (Baldwin et al., 1996).

2. Natural antimicrobial compound, Chitosan [Poly b-(1-4) N-acetyl-d-glucosamine] can be used to lower the postharvest decay of horticultural products. It is deacetylated form of chitin which is an eco-friendly means of pre and postharvest diseases control. It has been reported that Chitosan being a natural compound can successfully substitute the synthetic fungicides by improving resistance in tomato against gray mould caused by B. cinerea.

3. Nanotechnology is using for antifungal in many fruits and vegetables. A technology has been developed to produce zinc oxide nanoparticles using microbial approach. Some nanoparticles have been used for antifungal in vitro culture and postharvest of banana, carrot, tomato, onion and etc.

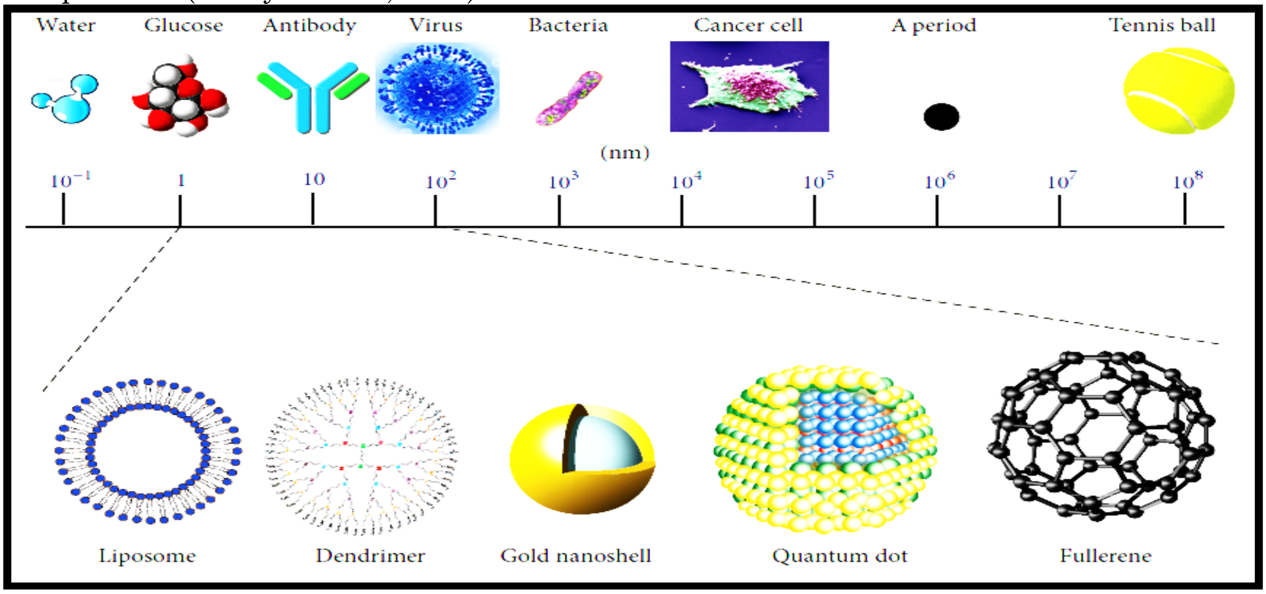
4. The introduction of a new generation of packaging coverages (films) has been useful in protecting post-harvest produces. The mixtures of polymers with organic or inorganic additives of certain geometries (spheres, flakes, fibres, particulates) produce polymer composites. With the use of nanoscale fillers, polymer nanocomposites are developed that has become a radical substitute for the conventional polymer composites. The nanocomposites have proved to be successful in expanding the use of biodegradable and edible films (Sinha Ray and Okamoto, 2003).

5. Titanium dioxide (TiO2), semiconductor nanoparticles are focus photocatalysts in photocatalysis because of their physical and chemical stability, ease of availability, low cost and non-toxicity. The nano-TiO2 has light catalyzing capability which can oxidize ethylene into water and CO2 . Similarly, silver ions are also important nanoparticles due to their semiconductor photocatalysis, nanocrystallites, photoactivity and antibacterial properties. Nano-Ag has proved to have more effective antibacterial activity compared to Ag+ with the property of absorbing and decomposing ethylene (Hu and Fu, 2003).



6. Nanotechnology aids in improving the quality and strength of packaging material. The packages produced by adding nano particles have stronger mechanical and thermal resistance. To ensure food safety, nano-structured materials prevent the entry of bacteria and micro-organisms in food items.

7. Nanobiosensors embedded in packaging can alert the consumer when a food has become non-edible and can be used in plant and insect virus recognition by development and characterization of nanocomposite materials and many other viruses' recognition by using antibody sensor arrays on nanoscale block copolymer patterns (Charych et al., 1996).



Nanomaterials are seen, ranging from a scale of 1 to 100 nm. The reduced size of these nanomaterials makes them efficient.

Conclusion

Nanotechnology has brought forth a revolutionary effect on the food processing and preservation industry. There are definite advantages of the technology but the drawbacks are equally prominent. Several food industry giants are paying in millions to develop Nano systems that will help preserve industry. Researchers are trying to develop better and more efficient Nano carriers with increased level of bioavailability without compromising the appearance and taste of the food products in which these carriers are incorporated. The idea of "Smart Packaging" is slowly being realized and research is being carried out in developing antigen specific biomarkers used in packaging of food and also the incorporation of nanoparticles to make polymer nanocomposite films. The antigen specific biomarkers will help to detect the presence of the organism responsible for the spoilage of the food material.

References

1. Baldwin, E. A., Nisperos, M. O., Chen, X. and Hagenmaier, R .D. 1996. Improving storage life of cut apples and potato with edible coating. Postharvest Biol. Tech. 9(2):151-163. Benhamou, N. 1996. Elicitor-induced plant defence pathways. Trends Plant Sci. 1:233- 240.
2. Charych, D., Cheng, Q., Reichert, A., Kuziemko, G., Stroh, N., Nagy, J., Spevak, W. and Stevens, R. 1996. A 'litmus test' for molecular recognition using artificial membranes. Chem. Biol. 3:113.
3. Hu, A. W., Fu, Z. H., 2003. Nano technology and its application in packaging and packaging machinery, Packag. Eng. 24, 22-24.
4. Sinha Ray, S., Okamoto, M., 2003. Polymer/layered silicate nanocomposites: a review from preparation to processing. Progress Polym. Sci. 28, 1539-1641.

Farmers Service Societies in Kole Lands of Thrissur District Kerala - An Overview

Article ID: 11592

Akshaya M. V[1], J. Pushpa[2]
[1]P.G scholar, [2]Professor, Department of Agricultural Extension and Rural Sociology, Tamil Nadu Agricultural University, Agricultural College &Research Institute, Madurai- 625 104.

Introduction

Kerala is one of the front runners of Agriculture in South India has twenty-three agro-ecological units with various climate variability, land form and soil pattern. The Kole land's agro-ecological units constitute a major share in paddy cultivation spread and is over Thrissur and Malappuram districts of Kerala. The word Kole in regional language means 'luck or bumper yield' which indicates the particular way of cultivation adopted by the farmers. Kole lands are enriched with diverse agri-ecosystem and other allied activities like prawn farming, duck farming, cattle rearing etc.

During1960's, farmers of Kole land organised to form, joint-farming cooperative societies called 'Padav, Padasekharam'. The management of padav or societies is operated by a committee which is constituted by elected members consisting of a president, two secretaries and several coordinating members. This societies were initially involved in providing guidance to the farmers in cultivation related aspects, pooling resources and supervision. Farmers cultivate their area individually and management activities were vested with societies. There after Kole land started facing drastic reduction in the yield due to decrease in the area and number of interested farmers.

This has warranted committee to extent their helping hands to sustain the farming in Kole areas. The present investigation probes into the various managerial activities which brought out revolutionary changes in successful farming at Chenam of Thrissur district of Kerala.

Reasons for Reduction in Number of Farmers

1. Non availability of labourers.
2. High wages.
3. Severe pests and diseases attack
4. Changing pattern of monsoon and periodic moisture stress condition.
5. Inadequate Government intervention.
6. Inability to perform timely weed management practices.
7. High input cost.

All these reasons led to dwindling of Kole land cultivation.

This scenario enforced the societies to strengthen their efforts and the committee put forth the following strategies for the revival of Kole lands in collaboration with Government.

a. Initiation regarding supply of Machineries.
b. Arranging labourers on contract basis.

Chenam farming society consists of nearly 600 farmers which is extended over 760 hectares. Majority of the farmers are marginal for whom purchasing of machinery was a limitation. Farmers laid their field free without cultivation since they could not meet the labour requirement at reasonable cost. Thus, joint farming cooperative societies took initiative to carry out the cultivation practices of all the farmers including small and large together by assigning workers and machines on contracts basis. This step became significant milestone in the history of Chenam farmers.

Kerala which was an agrarian economy has undergone changes in the employment pattern. Keralites who solely depended on agriculture started creeping into the non-agriculture sector which led to non-availability of labour for agriculture purposes. This necessitated farming societies to arrange migrant labourers for farming and allied activities. Migrant labourers engaged in all farm activities like native labourers at the cheapest wage rate. The temporary settlements offered by the committee for migrant labourers could ensure their ready availability all over the cropping season.

Timely Farm Advisory Services and Date Base for Kole Land Agriculture

Farming societies maintain a register in which all the details regarding the farmers, crop grown, practice to be followed in each stage of the crop etc are recorded. Each Kole is supervised by respective agriculture officers who give necessary information regarding pests, diseases occurrence, fertilization. Farming societies execute all the operations like sowing, transplanting, fertilizing, spraying, harvesting by arranging the harvesters for all farmers in timely manner in all fields on the prescribed dates. Timely control of pests, diseases and weeds increased the yield of Kole farmers. The only the duty of the farmer, is to visit the fields and inform the updates of crop condition regularly.

Provision of Subsides

Farming societies were formed to maintain the Kole lands in full strength, which increased the yield there by ensured better profit for farmers. Pest's attack, diseases occurrence, shifting monsoon pattern etc all these risk factors has been greater threats which discouraged many farmers for further cultivation. Societies tackled all those risk by timely support such as providing subsidies, crop insurance etc. After harvest, even marketing of the produces was taken care by the committee by linking with sales agents and warehousing cooperation and thus marketing risk was solved. Individual risk was reduced to a larger extent since the whole cultivation practices were completely monitored by the committee members. This imparted credibility in the farming community on societies which lead to increased production in the lands of Chenam.

Other Services of Societies

Committee arranged meetings for farmers in which requirements of all farmers were discussed. The farmer's children were given rewards after completing SSLC for perusing further studies. Further, the committee members have to enhance their standard living, from farming activities.

Conclusion

Farming societies have become life blood of Kole lands and started playing a key role in attracting the farmers back to agriculture. Kole lands has now turned into evergreen hub of agriculture by the timely involvement of joint farming cooperative societies. Mr. Suresh, P K, a member of society has expressed that Agriculture is no longer a risky occupation rather it has turned into an effortless venture.

References

1. Jeena T Srinivasan (2010). Understanding the Kole Lands in Kerala as A Multiple Use Wetland Ecosystem,RULNR working paper No.5,Research Unit for Livelihoods and Natural Resources, Centre for Economic and Social Studies,Hyderabad.
2. Deepak Johnson (2018). Rice Cultivation in Kole Wetlands of Kerala,Kolebirders community portal.
3. Puthuma Joy (2016). Impact Of Migrant Workers In The Kerala Economy, International Journal of Informative & Futuristic Research,volume 2 issue 8,published:26th April 2016.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Gene Pyramiding: Technique for Assembling Multiple Desirable Genes into a Single Genotype

Article ID: 11593

Malikireddy Jasmitha[1], Maraboina Sandhyarani[2]
[1]Ph.D. Scholar (Vegetable Science), Dr. Y. S. R Horticultural university, College of Horticulture, Venkataramannagudem.
[2]Ph.D. Scholar (Fruit Science), Dr. Y. S. R Horticultural university, College of Horticulture, Venkatramannagudem.

Abstract
The development of molecular genetics and associated technology like marker assisted selection has led to the emergence of a new field in plant breeding-Gene pyramiding. Pyramiding entails stacking multiple genes leading to the simultaneous expression of more than one gene in a variety to develop durable resistance expression. Gene pyramiding is gaining considerable importance as it would improve the efficiency of plant breeding leading to the development of genetic stocks and precise development of broad-spectrum resistance capabilities. The success of gene pyramiding depends upon several critical factors, including the number of genes to be transferred, the distance between the target genes and flanking markers, the number of genotypes selected in each breeding generation, the nature of germplasm etc. Innovative tools such as DNA chips, micro arrays, SNPs are making rapid strides, aiming towards assessing the gene functions through genome wide experimental approaches. The power and efficiency of genotyping are expected to improve in the coming decades.

Introduction
Watson and Singh (1953) first introduced the concept called gene pyramiding. Gene pyramiding is defined as a method aimed at assembling multiple desirable genes from multiple parents into a single genotype. The end product of a gene pyramiding program is a genotype with all of the target genes. Gene pyramiding is a breeding method aimed at assembling multiple genes with known effects on target traits. It is mainly used in improving existing elite cultivars for a few unsatisfactory traits, for which genes with large positive effects are identified. Traditionally, the identification of the sources of useful gene is very slow and breeder's capability to trace the presence or absence of the target genes is limited. This limits the number of genes to be incorporated into elite cultivars at any times (Joshi et al., 2010). The development of modern molecular and genomics technology has not only accelerated the discovery of favourable gene but also widened the sources of useful genes.

Distinct Gene Pyramiding Scheme
In a gene pyramiding scheme, strategy is to cumulate into a single genotype, genes that have been identified in multiple parents. The use of DNA markers, which permits complete gene identification of the progeny at each generation, increases the speed of pyramiding process. In general, the gene pyramiding aims at the derivation of an ideal genotype that is homozygous for the favourable alleles at all the loci. The gene pyramiding scheme can be distinguished into two parts (Fig. 1). The first part is called a pedigree, which aims at cumulating of all target genes in a single genotype called the root genotype. The second part is called the fixation step which aims at fixing the target genes into a homozygous state i.e., to derive the ideal genotype from the one single genotype. Each node of the tree is called an intermediate genotype and has two parents. Each of this intermediate genotype variety can resist. Moreover, pyramiding can also improve becomes a parent in the next cross. The intermediate genotypes are not just an arbitrary offspring of a given cross but it is a particular genotype selected from among the offspring in which all parental target genes are present. Although the pedigree step may be common, several different procedures can be used to undergo fixation in gene pyramiding. Generation of a population of doubled haploids from the root genotype is a possible procedure for the fixation steps. Here, a population of gametes is obtained from the genotypes and their genetic material is doubled. This leads to a population of fully homozygous individuals,

among which the ideotype can be found. Using this process, the ideal genotype can be obtained in just one additional generation after the root genotype is obtained. However, producing large population of doubled haploid is difficult and cumbersome in certain plant species.

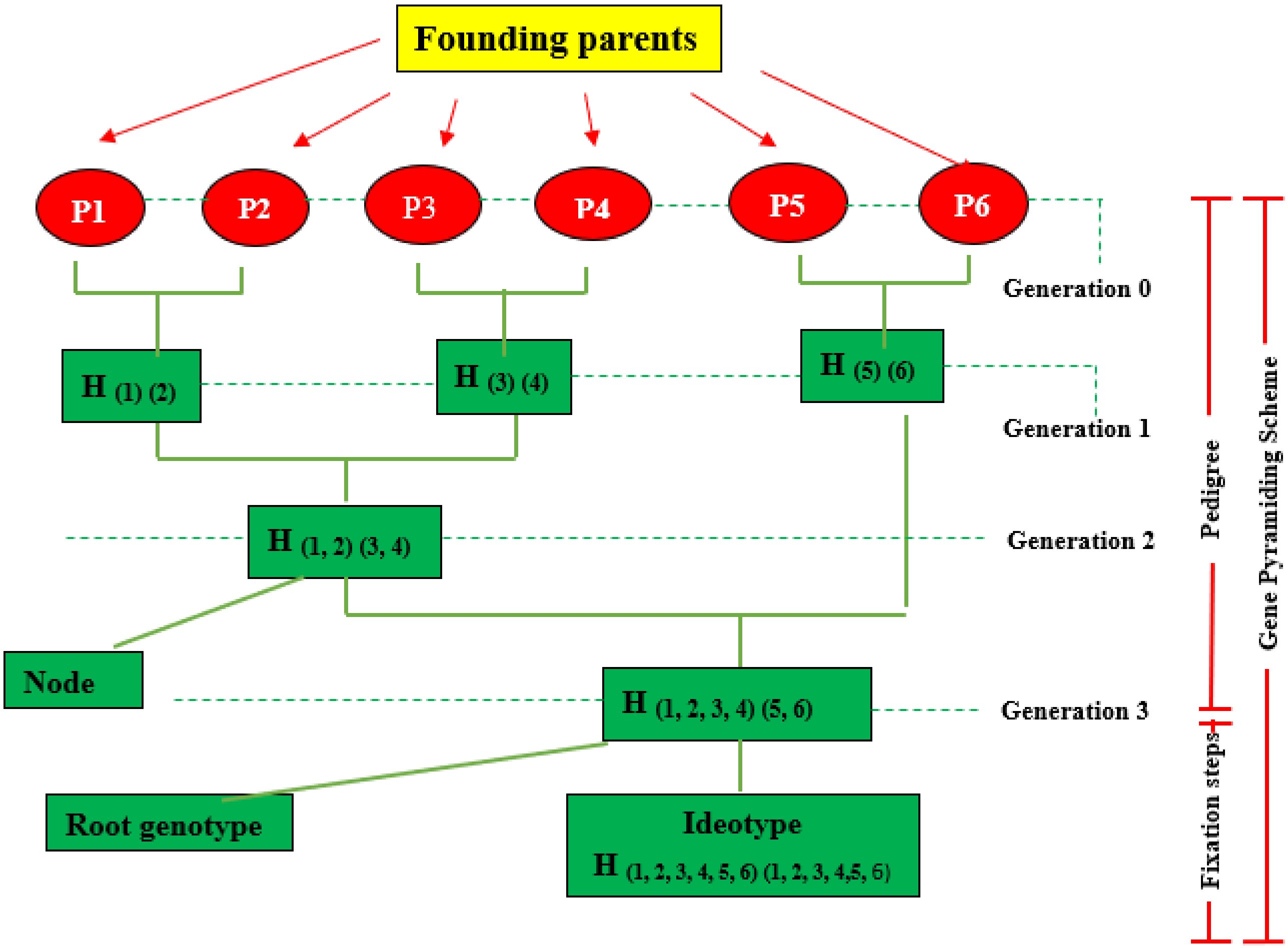


Fig. 3: A distinct gene pyramiding scheme cumulating six target genes (Hospital et al., 2004).

A possible alternative to this method is to self the root genotype directly to obtain the ideal genotype. However, selfing the root genotype will result in the breakage of linkage between the desired alleles and it will be difficult to derive these breaks as the linkage phase is rarely visible in selfed populations. As a result, it may span too many generations thereby stretching the gene pyramiding scheme.

Another alternative to all these methods would be to obtain a genotype carrying all favourable alleles in coupling by crossing the root genotype with a parent containing none of the favourable alleles. This confirms that the linkage phase of the offspring is known and the genotype can be derived without any mixing. The ideal genotype will be reached within two generations after the root genotype. However, instead of crossing with a blank parent, a more simplified method would be to cross the root genotype with one of the founding parents. In such programs, the linkage will still be known, and the selection will be for genotypes that are homozygous for the target gene brought by the founding parent but heterozygous for other regions. The desired genes need not be fixed subsequently, thereby increasing the probability of getting the ideal genotype.

Advantages Gene Pyramiding

1. Widely used for combining multiple disease resistance genes for specific races of a pathogen 2. Pyramiding is extremely difficult to achieve using conventional methods.
3. Consider - phenotyping a single plant for multiple forms of seedling resistance-almost impossible.
4. Important to develop 'durable' disease resistance against different races.
5. Main used to improve existing elite cultivar.
6. Eliminates extensive phenotyping.
7. Control linkage drag.

8. Reduces breeding duration.

Limitations of Gene Pyramiding

1. Lots of efforts have to made to incorporate several major gene into single cultivar.
2. Pyramiding is extremely difficult to achieve using conventional methods.
3. It is very difficult to integrate one gene from one cultivar or one species to another one by conventional method.
4. Stability of all desired gene in one plant is another issue which limited the gene pyramiding.

Conclusion

Gene pyramiding is an important strategy for crop improvement. Pyramiding requires that breeders consider the minimum population size that must be evaluated to have a reasonable chance of obtaining the desired genotype. Molecular marker genotyping can facilitate the gene pyramiding process by reducing the number of generations that breeders must evaluate to ensure they have the desired gene combination.

References

1. Hospital, F., Servin, B., Martin, O. C., Mezard, M., 2004. Gene-pyramiding scheme cumulating six target genes. Genetics. 168(1), 513–523.
2. Joshi, R. K. and Nayak, S., 2010. Gene pyramiding-A broad spectrum technique for developing durable stress resistance in crops. Biotechnology and Molecular Biology Reviews. 5(3): 51-60.
3. Malav, A. K., Chandrawat, K. S., 2016. Gene pyramiding: An Overview. Int. J. Curr. Res. Biosci Plant Biol.3(7): 22-28.
4. Watson, I.W., Singh, D., 1952. The future of rust resistant wheat in Australia. J. Aust. Inst. Agric. Sci. 28, 190-197.

Impact of Covid-19 on Horticultural Crop Production

Article ID: 11594

Shiv Kumar Ahirwar[1]

[1]Ph.D. Research Scholar, Department of Horticulture (Fruit Science), Jawahar Lal Nehru Krishi Vishwa Vidyalaya, Jabalpur MP 482004.

Abstract

Indian farmers facing post-harvest losses and the primary causes of which are poor storage and transportation facilities. Since a market is the primary medium for farmers to exchange their produce for money, lack of connectivity to ensure that their harvest reaches markets in time results in lowering of the farmers ability to monetize their produce. This becomes even more critical in case of perishable fruits and vegetables. COVID-19 has had unprecedented effects on the US economy, in large part because of its effects on workers. Within food and agriculture, these effects pose the greatest threat to the production of labor-intensive commodities—in particular, fruits and vegetables, the production of which tends to require large numbers of workers for harvesting and packing. We econometrically estimate the effects of COVID-19 on fruit and vegetable production as the US agricultural labor supply is adversely affected by this pandemic. The major crop losses include $16 million in lettuce, $5 million in apples, and $4 million in grapes.

Keywords: COVID-19, Fruit and vegetable production, Indian Farmers, Transportation Facilities.

Introduction

The novel Coronavirus (COVID-19) pandemic has rapidly spread across the world, adversely affecting the lives and livelihoods of millions across the globe. Given that the disease is highly contagious, the much-needed nation-wide lockdown was enforced starting 25 March 2020 in order to contain the spread of COVID-19 pandemic. India reported its first infection on 30 January 2020, prompting the authorities to initiated various measures like, different vaccines (Covaxin, Covishield, SputnikV- major effective vaccines) to contain the spread of the epidemic. During the initial few weeks, the restrictions were strict and all non-essential activities and businesses, including retail establishments, educational institutions, places of religious worship, across the country were prohibited from operating. A number of reports have pointed towards the possibility of contraction of Indian GDP in 2020-21. This is a worrisome indication, since a higher GDP contributes immensely towards achieving better living standards, reduced poverty as well as improvement in other socio-economic indicators. As one of the most labor-intensive sectors in agriculture (USDA-ERS 2016), fruit and vegetable production is one of the sectors with the most at stake in light of COVID-19's threats to the farm labor force. The challenges posed by the COVID-19 epidemic threaten an industry that has already been under siege from ongoing labor shortages (Charlton and Taylor 2016; Richards 2018). We explore COVID-19's effects on fruit and vegetable production in light of the ongoing and widespread proliferation of COVID-19 in the farm labor force. To accomplish this, we employ detailed county-level data on employment in agriculture, use of nonlabor inputs, and commodity-level production to econometrically estimate the relationship between labor supply and the production of labor-intensive fruits and vegetables.

COVID-19's Effects on Horticulture Crops

Horticulture being a perishable crop was adversely affected during the lockdown even though there was no restriction on sale of fruits and vegetables in the market, except ban on operations of rural markets. All states except Gujarat (5%), Rajasthan (2.5%) and Karnataka (1.7%) have witnessed a decrease in production in the horticulture sector. Amongst the larger states, Himachal Pradesh, Chhattisgarh and Tamil Nadu faced the highest decline of 18%, 17.9 and 13.9% respectively. In the agriculture subsector, most of the states have witnessed a decline in production. States like Chhattisgarh (13%) and Himachal Pradesh (15%) have witnessed a sharp decline in agriculture production. However, some large agricultural states like Telangana (23 % increase), Punjab (5%), Rajasthan (4.4%) and Gujarat (6.7%) have actually shown an increase in agricultural production which may be attributed to the fact that rabi season had witnessed a bumper crop production and harvesting of the crops had been completed in many of the states before the onset of the pandemic and the lockdown. The impact of COVID-19 is uneven on the prices of horticulture sector commodities. Some states like Arunachal Pradesh (15%), Kerala (13%) and Mizoram (10.7%) have reported an increase in the prices of horticulture commodities. Whereas, states like Karnataka (23%), Tamil Nadu (15.8%), Telangana (15%) and Madhya Pradesh (13.3%) have reported a decline in prices of horticulture commodities. At the aggregate all-India level, there was a 7.6% decline in prices of horticulture products. India's fruits and vegetable exports are likely to decline by 30-40% during the ongoing grape and mango season due to global lockdown that has been implemented to prevent the spread of the coronavirus (Covid-19) pandemic. Prime Minister Narendra Modi's announcement of a lockdown (a measure similar to curfew) for three weeks beginning March 24 has brought the entire value of fruits and vegetables to a standstill. Despite several efforts to revive mandis, distribute essentials and instruct ports to facilitate exports, the situation is far from normal. "Farmers. Our analysis of COVID-19's effects on fruit and vegetable production is comprised of two main elements. First, in order to predict the production response to COVID-19-induced disruptions in the farm labour supply, we must estimate the relationship between fruit and vegetable production and labour use, accounting for other inputs such as land, machinery, and chemicals. To achieve this, we estimate a county- and commodity-level production function and obtain the output elasticity of labour. Second, based on these estimates of the output elasticity of labour, we calculate the expected reduction in fruit and vegetable production by county as a function of the reduction in the labour supply based on the two alternative scenarios for active COVID-19 case rates described above. This allows us to predict, by county and commodity, the anticipated production losses in labour-intensive fruit and vegetable from the pandemic. To accomplish these tasks, we need to address two data-related issues. First, the extent of the virus's spread has varied widely across regions. Systematic evidence on the virus's spread in the farm labour force is not yet available, but farm workers are arguably at an elevated risk of contracting the virus.

Fig- Tomato growers of Haryana see red as prices crash to 3 rupees/Kg- Chandigarh

The wide variation in demographic and economic conditions across counties, policy responses from state and local governments of differing intensity and duration, and other unexplained factors have led to some regions experiencing widespread outbreaks, and others remaining relatively unscathed. This implies that an analysis that was to only consider state-level or regional outcomes would neglect important geographical variation; we therefore construct our estimates at the county level for the forty-eight contiguous US states. Second, fruit and vegetable production vary substantially in the degree to which operational practices rely on manual labour. For example, while the harvest of some lemons, grapes, and onions can be aided by machinery, commodities such as lettuce and fresh-market cherries are harvested and processed almost entirely by hand. Therefore, the effects of changes in the labour supply will differ from commodity to commodity, even within labour-intensive fruit and vegetable production. We thus break down our estimates across specific products, focusing on the labour-intensive fruits and vegetables for which labour-supply effects are likely to be most pronounced.

Fig- Largest losses of fruits and vegetables during Covid-19 in 2020-21

Conclusion

Fruit and vegetable production relies heavily on labour and faces significant challenges arising from COVID-19-induced disruptions to its workforce in addition to the critical labour shortages it already faces. Compounding these challenges is the fact that many of the worst outbreaks have occurred in major fruit- and vegetable-producing areas, with the crowded conditions under which farm laborers live and work exacerbating the virus's rapid spread. Based on these estimates and current active COVID-19 infection rates by county, we then forecast the likely production losses across commodities and geographical regions from shocks to the farm labour supply under conservative and extreme scenarios. In both scenarios, we anticipate that disruptions to the labour force in fruit and vegetable production will cause millions of dollars in lost production. These losses are incurred across several important commodities, including lettuce, apples, grapes, and strawberries, the production of which tends to be located in areas hit hard by the epidemic. The federal government was swift in its reaction to outbreaks among workers in the meat processing sector, but protections for the large number of workers involved in fruit and vegetable production have been slow in coming.

References

1. Barnes, Andrew. 2008. Technical Efficiency Estimates of Scottish Agriculture: A Note. Journal of Agricultural Economics 59(2): 370– 376.
2. Bernton, Hal 2020. Farmworker Death Draws State Scrutiny in Okanogan County, Where Covid-19 Cases Are Spiking. The Seattle Times, July 25, 2020,
3. Centers for Disease Control and Prevention (CDC). 2020. Coronavirus Disease 2019 – Racial and Ethnic Minority Groups. US Centers for Disease Control and Prevention.
4. Charlton, Diane, and J. Edward Taylor. 2016. A Declining Farm Workforce: Analysis of Panel Data from Rural Mexico. American Journal of Agricultural Economics 98(4): 1158– 1180.
5. Christensen, Laurits, Dale Jorgenson, and Lawrence Tau. 1973. Transcendental Logarithmic Production Frontiers. Review of Economics and Statistics 55(1): 28– 45.
6. Evans, Alun, Christopher Green, and Victor Murinde. 2002. Human Capital and Financial Development in Economic Growth: New Evidence Using the Translog Production Function. International Journal of Finance and Economics 7: 123– 140.
7. Hoang, Mai 2020. Workers at 6 Yakima-area Fruit-packing Plants Strike Over Coronavirus Concerns. The Seattle Times, May 18, 2020.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Impact of Cellular Examination in Oak Tasar Grainage Activities, *Antheraea proylei*

Article ID: 11595

Jagadjyothi Binkadakatti[1]
[1]Scientist-C, Research Extension Centre, CSB, Palampur, Himachal Pradesh, India.

Abstract

In India, recently the oak tasar cocoon production was drastically reduced due to certain virulent disease in oak tasar silkworms. The infection led to the significant mortality of the batches of oak tasar silkworms and the damage caused by this disease decreases cocoon crop production up to 80%. Some of the diseases transmitted through mother moth. Therefore, it is very essential to avoid the transmission of disease during grainage activities itself. The seed sector is backbone for the development of the silk industry. Quality of oak tasar seed and efficiency of grainage depend on the quality of the cocoons, selection of healthy seed cocoon, effective microscopic examination and production of dfl's.

Many techniques were identified to produce Disease free layings, among which REC, Palampur started using new Cellular moth examination technique. During the year 2016, REC, Palampur started cellular moth examination by using small paper box of size Lenght-3.5", Width-4.5" and Height-2.5" (Inch), in which single female moth was kept for oviposition. After oviposition was completed, each moth was microscopically examined for identification of bacteria, virus, pebrin etc. if any microbes identified, then the dfl produced was rejected and destroyed immediately. The procedure was carried out from 2016 to 2018. Before 2016, mass oviposition was carried out. In which small nylon net was used to keep 10-15 moths together. Which results to tremendous loss/rejection of the dfl's after microscopic examination and decrease in the numbers of dfl's production was occurred. Simultaneously, reduction of the efficiency of the grainage activities also noticed.

Pooled data of mass examination and cellular examination indicated that, cellular examination resulted with decrease in cocoon-dfl ratio (from 13.64:1 to 4.36:1), decrease in rejection of dfl's after microscopic examination (from 51.74% to 4.54%) and increasing trend in success of grainage after layings obtained (from 48.26% to 95.21%). This trend clearly indicated that, cellular examination of egg layings was very much helpful for production of oak tasar seeds and successful grainage activities. It will help to increase the commercial production of the Oak tasar industry in India, which leads to indirect benefit to farming communities, scientist, students and other stake holders who are in connected with Oak tasar industry.

Keywords: Cellular and mass examination, Grainage, Paper box, Laying, *Antheraea proylei* etc.

Introduction

In India, tasar and oak tasar culture is practiced from the immemorial in tropical and temperate belts even prior to the introduction of mulberry in India. The tasar culture has substantial income generation potential especially for the tribal folk who lives in undulating forest regions. Indian oak tasar silk is produced by non-mulberry silkworm, Antheraea poroylei. The oak tasar silkworm is a temperate species feeds on different species of the leaves of oak tree Quercus species found only in the states of Arunachal Pradesh, Assam, Himachal Pradesh, Jammu and Kashmir, Manipur, Meghalya, Nagaland and Uttarkhand, is an important source of oak tasar silk, a rough and coarse silk usually with natural shades of beige. Recently, the oak tasar cocoon production was drastically reduced due to certain virulent disease in oak tasar silkworms. The infection led to the significant mortality of the batches of oak tasar silkworms and the damage caused by this disease decreases cocoon crop production up to 80%. Some of the diseases transmitted through mother moth. Therefore, it is very essential to avoid the transmission of disease during grainage activities itself. The seed sector is important for the development of the silk industry. A Grainage activity usually takes place during January/February for preponed spring crop, April/May for summer/Monsoon crop and in August for autumn crop. Quality of oak tasar seed and efficiency of grainage depend on the quality of the cocoons, selection of healthy seed cocoon, effective microscopic examination and production of dfl's. The many techniques were identified to produce Disease free layings, among which REC, Palampur started using new Cellular moth examination technique. During the year 2016, REC, Palampur started cellular moth examination by using small paper box with the following objectives i.e.

1. Reduction in rejection of dfl's after microscopic examination.
2. Decrease in Cocoon-dfl ration.
3. Increase in success of grainage after layings obtained.

Materials and Methods

Cocoons harvested during summer/monsoon and autumn were kept in the form of garland in hanging condition in preservation room at high altitude. During first grainage, after coupling and rejection of poor/dead layigs, each single mother moth was kept in small paper box of size Lenght-3.5", Width-4.5" and Height-2.5" (Inch) for oviposition. Same procedure was used for rest of the mother moths. After oviposition was completed, each single mother moth kept in paper box separately and microscopically examined for identification of bacteria, virus, pebrin etc. if any microbes identified, then the dfl produced was rejected and destroyed immediately. The procedure was carried out from 2016 to 2018. The data on numbers of cocoons processed, numbers of pairs obtained, numbers of layings obtained, number of layings rejected after microscopic examination, numbers of dfl's produced and cocoon dfl's ratio for both mass and cellular examination was collected. The three-year data for Mass examination (from 2013 to 2015) and cellular examination (from 2016 to 2018) was collected separately for data analysis.

Results and Discussion

Table no.1and Fig.No.1 & 2 indicated the comparison between mass examination and cellular examination of the mother moth. The data of three years 2013 to 2015 has been pooled and analyzed for mass examination of mother moths. The trend showed that, the cocoon-dfl ratio of pooled data was at higher side (13.64:1). Year wise data revealed that higher cocoon-dfls ratio 17.16:1 was observed during 2014 grainage followed by 14.18:1 (2013) and 5.87:1 (2015). Further, Rejection of dfl's after mass examination pooled data showed that, rejection of dfl's was high (51.74%) and highest i.e.,76.07% was noticed during the year 2013 grainage. Success of grainage after laying obtained (pooled data) was less than 50% (i.e.,48.26%) and lowest was observed during 2013 (23.93%) grainage. Therefore, the pooled data for mass examination clarified that mass examination was not useful in success of grainage activities. This is due to practice of keeping 10-15 layings in single nylon bag for oviposition. After examination of the mother moth, if we find any microbes in a lot of 10-15 dfls, we straight away reject whole lot. This resulted in loss of dfl's production, increase in cocoon-dfl ratio, increase in dfl's rejection percentage and decrease in success of grainage percentage.

At the same time the data of three years 2016 to 2018 has been pooled and analyzed for cellular examination of mother moth. i.e., Single mother moth examination. The trend showed that, the cocoon-dfl ratio of pooled data was at lower side (4.36:1). Year wise data showed that lower cocoon-dfls ratio 4.08:1 was noticed during 2017 grainage followed by 4.31:1 (2018) and 7.98:1 (2016). Rejection of dfl's after mass examination pooled data revealed that, rejection of dfl's was low (4.50%) and very low i.e.,2.2.64% was noticed during the year 2018 grainage. Pooled data indicated that, Success of grainage after laying obtained was more than 90% (i.e.,95.21%) and highest was recorded during 2018 (97.01%) grainage. Hence, pooled data trend for cellular examination indicated that cellular examination of each mother moth is very useful in success of grainage activities. This is due to keeping of each mother moth in small paper box separately and remarkable result was achieved for the success of grainage activities in Oak tasar. In India, we have separate seed organization for mulberry silk worm (NSSO), Tasar silk worm (BTSSO) and muga and silk worm (MSSO) but there is no such separate organization available for Oak tasar seed organization. To produce more number of quality Oak tasar dfls is very much necessary. Now days, availability of oak tasar seeds for commercial rearing is in scarcity as compared to other type of silk worms seeds. Therefore, new technique of cellular examination with help of a small paper box may be the paradigm shift in Oak tasar grainage activities.

Conclusion

Pooled data of mass examination and cellular examination indicated that, cellular examination resulted with decrease in cocoon-dfl ratio (from 13.64:1 to 4.36:1), decrease in rejection of dfl's after microscopic examination (from 51.74% to 4.50%) and increasing trend in success of grainage after layings obtained (from 48.26% to 95.21%). This trend clearly indicated that, cellular examination of mother moth was very much helpful for production of oak tasar seeds and successful grainage activities. It will help to increase the commercial production of the Oak tasar industry in India, which leads to indirect benefit to farming communities, scientist, students and other stake holders who are in connected with Oak tasar industry. Finally, it will definitely overcome the shortage of Oak tasar seed production in India, since oak tasar seed is very precious as compared to other silk worm seed sector.

References

1. Kumar, A and Ali, S, 2017. Study on the relative coupling behaviour of different tasar
2. Silkworms under various artificial conditions, International Journal of Current Research, Vol. 9, Issue, 07, pp.54384-54387.
3. Dinesh Kumar, J.P. Pandey , Jugnu Kumari , A.K. Sinha and B.C. Prasad , 2012. Evaluation
4. of Antheraea mylitta Cocoons Preservation for Synchronize Seed Production Through
5. Eco-tasar-friendly Technique. Ecologia, 2: 43-51.
6. Ahsan, M.M., Jolly, M.S., Khatri, R.K., 1974. Some preliminary studies on the various aspects
7. of grainage in tasar silkworm (A. mylitta. D). Proc.1st Int. conf. Non Mulberry Silk, 4-5 Oct., Central Silk Board, Ranchi, pp. 158-159.
8. Dash, A.K., et al. 1993. Effect of mating duration on the oviposition rate and hatchability of the
9. Indian tasar silk moth Antheraea Mylitta (Saturniidae) in different season. Journal of Research on the lapidoptera, 32: pp 75-78.

Farmers Service Societies in Kole Lands of Thrissur District Kerala - An Overview

Article ID: 11596

Akshaya M. V[1], J. Pushpa[2]
[1]P.G scholar, [2]Professor, Department of Agricultural Extension and Rural Sociology, Tamil Nadu Agricultural University, Agricultural College & Research Institute, Madurai- 625 104.

Introduction

Kerala is one of the front runners of Agriculture in South India has twenty-three agro-ecological units with various climate variability, land form and soil pattern. The Kole land's agro-ecological units constitute a major share in paddy cultivation spread and is over Thrissur and Malappuram districts of Kerala. The word Kole in regional language means 'luck or bumper yield' which indicates the particular way of cultivation adopted by the farmers. Kole lands are enriched with divers agri-ecosystem and other allied activities like prawn farming, duck farming, cattle rearing etc.

During1960's, farmers of Kole land organised to form, joint-farming cooperative societies called 'Padav, Padasekharam'. The management of padav or societies is operated by a committee which is constituted by elected members consisting of a president, two secretaries and several coordinating members. This societies were initially involved in providing guidance to the farmers in cultivation related aspects, pooling resources and supervision. Farmers cultivate their area individually and management activities were vested with societies. There after Kole land started facing drastic reduction in the yield due to decrease in the area and number of interested farmers.

This has warranted committee to extent their helping hands to sustain the farming in Kole areas. The present investigation probes into the various managerial activities which brought out revolutionary changes in successful farming at Chenam of Thrissur district of Kerala.

Reasons for Reduction in Number of Farmers

1. Non availability of labourers.
2. High wages.
3. Severe pests and diseases attack
4. Changing pattern of monsoon and periodic moisture stress condition.
5. Inadequate Government intervention.
6. Inability to perform timely weed management practices.
7. High input cost.

All these reasons led to dwindling of Kole land cultivation.

This scenario enforced the societies to strengthen their efforts and the committee put forth the following strategies for the revival of Kole lands in collaboration with Government:

a. Initiation regarding supply of Machineries.
b. Arranging labourers on contract basis.

Chenam farming society consists of nearly 600 farmers which is extended over 760 hectares. Majority of the farmers are marginal for whom purchasing of machinery was a limitation. Farmers laid their field free without cultivation since they could not meet the labour requirement at reasonable cost. Thus, joint farming cooperative societies took initiative to carry out the cultivation practices of all the farmers including small and large together by assigning workers and machines on contracts basis. This step became significant milestone in the history of Chenam farmers.

Kerala which was an agrarian economy has undergone changes in the employment pattern. Keralites who solely depended on agriculture started creeping into the non-agriculture sector which led to non-availability of labour for agriculture purposes. This necessitated farming societies to arrange migrant labourers for farming and allied activities. Migrant labourers engaged in all farm activities like native labourers at the cheapest wage rate. The temporary settlements offered by the committee for migrant labourers could ensure their ready availability all over the cropping season.

Timely Farm Advisory Services and Date Base for Kole Land Agriculture

Farming societies maintain a register in which all the details regarding the farmers, crop grown, practice to be followed in each stage of the crop etc are recorded. Each Kole is supervised by respective agriculture officers who give necessary information regarding pests, diseases occurrence, fertilization. Farming societies execute all the operations like sowing, transplanting, fertilizing, spraying, harvesting by arranging the harvesters for all farmers in timely manner in all fields on the prescribed dates. Timely control of pests, diseases and weeds increased the yield of Kole farmers. The only the duty of the farmer, is to visit the fields and inform the updates of crop condition regularly.

Provision of Subsides

Farming societies were formed to maintain the Kole lands in full strength, which increased the yield there by ensured better profit for farmers. Pest's attack, diseases occurrence, shifting monsoon pattern etc all these risk factors has been greater threats which discouraged many farmers for further cultivation. Societies tackled all those risk by timely support such as providing subsidies, crop insurance etc. After harvest, even marketing of the produces was taken care by the committee by linking with sales agents and warehousing cooperation and thus marketing risk was solved. Individual risk was reduced to a larger extent since the whole cultivation practices were completely monitored by the committee members. This imparted credibility in the farming community on societies which lead to increased production in the lands of Chenam.

Other Services of Societies

Committee arranged meetings for farmers in which requirements of all farmers were discussed. The farmer's children were given rewards after completing SSLC for perusing further studies. Further, the committee members have to enhance their standard living, from farming activities.

Conclusion

Farming societies have become life blood of Kole lands and started playing a key role in attracting the farmers back to agriculture. Kole lands has now turned into evergreen hub of agriculture by the timely involvement of joint farming cooperative societies. Mr. Suresh, P K, a member of society has expired that Agriculture is no longer a risky occupation rather it has turned into an effortless venture.

References

1. Jeena T Srinivasan (2010). Understanding the Kole Lands in Kerala as A Multiple Use Wetland Ecosystem,RULNR working paper No.5,Research Unit for Livelihoods and Natural Resources, Centre for Economic and Social Studies,Hyderabad.
2. Deepak Johnson (2018). Rice Cultivation in Kole Wetlands of Kerala,Kolebirders community portal.
3. Puthuma Joy (2016). Impact Of Migrant Workers In The Kerala Economy, International Journal of Informative & Futuristic Research,volume 2 issue 8,published:26th April 2016.

E-ISSN: 2581 - 8317

Crop Lodging and its Impact on Cereal Crops

Article ID: 11597

Wangkhem Tampakleima Chanu[1]
[1]Assistant Professor, Department of Agriculture, Himalayan University Jollang, Arunachal Pradesh, Itanagar-791111.

Summary
This article is based on collective information resulting from available literature and expertise knowledge concerning about causes, effects and control of lodging in cereal crops.

Introduction
For a long time, lodging has been considered a significant ailment in cereals. Crop varieties that are semidwarf have helped to mitigate the issue to some extent, but not entirely. Increased use of fertilisers, irrigation, and often reverting to older cultivars for particular needs, as well as an increase in mechanised harvesting, may result in additional lodging losses. Breeding has reduced lodging losses by reducing the probability of the plant lodging through reduced height (primarily through the introduction of dwarfing genes), but lodging tends to affect cereal yields (Acreche and Slafer, 2010).

What is Lodging?
Lodging is the state of permanent displacement of the stems from their upright position or, lodging is also defined as the dislodgment of stems or roots from their upright and appropriate placement as a result of wind acting on the shoot and rain or irrigation weakening the soil and reducing anchorage strength (Berry et al., 2004).

Causes of Lodging in Cereal Crops
1. The combination of the crop's inadequate standing power and adverse weather conditions such as rain, wind, and/or hail causes lodging in cereals.
2. Lodging is often influenced by variety (cultivar).
3. Plants were more vulnerable to lodging as a result of high nitrogen fertilization.
4. The length of a crop's straw determines how likely it is to lodge.
5. Failure of the root system, the occurrence of fungal diseases, and/or stem weakness may all cause lodging.
6. Uprooting or irreversible bending and breaking of the lower internodes may result in lodging.

Effects of Lodging on Cereal Yield
Cereal yields are typically reduced as a result of lodging. After the plant matures, lodging does not affect the yield, but it does reduce the amount of harvestable grain. When lodging occurs after the plant has matured, it can result in neck breakage and the loss of the entire head, which can result in significant harvest losses. For examples losses due to lodging, in rice were reported up to 50% in Japan, wheat in the range of 12-66% in India, barley 40% and oats 35-40%. It also reported in maize, sorghum and sugar cane. Yield was reduced by decrease in the number and size of the grain but utmost yield reductions arise when lodged at anthesis or early grain filling.

Effects of Lodging on Cereal Quality
Lodging also reduced the quality of cereal considerably. The most common symptom of lodging is grain shrinkage and a decrease in test weight. The HFN (Hagberg Falling Number), 1000 grain weight, and specific weight were substantially reduced by lodging at early or late grain filling. The protein content, on the other hand, increased significantly. Because of the small grains and low specific weight, lodging decreased the supply of assimilates to the grains, resulting in an increase in protein concentration.

Control of Lodging
1. Cultivar selection: Selecting a variety of short, solid straw is the first step in preventing lodging.

2. Method of planting and tillage: Planting on raised beds is one of the better options to control lodging. To increase yields, lodging resistant wheat cultivars with high yields can be grown on raised beds

3. Sowing date and depth of sowing: In wheat, delayed sowing may result in a significant reduction in lodging. Even a two-week delay will result in a 30% reduction in lodging.
4. Irrigation: The lodging is decreased by restricting excessive vegetative growth by delaying or withholding first irrigation. This implies that delaying or withholding first irrigation may help to reduce lodging.

5. Crop rotation: Crop rotation is needed to avoid diseases like common root rot, scald, net blotch, root rot, and take-all.

6. Nutrition's: Increasing nitrogen supply to cereals increased the length of the bottom internodes, but actually shortened the upper internodes, resulting in a slight reduction in overall height. As a result, it appears that an increase in height is unlikely to be the primary cause of lodging in response to increased nitrogen. Hence supply of optimum dose of nitrogen and moderate application of phosphorus and potassium helps to reduced lodging losses.

Conclusion

Lodging causes major yield and quality losses in cereals. At the end of the growing season, the crop is more vulnerable to lodging. Lodging losses differ by crop, with the largest losses occurring in wheat, rice, barley, millets and oats. Selection of resistant genotypes, raised bed planting, proper N and K fertiliser application, irrigation at the right time and quantity, pest and disease control, and growth regulator application are all factors that can help minimise lodging and increase yield and quality.

References

1. Acreche, M.M. and Slafer, G.A. (2010). Lodging yield penalties as affected by breeding in Mediterranean wheats. J. Agric. Sci. 122, 40–48.
2. Berry, P.M, Sterling, M., Spink, J.H., Baker, C.J., Sylvester- Bradley R, Mooney, S., Tams, A. and Ennos, A.R. (2004). Understanding and reducing lodging in cereals. Adv Agron.,84:215–269.

Recent Rice Cultivation Practices (Manual)

Article ID: 11598

Pratibha Singh[1]
[1]Department of Genetics and Plant Breeding, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, U.P.-221005, India.

Dapog Method of Transplanting in Rice

1. It is an emergency method of raising paddy nursery.
2. Origin: Philippines.
3. Popular in: Andhra Pradesh.

Why Dapog?

a. Rapid method of planting.
b. Saves 50% time as compared to traditional method (21-30 days).
c. 30 m^2/ ha transplanting.

Pre-requisite conditions:

a. 36-48 hours pre-germinated seeds
b. Certified & treated seeds.
c. Nursery near to water source.

Material Required:

a. 3 kg seeds/ m^2 (90 kg/ ha).
b. Banana leaf without midrib or plastic sheets.
c. Sprayer, Bucket, Bricks, Net, Salt, Carbendazim etc.

Seed treatment:

a. Take 17% Salt Solution.
b. Immerse all the Seeds as required.
c. Separate all the floating seeds.
d. Remaining bottom sited seeds used after washing properly.
e. Beside above process carbendazim treated seeds also used.

Seed Incubation:

a. Soak seeds 12 hrs after treatment.
b. Drain out water, wrap seeds in a gunny bag.
c. Keep it in shady places for 24 hrs.

Nursery Raising Technique

a. 4-5 cm raised concrete bed.
b. Bed covered with plastic/ Banana leaf.
c. Disperse 0.5 - 1 cm thick pre germinated seeds uniformly.
d. Surround 5-7.5 cm high boundary above bed.
e. Press seeds lightly twice a day for 1st 3-6 days.
f. Sprinkle water 2-3 times a day for 1st 3-4 days.
g. 1-2 cm stagnant water for 12 days after 3-4 days.
h. Use net to avoid birds or other insects.
i. 12-14 days later prepared seedling cut & folded properly.

Field preparation

a. Ploughing, puddling & planking traditionally.
b. 2 cm standing water before transplanting.

Transplanting:

a. 2-3 seedlings/ hill.
b. 20 X 10 cm.
c. Depth: 2-4 cm.

Advantages:

a. Soil-less nursery raising technique.
b. No need of Fertilizers & manures till nursery raising.
c. Less time & space required.
d. Easy to carry to main field.
e. Least harm to roots.
f. An emergency method.

Disadvantages:

a. Regular water supply.
b. More seed rate.
c. Use of pre germinated seeds.
d. Flat & plain surface along with polythene covering.
e. Seeds are avoided from birds.
f. Use of early variety.

Conclusion: “Dapog is adopted to save time not money.”

SRI Method of Rice Cultivation

System of rice intensification (SRI) was developed in Medagaskar in 1983. “Henery de Lauline” is called as “father of SRI”. It is a relatively new methodology includes a set of practices for plants, soil, water and nutrient management. SRI is one such method which has potential to produce more rice with less water. In India it was first time adopted in Tamil Nadu.

Principle of SRI:

a. Wide planting (5-7 kg/ ha).
b. Less seed require.
c. Transplanting young seedling (8-12 days)
d. Less water required.
e. Turning back into the weed into the soil.
f. Use organic manure.
g. Control insect and disease by biological method.

Procedure:

a. Selection of land:

i. Avoid water logged low land area.
ii. Salt affected and barren land should be avoided.

b. Seed rate: 5-7 kg/ ha.

c. Preparation of nursery:

i. 1-2 times ploughing of land.
ii. Preparation of raised bed up to 15cm.
iii. First layer – 1 inch well decomposed FYM or compost canal should be prepared around raised bed for drainage.
iv. Second layer - half (1/2) inch soil.
v. Third layer – one inch well decomposed FYM and
vi. Fourth layer – again half (1/2) inch soil.

d. Seed treatment:

i. Seed should be mixed in 17% salt solution and then after sieving quality seed should be rinsed with water 2 times.
ii. Now fill the rinsed seed in sacks and keep it in water for 24-36 hours.
iii. After that seed should be kept in shade for 24 hours after removing the sacks.
iv. Spread the germinated seed on beds evenly.
v. Cover it by a layer of soil.
vi. For protecting the seed from rain water and birds, it may be covered by straw.
vii. But straw should be removed after 2-3 days.

e. Main field preparation: 1-2 ploughings by cultivator and levelling the field.

f. Water and nutrient management: Organic manure is recommended raising nursery time. This method does not require continuous flooding water. Irrigation is given only to maintain soil moisture to provide aerobic condition to root.

g. Transplanting of seedling: Young seedling is about 8- 12 days having intact root, planted in square pattern immediately after uprooting, single seedling per hills at 25cm x 25cm spacing

i. Weeding management: Alternate wetting. and drying in SRI facilitate weed growth. First weeding is done at 10-18 days after planting.

Precautions:

a. Transplanting 8-12 days old seedlings singly.
b. Careful transplanting at shallow depth.
c. Adoption of wider spacing (25cm X 25cm).

Advantages:

a. Require less water (saves up to 20-50% water).
b. Less seed requirement (80-90%).
c. Less land requirement for nursery raising.
d. Time saving (10-15days).
e. High yield.

Limitations:

a. No. of laborers required is more than conventional method.
b. Skilled persons are required for transplanting.

Use of Mud Balls in Transplanted Rice

Major causes of nitrogen loss in transplanted rice are:

1. Denitrification.
2. Vaporisation.
3. Leaching.
4. Runoff loss.

Due to these causes, nitrogen use efficiency reduces to 28-34%. Mud ball urea is a simple method to reduce loss of nitrogen. It helps in slow release of nitrogen in field.

Pre-requisite condition: Lowland condition.

Reasons for use:

a. Long-time availability of nitrogen to crop.
b. Slow release of fertilizer.
c. Less urea requirement.
d. Simple and easy technique.
e. More production.

Materials required (per acre):

a. Clay soil (1000 kg).
b. Urea (52kg).

Preparation procedure:

a. Selection of suitable soil.
b. Remove unwanted materials from soil (weeds, stubbles).
c. Make a ball of 3-5 cm diameter by mixing water and straw.
d. Make a hole in center of ball by thumb.
e. Place the ball in shady place for 1-2 days.

Method of use:

a. Use mud ball urea after 2-3 days of transplanting.
b. Maintain 2-3cm mater level in field.
c. Put mud ball area at a depth of 10-15cm with one ball between 4 crops.

Advantages:

a. Better nitrogen use efficiency.

b. Easy to prepare mud ball urea.
c. Cheaper than other slow-release fertilizer.
d. Less harmful effect on environment.
e. Relief from multiple application.

Limitations:

a. Not suitable for all rice growing regions.
b. More labor and time required.

Precautions:

a. Use clean soil.
b. Always make hole with thumb.
c. Do not use sandy soil.
d. Save the ball from sunlight.
e. Always transplant rice in a row.

Weed Management in DSR by Brown Manuring

Problems:

a. Increasing problem of weeds in direct-seeded rice.
b. Resistivity of weeds increasing.
c. Increase in cost of cultivation.

Introduction: Brown manuring is a technique to grow Sesbania (Dhaincha) in standing rice crop and kill them with the help of herbicide for manuring . After killing , the colour of the sesbania residue becomes brown so it is called "BROWN MANURING".

a. Very good technique to control weed infestation in direct seeded rice.
b. Weed control possible up to 50-70%.

Major weeds: *Cyperus* spp., *Echinochloa*, *Phylanthum*, *Ageratum* etc.

Pre –requisite conditions:

a. Upland / free from water logging conditions.
b. Line sown paddy.

Materials required:

a. Seeds of paddy (80kg/ha).
b. Seeds of Sesbania (10kg/ha).
c. 2,4-D (amine salt).
d. Knapsack sprayer.

Method:

Field preparation

⇩

Sowing of rice at spacing of 25cm from row to row and 10 cm from plant to plant.

⇩

Line sowing of Sesbania in the inter- row space of paddy.

⇩

Spraying of 2, 4-D after 20-25 days of sowing of Sesbania.

Advantages:

a. Weed control up to 50-70%
b. Availability of nitrogen by 25kg/ha
c. Increase in fertility of soil.
d. Increase in yield by 2-3 quintals.

Precautions:

a. Use only certified seeds.

b. There should not be water logging condition while sowing of Sesbania .
c. Kill Sesbania after 20-25 days of its sowing.
d. Use glove, mask and proper clothing while spraying 2, 4-D.
e. Do not spray 2, 4-D if there are chances of rain.

Limitations:

a. Not effective if rain occurs after spraying of 2, 4-D.
b. Cannot be used in transplanted paddy.

Rice-Cum Fish Culture

Production of fish in rice fields is almost as old as the practices of rice or paddy culture itself. Whenever water is stagnated within bunds as for rice culture, fish that naturally occur in the irrigation water and nearby tanks and pools enter the paddy fields and grow there until harvest, along with the paddy. Thus, fish production in rice fields dates from very early days, even though it was based on capture rather than culture. Rice cum fish culture can be used to generate extra income from the same area. It is done for overall utilization of field to obtain all the nutrients in balance amount. It is practiced by the small and marginal farmers.

Pre-requisite conditions:

a. Rice cum fish culture for this area must receive high rainfall as well as irrigation facilities availability necessary.
b. Soil pH (7.5-8) required.
c. Proper irrigation and drainage facilities available.

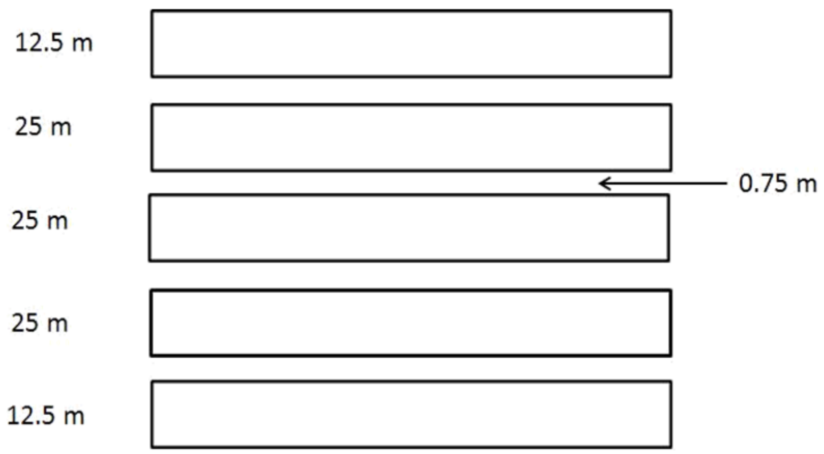
Selection of fish: The selection of fish depends on water holding capacity ,varieties of rice, amount of dissolved oxygen, soil pH, temperature.

Suitable Varieties of fish: Mangour, Rohu, Katla etc.

Preparation of field: Preparation of the paddy plot can vary according to the land contours and topography.

a. Perimeter type: The paddy growing area may be placed at the middle with moderate elevation and ground sloping on all sides into perimeter trenches to facilitate easy drainage.
b. Central Pond type: Paddy growing area is on the fringe with slopes towards the middle.
c. Lateral trench type: Trenches are prepared on one or both lateral sides of the moderately sloping paddy field.

Here we are discussing lateral trench type in synchronous refuge system: This system adopted in the area where water retention capacity is high.



Application of fertilizer and transplanting:

FYM – 10 tonnes/ ha.
Urea - 200 kg/ ha.
DAP – 130 kg/ ha.
MOP- 100 kg/ ha.

1. The whole amount of FYM, DAP, MOP and Urea are applied as basal dose.
2. Transplanting is done 2-3 plants at 25 X 15 cm.
3. The level of water maintains half of the plant height up to the 15-20 days.

Releasing of fingerling in the field: One week of transplanting the fingerling are release@ 10,000 fingerlings/ ha.

Advantages:

a. Increase in organic fertilization by fish excreta and remains of artificial feed.
b. Full utilization of land.
c. Increase the rice production 5-15 %.
d. Better tillering of the rice seedlings due to the activity of the fish.
e. Reductions in the number of harmful insects, such as paddy stem borers, whose larvae are eaten by fish.
f. Reduction in rat population due to increase in the water level.
g. Increased mineralization of the organic matter and increased aeration of the soil resulting from the puddling of mud by benthic feeders.
h. Excreta of fish act as manure for rice.
i. Control of algae and weeds which compete with rice for light and nutrients.

Disadvantages:

a. A greater supply of irrigation water and a greater water depth required for fish culture. Especially in view of the shortage of water due to increase in human demands this will be a very serious difficulty in future.
b. Extra investment and labour involved in raising and strengthening fields bunds.
c. The need for rice variety tolerant to deep water and to low temperature.
d. Fish may damage the young seedlings by uprooting them (carps) or eating them.
e. Certain parts of the field are lost for fish culture by the construction of trenches and refuges for fish.
f. Additional costs are involved in fertilizing and feeding the fish.
g. In certain types of soil continuous inundation may not be possible.

Feed of the fish:

a. Rice bran : fish meal- 2 : 1.
b. 5% according to weight of the fish.

Insect pest management:

a. Apply carbofuron@ 3g/ m2 in the nursery 5-7 days before transplanting.
b. Neem oil 0.2% spray.

Application of lime:

a. Initially, 25-30 kg.
b. Then apply 20-25 kg at one month interval.

Production:

a. Rice – 50 – 55 qt./ha.
b. Fish – 1500 – 1800 kg/ha.

Limitations:

a. Less use of the chemical.
b. Use suitable variety of the fish which does not harm the crop and survive in less water.
c. Fear of predator.
d. Timely monitoring of the field is done.
e. The bund of the field should be high so that overflow of the water does not take place in case of high rainfall.

Precautions:

a. Water level must be maintained.
b. Liming use must be done after sunset.
c. Feeding of fish must be done at regular interval.

d. Dissolved oxygen in water is maintained.

References

1. Jat, Aanandi Lal. 2013. Increasing Rice Production through System of Rice Intensification. Popular Kheti 1(1): 10-14, January-March.
2. Dash, Tuskar Kanta and Ashutosh Pal. 2011. Growing Crops with SRI Principles. SDTT-SRI website (42p).
3. Mahender Kumar R., Ch Padmavathi, K. Surekha, L. V. Subba Rao, V. R. Babu, M. S. Prasad, SP Singh, S. V. Subbaiah, P. Muthuraman and B. C. Viraktamath. 2008. Package of practices for SRI. Technical Bulletin No. 31. Rice Management Knowledge Portal. (27p).
4. RASS-ARKVK. 2004. System of Rice Intensification. Acharya Ranga Krishi Vigyan Kendra (ARKVK) Rashtriya Seva Samithi (RASS) Website.
5. Kumar, Rajesh, and Sourav Nayak. Kadiramangalam System of Rice Intensification. System of Rice Intensification website.
6. Satyanarayana, A., and K. S. Babu. 2004. SRI: A Revolutionary Method of Rice Cultivation. Acharya N. G. Ranga Agricultural University, India. System of Rice Intensification website. (14p).
7. WASSAN. 2006. System of Rice Intensification: An Emerging Alternative. Watershed Support Services and Activities Network website. (20p).
8. Lakshmi, Prayaga (translation). 2006. SRI Method of Paddy Cultivation. Watershed Support Services and Activities Network website. (20p).
9. WASSAN. 2006. Weeders: A Reference Compendium. Watershed Support Services and Activities Network website. (28p).
10. Ramasamy, S., C. Susheela and K. Sathyamoorthi. 2006. 'Direct-Planting System' - Energy Saving High Output Rice Establishment Technique for Lowland. Tamil Nadu Agricultural University. System of Rice Intensification website.
11. Rice: System of Rice Intensification. IKISAN Agriportal website.
12. 2007. SRI in Large Irrigation Projects in Andhra Pradesh, India. Jalaspandana website.
13. Sen Debanish and Sarkar, N. C. 2007. System of Rice Intensification- Minor Change in Management for Major Increase in Rice Yield. e-Arik website.
14. Special Technology: System of Rice Intensification. Tamil Nadu Agricultural University Agritech Portal.
15. Singh, Pratyush Ranjan. 2011. System of Rice Intensification (SRI) - Practices for improving crop and water productivity in India.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Edible Coating: A Preventive Measure to Enhance Shelf Life of Fruits and Vegetables

Article ID: 11599

G Siva Koteswara Rao[1], B Srinivasulu[2]
[1]Ph.D. Scholar, Department of Fruit Science, COH, A. R. Peta, Dr. Y.S.R. Horticultural University, Andhra Pradesh.
[2]Ph.D. Scholar, Department of Vegetable Science, COH, V. R. Gudem, Dr. Y.S.R. Horticultural University, Andhra Pradesh.

Introduction

Nowadays, fruits and vegetables are highly demanded in the market because of its nutritional value. Fruits and vegetables have short shelf life due to its perishable nature. About 30% fruits and vegetables are affected or damaged by insects, microorganisms, pre and post harvesting conditions during transport and preservation. Preservation of fruits and vegetables is a big challenge for world. Edible coating is an effective method to solve this problem. It provides protective edible covering to fruits and vegetables. It is beneficial for consumers and environment.

Edible coatings are thin layer of material may be of protein, lipid, polysaccharide, resin alone or in combination provide replacement and/or fortification of natural layers to prevent moisture losses, while selectively allowing for controlled exchange of important gases, such as oxygen, carbon dioxide, and ethylene, which are involved in respiration processes. A film or coating can also provide surface sterility and prevent loss of other important components. Generally, its thickness is less than 0.3 mm.

Edible coatings should be applied on fruits and vegetables by different methods. These methods are dipping, brushing, extrusion, spraying and solvent casting. The dipping method is used widely for applying edible coatings on fruits and vegetables, in this method fruits and vegetables are dipped in coating solution for 5-30 sec. It is easy to apply on mostly fruits. While brushing method gives good result, edible coatings applied on generally, beans and highly perishable fruits and vegetables such as strawberry, berries. Other three methods spraying, extrusion and solvent castings are also used in food industry.

Ideal Edible Film Should have the Following Characteristics

1. Edible coatings have good barrier properties to water, moisture, O_2, CO_2, and ethylene.
2. It improves appearance and mechanical handling to maintain structure and colour of fruits and vegetables.
3. These coatings provide a protective covering on fruits and vegetables and enhance their shelf life.
4. Contain no toxic, allergic and non-digestible components.
5. Have good adhesion to surface of food to be protected providing uniform coverage.
6. Prevent loss or uptake of components that stabilize aroma, flavour, nutritional and organoleptic characteristics necessary for consumer acceptance while not adversely altering the taste or appearance.
7. Provide biochemical and microbial surface stability while protecting against contamination, pest infestation, microbe proliferation, and other types of decay.
8. Incorporation of antioxidants and antimicrobial agents can be limited to the surface through use of edible films, thus minimizing cost and intrusive taste.
9. Be easily manufactured and economically viable.

Functional Attributes

1. Edible films/coatings decrease water vapour transmission rate by forming a barrier on the fruit or vegetable surface. This barrier prevents texture decay, since water is essential for preservation of cell turgor (Garcia and Barret, 2002). Metabolic alterations that can cause accelerated rate of senescence due to water loss can also be avoided with their use.

2. A novel edible coating should have good gas-barrier properties. It slows down the rate of respiration of fruits/vegetables after harvest by preventing the transfer of flavour and aroma components with the surrounding. Inside the food produce edible coating creates a modified or controlled atmosphere that will enhance the shelf life of fruits/vegetables after harvesting.

3. A well selected edible coating will produce a modified atmosphere inside the fruit, reducing levels of internal oxygen. If oxygen concentration inside the commodity drops below 8%, there will be a decrease in ethylene production (Kader 1986) and the commodity's quality will be preserved longer.

4. It reduces the microbial population on the food surface, delay the ripening of fruits/vegetables also delaying browning and discoloration of fruit surface and improving quality. As it carries many antioxidants and antimicrobial agents and colour and flavour characteristics to the food produce.

Edible Coating Materials for Fruits and Vegetables

There are different types of coating material are used like polysaccharides, lipids, proteins, and resins which can be used alone or in different combinations. Coating materials are selection on the basis of their hydrophilic and hydrophobic nature, easy development of coatings, water solubility, and sensory properties.

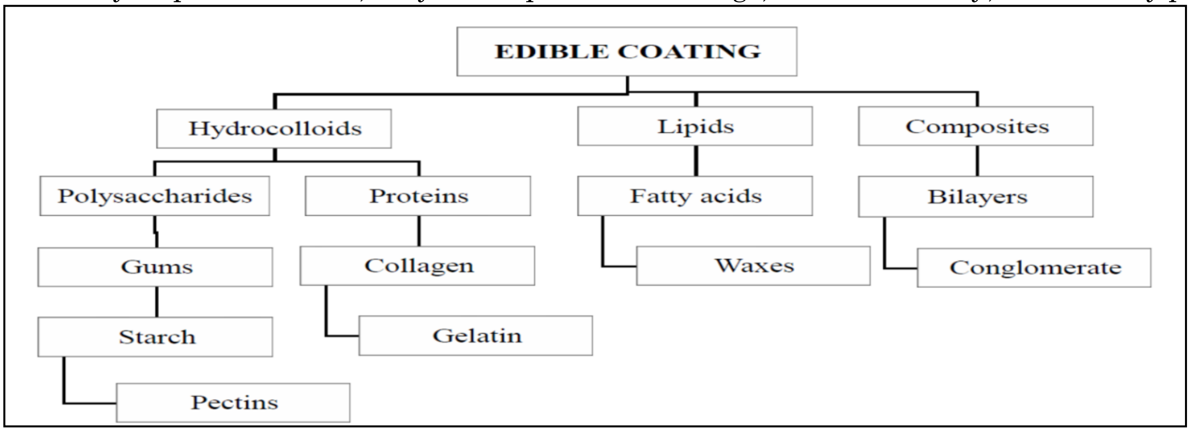


Fig: Different types of edible coatings

Polysaccharides - Based Coating

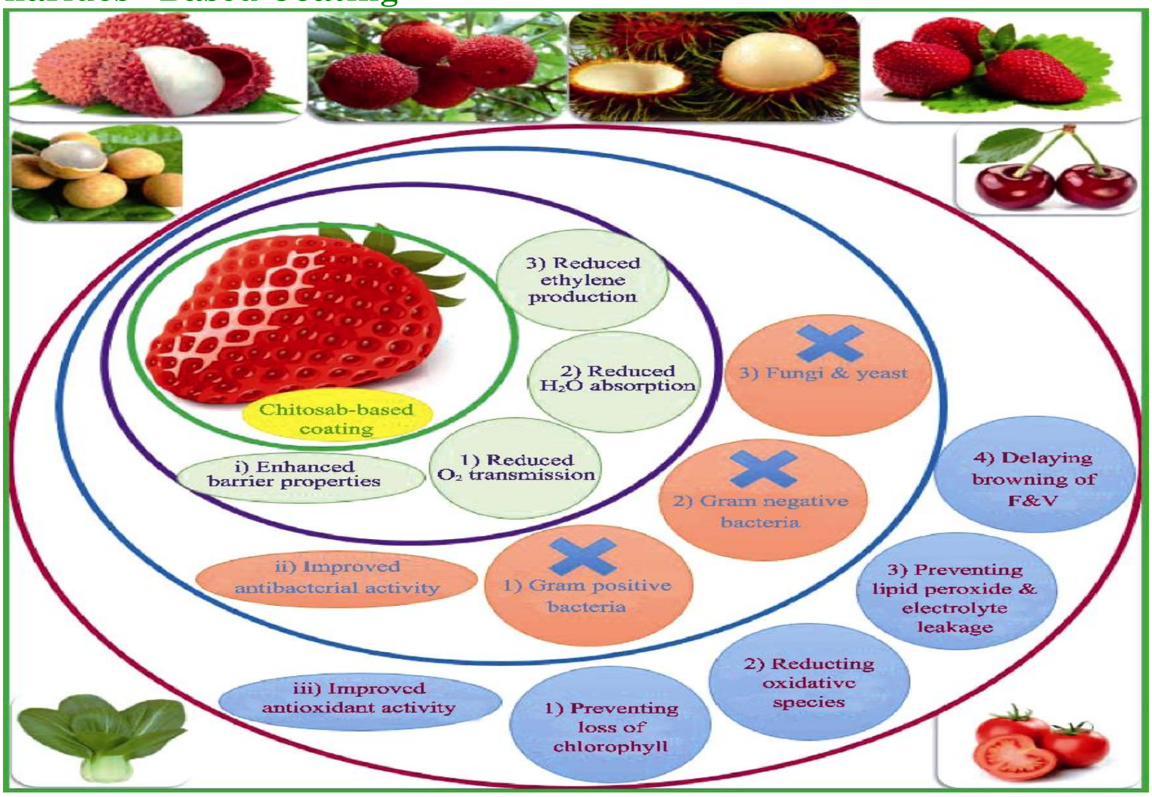


Fig: Effect of chitosan edible coatings on fruits and vegetables

Polysaccharides based coatings were prepared by various coating materials such as alginates, carrageenans, cellulose derivatives, starch and starch derivatives, chitosan, various plant and microbial gums and chitosan. Such coatings have been used to retard moisture loss of some foods during short-term storage.

However, polysaccharides, being hydrophilic in nature, do not function well as physical moisture barriers. In addition to preventing moisture loss, some types of polysaccharide films are less permeable to oxygen, which can help to preserve certain foods.

Protein Based Edible Coating

Protein based edible coatings are derived from animals and plants. The plant-based protein edible coating material are milk protein casein, whey protein, zein (from maize), gluten (from wheat), soy protein etc. and the animal-based protein are egg albumen, collagen etc., (Baldwin et al., 1995).

Protein based edible coating consist excellent barrier properties for aroma, oil and oxygen and it gives strength but it is not effective barrier for moisture (Krochta and Johnson (1997); Mohamoud & Savello (1992).

Lipid-Based Coatings

Various fatty acids, waxes, and resins are generally used for coating material for fruits/vegetables as lipid-based coating. Lipid coatings are mainly used for their hydrophobic properties, which make them good barriers to moisture loss. In addition to preventing water loss, lipid-based coatings have been used to reduce respiration, thereby extending shelf life and to improve appearance by generating a shine on fruits and vegetables.

Composites Based Edible Coating

Composites or Multicomponent films and coatings contain combination of protein, polysaccharides and lipid-based material. This is used to enhance and improve mechanical strength, moisture and gas barrier properties of edible coatings and films (Phan et al. 2008; Robertson, 2009).

Herbal Edible Coatings: A New Concept

Herbal edible coating is a new technique for food industry. It is made from herbs or combination of other edible coatings and herbs, most common herbs used in edible coatings are such as Aloe vera gel, neem, lemon grass, rosemary, tulsi and turmeric.

Herbs have antimicrobial properties, it consists vitamins, antioxidants and essential minerals (Douglas et al. 2005). As recently Aloe vera gel is widely used in coating on Fruits and Vegetables, because of its antimicrobial property, it also reduces loss of moisture and water.

Challenges in Developing Edible Coatings for Food Produce

The success of an edible coating depends on its permeability to moisture and gases (O_2 and CO_2) and chemical attributes of the coating material, types of food produce, and environmental factors in which produce is stored.

There are some points which should be considered when developing an edible coatings formulation:
1. Edible coating materials which have hydrophilic in nature shows inadequate moisture-barrier properties.
2. Due to inappropriate storage condition, unsuitable transportation and marketing of food produce O_2 and CO_2 barrier properties were varied.
3. Improper technique of coating and poor coating adhesion between coating layer and the surface of fruits and vegetables.
4. Unwanted flavour is added to the food produce as applied some of the coating material which results unnecessary sensory attribute.

Reference

1. E.A. Baldwin, M.O. Nesperos-Carriedo & R.A. Baker. 1995. Use of edible coating to preserve quality of lightly and slightly processed product, Criti. Rev. Food Sc. Nutri. 35, pp. 509-552.

2. G.L. Robertson. 2009. Food packaging, principle and practices, 2nd edition.
3. Garcia, E. and D.M. Barret. 2002. Preservative treatments for fresh cut fruits and vegetables. In O. Lamikanra, Ed., Fresh-cut Fruits and Vegetables, pp. 267–304. Boca Raton, Florida: CRC Press.
4. https://krishijagran.com/featured/edible-coating-a-preventive-measure-to-enhance-shelf-life-of-fruits-and-vegetables/
5. J.M. Krochta & C. Mulder-Johnson.1997. Edible and biodegradable polymer films challenges and opportunities, Food tech, 52, pp. 661-74
6. M. Douglas, J. Heys & B. Smallfield. 2005. Herb spice and essential oil: post-harvest operation in developing country, 2nd Edition, pp. 45-55.
7. R. Mohamoud & P. Savello. 1992. Mechanical property of and water vapour transferability through whey protein film, J. Dairy Sc., 75, pp. 942-946 .
8. T.D. Phan, F. Debeaufort, D. Luv & A. Voilley. 2008. Moisture barrier wetting and mechanical properties of shellac/agar or shellac/cassava starch bilayer and bio membrane for food application, Jour. of Membrane Sc., 325, pp. 277-283.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Importance of Pollination in Fruit Crop Production

Article ID: 11600

G Siva Koteswara Rao[1], B Srinivasulu[2]

[1]Ph.D. Scholar, Department of Fruit Science, COH, A. R. Peta, Dr. Y.S.R. Horticultural University, Andhra Pradesh.

[2]Ph.D. Scholar, Department of Vegetable Science, COH, V. R. Gudem, Dr. Y.S.R. Horticultural University, Andhra Pradesh.

Introduction

Pollination is the transfer of pollen from the male part of the flower to the female part of the flower. Some types of fruit trees may be pollinated with their own pollen and are considered self-fruitful or self-pollinating. Other types of trees require pollen from a different variety of the same type of tree and are considered self-unfruitful. The transfer of pollen from one variety to a different variety of the same type of tree is called cross pollination. Many fruit crops require an insect pollinator to help insure pollination for fruit set. (i.e., apples, blueberries, blackberries, cherries, cranberries, raspberries, strawberries). Having enough pollinators during bloom is essential to produce a sustainable crop. Improving pollination can lead to increased production owing to larger and better-shaped fruit and/or a greater number of fruits per tree. Research has shown that fruit size and calcium content are directly related to the number of seeds per fruit, with the number of seeds being dependent on good pollination

Table 1: Classification of fruit crops based on pollination:

Insect pollinated fruits	Wind pollinated fruits	Bird pollinated fruits	Water pollinated fruits	Man pollinated fruits
Apple, Pear, Peach, Plum, Almond, Apricot, Cherries, Ber, Litchi, Citrus and Mango	Walnut, Pecanut, Hazel nut, Chest nut, Papaya, Date palm, Pomegranate and Sapota	Banana and Pineapple	Water chestnut	Date palm and Custard Apple (Arka Sahan)

Pollinizers in Fruit Crop Production

An ideal pollinizer should have the following characteristics:

1. Pollinizer and main variety bloom periods must overlap.
2. The pollinizer variety must have viable diploid pollen.
3. The pollinizer variety must be located near the producing tree.
4. Bees and other insects must be present in the orchard and be active at bloom.
5. Weed blossoms, such as dandelions, mustard, and wild radish, should not be present in quantity since they attract bees away from fruit tree blossoms.

Proportion of a Pollinizer in an Orchard

For commercial production of delicious apples in India, at least 33% of pollinizers have been recommended. In olive, at least 11% pollinizer should be inter-pollinated in the orchard. For adequate pollination in lemon at least 10% plants should be pollinizing variety.

Suitable Pollinizers for Different Fruit Crops

S. No.	Crop	Cultivars	Pollinizers
1	Apple	Gala Mast, Cooper IV, Oregon Spur, Vance Delicious, Well spur, Red chief, Imperial Gala, Red Fuji, Red Spur, Firdous, Shireen and Top Red.	Sparten, Red Gold, Ginger Gold, McIntosh and Lord Lambourne.

2	Pear	Bartlett	Fertility, d'Anjou, Bosc, Comice, Clapps Favourite and Conference.
3	Peach	J.H. Hale, Earlihale, Hal-Berta, Candoka and July Elberta of peaches	Mostly all other varieties of peaches will pollinate these self-unfruitful varieties
4	Sweet cherry	Bing, Rainer, Royal Ann and Lambert	Sam, Van, Montmorency, Rainer, Stella, Compact Stella, Garden Bing
5	Plums	Santa Rosa (partially self fruitfull)	Satsuma, Shiro, Burbank.
6	Almond	Most of the cultivars except non-Pariel	IXL and Ne- Plus Ultra
7	Kiwifruit	-	Tomuri, Matua

Mango

Mango is a cross pollinated fruit crop and thus adequate pollination is essential for better fruit set. Houseflies primarily do pollination. Due to the presence of self-incompatibility in cvs. like Dasheri, Chausa and Bombay green, in these cvs. fruit setting is problem if grown in isolation. Thus, these cvs. require suitable pollinizer. Bombay green is a good pollinizer for Dasheri. Dasheri is a good pollinzier for Chausa.

Pollinizer Placement

The placement of pollinizers is important. Ideally, every tree in an orchard should be located as close to a pollinizer tree as possible. If another commercial variety is used as the pollinizer, the preferred arrangement is in solid rows. One scheme is to alternate two rows of pollinizers between four rows of the major cultivar. An exception is planting cultivars such as Delicious that have a tendency to be less self-fruitful. In these instances, and when it is desirable to maximize pollination, a pollinizer row should be set every third row.

Pollinators in Fruit Production

Most of the cross-pollinated fruit trees are effectively pollinated either by insects or wind. Among insects, honey bees, butterflies, wasps, syrphid flies, bumble bees, moths and beetles are common visitors to the flowers. However, honeybees, butterflies, bumble bees; syrphid flies etc only known to help in pollination. Honeybees are considered to be most effective pollinators.

Honey Bees are Considered as the Most Effective Pollinators for Many Fruit Crops Because of the Following Characteristics

1. They can work for long hours.
2. They can work even under adverse climatic conditions.
3. They are adaptable to different and difficult climates.
4. They can visit the flowers up to a radius of 5- 6 kms.

Effective Pollination Period (EPP)

The effective pollination period (EPP) is the difference between the period of time for pollen tube growth and that of ovule longevity.

Mean daily temp (°F)	41	43	45	46	48	50	52	54	55	57	59
Pollen tube growth index (%)	8	9	10	11	12	14	17	20	25	35	50

Table 2: Pollination, pollinators and pollinizer requirement of different fruit crops:

Fruit crop	Pollination type	Major pollinators	Number of Bees/ ha	Ratio of pollinizers to main variety
Apple	Cross	Honey bees, Bumble bees	4 - 5	33%
Pear	Cross	Honey bees, Bumble bees	3 - 4	
Apricot	Cross	Honey bees	2 - 3	33%
Peach	Cross	Honey bees	2 - 3	1 : 2
Almond	Cross	Honey bees	6 - 8	
Cherry	Cross	Honey bees	2 - 3	10%

Pistachio nut	Cross	Wind, Honey bees		1 : 8 (Male: Female)
Mango	Cross	Hose flies	5 - 7	
Grape		Honey bees	1	
Banana		Birds , Bats		
Papaya	Self to cross	Sphinx moth		10% male plants for dioecious cvs.
Litchi	Cross	Honey bees	4 - 5	

Temporary Aids to Pollination

Used when low temperature kill or delay the bloom on pollinizer variety or weather condition reduce honey bee activity. These methods include:

1. Flowering branches of other cultivars ('bouquets') can be placed in containers with the cut end in water. The bouquets should consist of large branches and some dehiscing as well as unopened blossoms. Large concentrations of bees should also be maintained in the orchards at the time when bouquets are placed.
2. Pollen can be purchased from commercial companies and used in inserts placed at the entrance of honey bee (Apis mellifera). Bees exiting the hive unwillingly pick up pollen and carry it to the flowers visited.
3. Pollen can also be 'dusted' on trees by dropping it into the draught created by an air-blast sprayer.
4. Flowers can be pollinated by hand, but the labour cost is high, even though only one or two flowers in several clusters need to be treated.

Conclusion

Pollination plays a crucial role in increasing the production of fruit crops. One can go for use of improved agricultural technologies, such as the use of quality planting material, high yielding verities, good agronomic practices like timely irrigation and fertilizers, but without pollination, neither fruit nor seed will be formed. Therefore, adequate number of Pollinizers should be planted in the orchard keeping in view the recommendations.

Reference

1. https://extension.psu.edu/orchard-pollination-pollinizers-pollinators-and-weather.
2. Shaila Din, Rayees A Wani, Ab Waheed Wani, Fouzea Nisar, Sayeda Farwah, Seerat Rizvi, Tajamul Farooq Wani and Sheemo Nisar. 2019. Fruit set and development: Pre-requisites and enhancement in temperate fruit crops. Journal of Pharmacognosy and Phytochemistry. 8(2): 1203-1216.

Apomixis and its Importance in Crop Improvement

Article ID: 11601

Islavath Suresh Naik[1], Priyanka. M[2]

[1]Ph.D. Scholar, Department of Seed Science and Technology, University of Agricultural sciences, Dharwad, 580005.

[2]Assistant professor (Contractual), Department of Seed Science and Technology, College of Horticulture, Mudigere, Karnataka.

Introduction

Apomixis is a form of asexual reproduction that occurs via seeds, in which embryos develop without fertilization or Apomixis is a type of reproduction in which sexual organs of related structures take part but seeds are formed without union of gametes. Apomictically produced offspring are genetically identical to the parent plant. Because apomictic plants are genetically identical from one generation to the next, each lineage has some of the characters of a true species, maintaining distinctions from other apomictic lineages within the same genus, while having much smaller differences than is normal between species of most genera. They are therefore often called microspecies.

Cytological analysis agamic reproduction by seeds i.e., Agamospermy. This of ovule development process and characterization of is in contrast to amphimixis or sexual reproduction genetic variability or uniformity of an individual. Apomixis can be of broadly three types viz., adventitious embryony, diplospory and apospory. Sporophytic and gametophytic apomixis differs on the fact that in the former there is no alteration of generations prior to embryo development. The formation of embryo is directly from a somatic cell in the ovule, mostly a nucellar cell and sometimes from the cell of integuments. For seed development nutritious endosperm is of supreme importance and this can be catered to through amphimixis that happens during the gametophytic phase of the lifecycle. Amphimixis is concurrent with Sporophytic apomicts. As a result, reduced embryo sacs and adventitious embryos occur simultaneously. So, after the fertilization of the central cell of reduced embryo sac or polar bodies, endosperm develops that provides nutrition to either an adventitious embryo or zygotic embryo when one out competes the other, or both may develop to relative maturity resulting in poly-embryony.

Obligate Gametophytic apomixis doesn't have amphimixis. It's rare to find a completely obligate apomict. They hardly exist. Development of megaspore mother cell is arrested or it somehow cannot complete meiosis. So, in the absence of meiosis, haploid (n) megaspore cannot develop and all cells of the unfertilized ovule retain somatic chromosome number. When megaspore mother cell or one of its diploid daughter cells develops into an unreduced female gametophyte, this phenomenon is called diplospory. There are various sorts of diplospory viz., mitotic diplospory or Antennaria types which is ubiquitous. In this megaspore mother cell directly undergoes mitosis and another one which occurs in Taraxacum sp. where there is restitution in meiosis I.

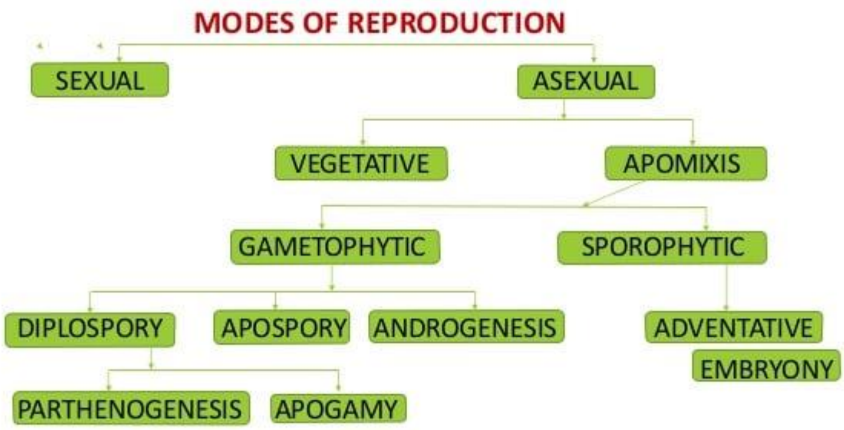
In case of Apospory, somatic cell is the origin of unreduced female gametophyte therefore possibility lies that both apomixis and amphimixis occurs in the same ovule in facultative apomicts. This is rare and most of the times one process outcompetes the other. When an unfertilized gamete develops into a plant then the process is called Parthenogenesis. There are some rare cases when an unreduced egg fertilizes resulting in a hybrid embryo with high ploidy levels. There is a syngamy between egg and sperm when meiosis occurs in an apomict. Embryo development from an unreduced egg could be precocious. Salmon system in wheat is a good model to explain parthenogenesis in plants. In a particular cytoplasmic background, there is a wheat rye translocation in the nucleus resulting in male for molecular studies including the construction of egg- cell specific cDNA libraries.

Pseudogamy or fertilization of central cell is really important for the production of endosperm in many apomictic species. There are some exceptions to it. Plants of Asteraceae family do not require fertilization and there is an autonomous endosperm development. The maternal to paternal genome contribution to the endosperm and its relationship to the ploidy level of embryo have a strong effect on seed viability of amphimicts. This change in the developmental pattern occurs when apomixis is introgressed into sexually reproducing *Pennisetum glaucum* from an apomictic relative. There is an increase in the binucleate central cells as compared to the uninucleate central cells and all this is related to reduced seed set. Adventive embryony is the process of the embryonic development without fertilization. The embryo does not develop from the reproductive cells or the gametes. They may develop from the nucellus or integumentary cells.

Apomixis is widely distributed among angiosperms. Most widespread in the grass (Poaceae) and sunflower (Asteraceae). Apomixis occurs due to deregulation of the sexual processes in various developmental stages. Sporophytic apomixis is a dominant. In Apospory when aposporus male parent is crossed with strictly sexual female parent the phenomenon of apospory appears to be simply inherited. sterility and haploid parthenogenesis. Salmon system isn't apomictic but it provides useful isogenic lines Apospory behaves as a dominant trait. The association of apospory with the heterochromatic region of the genome, rich in retrotransposons as in Pennisetum, raises the intriguing possibility that chromatin structure/ RNA Interference could play a role in control of apomictic gene expression.

Gametophytic apomixis has two morphologically different forms viz., diplospory and apospory. They differ in heterochronicity and regulatory control of gene expression. If we want to manipulate the genetic expression of a crop plant then it is imperative to study their genetic mechanism. Crops which are maternally alike are useful for creating hybrids. It remains a conundrum that isolation of the genetic components of apomicts and their transfer to the crop species or synthesis of apomixis from combination of mutations for its components in sexual plants. In addition, interspecific crosses formed as a result of gene escape from apomictic crops into wild relatives will not have meiotic irregularities leading to sterility and therefore will survive under natural conditions. Transfer of apomixis to crop species through wide crosses has not been successful so far, but transgenic technology offers a more powerful way to introgress apomixis into crop species. Alteration of a single gene in a sexual plant can bring about functional apomeiosis, a major component of apomixis.

Apomixis is a problematic when plant breeding is done to produce sexual progeny such as inbreds and hybrids but it's of supreme importance when the crosses are to be maintained indefinitely. Plant breeders have developed various schemes to use apomixis for fixing of heterosis and hence the way forward is to avoid apomixis when the crossing is done in the apomictic species but once a hybrid or inbred is created then it can be maintained and multiplied by the process of Apomixis.



AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Postharvest Management of Fresh Horticultural Produce

Article ID: 11602

Assumi S. R[1], Angami T[1]
[1]ICAR Research Complex for NEH Region, Umiam-793103, Meghalaya, India.

Introduction

Due to the diversity in the morphological structures (root, stem, leaves, flower, fruit, etc.), composition and general physiology of the fresh horticultural crops, the requirements and recommendations for maximum postharvest shelf life vary. All horticultural crops are high in moisture content and are susceptible to desiccation (wilting, shriveling), mechanical injury, biological deterioration (increase in respiration rate and ethylene production, compositional changes with respect to color, texture, flavor, nutritive value), sprouting, rooting, physiological disorders and attack by bacteria and fungi with associated pathological breakdown. However, the rate of biological deterioration depends on several environmental factors *viz.* temperature, relative humidity, air velocity, atmospheric composition (oxygen, carbon dioxide, ethylene) and sanitation procedures. Fresh fruits and vegetables play a very significant role in human nutrition, especially as sources of vitamins (C, A, B_6, thiamine, niacin), minerals and dietary fiber. Also, the other constituents *viz.* flavonoids, carotenoids, polyphenols and other phytonutrients may lower risk of cancer and other lifestyle diseases. The nutritional quality losses incurred after harvest, particularly vitamin C content can be significant and which is further enhanced by physical damage, longer storage duration, high temperatures, low relative humidity and storage chilling injury of chilling-sensitive commodities.

Postharvest Management

A wide range of postharvest physical, chemical and gaseous treatments exist (Table 1) that may be applied to maintain and extend the fresh-like quality with high nutritional value and meet safety standards of fresh produce. Postharvest management treatments include to manipulate the environment of the packaging; control of air movement, circulation, air exchange or ventilation in storage; exclusion or removal of ethylene in package and stores; controlled and modified atmospheres; water disinfection and other effective sanitation procedures to minimize microbial contamination and assuring food safety. These postharvest treatment approaches are typically combined with appropriate management of storage temperatures and relative humidity. The postharvest handling system of fresh produce begins with harvesting and involves the preparation for fresh market or cooling, transportation, storage and/or handling at destination (wholesale and retail marketing) and also for processing (e.g., drying, freezing, canning, pulping, beverage making, jam, pickling, etc.). In all these steps, effort for providing the optimum ranges of temperature and relative humidity is both essential and crucial for maintaining produce quality, safety and for minimizing postharvest losses between production and consumption sites or until it reaches the consumers plates.

Table 1: An overview of postharvest treatments for fresh produce:

Treatment	Benefits	Example of commercial applications
Heat treatment	Reduction of chilling injury, delay of ripening, kills critical insect contaminants, control decay	Potato, tomato, carrot, strawberry, asparagus, broccoli, bean, kiwi, celery, lettuce, melon, grape, plum, peach, spinach, rocket leaves
Edible coating	Provide a partial barrier to O_2 /CO_2 /H_2O, minimize moisture loss, establish modified atmosphere, preserve colour and texture, retain natural aroma	Apple, pear, strawberry, mushroom, citrus fruits, fresh cut fruits and vegetables, cantaloupe, cucumber, capsicum, tomato, carrot, celery
Irradiation	Inhibit sprouting of tubers, bulbs and roots, meets quarantine	Potato, onion, strawberry, mango

	requirements for export trade and recognized as a safe process	
Antimicrobial and anti-browning agents	Retards browning, deterioration of texture and microbial growth	Apple, strawberry, lettuce, melon, orange, prune, tomato, grape, fresh-cut produce
NO (nitric oxide)	Inhibit ethylene biosynthesis, reduce respiration rate, water loss, browning, lower incidence of postharvest diseases	Apple, banana, kiwifruit, mango, peach, pear, plum, strawberry, tomato, papaya, loquat, jujube fruit, bayberry
Sulfur dioxide	Prevent postharvest decay	Grape, litchi, fig, banana, lemon, apple, blueberry
Ozone	Easily incorporated into existing cold storage, washing system, better efficacy than chlorine	Apple, cherry, carrot, garlic, kiwi, onion, peach, plum, potato, grape
Ethylene	Trigger ripening process thereby improve fruit colour and quality, degreening	Banana, avocado, persimmon, tomato, kiwifruit, mango, citrus fruits
1-MCP (methylcyclopropene)	Maintain fruit cell wall integrity and peel colour, develop aroma and flavour	Apple, avocado, banana, broccoli, cucumber, date, kiwifruit, mango, melon, nectarine, papaya, peach, pear, pepper, persimmon, pineapple, plantain, plum, squash, tomato
CA (controlled atmosphere) storage	Retard senescence, associated biochemical and physiological changes, reduction in decay severity	Apple, pear, avocado, strawberry, cherry, cabbage, kiwifruit, avocado, persimmon, pomegranate, asparagus, banana, broccoli, cranberry, mango, melon, nectarine, peach, plum
MAP (modified atmosphere package)	Delay in respiration, senescence, slow down rate of deterioration	Strawberry, banana, cherry, carrot, fresh-cut fruits, salad mix, green leafy vegetables

Also, the following postharvest management procedures are often commercially used as supplements to temperature and relative humidity management:

1. Treatments applied to commodities include curing of certain root, bulb and tuber vegetables.
2. Cleaning followed by removal of excess surface moisture.
3. Sorting to eliminate defects.
4. Waxing and other surface coatings including film wrapping.
5. Heat treatments (hot water, hot air or vapor heat).
6. Treatments with special chemicals of specific functions (sprout inhibitors, scald inhibitors, growth regulators, ethylene-action inhibitors such as 1-methylcyclopropene, postharvest fungicides, calcium treatment, etc.).
7. Fumigation and/or irradiation for insects' control.
8. Ethylene treatment (de-greening citrus/banana, ripening of climacteric fruits).

Table 2: Summary of edible coating(s) used on fresh/fresh-cut fruits and vegetables:

Coating material	Purpose of coating
Guar gum, pea/potato starch ± potassium sorbate	Antimicrobial
Candelilla wax-based	Antimicrobial, antioxidant; quality
Soya bean gum, jojoba wax, glycerol, arabic gum, pectin base, aloe vera gel, chitosan	Overall quality
Shellac ± Aloe vera gel	Keeping quality
Soy protein, carboxymethyl cellulose, pectin base, alginate, sucrose-polyester based	Antioxidant, H_2O barrier
Chitosan, zein, methyl cellulose	Antioxidant, antimicrobial, $O_2/CO_2/H_2O$ barrier
Beeswax, coconut oil, sunflower oil	Antimicrobial, antioxidant, overall quality

Agar, chitosan, acetic acid (combined)	Antimicrobial, O_2/CO_2 barrier.
Whey protein, rice bran oil	H_2O barrier, overall quality.
Alginate and gellan based	O_2/CO_2/H_2O barrier.

Besides, the strategies for appropriate postharvest management for reducing postharvest losses should include the following mentioned below:

a. Application of current knowledge to improve the handling systems (especially packaging and cold chain maintenance) of horticultural perishables and assure their quality and safety.

b. Overcoming the socioeconomic constraints such as inadequacies of infrastructure, poor marketing systems, weak R&D capacity and

c. Encouraging consolidation and vertical integration among producers and marketers of horticultural crops.

Conclusion

Strategies for increasing food security by reducing postharvest losses and valorization of wastes, not only employs the use of the above-mentioned procedures but also is inclusive of the use of cultivars/varieties with longer postharvest shelf life, practice of an integrated crop management system that maximizes both yield as well as quality, and use of proper harvesting and postharvest handling practices for maintenance of quality and safety of horticultural crops and their products.

References

1. Mahajan PV, Caleb OJ, Singh Z, Watkins CB and Geyer M. 2014. Postharvest treatments of fresh produce. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 372: 20130309. (doi.10.1098/rsta.2013.0309).
2. Kader AA. 2013. Postharvest technology of horticultural crops - An overview from farm to fork. Ethiopian Journal of Applied and Science Technology, Special Issue No.1: 1-8.

People's Participation in Agriculture and Rural Development Programme

Article ID: 11603

A. K. Paswan[1], Satya Prakash[1], M. N. Ansari[1]

[1]Tirhut College of Agriculture, Dholi (Muzffarpur),Bihar-8431 21, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar.

Introduction

In India agriculture is the predominant occupation nearly, 60 per cent of population of the country depends on it for livelihood. The concept of 'development' has undergone many important and significant changes over the years. The development efforts during 1950s, 1960s and 1970s were based on a top-down service delivery approach.

The scientific and rational planning was its hallmark and emphasis was on a centralized delivery system based on the efficiency of civil personnel as agents of development. This approach is now largely discredited since the expected trickle-down effect never took place. Important factors for the failure at the system level were the lack of reward and punishment for development agents and lack of political will on the part of the government.

At the local level, the rural people did not feel involved and therefore, never took up the developmental programmes as their own. The present agricultural and rural development paradigm revolves around people and strongly believes that unless and until local people are involved in decision making at all levels of programme need identification, planning and designing, implementation as well as monitoring and evaluation, the desired development cannot be achieved.

Concept of People's Participation

People's Participation may be defined as the process of giving priority to local people's perspective in identifying and analyzing their problems and opportunities, and improving the situation through their self-mobilization. The focus is on the 'insiders" i.e., local people's perspective, rather than on "outsiders" i.e. change agents development administrators perspective.

People's participation is contrary to 'I know what they require' type of bureaucratic approach. Many development interventions have been seen to create a sort of dependence syndrome. With active involvement of the local people, it is possible not only to break the mentality of dependence, but also to increase their awareness, self – confidence, and control of the development process. A familiar dilemma facing all who aim to work in a participatory manner is the issue of 'who participates?'

It is all too easy to find one working with those who have time to participate, or who see some particular advantage in developing a relationship with an external agency, or with those who are usually most influential or vociferous. Participatory process can, of one is not careful, may reinforce existing patterns of discrimination and disadvantage within rural communities.

Levels of Participation

There may be several levels of participation by the people's in agriculture and rural development programme:

1. Receiving information: Participants are informed what a project will do after it has been decided by others.

2. Passive information giving: Participants can respond to questions and issues that interventionists deem relevant for making decisions about projects.

3. Consultation: Participants are asked about their views and opinions openly and without restrictions, but the interventionists unilaterally decide what they will do with the information.

4. Collaboration: Participants are partners in a project and jointly decide about issues with project staff.

5. Self-mobilization: Participants initiate, work on and decide on projects independently, with interventionists in a supportive role only.

Key Paradigm of Participatory Development Approach

Participatory development approach in agriculture and rural development programmes should be based on the following key paradigms:

1. Primacy of people: People's participation is not optional or convenient choice but people themselves are at centre stage. People's interests must be taken into consideration throughout the programme.

2. People's knowledge and skills must be seen as a positive contribution to the programme: It should make use of people's knowledge for effectiveness of the programme and of local resources, avoid dependence on external assistance, and help to build local capability.

3. People's participation must empower women: It must seek mechanisms to reduce gender inequalities by providing means by. Which women can take part in decision-making and create transforming changes against the social and cultural banners?

4. Autonomy as opposed to control: It should invest responsibility with the local people. This strategy should be for sustainability of the programme.

5. Local action as opposed to local responses: It should encourage local proposed by others. People to make decisions and to take action within the broad parameters of the programme, as opposed to merely responding passively to initiatives proposed by others.

6. Allow flexibility in programme direction: The project should create to accommodate the abilities of local people to play increasing role and begin to assume responsibility.

Basic Principles of Participation

The following basic principles underlying people's participation in agricultural and rural development programme:

1. Mutual respect: All people must be accepted as they are with their weaknesses and strengths. There should be mutual respect among them.

2. Active participation: There should be active participation of ail people in the programme and participation patterns must continue from planning through evaluation.

3. Agree to disagree: Participation requires an implicit and explicit understanding to agree and disagree and to accept common interest above personal interest.

4. Building consensus: Collective responsibility for the decision made is must and there should be consensus on the same.

5. Commitment to action: All participating partners must commit themselves to action on the basis of agreed upon decisions and plans.

Advantages of People's Participation

1. Participation makes it possible to make use of knowledge, experience and resources of the local people.
2. Participation is a learning process through which people can develop their capabilities.
3. It helps in individual and collective decision making and problem solving.
4. Programmes involving participation of the people are more likely to be sustained after outside funding and support are reduced or withdrawn.
5. Participation by the poorer elements prevents the 'hijacking' of programme benefits by wealthier sections of the community.
6. It helps a society to remain integrated, as lack of participation may develop in the people a feeling of isolation and neglect, and ultimately generate frustration and dissidence amongst them.

Limitations of People's Participation

1. Participation may lead to a delayed start and slow progress in the initial stages of the fieldwork, thereby delaying the achievement of physical as well as financial targets.

2. An increased requirement of material and human resourced to support participation may be a more costly method of implementing development programmes.

3. Since participation is a process, once it is initiated the process has to be allowed to take its own course and hence may not move along the expected lines.

4. Since participation is an empowering process where the people or communities are empowered to make decisions, donors, Governments, and other players have to relinquish power and control. Relinquishing power and control is not easy.

5. In participatory process a lot of expectations of the people are generated. Increased expectations due to involvement of the local people, however, may not always be realized.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Ecosystem Restoration: Resetting Our Relation with Nature

Article ID: 11604

Apoorva[1]
[1]Centre of Advance Study in Botany, Institute of Science, Banaras Hindu University, Varanasi-221005.

Ecosystem restoration, the process of serving an ecosystem that has been damaged, deteriorated, or destroyed to rejuvenate has now emerged as a global phenomenon to reduce biodiversity loss. Billions of US dollars are spent annually for the restoration of damaged ecosystems. While conserving an ecosystem protects the past, ecosystem restoration restores the future. The UN Decade on Ecosystem Restoration (2021-2030) is a rallying global call designed to prevent, halt and revive the degrading ecosystems throughout the world with scientific research, political support, and financial assistance. Healthy ecosystems harbor biodiversity, regulate climate, replenish aquifers, mitigates natural hazards, provide clean water, and cradle indigenous cultures.

Over the past few decades, ecosystem degradation has been among the greatest threats to the environment. Almost all of our ecosystems, whether terrestrial or otherwise, are being deteriorated to varying levels by a multitude of factors like population growth, developmental pressures, over-exploitation, etc. Ninety-five percent of the Earth's land is expected to degrade by the end of 2050.

Unsustainable agricultural practices have already eroded 24 billion tons of soil causing loss of ecosystem functions like nutrient cycling and climate regulation that sustains the life on Earth. At present, 3.2 billion people suffer from these negative impacts which have been estimated to cost about 10% of the global annual GDP. Around 1,300 scientists worldwide have worked and concluded that 15 of our 24 primary ecosystems that support human survival are continually degrading.

Future threats include climate change, changes in water quality, the emergence of zoonotic diseases, establishment of "dead zones" in coastal shelf areas, collapse of fisheries, etc. Ecological degradation has its impact on both biodiversity and ecosystem services. For example, the deterioration of the natural ecosystems in the Western Ghats directly affected the water security that further influenced the livelihoods in the plains.

We have long taken our ecosystems for granted, assuming that they are inexhaustible. Over-exploitation, unrelenting increase in population, deforestation, intensive farming, pollution, logging, invasive pests, wildfires, commercial pressures, harmful policies, and weak tenure laws have hampered their ability to sustain biodiversity and human population. Every year, approximately 4.7 million hectares of forests are being wiped out for land and resources.

Home to an incredible diversity of wildlife species, the grasslands, shrublands, and savannahs are being overgrazed and converted into agricultural lands. Stores of water and carbon from peatlands are being drained, degraded by fire, and extracted for agricultural purposes which must be kept wet and, in the ground, to avoid the dangerous effects of climate change. According to the IUCN Red List of Threatened Species, the planet's flora and fauna are being lost 1,000 times faster than the natural rate.

Furthermore, over 600 glaciers have melted in the last few decades, affecting the downstream livelihoods of people. Both marine and freshwater ecosystems are under threat. More than 33% of our wetlands have been drained and cemented to make way for industries, resulting in the extinction of one of every three aquatic species since 1970. Additionally, many of our protected areas are ecologically vulnerable due to invasive species like *Parthenium*, and *Lantana*.

In 2014, a research article published on emerging zoonotic viral diseases stated that the changes in the environment, human behavior, and habitats are responsible for the increased emergence of infectious diseases, with wildlife serving as the primary source. The article mentioned palm civet cats from live markets in Guangdong province of China as the true reservoirs of SARS. Seven years later, we are amid a global pandemic originated from bats at a wet market that traded live animals. We knew this could happen.

Just as we knew that locust invasion was expanding and the intensities and frequencies of tropical cyclones are increasing. For years, humanity has seen the warning signs but has not taken them seriously. The COVID-19 pandemic is a red flag pointing towards the disharmony and imbalance in natural ecosystems. Restoring what is lost to re-establish a sense of equilibrium is the only way forward.

Across the globe, calls for a green recovery from the COVID-19 pandemic are increasing. Such recuperations can create resilient economies and spark urgent action on climate change. Without humans and their activity, the Earth can rejuvenate on its own. The natural processes like grazing, scavenging, predation, calamities, and weather conditions function more effectively.

These processes have a pivotal role in shaping functional ecological landscapes. Most people know about the Chernobyl tragedy of 1986, the world's worst nuclear accident. The fire raged on for more than a week and was estimated to cause more than 4,000 deaths. The parts of the exclusion zone have now turned into a biodiversity hotspot.

Untouched by anthropogenic activities, species have found ways to adapt and flourish in the region. Scientists have witnessed growing numbers of lynxes, boars, bears, and European bison at the site. This reveals that the natural world could survive far better in a catastrophic event than in continuous human activities. Nature doesn't need us- we need nature. Nature can endure the extinction of human beings and remain fine, but humanity can't survive without nature.

Forty years ago, restoration was conceived as natural science. Today, it is recognized as a scientific and social phenomenon. Restoring an ecosystem adopts a holistic approach that is focused on components of the ecosystem like, water, soil, flora, and fauna, etc. It is an active choice that can involve technological innovations but requires people to interact.

Adaptive management, incorporation of biological spatial variation, linking landscapes, emphasizing repairs against replacements, treating the causes instead of symptoms, letting process self-regenerate, monitoring protocols, empowering stakeholders, considering all forms of scientific, and indigenous aspects accounts for a good ecosystem restoration project.

An ecological restoration helps in sustaining the rich diversity of human culture as well as protects the indigenous rights. It reduces the risk of natural disasters; buffers disease outbreaks and can help us accomplish all our Sustainable Development Goals. Restoration slows down climate change, provides clean air and water, fertile soil, increases food security, creates jobs, raises income levels, carbon sequestration, and brings back biodiversity.

With trillions of dollars being put several ecological projects like Walker Basin in South India, North American-Eastern deciduous forests in the United States, Calcareous Grassland in Europe, Great Green Wall of Africa, Prime Hook National Wildlife Refuge in Delaware, Pakistan's Tree Tsunami, Peruvian Amazon, Belize Barrier Reef System, Maiden Island Reef in the Caribbean Sea, and Mexico's National Forestry, etc. are being carried out for decades using multitude of strategies.

Some successful examples of restoration include the rewilding ecosystems across Europe, seminatural prairie communities, and enhancement of endangered species like pronghorn antelope, American elk, American beaver, humpback whale, elephant seal, and gray seal in North America. Additionally, the UN Decade on Ecosystem Restoration, starting this year is scaling out these efforts to halt, protect and reverse the worldwide ecosystem degradations.

It is estimated that till the end of 2030, restoration of 350 million hectares of deteriorated aquatic and terrestrial ecosystems could produce about 9 trillion US dollars in ecosystem services. As well as, 13 to 26 gigatons of harmful greenhouse gases could be removed from the atmosphere.

In India, ecosystem restoration is still a developing discipline. With a limited number of projects and practitioners, our initiatives are usually small and site-specific. A recent report on the Bonn Challenge reveals that since 2011, India has brought around 9.8 million hectares of degraded and deforested lands under restoration.

By the end of 2030, the country has an ambitious target of restoring an area of about 26 million hectares. Although there was a sudden decline in the area restored in 2012-2013, it was increased in 2016-2017. A study conducted by Columbia University, USA and Nature Conservation Foundation, India published in Ecosphere in 2019 reveals that the Anamalai Hills, the biodiversity hotspot of the Western Ghats in India has shown a significant increase in forest cover and biodiversity under restoration. Since 2006, around 1,075 hectares is being protected in 35 rainforest fragments and more than 15,000 saplings of 60 native tree species have been planted.

Moreover, a restoration project for addressing the degradation of habitats of the Gangetic Dolphins in the Brahmaputra River that happens due to deterioration of riparian vegetation as well as pollution is also being carried out.

In due course of time, human beings will win over this pandemic like the previous catastrophes. However, humans must realize the limits at which they can thrust ecosystems. Re-establishing forests, restoring natural dams, reconnecting rivers with their floodplains, protecting wetlands and mountains helps nature restore its defense against disasters, outbreaks, and extreme weather conditions.

Adopting agricultural practices like crop rotation, reducing tillage, creative grazing, use of natural fertilizers, etc can rebuild farmlands and revive the soil. Restoring our Earth's imperiled ecosystems will reset our relationship with nature and provide a chance to bring back a healthy life to our scarred ecosystems.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Biofortification and it's Applications in Vegetable Crops

Article ID: 11605

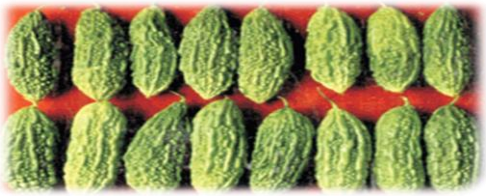
Gulab Choudhary[1], Seema Yadav[2], Jaipal Yadav[3], Manju Netwal[4]
[1]Department of Horticulture, SKNAU, Jobner, Jaipur, Rajasthan.
[2]Department of Agronomy, SKNAU, Jobner, Jaipur, Rajasthan.
[3]Department of soil science and agricultural chemistry, MPUAT, Udaipur, Rajasthan.
[4]Department of Horticulture, SKNAU, Jobner, Jaipur, Rajasthan.

Introduction

Greek word "bios" means life and Latin word "fortificare" means make strong. The process by which the nutritional quality of food crops is improved through agronomic practices, conventional plant breeding, or modern biotechnology.


Pusa Meghali- carotene rich


Pusa Kiran- Fe rich


Pusa Hybrid 1- Fe rich

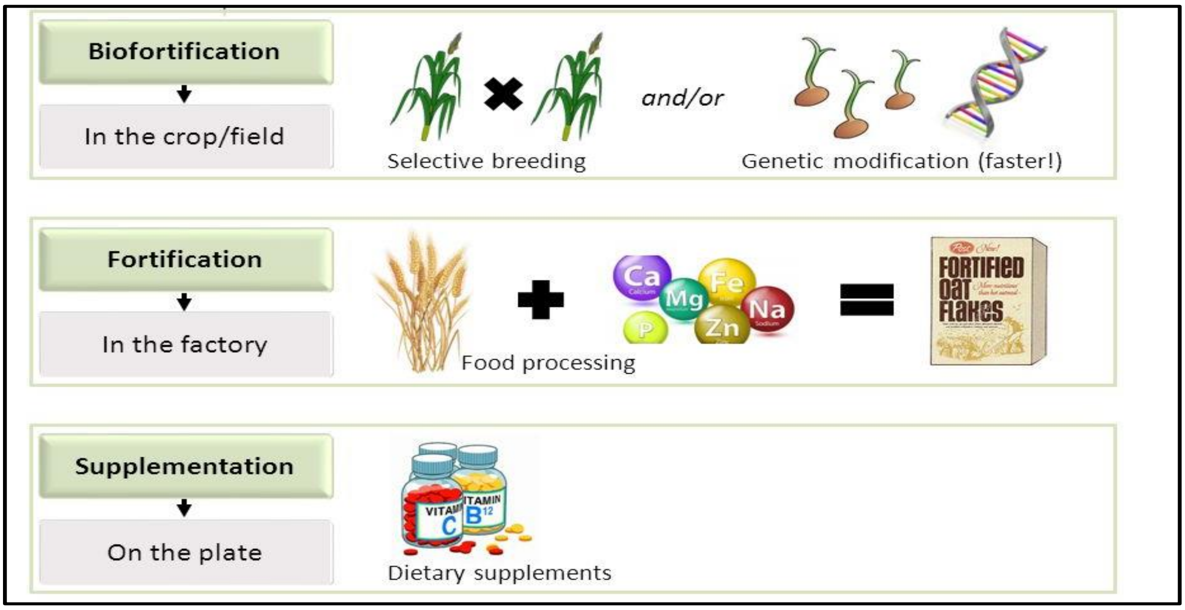
What is Bio-Fortified Crops?

1. Most often means increased content of essential micronutrients (minerals and vitamins).
2. Developed through plant breeding and agronomic practices.
3. Bio-fortified crops released in 27 countries.
4. 8 in Africa, 4 in Asia, 5 in LAC.
5. In testing in 43 countries.
6. 26 in Africa, 8 in Asia, 9 in LAC.

Why Bio-Fortification?

1. Provides a feasible means of reaching malnourished rural populations who may have limited access to diverse diets, supplements, and commercially fortified foods.
2. Reaching consumers in first rural and then urban areas, in contrast to complementary interventions, such as fortification and supplementation.
3. Unlike the continual financial outlays required for supplementation and commercial fortification programmes, a one-time investment in plant breeding.

Biofortification vs Fortification vs Supplementation



Advantages of Bio-Fortification

1. Capitalizes the regular daily intake of food staples. Implicitly targets low-income households.
2. After the one-time investment to develop fortified seeds, recurrent costs are low.
3. Once in place, the fortified crop system is highly sustainable.
4. To overcome the mal-nutritions in human beings.
5. Increment of nutritional quality in daily diets.
6. Improvement of plant or crop quality and increment of variability in germsplasm.

Commercially available fortified foods

Importance of Biofortication

1. To improves the plant or crop quality.
2. To increase the nutritional quality in daily diets.
3. To overcome malnutrition in human beings.

4. Application of bio-fortified crops would benefit farmers by increasing their income in the long term.

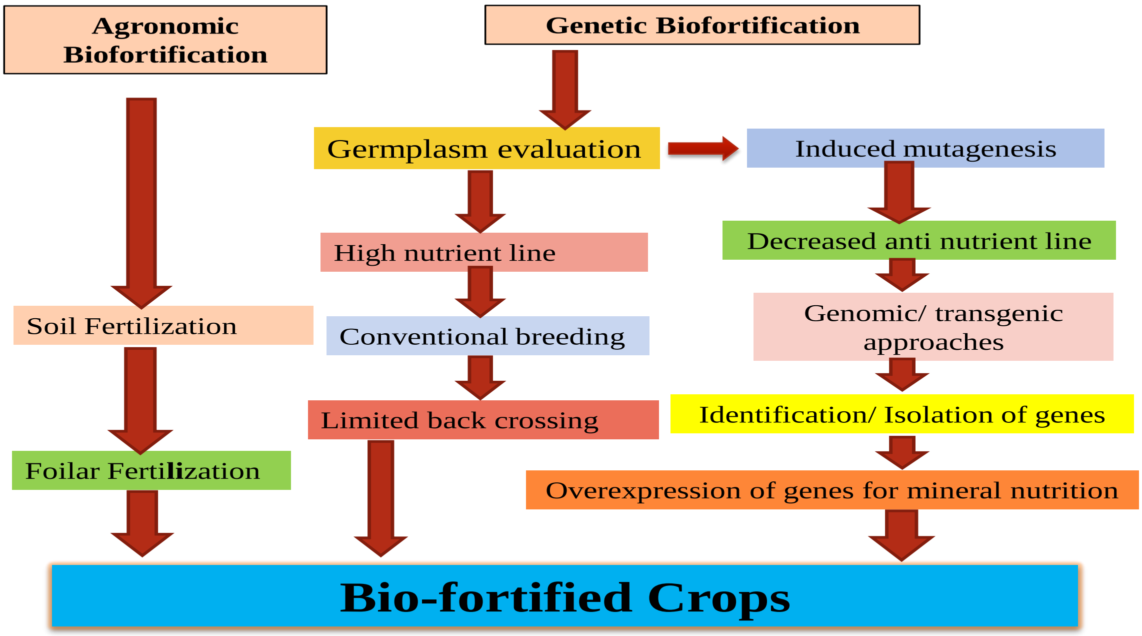
Source of nutrients from vegetables

NUTRIENTS	VEGETABLES
Carbohydrate	Sweet potato, potato, cassava
Protein	Pea, lima bean, french bean, cowpea
Vitamin A	Carrot, spinach, pumpkin
Vitamin B_1	Tomato, chilli, garlic, leek, pea
Vitamin C	Chilli, sweet pepper, cabbage, drumstick
Calcium	Hyacinth bean, amaranthus, palak
Iron	Amaranthus, palak, spinach, lettuce, bitter gourd
Phosphorous	Pea, lima bean, taro, drumstick leaves
Vitamin B_5	Palak, amaranthus, bitter gourd, pointed gourd
Iodine	Tomato, sweet pepper, carrot, garlic, okra
Sodium	Celery, green onion, Chinese cabbage, radish

Different Bio-Fortified Varieties

Crop	Variety	Attributes
Tomato	Pusa Uphar, Pusa Rohini Pusa Hybrid 2 Pusa Red Plum	Vitamin C & Lycopene
Paprika	KTPL-19	Capsanthin
Carrot	Pusa Asita Pusa Rudhira	Anthocyanin Lycopene
	Pusa Vrishti ,Pusa Yamdagni Pusa Meghali	Beta carotene
Radish	Pusa Jamuni	Anthocyanin
	Pusa Gulabi	Lycopene
	VARIETY	ATTRIBUTES
	Red Acre	Anthocyanin
	Pusa Bharati Pusa Jyoti	Vitamin A ,C, Fe, Ca
	Pusa Aushadi Pusa Vishesh Pusa Hybrid -2	Beta carotene Ca & Fe Ca &Fe
	Arka Chandan	Beta-carotene
	Sree Visakam	Beta-carotene
	Sree Kanaka BHU Sona BHU Krishna	Beta –carotene Anthocyanin
	Amt. 105	Carotene and protein
	Pusa Pragati and Arkel	Protein

Methods of Bio-fortification



Conclusion

1. Bio-fortification is a cost- effective, feasible means of reaching populations who may have limited availability and access to diverse diets, supplements, or commercially fortified foods. Because bio-fortification combines increased micronutrient content with preferred agronomic and quality traits.
2. Bio-fortification of vegetable crop is a potential mechanism for alleviating micronutrient deficiencies (malnutrition).
3. A one-time investment in plant breeding yields micronutrient rich varieties for farmers to grow for years to come , and the same varieties can be evaluated in other target geographies with similar agro-ecological conditions, thus multiplying the benefit of the initial investment.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Jamun (Avenue Tree of Bundelkhand Region)

Article ID: 11606

Shubham Jain[1], Dr. Saket Mishra[2]
[1]M.Sc. horticulture (fruit science) student, Shuats Naini Prayagraj.
[2]Assistant professor (Horticulture), Shuats Naini Prayagraj.

Introduction

Jamun is an important minor fruit crop in india . It is a most popular indigenous fruit of india . It is believed to be a boon for diabetic patients. In India the maximum number of jamun trees are found in tropical and subtropical regions.

Common name: Jamun

Others name: java plum, Indian black berry, diabatic fighter.

Botanical name: *Syzygium cuminii*

Family: Myrtaceae.

Origin: India.

Fruit type: Drupe.

Edible part: Mesocarp and epicarp.

Blue and purple colour: Anthocyanin.

Soil

The jamun tree can be grown on a wide range of soils. However, for high yield potential and good plant growth, deep loam and a well-drained soil are needed. Such soils also retain sufficient soil moisture which is beneficial for optimum growth and good fruiting.

Jamun can grow well under salinity and waterlogged conditions too. However, it is not economical to grow jamun on very heavy or light sandy soils. PH range of soil is 6-7.

Climate

Jamun is a hardy fruit, it can be grown under adverse climate conditions. It thrives well under both tropical and subtropical climate. It requires dry weather at the time of flowering and fruit setting.

Early rains are beneficial for better growth, development and ripening of fruit. Young plants are susceptible to frost. Temperature require for jamun is 15^0C - 25^0C.

Advantages of Bio-Fortification

1. Capitalizes the regular daily intake of food staples. Implicitly targets low-income households.
2. After the one-time investment to develop fortified seeds, recurrent costs are low.
3. Once in place, the fortified crop system is highly sustainable.
4. To overcome the mal-nutritions in human beings.
5. Increment of nutritional quality in daily diets.
6. Improvement of plant or crop quality and increment of variability in germsplasm.

Related Species

Common Name	Botanical Name
Rose apple	*Syzygium jambose*
Watery Rose Apple	*Syzygium aqueum*
Malay Rose Apple	*Syzygium malaccense*
Surinam cherry	*Syzygium uniflora*

Varieties - Ra Jamun: Large sized fruits.

CISH J-42: Seedless type.

Goma Priyanka: Early type, semi dwarf.

Dhoopdal: Popular in Karnataka (GI tag).

Konkan bhadoli: Best variety for Maharashtra.

Jamrul & Farida: Purple colour.

N-6, N-9: Round shaped.

Rajendra -1: Sweetest varieties.

Propagation

The Jamun is propagated both by seed and vegetative methods. Due to existence of polyembryony, it comes true to parent through seed. Though vegetative methods followed in most cases have attained some success, seed propagation is still preferred. However, seed propagation is not advisable as it results in late bearing.

The seeds have no dormancy. Fresh seeds can be sown. Germination takes place in about 10 to 15 days. Seedlings are ready for transplanting for the use as rootstock in the following spring (February to March) or monsoon i.e., August to September.

Planting

Jamun can be planted both in spring season (February – March) & monsoon season (July – august). Prior to planting, the field is properly cleared and ploughed.

Pits of 1 x 1 x 1 m size are dug at the distance of 10m both ways. Usually, work of digging of pits is completed before the onset of monsoon. The pit is filled with mixture of75% top soil and 25% well rotten farmyard manure or compost.

Fertilizer Application

One Year dose of about 23 kg farm yard manure during the pre-bearing period and 65 kg per tree bearing trees is considered. Normally, seedling jamun trees start bearing at the age of 8 years while grafted or budded trees come into bearing in 6 years. On very rich soils, the trees have a tendency to put on more vegetative growth with the result that fruiting is delayed.

Irrigation

In early stages, the jamun tree requires frequent irrigations but after 1 year's trees gets established, the interval between irrigations can be greatly decreased. Young trees require 8 to 10 irrigations in a year.

The mature trees require only about half the number, which should be applied during May and June when the fruit is ripening. During autumn and winter months, just an occasional irrigation may be applied when the soil is dry. This will also save the trees from the ill effects of frost in winter.

Intercropping

In the initial years of planting, when a lot of interspaces is available in the orchard, appropriate intercrop especially legumenous crops and vegetables can be taken during rainy season.

Training & Pruning

Regular pruning in jamun is not required. However, in later years the dry twigs and crossed branches are removed. While training the plants, the framework of branches is allowed to develop above 100 cm from the ground level.

Flowering & Fruiting

Flowering starts in the first week of March and continues up to the end of April. The pollen fertility is higher in the beginning of the season. The maximum receptivity of stigma is one day after anthesis. Flowers are borne in the axils of leaves on branches.

The jamun is a cross-pollinated and the pollination is done by wind. The pattern of growth and fruit development of jamun can be divided into three phases: the first phase from 15-50days after fruit set having slow growth of fruit, the second phase from 50 to 58 days after fruit set having fast growth and the third and last phase from 58 to 60 days after fruit set having slow growth and very little addition in fruit weight.

Harvesting

The fruit ripens in the month of June -July. The main characteristic of ripe fruit at full size is deep purple or black colour. The fruit should be picked immediately when picked singly by climbing the tree with bags slung on the shoulder. The seedling jamun plants start bearing after 8 to 10 years of planting, while grafted ones bear after 6 to 7 years. However, commercial bearing starts after 8 to 10 years of planting and continues till the tree becomes 50 to 70 years old.

Yield

The average yield of fruits from a full-grown seedling tree is about 80 to 100 kg and from a grafted one 80 kg per year.

Insect & Pest

1. White fly *(Dialeurodes eugenia)*: It damages jamun tree in all parts of India. Affected fruits get wormy appearance on the surface. White fly can be controlled in the following ways.
Control:
a. Maintain sanitary conditions around the tree.
b. Pluck all affected fruits and destroy them.

2. Leaf eating caterpillar *(Carea subtillis)*: This caterpillar is only found in Coimbatore. The insect infests the leaves and may defoliate the tree. It can be controlled by spraying Malathion @ 0.1 per cent.

Diseases

Anthracnose *(Glomerella cingulata)*: The fungus incites leaf spots and fruit rot. Affected leaves show small scattered spots, light brown or reddish brown in colour. Affected fruits show small water soaked, circular and depressed lesions. Ultimately, the fruits rot and shrivel.
Control: Spraying with Dithane Z- 78 @ 0.2% or Bordeaux mixture at : 4:4:50 concentration shall check the disease.

Storage

The fruits are highly perishable in nature. They cannot be stored for more than 3 to 4 days under ordinary conditions. However, pre cooled fruits packed in polythene bags can be stored well up to three weeks at low temperatures of 8 to 10°C and 85 to 90% relative humidity.

Nutritional value per 100 gm Jamun (source as per USDA):

Energy	251 kj
Carbohydrate	15.56 g
Fat	0.23
protein	0.72
Vit A	3 IU
Thiamine	0.006 mg
Riboflavin	0.012
Niacin	0.260 mg
Vit C	14.3 mg
Iron	0.19mg

Key Point

1. Used as avenue tree.
2. Used as wind break.
3. Jamun is non-climacteric fruit.
4. Fruits ripe during June -July.
5. Inflorescence -Panicle.
6. Propagation by seeds.

7. Jamun is evergreen fruit tree.
8. Good source of iron.
9. Jamun seeds effective medicine for diabetes.
10. Jamun is hexaploid tree.
11. Main responsible for astringency -tannin
12. Type of pollination -highly cross pollination.

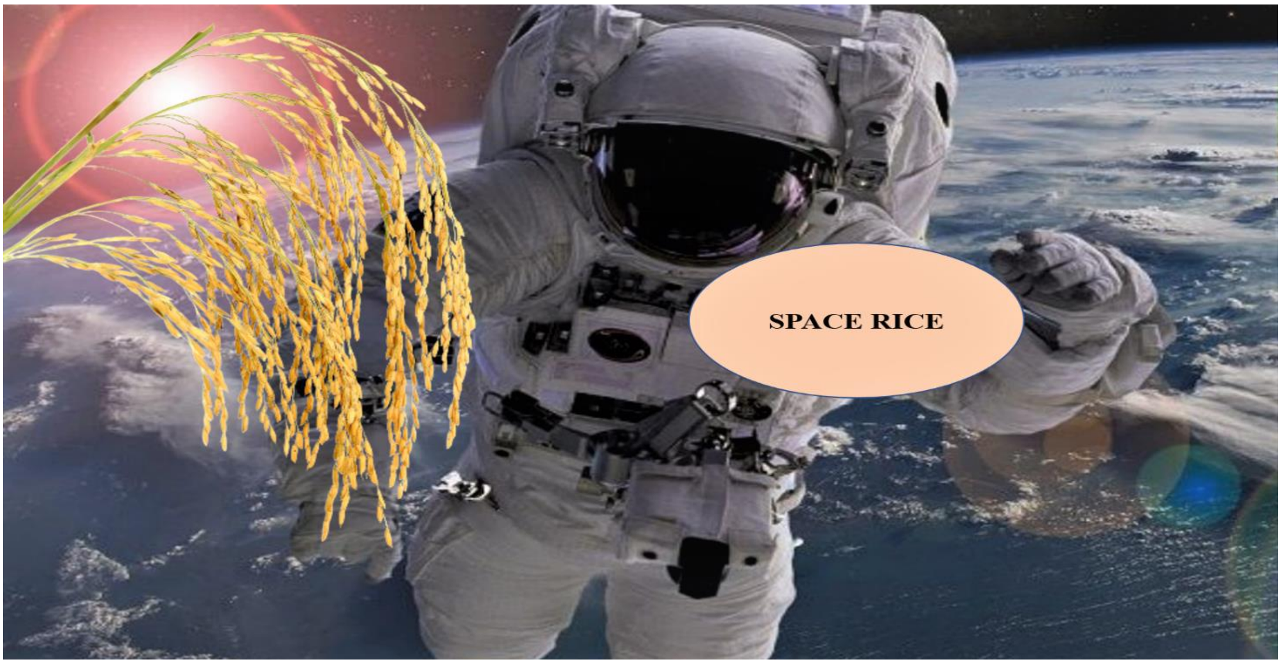
References

1. Handbook of horticulture by K L Chadha.
2. Glaustas Horticulture by P. Muthu Kumar & R. Selvakumar.
3. Instant of horticulture by S. N. Gupta.

Space Rice: A New Height of Crop Improvement

Article ID: 11607

Partha Mondal[1]
[1]Ph.D scholar, Department of Agricultural Biochemistry, Bidhan Chandra Krishi Viswavidyalay, West Bengal.



Picture Courtesy: Newsyolo & Flickr

What is Space Rice?

Of late a new edge of science has been surfaced out i.e., space rice. Rice seeds are exposed in space environment and after that those are grown in green house rice field for further study in crop improvement vis-à-vis yield and other desirable parameters. South China Agricultural University has harvested the Space rice for the first time. In international social media it is also popular as 'rice from heaven'.

Why Space Rice?

China has been bringing seeds of rice as well as other crops to space since 1987. It is reported that more than 200 space plant varieties of cotton, tomatoes etc. have been approved for planting. More than 2.4 million hectares area is approved for space crops in China, which is supposed to combat upcoming food crisis and for more export to earn more foreign currency of this country. And this is the latest study that rice seeds exposed to the environment in space may mutate and produce higher yields once planted on earth. Several other experiments of growing plants in space have been conducted by National Aeronautical and Space Administration (NASA).

Experiment in Nutshell

Under this experiment 1500 seeds (about 40g) brought to a 23-days lunar voyage about 760,000 km with China's Chang'e-5 in November,2020 that returned to earth on December,17 in 2020 after 23 days have been transplanted to the rice fields in greenhouse of the National Engineering Research Centre of Plant Space Breeding of South China Agricultural University (SCAU). After harvesting the first batch in July,2021 the remaining seeds have been segregated into three parcels for further study. These 1-centimetre-long seeds will soon be bred in laboratories and then will be planted in fields.

The seeds were second-generation space-bred ones because their "parents" were also space-bred seeds. But the experiment on the Chang'e 5 probe is different from previous ones. It was the first such experiment conducted in a deep space environment. The space flight time was longer, and the probe encountered radiation in the Van Allen Belts and from sunspot activity, according to the centre's director Chen Zhiqiang. After over four months of growth, the dropping ears of the 2,000 "space rice plants" at the space breeding research centre of the South China Agricultural University in South China's Guangdong Province promise a fruitful harvest. Stronger hereditary effects are expected to be produced in this experiment, as a deep space environment is more similar to a real space extreme environment, according to the centre's deputy director Guo Tao and further studies related to various stress would be the next generation tools to combat the upcoming challenge in food security and crop improvement.

Conclusion

The seeds will offer new varieties of rice that will help boost China's breeding industry efficiency. It will help researchers learn how hereditary effects induced in deep space and a low-earth orbit environment differ and provide important experimental samples and data for further research on mutation rules in space breeding. It would also lay grounds for future manned deep-space explorations to the Moon, Mars and other celestial bodies. With long-term human stays at the space station, researchers are expecting to conduct experiments to test a self-recycling ecosystem in space, which will greatly cut costs and reduce the resources needed for future manned spaceflights. This will support more deep-space explorations, including the building of a lunar research base and manned missions to Mars.

Moreover, China distributed batches of 17 grams of lunar soils to 13 research institutes, including the Chinese Academy of Sciences, China University of Geosciences, and Sun Yat-Sen University to understand more about the moon's geology and evolution, but also to peer into its potential habitability. In its lunar mission, China was already able to grow crops on the lunar surface, after cotton seeds successfully sprouted inside a special mini-biosphere container.

Future Prospects

The exposure of cosmic radiation and zero gravity may cause some desirable mutation. The most expected study for supposed to be conducted by SCAU would be based upon previous studies. Kranz,1986 studied that there are no such differences between space and earth condition seeds appeared to germinate and grow into plants, and there was no notable variation in morphological features to plants grown on Earth, whether the effects of abnormalities observed have perhaps been attributable to microgravity. Genetic stability, cell division, nuclear and chromosomal behaviour, and general viability seemed to be disturbed in some cases. Such changes might be helpful in crop improvement research.

Moreno-Villanueva et al.,2017 studied that space radiation can cause damage to DNA directly, through the interaction of charged particles with the DNA molecules themselves, or indirectly through the production of free radicals. Although organisms have evolved strategies on Earth to confront such damage, space environmental conditions, especially microgravity, can impact DNA repair resulting in accumulation of severe DNA. Based upon such theory there would be some desirable traits may come in those seeds which could be useful to study anti-oxidant activity in plants evolved from those space rice. Rate of mutation in space is more rapid than normal and scientists theorize patterns of those mutations could help predict how pathogens become resistant to antibiotics.

Based upon such theory it would be studied various combination of mutant with proper expression of such condition and by using some bioinformatics study, mutation in seeds might help in development of new varieties which could be the savers in critical time later by using data from mutation spectrum and also combining that with algorithms can improve the ability to predict mutations. Spaceflight environment influences metabolite production (not effect on morphological parameters) in ways that may affect flavour and nutritional quality of potential space produce.

Significant differences in growth (yield) and development (like fertility, cell wall structures, chloroplasts and mitochondria) relative to earth condition. Micro gravity limits mixing of the gaseous microenvironments inside the closed tissues and that the resulting gas composition surrounding the seeds and pollen retards their development. Amyloplasts contain less Starch and an abundance of oil droplets. The space environment somehow disrupts normal carbohydrate metabolism in root cells. Based upon such earlier study the new study could bring some insights for crop improvement. Looking forward to see the best outcome from this research its application in crop improvement.

References

1. China Harvests First Crop of ‘Space Rice’ in Food Security Push- Bloomberg News https://www.bloomberg.com/news/articles/2021-07-12/china-harvests-first-crop-of-space-rice-in-food-security-push
2. China harvests 'space rice seeds'- Ecns wire http://www.ecns.cn/cns-wire/2021-07-13/detail-ihapauxv0565059.shtml
3. China's first 'space rice' that made round trip to moon yields grain-Global Times https://www.globaltimes.cn/page/202107/1228365.shtml
4. Howard G. Levine, The Influence of Microgravity on Plants www.nasa.gov
5. Kranz, A. R. (1986). Genetic and physiological damage induced by cosmic radiation on dry plant seeds during space flight. Advances in Space Research, 6(12), 135-138.
6. Moreno-Villanueva, M., Wong, M., Lu, T., Zhang, Y., & Wu, H. (2017). Interplay of space radiation and microgravity in DNA damage and DNA damage response. npj Microgravity, 3(1), 1-8.
7. Mutants in Microgravity https://www.nasa.gov/mission_pages/station/research/news/nanobiosym_genes
8. Rice seeds from space transplanted in south China -Xinhua http://www.xinhuanet.com/english/asiapacific/2021-03/29/c_139844919_2.htm
9. Space rice feeds new space race: China is getting serious-Zmescience https://www.zmescience.com/science/agriculture-science/china-space-crop-13072021/
10. 'Space Rice': China harvests first batch of rice that travelled around the moon-Times now https://www.timesnownews.com/technology-science/article/space-rice-china-harvests-first-batch-of-rice-that-travelled-around-the-moon/784687
11. What is Space rice? China harvests 1st batch of seeds that travelled around moon-Hindustan timeshttps://www.hindustantimes.com/india-news/what-is-space-rice-china-harvests-1st-batch-of-seeds-that-travelled-around-moon-101626229101405.html.

Nanotechnology for Precision Agriculture

Article ID: 11608

Dr. Sanjay Kumar Singh[1], Dr. Ajeet Kumar[2]
[1]Assistant Professor-cum-Scientist, Department of Soil Science, RPCAU, Pusa, Bihar.
[2]Assistant Professor-cum-Scientist, Department of Soil Science, Sugarcane Research Institute, RPCAU, Pusa, Bihar.

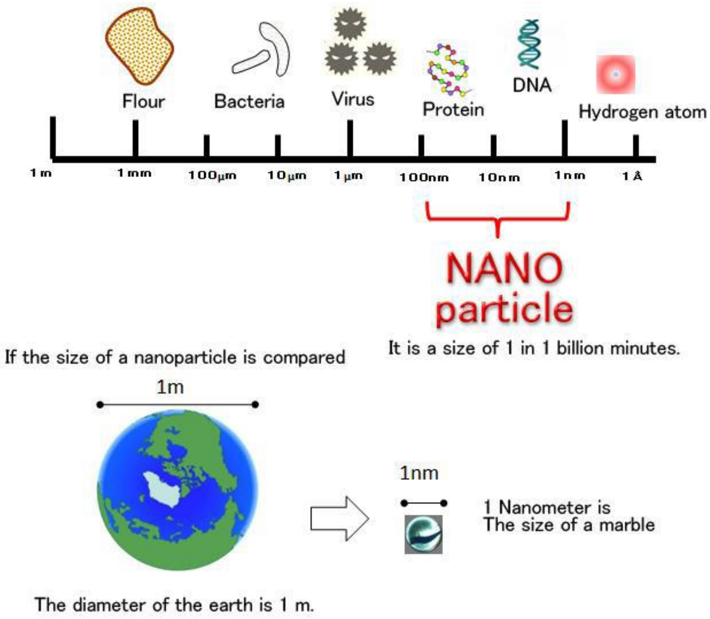
Introduction

Indian Agriculture is facing a wide spectrum of constrains such as burgeoning population, shrinking farm land, restricted water availability, imbalanced fertilization, low soil organic carbon, besides experiencing the fatigue of green revolution and vagaries of climate change. To address all the challenges ahead, we should think of an alternate technology such as "nanotechnology" to precisely detect and deliver the correct quantity of nutrients or other inputs required by crops that promote productivity while ensuring environmental safety. The word "nano" refers to the size of one-billionth of a meter of one-million of a millimeter in any one of the dimensions.

The term "Nanotechnology" was first defined in 1974 by Norio Taniguchi of the Tokyo Science University. Nanotechnology, abbreviated to "Nanotech", is the study of manipulating matter on an atomic and molecular scale. By and large nanotechnology deals with structures in the size range between 1 to 100 nm and involves developing materials or devices within that size.

What are Nanoparticles?

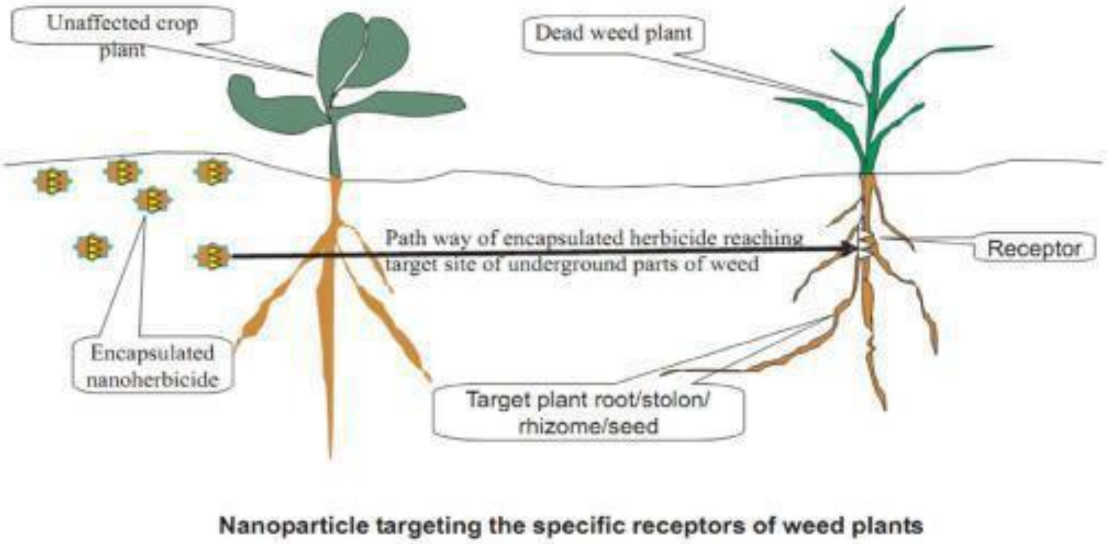
A nanoparticle (or nanopowder or nanocluster or nanocrystal) is a small particle with at least one dimension less than 100 nm.
1 Nanometer = 10^{-9} m = 1 billionth of a meter
For comparison, a virus is roughly 100 nano metres (nm) in size.



Nano Agriculture – Principles and Practices

1. Early Detection of Diseases and Nutrient Deficiencies using Diagnostic Kits.
2. Nano-pheromone for Effective Pest Monitoring.
3. Enhanced Input Use Efficiency.
4. Nano-Fertilizers for balanced crop nutrition.
5. Nano-herbicide for effective weed control.

6. Nano insecticides.
7. Nanodevices for Identity Preservation (IP) and Tracking.
8. Nanotechnology for Environmental Safety.



Smart delivery of nanoencapsulated herbicide in the crop-weed environment

Nano-Fertilizers (Smart Nutrient Delivery System)

Nano fertilizers are synthesized or modified form of traditional fertilizers, fertilizers bulk materials or extracted from different vegetative or reproductive parts of the plant by different chemical, physical, mechanical or biological methods with the help of nanotechnology used to improve soil fertility, productivity and quality of agricultural produces. Nanoparticles can be made from fully bulk materials.

At nano scale physical and chemical properties are differ than bulk material. Rock phosphate if use as nano form it may increase availability of phosphorus to the plant because direct application of rock phosphate nano particles on the crop may prevent fixation in the soil similarly there is no silicic acid, iron and calcium for fixation of the phosphorus hence, it increases phosphorus availability to the crop plants.

Conventional Fertilizers v/s Nano-Fertilizers

Conventional fertilizers are generally applied on the crops by either spraying or broadcasting. However, one of the major factors that decide the mode of application is the final concentration of the fertilizers reaching to the plant. In practical scenario, very less concentration to the targeted site due to leaching of chemicals, drift, runoff, evaporation, hydrolysis by soil moisture and photolytic and microbial degradation. It has been estimated that around 40-70% of nitrogen, 80-90% of phosphorus, and 50-90% of potassium content of applied fertilizers are lost in the environment and could not reach the plant which causes sustainable and economic losses. These problems have initiated repeated use of fertilizer and pesticide which adversely affects the inherent nutrient balance of the soil. The large-scale use of chemicals as fertilizers and pesticides has resulted in environmental pollution affecting normal flora and fauna.

Precision Farming

Precision farming has been a long-desired goal to maximize output (i.e., crop yields) while minimizing input (i.e., fertilizers, pesticides, herbicides, etc.) through monitoring environmental variables and applying targeted action. Precision farming makes use of computers, global satellite positioning systems, and remote sensing devices to measure highly localized environmental conditions thus determining whether crops are growing at maximum efficiency or precisely identifying the nature and location of problems. By using centralized data to determine soil conditions and plant development, seeding, fertilizer, chemical and water use can be fine-tuned to lower production costs and potentially increase production all benefiting the farmers. Precision farming can also help to reduce agricultural waste and thus keep environmental pollution to a minimum. Although not fully implemented yet, tiny sensors and monitoring systems enabled by nanotechnology will have a large impact on future precision farming methodologies.

Benefits of Nanotechnology

1. Nanotechnology today is regarded as a revolutionary technology.
2. Nanotechnology interventions could enable the successful development of renewable energy solutions and reduce our dependence of fossil fuels.
3. Enhancement of agricultural productivity has been identified as the second most critical area of application of nanotechnology for attaining the Millennium Development Goals.
4. Nanotechnology is believed to enhance agricultural productivity through genetic improvement and make crops more resistant to heat and water logging. Water treatment and remediation has been cited as the third most critical area where nanotechnology includes water purification, detection of contaminants and waste water treatment.

Challenges

1. Producing the nanomaterials in large enough volumes, with consistent quality, and at acceptable costs.
2. Supplying the nanomaterials in a form (such as proper particle size, surface chemistry, dispersion capability, compatibility with various media, etc.) that would allow integration into the process.
3. Engineering and customizing the nano-based system to local requirements.
4. Addressing environmental, health and safety concerns in the use and disposal of nano products.
5. One of the biggest challenges has been in terms of the interdisciplinary nature of nanotechnology per se and the scope of its applications. This has led to significant overlaps in the areas for R&D support identified by different agencies.
6. The gap between basic research and application is another challenge in nanotechnology, like several other technologies. There is poor lab-firm integration which is compounded by the paucity of skilled manpower that could provide linkages between the technology and commercial domains.
7. Being cost and risk intensive, and being dependent upon sophisticated and complex equipment, technical know-how and capacity, financial constraints often act as impediment in this regard.
8. The main challenges faced by regulatory institutions currently relate to the regulatory capacity, information asymmetry and absence of interagency coordination.

Millets – The Nutri-Cereals

Article ID: 11609

Chaithra C.[1], Roopa K. Muttappanavar[2]
[1]M.Sc. (Agri), Department of Agronomy, UAS, GKVK, Bangalore, Karnataka-560065.
[2]Ph.D. Scholar, Department of Agronomy, UAS, GKVK, Bangalore, Karnataka-560065.

A group of small-grained cereal food crops known as millets, which are highly drought, pest, and disease tolerant and are grown with lesser chemical inputs such as fertilizers and pesticides. Millets are popularly known as Nutri-cereals or nutraceuticals as they supply most of the nutrients required for the human body's normal functioning. The majority of the millets are native to India. Based on their grain size millets are categorized as major millets and minor millets. Major millets include Sorghum (*Sorghum bicolor*) and Pearl millet(*Pennisetum glaucum*). Minor millets are Finger millet (*Eleusine coracana*), Kodo millet (*Paspalum scorbiculatum*), proso millet (*Panicum miliaceum*), foxtail millet (*Setaria italica*), little millet (*Panicum sumatrense*), and barnyard millet (Echinochloa colona). Millets are a major food component of most of the African and Asian countries because of water scarcity and increasing populations. Compared to major cereals, millets are the most drought-resistant crops, pests and diseases resistant, have a short growing season, and more productivity under drought situations (Devi et al., 2011). Various traditional recipes like, bread, porridges, and snack foods are prepared out of it. Therefore, millets are now gaining specific attention from the developing countries in terms of utilization as food as well as from some developed countries in terms of their good potential in the manufacturing of bioethanol and biofilms.

Millets have several health benefits such as preventing cardiovascular diseases, reducing the incidence of cancer and tumor, lowering blood pressure, reducing the risk of heart disease, cholesterol, and rate of fat absorption, and delaying gastric emptying have been reported for millet thus, it can be potentially developed as a nutraceutical and industrial bio researches for a sustainable healthy society and nature. (Gupta et al., 2012).

Before consumption millets are usually processed by traditional processing techniques i.e., decorticating, malting, fermentation, roasting, flaking, and grinding to improve their sensory, edible, and nutritional properties. Negative changes in the nutritional properties while processing is not avoidable because industrial methods for processing millets are not as developed as processing methods of wheat and rice. Therefore, with value-added strategies and appropriate processing technologies, several value-added and health food products, can be prepared out of millets, which may then enhance the demand from non-traditional millet users and large urban population.

Nutritional Benefits of Millet Grains

To maintaining the overall physical wellness of a human being the nutritional quality of the food plays a crucial role because nutritional well-being is a sustainable way for healthy growth and development. Therefore, the dietary quality of the food should be taken into consideration for solving the deep-rooted problem of food insecurity, malnutrition, and dietary quality (Singh and Raghuvanshi, 2012). In addition to their growing advantages, millets are highly nutritious and comparable to wheat and rice. Millet proteins are good sources of essential amino acids except for lysine and threonine. They are rich sources of phytochemicals and micronutrients but are a relatively rich source of methionine.

For example, Sorghum is an excellent source of protein and starch. It is gluten-free, with implications to present-day scenario where the occurrence of Celiac Disease (CD), immunological response to gluten intolerance is growing. phenolic compounds in sorghum grain like flavonoids have been found to inhibit tumor development. It could be beneficial to diabetics as the starches and sugars are released more slowly as compared to other cereals (Kulamarva et al. 2009). Pearl millet was found significantly rich in resistant starch, soluble and insoluble dietary fibers, minerals, and antioxidants. It contains about 92.5% of dry matter, 2.1% of ash, 2.8% of crude fiber, 7.8% of crude fat, 13.6% of crude protein, and 63.2% of starch.

Finger millet also is known to have several potential health benefits due to its polyphenol contents. Its carbohydrate of 81.5% of carbohydrate, 9.8% of protein, 4.3% of crude fiber, and 2.7% of mineral that is comparable to other cereals and millets. Its crude fiber and mineral contents are higher than those of wheat (1.2% fiber, 1.5% minerals, respectively) and rice (0.2% fiber, 0.6% minerals, respectively); its protein contains more of lysine, threonine, and valine making it better balanced than other millets.

Kodo millet and Little millet are known to have of dietary fiber(37% and 38%, respectively) which is the highest among the cereals; and they are source of higher polyunsaturated fatty acids. The protein content of Proso millet (11.6% of dry matter) was found to be comparable with that of wheat and the grain of proso millet was significantly richer in essential amino acids (leucine, isoleucine, and methionine) than wheat protein (Kalinova and Moudry, 2006).

Foxtail millets contain high fiber content (42.6%), protein and have a low glycaemic index. This results in hypoglycemic and hypocholestrolaemic effect which is beneficial for prevention of diabetes and cardiovascular diseases (Hariprasanna, 2016).

Barnyard millet is nutritionally superior with good amounts of macronutrients and dietary fiber in it. The millet is comprised of protein(10.5%), fat(3.6%), carbohydrate(68.8%) and 398 kcal/100 g of energy. The total dietary fibre content was high (12.6%) including soluble (4.2%) and insoluble (8.4%) fractions. Low glycemic index of the grains both dehulled (50.0) and dehulled and heat treated (41.7) is helpful for type-II diabetics proving potential benefits of barnyard millet in the diet therapy of diabetics (Roopashree et al., 2014)

The average of nutrient composition of some millet grains and other grains is summarized in Table 1.

Table 1: Nutrient composition of millets and other cereals (per 100 g edible portion; 12% moisture):

Food	Proteina (g)	Fat (g)	Ash (g)	Crude fiber (g)	CHO (g)	Energy (K cal)	Ca (mg)	Fe (mg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)
Rice	7.90	2.70	1.30	1.00	76.00	362	33	1.80	0.41	0.04	4.30
Wheat	11.60	2.00	1.60	2.00	71.00	348	30	3.50	0.41	0.10	5.10
Maize	9.20	4.60	1.20	2.80	73.00	358	26	2.70	0.38	0.20	3.60
Sorghum	10.40	3.10	1.60	2.00	70.70	329	25	5.40	0.38	0.15	4.30
Pearl millet	11.80	4.80	2.20	2.30	67.00	363	42	11.00	0.38	0.21	2.80
Finger millet	7.70	1.50	2.60	3.60	72.60	336	350	3.90	0.42	0.19	1.10
Foxtail millet	11.20	4.00	3.30	6.70	63.20	351	31	2.80	0.59	0.11	3.20
Common millet	12.50	3.50	3.10	5.20	63.80	364	8	2.90	0.41	0.28	4.50
Little millet	9.70	5.20	5.40	7.60	60.90	329	17	9.30	0.30	0.09	3.20
Barnyard millet	11.00	3.90	4.50	13.60	55.00	300	22	18.60	0.33	0.10	4.20
Kodo millet	9.80	3.60	3.30	5.20	66.60	353	35	1.70	0.15	0.09	2.00

All values except protein are expressed on a dry weight basis.
Sources: Hulse et al.1980 and FAO (2012).

Potential Health Benefits of Millet Grains

Some studies suggest that a diet rich in foods protects against several degenerative diseases such as cancer, cardiovascular disease, diabetes, metabolic syndrome, and Parkinson's disease. Plus, whole grains have been shown to protect against several age-related illnesses such as diabetes, heart disease, and cancer. The vitamins, minerals, essential fatty acids, and fiber found in whole grains are believed to be the reason for their health benefits.

Therefore, millet should also be considered a functional and nutritional food as it provides fiber, protein, energy, minerals, vitamins, and antioxidants necessary for human health. Thus, millet seeds act as a shield against nutritional deficiency disorders and provide nutritional security and make them suitable for large-scale use in the production of baby food, fodder, and diet food.

References

1. Devi, P. B., Vijayabharathi, R., Sathyabama, S., Malleshi, N. G. and Priyadarisini, V. B., 2011. Health benefits of finger millet (Eleusine coracana L.) polyphenols and dietary fiber: a review. Journal of Food Science and Technology. DOI: [http://www.springerlink.com].
2. FAO (Food and Agriculture Organization). 2012. Sorghum and millets in human nutrition. Rome, Italy: FAO.
3. Gupta, N., Srivastava, A. K. and Pandey, V. N., 2012. Biodiversity and nutraceutical quality of some indian millets. Proceedings of the National Academy of Sciences, India Section B: Biological Science. [http://www.springerlink.com].
4. Hulse, J. H., Laing, E. M. and Pearson, O. E., 1980. Sorghum and the millets: their composition and nutritive value. New York: Academic Press. p 1–997.
5. Hariprasanna, K., (2016). Foxtail Millet – Nutritional importance and cultivation aspects. Indian Farming. 65. 25-29.
6. Kalinova. J. and Moudry, J., 2006. Content and quality of protein in proso millet (Panicum miliaceum L.) varieties. Plant Food for Human Nutrition., 61:45–9.
7. Kulamarva, Arun & Sosle, Venkatesh & Raghavan, Vijaya. (2009). Nutritional and Rheological Properties of Sorghum. International Journal of Food Properties. 12. 55-69. 10.1080/10942910802252148.
8. Singh, P. and Raghuvanshi, R. S., 2012. Finger millet for food and nutritional security. African Journal of Food Science., 6(4):77–84.
9. Ugare, R., Chimmad, B., Naik, R., Bharati, P., & Itagi, S. (2014). Glycemic index and significance of barnyard millet (Echinochloa frumentacae) in type II diabetics. Journal of food science and technology, 51(2), 392–395. https://doi.org/10.1007/s13197-011-0516-8.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Phytoalexins in Nematode Management

Article ID: 11610

S. P. Deepa[1], K. Sankari Meena[2]

[1]Assistant Professor, Department of Nematology, J.K.K.Munirajah College of Agricultural Science, T. N. Palayam, Gobi, Erode.

[2]Scientist (Nematology) Crop Protection Division, ICAR-Indian Institute of Oilseeds Research, Hyderabad, Telangana, India.

Summary

Yield losses attributes due to plant-parasitic nematodes and the limited availability of sustainable control strategies, new plant-parasitic nematode control strategies are urgently needed. To defend themselves against nematode attack, plants possess sophisticated multi-layered immune systems. Plants produce low molecular weight antimicrobial compounds which acts against nematodes, either constitutively or after nematode infection. This article provides an overview of such metabolites that have been identified to date, their chemical nature and mode of action against nematodes.

Introduction

Phytoalexins are low molecular weight antimicrobial compounds that are synthesized by accumulated in plants that have been exposed to microorganism. These phytoalexin are considered to be significant in rendering post infectional resistance in plants.

Phytoalexins are antibiotic compounds synthesized in an infected plant in response to infection. Nematodes are capable of eliciting phytoalexins in resistant plants. Resistant lima bean (*Phaseoluslunatus*) infected by *Pratylenchuspenetrans* produces the phytoalexin, coumestrol; soybean (*Glycine max*) infected by *Meloidogyne incognita* produces glyceollin; cotton (*Gossypiumhirsuturn*) infected by *M. incognita* produces terpenoid aldehydes (Veech, 1982)

Phytoalexins are broad spectrum inhibitors and are chemically diverse with different types characteristic of particular plant species. Phytoalexins tend to fall into several classes including terpenoids, glycosteroids and alkaloids. Their importance in plant defense is indicated by an increase in susceptibility of plant tissue to infection when phytoalexin biosynthesis is inhibited. Mutants' incapable of phytoalexin production exhibit more extensive pathogen colonization as compared to wild type.

When a plant cell recognizes particles from damaged cells or from pathogens or nematodes, the plant launches a two-pronged resistance: a general short-term response and a delayed long-term specific response. As part of the induced resistance, plant deploys reactive oxygen species such as superoxide and hydrogen peroxide to kill the invading enemies.

Plant-parasitic nematodes resistance can be classified as pre-penetration or post-penetration resistance. Pre-penetration resistance refers to a situation in which a nematode is unable to enter the host plant due to the absence of metabolites needed for host recognition. Due to the presence of repellent host exudates or the presence of a physical barrier, the nematode is unable to penetrate (Lee *et al*., 2017). In post-penetration resistance, the PPN enters the host, but unable to survive or reproduce due to the presence of toxic metabolites or inability to feed. For sedentary PPN, this resistance can be further divided into *early* and *late* resistance; early resistance occurs during migration or feeding site formation, whereas late resistance occurs after the establishment of feeding sites by the nematodes (Fuller *et al*., 2008).

In nematode interactions, the common short-term response is the hypersensitive response, in which cells surrounding the site of infection are signaled to undergo apoptosis, or programmed cell death, in order to prevent the spread of the pathogen to rest of the plant.

Long-term resistance, or systemic acquired resistance (SAR), involves communication of damaged tissue with the rest of the plant using plant hormones such as jasmonic acid, ethylene, abscisic acid or salicylic acid. Reception of the signal leads to global changes within the plant, which induce genes that protect from further pathogen intrusion, including enzymes involved in the production of phytoalexins. Often, if jasmonates or ethylene (both gaseous hormones) is released from the wounded tissue, neighboring plants also manufacture phytoalexins in response to that.

For phytoalexins to be an effective resistance mechanism, they must fulfill certain requirements of a time-space- effect (TSE) inter relationship *i.e* they must be produced at proper time (1-5 days after infection) localized in the proper cells or tissue (in closed promixity to pathogen) and hence some type of antibiotic effect on the pathogen (death, inhibit development or prevent spread) can be observed.

Mechanism of Resistance

Elicitors compounds bind to cell walls in a manner similar to wall binding of phytotoxins. The binding of the elicitor then impairs the permeability of the membrane which in turn leads to phytoalexin production and subsequent cell death. This hypothesis is attractive but whether it will withstand kinetic analysis remains to be determined.

Differential accumulation of phytoalexins in susceptible and resistant hosts is often encountered and can form the basis of resistance. Absence of resistant response in the presence of toxic concentrations of phytoalexin may be explained by the rate at which accumulation occurs or by the sites at which phytoalexins accumulate. Additionally, oxidation of endogenous non-toxic derivatives to toxic phytoalexins during extraction and chemical work up may occur. If phytoalexin accumulation is not timely or if accumulation is not anatomically localized to contain the development or spread of the invading organism, toxic concentrations may accumulate but, a susceptible host response will be observed. Both susceptible and resistant host cultivars will respond initially to elicitation, but the rate of accumulation is usually faster in resistant hosts. Phytoalexins may occasionally fail to be effective because some pathogens have a mechanism to metabolically detoxify phytoalexins. Although detoxification is not consistently associated with virulence, it can be considered a defense reaction of the pathogen to the host plant.

Glyceollin

The accumulation of iso flavonoids has been associated with an incompatible response of soybean roots to infection by the root-knot nematode. The phytoalexin accumulated in soybean tissues in response to nematode infection is glyceollin, which is derived from the iso flavonoid precursor daidzein. Accumulation of the iso flavonoids genistin and daidzin and their aglyconesgenistein and daidzein in soybean roots following inoculation with *Meloidogyneincognita* race 3 was determined in the whole root system (Carpentieri-Pípolo et al.,2005).

Coumestrol and Psoralidin

Lima beans are resistant to *Pratylenchus scribneri* and produce a hypersensitive response to infection. Snap beans are susceptible to *P. scribneri*. The nematode reproduces well, and no hypersensitive response is observed. Both types of beans constitutively produce low levels of coumestrol (5-20 µg/g fresh weight tissue) but only limabeans when infected with *P.scribneri* respond by producing infection – elicited coumestans. Within one day after inoculation, the coumestan, coumestrol, have accumulated (<40µg/g fresh weight) in infected limabean roots. By 4 days after inoculation infected limabean roots contained more than 70 µg coumestrol/g root tissue (Bert Zuckerman, 2012).

Terpenoids

Gossypol and related terpenoid aldehydes have been isolated from cotton and identified as antifungal phytoalexins. The role of gossypol and related terpenoids in cotton resistance to root-knot nematode. Changes in the concentrations of five specific terpenoids (hemigossypol, methoxyhemigossypol, gossypol, methoxygossypol, dimethoxygossypol). In non-inoculated plants, the concentrations of total and individual terpenoids increased as seedlings matured, thus indicating constitutive terpenoid accumulation by both cultivars.

Thus, it appeared that terpenoids accumulated in *M. incognita* infected resistant cotton in two ways:
1. Constitutive accumulation associated with host maturation.
2. Accumulation associated with infection.

More terpenoids accumulates in the infected than in the non-inoculated roots. In the infected susceptible plants, one could suggest that accumulation is reduced because constitutive biosynthesis is inhibited, or biodegradation is enhanced.

It was not particularly distributing to find that preformed terpenoids had no relationship to host resistance. The preformed terpenoids in the root are localized in the epidermis and in occasional scattered cortical cells. They are noticeably absent from the stele. Therefore, even if constitutive terpenoid concentrations had shown a statistical relationship to host resistance, it would be difficult to explain how terpenoids in the epidermis could affect a nematode in the stele.

Conclusion

The development of phytochemicals has not yet reached maturity; efforts have largely consisted of basic, descriptive research. One conspicuous aspect of this descriptive research is the small number of botanical families examined. Obviously, a broader range of plant taxa needs to be included in the future.

References

1. Afifah, E. N., Murti, R. H., Nuringtyas, T. R., (2019). Metabolomics approach for the analysis of resistance of four tomato genotypes (Solanumlycopersicum L.) to root-knot nematodes (Meloidogyne incognita). Open Life Sci. 14, 141–149.
2. Chong, J., Wishart, D. S., Xia, J., (2019). Using MetaboAnalyst 4.0 for comprehensive and integrative metabolomics data analysis. Curr. Protoc. Bioinformatics 68:e86.
3. Ehness R, Ecker M, Godt DE, Roitsch T., (1997). Glucose and stress independently regulate source and sink metabolism and defense mechanisms via signal transduction pathways involving protein phosphorylation. Plant Cell. 9:1825-1841.

Industrial Methods for Freezing of Foods

Article ID: 11611

P. R. Davara[1], V. P. Sangani[1]
[1]Assistant Professor, Dept. of Processing and Food Engineering, College of Agril. Engg. & Technology
Junagadh Agricultural University, Junagadh - 362001.

Introduction

Freezing is a method of food preservation whereby the heat is removed (heat of fusion), the temperature of food is reduced below its freezing point and a portion of water in food undergoes a change in state to form ice crystals. Removing sufficient energy from a food product to change its state from "liquid like" to "solid-like" is a process known as freezing.

Freezing foods involves the removal of energy from the food or the reduction in heat content of food. When the food is kept below freezing point, the formation of ice crystals within the product changes the availability of water to participate in reactions.

With the reduction in the temperature, more amount water is converted to a solid state and less water is available to support deteriorative reactions. At temperatures below 0°C there is a significant reduction in growth rates for microorganisms and in the corresponding deterioration of the product due to microbial activity. At very low temperature, most other reactions that might normally occur in the product, such as enzymatic and oxidative reactions will not be taken place. Some of the freezing methods used in the freezing industries are explained as under.

Indirect Contact Freezing Systems

1. Plate freezers: The plate freezer is widely used indirect contact system of freezing. The product is to be held between two refrigerated plates. The plates are mounted parallel to each other and can be arranged horizontally or vertically. A hydraulic system is provided to open the space between plates for loading and unloading, as well as to close the plates. Hence, the effective contact of plates with the food product can be created during freezing. Spacers or limit stops are equipped between plates and a pressure relief valve is provided in the hydraulic circuit to avoid the product being crushed unevenly or excessively flattened during plate closure. Vertical plate freezers are most suited for freezing of unpackaged deformable products like fish and meat. Horizontal plate freezers are generally suitable for the product packed into rectangular cartons as well as product formed into rectangular shapes by metal molds or trays.

Vertical Plate Freezer

Horizontal Plate Freezer

2. Freezer for liquid foods: Liquid products can be frozen in a wide variety of freezer types if packaged into suitable containers. The main specialist type is scraped-surface heat exchangers in which the liquid freezes onto the inside or outside of a refrigerated cylindrical surface scraped continuously by rotating blades. For example, ice cream mix is partially frozen on the inside surface of a cylindrical barrel (ice cream freezing is usually completed in air-blast hardening tunnels after the partially frozen liquid is poured into the final packaging).

Direct Contact Systems

1. Air blast freezer: Either as still air or forced air is used in the freezing design as a freezing medium. Freezing is carried out by placing the food in freezing rooms called sharp freezers. Freezing time is largely dependent on the temperature of the freezing chamber and the type, initial temperature, and size of product in sharp freezers. In air blast freezers, the temperature is kept in the range of -20 to -40 °C and the air velocity varies from 0.5 to 18 m/s.

a. Air-Blast Tunnel Freezers: The products are loaded in the trays and placed in racks or trolleys. Cold air is circulated inside the tunnel where the tray is moving from one end to another end. optimum space is provided between layers of trolley for better air circulation within the tunnel. The trays can be moved continuously in and out of the freezer manually or by forklift trucks.

b. Belt Freezers: In case of belt freezers, the product is to be placed on the perforated belt which is continuously passing through a tunnel freezer. The air flow is directed vertically up through the belt and product layer. Belt may be passed multiple times. This kind of freezers are commonly used for small unwrapped products with uniform shape in which a free-flow individually quick frozen (IQF) product is desired. The air velocities are typically in the range 1 to 6 m/s and the layer of product can be partially fluidized.

c. Spiral Belt Freezers: Spiral freezers are a specialized type of belt freezer. In the spiral belt freezers, continuous belt is stacked in a spiral arrangement up to 50 or so tiers high. A very long belt is accommodated in a compact area as long as sufficient overhead space is available which can provide the long product residence times. Due to such design, these freezers are very suitable for processing products with higher freezing times compared with other belt freezers (e.g., larger products and packaged products for which the packaging impedes heat transfer). The size of the product is limited by the distance between each spiral tier and the total height of the stack. Air flow can be either horizontal across or vertical through the belts.

d. Fluidized Belt Freezers: Only small unwrapped IQF products of uniform size and shape can be freezed using fluidized bed freezers. Freezing of such products, the energy requirements for fluidization are not excessive, e.g., peas, cut green beans, strawberries, whole kernel corn, etc. Similar to belt freezing system, bed of product will be rested on the perforated belt and air at a flowrate necessary to fluidize the product is directed up through a perforated plate and bed of the product. Fluidization can significantly improve the distribution of the product and prevents the problem of clumping. Very wet and moisturized incoming product can also be freezed using this freezer. The surface heat transfer is significantly enhanced due to fluidization of bed. The product moves by flowing within the fluidized bed, but this can be aided by vibrating and/or sloping the air distribution plate.

2. Liquid immersion freezers: The cooled freezing media filled in the tank in which the product is immersed in this solution or sprayed while being conveyed through the freezer. Glycol, glycerol, sodium chloride, calcium chloride, and mixtures of salt and sugar are generally used as cooled freezing media. Due to direct heat exchange, a very fast temperature reduction can be achieved. The freezing media should be safe and should not affect the taste, odour, colour, or flavor of desired product. Due to the reducing ability of product dehydration, it has been commonly used for shell freezing of large particles when the outer layer is frozen quickly. Through suitable packaging of product cross-contamination between the liquid and the product can be prevented.

3. Cryogenic Freezers: Liquid nitrogen (LN_2) and liquid carbon dioxide (LCO_2) are mostly used as cryogens in the cryogenic freezers. Due to very low boiling point of such cryogens (–196°C for LN_2 and –79°C for LCO_2), a very large temperature differences and high rates of heat transfer can be achieved in the system. These cryogens are colorless, odorless, chemically inert, and nontoxic in normal concentrations and hence safe to use without any adverse effect on the product quality even for direct contact with food. The product to be frozen is loaded on a conveyor belt and conveyed into the insulated chamber. The product will be frozen either by spraying or immersion in the cryogen at atmospheric pressure. Such freezers are mostly used for small to medium sized products. In case of larger products, the rate of freezing is limited by heat transfer internal to the product. The cryogens are usually supplied as a high-pressure liquid, rather than being produced on-site, and are vented to the atmosphere in the form of gas after use. Effective insulation of the freezing or refrigeration tank is necessary to prevent excess heat ingress and cryogenic loss. For efficient use of the cryogen, the product and cryogen flows are usually countercurrent and the cryogen vent temperature is kept reasonably close to ambient conditions (–50°C to 0°C).

Conclusion

The market share of frozen food products is increasing day to day due to an excellent overall safety record. Preservation of food through freezing is very easy and convenient method as compared to other preservation techniques (e.g., thermal processing or drying). There is a minimum impact on the product quality after freezing. Further, this impact could be reduced with the adoption of advanced and novel freezing technologies and higher quality frozen products with extended shelf life can be prepared. There is good potential for food freezing industries to be grown in the Indian market.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Healthy Nutrition for a Healthy Child: Breastfeeding Practices in India

Article ID: 11612

Jaiswal Apoorva[1], Dr. Anisha Verma[1]
[1]Department of Food Nutrition and Public Health, Ethelind College of Home Sciences, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj.

Introduction

"Breastfeeding saves lives"

The World Health Organization (WHO) recommends exclusive breastfeeding for the first six months of life and the addition of complementary feeds from six months onwards, with continued breastfeed still atleast two years of age.

Apart from exclusive breastfeeding initially, time of introduction, content, and consistency of complementary feeds are critical for early nutrition. The early introduction of complementary feeds before the age of six months can lead to displacement of breast milk and increased risk of infections, besides the babies being physiologically immature.

Similarly, inadequate and inappropriate complementary feeding with unhygienic practices leads to recurrent and persistent infections and malnutrition which is followed by growth retardation, immunodeficiency, and eventually fatal outcomes. This is a concern for Indian scenario, where previous studies have suggested inability to maintain exclusive breastfeeding and late introduction of complementary feeds.

Evidence based studies have stressed the importance of human milk and concluded that infant feeding should be considered as basic health issue rather than life style choice. Breastfeeding though is a natural act; it is a behavior that needs to be learned. Mothers and other care givers need active assistance for optimum breastfeeding practices. The Global Strategy for Infant and Young Child Feeding describes the essential interventions to promote, protect, and support exclusive breastfeeding.

Benefits of Breastfeeding for Baby & Mother

Breastfed babies have:

1. Stronger immune systems.
2. Less diarrhea, constipation, gastroenteritis, gastro esophageal reflux, and preterm necrotizing enterocolitis (NEC).
3. Fewer colds and respiratory illnesses like pneumonia, respiratory syncytial virus (RSV) and whooping cough.
4. Fewer ear infections, especially those that damage hearing.
5. Fewer case of bacterial meningitis.
6. Better vision and less retinopathy of prematurity.
7. Lower rates of infant mortality.
8. Lower rates of Sudden Infant Death Syndrome (SIDS).
9. Less illness overall and less hospitalization.

Colostrum- First Food

The WHO universally recommends colostrum, as the perfect food for every newborn. The sticky, yellowish substance produced by the mother at parturition which lasts from the first 2–4 days is rich in lactalbumin and lactoprotein.[2] Colostrum, to be started within the 1st h of birth, is rich in immunoglobulin's (Igs) such as IgA, IgG, IgG2, and IgM antibodies, antimicrobial peptides such as lactoferrin and lactoperoxidase, growth factors such as epidermal growth factor, transforming growth factor (TGF- alpha), TGß, insulin-like growth factor, and vascular endothelial growth factors, and growth hormone which not only provide immunity but also foster the growth and development of the newborn.

Immediate skin- to -skin contact of the mother and baby immediately after the birth keeps the baby appropriately warm, induces the release of maternal oxytocin, and ensures that the baby receives colostrum during the first feeds. The growth factors and Vitamin A in colostrum help the infant's intestine to mature and stimulate bowel movement to clear it of meconium and reduce infection. Colostrum as nutraceutical is used in the wide variety of gastrointestinal conditions and infection and immune deficiency related disorders.

Exclusive Breastfeeding

Exclusive breastfeeding is defined as the practice of giving only breast milk for the first 6 months of life (no other foods or water). Exclusive breastfeeding meets all the nutritional needs of infants if the breastfeeding technique is followed appropriately. It is an integral part of optimal infant and young child feeding practice, which also includes the early initiation of breastfeeding within 1 h of birth and continued breastfeeding for up to 2 years.

Complementary Feeding

In addition to breastfeeding, to meet the nutritional needs of the infant, complementary foods are added to the diet of the child. The transition from exclusive breastfeeding to family foods, referred to as complementary feeding, typically covers the period from 6 to 24 months of age, a very vulnerable period prone to malnutrition. Apart from energy requirement, certain micronutrients such as iron, zinc, and Vitamin A which are reduced in breastfeeding before 6 months should be supplemented in complementary feeding. Timely introduction of complementary feeding at 6–8 months is crucial. Early weaning leads to an increased risk of type 1 diabetes, obesity, celiac disease, and eczema, and late weaning after 8 months leads to deficiency of zinc, protein, iron, and Vitamins B and D.

Breastfeeding Promotion Network of India (BPNI) was founded on 3rd December, 1991 at Wardha, Maharashtra. BPNI is a registered, independent, nonprofit, national organization; working towards protecting, promoting and supporting breastfeeding and appropriate complementary feeding of infants & young children. BPNI acts on the targets of Innocent Declarations, Convention on the Rights of the Child (CRC), International Code of Marketing of Breast milk Substitutes and the Global Strategy for Infant and Young Child Feeding (WH0 2002).

Improving Awareness

World breastfeeding week (WBW) is celebrated every year from 1 to 7 August by the WHO, UNICEF, World Alliance for Breastfeeding Alliance (WABA), and government policymakers to protect, promote, support breastfeeding and join hands with health centers and hospitals to encourage all mothers to adopt appropriate breastfeeding practices. Interactive sessions with mothers, sensitization programs for undergraduates and postgraduates on breastfeeding, symposiums, exhibitions, and outreach programs on breastfeeding all over India to emphasize the importance of breastfeeding take place. Hospitals and medical colleges have been rewarded by WABA for their outstanding performance on breastfeeding promotion every year.

Human Milk Bank

A human milk bank or breast milk bank is a service which collects, screens, processes, and dispenses by prescription human milk donated by nursing mothers who are not biologically related to the recipient infant. The optimum nutrition for newborn infants is breastfeeding, if possible, for the first year. Human milk banks offer a solution to the mothers that cannot supply their own breast milk to their child, for reasons such as a baby being at risk of getting diseases and infections from a mother with certain diseases, or when a child is hospitalized at birth due to very low birth weight (and thus at risk for conditions such as necrotizing enterocolitis), and the mother cannot provide her own milk during the extended stay for reasons such as living far from the hospital.

Conclusion

Breastfeeding has been found to promote a healthier lifestyle for the child and the mother and I feel that everyone should consider the important research that has been done and consider breastfeeding their infants to help decrease the risk of certain illnesses their child may come about in the near future. It's a cheap health boost that society has accepted and instead of turning to formula, gives breastfeeding a chance. Mothers and families should be actively involved in promoting and supporting infant feeding. Special attention should be paid to short- and long-term nutritional policies for infant and young children feeding practices.

References

1. Godhia ML, Patel N. (2013) Colostrum- its composition, benefits as a nutraceutical – A review. Curr Res Nutr Food Sci J; 1:37-47.
2. Italian Association of Donor Human Milk Banks (2015) Survey of Italian Human Milk Banks. Retrieved from http://jhl.sagepub.com
3. Thapa BR. (2005) Health factors in colostrum. Indian J Pediatr; 72:579-81.
4. World Health Organization. (2018) Global Strategy for Infant and Young Child Feeding. WorldHealthOrganization;Availablefrom:http://www.who.int/nutrition/topics/global_strategy/ en/. [Last accessed on 2018 Oct 15].
5. World Breastfeeding Week Celebrated Across Tamil Nadu: UNICEF.Org; (2019). Availablefrom:http://unicef.in/Story/600/World-Breastfeeding-Week-celebrated-across-Tamil-Nadu. [Last accessed on Jan 03].

Horticultural and Therapeutic Potential of Catharanthus Roseus: A Model Plant for Terpenoid Indole Alkaloid Synthesis

Article ID: 11613

Shashi Pandey Rai[1], Apoorva[1], Sanjay Kumar Rai[2]
[1]Centre of Advance Study in Botany, Institute of Science, Banaras Hindu University, Varanasi-22100.
[2]Rajendra Agricultural University, Bihar, Pusa, Samastipur-803 113.

Introduction

Medagascar Periwinkle, *Catharanthus roseus* (L.) (G. Don) (2n= 16), a perennial tropical subshrub of the family apocynaceae have considerable economic potential on account of being in-planta source of the anti-cancerous dimeric leaf alkaloids, vinblastine, vincristine and leurosidine. It is also an alternate source of the alkaloid, ajmalicine and serpentine produced by the roots of the plants. Beside medicinal potential it is also used as an evergreen ornamental plant of tropical and sub-tropical regions well growing in humid dry, hot and cool locations. It is commonly known as Cape periwinkle, bright eyes, Madagascar periwinkle, old maid, graveyard plant, pink periwinkle, rose periwinkle, nayantara, sadabahar etc. The plant *C. roseus* also bears the distinction of a genus bearing large/high number of indole alkaloids in the whole plant kingdom. All parts of this plant contain upto 400 alkaloids having bioactive potential therefore used as flavour, fragrance, pharmacological activities, food additives, pesticides and agrochemicals. About 100 monoterpenoid indole alkaloids (TIA) are produced by these plants in different organs of the plant such as leaves and roots, where concentrations of these compounds vary with the part, place of cultivation and time of harvest. The root alkaloid, ajmalicine is commonly used in the treatment to control high blood pressure whereas leaf alkaloids have antioxidative, anti-neoplastic, anti-inflammatory, antimicrobial, antifungal, antibacterial, antithrombotic, anti-allergic, vasodilatory effects and cardio-protective properties. However, the worldwide production of these alkaloids is limited due to low in-planta yield of these compounds whereas, the uses and demand of these alkaloids is being continuously increasing due to its anticancerous potentials. The alkaloid ajmalicine is produced in about 3800 kg/year amounts and anticanceous dimeric alkaloid vincristine and vinblastine production is in few kilograms range only. The commercial market value of these alkaloids has been estimated to be in the range of several hundred million dollars. Due to high cost and large demand intensive researches have been also carried out under in-vitro conditions to optimize culture media for large biomass production, precursor feeding approaches for enhanced production of metabolites as well as genetic engineering approaches to increase the production these alkaloids.

Anti-cancerous alkaloids, vincristine and vinblastine are the most important clinically useful agents and are the most expensive because of their low abundance in the plant parts. Vinblastine sulphate (velban), is used in the treatment of Hodgkin's disease, neuro-blastoma, charo-carcinoma, lympho-sarcoma, sarcoma of the breast and lungs and also in acute chronic leukaemia. Vincristine sulphate (oncanin), is another compound used in the treatment of acute leukaemia in children, lymphocytic leukaemia, neuro-blastoma, Wilmis tumor, rhabdo-sarcoma and reticulum cell sarcoma. Another compound Ajmalicine is used in the treatment of blood circulatory diseases of humans, especially to treat obstruction of normal cerebral blood flow. However, Serpentine can be converted to ajmalicine by the process of hydrogenation for its pharmaceutical utilization. The useful alkaloids of *C. roseus* cannot be economically synthesized by utilizing the monomers, but for the monomers also the plant remains is the only source of such medicinal compounds. There is therefore need for enhanced synthesis and production of alkaloids in *C. roseus* leaves and roots in-planta through molecular breeding and genetic engineering approaches.

Important Features of Catharanthus Roseus as a Good Genetic System

C. roseus is an erect short lived perennial sub-shrub of 30-120 cm height with small obovate to narrowly elliptic leaves. The plant is well suited for genetic studies because of the ease in its propagation and wide adaptability in semi-temperate to tropical environments and a variety of soils. Small size of seedling and

plant facilitates propagation of their large populations under in vitro culture, glass house, green house or field conditions. Short cycle from seed germination to fruiting, despite a perennial herbaceous nature, allows several generations to be taken in a year. Plant continues to flower throughout the year. First flower appears on the plant as early as four weeks from planting and several seeds are formed from one pollination. Seeds could be germinated within a week; they do not go into dormancy. These characteristics and low chromosome number (2n=16) shows that the plant can serve as a genetic system much like Arabidopsis thaliana (2n=10) for dissecting its metabolism and causing improvement of its elements selective for high economic and/or ornamental values. Like *A. thaliana*, the periwinkle plant is expected/supposed to respond to induction of variation through for qualitative and quantitative traits. The induced variants through mutagenesis from different genetic background are now expected to generate basic genetic material for deciphering the genetics and genomics of a variety of traits like in Arabidopsis.
In A. thaliana, the stably expressed recessive and dominant plant mutants have become available to the geneticists, for characterization of genes and their products involved in variety of functions. Likewise on account of its features (Table 1), *C. roseus* has provided opportunities for the dissection of interesting pathways. Following is some of the objectives for seeking biochemical mutants in *C. roseus*: (1) to identify mutants of potential agronomic value; (2) to study the genetics of abiotic and biotic stress resistance mechanisms; (3) to provide genetic markers for genomic mapping; (4) to study cell dynamics; (5) to study development and morphogenesis; (6) and to generate molecular markers for gametic/somatic cell genetics. The above kinds of whole organism mutants can be useful for providing answers to important biochemical, molecular, agronomical and secondary metabolism related questions (Pandey Rai S., 2000, 2001and 2003). Arabidopsis has been shown to combine a number of criteria that make it suitable for use as a model system in genomic investigations on plants. Some of the useful features of Arabidopsis are shared by *C. roseus* and since latter is most studied for its chemistry and pharmacology, it is an apparent choice for development in the functional genetics of alkaloids.

Table1: Commonality of features in Arabidopsis, pea, maize and Catharanthus roseus as: model systems for genetical and plant breeding investigations:

Attributes	*Arabidopsis thaliana*	*Zea mays*	*Pisum Sativum*	*Catharanthus roseus*
Class	Dicot	Monocot	Dicot	Dicot
Family	Brassicaceae	Poaceae	Papilionaceae	Apocynaceae
Chromosome number (n)	5	10	7	8
Generation time	40 days	120 days	120 days	90 days
Habit	Annual	Annual	Annual	Perennial
Flower	Bisexual	Unisexual	Bisexual	Bisexual
Pollination	Self /cross	Anemophilous	Self	Self/cross
Fruit	Siliqua	Caryopsis	Legume	Siliqua
Fruits per plant	Many	Many	Many	Many
Seeds per fruit	30-60	400-600	3-8	15-20
Seed length	0.5 mm	8mm	6mm	4.6mm
Seed weight	30 µg	200mg	300mg	0.80mg
Seed dormancy Shoot apex	Yes Small	No Large	No Small	No Small
Leaf primordia in seed	Absent	Present	Absent	Absent
Endosperm	Absent	Present	Absent	Absent
Vegetative propagation	No	No	No	Yes
In-vitro micropropagation	Yes	No	Yes	Yes

Distribution and Taxonomy of *C. roseus*

The *C. roseus* is a pan-tropical species occurring chiefly in West Indies and Madagascar. The plant is well adapted to variable climatic situations present is India and is extensively cultivated in the states of Tamil Nadu, Madhya Pradesh, Karnataka, Uttar Pradesh, Gujarat, and Assam as a medicinal and ornamental crop. In the Northern belt of India low winter temperatures adversely affect its growth. *C. roseus* belongs to apocynaceae and the confusion in its taxonomic nomenclature was conclusively resolved by Stearn (1966). Thus, the earlier reference to this species as Vinca rosea in literature is not validated by the available information. The species Catharanthus roseus was described as Vinca rosea by Linnaeus (1753) in his Species Plantarum (1:2.9). Later Reichenbach gave it the name Lochnera rosea. The correct name for this genus under the international code of botanical nomenclature is Catharanthus and not Lochnera and the correct name of Madagascar periwinkle is Catharanthus roseus not Lochnera rosea (Table 2 and 3).

Table 2 : Various technical names given to Catharanthus roseus since Linnaeus.

Nomenclature	Name of the Scientist	Year
Vinca rosea	Carolis Linnaeus	1759
Lochnera rosea	Heinrich Gottlieb Ludwig Reichenbach	1828
Catharanthus roseus	George Don	1935
Ammocallis rosea	John Kunkel Small	1903
Catharanthus roseus	Stearn W.T.	1966

Table 3: The hierarchical taxonomic classification of periwinkle:

Taxonic Status	Designation	Reference(s)
Kingdom	Plant	Datta, 1931
Division	Phanerogamia	Datta, 1931
Subdivision	Angiospermae	Datta, 1931
Class	Dicotyledones	Datta, 1931; Bentham and Hooker, 1983
Sub-class	Gamopetalae	Datta, 1931; Bentham and Hooker, 1983
Series	Bicarpellatae	Datta, 1931; Bentham and Hooker, 1983
Super order	Asteridae	Datta, 1931; Bentham and Hooker, 1983
Order	Gentianales	Datta, 1931; Bentham and Hooker, 1983
Family	Apocynaceae	Stearn, 1966
Sub-family	Plumerioideae	Taylor and Fransworth, 1975
Tribe	Plumerieae	Taylor and Fransworth, 1975
Sub-tribe	Alstoniae	Lawrence George, 1964
Genus	*Catharanthus*	Taylor and Fransworth ,1975
Species	*roseus*	Taylor and Fransworth, 1975

Morphological Features and Ornamental Potential of *C. roseus*

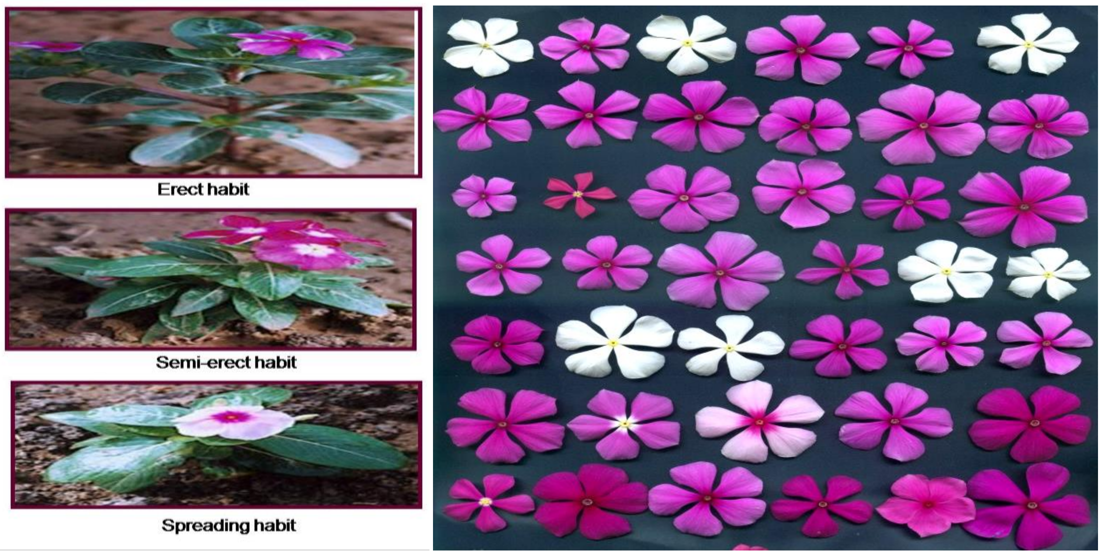


Figure 1: Catharanthus roseus plant with different habit and flowers having combinations of colour

C. roseus is an erect, highly branched perennial subshrub, growing to a height of up to 100 cm, laticiferous tissues present in its aerial parts. The oblong obovate leaves, opposite, short petioled, smooth with entire margin. The upper surface is deeper green than the lower surface, stomata occur on both surfaces. The pink, pink eyed or white coloured flowers generally axillary in nature. The calyx lobes are linear-subulate, corolla tube is cylindrical (Stearn, 1966). The epipetalous anthers are borne on short filaments, a column like nectarium around the pistil and a secretary cringulam encircling the flower papillate stigma helping in pollination-fecundation process. The bicarpellate ovary which is basally free with fused style and stigma representing the post genital carpel fusion during the flower developmental process. The dehiscence of the seeds occurs by longitudinal split of the siliqua. The plantlets of *C. roseus* are easy in plantation/cultivation having multitudinous ornamental decorative phenotypes with perennial ground cover, dwarf, spreading, semidwarf, erect habits having an ever-blooming property that makes it more suitable for horticultural purposes (Figure 1).

Recently, various horticultural practices and breeding programmes have been carried out for improvement in the distribution, biology, tolerance to abiotic stresses and ornamental characteristics of *C. roseus* flowers that enhances horticultural importance of this species (Pandey Rai S., 2003). The new mutants/lines have been also developed having variations in colouration of petal along with high frequency of flowering with altered pattern of flower arrangement on the inflorescence (LLI mutant). In this new floricultural line, the extensive-flowering characteristics that is "LLI" trait was also combined using classical breeding approaches for creation of variation in habit, plant height, branches, leaf morphologies, petalcolouration, eye colors, and also tolerance to biotic and abiotic stresses.

Conclusion

Large number of cultivars/lines and mutants have been already developed primarily having ornamental characteristics and alkaloid content. There is strong need towards testing of agronomic performance, disease resistance, abiotic stress tolerance and genetic background. Generation of new cultivars with improved physiological characteristics and secondary metabolism can be helpful towards high quantity/quality of alkaloids.

References

1. Bentham G. and Hooker J.D. (1873). Genera Plantanum volume II: 1862-1883.
2. Datta S.C. (1931). Handbook of systemic botany Asia publishing house Bombay Page no. 283 (329-330).
3. Johnson I.S., Wright H.F. and Svoboda G.H. (1964). Catharanthus roseus (Vinca rosea). The importance and value of a chance. Olgenation Lloydia 27:280-281.
4. Kulkarni R.N., Baskaran K., Chandrashekara R.S. and Kumar S. (1999). Inheritance of morphological traits of periwinkle mutants with modified contents and yields of leaf and root alkaloids. Plant Breeding 118:71-74.
5. Lawrence G.H.M. (1964). Selected families of vascular plant. Pp. 637.
6. Linnaeus C. (1759). in Syst. Bot. 10th edition volume 2 pp. 944.
7. Naghmeh N., Alireza A., David C., Yee-How T., Maziah M., and Rambod A. (2014). Ornamental Exterior versus Therapeutic Interior of Madagascar Periwinkle (Catharanthus roseus): The Two Faces of a Versatile Herb. The Scientific World Journal. 10.1155/2015/982412.
8. Pandey-Rai S. and Kumar S. (2000). Induced mutation to monocotyledony in periwinkle, Catharanthus roseus, and suppression of mutant phenotype by kinetin. J. Genet. 79, 1–18.
9. Pandey-Rai S. and Kumar S. (2001). Heterocarpous flowers resulting from a recessive mutation in periwinkle, Catharanthus roseus. Curr. Sci. 80, 1581–1584.
10. Pandey-Rai, S., Luthra, R., Kumar, S.,(2003). Salt tolerant mutants in glycophytic response (GSR) genes in Catharanthus roseus. Theoret. Appl. Genet. 106, 221-230.
11. Pezzuto J..M. (1997). Plant derived anticancer agents. Biochem. Pharmacol. 53: 121-133.
12. Stearn W.T. (1966). Catharanthus roseus, the correct name for the Madagascar periwinkle. Lloydia 29: 196-200.
13. Stearn W.T. (1975). A synopsis of the genus Catharanthus (Apocynaceae) In: Catharanthus alkaloids. Editors WI Taylor and NR Eansworth. Marcel Dekker. New York 9-44.
14. Taylor W.I. and Farnsworth N.R. (1975). Catharanthus alkaloids. Mercel Dekker Inc. New York. pp 9-43.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Medicinal Benefits of Anti-Toothache Plant *Spilanthus acmella*

Article ID: 11614

Apoorva[1], Sanjay Kumar Rai[2], Shashi Pandey Rai[1]
[1]Centre of Advance Study in Botany, Institute of Science, Banaras Hindu University, Varanasi-22100.
[2]Rajendra Agricultural University, Bihar, Pusa, Samastipur-803 113.

Spilanthes acmella Murr., commonly known as Anti-toothache plant, Paracress, Eyeball, Aarakara or Jambu etc. is an important medicinal herb of family Asteraceae. The plant belongs to genus Spilanthes that is predominantly represented by about six different species in India ie. *S. paniculata*, *S. radicans* , *S, calva, S. uliginosa, S. ciliata*, and *S. Oleracea*. This *S. acmella* species is native to Brazil but has been found growing in tropical and subtropical climatic conditions of the globe, such as Asia, Africa, America, Bangladesh, India, Pakistan and Sri Lanka etc. throughout the year as an ornamental and medicinal plant It is a perennial herb with highly spreading habit (Abascal and Yarnell 2001). Generally, the plant loves to grow in damp areas and seeds have low rate of germination. The plant leaves and flowers of *S. Acmella* have strong pungent taste associated with tingling sensation and numbness when eaten or touched (Arora et al., 2011). This plant has been largely used in folk-floric remedies for treating toothache, rheumatic arthritis and fever. It is also used as as fresh vegetables as well as spice in Japanese food system as an appetizer (Abascal and Yarnell 2010).

***Spilanthus acmella* plant with flower head**

Extensive investigations have been already carried out demonstrating its various bio-activities such as its anti-diuretic, anti-pyretic, anti-oxidant, immunomodulatory, anti-inflammatory, hepatoprotective, anticancerous, anaesthetic, anti-microbial and anti-toothache properties etc. It is also used to cure facial paralysis, anxiety, depression, chronic cough, tonsillitis, burns and sores etc. Beside this in India, flower heads of *S. acmella* were also applied to treat stammering in children, estrogens imbalance i.e. in treating leucorrhoea, as remedial agent in snake bite etc (Barman et al., 2009; Belfer 2007).

Due to its large number of medicinal and pharmacological benefits along with traditional claims various researchers have characterized and isolated/extracted bioactive secondary metabolites produced by the the leaves and flowers of this plant. The plant has been found to produce many important secondary metabolites of commercial importance such as spilanthol, scopoletin, myrecene, β-Caryophyllene, β-Ocimene, β-Sitosterol, Stigmasterol, α-Amyrin, β-Amyrin, Limonene, Germacrene-D, Myrecene, Scopoletin and trans-Isoferulic acid etc. The bioactive compound spilanthol, which is an isobutylamide are rich in roots as well as in all aerial parts of the plant including flowers (Borek, 2010). The pungent characteristic of spilanthol is known for modulating chemosensory receptors and associated ligands of receptors. Due to its potent activities spilanthol along with its several derivatives, have been also synthesized and tested by various researchers for its trigeminal sensory attributes like pungency, burning, numbing, tingling, scratching, mouth-watering effects, warming, and cooling properties (Chakraborty et al., 2010). It is also characterized for its large number of pharmaceutical and biological properties such as antioxidant, neuroprotective, analgesic, anti-cancer, antimutagenic, antimicrobial, anti-inflammatory, insecticidal and antilarvicidal activities.

Due to its variety of actions the spilanthol has large commercial/industrial demand by pharmaceutical, toothpaste and cosmetic industry. The European Union have already calculated average daily deman of spilanthol which was 24µg/person in a day. Various researched using mice model also demonstrated that spilanthol acts as suppressor of lipogenesis by activating AMPK signalling. It also inhibits inflammatory responses by blocking JNK and P38 phosphorylation. It is also known for alleviating serum TC, leptin, and HDL-C. More importantly, it also regulates the hepatic lipid accumulation by AMPK activation and by repressing transcription factors related to lipogenesis/adipogenesis. These characteristics of spilanthol demonstrated its potential as anti-obesity agent in several metabolic disorders.

Due to large demand of spilanthol at commercial level the *S. acmella* plants are now under threat and quickly getting depleted from its natural habitat. Seeing its wider applications for commercial uses different conservation strategies are now essential to meet its conservation and demand. However, during last few years, large numbers of efforts have been carried out for its in vitro micropropagation and plant regeneration through organogenesis. Synthetic seed technologies have been also applied by several workers for fast rate of multiplication.

Conclusion

It is very interesting that the species *S. acmella*, is producer of highly valuable medicinal compounds in-planta having multifunctional roles not only in folk-floric medicine system but have potential as therapeutics in medicine, beauty care, cosmetics and an array of diverse bioactivities. However, further experiments and new conservation strategies are required to achieve the high demand.

References

1. Abascal K, Yarnell E. Herbs for treating periodontal disease. Alternat Comple-mentary Ther. 2001;7:216–220.
2. Abascal K, Yarnell E. Treatment for recurrent aphthous stomatitis. Alternat Complement Ther. 2010;16:100–106.
3. Arora S, Vijay S, Kumar D. Phytochemical and antimicrobial studies on the leaves of Spilanthes acmella. J Chem Pharm Res. 2011;3:145–150
4. Barman S, Sahu N, Deka S, Dutta S, Das S. Antiinflammatory and analgesic activity of leaves of Spilanthes acmella (ELSA) in experimental animal models. Pharmacology online. 2009;1: 1027–1034.
5. Belfer WA. Cosmetic compositions comprising peptides and Acmella oleracea extract to accelerate repair of functional wrinkles. US Pat. 2007.
6. Borek C. Garlic and aging: current knowledge and future considerations. In: Watson RR, Preedy RR, editors. Bioactive foods in promoting health. San Diego, CA: Academic Press; 2010. pp. 221–234.
7. Chakraborty A, Devi BRK, Thokchom I, Sanjebam R, Khumbong S. Preliminary studies on local anesthetic and antipyretic activities of Spilanthes acmella Murr. in experimental animal models. Indian J Pharmacol. 2010;42:277–279.

Impact of COVID-19 on the Indian Agricultural System: A 10-Point Strategy for Post-Pandemic Recovery

Article ID: 11615

Shanjeevika. V[1]
[1]Ph.D Scholar, Department of Agricultural Extension and Rural Sociology, Tamil Nadu Agricultural University, Coimbatore.

Introduction

COVID-19, originating from Wuhan, China – the epicentre – has eventually spread through the whole world and emerged into a pandemic. India has already become a hotspot for the virus, next to the USA, infecting 9.6 million (14.6% of global infection) as of December 6th, 2020[1] which has resulted in a decline of 23.9% gross domestic product in quarter 1, FY 2020–21.[2] A pandemic shock can have a greater significance on economies due to lost human lives compared to a weather shock such as drought or flood or a trade embargo. Undoubtedly, all these shocks affect agricultural systems; however, pandemic shocks affect all the sectors of an economy.

As a protective and preventative measure, the Indian government ordered a nationwide lockdown, the severity of which is rated >80 in the global stringency index, from 25th March, 2020[3] affecting the economy including agriculture. The agriculture sector registered positive growth post-pandemic (3.4% FY 2020–21 Quarter 1: April to June) but less than its immediate past quarter growth (5.9% FY 2019–20 Quarter 4: January to March) witnessing a decline by 2.5% point due to the impact of COVID-19. Quarter 1 (FY 2020–21) positive growth in agriculture, although attributed to a bumper crop harvest coupled with relaxation in agriculture related activities during the lockdown, has not witnessed a significant increase in the farm income but registered an inflation of 2.3% (ET, 2020). food commodities such as milk,[5] vegetables[6] and fruits[7] were wasted at farm level while distribution of milk by the Anand Milk Union Limited (AMUL) – the largest milk cooperative in India – was also affected.

Impact of COVID-19 on the Indian Agricultural System: Production, Marketing and Consumption

COVID-19 induced lockdown in India disrupted food markets which forced consumers to alter their consumption patterns. Consumers prioritized what they wanted and what they really needed. Various surveys report that individuals lost their jobs or their income decreased during lockdown (Arun, 2020; Cariappa et al., 2020a; Imbert, 2020; Ray, 2020). The lockdown coupled with sudden negative income shock posed serious concerns about food and nutrition security in India. In a survey of 2259 migrant youth, 32% reduced their daily food intake (Imbert, 2020). Consumers changed their behaviour patterns by reducing consumption of non-essentials, reduced market visits, stocking and consumption behaviour changed equally across intensity of incidence viz., green, orange and red (Cariappa et al., 2020a).

Social Safety Nets

The imminent shut down stopped production leading to job and income loss and demand recession. The pandemic also led to food loss and wastages that affected the food and nutrition security especially of the vulnerable sector, though briefly, and can have lifelong impacts on capabilities. ndia's employment guarantee scheme – Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) could employ migrants who have come back to their own villages and direct transfers could put cash into the hands of poor who do not have access to MGNREGA. Government expenditures should thus be towards increased funding for MGNREGA (employment), PM-KISAN (cash transfer to farmers under the Prime Minister-Farmer Honour Fund) and PDS (offering nutri-rich foods through public distribution system.

Price and Revenue Risk Management

COVID-19 had less or negligible effect on food prices (except for vegetables). However, food prices are plagued by high volatility which translates into price risk to farmers. The Government should consider setting up a price stabilization fund to insulate farmers from the price risk. To meet the contract size set by the commodity exchanges, Farmer Producer Companies (FPCs) can transform themselves into aggregators.

Shifting the Focus from Primary to Secondary Agriculture

COVID-19 induced lockdown has disrupted agricultural labour markets that witnessed huge reverse migration. A survey reports that 45% of the migrants returned home during lockdown (Imbert, 2020). Structural weakness in the system should be addressed to enable recognition of farming as an enterprise. Further, innovations in the post-harvest technologies of medicinal and aromatic plants which supply raw materials to herbal medicines, pharmaceuticals, cosmetics, and food flavour industries could increase export potential and create employment (Chengappa, 2013).

Family Farming

In strategizing to strengthen the agricultural sector, we must pay attention to the concept of sustainability. Nothing comes closer as family farming to the exemplar of sustainable food production (FAO and IFAD, 2019). Family farmers not only produce food; they save biodiversity, produce nutritious and local foods, develop new strategies and develop innovations to tackle social, economic and environmental challenges (FAO and IFAD, 2019). FAO suggests affirmative policies to support family farmers as a solution to the unsatisfactory world food system in which one-third of the food produced goes to waste.

Collective Farming

Crop farmers should heed the successful cases like dairy cooperatives to increase productivity and profits. Unlike cereals, pulses and vegetables, milk prices were not affected by the lockdown (Cariappa et al., 2020a). Through aggregation (of inputs used and output produced), economies of scale can be ensured. Nudging by the union government on the principles of cooperative federalism (as done for Goods and Services Tax) is required for land reforms and contract farming. These steps together will have the potential to overcome challenges of production and marketing risks of the farmers.

Investment in Agricultural Research and Development

The estimated annual growth (in real terms) from 2014–15 to 2018–19 in agriculture and allied sectors was 2.9% (Government of India, 2020a). While the Indian economy contracted by 23.9% in the first quarter of 2020–21, agriculture was the only sector to register a positive growth of 3.4% (ET, 2020). It is time to realize that agriculture sector could keep the growth engine sputtering when other sectors fail to rise to the occasion despite the farmers facing enormous amount of production and marketing risks even during normal times. Undoubtedly, inclusion of the private sector increases the investment flow as well as efficiency in functioning of the system. Private and government investments in agricultural research and development, insurance, finance, mechanization, cold storage, logistics, automation, digital procurement and distribution (e-marketing) should be taken up as a priority.

Buffer Stock

Monetizing the excess stock in the buffer could be a potential source of revenue for the union government. The stock held by the Food Corporation of India has in store more than double the buffer stock norms and is worth at least ₹1,50,000 crore (US$205 billion) (Gulati, 2020). Monetizing the surplus besides revenues, may also reduce huge maintenance and logistics costs. This amount could be invested in promoting rural agriculture enterprises or capacity building, drought proofing, etc. Again, to reduce wastage through scientific storage is urgently needed.

Staggered Procurement and Pricing

During pandemic situations which disrupt logistics, markets, storages, etc. the government can opt for a staggered procurement and pricing strategy which accounts for the threshold level in cost of storage (Sendhil et al., 2020a) especially for staples like rice and wheat produced and consumed by millions. This would also encourage farmers to store the commodities at farm level, providing storage is available, against distress selling.

Reforms in Agricultural Finance

Access to cheap loans has to be enabled, especially for small and marginal land holders to revive the sector. Restructuring agricultural loans and repayment schedules, withholding the declaration of long-term loans as non-performing asset (NPA), interest subvention on availed loans during the moratorium period etc. should be implemented to safeguard the livelihoods and welfare of the poor.

Stakeholder Partnerships

Concerted efforts and inter-institutional partnership (regional as well as global) are inevitable (Baudron and Liegeois, 2020) as envisaged in the Sustainable Development Goal 17 to strengthen the weaker and vulnerable sections of the society. The idea here is to educate people not to opt for panic buying and hoarding essential items, to maintain hygiene of market functionaries, and to sanitize market yards in addition to social distancing which are essential for smooth functioning of the markets in lieu of COVID-19 crisis (Workie et al., 2020).

Conclusions

The pandemic led crisis has wreaked havoc on both the Indian and global agricultural system. A global food security crisis is in potentially looming that cannot be countered without understanding the impacts of COVID-19 on the agricultural system, especially of the developing countries. A host of food exporting nations viz., Kazakhstan, Myanmar, Russia and Vietnam have imposed cereal trade restrictions like bans, quotas and licensing (GTA, 2020) which are distorting the global food supply. Disruptions in supply and/or value chains leads to food wastage unleashing volatility in prices and having implications to food and nutritional security

On the consumption front, the effect of the pandemic on consumer behaviour seems more or less similar across three regions of COVID-19 incidence viz., red, green and orange. No access to markets has been reported by 45.7%, 51.7% and 33.7% of the consumers across red, orange and green zone, respectively while 72.7%, 79.4% and 73.3% perceived an increase in food prices. More than 90% of consumers across all the regions have changed their shopping behaviour. As the pandemic continues to threaten the global food system, the role of state becomes much more pertinent. In order to protect and safeguard the livelihoods of millions of people associated with the agricultural system, the state should increase spending on social safety nets immediately and take up other short- and medium-term strategies. Raising revenue by offloading excess buffer stock and increased credit to the agriculture sector should be the top priority for post-pandemic economy restoration.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Bacterial Blight of Pomegranate - A Deadly Disease of Pomegranate in India

Article ID: 11616

Sukanya Gogoi[1]
[1]Ph.D. Scholar, Department of Plant Pathology, College of Agriculture, Assam Agricultural University, Jorhat-785013, Assam, India.

Summary
Pomegranate (*Punica granatum* L.), a high value horticultural crop, is known for its high nutritive and medicinal values. Yield of pomegranate have been rigorously abridged in various parts of the world as it is attacked by a number of diseases. Bacterial blight of pomegranate caused by *Xanthomonas axonopodis* pv. *punicae* is one of the most important diseases which not only reduces the yield but also deteriorate the quality of fruits. Hence, there is a need of in-depth study of the disease before formulation of management strategies. This article covers the information on the economic importance of the disease, its symptoms, causal organism, epidemiology, survival and spread of the bacterium and its management strategies.

Introduction
Bacterial blight of pomegranate was first reported in India from Delhi by Hingorani and Mehta (1952) which was of minor importance until 1998. Subsequently, it was reported from Karnataka (Hingorani and Singh, 1959), Himachal Pradesh (Sohi et al., 1964), Haryana (Kanwar, 1976) and Maharashtra (Dhandar et al., 2004). Recent epidemic reported from major pomegranate growing states viz., Maharashtra, Karnataka and Andhra Pradesh, inflicting enormous losses on growers.

This is one of the major production constraints of pomegranate is Bacterial blight disease, which is most destructive and takes heavy toll of the crop and reduces the marketability of the fruits (Ravikumar et al., 2009; Sharma et al., 2012a).

Economic Importance of the Disease
Bacterial blight of pomegranate can cause 50-100% production loss depending on disease severity. In Maharashtra, blight resulted in losses up to 80% in some orchards of Solapur District in 2006–2007 (NRCP Ann. Report, 2006 –2007). As per Maharashtra state statistics, about 31,000 ha area has been affected by blight out of a total area of 93,000 ha under pomegranate cultivation in 2007–2008 (Jadhav and Sharma, 2009). The disease also appeared as an epidemic in Bangalore, Karnataka causing 60-80% yield losses (Mondal and Sharma, 2009). In Karnataka, production of pomegranate declined from 1.8 lakh tonnes per annum to less than 10,000 tonnes in 2007– 2008 per annum in a span of 4 years, thereby causing a revenue loss of about Rs. 200 crores (Benagi and Ravi Kumar, 2009). Since 2002, the disease has reached an alarming stage and severely reduced the yield and marketability of fruits. The disease is gaining international attention through its recent spread to other major growing areas of the world such as Pakistan, South Africa, and Turkey.

Etiology
Causal organism: *Xanthomonas axonopodis* pv. *punicae*.

Until 1995, the blight pathogen was classified as *Xanthomonas campestris* pv. *punicae* (Hingorani & Singh) Dye. However, in 1995, Vauterine, Hoste, Kersters, and Swings reclassified the bacterium on the basis of DNA hybridization and named it *Xanthomonas axonopodis* pv. *punicae* (Hingorani & Singh) (Vauterine et al. 1995).

Classification
Division: Bacteria; Class: Gammaproteobacteria; Order: Xanthomonadales; Family: Xanthonomonadaceae
Xap is a gram negative, rod shaped bacterium, measures 0.4 - 0.75×1.0 to 3.0 µm with single polar flagellum. The bacterium can be cultured in vitro on different synthetic media like peptone yeast extract

dextrose media, nutrient glucose agar and Luria-Bertani media. The bacterium, Xap produces smooth, circular, light yellow, glistening mucoid, butyrous and convex colonies with entire margins. Xap grows better at temperature range of 23.0–30.0 °C, whereas it could not grow below 10.0 °C and above 40.0 °C (Mogle et al. 2009).

Symptomatology

Mostly attacks all the above ground parts of the plant (leaves, twigs and fruits) (Ramesh and Ram, 1991). In leaves, small, irregular, prominent water-soaked spots, which later become necrotic with light to dark brown centre surrounded by prominent water-soaked margins. At advance stage, individual spots coalesce giving an eventual blighted appearance. Lesions on the stems shows dark brown to black, which often leads to cracking and the breaking of branches. Lesions on fruit irregular, shining brown to black spots, slightly raised oily appearance, with Y or L- shaped cracking or splitting of pericarp, reducing the marketability of the fruits.

Epidemiology

Symptoms on pomegranate appear after 3 to 4 days of challenge infection under favorable conditions. Increase in day temperature (38.6°C) and afternoon relative humidity (>30%) along with, cloudy weather and intermittent rainfall (in July to September) is highly conducive for Xap infection in pomegranate which favors disease initiation and further spread. The pathogen overwinters in infected leaves of neem and bael planted along the bund of pomegranate fields.

Survival and Spread

Primary source of inoculum: Infected planting material or neighbouring orchards.

Secondary source of inoculum: Mainly through rain and spray splashes, pruning tools, humans and insect vectors.

The bacteria primarily enter through natural openings on leaves or occasionally through wounds. The pathogen is not transmitted systemically.

In India, blight severity increases during June and July and reaches a maximum in September and October, and then gradually declines (Sharma et al., 2017). This rapid spread is attributed to the seasonal south-west monsoon, which contributes to the spread and entry of the pathogen at new sites due to high humidity in the orchards. Bacterial cells, without a host, are capable of surviving in soil for no more than 30 days (Rani and Verma, 2002; Sharma et al., 2012b). They also can survive in dormant buds during the offseason and are responsible for new infections in the following season (Sharma et al., 2017).

Management Practices

Resistant Varieties: At present no pomegranate variety is available which imparts resistance to bacterial blight. Some germplasm accessions like Nana and Daru have revealed some degree of resistance against the blight pathogen, both under controlled and field conditions, and resistance is being exploited in further breeding programs (NRCP, Ann. Report, 2009).

Biological Control: Among the various bioagents studied, sprays of Pseudomonas fluorescens (0.1%) have been found effective in blight control under field conditions; however, the bioagent was found not superior to antibiotic Streptocycline (NRCP, Ann. Report, 2008-2009).

Similarly, Yenjerappa et al. (2009) in Karnataka also reported the efficacy of Pseudomonas fluorescens (0.5%) in managing bacterial blight in field but found the bioagent inferior to antibiotics streptocycline and Bactrinol.

Chemical Control:

a. Benagi and RaviKumar et al. (2009) reported the efficacy of streptocycline (500 ppm) + Copper oxychloride (COC) (0.2%) followed by Bronopol (2-bromo-2-nitropropane-1, 3- diol) (500 ppm) + COC (0.2%) in controlling disease and increasing yield.

b. Application of Bromopal (500 ppm) + COC (2,000 ppm) followed by Zinc sulphate (1.0g) + Magnesium sulphate (1.0g) + Boron (1.0g) + Lime (1.0g) /litre water- sprayed one day after spray of chemicals or Streptocycline (500 ppm) + COC (2,000 ppm) was found effective in controlling the disease recording 19.08% and 19.65% incidence, compared to control 78.65% incidence after 5th sprays at 10 days intervals (Kumar et al., 2009).

c. According to Yenjerappa et al. (2009), least disease was observed in plots sprayed with Streptocycline (0.05%) + COC (0.2%) followed by Bactrinol (0.05%) + COC (0.2%).

Integrated Disease Management

1. Includes selection of healthy and disease-free planting material.
2. Avoidance of rainy season crop, following stringent sanitation measures.
3. Providing rest period (3–4 months) to the crop (by restricting the irrigation and nutrients supply to minimum to encourage vigorous growth during the ensuing season).
4. Applying organic manures and nutrients.
5. Spraying the crop with antibiotics like streptocycline (500 ppm) along with copper-based fungicides like copper oxychloride (0.2%)/copper hydroxide (0.2%) at 15-day interval as mentioned above.

From Molecular Aspect

Reliable and early diagnosis of bacterial blight in pomegranate can be done by using sensitive PCR techniques (Doddaraju et. al, 2019). PCR coupled with agarose gel electrophoresis (PCR-AGE), PCR coupled with capillary electrophoresis (PCR-CE) and Real-time PCR (qPCR).

PCR-CE and qPCR were capable of diagnosing bacterial blight 6 to 10 days before symptom appearance, with detection limits of 100 fg and 10 fg of bacterial DNA respectively. Conventional PCR-AGE detected pathogen at the onset of disease symptoms with a detection limit of 10 pg of bacterial DNA. qPCR detected bacterial blight in orchards that did not show any disease symptoms.

Reference

1. Anonymous (2017). Horticultural statistics at a glance, National Horticulture Board, Govt. of India, 46.
2. Benagi V.I., RaviKumar M.R., (2009). Present status of pomegranate bacterial blight and its management. In: Souvenir & abstracts, 2nd international symposium on pomegranate and minor including Mediterranean fruits, org. ISHS, Belgium, June 23–27, 2009 at UAS, Dharwad. Karnataka, India, pp 53–58.
3. Dhandar D.G., Nallathambi P., Rawal R.D. and Sawant D.M., (2004). Bacterial leaf and fruit spot. A new threat to Pomegranate orchards in Maharashtra. J Mycol Plant Pathol. 34 (3): 971.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Cultivation Practices of Isabgol

Article ID: 11617

J. E. Adeline Vinila[1], K. Arunkumar[2], G. Vaidehi[3]
[1]Teaching Assistant, Horticultural College and Research Institute,
[2]Ph.D. Scholar, Horticultural College and Research Institute,
Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.
[3]Jeya agricultural college, Arakkonam.

Plantago is a large genus of herbs and subshrubs, distributed "mostly in the temperate regions and a few in the tropics. It comprises of about 200 species, of which 10-14 are natives of India. *Plantago Quata* Forsk (Syn. *P. isphagula* Roxb.), commonly known as lsabgol or blonde psyllium or Indian plantago or psyllium in commerce, is important for its seeds and husks which have been used in indigenous medicine for many centuries. Because of the superior quality and yield of its seeds, it has replaced the French psyllium, *P. psyllium* Unn, in the world market. In fact, France now depends on India for its requirements.

It derives its name from two Persian words, 'asp' and 'ghot' meaning a horse-ear, referring to its characteristic boat-shaped seeds. Plantago is from Latin, meaning 'sole of the foot' and refers to the shape of the leaf, Psyllium is from the Greek, meaning 'flea,' in reference to the colour, size and shape of seeds (flea-seed) and ovata refers to the ovate shape of the leaves.

The husk of the seed is the economic part and is separated by a physical process. The seed-husk contains a colloidal mucilage (30%), mainly consisting of xylose, arabinose, galacturonic acid with rhamnose and galactose, etc. The seed also contains some oil and small amounts of glycoside acubin and tannin.

The husk has the property of absorbing and retaining water and, therefore, it works as an antidiarrhoeal drug. It is beneficial in chronic dysentries of amoebic and bacillary origin. It is also used for treating constipation and intestinal disorders because it works as calorie-free fibre food, promoting regular bowel movement. It is reported to have no adverse side-effects.

The seed has also cooling and demulscent effects and is used in Ayurvedic, Unani and Allopathic systems of medicine. The seeds and husks are used to cure inflammations of the mucous membranes of gastro-intestinal and genito-urinary tracts, duodenal ulcers, gonorrhea and piles. It can also be used as a cervical dilator for the termination of pregnancy.

In addition to these medicinal uses, it has a place in dyeing, calico printing, in the ice-cream industry as a stabilizer, also in confectionery and cosmetic industries. The seed without the husk, which contains about 17-19% protein, is used as cattle-feed.

Distribution, Area and Production

The plant is indigenous to Persia and West Asia, extending up to the Sutlej, Sind and West Pakistan. The plant has also acclimatized well in Mexico and the Mediterranean regions.

At present, the Isabgol crop has acquired the place of the 'dollar earner' crop of north Gujarat, where it is being cultivated on about 10000 ha with a production of 40 000 tonnes. It has now been introduced in Southern Rajasthan, Punjab and, to a very small extent, in Maharashtra and Uttar Pradesh. Experimental cultivation at Bangalore has been quite successful.

The quality of husk and yield is comparable to the crop grown in Gujarat. About 75-80% of the total annual produce of north Gujarat is exported, which brings crores of rupees of foreign exchange annually. India continues to hold a monopoly in its production and trade in the world. Though India enjoys the monopoly in production and export of Isabgol, hardly 50% of the requirement of the USA is being met.

In view of its s unstained demand, there is still scope to increase the area and production and to intensify its cultivation. Therefore, if India is to retain its monopoly in the production of this important foreign exchange earning commodity, there is an urgent need to evolve high-yielding strains and to examine suitable locations for growing this crop in other states of the country.

Soil

It is an irrigated crop which grows well on light soils. Heavy soils and those with poor drainage are not conducive to the good growth of this crop. A silty-loam soil, having a soil pH from 4.7 to 7.7 with low nitrogen and moisture content, is reported to be ideal for the rich growth of these plants and high yield of the seeds.

Climate

Isabgol thrives in warm temperate regions. It requires cool, dry weather and is sown during the winter months. Sowing during the first week of November gives the best yields. Early sowing, especially with a higher seed rate, makes the crop vulnerable to downy mildew diseases; whereas, late sowing provides a shorter period of growth in winter along with the possibility of seed-shattering due to summer rains in April-May. At maturity, if the weather is humid, its seeds shatter, resulting in reduced yield. Heavy dew or even a light shower will proportionately decrease the yield, sometimes even leading to a total loss of the crop. The temperature required for maximum seed germination is reported to be between 20° and 30°C.

Cultivation

Land Preparation: The field must be free of weeds and clods and should have a fine tilth for good germination. The number of ploughings, harrowings and hoeings depend upon the soil conditions, the previous crop and the degree of weed infestation.

About 10-15 t of FYM/ha is incorporated into the soil at the time of the last ploughing. The field should be divided into suitable plots of convenient size, depending upon the texture of the soil, the slope of the field and the source and quantum of irrigation water. For light soils with even contours, a plot size of 8.0 m x 3.0 m is convenient. Spacing of 60x30cm is recommended.

Fertilizer Application

Isabgol does not require the application of heavy doses of fertilizers. A fertilizer dose consisting of 50 kg N, and 25 kg P/ha, has given the maximum seed yield under Bangalore conditions. The full dose of P and K along with half of the N is given as a basal dose at the time of sowing itself, and the second split dose of N is applied as a top-dressing after one month of sowing. For other areas, a basal dose of 25 kg N and 25 kg pps/ha is recommended. A top-dressing of 25 kg N/ha is given 32 days after sowing.

Irrigation

Immediately after sowing, light irrigation is essential. First, irrigation should be given with a light flow of water otherwise, with a fast cur¬rent of water, most of the seeds will be swept off to one side of the plot and the germination and distribution will not be uniform. The seeds germinate in 6-7 days. If the germination is poor, a second irrigation should be given. Later on, irrigations are given as and when required. The last irrigation should be given at the time when the maximum number of spikes have reached the milk-stage. The crop requires totally 6-7 irrigations for good productivity in medium sandy soils.

Interculture

The first weeding is done after about 20-25 days of sowing. Since' the crop is sown by broadcasting, hand-weeding is a very costly operation, ordinarily, 2-3 weeding within two months of sowing will help to keep the weeds under control.

Harvesting and Processing

Blooming begins two months after sowing and the crop is ready for harvest in February-March (110-130 days after sowing). When mature, the crop turns yellowish in colour and the spikes turn brown in colour. The seeds are shed when the spikes are pressed even slightly. At the time of harvest, the atmosphere must be dry and there should be no moisture on the plant, otherwise harvesting will lead to considerable seed-shattering. Hence, the crop should harvest after 10 a.m.

The plants are normally cut at the ground level or are uprooted, depending upon the texture of the soil. The harvested plants are transported to the threshing yard, bundled in large cloth pieces and spread out. After 2 days, they are threshed with the help of a tractor or bullocks.

Threshing should preferably be done during the early morning hours to facilitate the easy separation of the seed from the spike. Sometimes, water is sprinkled over the heap for easy threshing. Care should be taken not to sprinkle excess water, lest it should spoil the quality of the produce.

Its straw is used as cattle feed. The plants are threshed and winnowed and the seeds sieved until they are clean, the seeds may be marketed whole or the husk may be sold separately. To remove the husk, the cleaned seeds are passed 6 to 7 times through stone-grinders, sieved and screened through several grades of mesh to sort according to fineness. Most of the exported husk is of the grade designated as 70 mesh. The highest quality husk is white with no particles of the red kernels. The husk seed ratio is 25:75 'by weight.

Yield

Gujarat lsabgol 1 variety yields 800--900 kg of seedslha. The new variety, 'Gujarat lsabgol 2' has a potential to yield a 1 000 kg of seeds/ha. Increased yield can be obtained in this crop by spraying cycocel (CCC) at 25 mg/l. twice: at the seedling stage and just before the heading stage.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Watershed: The Adaptive Technique for Soil and Water Management

Article ID: 11618

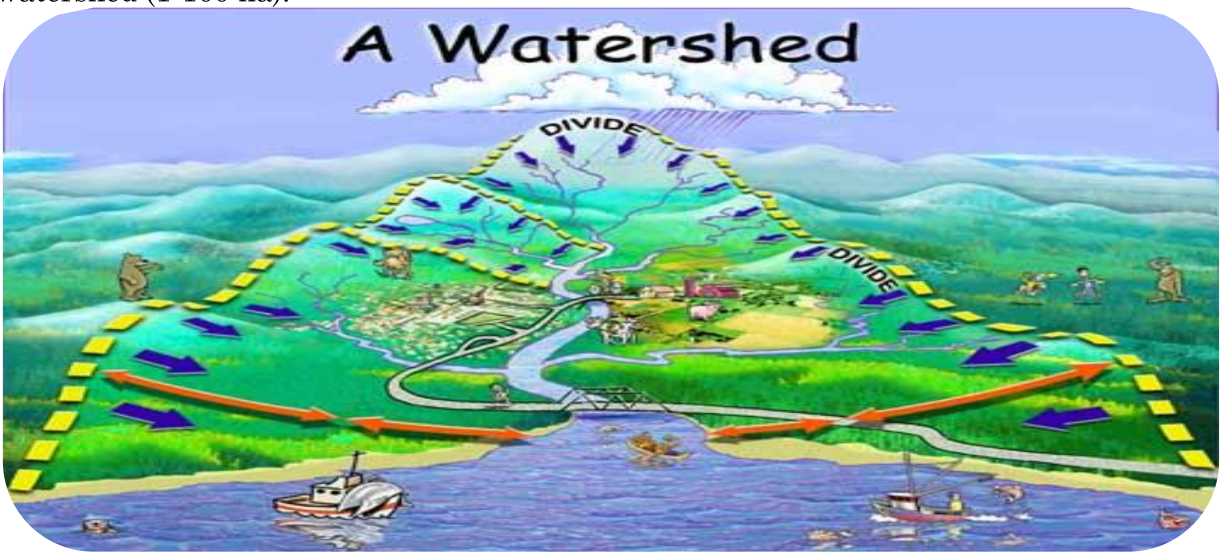
Jaipal Yadav[1], Ajit Kumar Meena[2], Gulab Choudhary[3], Seema Yadav[4], Anshul Mishra[5]
[1,2]Department of Soil Science and Agricultural Chemistry, MPUAT, Udaipur, Rajasthan.
[3]Department of Horticulture, SKNAU, Jobner, Jaipur, Rajasthan.
[4]Department of Agronomy, SKNAU, Jobner, Jaipur, Rajasthan.
[5]Department of Genetics and Plant Breeding, RCA, MPUAT, Udaipur, Rajasthan.

Introduction

Watershed is defined as a natural geohydrological land unit which drains all of its excess rainfall through surface or sub-surface flow at a single common outlet in the same land unit and the climate and the soil remains more or less same within the said land unit.

Types of Watersheds

Based on the area (size), watersheds are classified as follows:
1. Macro watershed (>50000 ha).
2. Sub macro watershed (10000-50000 ha).
3. Mili watershed (1000-10000 ha).
4. Micro watershed (100-1000 ha).
5. Mini watershed (1-100 ha).



Watershed Management

Implies the rational utilization of land and water resources for optimum production with minimum hazard to natural resources. It refers to the optimum development of land, water and plant resource to meet the basic needs of the people and animal on sustained basis. It is term used to protect and improve the quantity of the water & other natural resources within watershed by managing the use of those land & water resources in a comprehensive manner.

Components of Watershed Management

1. Foundation practices of engineering and biological measures for soil and water conservation includes:

> **a. Land treatment:** Contour farming, graded and vegetative bunds terracing, check dam and grassed water ways.
>
> **b. Water storage structure:** Nala bund, gully - plugs, bunds, percolation tanks.

c. Non arable lands: alternate land use plantation of fodder and fuel trees.

2. Improved production practices:

a. In situ water conservation
b. Improved cropping system
c. Variety
d. Fertility
e. Plant protection measures etc.

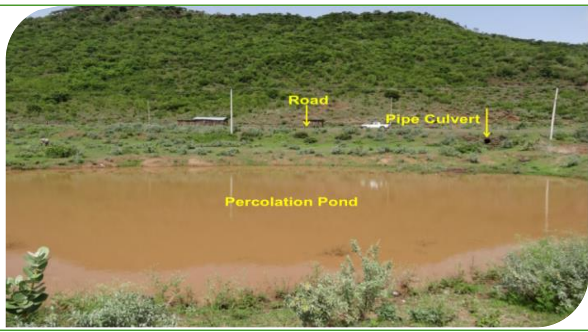
Need of Watershed Management

1. It constitutes a technical and ecological unit which is self-contained, physically composite, functionally coherent for land and water resources planning and management.
2. Irrigation, flood control, soil and water conservation and recycling can be rationally articulated for comprehensive short term and long-term development.
3. This approach provides the best way of managing the renewable and non- renewable resources so as to meet the present and future needs of the community without destroying the environment.
4. Thus production becomes resource centric and environment based to help in promoting a sustained process of development.

Adaptive Techniques for Soil & Water Management

Engineering practices:

Check dam



Percolation pond

Micro Catchments

Contour Bunds

Contour Trenches

Gully Plugs

Agronomic Practices:

	
Broad Bed Furrow	**Mulching**
	
Strip Cropping	

Conclusion

Watershed management practices plays a vital role in sustainable development of watershed and it not only decrease the runoff and soil loss but also help in increasing the profile water storage and improve the productivity of soil. Harvested water can be profitably used for increasing and stabilizing production of crops.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Insect Infestation in Dried Fish and their Management

Article ID: 11619

Guru P. N.[1], Sharma T[1], Akanksha[1]
[1]ICAR- Central Institute of Post-harvest Engineering and Technology, Ludhiana, Punjab.

Introduction

Fish is one of the excellent sources of animal protein in the diet of man throughout the world and has been widely accepted as a good source of protein and other elements (vitamins and minerals) for the maintenance of healthy body (Ravichandran *et al*, 2012). Fish protein compares favorably with eggs, meat and milk in its amino acid content and has a higher level of essential lysine and methionine both of which are lacking in a cereal-based diet. Since the fish is a perishable agricultural product, highly susceptible to spoilage and deterioration immediately after harvest and to prevent economic losses, the processing and preservation of fish is of utmost importance. However, dried fish are also one of the preferred diets in many non-vegetarians across the country.

Dried fish products have reduced oil and moisture content and it contains more protein on weight for weight basis. The smoked dry fish especially in the tropics are highly favored and preferred due to their aroma and flavor and it is one of the highly digestible and respectable sources of proteins and essential minerals but it is highly susceptible to insect pest infestation (Odeyemi *et al*., 2000). Dried fish products may deteriorate very rapidly from infestation by insect pests, mainly by beetle (Coleoptera) like *Dermestes* and *Necrobia*. In addition, improperly or adequately dried fish that has reabsorbed moisture could harbor large population of blowfly belonging to the genus *Chrysomia* (scavengers) and other dipteran flies like genera of *Calliphora*, *Chrysomia*, *Lucillia* and *Musca*. These insect pests generally infest dried fish during storage, transportation and marketing, thus responsible for extensive damage to marketed fish leading to enormous weight loss. Both adults and grubs feed on the internal content of the body sometimes only bones will be left behind. Beetle infestation of dried fish has been reported to cause losses ranging from 22 - 50% in some parts of the world. Based on a conservative estimate, the loss represents about 2.75 mt of dry fish for a year in all over world. Additionally, the fish that harbors insect pests has significant reduction for crude protein levels than uninfected fish.

Apart from these, dried fishery products frequently suffer severe losses due to infestation by dipteran flies like flesh flies (Sarcophagidae) and mites (*Lardoglyphus* and *Lyrophagus spp*.). These infestations are heavy in dried products containing 7–21% salt and stored under tropical conditions, at 20–32^{0}C and air humidity of 73–87%. A large quantity of dried fish is lost in India due to infestation by earwig, hide beetles, and copra beetles. The most destructive pest is the hide beetle scientifically called; *Dermestes maculatus*. The losses have been attributed to net reductions in the amount of nutrients available to the consumer (nutritive quality) resulting to declining consumer acceptability and market prices (economic losses) or both quantitative and qualitative losses.

Losses

Dried fish can suffer considerable loss of weight due to feeding damage by insect and mite pests. Under adverse conditions, quantitative losses of up to 30% due to fly damage during processing and up to 50% due to beetle damage during storage for several months, have been reported. Pest damage can also cause fragmentation of the cured fish (FAO, 1989), which can lead to both quantitative loss of the smaller fragments (or downgrading of this fraction for use as animal feed) and loss of value due to quality reduction, since a higher price is often obtained for intact pieces of fish. Indirect damage like, contamination by live or dead pests or by their cast skins and excreta (frass), also causes a change in visual quality that may reduce the value of the fish. Additionally, insect and mite pests often transmit fungal spores and the heat and moisture produced by heavy infestations can create conditions suitable for mould growth on fish that has previously been dried.

In India about 30% of the total fish catch is preserved by curing, i.e., salting, drying or smoking or a combination of those treatments. Drying is regarded as a traditional, low-cost and simplest method of preservation of fishes and it plays a vital part in the developing countries of the world like India. About 20% of the freshly harvested fish is spoiled every year due to lack of proper preservation technique in the country and about 25% of the remaining harvested fish was dried and this amount was 0.615 million metric ton in 2012. In India during monsoon, humidity levels are high, sufficient drying cannot be achieved using traditional technique, processed and stored dried fishes re-absorb moisture and become favorable conditions to insect attack. Post-harvest fish losses are a major concern and occur in most fish distribution chains throughout the world.

In addition to causing quality and quantitative losses, the insect pests of dried fishes also damage other materials in and around their habitats. For instance, the hide or leather beetle *D. maculatus* is known to damage wooden frames as well as polystyrene and glass fibre wadding in premises when the last instar larva is about to pupate.

Both grubs and adults cause both quantitative loss and qualitative losses due to contamination of insect bodies and cast skins with fish and it also leads to fragmentation of fish. The extent of losses to dried fish varies with the storage condition and storage period of the fish. When its infestation is associated with Dermestes beetle, *N. rufipes* is usually in the minority but its contribution to the total beetle damage may be significant.

Table 1: List of insect-pests infesting dried fish and fish products:

Common name	Scientific name	Family	Order
Hide or leather or skin beetles	*Dermestes maculatus* *D. frischii* *D. carnivorus*	Dermestidae	Coleoptera
Red-legged ham beetles	*Necrobiarufipes* *N. ruficollis* *N. violacea*	Cleridae	Coleoptera
Shore flies	*Discomyza maculipennis*	Ephydridae	Diptera
Blow fly	*Chrysomia sp.*	Calliphoridae	Diptera
Blue bottle flies	*Calliphora vicina* *C. vomitoria*	Calliphoridae	Diptera
Common green bottle fly	*Lucilia sericata*	Calliphoridae	Diptera
Common flesh flies	*Sarcophaga spp.*	Sarcophagidae	Diptera
House fly	*Musca domestica*	Muscidae	Diptera
Mites infesting on fish	*Lardoglyphu skonoi* *L. zacheri* *L. angelinae*	Lardoglyphidae or Acaridae	Sarcoptiformes (Astigmatina)

Adult of *Dermestes maculatus*

Adult of *Necrobia rufipes*

		
Adult of *Calliphora vicina* (Calliphoridae)	**Adult shore or brine fly (Ephydridae)**	**Adult house fly (Muscidae)**

Source of Insect-Pest Infestation

The insects infesting dry fish are sexually active fliers and they infest during the process of handling, processing, drying and packaging, etc. Majority of these synchronizing with drying of the fishes in the traditional open yards leads to cross infestation. Mixing of old and newly purchased fish in storage will also affect the quality of new product due to cross infestation. Long storage periods and undisturbed storage and processing process are also some for increase of the populations of pests. Apart from these other reasons for source of infestation includes inadequate smoking by the fish catchers and mixing of dried fish with other commodities or grains near to storage or transportation.

Protection/ Management of Pests of Dried Fish

Preventive measures:

a. Use of scientific handling, processing methods and storage conditions.

b. Proper curing of fish viz., smoking, sun drying, salting etc. to be taken care.

c. Maintaining proper moisture content to about 13 per cent and use of proper packaging, avoid sprinkling of water/moisture on fishes oftenly.

d. Good sanitation practices to prevent deposition of insect eggs on fish products.

e. Radiation treatment (electromagnetic radiation) to kill the eggs, by exposure to the recommended dosage.

f. Maintain separate storage practices for new and old fishes.

g. Physical methods such as insect-proof packing of dried fish and use of mesh screens to protect dried fish during storage.

h. Powdered plant materials and plant extracts have also been examined for insect control in dried fish. Neem seed, *(Azadirachta indica)* powder at a dosage of 1.0–8.0 g/100 g fish inhibited oviposition of *Dermestes* spp. and caused mortality of adults. However, the higher dosage might affect on consumer acceptability.

i. Addition of salt to dried fish also affected negatively the fecundity of adults and the viability of eggs

j. Fish liver oil, citrus peel oil, some vegetable oils, extract of garlic and white pepper are used traditionally for protecting cured fish from insect pests; oil treatment is also used by traders to make their fish look more attractive.

k. Among the chemicals Diflubenzuron (Insect growth regulator) may be used as impregnation to packaging materials to avoid *D. maculatus*. However, the chemical methods may consider as last option, only if necessary.

Curative measure: Curative measures are used in case the infestation is severe and also the commodity value is high. This can be applied after observation of damage or insects.

a. Irradiation of packaged/tray set dry fishes by a dose of 0.5 kGy is an effective management strategy. However, this may be useful at ≤40 per cent moisture content. In addition, irradiation along with treatment of potassium sorbate manages the fungal infection during drying of fishes. This will enhance the storability by 3-6 months (Singh et al., 2018).

b. Contact insecticides have been extensively used in the protection of dried fish, hides, skin and woolen materials.

c. Phosphine fumigation is commonly practiced for controlling insect pests in dried fish. An effective dosage of 1.5 g PH3/m3 for 5 d with a minimum terminal concentration of 0.2 g/m3 (144 ppm).

Conclusion

Insect infestation in dry fishes is one of the serious reasons of post-harvest losses. The damage caused by both direct and indirectly to the quality and quantity. Traditional method of drying is one of the major issues to be addressed to manage pest infestation. Major species of insects like beetles (*Dermestes* sp. and *Necrobia*) and flies are contributing to the quality reduction by fragmentation and also acts as vectors of various diseases. However, there is meagre knowledge among the farmers and cultivators regarding these serious pest problems and their scientific management. Scientific interventions for drying, handling, processing and storage are the need of hour. Chemical treatment although looks promising but need to replace by safety options.

References

1. FAO, 1989, A field guide to the types of insects and mites infesting cured fish. Corporate Document Repository, Food and Agricultural Organization, Geneva.
2. Odeyemi, O. O., Owoade, R. A. and Akinkurolere, O., 2000, Toxicity and population Suppression effects of Parkia clappatoniana on dried fish pests (Dermestes maculatus and Necrobiarufipes). Global Journal of Pure and Applied Sciences. 6:191-195.
3. Ravichandran, S., Joseph, F. R., Kanagalakshmi, F. and Ramya, M. S., 2012, Variation in nutritive composition of two commercially important marine fin fishes. Int. J. Zool. Res., 8:43-51.
4. Singh, S. M., Siddhnath, Bharti, R., Aziz, A., Subir, P., Bhagchand, C. and Kaur, N., 2018, Insect infestation in dried fishes. J. Entomol. Zool. Stud., 6 (2): 2720-2725.

Green Manuring

Article ID: 11620

Mr. Ravindra Singh Chouhan[1], Ms. Arti Singh[1]
[1]Asst.Prof., SAGE University, Indore.

Green manuring is a practice of ploughing or turning of un-decomposed green plant into the soil for the purpose of improving physical condition and fertility status of soil.

Characteristics of Green Manuring Crops

1. Capable of establishing and growing quickly.
2. Tolerant to adverse climatic conditions such as drought, water logging, high and low temperature etc. and tolerant to pests and diseases.
3. Should possess adequate Rhizobium nodulation potential and must be effective nitrogen fixer.
4. Should be capable of growing very fast and capable of accumulating sufficient fixed Nitrogenin4-6weeks.
5. Easy to incorporate and quickly decomposable.

Types of Green Manures

1. Green manuring in situ: In this system green manure crops are grown in situ or in the field and buried in the same field which is to be green manured. Paddy makes good response immediately after green manuring with dhaincha.

Land Preparation: Land is prepared by giving 3 to 4ploughings followed by planking.

Sowing of Seeds: The seeds of green manuring crops are sown in May to June, immediately after first monsoon rain.

Method of Sowing: Green manures crops usually can be sown by broad casting.

Dhaincha: 40-45kg/ha

Sunhemp: 40-50kg/ha

Berseem: 20-25kg/ha

Mung: 15-20kg/ha

Burial of green manuring crops: The best time for turning the green manuring crops is when it is at flowering stage. The majority of green manuring crops take about 6-8 weeks from date of sowing to attain the flowering stage. At 6-8 weeks old Dhaincha and 4-5 weeks old Sun hemp crops are suitable for buring. The crops to be buried for green manuring should be succulent. The Green Manure crops are allowed to decompose for 3- 4 weeks and then the planting of next crops is done for satisfactory results.

2. Green manuring ex-situ: It refers to the collection of leaves and tender twigs from shrubs and trees grown on bunds, waste land and nearby forest areas and then incorporates them into cultivable.

Principal of Green Manuring: Both legumes and non-legumes are being used as green manure in India since ages. But the inherent quality of nitrogen fixation by legumes makes them more suitable as green manures.

Some of the important green manure crops are as follows:

Leguminous green manure crops: Sunhemp, Dhaincha, Blackgram, Mung, Cowpea, Khesri, Berseem, Azolla, Rice bean, Soyabean, Lentil, Pea.

Advantages of Green Manuring

1. Deep-penetrating roots of green manures crops break open the deep layer of hard pan of the soil.
2. Brings up the nutrients from the deeper soil layer and make it available to the shallow rooted crops upon its decomposition.
3. Enrich the soil with biologically fixed nitrogen, adds organic matter and other macro and micro nutrients to the soil.
4. The organic matter added to the soil through green manures acts as a food for microorganism.
5. Green manure protects the soil from erosion and nutrient loss.

Important Conclusive Points of Green Manuring

1. Green manuring is an effective and cheap way of improving the soil fertility.
2. For green crop legume is preferable.
3. It acts as cover crop in soil erosion areas.
4. It is a good amendment source for reclamation of soil problem.
5. Young leaves can be incorporated immediately after planting but older crop is to be buried 4-8 weeks ahead of the planting.
6. Optimum dose of green biomass is 4-5 ton/ha.
7. Green manure is as efficient as ammonium sulphate or urea.
8. Improves fertility status of soils.
9. Important component of low input natural farming.

Nematode as Biological Model - *Caenorhabditis elegans*

Article ID: 11621

Sujata[1], Lochan Sharma[2]
[1]Ph.D. Scholar, Deptt. of Nematology, CCS HAU, Hisar.
[2]Ph. D. Scholar, Deptt. of Nematology, CCS HAU, Hisar.

Introduction

C. elegans is a non-hazardous, non-infectious, non-pathogenic, non-parasitic free-living organism belongs to family Rhabditidae have efficient potential to use as a biological model in all biological research aspects. Brenner (1974) settled *C. elegans* as a model organism to study animal development. There are many organisms that are used as biological model e.g., Fruit fly, yeast, zebra fish, but *C. elegans* often most studied organism due to small size, short life span (cycle) (~21 days) (2-3 days) and large progeny production (~300 by self-fertilization). Besides it, this nematode's genome and various other biological development processes of are the same as that of higher vertebrates including men.

Body and Biology of *C. elegans*

Caenorhabditis elegans is microscopic with transparent and unsegmented body with bilateral symmetry. The body of an adult *C. elegans* is approximately 1 mm long. Genome size is 100 million base pair with 5 autosome, 1 sex chromosome and mitochondrial chromosome 26 per cent introns and 47 per cent exons (Blumenthal *et al.,* 2002). There are two genders of *C. elegans*, hermaphrodites (having two XX chromosomes) and male (having single X chromosome) which help to study the self and cross fertilization (Dimitriadi and Hart, 2010). Mostly individuals are hermaphrodites with male comprising just 0.05 per cent of the total population on average. The life cycle of *C. elegans* consists of 4 larval stages (L1–L4) and adulthood. In absence of food resources and high crowd the L2 enters in inactive stage which is non-feeding called dauer stage. Furthermore, the life cycle also depends upon the temperature (Garcia-Sancho 2012). Under unfavorable environmental like food shortage and high temperature *C. elegans* can pause its development passing into another L3 stage called *dauer*, which might survive for months. During this survival stage, the nematode does not feed and its cuticle is tougher. Nematodes can revive again at reproductive life cycle L4 when conditions are more favorable (Wang et al. 2010b).

Characteristic of *C. elegans* for Good Model Organism

1. Very few No. of cells with well-developed organ system.
2. Easily cultured *in vitro.*
3. Simple genetic makeup.
4. Ease of genetic manipulation.
5. Ease of storage: can be stored for a long term in the laboratory.
6. Short life cycle: 2.5- 3 days per generation.
7. Small size.
8. Transparent cuticle: facilitating the study of cellular differentiation and other and other developmental process in the intact organism.
9. Large progeny production (~300 by self-fertilization).
10. Minimum growth and nutritional requirement.
11. Whole genome sequenced: *C. elegans* is only single organism whose complete genome sequenced is known.
12. About 35% of Human Genes have related genes in *C. elegans.*
13. Self-fertilization or cross fertilization easily understood due to presence of hermaphrodite or male.

Positive Facts About C. elegans which Make it Unique for Biological Model Identity

1	Mode of reproduction	Self as well as cross fertilisation
2	Chromosome number	6 chromosome (5 autosome and 1 sex chromosome)
3	Genome size	100 million base pair

4	Life cycle (egg to mature one)	Approx. 2.5- 3 days, at 20°C
5	Life span	~2.5 weeks(doubt)
6	Cuticle	Transparent
7	Female reproductive capacity	250 to 1000 progeny
8	Diet	Can be easily grow on Escherichia coli
9	Easy storage	Cryogenic freezing can be done without loss of alleles and no change of phenotype
10	Facile molecular genetics	Easy gene silencing through RNA interference

Applications in Various Biological Research Areas

1. Genetics.
2. Developmental Biology.
3. Nutrition.
4. Environmental toxicology.
5. Pharmacology.
6. Gerontology.

Conclusion

1. Gene of *C. Elegans* match about 35% and genome is fully sequenced that's why it is the best biological model.
2. Function of the specific gene can be disrupted by RNA interference or function of specific gene can be identified easily by RNAi method.

References

1. Blumenthal, T.D., Link, C.D., Guffanti, A.D.D., Chiu, W.L. and Kim, S.K. (2002). A global analysis of Caenorhabditis elegans operons". Nature, 417 (5): 851-857.
2. Brenner, S. (1974). The genetics of Caenorhabditis elegans. Nature Review Genetics, 77(1):71- 94.
3. Dimitriadi M, Hart A (2010). Neurodegenerative disorders: insights from the nematode Caenorhabditis elegans . Neurobiol Dis 40(1):4-11.
4. Garcia-Sancho, M. (2012). From the genetic to the computer program: the historicity of 'data' and 'computation' in the investigations on the nematode worm C. elegans (1963–1998). Stud Hist Philos Biol Biomed Sci C 43(1):16-28.
5. Wang D, Wang Y, and Shen L. (2010b). Confirmation of combinational effects of calcium with other metals in a paper recycling mill effluent on nematode lifespan with toxicity identification evaluation method. J Environ Sci 22(5):731-737.

Gametoclonal Variations: Mechanism and Application in Plant Breeding

Article ID: 11622

Bansuli[1]
[1]Department of Agricultural Biotechnology, CSK Himachal Pradesh Agriculture University, Palampur.

Summary of Article

The variation among plants regenerated from gametic cell cultures is termed as gametoclonal variation. The concept of gametoclonal variation originated from somaclonal variation. Both variations were found in cultured cells and regenerated plants. New genetic variation induced by the cell culture procedure and from segregation and independent assortment. New variations at the haploid level are induced by the doubling procedure. Anther and microspore culture technology has been well used for the production of double haploids. Speedy induction of homozygosity from hybrid donor plant is a primary aspect of gametoclonal variation. A distinct feature of gametoclonal variation is expression of recessive mutations along with the dominant mutations directly in the regenerated plants. In many crops such as barley, wheat, rice, tobacco, potato etc, gametoclonal variants have been generated and used to step up and enrich the breeding programme. Anthers and isolated microspores culture technology have been well established in many plant species for the production of double haploids and also utilized in vitro screening of microspores against stress.

Introduction

The variation among plants regenerated from gametic cell cultures is termed as gametoclonal variation. The concept of gametoclonal variation originated from somaclonal variation. Both variations were found in cultured cells and regenerated plants. Genetic variation is a crucial element of conventional crop breeding. Gametoclonal variation is found in plants which are regenerated from cultured gametic cells. These variations are very important contributing factor for genetic variation. Such variations are due to recombination and segregation during meiosis. Genetic variation observed in plants regenerated from somatic tissues cultured in vitro is called as somaclonal variation. The life cycle of higher plants have a sporophytic (2n) and a gametophytic (n) phase. For genetics studies, it is necessary to discriminate between plants regenerated from somatic (2n, somaclones) and gametic tissues (n, gametoclones). The gametes are products of meiosis and this is followed by Mendel's laws of segregation and independent assortment. Straight expression of dominant and recessive mutations in the regenerated plants is a distinctive feature of gametoclonal variation. Since plants resulting from gametic cells are usually haploid but to maintain the fertility of chromosome number should be doubled and chromosome number can be doubled by treating haploids with colchicines (mutagen). The term 'gametoclonal variation' can be described as the variation among derivatives of gametic cells in culture. These variants are obtained from both meiotic and mitotic divisions. A distinct feature of gametoclonal variation is expression of recessive mutations along with the dominant mutations directly in the regenerated plants.

Sources of Gametoclonal Variation

New genetic variation induced by the cell culture procedure and from segregation and independent assortment. New variations at the haploid level are induced by the doubling procedure. Anther and microspore culture technology has been well used for the production of double haploids. These techniques also used for in vitro screening of microspores against stresses. Tissue culture derived double haploid (DHs) are potentially useful in breeding programmes. Benefits from anther and microspore culture have been realized for crops such as tobacco, rice and wheat by exploiting one aspect of gametoclonal variation i.e. Hybrid sorting. Hybrid sorting is a process in which desirable homozygous lines are selected from a gametic array. Haploids can improve the efficiency and the speed rather inefficient conventional breeding methods. In gametoclonal variation both the dominant and recessive mutants are expressed and can be directly selected.

Mechanism of Gametoclonal Variations

There are four distinct sources of gametoclonal variation:
1. New genetic variations induced by the cell culture procedures.
2. Variations resulting from segregation and independent assortment.
3. New variation at the haploid level induced by the chromosome doubling.
4. New variation induced at the diploid level, resulting in heterozygosity.

New Genetic Variation Induced by Cell Culture Procedure

1. Pollen dimorphism: Gametoclonal variation may partially be due to pre-existing variation even before the tissue culture. The terms E- (embryogenic) or P-grains (embryogenic pollen grains) has been used and refer to the anomalous pollen found in anthers in vivo. The frequency of occurrence of anomalous pollen grains varies with species to species and physiological conditions. For example, in tobacco the frequency of anomalous pollen can be improved by a short day and a low temperature treatment for donor plant growth. The condition is to increase male sterility in vivo and promote microspore embryogenests in vitro. In a number of plants almost 100% of the pollen is anomalous which results in male sterility. Different changes may occur in individual microspores within the anomalous population leading to the gametoclonal. To prove genetic diversity of a microspore genomic DNA of each microspore needs to be studied and compared. The comparison at the sequence level would be a difficult task because of the amount of DNA available for each single cell and the large sample size require, but studies at the chromosomal level may clear the diversity of microspore population.

2. Variation resulting from segregation and independent assortment: In law of segregation two alleles of a gene remain separate and do not interfere each other in the hybrid. In law of independent assortment segregation of two or more traits in the same hybrid is independent of each other.

3. New variation at the haploid level induced by the doubling procedure: As haploid do not reach reproductive phase so in order to restore the fertility chromosome number must be doubled.

4. New variation induced at the diploid level resulting in heterozygosity: The sporophyte is the result of fertilization of male and female gametes and it contains a set of chromosomes from both parents with 2n genomic constitution. This diploid variation arises from it or after doubling with colchicines.

Genetic Basis of Gametoclonal Variations

Elimination of residual heterozygosity: Speedy induction of homozygosity from hybrid donor plant is a primary aspect of gametoclonal variation. The degree of heterozygosity of the hybrid reflects the amount of variation observed between gametoclones. In the inbred line production, we need homozygous lines but they might not be completely homozygous even after many years of selfing. So, we can use the haploid production to eliminate the remaining heterozygosity which might be left after selfing.

Application of gametoclonal variations in plant breeding: In many crops such as barley, wheat, rice, tobacco, potato etc, gametoclonal variants have been generated and used to step up and enrich the breeding programme. There have been several exmples of variation in plants regenerated from gametophytic tissue. *Brassica napus* (variation was observed in time of flower, glucosinolate content, leaf shape and flower type, pod size and shape), *Hordeum vulgare* (Plant height, yield, fertility, days to maturity), *Nicotiana sylvestris* (Leaf colour, leaf shape, growth rate, DNA content, repeated sequence of DNA), *N. tabacum* (TMV resistance, root knot resistance, time of flowering, plant size, leaf shape, alkanoid content, number of leaves), *Oryza sativa* (Altered temperature sensitivity, level of tillering waxy mutant), Saintpaulia ionantha (RuBSase activity).

Conclusion

Gametoclones can be produced through the culture of either male or female gametic cell. Most commonly used method for a wide range of species is anther or isolated microspores culture. Anthers and isolated microspores culture technology have been well established in many plant species for the production of double haploids and also utilized in vitro screening of microspores against stress.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Assessment of Soil Nutrient Status and Cropping Pattern in Western Agro-Climatic Zone of Tamil Nadu

Article ID: 11623

B. Bhakiyathu Saliha[1], P. Sathya Sree[2], R. S. Prasanna Gopika[3], I. Saranya[4]
[1]Associate Professor (Soil Science), Department of Soil Science & Agricultural Chemistry.
[2,3 &4]B.Sc.(Hons) Agri Students, Agricultural College and Research Institute, Killikulam, Thoothukudi dt-628252.

Introduction

Agriculture is the primary source of livelihood for about 58% of India's population. The share of agriculture in GDP increased to 19.9 per cent in 2020-21 from 17.8 per cent in 2019-20. Agriculture continues to be the most predominant sector of the economy of Tamil Nadu, as 70 % of the population is engaged in Agriculture and allied activities for their livelihood. The total geographical area of Tamil Nadu is 130.33 lakh hectares which constitutes 4 % of the National geographical area. The gross cropped area is around 63 lakh hectare. Tamil Nadu has all along been one of the states with a creditable performance in agricultural production with the farmers relatively more responsive and receptive to changing technologies and market forces. In the financial year of 2020, the gross domestic product from agriculture sector of Tamil Nadu amounted to over one trillion Indian rupees. This was a significant increase from about 833 billion rupees in the previous year. Soil fertility plays a major role in increasing crop productivity. Western zone of Tamil Nadu is a predominant zone that plays a key role in agricultural scenario of state. Understanding the soil nutrient status, its availability for crop uptake will determine the productivity of the crop thus increasing profitability of farmer's revenue and enhancing the quality of their livelihood.

Western Agro-Climatic Zone

Western agro-climatic zone of Tamil Nadu covers the districts of Erode, Coimbatore, Tiruppur, Namakkal, Karur, Dindigul and Theni and climatologically classified under semi-arid. Cauvery, Noiyal, Bhavani, Uppar, Siruvani and Amaravathi are major rivers and Mettur, Bhavanisagar and Amaravathi are the major dams utilized by the zone. The area under cultivation is 6,98,105 hectares which is 44.5 per cent of the total area of 15,678 sq. km. The Western zone receives a mean annual rainfall of 715 mm in 45 rainy days of which 49 % is received during northeast monsoon season. About 42 per cent of the area under cultivation is the irrigated area i.e., 2,96,201 hectares. Rice, sugarcane and banana are grown under wetland condition whereas sorghum, groundnut, small millets and pulses are grown as rainfed crops in red soils and cotton, sorghum, bengal gram and sunflower are the rainfed crops in black soils. Coconut is also grown in a large area.

Soil Nutrient Status

The major soil type of the zone is red loamy and black soil. Nitrogen, organic carbon and micronutrient content in the soil is low in all the districts of this zone. The soils of Erode, Namakkal and Tiruppur districts have medium soil phosphorous while other districts of this zone have high soil phosphorous . Potassium in the soil is medium in Erode, Coimbatore, Theni and Dindigul whereas other districts have high soil potassium content.

Tamil Nadu Agricultural University (EARD-TN, 2020) analytical report projects that the average Zinc deficiency slightly increased from 56.5 percent to 63 percent, Copper deficiency increased from 5.4 percent to 30 percent and Boron deficiency from 8 percent to 19 percent and sulphur deficiency from 3.5 to 10 percent over a period of 10 years from 2010 – 2020[1]. Arunachalam et. al.,(2013) shows that zinc is becoming second most deficient nutrient in soil next to nitrogen[2].

Cropping Pattern

In command areas of this zone rice (June-Sep.) - rice (Oct.-Jan.) - green manure or pulses (Feb.-April) is the pattern followed in Theni and Coimbatore districts. Rice cultivation in (Aug – Jan) followed by rice, pulses, oil seeds or vegetables, groundnut in (June-Sep.) followed by rice (Oct.-Jan.) and maize (Feb.-May) are adopted in Erode and Coimbatore districts.

In well irrigated areas, cotton or rice is cultivated during August to January followed by any other crops. Annual moringa with 2 years rotation is followed in Erode. Turmeric is cultivated during May to December which is followed by rice in command areas and groundnut or vegetables in well irrigated areas.

Millets (June-Sep.) followed by pulses (Oct.-Jan.) and Groundnut (July-Oct.) followed by fallow or pulses (Oct-Jan) are the major cropping pattern adopted in rainfed areas of this zone. Inter-cropping of pulses is also a major cropping practise in rainfed areas.

Fertilizer Practices

For paddy, in the nursery stage, FYM and 3kg DAP is applied in the for-nursery area required for planting 1 acre grain field. At the time of transplanting basal application of 100 kg DAP, 25kg potash and 15 kg urea are applied per acre. After 20 days of transplanting (DAT), 30 kg urea and after 50 DAT, 50kg urea along with potash are applied. Addition of 10 kg $ZnSO_4$ and 10 kg micronutrient mix is also followed by some farmers of this region. Sorghum is grown in rainfed condition in most of the region and only urea is applied at the rate of 50 to 100 kg/acre. Groundnut growers use DAP @ 70-100 kg as basal, 150 kg gypsum and potash 50 kg at 40-45 DAS per acre in Erode and Namakkal districts. While sowing Bengal gram, urea is drilled along with seeds @ 100kg per acre in Tirupur and Coimbatore region.

For vegetable crops in Coimbatore, FYM @2 tonnes per acre is applied as basal. DAP @ 50 kg per acre is applied at 50 to 60days for brinjal and at 20th day for bhendi, while 19:19:19 is applied through fertigation from first month onwards for brinjal. For onion in Namakkal, Factomphos @100kg/acre is applied @ 20 DAS and 17:17:17@ 100Kg/acre is applied around 40DAS . Potash combined with sulphate is applied at the rate of 100kg/acre around 60DAS

For banana in Coimbatore , 8 tonnes of FYM are applied as basal for an acre. DAP @ 150 kg per acre is applied around the second month while mixed fertilizer 12:4:12 @250 kg is applied around 70 days. At the time of bunch emergence, potash and sulphate is applied at 100 kg each through fertigation. Coconut is fertilised twice in a year in Coimbatore region. The first dose of fertilizer is applied with onset of monsoon which contains FYM@ 15 to 20 kg per palm and mixture of urea, DAP and MOP or mixed fertilizer 8:8:16 @ 5kg per palm. The second dosage is applied after six months from the first dose.

Tapioca cultivators in Coimbatore region apply gypsum and super phosphate @ 250 kg each for an acre as basal followed by DAP @ 100 kg per acre at second month with 200kg of potash between 6 to 9 months.

Soil Nutrient Management

Due to adoption of multiple cropping and introducing of high yielding varieties of principal crops in our country, soils are depleted in nutrients at a much faster rate than in the case of old cropping system. As a result, crop production has become highly fertilizer oriented. Considering cost of fertilizers and soil health, judicious uses of fertilizers are required. Soil testing is one of the accepted methods for the economic use of fertilizer. Soil testing involves collecting the soil samples, preparation for analysis, chemical and physical analysis, interpretation of analysis and finally making fertilizer recommendations for the crops (Claire et. al., 2019)3.

Ripa et. al., (2006) indicated that 36 percent of the farmers who have conducted their soil tests are willing to apply fertilizers based on recommendations, but are not convinced of the benefits from applied fertilizer4. The results of the soil tests conducted by Tamil Nadu Agricultural University have revealed that soil test-based fertilizer application can increase soil fertility and crop production.

Soil test-based approach helps making recommendation of manure for both macro and micro nutrients according to soil fertility level suitable for crops. Soil testing helps in recommending only essential and adequate amount of nutrients preventing possible nutrient toxicity and overuse of fertilisers which in turn results in reduction the cost of cultivation and prevention of degradation of soil quality due to overuse of fertilisers. Soil test maintain proper soil health and plant nutrients reserves for healthy growth of next crop in sequence.

In order to maintain soil fertility and to increase the soil productivity 4R's to be followed are right source (matches fertilizer type to crop needs), right rate (matches amount of fertilizer type crop needs), right time (makes nutrients available when crops need them) and right place (keep nutrients where crops can use them). Hence the farmers of the western agro-climatic zone of Tamil Nadu need to focus on soil testing and soil test based Nutrient management practices for achieving the maximum yield of the principal crops grown.

Conclusion

It is important to keep soil healthy and productive to function optimally and to increase agriculture production with appropriate soil nutrient and crop management practices. In rural areas, the living standards of people mainly depend on agriculture, which is often determined by the fertility and productivity of soil. It may be maintained by scientific crop rotations and the application of fertilizers in a right manner. The traditional fertilizing methods are not scientifically relevant and efficient in places with heterogeneous nutrient status. Overuse of fertilizers can certainly lead to a waste of fertilizer resources and a serious environmental pollution. Hence, a comprehensive knowledge of soil fertility, cropping pattern and application of fertilizers and manures provides a better understanding on soil nutrient requirement and that can lead to sustainable soil health and crop yields.

References

1. K. Murugan, K. Jothi Sivagnanam- July 2020- An Estimation of Soil Health Status and Recommended Doses of Fertilizers in Tamil Nadu- Vol. 5(2), pp. 577-582.
2. Arunachalam, P., Kannan, P., Prabukumar, G. and Govindaraj, M. 2013. Zinc deficiency in Indian soils with special focus to enrich zinc in peanut. African Journal of Agricultural Research, 8(50) : 6681-6688.
3. Arunachalam, P., Kannan, P., Prabukumar, G. and Govindaraj, M. 2013. Zinc deficiency in Indian soils with special focus to enrich zinc in peanut. African Journal of Agricultural Research, 8(50) : 6681-6688.
4. Claire, J. Glendenning, Suresh Chandra Babu and KwadwoAsenso-Okyere, 2019. Extension through entrepreneurial approach: evaluating the agriclinics program. Agricultural Extension Reforms in South. Status, Challenges, and Policy Options, pp: 201-234.
5. Ripa (2006); Logan 1993; D'Arcy and Frost (2001) D'Arcy, B and A Frost (2001) The Role of Best Management Practices in Alleviating Water Quality Problems Associated with Diffuse Pollution, The Science of the Total Environment, 265(1-3).
6. Annual report 2018- 19 on Forecasting Agricultural output using Space, Agrometeorology and Land based observation (FASAL)-Yield Forecasting for Rice, Maize and Groundnut in western zone of Tamil Nadu using Space, Agro meteorology and Land based observations, Agro Climate Research Centre, Coimbatore, Tamil Nadu.
7. TNAU Agritech portal- Agritech.tnau.ac.in
8. Department Of Agriculture-Government of Tamil Nadu – Policy Note- 2020-2021.
9. Salient statistics on agriculture 2021- tnagrisnet.tn.gov.in.

Implication of Sensors for Pest Detection and Monitoring in Crops

Article ID: 11624

Radha Koranga[1], Ravi Prakash Maurya[1], Anees M M[2], Saty Saran[1]
[1]Department of Entomology, GBPUAT, Pantnagar (UK), India.
[2]Department of Entomology, CSKHPKV, Palampur (HP), India.

Introduction

A successful crop production requires various farm activities and constant maintenance in order to provide a high and healthy yield. A farmer should monitor his crops because of various insect pests and diseases in the crop field right from the initial stages of the crop as they tend to be the biggest threat to successful crop production. Approximately, 20-40% of the yield loss can be reduced by early pest detection depending on the growth stage and crop type (Thomas et al., 2015). So, the farmers need to put all of their efforts into constant crop monitoring instead of just walking down the field. Though monitoring crops is highly laborious, farmers can use various tools to monitor their crops faster and more accurately, such as sensors. Sensors are artificial devices that are used to detect electrical or optical signals and respond to it. They convert the physical parameter (for example: humidity, temperature, blood pressure, speed, etc.) into a signal that can be measured electrically. In crop production, insect pest and diseases are significant issues. For this reason, improved sensors for precision farming are constantly being improved. Such modern technology includes pest detection sensors which detect disease and insect pest occurrence on crops. Sensors provide us real-time data from the field. Given that the traditional monitoring techniques are laborious and offer poor temporal resolution measurement, the changes in pest population density in the field cannot be accurately monitored. Consequently, a proper estimation for a target pest population will be limited to a long-term scale.

Common sensors used in Entomology are:
1. Low-image Sensors.
2. High-image Sensors.
3. Sound Detection Sensors.
4. Volatile Detection Sensors.
5. Spectral Remote Sensors.
6. Fluorescence Image Sensing.

Sensors for Pest Detection and Monitoring

There are different categories of sensors that can be utilized for the purpose of insect-pest and monitoring.
1. Image sensor: The low-power image sensor is a wireless autonomous monitoring system that is based on a low-cost image sensor. This sensor periodically captures images of the trap contents and sends them to a control station.

Control station deals with the storage of the captured images and the processing of the captured images in order to determine the number of individuals found at each trap by means of image recognition algorithms. Based on number of insect population, a farmer can plan when to start crop protection and in which field areas.

These types of sensors are utilized to monitor the large areas with low energy consumption. Low image sensors provide many benefits in farm production. Therefore, various sensors have been proposed based on a low-cost system on battery-powered wireless image sensors that accurately monitor pest populations with a higher temporal resolution and a significant reduction of pest monitoring costs, as no human intervention is required during the monitoring process. Efficiency of image sensor was tested by Rustia et al., 2020. The image was passed through various steps to get a clear picture so that the actual number of insects can be counted.

The t-statistic results after conducting a paired t-test, excluding the mean automatic and manual counts, showed values close to zero which means the automatic counting results are not significantly different from the manual counts. However, there were still instances in which the algorithm failed to have a high accuracy in detection and these discrepancies are caused by the presence of dirt left from water droplets that are sometimes identified as insects. The values of the automatic and manual counts are consistent with each other.

2. Acoustic sensors: An acoustic sensor is an insect pest detection sensor which detects the noise level of the insect pests. In these, the wireless sensor nodes connected to a base station are placed in the field. A sensor transmits the information to the control room computer, when the noise level of pest crosses the threshold, which then accurately indicates the infestation area.

These sensors greatly reducing crop damage as they help in detecting an infestation at a very early stage. Gutiérrez et al., 2012 conducted a study on working of acoustic sensors performed inside a climate control room at 25°C located in order to elude other noise sources different from the pest (wind, birds, etc.). Twelve three-year-old palm trees (*Phoenix canariensis* cultivar) around 30-40 cm tall with a stout trunk of 20 cm diameter were selected and artificially infested with two-week-old larvae of red palm weevil.

In 70% of infested palms, significant peaks due to larvae activity were found in a frequency range between 2230 Hz and 2270 Hz. It can be observed that the activities (probably locomotive) of all other insects produced significant peak between 5000 and 7000 Hz. These peaks are different to those possibly produced by the Red Palm Weevil larvae during feeding, that are in the frequency range 2230-2270Hz.

3. Volatile detection sensors: Plants normally produce a range of volatile organic compounds (VOCs) which vary qualitatively and quantitatively according to plant species. On attack of pests and diseases, plants emit much greater amounts of VOCs than non-attacked plants. This emission of VOCs is not only from sites of injury, but also from elsewhere on the plant not directly subject to attacks.

In the past decade, the concept of electronic nose (e-nose) has been realized and it provides an easier alternative for detecting VOCs. The instrument is made up of an array of gas sensitive, nonspecific, chemical sensors, as artificial odour receptors. The specificity of plant VOC profiles produced in response to pest and disease attacks potentially provides an opportunity for them to be used for non-invasive plant pest and disease monitoring in agricultural or horticultural settings, thereby allowing more targeted pest control strategies to be employed.

The cottons balls which were artificially infested by *Euschistus servus* and *Nezara viridula* bugs showed certain volatile emissions. Total emissions showed the strongest increase between the 48 and 72 hr of sampling period, and emissions remained significantly elevated 96 hr after initial exposure (David et al., 2012).

References

1. Thomas, K., Aswathi, K., Blessi, S., Veena, J., Saravanan, K. 2015. Agrobot: Novel method of implementing thermal camera and automisation. International Research Journal of Engineering and Technology, 7(5): 73-49.
2. Rustia, D., Chien, L., Jui, Y., Zhuangc, Y., Hsuc, J. 2020. Application of an image and environmental sensor network for automated greenhouse insect pest monitoring. 2020. Journal of Asia-Pacific Entomology, 23(3): 17–28.
3. Gutierrez, A., Ruiz, V., Molto, E., Tapia, G. and Maria, D., 2010. Development of a bioacoustic sensor for the early detection of Red Palm Weevil (Rhynchophorus ferrugineus Olivier). Crop Protection, 29: 671-676.
4. David, C.D., Jeremy, K.G., Ahmad, K. 2012. Temporal dynamics and electronic nose detection of stink bug – induced volatile emissions from cotton bolls. Psyche. 2012:9.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Natural Pigments from Microbes

Article ID: 11625

Sankari Meena K[1], Deepa S. P[2], Manju P[3], Vijaykumar S[1], Sivanesh H[4], Ananda Kumar A. M.[5]
[1]ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad, Telangana.
[2]J. K. K. Munirajah College of Agricultural Science, Erode, Tamil Nadu.
[3]Kumaraguru Institute of Agriculture, Erode, Tamil Nadu.
[4]Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu.
[5]Nallamuthu Gounder Mahalingam College, Pollachi, Tamil Nadu.

Summary
Microbes produce a wide range of pigments such as carotenoids, melanins, monascins and violacein that can be used as color intensifiers, additives, antioxidants and functional food ingredients. Understanding the diversity of microorganisms and the related pigment production by them leads to the development of novel natural products from the microorganism that will increase the marketability of products.

Introduction
Synthetic pigments pollute the environment and have toxicological negative effects. Owing to the hyperallergenicity of artificial colourants, many of them were disqualified, prompting an upsurge in research into natural substances. As a result, it is critical to investigate numerous natural sources of food grade colorants as well as their prospective applications. Use of microbial pigments in processed foods is a promising subject with significant economic potential. Microbial pigments, on the other hand, provide issues due to their high cost, reduced stability, and shade variation due to changes in pH. Despite their high cost, considering the beneficial effect of microbes derived pigments, many food and beverage sectors, utilise natural colours obtained from microbial sources (Newsome et al., 2014), with the goal of identifying promising chemicals with bioactivities in pigments. (Tuli et al., 2014).

Microbial Pigments and their Applications
Microbial pigments have recently received attention due to the shortcomings of plant pigments, such as their low water solubility and instability to light and heat. Fast growing microorganisms can be cultured in a low-cost culture media, and the chemicals produced by these microbes should be examined (Shahid et al., 2013). Majority of the bacterial and fungal microorganisms can be isolated from soil, plants, water bodies and insects and many of them are being explored for the production of various colors due to the high demand for colouring agents in the textile, paper, paint and food industries (Dufosse et al., 2014). In recent days, there has been an increase in demand for the commercial application of microbial pigments in the medical and pharmaceutical industries as well (Tuli et al., 2014).

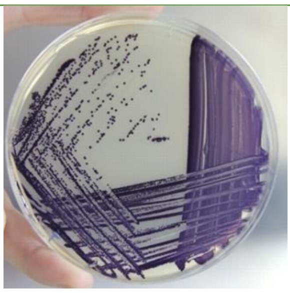
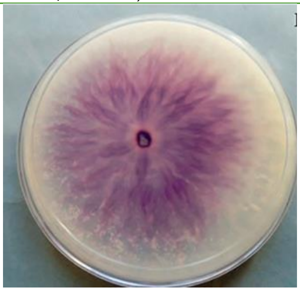
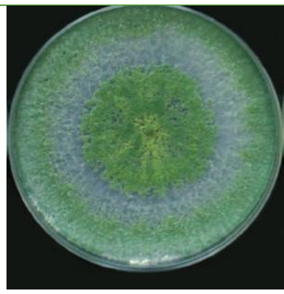
The red pigment produced by gram positive and gram-negative bacteria, prodigiosins, has a wide range of therapeutic applications (Darshan and Manonmani, 2015). Similarly, the fungus *Monascus* spp. produces red pigment that is being utilised as a food colourant (Babitha, 2009).

Fungi, unlike bacteria, produce a wide range of colours that are frequently employed in the food industry.

Furthermore, the sites and substrates with significant microbial richness should be discovered for the detection of unique chemicals produced by microorganisms. Dark septate endophytes, for example, are frequently connected with the roots of variety of rare and endangered plants that must be preserved in order to maintain the fungus diversity to obtain the pigments. (Hawksworth, 2001).

Fungi, in general produce a variety of metabolites, such as enzymes, acids, peptides, pigments and antibiotics. These pigments assist the fungi to survive in harsh environments.

Carotenoids, for example, protect fungus from UV light and melanin protects them from radiation. The fungal hyphal wall contains sporopollenin, which protects them from abiotic stresses such as drought (Velisek and Cejpek, 2011). Fungi use melanin to protect themselves from both biotic (natural enemies) and abiotic (UV radiation, temperature) stresses (Nosanchuk and Casadevall, 2003). In Antartica, investigation of soil and water samples confirmed the presence of yeast recovered from the samples. Production of photoprotective chemicals such as carotenoids and mycosporines is essential for their ability to survive under such extreme environments (Libkind et al., 2009).

			
Chromobacterium violaceum	*Serratia* spp.	*Fusarium* spp.	*Trichoderma* spp.
Pigment producing bacteria		**Pigment producing fungi**	

In addition to UV protection, mycosporins and pigments like melanin and carotenes have antioxidant properties (Pagano and Dhar, 2015).

It is known that the fungal melanin's can increase their survival under extreme environments (Rizner and Wheeler, 2003). Furthermore, the presence of melanins in fungal hyphae aids in the wide dispersion of the fungi, as proven in the case of *Phyllosticta capitalensis*, where the presence of melanin in the fungal hyphae has been linked to the extensive distribution of the fungi in mangrove and deciduous forests (Suryanarayanan et al., 2004).

Melanin is a durable polymer that provides structural support as well as resistance to environmental stress. As a result, the coexistence of highly melanized fungal structures with various plant taxa in various habitats gives protection against pathogens or abiotic stresses such as drought, temperature extremes and so on.

Conclusion

Given the significance of microbial pigments in increasing the adaption strategies of microbes, these microorganisms and their pigments should be considered for the manufacturing of important compounds suitable for the bioprospecting market. Moreover, understanding the different pigment producing microbes associated with different endemic plants is important for understanding the diversity of pigments associated with different regions. A systemic study of microbial pigments is important to evaluate and screen the efficient microbes. To fully comprehend the mechanism of pigments in extensive microorganism associations, more research is further needed.

References

1. Darshan N. and Manonmani HK., (2015). Prodigiosin and its potential applications. J Food Sci Technol. DOI: 10.1007/s13197-015-1740-4.
2. Newsome AG., Culver CA. and Van Breemen RB., (2014). Nature's Palette: The search for Natural Blue Colorants. J. Agric. Food Chem. 62 (28): 6498–6511.
3. Pagano M.C., Rosa L.H. and Fernandez NN., (2021). Microbial pigments: Recent advancements and future developments. In: Microbial Applications. DOI:10.1515/9783110412789-008.
4. Suryanarayanan TS., Ravishankar JP., Venkatesan G. and Murali TS., (2004). Characterization of the melanin pigment of a cosmopolitan fungal endophyte. Mycol. Res. 108(8): 974–978.
5. Velisek J. and Cejpek K., (2011). Pigments of higher fungi: a review. Czech J. Food Sci. 29 (2):87 - 102.

"Red Rot of Sugarcane" – The Cancer of Sugarcane

Article ID: 11626

Sukanya Gogoi[1], Dipanjali Baruati[2]
[1]Ph.D. Scholar, Department of Plant Pathology, Assam Agricultural University, Jorhat, Assam.
[2]MSc. Student, Department of Horticulture, Assam Agricultural University, Jorhat, Assam.

Summary

Sugarcane *(Saccharum officinarum)*, belonging to family Poaceae, is a perennial grass, commercially used to produce sugar in many tropical and sub-tropical countries. It is one of the most important agro industrial crops in India next to the textile industry. In addition to sugar, sugarcane is also used to produce ethanol, bagasse, molasses, and lobby mud. The crop is reported to be affected by more than 120 diseases from the stage of planting to harvest. The red rot is a very important disease of sugarcane and poses a serious threat to sugarcane cultivation. This chapter presents information on 'Red rot of Sugarcane' including its economic importance, symptoms, causal organism, epidemiology, survival and spread and its management strategies.

Introduction

Red rot is one of the oldest diseases of sugarcane dating back to the times of Buddha. It was reported for the first time from Java (Went 1893) as "red-smut" and it became a serious cause of the decline of several popular varieties of sugarcane in other countries. Due to its devastating nature, it is known as "cancer of sugarcane". The disease is distributed worldwide but is found mainly in subtropical and tropical regions (Kumar et al. 2011). The disease results in reduction of the stalk mass and also the sucrose content of infected stalks and can be very severe in its later stages causing heavy economic losses. The ratoon crops are easily damaged by the disease.

Economic Importance of the Disease

Severe losses due to red rot of sugarcane have been reported in many countries. First, large-scale destruction of sugarcane in India by the disease was noticed in Godavari delta of then Madras Presidency on the cultivar Red Mauritius from 1895 to 1899 (Barber 1901). Butler (1906) reported the disease-causing heavy losses in Indian cane varieties and renamed this disease as "Red rot".

The epidemic of 1938-40 in India was disastrous when the most widely grown variety in the states of Uttar Pradesh and Bihar, Co213, was wiped out. However, much higher yield losses of up to 100% from India has been reported when the disease occurred in epidemic form during different decades and many popular varieties were removed from cultivation (Viswanathan 2010). Today, this disease appears in low and severe condition in almost all the sugarcane growing states in India, especially in eastern Uttar Pradesh, Northern Bihar, and pockets of Punjab (Babu et al. 2010). Wherever sugarcane is subject to damage from stalk boring insects, there is a risk of associated damage from red rot because the wounds provide entry points for infection (Sandhu et al., 1969).

Symptomatology

The disease appears in the field after the rainy season when the growth of the plants stops, and the formation of sucrose starts.

Leaf symptom: Initially, leaves start losing color, and drooping of upper leaves of the shoots occur. The margins of the infected plants wither and continue until the whole crown withers and results in plant death within 4 to 8 days. The leaves also show dark blood red lesions on the midrib in both directions, which elongates throughout the leaf length. Later, these lesions become straw-colored in the center with the development of black acervuli and dark reddish-brown margins. The infected leaves often break at the point of the lesions and hang off.

Stalk symptom: The stalk becomes dry, wrinkled, hollow, showing a characteristic red color, especially throughout the vascular bundles and an alcoholic smell is emitted.

The Characteristic Symptoms of the Disease can be Observed as Both External and Internal Manifestations

1. External symptoms of infected stalks: External symptoms of ill-defined red brown patches on the rind i.e rind discoloration may also be observed. In the late stages of the disease in susceptible varieties, the stalks dry out and shrink, appearing mummified. The leaf canopy becomes yellow and eventually desiccates if stalk rotting is severe. Elongated lesions on the leaf midribs, caused by the red rot pathogen following insect feeding, are commonly seen.

2. Internal symptoms of infected stalks: The diagnostic character for identification of this disease is the white patches between the red tissues as transverse bands, which can be observed on the splitting of the stem. As the disease advances, the whole affected stem rots. The internodes of the plants may be shortened, and profuse whitish mycelial growth can be seen in the tissues. The fungal pathogen sometimes produces black colored minute velvety bodies representing acervuli. The rate of spread through the internodes and along the stalk relies upon the susceptibility of the variety.

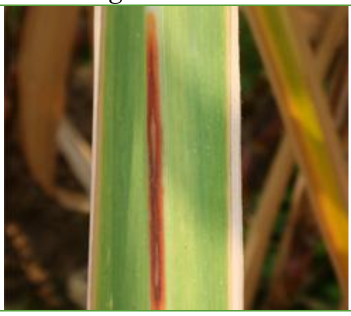
	
Affected mid rib	**Red tissues on splitting of sugarcane stem**

Fig. Symptoms of Red rot of Sugarcane

Causal Organism

Perfect state: *Glomerella tucumanensis* (Speg.).
Imperfect state: *Colletotrichum falcatum* Went.

The fungus belongs to Division- Deuteromycota, Class- Coelomycetes, Order- Melanconiales, Family-Melanconiaceae and Genus- Colletotrichum.

Epidemiology

Climatic factors affect both the spread and severity of red rot. In newly-planted cane, the disease is favored by excessive-high humidity, waterlogging conditions, drought conditions, low temperatures, improper cultural practices, and continuous cultivation. The type of symptoms varies depending on the prevailing weather conditions.

Survival and Spread

The infected cane setts deliver the primary infection to the field. Depending on the nature of infection and availability of favorable environment, pathogen starts taking a toll by killing the bud, and this affects the initial establishment of the crop. In the rainy season, the disease spreads so fast that the entire crop dries and not a single millable cane is obtained.

Management Strategies

Integrated disease management (IDM) is one of the best methods for the management of the pathogen. IDM practices reduce red rot incidence, enhance growth parameters and quality attributes of sugarcane compared to non-IPM practices. IDM combines all the methods of management which are as following:

Cultural practice:

a. Crop rotation after two to three years with non-host crops helps destruction of disease inoculum.
b. Ratooning should be discouraged.
c. Clearing fields of excessive trash and ensuring efficient drainage makes the cultivation conditions hygienic, and in turn, reduces disease inoculums.

d. During winter and early spring planting, sugarcane should be mulched with plastic films, which can promote the germination of seed canes and avoid invasion by the pathogen.

Physical treatment:

a. The best remedy for avoiding this fungal disease is to cultivate only resistant sugarcane varieties that have been released for cultivation in different sugarcane-growing states.

b. Hot-water treatment of sets before planting (at 52°C for 30 mins) and moist hot air treatment (at 54°C for 4 hrs) are also recommended and these are effective for the inactivation of superficial infection (Singh, 1973), but difficult to eliminate the deep-seated infection of the pathogen inside the cane.

Biological control:

a. Different bio-control agents viz., *Pseudomonas* sp., *Trichoderma* sp, etc. have been integrated with cultural practices, soil solarization, fungicides, and disease-resistant varieties for the management of various diseases in different crops (Gogoi et al. 2007). These bio-agents either work alone or in combination with other methods of management.

b. Singh (1994) reported that sett treatment or foliar spray with *Trichoderma harzianum* Rifai improved germination and was effective against red rot disease development in the field.

Chemical control:

a. Seed setts can be sterilized by using 1% $CuSO_4$ solution (soaked for 2 hrs) or by dipping setts in 1% Bordeaux mixture before planting.

b. Fresh sowing should be done with seed setts from a resistant variety, dipping these in 0.25% solution of Agallol or Aretan for 2-3 minutes.

References

1. Babu C. (2010). Pre-Breeding In Sugarcane (Saccharum Sp. Hybrids) For Red Rot Resistance and Economic Traits. Electr J Plant Breed. 1: 1024-1034.
2. Barber C.A. (1901). Sugarcane diseases in Godavari and Ganjam districts. Madras Dept. Land Records and Agric. Bull., 43: 181-194.
3. Butler E.J. (1906). Fungus Diseases of Sugar-cane in Bengal. India Dept. Agr. Mem., Bot. Ser. 1(3): 2-24.
4. Gogoi R., Saikia M., Helim R., Ullah Z. (2007). Management of potato diseases using Trichoderma viride formulations. J Mycol Plant Pathol. 37(2): 227-230.
5. Kumar N., Tripta J., Satyavir S., Tilak R.S. (2011). Molecular and Pathological Characterization of Colletotrichum falcatum Infecting Subtropical Indian Sugarcane. J Phytopathol. 159(4): 260-267.
6. Sandhu S.S., Mehan V.K., Singh K. (1969). Extent of losses in sugarcane caused by red rot (Physalospora tucumanensis Speg) and smut (Ustilago scitaminea Sydow). J Res Ludhiana. 6: 341–344.
7. Singh K. (1973). Hot air therapy against Red rot of sugarcane. Plant Dis Rep. 57: 220-222.
8. Singh N. (1994). Trichoderma harzianum and Chaetomium sp. as potential biocontrol fungi in management of red rot disease of sugarcane. J Biol Cont. 8: 65-67.
9. Viswanathan R. (2010). Plant disease: Red rot of sugarcane, 306. New Delhi, Anmol Publishers.
10. Went FAFC (1893). Het Rood Snot (Summary in English). Archiefvoor De Java Suikerindustrie. 1: 265-282.

Rhizosphere Chemistry in Association with Plant Nutrition

Article ID: 11627

Eramma[1]
[1]Ph.D. Scholar, Department of Agricultural Microbiology, University of Agricultural Sciences, Raichur.

Introduction

The rhizosphere is the interface between roots and the soil where nutrient absorption for plant growth in agro ecosystems is facilitated. In 1904, Lorenz Hiltner defined the soil–root interface or rhizosphere as the volume of soil surrounding the roots, which is influenced by root activity. Rhizosphere effect can be described as stimulation of microbial growth in the soil near the root surface, as well as plant interactions with beneficial or pathogenic microorganisms and potential implications for nutrient cycling in soils, plant nutrition and plant health. The stimulation of microbial activity and density in the rhizosphere is mainly due to the release of easily decomposable root exudates.

Plant roots can modify the rhizosphere chemistry in a number of ways:
1. By release and uptake of organic compounds.
2. By gas exchange (CO_2/ O_2) related with respiration of roots and rhizosphere microorganisms.
3. By root uptake as well as release of water and nutrients, which may be associated with uptake or extrusion of protons and modifications of the redox potential.

Spatial Extent of the Rhizosphere

The extent of the rhizosphere in space and time is highly variable. Gradients exist both in radial direction towards the bulk soil and in longitudinal orientation along the roots.

Radial Gradients: The radial gradients of nutrients in the rhizosphere are determined by their solubility and mobility, and the uptake capacity of the roots. Nutrient uptake is closely coupled to uptake or release of protons and therefore frequently associated with root-induced changes in rhizosphere pH.

Longitudinal Gradients: Along single roots, gradients are formed between apical root zones and the older, more basal parts of the root. The presence of root hairs increases the surface available for nutrient absorption and may also be responsible for an increased release of protons and organic compounds in this zone.

Inorganic Elements in the Rhizosphere

Although the total soil content of nutrients frequently exceeds the plant requirements by several orders of magnitude, plant availability is often limited by low solubility of nutrients such as P, K, ammonium, Fe, Zn, Mn, Cu and Mo. Therefore, these nutrients reach the root surface mainly by diffusion. Modifications of the rhizosphere chemistry increases the solubility of sparingly available nutrients.

Rhizosphere pH

The most important factor for root-induced changes in rhizosphere pH is the uptake of nutrients, which is coupled with proton transport in higher plants. The driving force for nutrient uptake by root cells is H^+ extrusion, mediated by the activity of a plasma membrane-bound H+ pumping ATPase (PM-ATPse), which creates an outward positive gradient in electropotential and pH between the cytosol (pH 7–7.5) and the rhizosphere (pH 5–6). The pH buffering capacity of soils depends primarily on initial pH and organic matter content, but also on clay content. Protons may replace other cations from the cation exchange sites of the soil and thereby affect the mobilization/immobilization of nutrients (Hinsinger et al., 2009).

Nitrate uptake results in excess uptake of anions over cations, net uptake of protons and thus an increase in rhizosphere pH. Furthermore, nitrate assimilation in the root tissue is associated with production of OH^-, and may therefore contribute to some extent to rhizosphere alkalinization by release of OH^- into the rhizosphere for intracellular pH stabilization. In acid soils, the pH increase induced by nitrate supply enhances P uptake by exchange of phosphate adsorbed to Fe and Al by $HCO3^-$ or by stimulation of microbial P mineralization. Rhizosphere alkalization may also alleviate the negative effects of soil acidity on plant growth by increasing the availability of Ca and Mg, but reducing the concentration of toxic Al species in the rhizosphere soil.

Effects of pH on Nutrient Uptake

Changes in rhizosphere pH not only affect nutrient solubility in soils, but also nutrient uptake. Generally, cation uptake decreases with declining pH, whereas anion uptake is inhibited when the pH of the external medium increases. This can be attributed to:

1. Competition between H^+ and OH^- ($HCO3^-$) with cations or anions.
2. External pH effects on the electrochemical potential gradient providing energy supply for nutrient uptake.
3. pH-induced alterations of root metabolism. However, positive pH effects on nutrient availability may counteract negative pH effects on nutrient uptake.

Redox Potential and Reducing Processes

The decrease in redox potential is correlated with a range of changes in the solubility of nutrients. Low-molecular-weight organic acids as products of microbial fermentation processes and Fe^{2+}, Mn^{2+} and H_2S can accumulate in phytotoxic concentrations.

Mn Mobilization: The activity of rhizosphere microorganisms is of particular significance for Mn nutrition of plants, since microorganisms can mediate Mn immobilization by oxidation reactions in soils as well as Mn solubilization by Mn reduction.

Fe Mobilization: The reductive capacity is increased by expression of a PM-bound reductase oxidase system with a low pH. The PM reductase-oxidase is further activated by rhizosphere acidification which is the result of increased expression of PM H^+- ATPase in the sub-apical root zones. Phenolic compounds released from Fe-deficient plant roots have been implicated in the remobilization of Fe precipitated on the root surface and in the rhizosphere.

Root Exudates: High-Molecular-Weight Compounds

Mucilage and Mucigel: The close contact between soil particles and root surface via mucilage can be of considerable importance for the uptake of nutrients. This applies particularly to micronutrients and P. In dry soils, stimulation of mucilage secretion in response to increased soil mechanical impedance can contribute to the maintenance of Zn^{2+} uptake by facilitating Zn^{2+} transport from embedded soil particles to the root surface. Mucilage may also contribute to exclusion of toxic elements such as Al and heavy metals.

Secretory Proteins: Plant roots release a wide range of proteins including various enzymes. A wide range of enzyme activities involved in the hydrolysis of organic P esters, such as phytase, nuclease, pyrophosphatase, apyrase and alkaline phosphatise, have been detected in the rhizosphere. In some plant species, root secretion of carboxylates, such as oxalate and citrate, may enhance the solubility of organic P forms, making them available for hydrolysis by phosphohydrolases in the rhizosphere.

Low molecular weight Root Exudates: Major fractions of low molecular weight compounds detected in root exudates include sugars, organic acid anions, amino acids and various phenolics. Uptake is mediated by transporters and involves an active mechanism with H^+ co-transport. Amino acid and peptide transporters frequently show enhanced expression under limited N supply. Secretion of organic acid anions is also a mechanism to mobilize sparingly available P adsorbed to Fe and Al oxides/ hydroxides or as Fe, Al and Ca phosphates via solubilization and chelation of metal cations. In the rhizosphere, PS mobilize Fe^{3+}, but also other micronutrients, such as Zn, Mn and Cu, by formation of stable complexes even at high soil pH.

Summary

The physicochemical processes of rhizosphere soil are influenced by the activity of plant roots and the consequences for plant nutrition. The physiological mechanisms determining root-induced modifications of the pH and the redox conditions in the rhizosphere are discussed with respect to the consequences for the solubility and plant availability of nutrients and toxic elements in soils and the impact on plant–microbe interactions.

References

1. Neumann G., George T.S. and Plassard C. (2009). Strategies and meth¬ods for studying the rhizosphere – the plant science toolbox. Plant Soil. 321: 431–456.
2. Hinsinger P., Gobran G.R., Gregory P.J. and Wenzel W.W. (2005). Rhizosphere geometry and heterogeneity arising from root-mediated physical and chemical processes. New Phytol. 168: 293–303.
3. Gregory P.J. (2006b). Roots, rhizosphere, and soil: the route to a better understanding of soil science? European. Journal of Soil Science. 57:2–12.
4. Clarkson D.T. (1991). Root structure and sites of ion uptake. In Plant Roots – The Hidden Half. pp. 417–453.
5. Hinsinger P., Bengough A.G., Vetterlein D. and Young, I.M. (2009). Rhizosphere: biophysics, biogeochemistry and ecological relevance. Plant Soil. 32:117–152.
6. Gahoonia T.S. and Nielsen N.E. (1992). The effects of root-induced pH changes on the depletion of inorganic and organic phosphorus in the rhizosphere. Plant Soil. 143:185–191.
7. Jin C.W., You G.Y., He Y.F., Tang C., Wu P. and Zheng S.J. (2007). Iron deficiency-induced secretion of phenolics facilitates the reutilization of root apoplastic iron in red clover. Plant Physiology. 144:278–285
8. Holden M.J., Luster D.G., Chaney R.L., Buckhout T.J. and Robinson C. (1991). Fe3+chelate reductase activity of plasma mem¬branes isolated from tomato (Lycopersicon esculentum Mill.) roots. Plant Physiology. 97:537–544.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Nano Urea Liquid by IFFCO & Why it's Needed

Article ID: 11628

Rajesh Kumar Bishnoi[1], Amit Kumar Langadi[2]
[1]MBA (Agri Business) Dr. RPCAU, PUSA, Samastipur, Bihar.
[2]M.Sc. (Agronomy), Career Point University, Kota, Rajasthan.

Introduction

The Indian Farmers Fertiliser Cooperative Limited (IFFCO) introduced the world's first Nano Urea Liquid for farmers across the world. Leading fertiliser cooperative IFFCO said it has started commercial production of nano urea liquid and dispatched the first consignment to Uttar Pradesh for use of farmers. IFFCO has priced nano urea liquid at ₹240 per bottle, which is 10 per cent cheaper than the cost of a bag of conventional urea.

This nano-fertiliser has been developed indigenously, for the first time in the world at IFFCO - Nano Biotechnology Research Centre (NBRC) Kalol, Gujarat through a proprietary patented technology. Nano Urea (Liquid) is a source of nitrogen which is a major essential nutrient required for proper growth and development of a plant. Nitrogen is a key constituent of amino acids, enzymes, genetic materials, photosynthetic pigments and energy transfer compounds in a plant. Typically, nitrogen content in a healthy plant is in the range of 1.5 to 4%. Foliar application of Nano Urea (Liquid) at critical crop growth stages of a plant effectively fulfils its nitrogen requirement and leads to higher crop productivity and quality in comparison to conventional urea.

Technical Specifications

1. It is a nutrient (liquid) to provide nitrogen to plants as an alternative to the conventional urea.
2. It is developed to replace conventional urea and it can curtail the requirement of the same by at least 50%.
3. It contains 40,000 mg/L of nitrogen in a 500 ml bottle which is equivalent to the impact of nitrogen nutrient provided by one bag of conventional urea.
4. Conventional urea is effective 30-40% in delivering nitrogen to plants, while the effectiveness of the Nano Urea Liquid is over 80%.

Trails Across the Nation

All India efficacy trials have been conducted on 20 ICAR research institutes and State Agricultural Universities on 43 crops. At all India level 11,000 farmer field trials on 90 crops have been undertaken in supervision of Krishi Vigyan Kendras. It has been recorded in the trials that Nano Urea (liquid) increases crop productivity and can reduce the requirement of conventional Urea by 50%. Further, application of nano urea (liquid) improves yield, biomass, soil health and nutritional quality of the produce.

Requirement of this Step

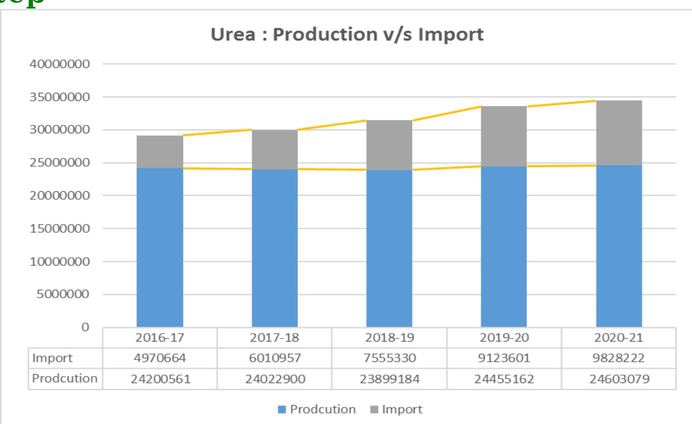


FIG 1 :- Urea: Production v/s Import in India from 2016-17 to 2020-21 | Sources: mFMS

India is very much dependent on imported urea as we can see in last 5 years with the help of the graph. In last year 2020-21, India imported around 28% of the total urea consumed in our country. From 2016-17 to 2020-21 import has been increasing gradually as we can see below:

Benefits for Everyone

According to the reports from the trails by KVKs it has been found effective and efficient for plant nutrition which increases the production with improved nutritional quality. It will boost a balanced nutrition program by reducing the excess use of Urea application in the soil and will make the crops stronger, healthier and protect them from lodging effect. Lodging is the bending over of the stems near ground level of grain crops, which makes them very difficult to harvest, and can dramatically reduce yield. It will also have a huge positive impact on the quality of underground water, a very significant reduction in global warming with an impact on climate change and sustainable development. Also, from the farmers point of view the prices is less as compared to 45kg Urea bag and also it is easy to carry and use in field. Because it's required in less quantity and the size of the bottle is small so it will reduce the cost of logistics and warehousing. Conventional 45kg Urea bags are transported through Railway wagon and trucks but this revolutionary product will make handling and transportation easy for all the stakeholders.

Production Planning & Future Prospectus

In the Phase-I, the annual production capacity of 14 crore bottles is being installed which would be ramped to additional 18 crore bottles in the Phase–II by the year 2023. These 32 crore bottles are expected to potentially replace 1.37 crore tonnes of urea by the year 2023.

Conclusion

IFFCO's nano urea is a giant step towards sustainable agriculture and food systems with a step towards precision and smart farming. This has the potential to revolutionise the entire agriculture sector across the world. Nano Urea (Liquid) does not involve any government subsidy and will be made available to farmers at a 10% lower price than a bag of subsidised Urea. As it will significantly bring down the cost of logistics and warehousing, it will be effective in increasing farmers' income.

References

1. https://www.iffco.in/index.php/ourproducts/index/nano-urea.
2. https://www.drishtiias.com/daily-updates/daily-news-analysis/nano-urea-liquid-iffco.
3. https://reports.dbtfert.nic.in/mfmsReports/getCompanyWiseProductionAndImportDetails.action.
4. https://www.livemint.com/companies/news/iffco-begins-commercial-production-of-nano-urea-liquid-11622987605932.html.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Citrus Decline & its Rejuvenation Strategies in Northeastern India

Article ID: 11629

Dipanjali Baruati[1], Sukanya Gogoi[2]
[1]M. Sc., Department of Horticulture, Assam Agricultural University, Jorhat, Assam.
[2]Ph.D. Scholar, Department of Plant Pathology, Assam Agricultural University, Jorhat, Assam.

Summary
Citrus is considered to be native of Himalayan foot hills of North-Eastern India, North Central China and its adjoining areas from where a number of Citrus species or varieties have their origin and later has dispersed to leading citrus growing countries of the world. However, the crop is infected with large number of diseases, insect-pests and nutritional deficiencies or disorders. As a result, yield of citrus have been rigorously abridged due to these factors, leading to citrus decline, which is a complex problem, gradually declining production and productivity of orchards, finally making them unproductive. Hence, it is necessary to formulate definite planning and strategies for its management.

Introduction
Citrus decline, commonly known as 'dieback', is not a specific disease but an integrated expression of many abiotic and biotic factors like insect-pests, some viral, fungal and bacterial diseases and nutritional deficiencies or disorders, leading the plant to decline in productivity, reduced productive life and poor fruit quality. It involves the defoliation of young shoots and dying back of twigs from the tip downwards, resulting in loss of vigor, general health, decreased fruit production, depending upon the specific geographical locations, age of the plants, orchard maintenance, in severe cases plants may die. The extent of decline increases with the age of plant and after 20-25 days affected plants become uneconomical.

First observance of Citrus decline was recorded to have been present as early as the eighteenth century by Roghoji Bhonsale in the Central province but it has assumed alarming proportions during the last few decades. In Assam, it was first observed in the year 1888. The decline of sweet orange, mandarin and grapefruit varieties grafted on sour orange led to the loss of about 100 million.

Major Causes of Citrus Decline in North-Eastern India
1. Citrus trunk borer.
2. Occurrence of greening disease exists in north eastern citrus growing region. Greening and tristeza are present in Khasi mandarin, tristeza is also present in Kagzi lime and Assam lemon in the NE of India by Bhagabati et al., (1989).
3. High Incidence of CTV (Singh et al., 2017) in NE states of India.
4. Phytophthora rot.
5. Overall neglect of grove.

Factors Responsible for Citrus Decline
The factors responsible for decline can be grouped as abiotic and biotic factors as following:
1. Abiotic factors consists of soil and nutrient related problems, moisture content, physiological disorders.
2. Biotic factors consists of rootstock, phanerogamic parasites, intercrops, insects-pest, nematodes and diseases (fungal, bacterial and viral).

Abiotic Factors
1. Nutrient imbalance: Balance of the nutrients both in the soil and plants is essential for proper growth and development, malnutrition also responsible for citrus decline.
2. Soil related constraints: Unsuitable soil is another major factor for declining of an orchard, excessive free lime, excessive salts, defective drainage, presence of hard pan and low soil fertility are some of the soil properties found responsible for decline of citrus plantations.

3. Physiological disorders: It also contributes to citrus decline such as fruit drop, splitting, granulation etc.
4. Biotic factors.
5. Rootstock: The use of improper rootstocks causes incompatibility which is genetic or physiological in congeniality between stock and scion leads to decline of citrus orchards.
6. Intercrops: Exhaustive crops like wheat, maize, sugarcane is unfavourable for citrus, causing severe infestation of root knot nematodes.
7. Phanerogamic parasites: Loranthus feeds on the host leading dieback, death of infested twigs and dodder carry viruses, feed on hosts.
8. Diseases: Numerous pathogens infecting citrus plants belongs to genus Phytophthora *(P. palmivora, P. citropthora, P. parasitica)*, powdery mildew *(Oidium tingitaninum)*, scab *(Elsinoe fawcetti)*, algal spot *(Cephaleuros mycoidea)*, bacterial canker (*Xanthomonas compestris* pv. *citri*) and several viral diseases such as Tristeza, Psorosis, Greening etc.
9. Pests: Citrus trunk borer is the most serious pest in Northeastern India; citrus psylla *(Diaphorina citri)*, which feeds all kinds of citrus by sucking the sap from young leaves and tender shoots, is also a vector of citrus greening disease; leaf miner *(Phyllocnistis citrella)* damages both young and old plants; lemon butterfly *(Papilo demolens)* lay eggs on younger leaves; mealy bug (*Psuedococcus* sp) suck the plant sap, severe infestation leads to partial or complete defoliation.
10. Nematode: These are responsible for slow or spreading decline of citrus plantations.

Types of Citrus Decline According to Visual Appearances or Symptoms

1. Quick Decline: It occurs due to Tristeza virus, where plant may die within 1-3 weeks following symptoms.
2. Slow Decline: It is a gradual deteriorating process exhibiting loss of vigor, death of twigs and branches, reduction in yield and ultimate death in severe cases due to poor nutrient, soil status and nematodes *(Tylenchulus semipenitrans)* infection.

Management Practices for Citrus Decline

Rejuvenation of major citrus species are possible through various aspects like production of quality planting materials, proper site selection, systematic planting, proper manuring schedule, improved orchard management practices, adoption of suitable soil and water conservation measures, plant protection measures etc.
1. Scientific cultivation: Adopting package of practices like maintaining proper spacing, regularly doing intercultural operations, spray of insecticides when needed, maintain balance of essential nutrients in soil and plants. Maintaining soil fertility, using of disease-free bud wood, clean equipment like knives, scissor etc.
2. Grow resistant species/ varieties: Troyer citrange, *Poncirus trifoliate* etc selection of rootstock according to desirable characteristics.
3. Use indexed planting material: For early detection of viruses like using of sweet orange for detection of greening disease, it shows symptoms within 4-12 weeks after infection. Use of appropriate rootstock. If compatible rootstock is used, then citrus plantations will be long lasting, healthy with better yield.
4. Nutrient management: Maintains a balance amount of nutrients in the soil and plants, neither excess nor deficient.
5. Water management: Requires frequent irrigation in summer. In winter, the crop should be irrigated at 15-20 days interval. Grow only selected intercrops and management of weeds. Select right soil type and/ or manage it properly.
6. Diseases, insect pests and nematode management.

Calendar of Operation for the Rejuvenation of a Declining Citrus Orchard

Months	Operations
Dec-Jan	Make tree basin for placement of FYM or compost as well as to reduce the nutrient loss. Water sprouts, diseases and dried/dead twigs is removed and cut end is pasted with Bordeaux paste. Scarification of gum oozing wounds and dressing with Bordeaux paint
Feb	Apply dolomite lime powder @ 3kg/tree in alternate year.

March	Apply 30 kg FYM/tree/year.
April	Application of Bordeaux paste on the tree (upto 60 cm height from ground level). Spray neem oil @ 5 ml/litre or other organic pesticides for insect pest and diseases. Spray micro nutrients such as Zinc sulphate (0.5%)+ Magnesium sulphate (0.2%)+ Copper sulphate (0.4%) + Manganese sulphate (0.4%) on new flushes
May	Collection and destruction of trunk borer adults by shaking the branches 2-3 times at 10 days interval.
June-July	Spray neem oil @ 5 ml/litre or other organic pesticides for insect pest and diseases. After 15 days spray with Bordeaux Mixture (1%) Spray micro nutrients such as Zinc sulphate (0.5%)+ Magnesium sulphate (0.2%)+ Copper sulphate (0.4%) + Manganese sulphate (0.4%) on new flushes.
Aug-Sept	Application of Bordeaux paste on the tree (upto 60 cm height from ground level) and repeat the same schedule of June- July month. To kill the trunk borer grubs, clean the bored holes of the infested trunk with iron wire and insert a cotton swab soaked in petrol and plug with mud.
Oct-Nov	Spray neem-based insecticide to prevent from fruit fly infestation.

Conclusion

It is very dangerous complex problem we shouldn't neglect as it affects all the citrus growing belts in the world. We should focus on scientific cultivation, aware farmers about citrus decline, its prevention and control. Through CRISPR technology, RNA interference, RdRp etc., alteration genes can be developed against CTV that binds to vector's forgut so that vectors will not be able to carry the viruses. The introduction of site-specific practices in citrus orchards, Precision citriculture requires to be popularized to identify sectorial occurrence of citrus decline, and accordingly develop the averting mechanism. Exploiting the utility of mycorrhiza and rootstock breeding for resistance, cost effective technology for production of quality planting materials, use of genetic engineering technology should be encouraged.

References

1. Bhagabati, K. N., Ahlawat, Y. S., Chakraborty, N. K., Borthakur, B. C. (1989). Distribution of greening, tristeza and mosaic diseases of citrus in north-eastern states of India, Indian Phytopathology. 42 (4): 552-555.
2. Meena,A.K., Dutta, F.,Marak, M.C., and Meena, R.K. (2018). Citrus Decline. Int.J.Curr.Microbiol.App.Sci. 7(04): 2807-2815.
3. Singh, A.K., Meetei, N.T., Singh, B.K. et al., (2017). High incidence of citrus tristeza virus in mandarin (Citrus reticulata) in north-east states of India, Virus Dis. 28 (4): 401–407.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Major Diseases of Tomato and their Management: A Brief Review

Article ID: 11630

Rallabandi Divya Latha[1], D. R. M. S. Vidya Sagar[2]
[1]M.Sc (Ag) Plant Pathology, Department of Plant Pathology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211007, Uttar Pradesh.
[2]M.Sc (Ag) Agronomy, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211007, Uttar Pradesh.

Tomato Diseases Damping Off *(Pythium aphanidermatum)*

This is one of the worst diseases of tomato occurs as pre-emergence and post emergence damping off. In the pre-emergence the phase the seedlings are killed before emergence where young radical and plumule are killed leads to rotting in seedlings. The post emergence phase is characterized by the infection of young seedlings which become soft and water soaked at the collar region at ground level and leads to toppling or collapse of the seedlings.

Control: Seed treatment with fungal culture *Trichoderma viride* (4 g/kg of seed) or Thiram (3 g/kg of seed) is the only preventive measure to control the pre-emergence damping off. Soil drenching of the affected seedlings with Dithane M45 (3 g/litre of water) helps to reduce the disease incidence.

Early Blight *(Alternaria solani)*

Symptoms on leaves are like spots which are brown and circular with small dark irregular spots with concentric lesions (characteristic symptom of early blight) which coalesce and cause drying and defoliation. Lesions occurring on stems are often sunken and lens shape with light center had have typical concentric rings on young tomato seedlings lesions may completely griddle the stem this phase of disease is known collar rot which leads to death of plant.

Control: Removal and destruction of the affected plant parts. Practicing crop rotation helps to minimize the disease incidence. Spraying the crop with Difolatan (0.2%), Dithane M-45 (0.2%) or Bavistin (0.1%) is recommended for effective disease control.

Late Blight *(Phytophthora infestans)*

The pathogen is best known for causing the devasting Irish potato famine in 1845 which killed billion people. Symptoms are Dark brown, firm lesions occur enlarges and destroys the entire fruit and on leaves first appears on leaves on lower side of leaves as water soaked, grey-green spots. As the disease matures, these spots darken and white fungal growth forms under side. Eventually the entire plant will become infected.

Control: Control practices include rotating fields so as not to follow potato or tomato; avoiding planting tomatoes near potatoes; using disease-free seeds and transplants. Adopting certain prophylactic measures can also control the disease. Firstly, the seed material should be obtained from a disease-free area. Before planting the seeds should be treated with Thiram (2-3 g/kg of seed). The plants must be sprayed with Captafol (2 g/litre of water) or Dithane M 45 (2 g/kg of seed) at 15 days interval, starting from 30 days after transplanting.

Fusarium Wilt (*Fusarium oxysporum* f.sp. *lycopersici*)

This is one of the worst diseases of tomato occurring mostly in the nurseries. The first symptoms of the disease are clearing of the veinlets and chlorosis of the leaves. The younger leaves may die in succession and the entire may wilt and die in a course of few days. Soon the petiole and the leaves droop and wilt. In young plants, symptom consists of clearing of veinlet and dropping of petioles. In field, yellowing of the lower leaves first and affected leaflets wilt and die. The symptoms continue in subsequent leaves. At later stage, browning of vascular system occurs. Plants become stunted and die.

Control: The nursery should be regularly inspected for wilt infected plants. The affected plants should be removed and destroyed. Prior to planting the beds should be drenched with Carbendazim (0.1%) and the seeds should be treated with the Thiram (2.5 kg/ha). Crop rotation with a non-host crop such as cereals helps to reduce the disease inoculum.

Septoria Leaf Spot *(Septoria lycopersici)*

The plant may be attacked at any stage of its growth. The disease is characterized by numerous, small, grey, circular leaf spots having dark border.

Control: Removal and destruction of the affected plant parts. Seed treatment with Thiram or Dithane M-45 (2 g/kg seed) is useful in checking seed borne infection. In the field spraying with Dithane Z-78 (0.2%) effectively controls the disease.

Powdery Mildew *(Leveillula taurica)*

The disease occurs severely during dry seasons. A white powdery coating of the fungal growth appears on the leaf surface. Infected leaves may be dwarfed, stiff, and narrow. The fungus progressively attacks new leaves, spreading over leaf stems, twigs, and even the fruit. Terminal growth of the affected shoot is stunted or killed. The fruit yield is reduced and the affected fruit are smaller in size.

Control: Spraying with Karathane (0.1%) or Wettable Sulphur (3 g/ litre of water) twice at an interval of 10 days helps to control the disease.

Bacterial Wilt *(Pseudomonas solanacearum)*

This is one of the most serious diseases of tomato crop. Relatively high soil moisture and soil temperature favour disease development. Characteristic symptoms of bacterial wilt are the rapid and complete wilting of normal grown-up plants. Lower leaves may drop before wilting. Pathogen is mostly confined to vascular region; in advantage cases, it may invade the cortex and pith and cause yellow brown discolouration of tissues. Infected plant parts when cut and immersed in clear water, a white streak of bacterial ooze is seen coming out from cut ends.

Control: Crop rotations viz., cowpea-maize-cabbage, okra-cowpea-maize, maize- cowpea-maize and finger millet-eggplant are reported effective in reducing bacterial wilt of tomato. Seedling treatment with Streptocycline (1 g/40 litres of water) for 30 min protects the seedlings in the initial stages of growth.

Bacterial Leaf Spot (*Xanthomonas campestris* pv. *vesicatoria*)

Moist weather and splattering rains are conducive to disease development. Most outbreaks of the disease can be traced back to heavy rainstorms that occur in the area. Infected leaves show small, brown, water soaked, circular spots surrounded with yellowish halo. On older plants the leaflet infection is mostly on older leaves and may cause serious defoliation. The most striking symptoms are on the green fruit. Small, water-soaked spots first appear which later become raised and enlarge until they are one-eighth to one-fourth inch in diameter. Centres of these lesions become irregular, light brown and slightly sunken with a rough, scabby surface. Ripe fruits are not susceptible to the disease. Surface of the seed becomes contaminated with the bacteria, remaining on the seed surface for some time. The organism survives in alternate hosts, on volunteer tomato plants and on infected plant debris.

Control: Bacterial spot is difficult to control once it appears in the field. Disease-free seed and seedlings should always be used and the crop should be rotated with non-host crops so as to avoid last year’s crop residue. Seed treatment with mercuric chloride (1:1000) is also recommended for control of disease. Spraying with a combination of copper and organic fungicides in a regular preventative spray program at 5-to-10-day intervals or spraying with Agrimycin-100 (100 ppm) thrice at 10 days intervals effectively controls the disease.

Bacterial Canker (*Clavibacter michiganensis* pv. *michiganensis*)

Temporary and later on permanent wilting of leaflets of affected plants is observed the disease in the field. Light streaks appear at the juncture of petiole and stem extending down the internode and up the petiole. At a later stage canker like opening may appear in stem, petiole and midrib. When the stem of diseased plants is cut longitudinally, a creamy white, yellow or brown line follows the phloem. The disease appears on the green fruit as water-soaked spots with a white halo. Halo is the distinguishing character of bacterial leaf spot of tomato.

Control: Hot water treatment of seeds at 50°C for 25 minutes is effective. Seed treatment with mercuric chloride (1:1000) is also recommended for control of disease. Crop rotation with non-host crop helps in reducing the disease incidence. Soaking of seed in solution of Streptocycline (1g/40 litres of water) for 30 min protects the seedlings in the initial stages of growth.

Tomato Mosaic Virus (TMV)

The disease is characterized by light and day green mottling on the leaves often accompanied by wilting of young leaves in sunny days when plants first become infected. The leaflets of affected leaves are usually distorted, puckered and smaller than normal. Sometimes the leaflets become indented resulting in "fern leaf" symptoms. The affected plant appears stunted, pale green and spindly. The virus is spread by contact with clothes, hand of working labour, touching of infected plants with healthy ones, plant debris and implements.

Control: Seeds from disease free healthy plants should be selected for sowing. Soaking of the seeds in a solution of Trisodium Phosphate (90 g/litre of water) a day before sowing helps to reduce the disease incidence. The seeds should be thoroughly rinsed and dried in shade. In the nursery all the infected plants should be removed carefully and destroyed. Seedlings with infected with the viral disease should not be used for transplanting. Crop rotation with crops other than tobacco, potato, chilli, capsicum, brinjal, etc. should be undertaken.

Tomato Leaf Curl Virus (TLCV)

This disease is transmitted by whitefly *(Bemisia tabaci)*. It is one of the most devastating diseases of tomato. Leaf curl disease is characterized by severe stunting of the plants with downward rolling and crinkling of the leaves. The newly emerging leaves exhibit slight yellow colouration and later they also show curling symptoms. Older leaves become leathery and brittle. The nodes and internodes are significantly reduced in size. The infected plants look pale and produce more lateral branches giving a bushy appearance. The infected plants remain stunted.

Control: Keep yellow sticky traps @12/ha to monitor white fly. Raise barrier crops-cereals around the field. Removal of weed host. Protected nursery in net house or green house. Spray Imidochloprid or Dimethote @ 0.05% for 15 days interval after transplanting to control vector.

Tomato Bunch Top Virus (TBTV)

The infected plants show extensive abnormal growth with apical proliferation. The new leaves arising from the axillary buds give closely crowded bunchy appearance. The leaflet margins curl towards the tips and the surface show puckered conditions. Necrosis of leaves and stems are also characteristic symptoms. The diseased plants bear very few flowers and 1-2 very small fruit.

Control: The affected plants should be removed and destroyed. Alternate or collateral hosts harbouring the virus causing this disease is removed at the time of weeding or earthing up operations to minimize the spread of the disease.

Anthracnose *(Colletotrichum phomoides)*

At first, infected fruit show small, slightly sunken, water-soaked spots. These spots enlarge, become darker in colour, depressed and have concentric rings. Masses of the pink fruiting fungus can be seen on the surface of the lesions in moist weather. Under warm and humid conditions, the fungus penetrates the fruit, completely destroying it. The fungus persists on infected plant refuse in the soil. Fruit may be infected when green and small, but do not show any marked lesions until they begin to ripen. Fruit becomes more susceptible as they approach maturity.

Control: Control of this disease involves the use of well-drained soil; crop rotation and a preventative fungicide program is recommended.

E-ISSN: 2581 - 8317

A Case Study – "Artificial Recharge to Groundwater through Dug-wells"

Article ID: 11631

Dr. Upesh Kumar[1], Dr. S C Kantwa[2]
[1]Senior Scientist and Head, Krishi Vigyan Kendra, Patan (Gujarat).
[2]Subject Matter Specialist (LPM), Krishi Vigyan Kendra, Jaipur-II, SKNAU-Jobner, Jaipur (Raj).

Water is most crucial resource of sustainable agricultural production specially in the rain fed / dry land areas. However, the major part of the rain water coming over the farmer's field in these areas goes away unused as runoff. The runoff does not only cause loss of water but it also removes fertile top soil. Ground water play a vital role in food production, drinking water, drought mitigation etc. in the country. As per the latest ground water resource assessment many areas of the country underlain by hard rock aquifers having limited storage potentials are facing acute problems of over exploitation and depletion of ground water.

Artificial recharge structure is one of the most efficient ground water management tools for ensuring sustainability of ground water resources. CRDE- Krishi Vigyan Kendra has standardized location specific water harvesting technology in the form of dug well recharge structure at its instructional farm in the year 2008 to address the problem to farming community. The centre is actively up-scaling this dug well recharge structure technology district wide.

Technical drawing of recharge structure

Filling of soak pit with stones, gravels & sand

Main Features of the Technology

Artificial recharge to groundwater through dug-well recharge structure created at instructional farm of Krishi Vigyan Kendras having following features:

1. A pit excavated 6 feet away from dug well with the diameter- 2.5-meter length, 1.2-meter width, and 1.5-meter depth.
2. Pit has two compartment- one for silt collection and another for filtration of water.
3. Silt collection tank (1.2 meter) constructed with the modular bricks with providing and laying in position cement, concrete of the specified grade.
4. Water filter tank (1.3 meter) with RCC bottom filled with bolder (100 mm) gravels (75 mm and 40 mm) and sand from bottom to top.
5. A 6-inch PVC pipe (6 kg/cm2) installed at bottom of water filtration tank and connected in dug well. One end of the PVC pipe kept in filtration tank covered with 2 mm mess. Another end provided PVC bend to flow water horizontally in the dug well.

6. Provide a gentle slope in catchments area towards recharge structure for collecting runoff water.
7. Regular distillation of silt tank.
8. With the increase of volume of water in the dug well, the pressure of water also increased consequently recharging of underground water increased through aquifers.

Strategy

Artificial recharge of groundwater through dug-well recharge structure was taken at KVK instructional farm village – Sewania, Teh-Ichhawar, Distt- Sehore in the year 2008. This area receives on an average of 1000 mm rainfall annually and has good potential for runoff harvesting. Initially at KVK farm there was very limited water to produce second crop of the year. By creating the structure, the benefits reflected in the terms of more quantity of water availability in the peak period. It was observed in the same year the quantity of water increased almost four times over the past. With the availability of irrigational water Krishi Vigyan Kendra extended fruits crop plantation in 2 ha. land with 100% survivability and satisfactory growth. In the next year (2009) KVK ensure crop sowing in 100% areas and got satisfactory crop yield with the providing two irrigations in 15 ha. of land. However, in the earlier years it was not possible to grow the crops in entire instructional farm.

Enhanced cropping intensity and area covered under orchard with the help of Artificial recharge to groundwater through dug-well considered as successful technology in the area and no. of farmers from the neighboring villages are coming to see this module. This has raised enthusiasm among the farmers of the district to come forward to know the details of technology. Consequently, the district authorities of Distt-Sehore visited this successful structure and decided to construct the structure in all the existing dug wells in the district in the manner of convergence with the going MNREGA for up-scaling this intervention. This case has demonstrated the volume and usefulness of dug well recharge structure technology for sustainability of farming system and importance of convergence of R&D institution. The technological intervention being replicated by Zila Panchyat in the entire district with the technical support of Krishi Vigyan Kendra.

Training and exposure visit of district authorities for replicating the technology

Costing & Economic Viability

The capital cost of per artificial recharge structure involves Rs. 10,000/- per dug well. The material required for construction of structure are easily available in the local market. The main benefit of the technology is to increase the availability of ground water in peak period. Farmer are not only able to intensify their agriculture but also get safe drinking water.

Advantages

1. The technology easy to adopt at farmer's part and able to recharge underground water in larger volume than other methods.
2. Low capital investment and low maintenance cost.
3. Durable, safe and easy to repair technology.
4. Prevent chocking of soak pit through creating siltation tank.
5. Suitable and adaptable technology in rain fed areas of the country.

6. The technology in ensures the availability of irrigational as well as safe drinking water in the rural areas in off season.
7. With the availability of water farmers can increase crop productivity.

Limitations

Selection of site for construction of recharge pit should be at lower portion of the catchments area and where maximum runoff water moves.

Exposure Visit of SMSs of Zone VII

Growth of Lambda Phage and Isolation of Phage DNA a Key Techniques in Molecular Biology

Article ID: 11632

Soumya Swarup Panda[1]
[1]Department of Molecular Biology & Biotechnology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, India.

Abstract

It is a bacterial virus also known as lambda phage, coliphage λ or bacteriophage, that infects the bacterial species mainly Escherichia coli. This virus is temperate and might be living in the genome of its host via lysogeny. Lamda phage enter into a bacterium or inject the DNA with tip of tail adherence with host. Then usually lytic cycle or lysogenic cycle done. Then DNA extraction done with kits or procedures discussed in this article. Then purification has done with zinc chloride method because yield of DNA is the pretty good due to effective sedimentation. A simple and rapid procedure for purifying large quantities of bacteriophage lambda particles can be done by this method. For more purity phenol extraction and ethanol precipitation also performed.

Keywords: Bacteriophage; Lambda phage; Vector: DNA extraction; DNA purification.

Introduction

Lambda phage includes some virulent particle such as a head (additionally referred to as a capsid), tail and tail fibers. The head carries the double-stranded round DNA of phage. The phage particle acknowledges and binds to its host like E. coli, inflicting DNA within side the head of the phage to be ejected via the tail into the bacterial cytoplasm. Usually, a lytic cycle ensues, in which the lambda DNA is replicated frequently and the genes for head, tail and lysis proteins are expressed. This results in assembly of a couple of new phage particles in the cell and next cell lysis (Weigle, 1953; Kaiser, 1957). However, below certain conditions, the phage DNA might also additionally combine itself into the host chromosome in the lysogenic pathway. In this state, the λ DNA is referred to as a prophage and remains resident in the host's genome without obvious damage to the host. The host may be termed lysogen while a prophage is persisting.

Alternative Growth Modes of Phage Lambda

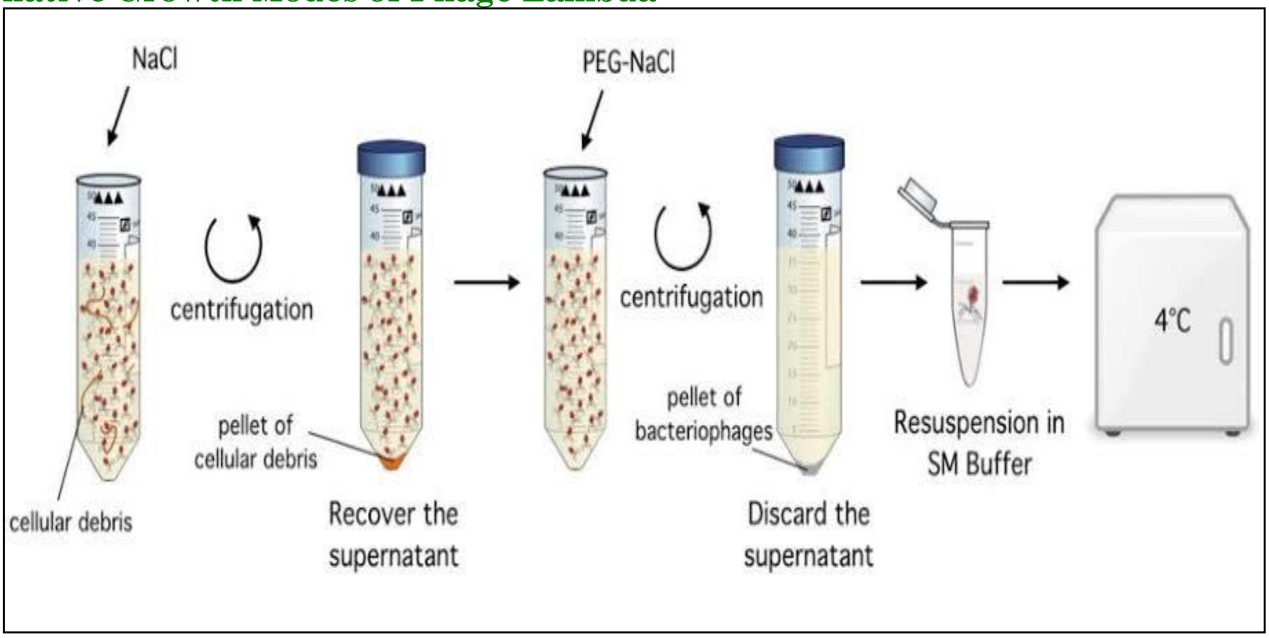


Fig 1- The established methods for lambda DNA isolation generally involve the following steps
Source- www.plantmethods.biomedcentral.com

Growth starts, while a phage particle adhere to the host via way of means of the tip of its tail (Hendrix, 1974) and deliver its DNA molecule.

Thus, can grow or multiply inside the bacteria by certainly considered one among three methods like:
1. In productive growth, the injected DNA molecule directs the synthesis of numerous gene, head, tail and promote replication of the phage DNA, and become a mature phage particle.
2. Lambda DNA can also persist in the host cell as a prophage and replicate passively as an integral part of the bacterial genome.
3. Under special conditions, the lambda genome persists in the carrier host as a one-integrated plasmid.

By two alternative modes of growth the bacteriophage lambda can reproduce. The phage infects a bacterial cell, in case of lytic mode, reproduces many copies of itself, lyses the host cell, and circulates through the environment to infect another host cell.

Another is in the lysogenic mode, the phage infects a bacterial cell, incorporates its DNA into the chromosome of the host cell, and remains quiescent, with its DNA being replicated along with that of the host. (Georgopoulos, 1973) Lysogeny is typically a stable state unless the host cell is compromised in some fashion (DNA damaged by UV radiation), and then the phage undergoes an induction process by which it excises its DNA from the host chromosome and initiates lytic growth.

Extraction of Genomic DNA from Lamda Bacteriophage

High tittered vibrio phage containing SM buffer suspension treated with RNAse A and Protease were incubated overnight. After those precipitant solutions like PEG and NaCl (Fig. 1) was added and gently mix.

After storing at extreme low temp for an hour centrifugation done. supernatant discarded and precipitate pellet resuspended in SM buffer and gently mixed by pipeting. Then again centrifuged and pellet collected again resuspended SM buffer. Twice phenol: chloroform: isoamyl alcohol (25:24:1) was added and thoroughly mix and centrifuged.

After adding same volume of chloroform then centrifuged collect the upper aqueous layer where sodium acetate added. Then equal volume of isopropyl alcohol was adding and followed by vortexing and incubated then centrifuged.

Discarding supernatant ethanol mixed and then centrifuged. Then dried pellet was dissolved in TE buffer of HCl and EDTA. Likewise, extraction of genomic DNA done but Some companies like Norgen etc. has also a bacteriophage DNA isolation kit which especially for a wide range of bacteriophage DNA.

DNA Purification

A stepped forward phage DNA isolation approach has been mentioned through the usage of zinc chloride as a phage precipitation agent, its cause efficient sedimentation.

DNA undergoes DEAE-cellulose column chromatography of the phage molecule and with a low ionic power buffer elution of the phage particles from the column done (Parent, 2014), The lambda DNA is prepared from the purified phage particles by the conventional method of phenol extraction and ethanol precipitation to attend more purity.

Future Perspectives and Conclusion

Bacteriophage lambda, a bacterial virus that infects E. coli, has been extensively used as a cloning vector. The virus is simple to propagate. So, it has been using as a model organism.

Uses consist of its utility as a vector for the cloning of recombinant DNA, the usage of its site-precise recombinase for the shuffling of cloned DNAs by the gateway approach and the utility of its red operon, together with the proteins red alpha (additionally called 'exo'), beta and gamma during the DNA engineering. (Thomason, 2014).

Using lambda, scientists evolved key strategies together with the way to collection of DNA and determined the enzymes vital for making RNA in vitro conditions. In addition, research on lambda virus caused the invention of simple molecular biology principles.

References

1. Georgopoulos C.P., Hendrix R.W., Casjens S.R. and Kaiser A.D. (1973). Host participation in bacteriophage lambda head assembly. Journal Mololecular Biology. 76:45–60.
2. Hendrix R.W. and Casjens S.R., (1974). Protein cleavage in bacteriophage lambda tail assembly. Virology. 61:156–159.
3. Kaiser A.D., (1957). Mutations in a temperate bacteriophage affecting its ability to lysogenize Escherichia coli. Virology. 3:42–49.
4. Parent K.N., Tang J., Cardone G., Gilcrease E.B., Janssen M.E., Olson N.H., Casjens S.R. and Baker T.S., (2014) Three-dimensional reconstructions of the bacteriophage CUS-3 virion reveal a conserved co. Virology. 464–465. 55–66.
5. Thomason L.C., Sawitzke J.A., Li X., Costantino N. and Court D.L., (2014). Recombineering: genetic engineering in bacteria using homologous recombination. Current Protocol Mololecular Biology. 106:1 161–1 16 39.
6. Weigle J., (1953). Induction of Mutations in a Bacterial Virus. Acad. Sci. U. S. A. 39:628–636.

Nano Fertilizer: A Step Towards Precision Agriculture

Article ID: 11633

Kannoj[1], Manish Tomar[1], Ruchika Chaudhary[1]
[1]Department of Agronomy, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur -313 001 (Rajasthan).

Nanotechnology offers great hope for sustainable agriculture practice and is expected that it will convert conventional agriculture practice to precision farming. The use of nanoformulation, nanoencapsulation, and functionalized nanomaterial of next-generation fertilizers and pesticides provide site-specific and controlled delivery of active ingredients (fertilizers and protectants) to plants and reduces excess run-off (Nair et.al. 2010; Ghormade et.al. 2011; Khot et.al. 2012).

Nano fertilizers have a wide surface area compared to their size and have the ability to penetrate the pant tissue easier than other conventional types of fertilizer. A new generation of fertilizers (Nano fertilizers) will increase this efficiency from 30 percent to upwards of 80percent. Nutrients Use efficiency (NUE) represents a key indicator to evaluate the progress towards better nutrient management. Agriculture is usually the backbone of many developing countries.

In agriculture, the most reason to use fertilizer is to administer full-fledged macro and small nutrients that typically soil lacks. Approximately, 35-40% of the crop productivity depends upon fertilizer. Regular use of standard bulk fertilizers or ancient fertilizers don't seem to be solely big-ticket for the producer, however is also harmful to humans and also the atmosphere because they posed various environmental threats to us.

So, there is a need to improve conventional farming practices into smart practices by the involvement of advanced technologies like nanotechnology for sustainable agriculture. This has led to the look for environmentally friendly fertilizers or sensible fertilizers, chiefly those with high nutrient-use potency, and applied science is rising as a promising alternate i.e., Nano fertilizers.

Nano Fertilizer

Nano fertilizers are nanomaterial or nanoscale formulations of standard fertilizer, responsible for providing one or more types of nutrients to the growing plants, and support their growth, and improve production (Liu and Lal 2015). The small size and high-surface-to-volume ratio character of nanoparticles make them more efficient in comparison with their bulk components.

Nanoparticles enter into the intercellular spaces of the cell through an apoplastic pathway. Rico et.al. (2011) hypothesized that the symplastic (through cytoplasm) route is a more organized and regulated pathway for the movement of engineered nanoparticles into plants. Nano form of conventional agri-inputs provides the site-specific and controlled release of active ingredients that can reduce the excess run-off and prevent eutrophication and residual contamination.

Nano Fertilizer Versus Conventional Fertilizers

Presently, Nanotechnology in agriculture is focusing on target farming that applies nanosized particles with unique properties to boost crop production (Batsmanova et.al. 2013; Scott and Chen 2013). Nano fertilizers are more beneficial than conventional fertilizers as they increase soil fertility, yield, and quality parameters of the crop, they are nontoxic and also less harmful to the environment and humans, they minimize cost and maximize profit.

Nanoparticles increase nutrients use efficiency and minimizing the costs of environmental protection. The over-accumulation of salt in soil will be decreased because it is needed in a bit. Nano fertilizers are synthesized as per the nutrient necessities of planned crops. This will lead to improvement in the nutritional content of crops and the quality of the taste.

Enhance plants growth by resisting diseases and improving the stability of the plants by anti-bending and deeper rooting of crops. Balanced fertilization to the crop plant may be achieved through nanotechnology.

However, the in-depth use of nano fertilizers in agriculture may have some important limitations, which must also be taken into consideration and it is crucial to determine the toxicity/biocompatibility of nano fertilizers.

Three Categories of Nano Fertilizers are Proposed

1. Nanoscale fertilizer (nanoparticles that contain nutrients).
2. Nanoscale additives (traditional fertilizers with nanoscale additives).
3. Nanoscale coating (traditional fertilizers coated or loaded with nanoparticles).

Nanomaterial coatings (such as a nanomembrane) could slow the discharge of nutrients or a porous nano fertilizer could embody a network of channels that retard nutrient solubility.

Another promising application of applied science is that the encapsulation of useful microorganisms will improve plant root health. These might embody varied microorganisms or fungi that enhance the supply of chemical elements, phosphorus, and potassium in the root zone.

Limitation of Nanofertilizer

1. Nanomaterial phytotoxicity is an issue since different plants respond differently to various nanomaterials in a dose-dependent manner.
2. Nanomaterials are very reactive because of their minute size with the enhanced surface area so this raises safety concerns for farmworkers because they may be xenobiotic to the body.
3. Some studies have reported the phytotoxic effect of nanoparticles in plants, depending on species, dose, and application method as well as their type.

Nano Urea

Urea that's made from nanotechnology to enhance the potency of the nutrients for the crops is termed as nano organic compound. The nano organic compound liquid can replace standard organic compound and it will curtail its demand by a minimum of 50%. The Nano organic compound Liquid is effective and economical for plant nutrition, which will increase production with improved organic process quality.

According to IFFCO, the nano organic compound liquid also will have a positive impact on the standard of underground water, terribly vital in reduction of warming with an impression on temperature change and property development.

The introduction of nano organic compound liquid is important as its use by farmers can boost balanced nutrition programs by reducing the surplus use of organic compound application within the soil. It'll facilitate & create the crops stronger, healthier and defend them from the lodging impact.

Excess organic compound not solely causes environmental pollution however additionally harms soil health and makes plants a lot of at risk of illness and bug infestation, delaying the maturity of the crop and leading to production loss.

Advantages of Nano Fertilizers

1. Nanocoating and technology will facilitate in varied ways that it cut back prices and increase productivity round the farm.
2. Improvement in soil aggregation, wet retention, and carbon build-up.
3. The yield per square measure is additionally abundant beyond standard fertilizers, therefore giving higher returns to the farmers.

Conclusion

Science and technology have taken many leaps forward with the introduction of nanotechnology. Applying it to the field level will solve out several problems of farmers and nature. It will help in the conservation of nature and natural resources and also making agriculture more sustainable.

This fertilizer will increase the overall efficiency and availability of nutrients to plant, help in site-specific management of crops and also help in minimizing the losses of runoff, which had created lots of problems for nature and living organisms.

It will not increase the productivity of the plant but also the quality of product will improve, which in turn will benefit farmers in repaying more cash.

References

1. Raliya, R., Saharan, V., Dimkpa, C. and Biswas, P., 2017. Nano fertilizer for precision and sustainable agriculture: current state and future perspectives. Journal of agricultural and food chemistry, 66(26), 6487-6503.
2. Zulfiqar, F., Navarro, M., Ashraf, M., Akram, N.A., and Munné-Bosch, S., 2019. Nano fertilizer use for sustainable agriculture: advantages and limitations. Plant Science, 110270.
3. Chhipa, H. (2017). Nano fertilizers and nanopesticides for agriculture. Environmental Chemistry Letters, 15(1), 15–22.
4. Singh, D. M., Gautam, C., Prakash, P. O., Mohan, M. H., Prakasha, G., & Vishwajith, V. (2017). Nano-Fertilizers is a New Way to Increase Nutrients Use Efficiency in Crop Production. International Journal of Agriculture Sciences Citation, 9(7), 3831–3833.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Nutri-Cereals: Millets with Properties to Combat Malnutrition

Article ID: 11634

Rajwanti Saran[1], Dalip[2]

[1]Department of Plant Breeding and Genetics, Rajasthan Agricultural Research Institute, SKNAU.
[2]Durgapura, Jaipur-302018 (Rajasthan) and 2SKN College, SKNAU, Jobner, Jaipur.

Introduction

Millets comprise one of the oldest foods likely to be under cultivation since 8000 B.C. Millets are also known as nutri-cereals as they are highly nutritious and contribute considerably for food and nutritional security of the consumers. Millets are ancient super grains the reservoirs of nutrition for a better health. Millets are the important food and fodder crops in semi-arid regions, and are predominantly gaining more importance in the world that is increasingly becoming populous, malnourished and facing large climatic uncertainties. Millets are a group of cereal food grain crops which are small seeded, adapted to cultivation over a range of tropical and subtropical climates, can be grown with very low inputs.

Major millets under cultivation are consist of pearl millet (*Pennisetum glaucum*), sorghum (*Sorghum bicolor*), finger millet (*Eleusine coracana*), and small millets include kodo millet (*Paspalum scrobiculatum*), proso millet (*Penicum miliaceum*), foxtail millet (*Setaria italic*), little millet (*Panicum miliare*), and barnyard millet (*Echinochloa frumentacea*).

Fig.1 Major millet crops cultivated in India

Brown top millet *(Brachiaria ramosum)* and Crap grass *(Digitaria cruciata)* are fewer known millets while Job's tear millet (*Coix lacryma* (L.)) is comes under extinct millet.

Millet crops perform very well in marginal or rainfed climatic conditions and are superior in nutritional properties with high micronutrient and low glycemic indices. These crops are also known as climate resilient crops.

Millets having unique nutritional characteristics especially have complex carbohydrates, rich in dietary fibre, minerals (Ca, Fe, P and Zn), vitamins, proteins and also contains phenolic compounds and phytochemicals possessing medicinal properties therefore helps in curbing the problem of malnutrition and minimizing the diseases like diabetes, cancer, cardiovascular disease. They are non-acid forming thus easy to digest.

The global production of millet is 94.3 million metric tonnes from an area of 76.18 million hactare. Among millets, sorghum and pearl millet occupies 92.06% of the total world millet production followed by finger, foxtail, proso, little and kodo millet which all together comprise about 7.94%. The productivity of foxtail millet is highest among all millets.

India is the leading producer of pearl millet in Asia, constitute about 7.13 million hactare area with 10.3 million metric tonnes production and 1442 kg/ha productivity. India is the top most producer of barnyard millet (99.9%), finger millet (53.3%), kodo & little millet (100%) and pearl millet (44.5%) producing about 12.45 million metric tonnes with an area of 8.86 million hectare (Source: IIMR, 2018).

Nutritional Importance of Nutri-Cereals

Millet crops contains substantially high amount of protein, fiber and minerals in comparison to fine cereals like wheat and rice. Usually millets contain 7-12 % protein, 2-5% fat, 65-75% carbohydrates and 15-20% dietary fiber. The protein content in millets viz., sorghum (10.4), pearl millet (11.6), proso millet (12.5), foxtail millet (12.5) and barnyard millet (11.6) is comparable with wheat (11.8) and much higher than rice (6.8).

Though the finger millet contains lesser protein (7.3), but it is rich in mineral matter and calcium in comparison to wheat and rice. Finger millet is the richest source of calcium (344 mg/100-gram grains). All the millets contain more fibre than fine cereals. Particularly, the small millets namely barnyard millet (14.7), Kodo millet (9), little millet (8.6) and foxtail millet (8.0) are the richest in fibre in comparison to wheat (1.2) and rice (0.2).

Monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs) are significantly higher in millets than the wheat and rice. The millet protein has well balanced amino acid profile and good source of methionine, cystine and lycine. Therefore, millets are now being pronounced as “Miracle grains” and “nutri-cereals”.

Crop	Protein (g)	Carbohydrates (g)	Fat (g)	Crude fibre (g)	Energy (Kcal)	Ca (mg)	P (mg)	Fe (mg)
Sorghum	10. 4	72. 6	1. 9	1. 6	349	25	222	4.1
Pearl millet	11. 6	67. 5	5. 0	1. 2	361	42	296	8.0
Finger millet	7. 3	72. 0	1. 3	3. 6	328	344	283	3.9
Proso millet	12. 5	70. 4	1. 1	2. 2	341	14	206	0.8
Foxtail millet	12. 3	60. 9	4. 3	8. 0	331	31	290	2.8
Kodo millet	8. 3	65. 9	1. 4	9. 0	309	27	188	0.5
Little millet	8. 7	75. 7	5. 3	8. 6	341	17	220	9.3
Barnyard millet	11. 6	74. 3	5. 8	14. 7	307	20	280	5.0

Hypoglycemic Property of Millets

The glycemic index (GI) is a scale that assigns a number to every food. It is used to indicate how fast and how high a particular food can raise our blood glucose level.

GI value	0-55	56-69	>70
Category	Low	Moderate	High

GI of millets is less than the other cereal crops due to the effects of starch, proteins, lipids, polyphenols and fibers on millets starch hydrolysis. The millet starch architecture (polygonal and spherical) has also been a reason for their hypoglycemic property.

Foxtail, Proso and Pearl millets starch have pores in the structure which facilitate the starch hydrolyzing enzymes into the starch granules. Finger millets don’t have pores in the starch granules. Starch hydrolysis index of these millets are Finger<Pearl<Foxtail<Proso millets.

Low GI in the diets helps to decrease the blood glucose level, cholesterol level, the risk of type 2 diabetes mellitus and cardiovascular disease. The absence of gluten protein in millets prevents coeliac disease and related complications.

Anti-Nutrients in Millets

Phytic acid, polyphenol, Cyanogenic glucoside, tannins, oxalates, amylase inhibitor etc. are the major anti-nutrients found in millets. These anti-nutrients diminish the bioavailability of nutrients in the body. The proportions of these anti-nutrients can be reduced in the meals by adopting some household food processing techniques like fermentation, malting, germination, decortication etc., which improve the bioavailability of nutrients.

Conclusion

Millets are the traditional food crops have been an integral part of Indian agriculture both as food and fodder. These are the small seeded cereal crops that have wider ecological niche and are adapted to low input farming. These food grains are rich in micronutrients, carbohydrate, protein and vitamins, which have been critical to nutritional security of rural people in relation to mitigating the malnutrition problem.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Role of INM in Relation to Quality Yield and Soil Properties

Article ID: 11635

Jaipal Yadav[1], Gulab Choudhary[2], Seema Yadav[3], Ajit Kumar Meena[4], Deepak Meena[5]
[1,4]Department of Soil Science and Agricultural Chemistry, MPUAT, Udaipur, Rajasthan.
[2]Department of Horticulture, SKNAU, Jobner, Jaipur, Rajasthan.
[3]Department of Agronomy, SKNAU, Jobner, Jaipur, Rajasthan.
[5]Department of Genetics and Plant Breeding, RCA, MPUAT, Udaipur, Rajasthan.

Introduction

There is an urgent need to adopt an integrated nutrient supply and management system for promoting efficient and balanced use of plant nutrients. While the main emphasis was given on increasing the proper and balanced used of mineral fertilizers, the role of organic manure, biofertilizers, green manuring and recycling of organic wastes should be considered supplementary and not substitutable.

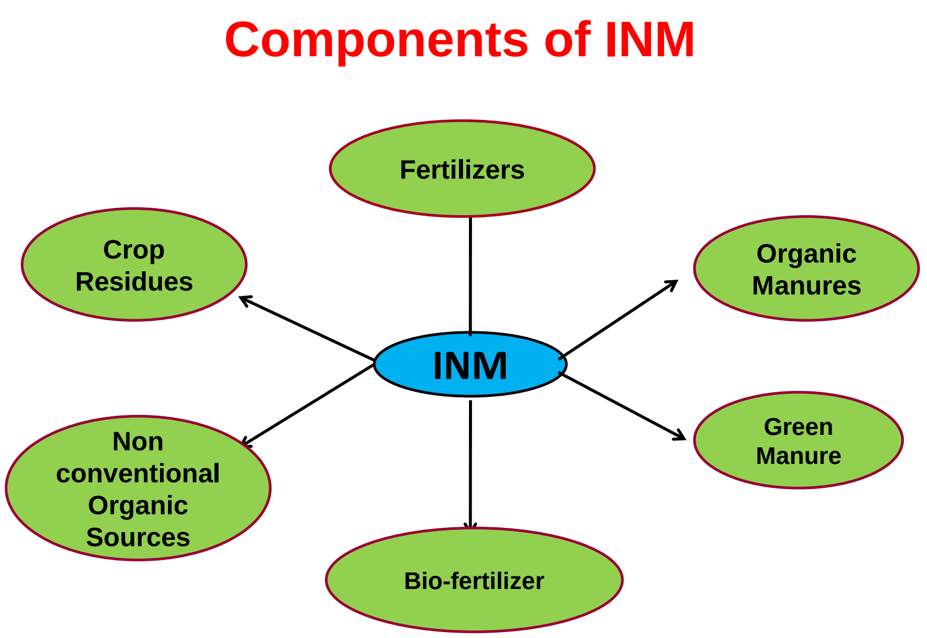
On the one hand, there is a vast scope for increasing plant nutrient supply through the use of organic fertilizers, but there is, on the other hand, no scope for reducing the consumption of mineral fertilizers since the present level of crop productivity has to be increased in the coming years. But now we are to think to educate farmers to make the use of organic, inorganic and biological fertilizers. Plant nutrient in future will require judicious and integrated management of all sources of nutrients.

What is INM?

Integrated nutrient management is the maintenance or adjustment of soil fertility and plant nutrient supply at an optimum level to sustain the desired crop productivity. This is done through optimization of the benefits from all possible sources of plant nutrients in an integrated manner. In other words, integrated nutrient management is the use of different sources of plant nutrients integrated to check nutrient depletion and maintain soil health and crop productivity.

Why is INM Needed?

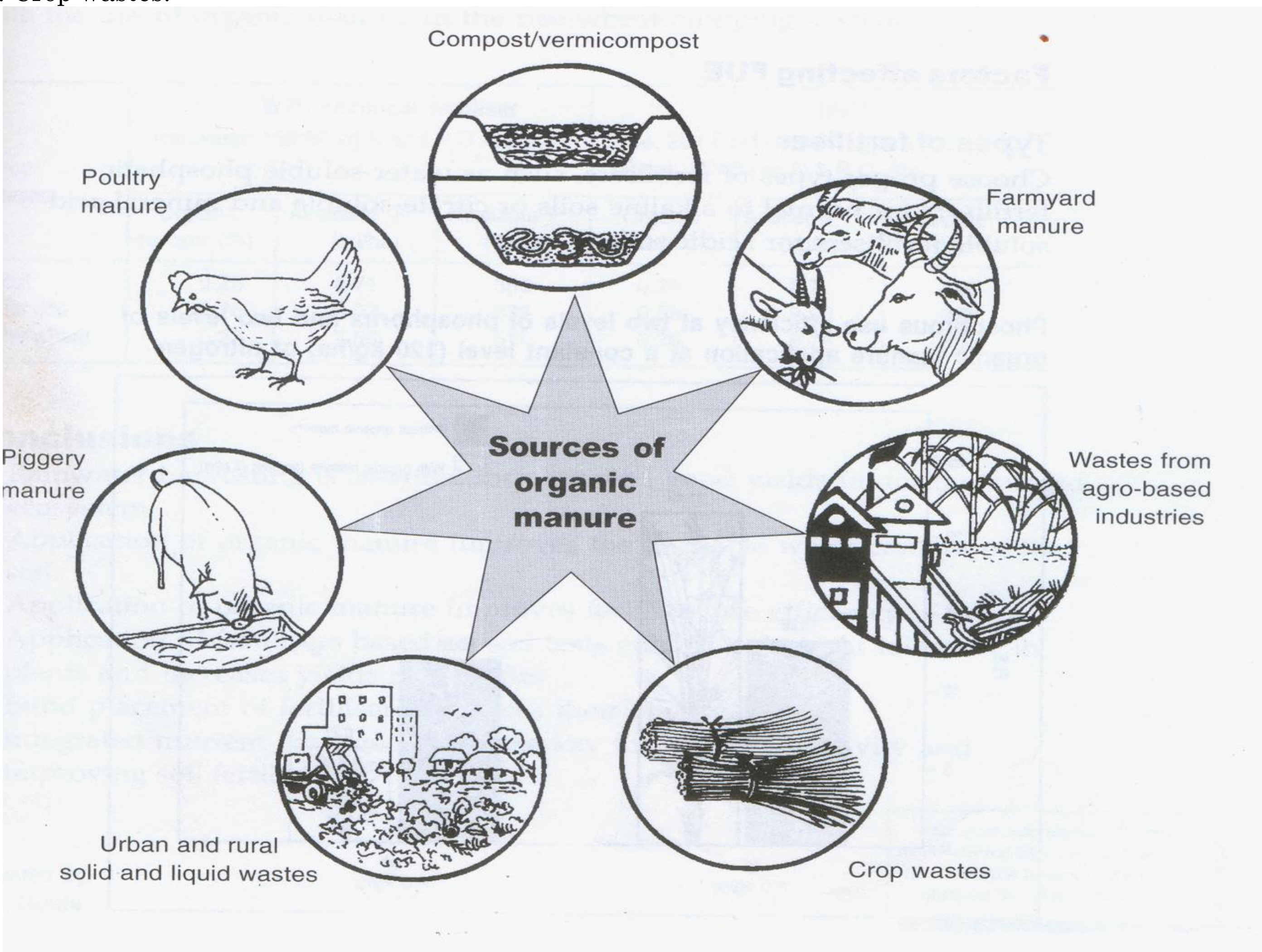
In India and also in the world the need to adopt INM concept in sustainable agriculture has been recognised due to following reasons:



1. Soils which receive plant nutrients only through chemical fertilizers are showing declining productivity despite being supplied with sufficient nutrients.
2. The decline in productivity can be attributed to the appearance of deficiency in secondary and micronutrients.
3. The physical condition of the soil is deteriorated as a result of long-term use of chemical fertilizers, especially the nitrogenous ones. It also aggravates the problem of poor fertilizer nitrogen use efficiency (NUE).
4. Excess nitrogen use leads to groundwater and environmental pollution apart from destroying the ozone layer through N_2O production.
5. The recent energy crisis, high fertilizer cost and low purchasing power of the farming community have made it necessary to rethink alternatives.

Sources of Organic Manure for INM

There are different sources of organic manure to be used for INM. Some of these are mentioned below :
1. Compost/vermicompost.
2. Farm Yard Manure (FYM).
3. Poultry Manure.
4. Piggery manure.
5. Urban and rural solid and liquid waste. Wastes from agro based industries.
6. Crop wastes.



Major sources of plant nutrients and their benefits

Component	Benefit	Opportunities
1. FYM / compost	3 to 3.6 kg NPK t^{-1} FYM or compost for single crop. 5 kg NPK t^{-1} FYM for double crops	All crops and cropping system Vegetable, potato, fruit crops and plantation crops.
2. Crop residues	3.5 kg N t^{-1} residue in *kharif* 2.0 kg N t^{-1} residue in *rabi* (10 to 15 % increase yield)	Mulch for moisture conservation
3. Green manure	40 to 60 kg N ha^{-1} (10-30 % yield increase)	Multiple crops
4. BNF		
A. Rhizobium	15-30 kg N ha^{-1} (10-30 % yield increase)	Legumes
B. Azotobacter/ Azospirillum	10-15 kg N ha^{-1} (5-10 % yield increase)	
C. BGA	15-25kg N ha^{-1} 10-15 kg BGA (10-20 % yield increase)	Rice
D. PSB	20-25 kg P ha^{-1} (10-15 % yield increase)	All crops and soils

Strategies

1. Nutrient balance sheet developed by including as many parameters as possible including additions through fertilizers, organic manuring, residue recycling precipitation and removal through harvest, leaching, erosion etc.
2. Monitoring of nutrient of soil and crops. It must include the effect of fertilization practices on changes in nutrient status of a soil and crop over a period of time. It must also provide information on possible extent of deficiency / toxicity of a particular nutrient in a given area.
3. Determination of proper zone in the soil for fertilizers placement in agriculture crops is important for determining the current amount of plant nutrient to be applied.
4. Standardization of plant tissue sampling technique and determination of nutrient status in agricultural crops at different growth stages.

Conclusion

1. Integrated use of quality organic resources of nutrient as per the need of is essential.
2. Understanding of nutrient flux with respect to crop demand is necessary.
3. Optimization of organic resource input combinations specific to agro ecological zones and horticultural crops to be estimated.

Silicon: A Modern Approach for Sustainable Farming and Climate Change Situation to Improve Crop Yields

Article ID: 11636

Ajit Kumar Meena[1], Jaipal Yadav[1], Deepak Meena[2]
[1]Ph. D Research Scholar, Department of Soil Science and Agricultural Chemistry, RCA, MPUAT, Udaipur (Raj.).
[2]Ph. D Research Scholar, Department of Genetics and Plant Breeding, RCA, MPUAT, Udaipur (Raj.).

The global population is presently around 7.7 billion and may further swell in the next few years to become 10 billion by 2050 (UN., 2019). Population ballooning severely impairs the land holding capacity, particularly in Asian countries. Increasing anthropogenic activities, such as the release of greenhouse gases, result in heating of the natural environment. Perturbations in climatic conditions, in turn, negatively impact food security, jeopardizing food availability and the livelihood of people. Feeding such a large population is an evolving challenge for the agricultural sector and scientists (FAO, 2008). Sustainable agricultural production is integral to food security; abiotic stressors, which are either the consequence of or are aggravated by climatic elements, attribute to about a 50% loss in agriculture Physical and chemical environmental factors, such as light, temperature, moisture, salinity, nutrient availability, presence of industrial and agrochemical contaminants in soil and water resources, etc., impact the growth rate and productivity. The osmotic stress caused by abiotic factors disruptsion distribution and cell homeostasis in plants. Abiotic stresses also interact with biotic stresses, making the plant more susceptible to infestations. The employment of silicon (Si) in agricultural activities is another potential element for the mitigation of abiotic stresses in crop plants. Silicon also exists in many irregular structures of biogenic origin, i.e., phytoliths and silica-enriched plants [, which constitutes about 1-3% of the overall Si pool of soil. It extends beneficial effects on plants' fitness, performance, and productivity by mitigating abiotic and biotic stresses. Along with the regulation of defense signaling pathways to synergically upregulate tolerance against stress. Si have an independent capacity to mitigate environmental stresses like salinity, water deficit, heavy metal toxicity, and nutrient deficiency (Epstein., 2009). Nearly 1–2% of cultivated land is affected by salinity, while a water deficit affects nearly 30% of the global land area. Both these stresses share several common characteristics on agriculture crop productivity. Heavy metal contamination, industrial waste discharge, and pesticides are increasingly polluting the ecosystem and, thereby, plant physiology and well-being. The present review deals with information pertaining to the mitigation of various stress factors through the application of Si and growth-promoting microbes and comparatively presents the functions by which mitigation occurs. The information generated from the use of Si from this review could be very beneficial for environmental protection and agricultural sustainability.

Si-Mediated Mitigation Against Stress in Plants

Application of Si in cultivating agricultural crops has been accepted as a sustainable strategy in mitigating salinity and water stress.

Plants' Root Development

Si positively influences the root area development, diameter, volume, and length of the main root and root biomass in plants grown under adverse environmental variables. It delays leaf fall, which enhances water use efficiency and cell wall extensibility synergistically extending water and nutrient absorption optimally to mitigate salinity and drought by activating specific plant hormones.

Improvement of Photosynthesis and Plant Growth

The photosynthetic machinery in plants is very sensitive to environmental stress. However, exogenous application of Si enhanced the photosynthetic capacity in various plants subjected to abiotic stresses Silicon enhanced photosynthesis, nutrient uptake, and ultimately plant growth development and biomass subjected to various stresses through increasing leaf gas exchange (Maghsoudi., 2015).

Biosynthesis of Phytohormones

Si is found to be associated with the enhanced adaptation of plant hormones, i.e., auxins, gibberellins, ethylene, cytokinins, and abscisic acid (ABA) were associated with saline and drought stress. The production of indole acetic acid (IAA) favors the root-developing structure, root tips, and area to help plants against stress. There is a possible influence of Si application on the activity of PGPRs and of the soil microbial consortia (Verma et al., 2019).

Uptake and Translocation of Minerals

Exogenous application of Si may balance the uptake and mobility of minerals in plants suffering from environmental stresses Sodium (Na^+) may cause an excessive nutritional deficiency in plants, while the presence of Si reduces Na^+ uptake by decreasing membrane permeability with its improved structural durability as seen in root cells Si protects plasma membrane integrity and permeability under salinity stress in plants. The availability of Si enhances the nitrogen (N) content in plants, while adequate phosphorous (P) availability ensures the presence of Si in various graminaceous plants. The application of Si may also support salt stress avoidance and the distribution of few essential minerals.

Reduction of Toxic Ions

The presence of Si may decrease Na^+ and Cl- levels with an enhancement in K^+ translocation or an increased K^+/Na^+ ratio) in plants during salinity stress. The exogenous application of Si enhances the photosynthetic characteristics in various plant species during stress. It was found to reduce Na^+ uptake by reducing the transpiration rate. Si and PGPRs, therefore, direct specific movement of K^+ over Na^+ and, thus, enhance the K^+/Na^+ ratio, which may be thought of as a major way to maintain plant development and yield against stress (Debona et al., 2017).

Response of Antioxidant Enzyme

The application of Si may mitigate oxidative damage in plants by modulating the enzymatic and non-enzymatic constituents. Generally, the negative impact of stress on plant metabolism leads to overproduction of ROS (e.g., singlet O_2, hydroxyl radical, H_2O_2 and superoxide anion), which impairs various metabolic functions, causing damage to proteins, lipids, carbohydrates, and DNA ROS, in turn, may also induce a damaging effect on the plasma membrane and endo-membrane systems, and disturb general metabolic processes.

Improvement of Plant Water Relations

Si application increases gs during drought to improve transpiration rates, ascribed as a positive factor to extract water from the soil. Drought-challenged plants may either maintain stomatal opening to support the photosynthetic rate despite the loss of water via transpiration, or decrease the stomatal opening to retard water loss and minimize the water deficit with a loss in carboxylation (Zhu and Gong., 2014).

Significant Role in Crop Nutrition

The different reviews showed that the application of the Silicon to the cereal crops give beneficial effects in crop production and also overcome the biotic and abiotic stresses. The role of silicon not only work as an essential nutrient but also as a beneficial nutrient was unnoticed because of its natural abundance. But if the application of more nitrogen was done then the crops become more succulent, prone to lodging and increased the incidence of pest and diseases which can be overcome by the application of silicon by which soil could be sustain (Amin et al., 2016). To the period of the issue of Si nutrition in rice production remains largely unknown. Identifying and implementing strategic Si nutrition management strategies may very well play a critical role for reversing deteriorating yield trend. Si has been shown to affect the availability of phosphorus in the soil. There should be development and standardization of different sources of silicon and quantify the number of different sources for the cereal crops.

Conclusions and Future Prospects

In the coming decades, land degradation will be a major threat to food security. The successful use of plant-associated bacteria in contaminant removal, soil fertility, or crop protection will rely on the capability to develop strains among the previous soil-inhabiting microbes. Plant-associated bacteria play a vital role in the restoration of degraded soils through fertility enhancement by affecting nutrient cycles as well as an improvement in the soil structure. Silicon is recognized as a non-essential element needed for plant processes with its multiple beneficial impacts on growth, development, and quality productivity of plants. The use of silicon results in promotion of the physiological fitness of plants/crops for sustainable agriculture to ensure the cultivation of food crops under climatic variables, viz., abiotic stresses. The association between plants and bacteria is well recognized for its enhanced capacity to support plant growth development and improve resistance against a myriad of environmental stressors. Hence, co-cultivation of plants with bacteria, organic manures and liquid organic manures PGPRs, and Si can easily mitigate abiotic stresses. Their synergic effects would definitely sustain the physiological fitness of plants for improved carboxylation linked with the plant growth rate and productivity under adverse environmental variables. The depletion of available Si in soil is an important soil-related factor that may be closely associated with progressive yield declines experienced in various crops, especially in the tropics. To date the issue of Si nutrition in crop production remains largely unexplored. Identifying and implementing strategic Si nutrition management strategies may play very well critical role in reversing declining yield trends in crop production. There is need for applied research to quantifying monosilicic and polysilicic acid contents to elaborate optimum Si rate and best time and methods of its application. This is imperative so that the application of Si may be one of the available pathways to improve crop growth and its production in arid or semi-arid areas.

References

1. Amin, M., Ahmad, R., Ali, A., Hussain, I., Mahmood, R., Aslam, M., Lee, D.J. Influence of silicon fertilization on maize performance under limited water supply (2016). Silicon, (10), 177-183.
2. Debona, D., Rodrigues, F.A., Datnoff, L.E. (2017). Silicon's role in abiotic and biotic plant stresses. Ann. Rev. Phytopathol., 55, 85–107.
3. Epstein, E. Silicon: Its manifold roles in plants (2009). Ann. Appl. Biol, 155, 155–160.
4. FAO. Climate Change and Food Security: A Framework Document; Food and Agricultural Organization of United Nation: Rome, Italy, 2008.
5. Maghsoudi, K.; Emam, Y.; Ashraf, M. Influence of foliar application of silicon on chlorophyll fluorescence, photosynthetic pigments, and growth in water-stressed wheat cultivars differing in drought tolerance (2015). Turk. J. Bot., 39, 625–634.
6. United Nations. 2019. World Population Prospects: Highlights. Available online: https://www.un.org/development/desa/publications/worldpopulationprospects2019highlightshtml.
7. Verma, K.K.; Liu, X.H.; Wu, K.C.; Singh, R.K.; Song, Q.Q.; Malviya, M.K.; Song, X.P.; Singh, P.; Verma, C.L.; Li, Y.R. The impact of silicon on photosynthetic and biochemical responses of sugarcane under different soil moisture levels (2019). Silicon, 12, 1355–1367.
8. Zhu, Y.; Gong, H. Beneficial effects of silicon on salt and drought tolerance in plants (2014). Agron. Sustain Dev., 34, 455–472.

Vermiculture Biotechnology for Sustainable Agriculture Development: A Holistic Approaches

Article ID: 11637

Ajit Kumar Meena[1], R. H. Meena[2], Jaipal Yadav[3], Deepak Meena[4], Anshul Mishra[5]
[1,2,3]Department of Soil Science and Agricultural Chemistry, RCA, MPUAT, Udaipur, Rajasthan.
[4,5]Department of Genetics and Plant Breeding, RCA, MPUAT, Udaipur, Rajasthan.

Introduction

Modern agriculture based on chemicals is not sustainable because of many problems such as loss of soil productivity from excessive erosion and associated plant nutrient losses, surface and ground water pollution from pesticides, fertilizers and sediment, impending shortages of non- renewable resources, and low farm income from high production costs. As a result, there is increasing awareness of the need for alternative agricultural systems. Such a system should integrate traditional practices with modern understanding of life science. The concept of soil, as a living system, is central to alternative farming systems as opposed to chemical farming.

Vermiculture Biotechnology

Biotechnology essential involves a large-scale application of bio-systems for economic and effective processing of materials to produce value added. Vermiculture is culturing of earthworms. Vermiculture biotechnology is, therefore, an aspect of biotechnology involving the use of earthworms as versatile natural bioreactors for effective recycling of non-toxic organic wastes to the soil, resulting in soil improvement and sustainable agriculture. Earthworms are invertebrates assigned to phylum *Annelida*, class *Chaetopoda* and order *Oligochaeta*. *Oligochaeta* includes the major earthworms belonging to *Megascolecidae*, *Lumbricidae* and other families. More than half the earthworm species of the world belong to *Megascolecidae*. The genus *Phretinia* alone has a large number of species. Both *Megascolecidae* and *Lumbricidae* are valuable to agriculture and are, therefore, intimately linked to human welfare, development and progress.

The commonly used species are:
1. *Eiseniafretida*, *Perionyx excavates*, *Lumbrieusrubellus*, *L. terrestris*, *Eudrillus* spp.
2. *Lampitomauritii*, *Octochaetona serrate*, *DrawidaWillsi*, *O. surensis* and *O. thurstoni*.
3. Earthworm’s gut is an effective tubular bioreactor with raw materials (feed) entering from one end and the product (castings) coming out through the other end.
4. They maintain a stable temperature through novel temperature regulation mechanisms, thus accelerating the rates of bioprocesses and preventing enzyme inactivation caused by high temperatures.

Procedure to Prepare Vermicompost

Culturing technique: A large number of wooden, plastic, card board or cement boxes of various sizes can be used. This volume can accommodate 1500 worms. Culturing is done indoors avoiding sunlight and rain. Culture bed: At the bottom of the box, a layer of bedding material is spread to a thickness of 2.5 to 5.0 cm. this can be any biodegradable material. On this, a second layer of about 5 cm thick partially digested cow dung is spread. Water is sprinkled on the bed to get a moisture level of 30-40 per cent. Worms or their cocoons are then introduced on the bed.

Feed composition: Dried dung of cattle, sheep, horse, pigs or droppings of poultry and small shredded pieces of vegetable waste form the ideal food for the worms. Cattle dung can be fed as such if available, but other dung materials or vegetable wastes can be mixed in equal quantity with cattle dung for feed acceptability. Wheat bran, grain bran and vegetable waste, when added to dung in 10 : 11.1 ratio, will enhance the quality of the compost and biomass production.

Feed application: The feed is to be placed uniformly in a layer on the culture bed and replenished as when it disappears from surface.

Wormcast production and collection: When compost is ready, watering is stopped for 2-3 days, when all the worms retire to the bed below where some water still exists. The compost is then dry and can be piled in small heaps in ambient conditions for a couple of hours when all the worms will godown the heap to the bed. The heaps then become compost heaps containing worm cocoons. Fresh feed material should be placed immediately the worms and should be discarded after 6 months and a fresh bed should be laid as done earlier.

Application of Vermicompost

In orchards the dose depends on the age of the tree. A deep ring of 15-20 cm is to be formed around the tree. A thin layer of dry cow dung and bone meal with 2-5 kg of vermicompost is then applied. This is covered with a thin layer of soil. This ring is mulched with organic matter and a light spray of water is given. In plots, a handful of vermicompost should be applied near the rootzone. The application should be repeated after one month and water should be added to keep it moist. For general use in agriculture, vermicompost should be applied at 5 t/ha. Vermicompost is mixed with equal quantity of dried cow dung. This is broadcasting when seedlings are 12-15 cm high and water should be sprinkled.

Fig.: Vermicompost production techniques

Benefits of Vermiculture Biotechnology

Vermiculture biotechnology can be fruitfully utilized to gain several benefits:
1. Less reliance on purchased inputs leading to low cost of production.
2. Enhancement of soil productivity.
3. The produce with better taste, lustre and keeping qualities without toxic residues can be produced, fetching a higher price.
4. Recycling of organic eastes is achieved.

5. There is a cost-effective pollution abatement technology.
6. Wastes create no pollution, as they become valuable raw materials for the soil biotechnology processes.

References

1. Abrol, I.P. and S.P. Palaniappan, 1998. Green manures crops in irrigated and rainfed rice based cropping systems in south Asia. Sustainable Agriculture-Green manure in rice farming. Pp. 71-82. Int. Rice. Res. Inst.,Los Banos, Laguna, Philippines.
2. Baddesha, H.S. and N.S. pasricha. 1991. Interaction effect of green manuring and fertilizers N in rapeseed mustard crop. Proc. Eighth Intern.Rapeseed Congr. Saskatoon, Canada. Gaur, A.C. 1982. Organic manures and biofertilizers-Review of soil research in India. Twelfth International Congress of Soil Science, New Delhi.Feb. 8-16, 1982, pp. 278-305.
3. Gaur, A.C. 1992.Bulky organic manure and crop residues. Fertilizers, organic Scientificrecyclable wastes and
4. biofertilizers. H.L.S. Tandon Fertilizer Development Corporation, New Delhi, p. 147.
5. Gaur, A.C. R.S. Mathura and T.S. Varshney. 1970. Decomposition of different types of added organic matter in soil Science & Agriculture Chemistry. 14: 524-532.
6. Rani Perumal, 1994. Residual effect of manures in organic farming National training on organic farming.Tamilnadu Agricultural University, Coimbatore.
7. Venkataraman, G.S. 1982. Nitrogen fixation by blue green algae and its economic importance.International Symposia papers I. non symbiotic nitrogen fixation and organic matter in the tropics.Transactions of the 12th International Congress of Soil Science, New Delhi.Feb. 6-16, 1982, pp. 69-82.

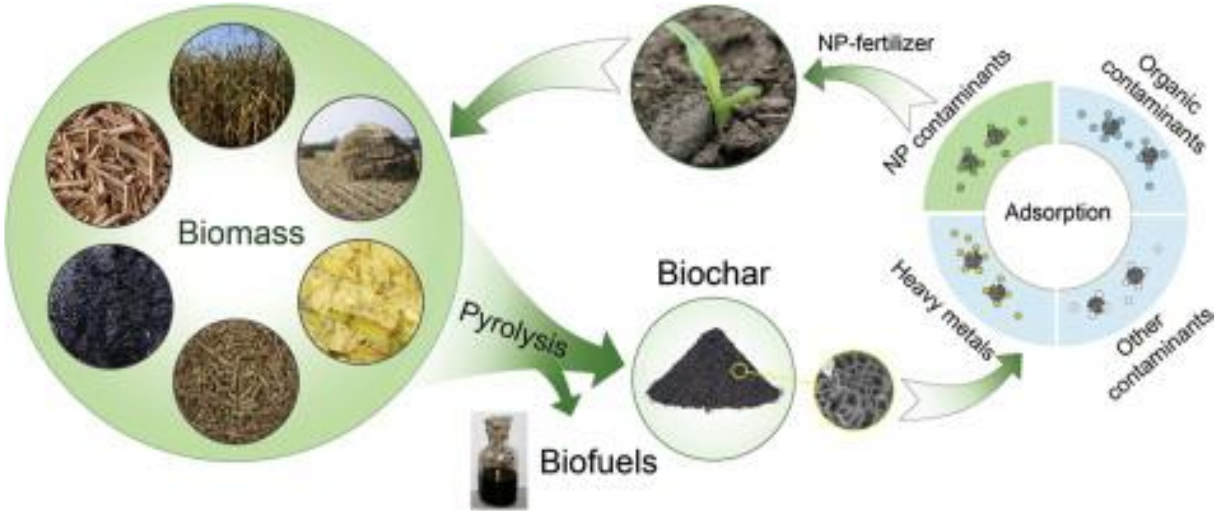
The Fundamentals of Biochar as a Soil Amendment Tool and Management in Agriculture Scope: An Overview for Farmers and Gardeners

Article ID: 11638

Ajit Kumar Meena[1], R. H. Meena[2], Jaipal Yadav[3], Anshul Mishra[4], Deepak Meena[5]
[1,2,3]Department of Soil Science and Agricultural Chemistry, RCA, MPUAT, Udaipur, Rajasthan.
[4,5]Department of Genetics and Plant Breeding, RCA, MPUAT, Udaipur, Rajasthan.

Abstract
Improving the soil and biomass with coal is estimated at the international level as a way to enhance soil productiveness, fertility and also to mitigate climate change. Biochar employed to improve land scope and impound carbon, is attracting a great deal of attention. Its characteristics of chemical, physical and biological properties, containing big surface area, CEC (Cation Exchange Capacity), high water-holding capacity, size of pore, volume, distribution, and element composition, affect its recognized influences, particularly on microbial communities. Therefore, farmers or peasants and gardeners are facing new opportunities and defiance each day, from feeding global extending and expanding population, whilst meeting severe new emissions requirements, to create more food on fewer land area while reducing their environmental emissions. Widespread application and utilization of biochar in agricultural scope, forestry production, energy, environmental protection and additional areas, has interested awareness by scientists and investigators inside and/or outside the country.

Introduction
The motivation to study biochar came from the soil possibility to remedy many of the challenges fronting the today's world: waste administration, renewable energy, soil declination, and climate change. Different several other stages for the extraction renewable energy from feedstocks, biochar builds up soil fertility and food availability rather than act as a challenging benefit. If suitably understood and applied, biochar has the possibility for generating several dissimilar win conditions with a few disadvantages. The concept to use biochar as a soil amendment may seem recent but it really comes from the study of very ancient soils in the Basin of Amazon.



Advantages
Agricultural Advantages: Biochar has caused in very high yield enhancements on very meagre or poor soils such as acidic humid and tropical soils. if biochar is applied and deficient nitrogen is supplied, nitrogen immobilization can happen and decrease crop yields. This also occurs with compost, for example: if the ratio of carbon to nitrogen (C:N) is too high. Biochar is a soil improvement that is to be used along with applicable

sources of nutrients, like animal composts, green manures, composts and fertilizers. It is not a replace for these inputs.

Though the ash in biochar fixes improves nutrients to plants, several biochars comprise only small quantities of ash. Also, any nutrients in ash not used by plants in the year after application are finally lost from the soil, sometimes quickly, for example by leaching.

Environmental Benefits

Decrease nutrient pollution in water bodies. Biochar may decrease the production of greenhouse gases by soil. Impacts of biochar on the bio-availability and movement of heavy metals have been extensively. So, biochar can decrease the bio-availability and mobility of pesticides and heavy metals in soil.

Biochar can be a Straightforward yet vigorous tool to fight climate change. As biological materials decompose, gases of greenhouse, such as carbon dioxide (CO_2) and CH_4 (methane), are released into the atmosphere.

Through carbonizing the biological sustenance, a lot of the carbon (C) becomes "steady" into additional unchanging constant form, and when the outputting biochar is applying to soils, (C) carbon is efficiently isolated or sequestered. It is assessed that employ of this technique to "tie up" (C) carbon has the possibility to decrease current universal carbon releases or emissions by more than 10%.

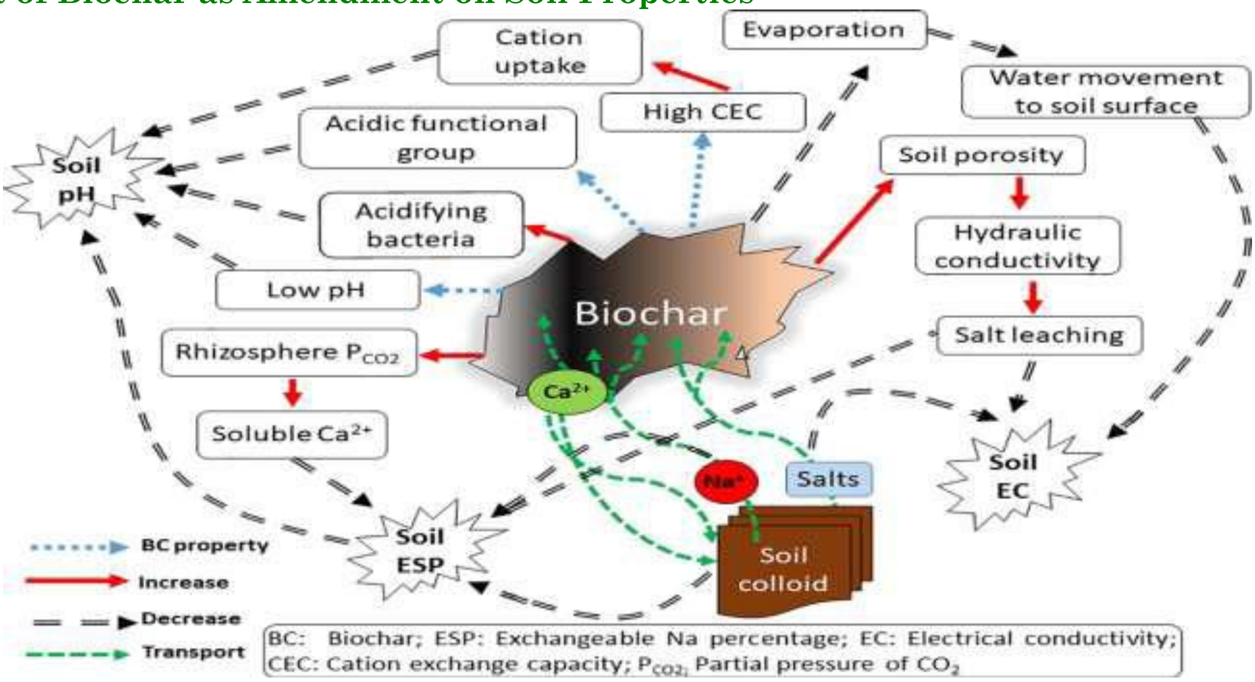
Biochar Application to Soils

The aim of applying biochar to soil fundamentally falls into four broad categories:
1. Agricultural profitability.
2. Management of pollution and eutrophication hazard to environment.
3. Reconquest of degraded land.
4. Sequestration of carbon from the atmosphere.

In nature happening biochar made from grassland and forest wastes, means that biochar can persist for thousands of years with a few decompose. Therefore, biochar has a long-lasting effect in soil, and those beneficial effects improve over time.

Studies lab employing the modern methods evaluate that biochar has a mean residence time in soils to many thousand years. Biochar can be applied to soil by hand or using conventional machinery such as manure spreaders and lime, and should be thoroughly incorporated into the soil by tillage.

Effect of Biochar as Amendment on Soil Properties



Conclusion

Biochar that has upgraded extensively is promoted to improve a range of soil properties and can be derived from a wide range of forest residue, sewage sludge, organic and agricultural wastes biomass feedstock, at different pyrolysis conditions and also can be made in simple or complex pyrolysis units and can be made in your backyard or on your farm. The properties of biochar specified by chemical and physical processes reveal the infrastructure of biochar. Biochar defined by its useful application to soil, is expected to enhance an advantage from enduring chemical and physical properties. Studies of charcoal tend to suggest stability in the order of many years in the normal environment, and various analytical methods inform quantification and an understanding of turn over processes.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Agronomic Fortification for Quality Produce and Sustainable Soil Health

Article ID: 11639

Ajit Kumar Meena[1], Jaipal Yadav[2], Deepak Meena[3], Anshul Mishra[4]
[1,2]Department of Soil Science and Agricultural Chemistry, RCA, MPUAT, Udaipur, Rajasthan.
[3,4]Department of Genetics and Plant Breeding, RCA, MPUAT, Udaipur, Rajasthan.

Introduction

Agronomic fortification is the process of providing Zn to plants (for example, by applying Zn-fertilizers to soil and to foliar) appears to be important to ensure success of breeding and agronomic efforts for increasing Zn concentration in grain increasing micronutrient concentrations of stable food crops, especially in cereal grains.

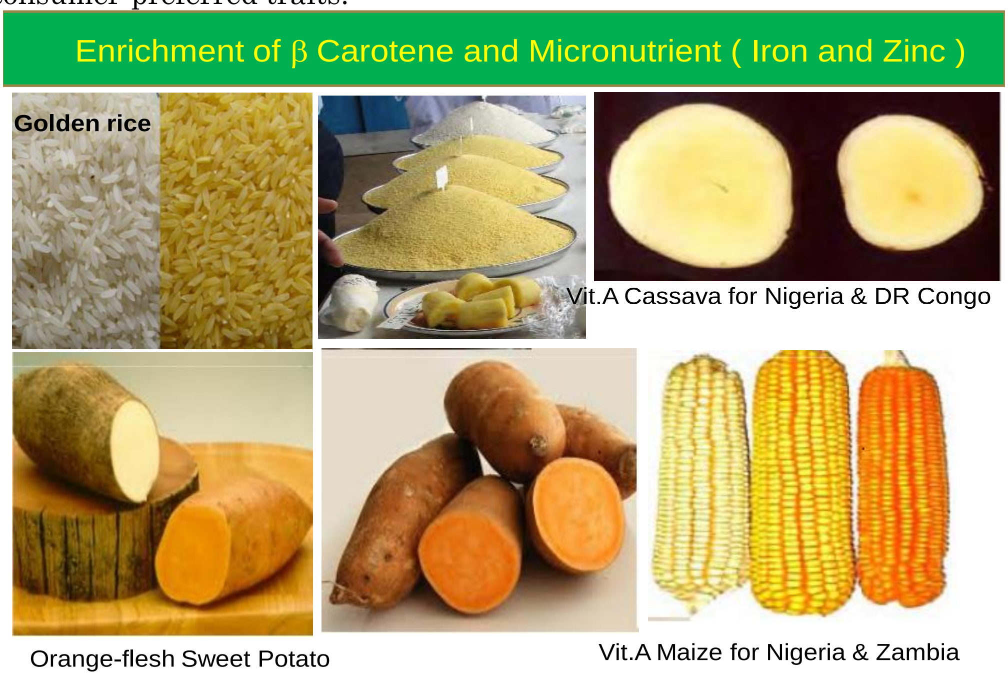
Agronomic fortification is essential for keeping sufficient amounts of available zinc in soil solution (by soil zinc applications) and in leaf tissue (by foliar zinc applications), which greatly contributes to the maintenance of adequate root zinc uptake. Increasing grain zinc concentrations through foliar zinc applications is similar to increasing zinc concentrations in other parts of the grain such as the endosperm, which is the most commonly eaten part of wheat grain.

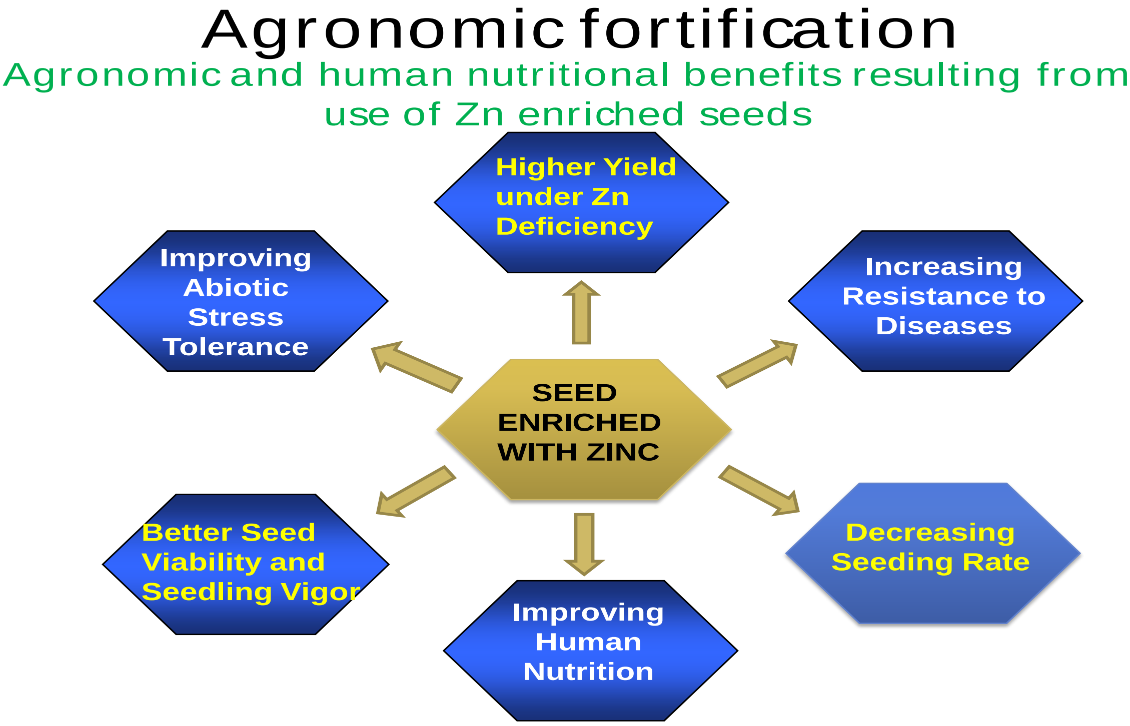
Objectives

1. To develop new mapping populations for grain Fe and Zn contents using diverse parents
2. To identify markers linked to high grain Fe and Zn content Quantitative Trait Loci (QTLs) for use in marker assisted selection (MAS)
3. To increase quality parameter of crops like that grain yield, test weight, plant height, grain colure etc.
4. To increase sustainable soil health due to added micronutrient fertilizer through soil and foliar application.

What is Agronomic and Genetic Fortification?

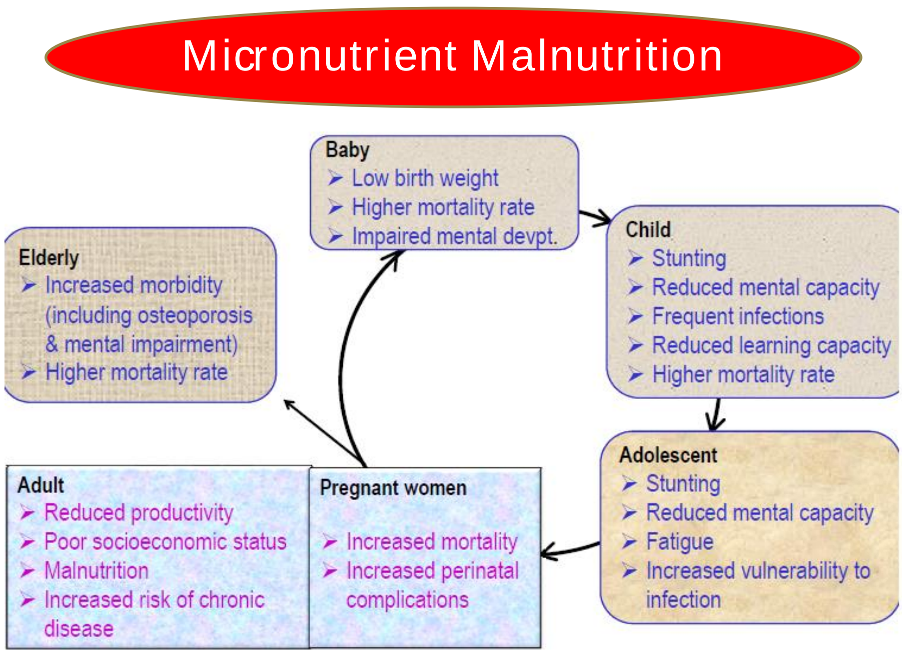
Agronomic and genetic fortification is the development of nutrient-dense staple crops using the best conventional agronomic practices and modern biotechnology, without sacrificing agronomic performance and important consumer-preferred traits.





Benefits of High Seed-Zn on Plant Growth

1. When seeds with low concentration of Zn are re-sown.
2. Important to maintain the sufficient amount of Zn in soils during seed germination and early seedling development.
3. Maintenance of the adequate amount of readily available Zn in soils or high Zn concentrations in seeds ensure good root growth and contribute to protection against soil-borne pathogens.
4. Increasing Zn transport from leaves into seeds can be achieved by foliar applications of Zn, particularly under environmental stress conditions (e.g., drought) and on potentially Zn-deficient soils.
5. Recently, we found that during seed germination Zn concentration of newly developed radicle and coleoptile is extremely high (up to 200 mg kg−1), indicating critical physiological roles of Zn during early seedling development.



Effect on Human Health Due to Zinc and Iron Deficiency

1. Impairments of physical growth.
2. Immune system and learning ability.
3. Combined with increased risk of infections.
4. DNA damage and cancer development.
5. Blindness
6. Anemia (even death) in more than half of the world's population, especially among women of reproductive age, pregnant and lactating women and pre-school children
7. Recent reports indicate that nearly 500,000 children under 5 years of age die annually because of Zn and Fe deficiencies.

Conclusion

1. Agronomic fortification can be a feasible strategy.
2. Agronomic fortification give better quality and quantity of nutrition in different crops.
3. Enrichment of micronutrient (Fe and Zn) and biological availability (protein, starch, b Carotene etc) in the grain and different edible part of crops.
4. Increasing of grain yield and quality.
5. Sustainable soil health due to increasing and maintain level of micronutrient in the soil through soil and foliar application of micronutrients.

Babycorn: A Healthy and Nutritious Vegetable Crop

Article ID: 11640

Deepak Meena[1], Subhash Bijarania[1], Ajit Kumar Meena[2]
[1]Ph. D Research Scholar, Department of Genetics and Plant Breeding, RCA, MPUAT, Udaipur (Raj.).
[2]Ph. D Research Scholar, Department of Soil Science and Agricultural Chemistry, RCA, MPUAT, Udaipur (Raj.).

Introduction

Babycorn (also known as young corn, mini corn or candle corn) is the ear of maize (*Zeamays* L.) plant harvested young, when the silks have either not emerged or just emerged and no fertilization has taken place. Baby corn is one of the most important dual-purpose crops grown round the year in India (Singh et al., 2015). Baby corn is becoming popular in domestic and foreign markets and has enormous processing and export potential. An interesting recent development is of growing maize for vegetable purpose (Dass et al., 2008). Currently, Thailand and China are the world leaders in baby corn production. In India, baby corn is being cultivated in Meghalaya, Western Uttar Pradesh, Haryana, Maharashtra, Karnataka and Andhra Pradesh.

Nutritional Value of Babycorn

Baby corn is a delicious, decorative and nutritious vegetable, without cholesterol. It is a low caloric vegetable which is rich in fiber content. One Baby corn can be compared with an 'egg' in terms of minerals. Probably it is the only vegetable without any pesticide residues. Baby corn is free from insect-pests and diseases and its nutritional value is comparable with other several high-priced vegetables. Due to its high succulence, palatability and digestibility, it is considered to be an ideal fodder crop and it can be used at any stage of its growth. Its green fodder is especially suited for milch cattle as it has lactogenic properties.

Components	Amount
Protein	15-18%
Sugar	0.016-0.020%
Phosphorus	0.6-0.9%
Potassium	2-3%
Fibre	3-5%
Calcium	0.3-0.5%
Ascorbic acid	75-80mg/100g

What is Agronomic and Genetic Fortification?

Agronomic and genetic fortification is the development of nutrient-dense staple crops using the best conventional agronomic practices and modern biotechnology, without sacrificing agronomic performance and important consumer-preferred traits.

Uses

The entire miniature ear of baby corn is edible. Baby corn can be eaten raw or cooked. It is used in variety of traditional and continental dishes besides being canned. It is used as decorative, crispy vegetable in salad, soup, pickles, pakodas, vegetable biryani, mixed vegetable, pasta, chutney, cutlets chat, dry vegetable, kofta curry, manchurian, raita, candy, jam, murabba, burfi, halwa, kheer, deep fried babycorn with meat and rice and other favourite dishes (Asaduzzaman et al., 2014). It can also be used after boiling and blanching. Besides corn, its plant can also be used as fodder for cattles, which is also nutritious. Moreover stover, dry leaves and cob covering can be used as good fuel.

Production Methods

Baby corn can be grown throughout the year but its growth and yield potential vary across the growing season. There are two methods for producing baby corn, either as a primary crop or as a secondary crop in a planting of sweet corn or field corn. In the first method, a seed variety is chosen and planted to produce only babycorn. In the second production method, the variety is selected to produce sweet or field corn. In this method, the top ear is allowed to mature for sweet corn or field corn while rest of the ears of the plant are harvested for babycorn.

Variety Selection

Many common sweet corn and field corn cultivars can be used for baby corn production. There is no taste advantage in growing a sweet corn variety over field corn, since the ears are harvested before the sugars have an opportunity to accumulate. Sweet corn cultivars tend to be easier to hand- harvest whereas field corn involves lower seed cost. Additionally, field corn stalks tend to have stronger resistance to lodging. Ear quality, more than yield, should be the primary objective when selecting a variety. Small kernel size, straight row kernel alignment, and tapered tips are preferred characteristics for high quality babycorn. Baby ear production is further enhanced by the silkless condition because all of the energy becomes devoted to producing more cobs instead of going first into silk growth and then into kernel development. The first baby corn variety, VL-78, was released in 2004. The single cross hybrid, HM 4, released by Chaudhary Charan Singh Haryana Agricultural University, Hisar is the best baby corn hybrid of the country. Now varieties specially bred for babycorn purpose are available in both public and private sectors.

Attributes of Maize Genotypes for Babycorn Production

The important attributes relevant to baby corn are early maturity, prolificacy, synchronized ear emergence and yellow kernels:

1. Early maturity (<55 days) provides opportunity to take baby corn as a catch crop and helps the crop to escape from many of those biotic and abiotic stresses which appear after the flowering stage.
2. Prolificacy- An ideal plant should bear at least three ears per plant without losing quality, size and shape of young ears.
3. Synchronized ear emergence reduces the harvesting and storage cost of ears drastically.
4. Yellow immature kernel with uniform row arrange mentis one of the criteria for babycorn cultivars.

Cultivation Practices

The cultivation practices for baby corn production are same as recommended for normal corn production. Among the other cultural practices, detasseling is an essential operation for babycorn production to ensure better quality (Moreira et al., 2010). Detasseling has to be done as and when tassels start emerging (usually around 40-45 days). The detasseling operation should be done on a daily basis till tassels from all the plants are removed. Removal of tassel just after its emergence gave 18% higher marketable baby corn yield than no detasseling. Although many studies have demonstrated beneficial effects of detasseling on baby corn and grain yield, negative detasseling effects on baby corn and grain yield were also found.

Harvesting

Babycorn is hand- harvested 1 to 2 days after silk emergence, while the ears are still immature (Bairagi et al., 2015). Baby corn ears which are 10 to 12 cm long and having a diameter of 1.0 to 1.5 cm arrangement are preferred in the market (Golada et al., 2013). Because ears can quickly become too large and tough to be sold as baby corn, frequent harvests of every 2 to 3 days are necessary (Chutkaew and Paroda, 1994). The harvest period can last 2 to 4 weeks. For baby corn as a primary crop, harvest all ears. A single planting maybe harvested 9–12 times over a period of 3–4 weeks.

Marketing and Economics of Babycorn

Fresh baby corn sold in the husk can be marketed directly at farmers markets and to ethnic markets. Restaurants, particularly those specializing in vegetarian dishes, may also be interested in purchasing fresh baby corn. Health food stores are a potential marketing avenue for organically grown ears. Baby corn is a high value crop which gives good returns in short period of time (About 60-63 days) with bonus of 50-60 tons/ha green fodder. Hence, it is best suited for multiple cropping. It also acts as a contingent crop at the time of crop failure. Babycorn is not only a cash crop but also a catch crop. Towards diversification and value addition through cultivation of baby corn for vegetable purpose is emerging as a highly profitable activity.

Conclusion

Baby corn is expected to catch the attention of more and more consumers and farmers because of its superior taste, texture and nutritional value. The baby corn industry generates employment for the rural poor, provides opportunities for higher income and has potential for export. In order to harness the benefits of baby corn, research and development support and appropriate policies at the national level are required. Hence, the Governments should concentrate on framing policies that should encompass motivating young farmers and finding creative ways to sustain babycorn industry by involving both private and public sectors.

Future Perspectives

In India very few cultivars have been exclusively bred for babycorn purpose. By the utilization of heterosis breeding and biotechnology, single cross yellow flint early maturing and regular row arrangement hybrid suited to the agro climatic zones should be developed for baby corn purpose as it fetches better market price. Keeping in mind the nutritive value of babycorn, the reisa need to popularize it further in rural areas also. The reisa need to develop appropriate entrepreneurship and establishment of appropriate storage and marketing facilities. Genotypes suited to the canning should be developed where baby corn is being grown for further market and export.

References

1. Asaduzzaman, M., Biswas, M., Islam, M. N., Rahman, M.M., Begum, R. and Sarkar, M.A.R. 2014. Variety and N-fertilizer rate influence the growth, yield and yield parameters of babycorn (Zea mays L.). Journal of Agricultural Science, 6(3):118-131.
2. Bairagi, S., Pandit, M. K., Sidhya, P., Adhikary, S. and Koundinya, A.V.V. 2015. Impacts of date of planting and crop geometry on growth and yield of baby corn (Zea mays var.rugosa). Journal Crop and Weed, 11(2): 127- 131.
3. Dass, S., Yadav, V. K., Kwatra, A., Jat, M. L., Rakshit, S., Kaul, J., Parkash, O., Singh, I.,Singh, K. P. and Sekhar, J. C. 2008. Baby corn in India. Technical Bulletin, Directorate of Maize Research, Pusa Campus, New Delhi. 6: 1-45.
4. Golada, S. L., Sharma, G.L. and Jain, H. K. 2013. Performance of baby corn (Zea mays L.) as influenced by spacing, nitrogen fertilization and plant growth regulators under sub humid condition in Rajasthan, India. African Journal of Agricultural Research, 8(12):1100-1107.
5. Moreira, J. N., Silva, P. S. L., Silva, K. M. B., Dombroski, J. L. D. and Castro, R. S. 2010. Effect of detas seling on babycorn, green ear and grain yield of two maize hybrids. Horticultura Brasileira, 28: 406-411.
6. Singh, A. K., Kumar, R., Bohra, J. S. and Kumawat, N. 2015. Fodder yield, nutrient uptake and quality of baby corn (Zea mays L.) as influenced by NPKS and Zn fertilisation. Researchon Crops, 16(2): 243-249.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Seabuckthorn: A Wonder Plant

Article ID: 11641

Rigzen Tsewang[1]
[1]University of Horticultural Sciences, Bagalkot, Karnataka, India (587103).

Introduction

Seabuckthorn is scientifically known as *Hippophae rhamnoides* L. and there are various other species endemic to different parts of the world. It belongs to the family Elaegnaceae. They are ecologically and economically important plants in Ladakh. Seabuckthorn shows an anemophily type of pollination i.e., they are pollinated through wind.

The plants have dioecious type of sexual orientation in which the male and female reproductive parts found on separate plants. The shrubs have silvery deciduous leaves with colorful red, orange or yellow berries depending on the type of species.

The plants are very hardy in nature and can withstand -43˚C to 40˚C. One of the reasons for its hardy nature is due to the presence of deep extensive root system. The plant has the ability to fix nitrogen as well due to presence of actimycetes like Frankia and fungi like Glomermycota that form arbuscular mycorrhiza (Shah, 2015).

Characteristics of Plants

The plants have varied important features that make the plants economically and ecologically important in nature. They have characteristics like tolerant to drought, water logging, salinity and alkalinity. Due to these features the plants are ideal for soil reclamation, soil remediation and protect soil from soil erosion.

The plant is also helpful for wildlife enhancement, due to this nature they serve as the perfect farm protection plant or live fence.

Nutritional Attributes

Seabuckthorn is one of the most nutritiously rich fruit to be found on earth. They have rich amount of Vitamin C (909 mg/100ml) which far more than orange (35-56mg/100ml) and aonla (478.5mg/100ml). They also rich source of Vitamin A, E, Riboflavin, Niacin, Panthothenic acid, Vitamin B6 and B2.

They also consist 18 different kinds of amino acids of which 8 are essential type. They are high in oleic acid and omega 3 and omega 6 fatty acids. The composition of Sea Buckthorn Berries/Juice is given in the table 1 (Beveridge et. al., 1999).

Health Benefits

There are many health benefits of Seabuckthorn and there are more than 100 popular formulations in various pharmacopoeias of Sowa Rigpa (Tibetan medicine) (Stobdan and Phunchok, 2017). They are rich in flavanoids which are helpful to reduce cholesterol level and improve cardiac function. The seed oil is used as sunscreen as it absorbs UV-B range light (290-320 nm).

The oil has high R-tocopherol content that has high antioxidant property. They are used to alleviate clinical neurological symptoms as an anticancer agent. They are used in the prevention and treatment of peptic ulcer, wound healing, cure eye burns. To relieve chronic eczema, cure dermatitis, and maintain healthy skin.

Table 1: Composition of Sea Buckthorn Berries/Juice:

Attributes (Units)	Average
Fruit weight (mg)	350
Moisture content (%)	82.3
Juice oil content (%)	0.90
Specific gravity	1.03797
Total carotenoid (mg/100 g)	16.9

Vitamin C (mg/100 g)	709
Soluble sugars (°Brix)	11.4
Glucose (% of total)	54.2
Fructose (% of total)	45.4

(Beveridge et. al., 1999)

Historical Background

Seabuckthorn has an interesting historical background. The medical value was recorded as early as the 8th century in the Tibetan medicine classic called as rGyud Bzi. The three major species in Tibetan medicine were Sa-sTsar (*H. tibetana*), Bar-sTar for *H. rhamnoides* and Nam-sTsar (*H. salicifolia).*

It was on record that Russian cosmonauts used Seabuckthorn beverage to enhance their health and resistance to stress in the outer atmosphere. And it was the first juice used in space which signifies its importance for human health and wellbeing not only on earth but also in outer space as well. It was known that the oil was used by Russian cosmonauts for the protection against harmful radiation.

Value Addition in Seabuckthorn

1. **Beverage:** Naturally extracted juice from the berries (Leh Berry).
2. **Bakery products:** Biscuits containing pulp and leaves. The product is rich in dietary fibre, flavanoids and other phyto-chemicals.
3. **Wine:** Seabuckthorn pulp along with grapes.
4. **Food colorant:** Yellow color isolated from the residues after extraction of pulp.
5. **Animal feed:** left over after extraction of juice like spend pulp and leaves.
6. **Yogurt:** Yogurt containing Seabuckthorn as main constituent along with probiotic bacteria.
7. **Jelly:** mixed fruit jelly along with grapes, papaya, and watermelon. Grape and Seabuckthorn jelly have good organoleptic characteristics (Stobdan and Phunchok, 2017).

Table 2: Distribution of Seabuckthorn in India:

Species	Ladakh	Himachal Pradesh	Uttrakhand	Sikkim
Hippophae rhamnoides	Indus valley, Nubra valley, Suru valley, Changthang valley	Tinu, Gemur, Jispa, Darcha, Sumdoh, Upper Kinnaur, Kiato, Lingthi, Rangrik	--	Nathula
Hippophae salicifolia	--	Upper Kinnaur, Lahual, Kaza	Gangotri, Harsil, Yamunotri valley, Niti, Gori, Budhi, Darma	Lachen, Zema I,II,Iii, Lachung
Hippophae tibetana	Zanskar valley, Changthang valley	Sangrum, Kibbar Takcha	Rajni, Niti,Gomukh, Gori, Milam, Shin-La	North Sikkim
Total Area (Ha)	9,267	1000	2000	800
Area (%)	70.9	7.6	15.3	6.1

(Stobdan and Phunchok, 2017)

Conclusion

Seabuckthorn has great potential in terms of health benefits, products that can be produce from it. It can be the ideal plant for soil preservation methods like soil reclamation, converting barren land into fertile one. It is also a perfect plant in prevention of soil erosion, protection of land from wild animals as a natural fencing plant and also at the same time serve as an enhancement of wildlife in the area.

The potential of the plant has not been fully realized in India and various works can be done for the promotion of this wonder plant. A lot of work has to be done in the field of its propagation and development of elite varieties and hybrids. The harvesting method also needs to be improved and use of improved harvesting machines should be encouraged.

References

1. Beveridge T., Thomas S. C.Li., B. Dave Oomah and Smith A., (1999). Sea Buckthorn Products: Manufacture and Composition. J. Agric. Food Chem. 47:3480-34882.
2. Shah S.R.U., (2015). Root system of Seabuckthorn (Hippophaë rhamnoides L.) Morphology, metabolism and gene expression. Ph.D. thesis. Swedish University of Agricultural Sciences Uppsala
3. Stobdan T. and Phunchok T., (2017).Value Chain analysis of Seabuckthorn (Hippophae rhamnoides L.) in Leh Ladakh.

Online Marketing of Agricultural Products in India

Article ID: 11642

Bairapureddy Hitaishi[1]
[1]Agriculture graduate, PAJANCOA &RI.

With more than 50 % of the population engaged in agriculture and allied activities, India is primarily an agriculture-based economy. Farmers, in their efforts to meet the rising demand are now turning to digital innovations to increase their yields and improve marketing conditions.

What is Online Marketing?

Online marketing is any effort to spread the word about your practice using the internet to reach people. Online marketing includes a wide range of marketing elements than traditional marketing due to the extra channels and marketing mechanisms available.

Online marketing or Digital Marketing in Agriculture industry is to use the new and advanced technologies integrated into single system is to enable farmers to improve food production and marketing environment.

Pandemic and e-Agri Business

COVID-19 has triggered the challenges of supply and demand of agricultural products and highlighted several problems of agricultural marketing for farmers. During the peak pandemic crisis, when supply chain has disrupted and shelves of grocery stores set empty had forced the food producers to destroy everything they produced. So, the farmers are looking at the road with new alternative where they can independently market their products directly to the customers and here comes the need of online marketing.

E-agri business has a pretty good package of advantages and also challenges. The online marketing of agricultural commodities enables the augmentation of number of market outlets that are readily available for producers and consumers, which in turn gives multiple choices to consumers and farmers. It is also a customer convenience service. It promises farmers a real time payment. By modernizing the agriculture industry, customer base is expanded and incredible amount of data can be collected and made available for consumers.

The platform also faces certain challenges which include lack of technical support and management for farmers, product compatibility (few products are highly perishable), lack of customer connections which is highly important in online marketing and also lack of proper package and distribution (Options for getting products ordered online to the customer include self-delivery, shipping/mail delivery, and pick-up by the customer. Each of these options has its own set of advantages and disadvantages that you will need to assess) for Indian farmers.

Examples of Online Agriculture Sites in India

1. Ninja cart is India's largest fresh produce supply chain company that is solving one of the toughest problems in the world through technology.
2. Agrostar is India's leading Agri-tech company is working on the mission of helping farmers win by providing a complete range of agri solutions at the fingertips of farmers.

Several efforts are taken by Government of India and other agencies like e-Nam platform which is a pan India electronic trading portal for agricultural commodities and also Digital India, a flagship programme of GOI with a vision to transform India into a digitally empowered society.

Global Scenario

E-Agribusiness and internet access are revolutionizing the agribusiness in developed countries. It rapidly reached significant position in countries like USA, Canada, UK, etc.

1. In United States, Agroy, an e-commerce platform founded in 2011 that lets farmers connect with other farmers and find wholesale products from around the globe. Commodit Ag, founded in 2017, offers an

online platform of high-quality farmer products such as crop protection and plant nutritional products to agriculture retailers). Agrellus is an online and mobile marketplace founded in 2015 that brings together buyers and sellers of agricultural inputs, services and commodities.

2. In France, Agriconomie founded in 2014, is an online retailer which aims to become the Amazon of agricultural supplies.

3. Yagro in the United Kingdom started off as an online marketplace connecting farmers with their suppliers and seeks to alleviate the pain points experienced by farmers in the purchasing and procurement of inputs by enabling them to request quotes and place orders online.

Conclusion

A global market is now accessible to any business with a Web site. Agroindustry is no exception. However, because agricultural products are perishable, numerous considerations for effective marketing are required. Proper handling and packaging, timely delivery, storage conditions, and knowledge of Internet operations and marketing are crucial.

Kitchen Garden through Natural Farming Method: A Boon During this Pandemic Covid-19

Article ID: 11643

K. Sowndarya[1]

[1]Department of Agricultural Biotechnology, College of Agriculture, Kerala Agricultural University, Vellayani, Thiruvananthapuram- 695522 (Kerala).

Home garden is also called Kitchen Garden. The practice of home garden has been in practice since ancient times. In the village, people used to build a small house garden around their courtyard or behind the house, due to which it is being seen vary widely in the cities as well, it is very important to have balanced nutrition in the daily diet for good health.

It is because adulteration in different types of diets and the use of pesticides made in the field is very harmful for our health. Fruits and Vegetables make their important contribution in maintaining good health and balance of our body so that Vitamin mineral in our body, carbohydrates, fats and bread turned out to be good sources so that we all remain healthy. Regular availability of fruits and vegetables should be maintained, so that the house is small and small near big.

Home garden should be maintained from time to time so that problems and diseases like water logging should be properly managed. From this house garden, daily needs can be fulfilled by producing healthy mother and quality favourite fruits and vegetables.

Need of Balanced Diet Per Person Per Day

According to Indian Council of Medical Research, for balanced diet, an adult person should consume 120 grams of fruits and 300 grams of vegetables per day. 125 grams of green leafy vegetables, 100 grams of root vegetables and 75 grams of all other types of vegetables should be consumed.

Availability of Balanced Diet Per Person

At present, the availability of fruits is 85 grams and the availability of vegetables is 145 grams per person. Fruits and vegetables are a protected diet that protects us from diseases. It is very important for humans to eat fruits and vegetables in the diet in addition to cereal pulses milk every day, because vitamins and minerals are found in sufficient quantity in them, which are very important for the growth and health of the body.

Home Garden Environment

By applying home garden in the house, the environment around the house feels beautiful and calm. In this life of stress, we get various types of diseases so that when we come in contact with tree plants, we get fresh feel the wind and coolness.

During this pandemic COVID-19, villagers can't reach out towards the towns and cities for buying vegetables and fruits, as it is a need to have food on daily basis. Looking upon this, our Organisation People's Action in Development- PAID NGO, K. Nageswar Reddy, Kadapa, Andhra Pradesh got an idea to distribute 12,000 Kitchen (nutritional) garden kits of desi seeds for villagers and farmers and also some seeds for fodder purpose of animals. Till now, he distributed 8,000 Kitchen (nutritional) garden kits. So, these Kitchen (nutritional) garden kits which helps them to rise the vegetables backyard of their houses and makes them to have a daily exercise and also having high nutritional food in their diet. As healthy and hygienic food is crucial to boost up the immunity during this pandemic COVID-19 and rising of vegetables.

Size of the Kitchen Garden

The size of the house garden depends on the availability of land and the number of persons in the family. Generally, a family of 4-5 persons requires 250-300 square meters of land to plan a house garden.

Layout of Kitchen Garden

It is very important to make a map so that we can know which crop to take when planning the garden. There are a few things to keep in mind.

1. When making compost in one corner of the house garden.
2. The position of annual crops and perennial crops should vary in the home garden.
3. The house garden should be dropped from the fence so as not to harm or save the animals.
4. The plants should have different preparation for each crop.
5. Proper management of irrigation and water logging should be done.

Fig.1. Kitchen (Nutritional) Garden kit Poster done by PAID NGO, K. Nageswar Reddy

Benefits of Kitchen Garden

1. Clean and fresh vegetables are available throughout the year.
2. Saves the money.
3. Working in the home garden makes good use of time. Along with exercise
4. The water released from the kitchen and bathroom is also used in the home garden.

Medicinal Importance of Kitchen Garden

1. Bitter gourd is helpful in removing acidosis.
2. Cholera and heat can be avoided with the use of onions.
3. Use of garlic is beneficial in constipation and heart diseases.

Economic Importance of Kitchen Garden

1. Almost all the crops are short term.
2. Only three to four crops can be taken in a year.
3. The crops are less prone to diseases due to being short term.
4. Save's money throughout the year.
5. Vegetables also have a versatile crop cycle.
6. Can be adopted, there is less stress due to contact with tree plants, so there is no need to go to the doctor.

Fig.2. Home Kitchen Garden

Fig.3. PAID NGO K. Nageswar Reddy, Kadapa, Andhra Pradesh in Home Kitchen Garden

Cropping Plan

Before sowing, it is also necessary to prepare a cropping plan in natural farming method so that we know exactly which crop is sown at what time and when, including the status of the beds, crop cycle for different beds, time of sowing etc. should be done.

1. The crop cycle should be such that vegetables are available continuously throughout the year.
2. The crops should be planted on the ridges.
3. Foliar crops should be used on the fence. Like in winter: Beans and peas. Summer: Cucumber, bitter gourd.

Before sowing seeds should be treated with beejamrutha. The seeds soaked with Beejamrutha helps to control the seed's disease, which increases seed germination. Timely spraying of jeevamrutha for growth of the plant and also helps to prevent fungal and bacterial plant diseases.

During rainy season, lady finger gourd etc. should be applied.

Best Plants to Grow in Kitchen Garden

Amaranthus: Amaranth is a plant. The leaf contains a small amount of vitamin-C. Amaranth is used for ulcers, diarrhoea, and swollen mouth and throat. It is also used to treat high cholesterol. In foods, amaranth is used as a cereal grain.

Lettuce: This one is a very fast-growing vegetable that can tolerate shade and moderate temperatures too. It is quite ideas for small garden spaces.

Gongura: Gongura contains high fibre content. Gongura leaves are rich with dietary fibre and these leaves contain various vitamins that benefit for the body health. Gongura rich in minerals, ease digestive, avoid fat absorption, helps in weight management and improve metabolic rate and anti-oxidant.

Radish: Radish is one vegetable that works well for salads and soups. Just like carrots, radishes will grow well in loose dirt but don't overcrowd the seeds.

Lady's Finger: Lady's Finger aids weight loss, lowers cholesterol, helps control blood sugar, helps in better digestion, builds immunity, improves anaemic condition, better eyesight and helps in hair health.

Cluster Bean: Cluster bean contains full of nutrients, great for diabetics, beneficial for the cardio health, make bone strong, better blood circulation, recommended during pregnancy, stimulates bowel movement, and do away with diseases.

Bitter gourd: Bitter gourd packs several important nutrients. It is a great source of several key nutrients, help reduce blood sugar, may have cancer-fighting properties, could decrease cholesterol levels, may aid weight loss, versatile and delicious.

Green beans: One of the most popular home-grown vegetables is green beans as they need a lot of sunlight and moderately rich soil. Green beans are loaded with vitamins C, K and folate.

Bottle gourd: Reduces stress, benefits the heart and skin, helps in weight loss, helps in treating sleeping disorders, prevent premature greying of hair, helps in digestion.

Ridge gourd: The significant amounts of vitamin A in ridge gourd, in the form of beta carotene, contribute to improving eyesight even at an older age, remedies anaemia, promotes weight loss, relieves constipation, and protects liver function.

Pumpkin: Pumpkin contains full of valuable nutrients, high in antioxidants, linked to a reduced risk of certain cancers, improve prostate and bladder health, very high in magnesium, may improve heart health, can lower blood sugar levels, high in fibre.

Carrot: It's a good thing to grow carrots at home as they are loaded with vitamin A. Carrots need soft soil which can be well-drained. Make sure your soil isn't too moist or else it will start attracting wireworms.

Beets: A very high in fibre vegetable, beets are loaded with vitamins A and C. They easily grow from seeds and need loose soil. Make sure you plant them in late summers or sprint time as they prefer acid and loamy soil.

Role of Phytomelatonin in Growth and Stress Management in Agricultural Crops

Article ID: 11644

Srikanth Bathula[1], Veerendra Jaldhani[2]
[1]Crop Physiology, PJTSAU, Rajendranagar, Hyderabad.
[2]Crop Improvement Section, IIRR, Rajendranagar, Hyderabad.

Introduction

Melatonin is one of the critical molecules among living organisms which functions as a secondary metabolite engaged with various natural, hormonal, and physiological mechanisms in the cell, tissue, and organ levels. Melatonin is the final product of the Tryptophan Metabolic Pathway (TMP). In agriculture, the role of melatonin becomes very crucial because of the investigation of its involvement in the increase of biomass, germination of seeds, improvement in the photosynthetic activities, fruit ripening, delayed flowering, and tolerance in the different types of biotic and biotic stresses (Asif et al., 2020). Due to the amphipathic, melatonin can move across the membranes, which makes them an essential molecule in agriculture, and cross-talk with different plant hormones is a crucial mechanism for various abiotic stress tolerance in agriculture crops (Mukherjee, 2018). It is essential to focus on the importance of melatonin in agriculture to determine the motive of applying exogenous melatonin in agriculture. Exogenous melatonin can be easily absorbed by plant roots. So total amount of the melatonin in plants was observed to be higher due to the increase of melatonin in leaves, but their endogenous synthesis under different stress is still under investigation. The higher concentration of melatonin can protect plants from excess water (water stress) and soil pollutants, other environmental stresses like UV-radiation, etc.

Role of Melatonin in Plant Stress Management

It can be discerned that melatonin has a vital role in the plant kingdom due to its capacity to synthesize at a molecular level and activate plant growth level while enhancing its hydroxyl antioxidant capacity. The studies and reviews indicate enough scope for further research in ascertaining the role of phytomelatonin in the total gamut of plant physiology and plant protection. Melatonin could directly scavenge ROS under various abiotic and biotic stresses, generating these stresses as a powerful antioxidant, thus promoting plants' stress resistance (Reiter et al., 2018). Though the role of phytomelatonin against selective abiotic stresses is widely reported, more research still needs to be done on the responses generated from specific plant parts and the conduction of signals. Effects of melatonin and its role in maize roots and leaves during drought conditions by comparing ROS accumulation and function of antioxidant enzymes were studied. The study concluded that melatonin was instrumental in addressing the increase in ROS, cell death, and deterioration of D1 protein. The outcome of leaf senescence in kiwifruit by giving a pretreatment of an exogenously applied melatonin indicated a significant reduction in membrane damage. Also, a reduced concentration of hydrogen peroxide was found with the increased activity of some antioxidant enzymes, resulting in Melatonin's potentially useful melatonin delaying the aging of kiwifruit leaves. Apart from this, the relationship between exogenous melatonin in osmopriming of cucumber and antioxidant defense concluded the decisive role of melatonin in the growth of cucumber seeds and young seedlings oxidative stress. Melatonin is one of the critical molecules which detoxify the cells from the excess generation of ROS. It can not only reduce the ROS but also balance the group of reactions which are responsible for the development of ROS factors.

Melatonin has also been effective against various abiotic stresses, including heavy metals, drought, UV radiation and toxic chemicals. Plant species having a lower concentration of melatonin showed their vulnerability to the presence of ozone in contrast to the relatively tolerant species for ozone. Similarly, the plant species grown in Alpine and Mediterranean regions are exposed to high UV radiations, and have a higher concentration of melatonin than the species grown away from these regions. It was reported that when the seeds of *Brassica oleracea* were pre-soaked in melatonin, copper ions did not exhibit any toxic effect on seed germination and inital growth phases. Researchers suggested that increased melatonin concentration and reduced levels of malondialdehyde was observed in transgenic rice plants, along with elevated levels of activities of enzymes like catalase and superoxide dismutase as compared to control samples. There are several reports of involvement of melatonin in enhancing physiological processes such as improving germination and ripening process, photosynthetic activities, biomass production, root system development, and managing abiotic stresses. However, recent researches and reviews reported that melatonin plays an instrumental role in managing biotic stresses and inducing gene expression in plants, which help to cope with different stresses. It was also reported that there is a significant role of endogenous melatonin in regulating plant growth attributes in various species. To evaluate the concentration of melatonin in plants, many sensitive detection methods, and assays are available that include radioimmunoassay, ELISA, gas chromatography-mass spectrometry, and high-performance liquid chromatography, HPLC-electrochemical detection, HPLC fluorescence detection (HPLC-FD), and HPLC-mass spectrometry (HPLC-MS) which can detect even the slightest concentrations of the melatonin present in a sample.

Interaction of Melatonin with Auxin, ABA and Salicilic Acid

Melatonin is somehow closely related to auxin in many ways. The structure of melatonin is almost similar to the IAA (Indole-3- Acetic Acid). Most importantly, tryptophan act as precursor molecule for both melatonin and IAA and exhibiting antioxidants properties. They promote plant growth promotion significantly. Melatonin exogenously enhances the development of roots and shoots directly or indirectly with the help of serotonin. It was found that both molecule co participate in plant growth activities. A dose-dependent activity relationship was also observed between melatonin and IAA in root formation. The lower concentration of melatonin in Arabidopsis and mustard roots augmented with the IAA level in the plant system. A water deficiency can likewise trigger the creation of the phytohormone abscisic acid (ABA), which causes stomata to close. Oxidative damage under drought stress is successfully managed by the application of melatonin. It is observed that the level of ABA production was significantly down regulated after the application of melatonin.

It infers ABA production on a genetic level by suppressing the gene responsible for the ABA synthesis. ABA plays an essential role in the stomatal closure with hydrogen peroxide as a signaling molecule. The influence of ion may generate with the increase of the ABA production, resulting in the loss of the turgor and ultimately closure of the stomatal pores. Melatonin may act via receptor dependent and receptor-independent mechanisms. Antioxidant activities doubtless indication of its receptor-independent function. It was also observed that the capacity of phytomelatonin-intervened stomatal closure through controlling H_2O_2 creation was receptor-driven; also, this stomatal closer done with the application of melatonin different from the ABA, which means melatonin has a different receptor than the ABA. Salicylic acid is importantly required in plants for protection against various pathogenic organisms. The discovery of salicylic acid was earlier than melatonin, and both of these not only share a similar precursor, but they are having a significant role in the tolerance of biotic and abiotic stress tolerance. Somehow, they are related in the biosynthetic pathways, but there are no comparative studies to demonstrate the relative effect. These molecules are considered as the stimulants of the photosynthetic pathways also. Melatonin and Salicylic acid are derived from the shikimic acid pathway in synthesis, but their mode of action is different. Melatonin, auxin and salicylic acid are evolved from a common precursor called Chorismate, which are involved in vital functions like signaling and regulation in plants.

Methods of the Exogenous Application of Melatonin

Initially, melatonin was considered as an endogenous plant hormone and antioxidant, but later due to its remarkable properties against biotic and abiotic stress tolerance in plants, its exogenous application is also increasing day by day. Effective treatment of the phytomelatonin is essential for the function against the various types of stresses.

However, several methods like root irrigation and leaf spraying are also used by researchers for the treatment of plants. Some studies indicated that that root irrigation could be a better option. On the other hand, foliar spraying could be effective under drought stress. In many cases, direct soaking treatment was done with the solution of an effective concentration. Soil drenching is also used for the treatment of the plants. On lab-scale research, saturated filter papers are used to study the impact of melatonin.

Conclusion and Way Forward

The attention and care of scientist for melatonin in the field of agriculture have given impetus to the importance of melatonin and establishing it as an important area of further research through systematic, well planned, location-specific, and crop-specific investigations to augment the production and productivity coupled with the improvement in the quality of produce. So far, scientists have indicated beneficial effects of melatonin and opined that it is an essential and useful molecule, but its antagonistic impact, if any, have yet not been envisaged and studied. There is a need to explore the biosynthesis mechanisms of melatonin inducing the resistance to both biotic and abiotic stresses for improved crop production. This may improve the nutritional value of crops and reduce the dependence of humans on synthetic dietary supplements. Melatonin enriched farm produce can potentially prevent the full range of post-harvest losses in different plants. There is a need to identify specific pathways for enhancing the defense mechanism in managing biotic stresses. This may lead us to use melatonin on a commercial scale. This will help reduce the cost of cultivation and promote organic farming and curb the use of chemicals in agriculture. The reaction of foliar use of melatonin to its retention and change of plant development advancement actually should be explored. Above all, melatonin is considered a non-toxic, biodegradable molecule that promotes organic farming.

References

1. Asif, Mehanoor, Pervez, Arshid, Irshad, Usman, Mehmood, Qaisar, Ahmad, Rafiq, 2020. Melatonin and plant growth-promoting rhizobacteria alleviate the cadmium and arsenic stresses and increase the growth of Spinacia oleracea L. Plant Soil Environ. 66, 234–241.
2. Mukherjee, S., 2018. Novel perspectives on the molecular crosstalk mechanisms of serotonin and melatonin in plants. Plant Physiol. Biochem. 132, 33–45.
3. Reiter, R.J., Tan, D.X., Rosales-Corral, S., Galano, A., Zhou, X.J., Xu, B., 2018. Mitochondria: central organelles for melatonin0 s antioxidant and anti-aging actions. Molecules 23 (2), 509.

Processing and Value Addition of Bamboo Shoot for Improving Nutritional Status and Income

Article ID: 11645

Y. Prabhabati Devi[1], Y. Jamuna Devi[2], Kumari Sunita[3]
[1]SMS, Home Sc. KVK, Chandel, ICAR, Manipur Centre.
[2]Asst. Prof. Standard College, Kongba, Imphal East, Manipur.
[3]Krishi Vigyan Kendra, Madhopur, West Champaran.

Introduction

Bamboo shoot is an indigenous health food, extensively prepared from young succulent bamboo. It is consumed as an indispensable constituent of the diet, familiar with social custom of Manipur and neighbouring states since time immemorial. Bamboo shoots are considered as one of the useful health foods because of the rich content of protein, carbohydrate, vitamins, fibre, mineral and very low fat. Freshly collected bamboo shoots are rich sources of dietary fibres and phytosterols and less cholesterol contents which make them one of the popular natural health foods. Bamboo shoot contains tyrocine, arginine, histidine and leucine as amino acid which help to facilitate the biochemical metabolism of our body. It also plays an important role in functioning of thyroid and pituitary gland which are involved in producing and regulating hormones in human body. Presence of high fibre and phytosterol help to reduce fat and cholesterol level of blood which becomes one of the important health foods among the patients with life style related disorder. It also helps to control blood pressure, hypertension, and obesity and also protect our body from coronary diseases and potential carcinogens. Though bamboo shoot provides lots of health benefit, their consumption is confined mostly to South East and North East part of the state. The acceptability of bamboo shoot as popular vegetable crop is very less due to their pungent smell and bitter taste. Bamboo shoot should be properly processed before they are consumed as it contains toxic cyanogenic glycosides, which may cause serious health problem. Bamboo shoot can be processed and preserved through value added product. Through processing and value addition the nutrients content and acceptability can be increased to certain extent. In the traditional method, succulent bamboo shoot sprouts are defoliated, chopped, pressed tightly into the wooden/earthen pots to ferment for 6-12 months Value addition is the process of converting raw bamboo shoot into something new through processing, drying, fermenting and cooking that differentiates the product from raw commodity. It makes the product more nutritive, attractive, and also increases the taste, texture and colour of the product. Promotion of value-added product is essential to minimize post-harvest loses and also to obtain maximum profit. As the bamboo shoot is very healthy and nutritious food item, it helps to increase the nutritional status of people of different age groups by consuming in the form of pickle, chutney, curry and khar item. All the value-added products got high sensorial scores as evaluated by the panelists. The value-added product in the form of pickle also helped to increase the income of the farm women throughout the year by selling the products in the state level exhibition and exporting to the neighbouring states.

Nutritional Value of Fermented Bamboo Shoot (Soibum)

Moisture – 92 %	Carbohydrate – 47 %
PH – 3.9 %	Ca – 16 mg/100 gm.
Acidity – 0.98 %	Na – 2.9 mg/100 gm.
Ash – 13.3 %	K – 212.1 mg/100 gm.
Fat – 3.2 %	Food value – 362.8 kcl/100 gm.
Protein – 36.3 %	-

Medicinal Value of Fermented Bamboo Shoot

1. It helps to control high blood pressure, hypertension, cardio-vascular ailments, and coronary heart disease.
2. It helps in prevention of diabetes and early-stage cancer.

3. It helps to reduce reproductive health related problems in women.
4. It helps in irregular menstrual cycle, heavy bleeding after delivery
5. It helps in improving the infertility problem of women
6. It also helped in inducing puberty in young girls.

Steps for Making Fermented Bambooshoot (Soibum)

Succulent bamboo shoot sprouts

↓

Defoliated and chopped slices

↓

Press tightly into the bamboo or earthen chamber

↓

Solid state fermentation (6 months to 1 year)

↓

Soibum

Some of the Value-Added Fermented Bamboo Shoot Products

Fermented bamboo shoot curry (process of making):

a. Wash bamboo shoot with hot water for 4/5 times to remove bitter acidic taste.
b. Heat oil in kadai till white fumes comes out.
c. Fry bori (chunk) till it turns slightly brown.
d. Add jeera whole and napakpi root and napakpi and nakupi leaf – fry till it turns brown.
e. Add properly washed and cut soibum – stir slowly. Cook for about 15 minutes till the bamboo slices turns slightly brown.
f. Add potato cube/piece, napakpi and nakupi leaf green chilli, continue cooking in low flame.
g. Add haldi and besan, mix, cook for 5 minutes.
h. Add about 3 litres water, continue cooking.
i. Add few pieces of heiribob and salt, now add bori.
j. Add another 500 ml. water and cook for 3 to 4 minutes.
k. Remove off the flame, add leafy dhania.

Fermented bamboo shoot chutney (process of making):

a. Wash young tender leaf. Boil with bean/potato and chilli.
b. Strain water and wash with motar. Make paste of chilli and fermented fish with salt.
c. Mix the chilli paste with mashed auriculata leaf and bean. Then add remaining extracted water and mix properly.
d. Now it is ready to serve.

Fermented bamboo shoot pickle (process of making):

a. Select tender bamboo shoot and remove outer scale, peel thinly.
b. Clean, cut and blanch fermented bamboo shoot and soak in water overnight.
c. Drain out water and blanch in boiling water for 5 minutes.
d. Heat oil, fry mustard seed till it starts spluttering, add ground garlic, ginger and mix well.
e. Add blanched bamboo shoot slices to the fried spices and mix well.
f. Add remaining spices, salt, sugar, chilli powder, acetic acid and cook for few minutes till it blended well.
g. Cool down and fill in pre-sterilized bottle.
h. Ensure a thin layer of oil at the top.

i. Seal and store in dry place.

				
Bamboo shoot	**Fermented bambooshoot**	**Fermented bambooshoot curry**	**Fermented bambooshoot chutney**	**Fermented bambooshoot pickle**

Conclusion

Bamboo shoot is an indigenous health food which is an indispensable constituent of the diet, familiar with social custom of Manipur and neighbouring states since time immemorial. Though this food provides lots of health benefits, the acceptability is very less due to high pungent smell and bitter acidic taste. Through processing and value addition the nutrients content and acceptability can be increased to certain extent. Processing is one of the important factors for increasing the nutrient of the products as well as to increase the shelf life of the products. The processed products can also help to increase the income of the farm women throughout the year without much investment from the local resources. This product also helps to increase the nutritional status of people different age groups. So, bamboo, shoot product should be consumed during season in order to have a healthy body and also to increase nutritional status as a whole.

References

1. Nongdam,P and Tikendra,L. 2014. The nutritional facts of bamboo shoots and their usageas important traditional foods of Northeast India,International Scholarly Research Notices.
2. Singhal,P.Mohan Bal,L,Satya,S.Sudhakar,P. and Naik,S.N.2013.Bamboo shoots: A novel source of nutrition and medicine Critical Reviews in Food and Nutrition.
3. Bahadur,K.N.and Jain S.S.1981.Rare bamboo shoot of India.Indian J.Forestr 4(4).

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Role of Insect Ecology in Organic Agriculture

Article ID: 11646

Abhibandana Das[1], Srishti Choudhury[2], S. K. Sahoo[3]
[1]M.Sc. (Ag.) Student, [2]M.Sc. (Ag.) Student,[3]Associate Professor,
Department of Entomology, Post Graduate College of Agriculture,
Dr. Rajendra Prasad Central Agricultural University, Pusa (Bihar).

Introduction

The necessity to meet food requirement of the ever-growing human population around the world has made agriculture become dependent on external inputs, like pesticides, to have a fast-paced increase in agricultural production. But most of the chemical pesticides and other agrochemicals used in conventional farming have a negative impact on the environment, ecological balance and biodiversity as a whole. Here enters the concept of organic agriculture which provides an environmentally safer farming approach and a healthy lifestyle to humans. An ecological understanding of insects is very important in the successful designing of an organic farm plan. Arthropods like insects have numerous beneficial ecological roles as pollinators, predators etc. in agricultural and natural ecosystems. To attain the goal of sustainable organic agriculture, we need to reconsider the role of insects in agricultural ecosystems. Recognizing the function of insects in ecosystems help us to comprehend their significance in sustainable functioning of agricultural systems and their role in future food security.

Why Organic Agriculture?

Organic farming is a holistic production approach that promotes and enhances agro-ecosystem health, including biodiversity without the use of chemical inputs. It depends on ecological processes and biodiversity instead of using inputs with adverse effects. An organic approach helps the farmer in creating a healthy balance between farming and nature, enabling crops and animals to coexist. There are ample of reasons to go for organic farming, some of which are listed below:

1. Lowers the toxic load by preventing chemicals and pollutants from entering the soil, air, water and our bodies. Environmental safety and sustainability are ensured.
2. Food security is ensured: There are no harmful residues or adulteration in food.
3. Feeding the soil with organic matter instead of synthetic fertilizers increase the nutrient content in produce by improving levels of vitamins and minerals in them.
4. Ensures better tastes and a more authentic flavour: According to new studies, organic produce has less nitrates and more antioxidants compared to conventional food.
5. Promotes biodiversity: A buzz of animal, bird and insect activity can be observed while visiting an organic farm. A good farm is one where the native flora and wildlife have lost acreage without going extinct.
6. Rich or poor, people from every economical background favour a meal which is ‘safe’ for them. As the awareness for food safety grows among people, the demand of ‘organic’ also goes high and hence organic food industry is rapidly growing and ensures high profitability.

Insect Ecology and its Importance

In 1869, Haeckel defined ecology as “the study of the natural environment including the relations of the organisms to one another and to their surroundings”. When ecological studies primarily focus on insect as the subject organism and the environmental interactions and effects encircling it, this becomes insect ecology.

Insect ecology studies the interaction of insects with their surrounding environment or ecosystem, either at an individual level or at a community level. Besides the common fields in ecology, insect ecology deals with population dynamics, abundance and distribution of insect population, their survival adaptations and their implication in an ecosystem. Insects play a very crucial role in any agroecosystem. Thus, we require to have a good knowledge of insect behaviour and their intra and interspecific interactions with others insect, animal species and plants. In all terrestrial ecosystems’ insects seen to form the basic biological foundation. They offer a significant food supply for other taxa, cycle nutrients, pollinate plants, distribute seeds, manage populations of other creatures and maintain soil fertility. Since organic agriculture does not support the use of chemicals and only accept approved, non-synthetic or synthetic materials as a last resort when other control measures fail, it becomes even more important to understand the role played by insect ecology to manage insects present in a farming system before it reaches injurious level and compels an organic farmer to take help of the last standing guards.

Role of Insect Ecology in Organic Farming System

The knowledge of insect ecology can be applied in an organic farming system to bring effective disease, insect and weed control, along with improving soil health and increasing crop yield.

1. Application of insect life table: A life table is a kind of bookkeeping system which ecologists use to summarise mortality at different life stages of the population they study. By studying the life table, the stage at which the subject insect is most vulnerable i.e., the stage in which maximum mortality is faced by the insect population can be determined. A life table also includes the factors responsible in causing mortality to that stage. Stage specific application of natural and botanical pesticides at the recognised vulnerable stage of the pest insect and other management practices increases efficiency in pest control with minimal expenditure of labour, resource and money.

2. Population distribution pattern: For effective pest management the first step is to identify the pest and know its distribution pattern. Individuals of the same population remain distributed in three patterns-

- **a. Clumped:** Where individuals of a population are found scattered in groups.
- **b. Uniform:** Where due to severe competition between individuals they are evenly spaced and tend to be as far apart from each other and
- **c. Random:** Where the probability of locating an individual at a point in a populated area is equal for all the points.

In agricultural systems, insects are most commonly found aggregated or clumped. Identification of their location allows target specific (localised) application of control measures. This localised approach brings down the cost of control and also manages pest more efficiently in organic farm plan.

3. Study of insect biology: Knowledge of the pest behaviour allows the farmer to choose an appropriate control measure. For example, if a crop is being infected by a nocturnal insect, then installation of light traps will provide better control and relieve the farmer from adopting any kind of spray at all. Many diapausing insects and pupa hide beneath soil surface, under crop litter, between leaf sheath etc. Hand picking them or destroying of their hiding location will help reduce pest population. One cultural method used in paddy fields is clipping-off of the leaf tips before transplanting as rice stem borer lay eggs at the tip of leaves.

4. Seasonal or cyclic patterns in behaviour: Cultural practices like selection of resistant varieties, date of sowing and prophylactic spraying can be adjusted based on understanding of phenological behavioural patterns like migration timing, plant stage attacked, diapause period.

5. Identification and conservation of beneficial insects: It is necessary to avoid accidental killing of beneficial insects. Beneficial insects are widely categorised as pollinators (honeybee, syrphid), natural enemies (predator-lady bird beetle, aphid lions: parasites and parasitoids- Strepsiptera order) and decomposers (dung beetle).

6. Ecosystem Recycling: Bacteria and insects (decomposers) convert the mineral elements present in soil and air into forms that could be taken by plants to aid in their growth. Hence, they play an important role in moving above-ground to below-ground nitrogen and phosphorus fluxes across entire ecosystems.

7. Weed management schemes: Identification, introduction and conservation of insects feeding on specifically on weeds can help reduce their number. For example, *Zygogramma bicolorata* is introduced in fields to feed and control carrot grass Parthenium species.

8. Implementation of Ecological Pest Management (EPM): Ecological pest management relies on above and below ground preventive strategies to build a farm's natural defences. Reactive strategies are only kept as a last resort. The broad strategies used in EPM are: crop management, soil management, planned supplemental pest management practices, planned supplemental soil practices to reduce crop stress and optimise yield and quality, reactive inputs for pest management and reactive inputs to reduce plant stress.

9. Maintaining and conserving insect species biodiversity: Increase in the diversity of parasitoids and predators is related to reduction in pest population outbreaks. In organic agriculture, a proactive strategy to support complimentary or synergistic effects of predator for pest control necessitate biodiversity management based on biological knowledge of interacting species and functional food webs. Enhanced biodiversity led to effective biological control of pests, pest dilution effects and can compensate for the absence and reduce dependency on synthetic pesticides.

10. Functional importance of species diversity: Functional characteristics of the species determine the properties of the ecosystem. For managing an agricultural pest, we require a natural enemy who will specifically feed on that insect pest and provide desirable control. If it has a broad range of prey, the effectivity of control will decrease.

Conclusion

With this knowledge of insect ecology, an organic farmer can design a farm plan that takes advantage of the beneficial roles played by insects. Successful organic farm managers utilize their ecological knowledge of insects to use them as friends in maintenance and improvement of their natural resource base. Future research in sustainable and organic agriculture should thus focus on the role of insects in natural and agricultural ecosystems.

Brief Notes on *Cassia tora* and its Unit Operations Involved for Production of Gums

Article ID: 11647

Palmei Gaibimei[1], Haraprasad Naiya[2]
[1]Scientist, ICAR- Indian Institute of Natural Resins and Gums, Ranchi-834010.
[2]Technical Assistant, ICAR- Indian Institute of Natural Resins and Gums, Ranchi-834010.

Abstract
Cassia tora is a weed grown broadly scatters throughout India's tropical regions. This plant was reported to have important phytochemical properties and applications in food and non-food products. They have notably been used in medicine and food industry. The seed contains gums which have favorable viscosity with high water retention ability and for production of this gum, several unit operations are involved.

Introduction
Cassia tora Linn (Syn. Senna tora Linn.), a member of Caesalpiniaceae family (Subfamily: Caesalpinioideae, tribe: Cassieae, sub tribe: Cassiinae) known commonly as sickle senna (Kumar et. al., 2018), is a wild annual herb native to the palaeotropical zone (Africa and Asia to eastward Polynesia) grown widely distributed across the world's tropical and sub-tropical regions. This plant is common throughout Bengal and in Maharashtra during rainy season. In the midlands and mountains, it grows wild along roadside and field margins in dry soil in tropical areas, as well as high hills with elevations of up to 1800 meters. The gifts and proficiency to withstand lots of stress make it incredibly simple for the plant to grow (Shadab et. al., 2019).

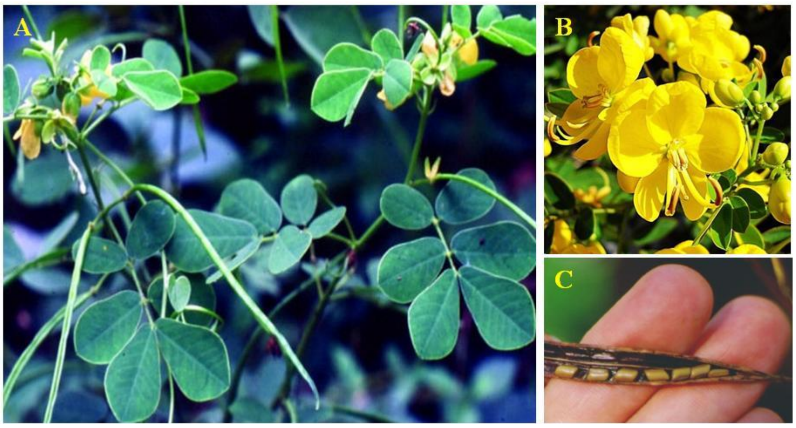


Fig 1: Different parts of *Cassia tora* plant
(A) Shoot part of the plant (B) Flower (C) Pod with the seed of *Cassia tora* plant.

Morphology
Cassia tora is a 30–90 cm tall annual foetid herb. Leaflets are in three pairs, distinctly petioled, opposite, conical at one end, ovate, oblong, and base oblique (Fig 1A). Leaves are green in colour, pinnate, up to 6-8cm long, leaflets are in three pairs, distinctly petioles, opposite, conical at one end. Flowers (Fig 1B) are light yellow in colour and grow in nearly sessile pairs in the axils of the leaves. They have five petals, the upper two of which are densely packed. Pods (Fig 1C) are 6-12 inches long, incompletely septate, and membranous, with numerous brown oblong rhombohedral seeds (Shadab et. al., 2019).

Importance and its Application
Medicines: The medicinal value of various parts *Cassia tora* such as leaves, seed, and root is well known for treating a variety of diseases in traditional medicine. The seeds and leaves are used to treat diverse skin conditions, most notably ringworm and itching. According to Unani literature, the seeds of *Cassia tora* are blood purifier enabling to treat both internally and externally affected skin diseases like leprosy,

ringworm, pityriasis, vitiligo, and melisma (Pawar and D'mello, 2011, Joshi and Biyani, 2015). Vitiligo is treated with a paste made from leaves and lime juice (Shadab *et. al.,* 2019). The important phytochemical properties reported for this plant are antiproliferative, hypolipidemic, immunostimulatory, anticancer, antimutagenic, and hepatoprotective properties (Meena *et. al.,* 2010). Due to these properties, several chemical compounds such as anthraquinone glycosides, naphthopyrone glycosides, phenolic compounds, flavonoids, etc. have been isolated from this plant for its implication usage in medicines (Pawar and D'mello, 2011).

Food industry: Cassia gums were used as a human food supplement, as well as pet food and cattle feed in Europe, India, and Japan. The plant contains around 1-2 % cassia oil making spicy aroma and a great taste in human food. These gums were a natural ingredient used in dairy, meat, poultry, personal care, and pharmaceutical products as a thickener, moisture retention agent, stabilizer, emulsifier, and texturizing agent (Mann *et. al.,* 2007). The roasted gum seed were also used as a coffee substitute.

Others: Indians use cassia gum powder, produced from *cassia tora* seeds and cassia breaks, as a pesticide as replacement of synthetic man made and sold at exorbitant rates. The mixture of tora gum powder and guar gum are also used in mining applications.

Physiochemical Property of *Cassia tora* Gum

Cassia gums is a free-flowing powder having favourable viscosity with high water retention ability, the pH of the 1% dispersion means that it is suitable for a variety of oral and topical dosage types (Joshi and Biyani, 2015). It is sparingly soluble in cold water and forms dispersion in warm water but insoluble in semi-polar and organic solvents. It is predominantly made up of a linear chain of 1, 4-ß-D-mannopyranose units connected by 1, 6 linked α-D galactopyranose units and contains at least 75% polysaccharide. Mannose to galactose is around a 5:1 ratio. The sugar analysis performed using HPLC showed the following composition: mannose (77.2-78.9%), galactose (15.7-14.7%), and glucose (7.1-6.3 %) (Mahungu and Meyland, 2008).

Unit Operations Involved in Extraction of *Cassia tora* Gum

Gum made from *Cassia tora* seeds were sometimes referred to as "Ponwar gum" (Pawar and D'mello, 2011). The seed comprises of an outer husk, an endosperm (split) and the ovary. These gums were made entirely from the endosperm which primarily composed of polysaccharides. The unit operations involved in extraction of gum using solvent precipitation method consists of following steps (Pawar and Lalitha, 2015).

Preparation of Samples

The seeds (Fig 2A) were separated and collected from matured pods then dried in shade and store in cool place till further use.

Splitting, Milling and Screening of Seeds

The dried seeds were dehusked and degermed by mechanical treatment such as roasting at 100-200 ºC for 2-10 min, followed by milling them coarsely (Fig 2B) by grinder and screening of the endosperm using sieve size of 35 BIS. The endosperm (split) remains intact and flexible during roasting, while the husk and germ, which are more sensitive to heat, become brittle.

Defatting of Seeds

For removing lipids or fats, the coarsely grinded endosperm was soaked in benzene-ethanol solution (1:1) overnight. The solution was drained and then dried in vacuum oven.

Extraction of Gums

The defatted powder was first soaked in distilled water in the ratio of 1:20 g/ml and then stirred for 3-4 hrs under overhead stirrer. After stirring, viscous solution obtained were filter properly using muslin cloth. The mucilage was collected while the marc obtained after filtration was again soaked with same amount of distilled water and boil for 1 hr and this cycle undergo multiple extractions until the marc becomes free from mucilage. All the viscous mucilage obtained were collected and mixed together.

Precipitation of Gums

To the mixture, an equal quantity of 10 % trichloro-acetic acid was added to precipitate the protein and the solution were centrifuged at 5100 rpm for 10 min. The supernatant was collected and precipitated by adding acetone in the ratio of 1:0.5 (v/v) with continuous stirring.

Drying of Gums

The white mass which is the coagulated mucilage were dried at vacuum oven at 40 °C, powdered (Fig 2C) and stored in airtight containers.

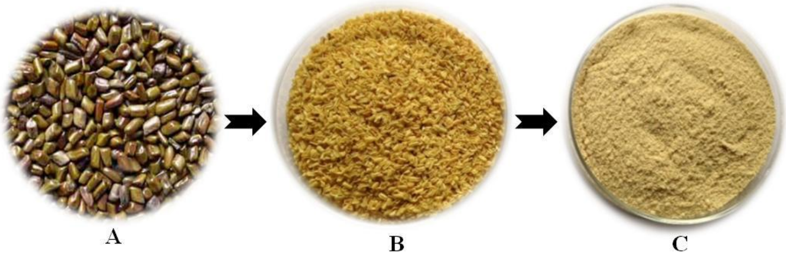


Fig 2: Cassia Gum powder isolated from the seed of the plant.
(A) Seed of Cassia tora (B) The endosperm (split) (C) Cassia Gum powder

Conclusion

Cassia tora though being a weed have many health benefiting properties and applications in various fields. A plant of such potential is not to be ignored and taken into account and given its credibility for researching to a greater extent and production of more innovative valuable products. This review gives a sense of looking into wider application of underutilised seed and giving an alternative source of gums other than forest waste and production of functional products in the future.

References

1. Joshi U. M. and Biyani K. R., (2015). Extraction of a Novel Seed Gum from Cassia tora Seeds and its Characterization. International Journal of Pharmacy & Pharmaceutical Research, Human. 4(1):243-251.
2. Jain S. and Patil U. K., (2010). Phytochemical and pharmacological profile of Cassia tora Linn.-An Overview. Indian Journal of Natural Products and Resources. 1(4): 430-437.
3. Kumar V. and Roy B. K., (2018). Population authentication of the traditional medicinal plant Cassia tora L. based on ISSR markers and FTIR analysis. Scientific Reports. 8(1): 1-11.
4. Mann A. S., Jain N. K. and Kharya M. D., (2007). Evaluation of the suspending properties of Cassia tora mucilage on sulphadimidine suspension. Asian J Exp Sci. 21(1): 63-67.
5. Mahungu S. M. and Meyland I., (2008). Cassia gum, chemical and technical assessment (CTA). Brussels, Belgium.
6. Meena A. K., Niranjan U. S., Yadav A. K., Singh B., Nagariya A. K. and Rao M., (2010). Cassia tora Linn: A review on its ethnobotany, phytochemical and pharmacological profile. Journal of Pharmacy Research. 3(3): 557-560.
7. Pawar H. A., and D'mello P. M., (2011). Cassia tora Linn.: an overview. International journal of pharmaceutical sciences and research. 2(9): 2286.
8. Pawar H. A. and Lalitha K. G. (2014). Isolation, purification and characterization of Galactomannans as ans Excipient from Senna tora seeds. International Journal of biological macromolecules. 65: 167- 175.
9. Shadab M., Shamsi S., and Ahmad I., (2019). Cassia tora Linn: A medicinal herb for skin diseases. Journal of Emerging Technologies and Innovative Research. 6(3): 97-104.

Effect of Water Stress on Growth and Yield of Crops

Article ID: 11648

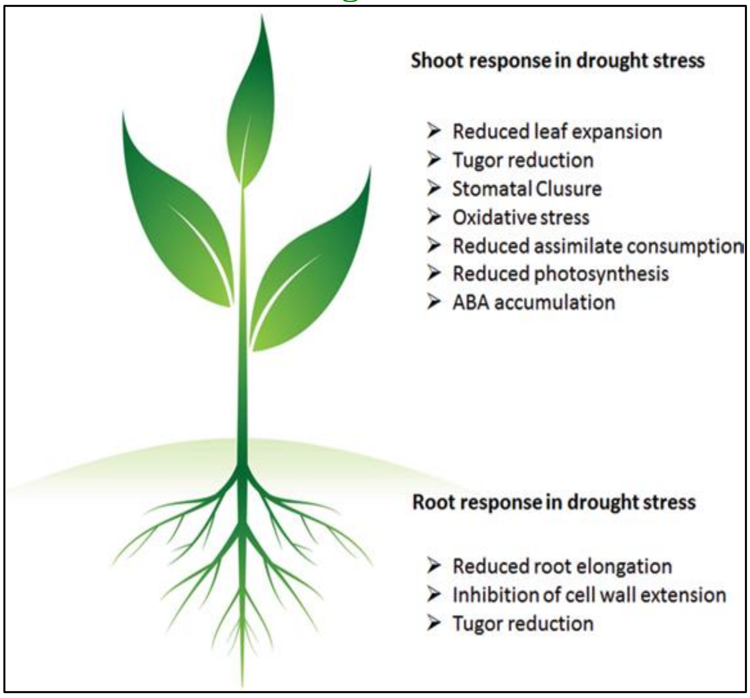
P. Prakash[1], E. Sobhana[2], P. Sujithra[2]
[1]Assistant Professor (Agronomy), S. Thangapazham Agricultural College (Affiliated to Tamil Nadu Agricultural University), Vasudevanallur, Tenkasi – 627 760.
[2]Research Scholar, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai – 625 104.

Introduction

Agricultural production is directly affected by climate variables such as temperature and precipitation. These variables control crop growth and health, annual crop yield over time. Climate extremes are expected to increase with climate change, which may negatively affect crop production. Study on the effects of climate extremes on crop production and on developing adaptation measures for rainfed and irrigated crops more important because declining of groundwater due to continuous drought.

Projected climate changes comprise more frequent weather extremes, including drought, which will affect many aspects of life, including water resources, health and prosperity of the inhabitants and agriculture. Drought a devastating natural hazard, affects a significant proportion of the global population, particularly those living in semi-arid and arid regions. The percentage of the planet affected by drought has more than doubled in the last 40 years and in the same timespan droughts have affected more people worldwide than any other natural hazard. Water deficit resulting from drought reduces crop yield because of its negative impacts on plant growth (Karl et al., 2009).

Physiological Response of Plants to Drought



(Iqbal et al., 2020)

Effect of Drought on Photosynthesis

1. One of the key physiological phenomena affected by the drought and heat stress in plants is photosynthesis.
2. It is mainly affected due to reduced leaf expansion, improper functioning of the photosynthetic machinery and leaf senescence (Wahid et al., 2007).

3. Stomatal closure under drought reduces the CO2 availability which makes plant more susceptible to photo damage (Lawlor and Cornic 2002).
4. The reduced moisture availability induces negative changes in photosynthetic pigments, damages the photosynthetic machinery and impairs the performance of important enzymes causing considerable loses in plant growth and yield (Monakhova and Chernyadev 2002).

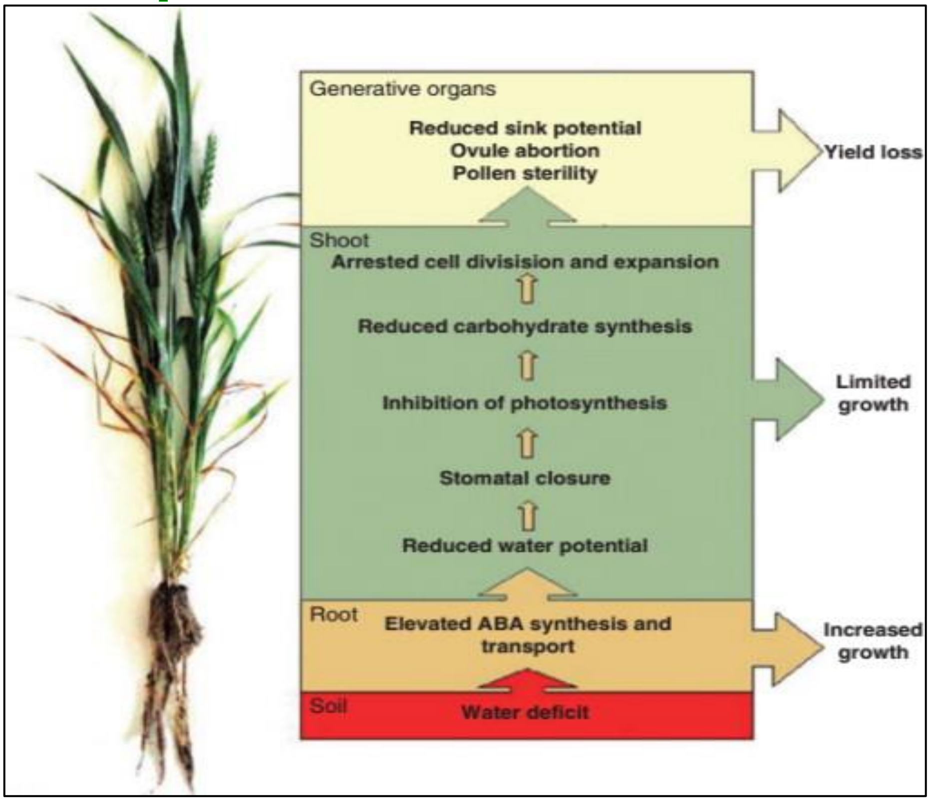
Effect of Drought on Growth of Crops

1. The preliminary consequence of drought conditions on plants is the deprived rate of germination and abridged formation of seedling (Hatzig et al. 2018).
2. Reduction of root/shoot dry weight, undersized length of hypocotyl and poor vegetative growth (Zeid and Shedeed 2006).
3. Cell division and differentiation, followed by cell enlargement, are the basic requirement of plant growth, but due to drought stress, cell elongation and mitosis are affected which results in reduced growth of plant (Farooq et al. 2009).

Effect of Drought on the Yield of Crops

1. With consideration of crop production, yield is mainly the multifarious amalgamation of the diverse physiological progressions. Drought stress reduces the time of anthesis at pre-anthesis stage, which further affects the fillings of the cereals (Ali et al. 2017).
2. Declining of photosynthesis rate, reduction of assimilate partitioning and meagre leaf development due to water stress conditions resulting in declined yield (Flexas et al. 2004).

Effect of Drought on Crops



(Karim and Rahman, 2015)

Conclusion

Globally drought stresses are vital limiting factor for the productivity of crops. Plants express an extensive series of reactions towards drought conditions that are generally shown by a range of modifications in the morphology, physiology and biochemical parameters of the plants. Though drought stress conditions might cause undesirable effects on general growth and development of plant, but mainly affect the reproductive growth of the plants.

References

1. Ali S, Liu Y, Ishaq M, Shah T, Abdullah IA, Din IU (2017) Climate change and its impact on the yield of major food crops: evidence from Pakistan. Foods 6(6):39.
2. Farooq M, Wahid A, Kobayashi ND, Fujita SMAB (2009) Plant drought stress: effects, mechanisms and management. Agron Sustain Dev 29(1):185–212.
3. Flexas J, Bota J, Loreto F, Cornic G, Sharkey TD (2004) Diffusive and metabolic limitations to photosynthesis under drought and salinity in C3 plants. Plant Biol 6:269–279.
4. Hatzig SV, Nuppenau JN, Snowdon RJ, Schießl SV (2018) Drought stress has transgenerational effects on seeds and seedlings in winter oilseed rape (Brassica napus L.). BMC Plant Biol 18:297.
5. Iqbal M.S., Singh A.K., Ansari M.I. (2020) Effect of Drought Stress on Crop Production. In: Rakshit A., Singh H., Singh A., Singh U., Fraceto L. (eds) New Frontiers in Stress Management for Durable Agriculture. Springer, Singapore.
6. Karim, R. Md and Rahman M.A. 2015. Drought risk management for increased cereal production in Asian Least Developed Countries / Weather and Climate Extremes, 7: 24–35.
7. Karl, T.R., J.M. Melillo, and T.C. Peterson, editors. 2009. Global climate change impacts in the United States. Cambridge Univ. Press, Cambridge, UK.
8. Lawlor, D. W., and Cornic, G. (2002). Photosynthetic carbon assimilation and associated metabolism in relation to water deficits in higher plants. Plant Cell Environ. 25, 275–294.
9. Monakhova, O. F., and Chernyadev, I. I. (2002). Protective role of kartolin-4 in wheat plants exposed to soil drought. App. Biochem. Microbiol. 38, 373–380.
10. Wahid, A., and Shabbir, A. (2005). Induction of heat stress tolerance in barley seedlings by pre-sowing seed treatment with glycinebetaine. Plant Growth Regul. 46, 133–141. doi: 10.1007/s10725-005-8379-5.
11. Zeid IM, Shedeed ZA (2006) Response of alfalfa to putrescine treatment under drought stress. Biol Plant 50:635–640.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

A Medicinal Sugar Destroyer - *Gymnema sylvestre.* L

Article ID: 11649

Sakthi Ishwarya M[1], Pandidurai G[1]
[1]Research Scholars, Tamil Nadu Agricultural University, Coimbatore - 641 003.

Introduction

India has a rich culture of medicinal herbs and spices. There are more than 2000 species with high potential ability. Recently WHO estimated that 80% of people use herbal medicines for their primary health care and about 21000 plant species have the potent to be used as a medicinal plant. Medicinal plants, which form the backbone of traditional medicine, have in the last few decades been the subject for very intense pharmacological studies. Plant products have been used to treat different ailments all around the world (Hossen et al., 2016). Phyto-chemicals obtained from plants normally kill or inhibit growth of bacteria (Singh et al., 2003). Plant materials remained a key source for combating ailments, including infectious diseases, and various plants have been investigated as novel drugs for the development of new therapeutic agents. Among these medicinal plants, "*Gymnema sylvestre*. L" has got an important place. It is extensively used in traditional systems of medicine and mentioned in the traditional literatures of Australia, Japan and Vietnam. These review attempts to encompass the botanical description, therapeutic properties, value added products, constraints and so on.

General Description

Gymnema sylvestre. L is a vital herb belongs to the family Asclepiadaceae and class dicotyledonae. It is considered as the vulnerable species and it is a slow growing, perennial and. generally requires support for growth. Its habit is medicinal woody climber found in central and peninsular India. The word "Gymnema" is derived from a Hindu word "Gurmar" which means "destroyer of sugar" and it is believed that it might neutralize the excess of sugar present in the body in Diabetes mellitus. The plant is commonly known as sirukurinjan and sakkaraikolli in Tamil, Periploca of the woods in English, Gurmar in Hindi, Meshashringi and madhunashini in Sanskrit, Kavali and kalikardori in Marathi, Dhuleti and mardashingi in Gujrathi, Adigamand Podapatri in Telgu.

Botanical Description

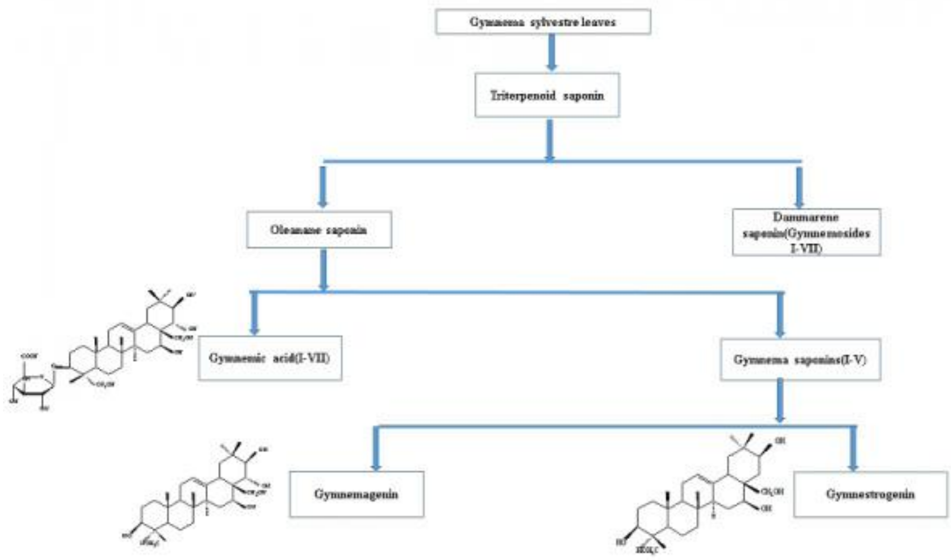
Gymnema sylvestre. L of is young, cylindrical, branched , twining and internode terete which is 0.7 to 17.2 cm long and 2-10 mm in diameter and root is taproot system. Leaves are opposite, usually elliptic or ovate (1.25–2.0 inch × 0.5–1.25 inch). Flowers are small, yellow, in umbellate cymes. Follicles are terete, lanceolate, up to 3 inches in length. The odour is characteristic and taste is slightly bitter and astringent. The Major economic part used here is Leaves and the Minor parts are stem and roots.

Geographical Distribution

The plant is native to central and western India, tropical Africa and Australia. In India, it is found in the forest of Andhra Pradesh, Bihar, Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh and West Bengal. In a dry forest up to 600-meter heights. It is found in Banda, Konkan, Western Ghats, Deccan extending to the part of the northern and western India, Ceylon-Tropical Africa.

Therapeutic Properties

It is a potent antidiabetic plant and used in folk, Ayurvedic and Homeopathic systems of medicine. In addition, it possesses antimicrobial, antihypercholesterolemic, hepato-protective and sweet suppressing activities. The anti-diabetic property of the plant is attributed to the presence of mixture of tri-terpines and saponins (Gymnemic acids, Gymnemagenin and Gurmarin) in the leaves. Gudmar leaves are used in food additives against obesity and caries. It also acts as feeding deterrents to caterpillar, *Prodenia eridania*; prevent dental caries caused by *Streptococcus mutans* and in skin cosmetics It is also used in the treatment of asthma, eye complaints, inflammations, family planning and snakebite.



Mechanism of Sugar Inhibition

1. It increases secretion of insulin.
2. It promotes regeneration of islet cells.
3. It increases utilization of glucose.
4. It is shown to increase the activities of enzymes responsible for utilization of glucose by insulin-dependent pathways.
5. An increase in phosphorylase activity.
6. Decrease in gluconeogenic enzymes and sorbitol dehydro- genase.
7. It causes inhibition of glucose absorption from intestine.

Constraints in Propagation

Madhunashini is propagated through seeds in its natural habitat. But there are problems like flower-shed, low fruit-set and a very short span of seed viability (Chandrasekar et al, 2003In the recent years, a lot of difficulties to root species are made to rooting easily by the use of root inducing chemicals and modify the surrounding environment (Thomas ,1985).To overcome this type of problem in *Gymnema sylvestre*. L, Vegetative propagation has the potential to produce the seedlings of high viability. Among several methods of propagation, stem cuttings were the most suitable technique to obtain the good stock material for planting of *Gymnema sylvestre.* L.

Precautions

1. It is not advisable for pregnant women.
2. *Gymnema* might affect blood sugar levels and could interfere with blood sugar control during and after surgical procedures.
3. *Gymnema* can affect blood sugar levels in people with diabetes. Watch for signs of low blood sugar (hypoglycemia) and monitor your blood sugar carefully if you have diabetes and use gymnema.

Value Added Products

The *Gymnema sylvestre*. L is available in crude plant material, powder; extract paste or solid in a standardized form. It is packed in well-closed polyethylene bags or HDPE drums protected from the light and moisture. The plant material is also made available in the form of combination with other herbal medicines in capsule or tablet form of various strengths.

The dosage used in Ayurvedic medicine ranges from 6 to 60 g of dry or powdered leaf per day. The adult dosage for *G. sylvestre* liquid extract is 25 to 75 ml per week. The recommended dose for powder. *Gymnema* leaves is 0.5 -1 spoon(2 – 4g per day).In case of capsule 100 mg taken 3 to 4 times a day. *Gymnema sylvestre*. L is conveniently prescribed in tablet form, in this case 8 to 12 g per day of leaf equivalent is recommended. Since they are best enterically-coated, tablets should be taken whole and not crushed.

Conclusion

As a result, the wide varieties of compounds isolated from this plant have extensive range of pharmacological activities which need to be researched in depth to establish their therapeutic potential. This broad range of uses and medicinal values reflects about the idea that, in future, pharmaceutical & drug manufacturing sector mainly relies on plants to obtain lifesaving therapeutics and drugs. Also, it has an excellent medicinal property, but still not used to the fullest by the people. So, it is essential to utilize the medicinal properties of *Gymnema* and get benefited by the people.

References

1. Parijat Kanetkar et al.,(2007) Recent Advances in Indian Herbal Drug Research, Journal of . Clinical Biochemistry and Nutrition., 41, 77–81.
2. Hossen MJ, Uddin MB, Ahmed SSU, et al., 2016. Traditional medicine/plants for the treatment of reproductive disorders in Asia nations. Pak Vet J 36:127-33.
3. Chandrasekar, A., Sankaranarayan, R., Balakrishnan, K. and Balakrishnan, A. 2003. Standardization of Gymnema (Gymnema sylvestre R. Br.) propagation. South Indian Hort., 51:275 – 277
4. Shailendra Gurav et al (2007), Pharmacognosy, phytochemistry, pharmacology and clinical applications of Gymnema sylvestre R Br. Shailendra, Pharmacognosy Reviews , Vol 1, Issue 2, Jul-Dec, 2007.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Role of Social Media in Agriculture and its Allied Sector

Article ID: 11650

Mamta Vyas[1], Nitin Saratkar[2], Deepak Kher[3]
[1]Assistant Professor, Department of Agriculture, Mandsaur University, Mandsaur(M.P.) -458001.
[2]Assistant Professor, Department of Agriculture, Mandsaur University, Mandsaur(M.P.) -458001.
[3]Director , Faculty of Agriculture Science , Mandsaur University, Mandsaur(M.P.) -458001.

Introduction

Agriculture plays a vital role for the Indian economy. Technology awareness, computer literacy and usage of smart phones and internet are increasing across the nation. Social media in agriculture is playing a very important role in dissemination of different agricultural information. There are more than 100 Information and Communication Technologies (ICTs) based initiatives such as e-Choupal, Digital Green etc. which have been launched in India for the development of agriculture and rural development. Many of them have won accolades nationally and internationally for their innovative methodologies for the rural development. Social media can be understood in different perspectives and we all should know the precise definition of social media. Various scholars define it in different ways. Most of the people believe that social network is linked with social networking sites, microblogging, various internet forms etc. Any media which interact with the public at level, be it radio, television etc. have the social responsibility. This a very important responsibility as it influences the development of the society The mass media such as television, radio, newspaper, social media etc. are indispensable and encourage people to express their views. The media should involve the people for planning the different developmental programmes and schemes. The media varies from country to country. We should always point out the fundamental problem in rural India. Role of mass media is extremely important for the lot of citizens of rural areas where the benefits of internet are not reaped properly.

Social media and rural development are linked together and there is need to make some deliberations on modern day media with the traditional media. Rural development in general is used to define the action taken for improving the standard of the people. Agricultural activities are prominently considered in this direction. India is having complex society with different cultures, castes, languages and there is disparity between the rural and urban people. Diverse social and infrastructural needs of the rural people must be addressed simultaneously to ensure the prosperity of the nation. After independence India has grown a strong nation and its economy is rapidly improving. The development is not a linear process but a multifaceted system. From time-to-time India has started various programmes and schemes for the development of rural areas.

Social media are a contemporary channel of digital communication that is composed of various evolving tools for discussion, interaction and sharing of information among people. These digital tools include among others Facebook, Twitter, Farmbook, WhatsApp, ResearchGate. According to Kuria (2014) social media has revolutionized communication whereby it has managed to surpass traditional gatekeepers in the traditional media; that is editors and other decision makers who set the agenda. Nevertheless, social media has not overthrown traditional media, but is complementing it in agenda setting. Traditional media has been the main medium for companies to reach their audiences and there has been a great deal of control which is avoided on social media. in the agricultural sector, there is growing rate of social media usage amongst stakeholders. Social media have ensured quick delivery and response to information between the sender and receiver. An effective way of ensuring successful delivery and sustainability of a viable agricultural extension subsector social media has fostered a fast platform for information dissemination and interactive contact; rivalled by none in this time.

A Brief About Social Media

Social media can be defined that the interaction with people in which they create, share, consume, and exchange information and ideas in virtual communities and networks "Social media are web-based tools of electronic communication that allow users to exchange information individually or in groups, share ideas, thoughts and opinions, make decisions and create decision and exchange information. These are digital networks that use user-created information - opinion, Video, audio, and multimedia are used to share and discuss.

Why Social Media?

Is social media important for agriculture? Although many outsiders would never think of connecting farmers, dairy farmers, animal keepers with Facebook and Twitter, they both represent a large group of active users on social networking sites. According to some farmers and scientists, social media is an indispensable communication tool to educate farmers about their industry.

Social media can be advantageously used in agricultural extension, as discussed below (Saravanan et al., 2015):

1. Highly cost-effective.
2. Simultaneously reaches large numbers of clients.
3. Location and client-specific, problem-oriented.
4. User-generated content and discussion among the community members.
5. Easily accessed from mobile phones.
6. Increases the internet presence of extension organizations and their client reach.
7. The democratization of information by making it accessible to all.
8. Brings all stakeholders into a single platform.

Social Networking Sites

Social Networking Site	Monthly Visits	Mobile Traffic Share	Desktop Traffic share
Facebook	1.6 Billion	99.25%	0.75%
YouTube	1.2 Billion	59.96%	40.04%
Quora	215.8 Million	98.89%	1.11%
Instagram	191.1 Million	99.02%	0.98%
Twitter	125.2 Million	97.81%	2.19%
Pinterest	49.8 Million	98.40%	1.60%
LinkedIn	29.9 Million	90.97%	9.03%

Indians now download more apps than residents of any other country – over 19 billion apps were downloaded by Indian users in 2019, resulting in a 195 % growth over 2016 data.The average Indian social media user spends 17 hours on the platforms each week, more than social media users in China and the United States. Indian internet users are fond of social media. In 2021, it is estimated that there will be around 448 million social network users in India, a significant increase from 2019 where it figures at 351 million. Facebook is the most popular social networking site in the country. There are about 270 million Facebook users in India as 2019, placing India as the country with the largest Facebook user base in the world.

The IPL, one in many cricketing events followed religiously in India, had the highest attendance among all cricket leagues worldwide. Apart from the attendance, fans seemed to be keen on updates about their favorite teams. The IPL teams registered over 59 million likes on Facebook alone and more than 81 million followers on Twitter.

Most of the Facebook usage came from the younger generation, aged between 18-24 years to be precise, with over 97 million users in 2018. Increased availability of internet connections and access in recent years, propelled by the central government's Digital India initiative was directly proportional in the growth of social media users.

Source: SEMrush, App Annie, Statista reports 2019.

Active Social Media Users in India

With the ease of internet access, the number of active social media users in India stood at 330 million in 2019 and it is expected to reach 448 million by 2023.

290 million active social media users in India access social networks through their mobile devices. Median age of India is 27.1 years. Millennials and Gen Z are the main contributors for social media usage in India. 52.3 % of social media results come from millennials. 28.4 % of social media conversations are from Gen Z and 15.1 % from those aged 35-44. 97 % of Indians who are connected to the internet watch videos online.

Facebook and YouTube are the most popular social media networks in India, Amazon and Flipkart are the most popular online shopping platforms and TikTok is the most downloaded app of 2019. The entry of WhatsApp into India's digital market boosted app usage, with a doubling in rural areas in recent years. Data shows that the reach of the messaging service extends wider than just urban areas. Other popular apps include TikTok and Instagram.

Source: Statista reports 2019 and Kantar IMRB ICUBE Report.

Social Media and its Importance in Agriculture

Social media are computer-based technologies that allow the creating and sharing of information, ideas, thoughts. Exchange views, career interests and other forms of expression via virtual communities and networks. There are some common features (Obar and Wildman, 2015; Kaplan and Michael, 2010; Boyd and Ellison, 2007) of social media:

1. Social media are interactive Web 2.0 Internet-based applications.
2. User-generated content, such as text posts or comments, digital photos or videos, and data generated through all online interactions, are the lifeblood of social media.
3. Users create service-specific profiles for the website or app that are designed and maintained by the social media organization.
4. Social media facilitate the development of online social networks by connecting a user's profile with those of other individuals and/or groups.

Social media use web-based technologies, desktop computers and mobile technologies (e.g., smartphones and tablet computers) to create highly interactive platforms through which individuals, communities and organizations can share, co-create, discuss, and modify user-generated content or pre-made content posted online. Social media is all about people.

It is a way to build relationships, share information, and connect with diverse audience of people. So, interacting on social media, whether it is Twitter, Facebook, or Pinterest, allows developing a community and share story in a way that was never possible before.

The general public still has faith in farmers and ranchers, but some are still wary of modern farm practices. It is important that agriculture unites and it has a chance to tell its side of the story. Social media is one way to make voice heard.

Role of Social Media in Farming

In the global context, the agricultural sector is using social media to promote relevant information and knowledge within the industry and to network with other like-minded agricultural professionals. Social media channels enhanced and strengthened the relationships of agri-based communities and helped rural workers combat the segregation created by their work. It has crossed geographical boundaries, thereby connecting the peasant communities to mutual interest.

So far, blogs have a large presence covering topics on agriculture, animal husbandry, health, education, and other topics/topics of general interest. Social media such as Facebook, Twitter, YouTube, and blogs are emerging as an appropriate platform to share information and create awareness among various stakeholders to generate and shape the content of the event.

These media complement traditional media as a viable source of information and facilitate the marketing of agricultural products and their products using pictures, links, and videos. They provide opportunities for users to share and exchange information and to discuss burning issues in agriculture based on their knowledge and experience and to formulate effective solutions to such problems, thus marketing and building networks We do.

Conclusion

Social media can offer many opportunities to farmers. It can help farmers to seek information on farm operations, clear their doubts on plants disease symptoms and can have immediate access to market related information. However, this can be possible only when they are socially networked with human resources - agricultural researchers, extension agents, animal doctors , progressive farmers, sellers & other buyers – in virtual space. The power of social media can be harnessed and will be beneficial for the farming communities. While social media has spread the concept of virality, social media itself has been viral in the world of communication.

Social media are electronic communication tools that allow users to communicate , create, share, retrieve and exchange information, thoughts and ideas in any form that can be discussed upon, archived, and used by virtual communities and networks. Agricultural is not in new concept; however, changing platforms for communication can seem foreign to some people. Perception of social media as a valuable tool rather than a time-wasting application is important to change to extend to the value to more people. The popular social media tools i.e., Facebook, WhatsApp, and YouTube are being used for information delivery and sharing across different agriculture subsectors (crops, horticulture, dairy, animal husbandry) in India. Most of them are through individual efforts. There is a definite lack of organized efforts to use social media from the public extension system in India.

References

1. Ajay Mamgain1, Udit Joshi2, Jaidev Chauhan3 Impact of Social Media in Enhancing Agriculture Extension(2020)
2. AMIT LATHIYA, ARVIND RATHOD AND KULDEEP CHOUDHARY, Role of social media in agriculture International Journal of Commerce and Business Management
3. Volume 8 | Issue 2 | October, 2015 | 268-273 e ISSN–0976–7940
4. Obar and Wildman, 2015; Kaplan and Michael, 2010; Boyd and Ellison, 2007
5. SEMrush, App Annie, Statista reports 2019
6. Statista reports 2019 and Kantar IMRB ICUBE Report.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Role of Liquid Organic Manure in Crop Production

Article ID: 11651

Seema Yadav[1], Gulab Choudhary[2], Jaipal Yadav[3], Manju Netwal[4]
[1]Department of Agronomy, SKNAU, Jobner, Jaipur, Rajasthan.
[2]Department of Horticulture, SKNAU, Jobner, Jaipur, Rajasthan.
[3]Department of soil science and agricultural chemistry, MPUAT, Udaipur, Rajasthan.
[4]Department of Horticulture, SKNAU, Jobner, Jaipur, Rajasthan.

Introduction

Manures are organic materials with plant nutrients in small concentrations. Organic manures are the main source of replenishing soil fertility. Now day's liquid organic manures have largely remained in background of biodynamic farming. Liquid Organic Manures are products obtained from the fermentation or decomposition of organic matter such as crop residues, animal dung, urine and other plant material.

Important Liquid Organic Manures are

1. Panchagavya.
2. Jeevamarutha.
3. Beejamarutha.
4. Vermiwash.
5. Cow Urine.
6. Sea Weed Extract.
7. Matka Khad.

Panchagavya

Panchagavya or panchakavyam is a mixture used in traditional Hindu rituals that is prepared by mixing five products of cow. The three direct constituents are cow dung, urine and milk; the two derived products are curd and ghee. These are mixed in proper ratio and then allowed to ferment. The Sanskrit word panchagavya means "mixture of five cow products".

Method of Preparation

Storing Panchagavya

Panchagavya should be kept in the shade and be covered at all times. Care has to be taken that no insect falls in the mixture or lays eggs in it. To prevent this, the container should always be covered with a wire mesh or plastic cover. Panchagavya can be stored for 60 days without any effect to its quality, provided

E-ISSN: 2581 - 8317

that it is kept in the shade and is being stirred twice a day. In the event that the solution thickens over time, water must be added appropriately.

For spraying: 3% of the solution in water i.e., 3 litres of Panchagavya to every 100 litres of water, is the most appropriate proportion for spraying.

For irrigation: The amount of Panchagavya per litre should be 20 litres/acre.

For seed treatment: Soak the seeds for 20 minutes in 3% Panchagavya solution in water before planting. Similarly, rhizomes of turmeric or ginger and cutting of sugarcane should be soaked for 30 minutes before planting.

Frequency of use: Before flowering- once in 15 days (two sprays), Flowering stage- once in 10 days (two sprays) and fruit bearing stage-once.

Jeevamrutha

Jeevamrutham is made of two words – Jeeva and Amrutham. Both are derived from Sanskrit and widely used words in Hinduism. The word "Jeeva" means is a living being or any entity imbued with a life force. The word "Amrutham" means elixir of life capable of prolonging life. In our context, Jeevamrutham is for crop life. Jeevamrutham is the best culture to increase the count of microorganisms. Jeevamrutha, popularized by Shri Subhash Palekar, is considered to be a panacea for the prosperity of small farmers. Jeevamrutha provides such an environment to beneficial microbes.

Preparation Method

Direction for use:

1. Soil Drenching: Apply ½ litre to small plants and 1 litre for big plants under good moisture condition for best results. Jeevamrutham can be used in 3 ways : Through irrigation water canal, Sprinkler/ Spray and Drip Irrigation.
2. Make sure to provide the complete 200 litres of Jeevamrutham to one acre.

Beejamrutha

Beejamrutha is effective in protecting young roots from fungus as well as from soil-borne and seed-borne diseases that comment affect plants after the monsoon period. It is composed of similar ingredients as Jeevamrutha - local cow dung, a powerful Natural fungicide & cow urine, a strong anti-bacterial liquid, lime, soil.

Method of Preparation

Vermiwash

Vermiwash is a liquid that is collected after the passage of water through a column of worm action and is very useful as a foliar spray. It is a collection of excretory products and mucus secretion of earthworms along with micronutrients from the soil organic molecules. These are transported to the leaf, shoots and other parts of the plants in the natural ecosystem. Vermiwash, if collected properly, is a clear and transparent, pale yellow coloured fluid.

Application:

1. Mix 1 litre of vermiwash with 7-10 litres of water and spray the solution in the leaf (upper lower side) in the evening at the growing crop.
2. Mix 1 litre of vermin wash with 1 litre of cow urine and then add 10 litres of water to the vermin urine solution and mixed thoroughly and keep it over night before spraying 50-60 litres of such solution and to be sprayed in one big hectare of land to control various crop diseases.

Cow Urine

Gomutra or gaumutra (Sanskrit: गोमूत्र gomūtra; cow urine) is urine from cows used for therapeutic purposes in traditional Indian medicine, Ayurveda and is an important component of the mixture called

Panchagavya. It is also used for purification in Vastu Shastra. Urine of a pregnant cow is considered special; it is claimed to contain special hormones and minerals.

Sea Weed Extract

1. Seaweeds are the plants especially marine algae growing in the sea, lakes, and large wetlands, like the rockweeds, kelps, sea lettuce, and dulses.
2. Liquid extracts derived from marine algae is known as seaweed extract. Used as foliar spray, application to soil and for soaking of seeds before sowing.

Benefits: It enhances the germination. Increase uptake of plant nutrients. Give resistance to frost and fungal diseases.

Method of preparation: Boil the chopped seaweeds properly and then filter. The filtrate is taken as 100% concentration.

Matka Khad

This is the method in which domestic material is used for the preparation of organic khad at no cost or very little cost. The material which is used to prepare such manure is found easily at home or at local market and most of the material used in it is purely domestic.

Method of preparation:

a. Take a mud pot (Matka) – the mud pod may be old which is not being used at home but the pot should not be broken. The water should not come out from the pot.
b. One kilogram chickpea flour (chane ka aata), One-kilogram jaggery (gud).
c. One handful soil below the tree of peepal (Ficus religiosa), neem or bund of the field.
d. 15-kilogram fresh cow dung. 2 liters of cow urine.
e. Now mix these all thing in water separately and pour in the mud pot if pot is vacant then fill it with the water.
f. After fifteen days the organic manure is ready to use.

Method of use:

a. Mix about 10 liters of Matka manure in 200 liters of water. Sprinkle this 200 liters of Matka manure in 1 acre area.
b. The spraying of this liquid manure is done every 15 days interval up to the 50% percent flowering is completed.

Advantages

1. These supply plant nutrients including micro-nutrients, and are easily available to plant
2. Improve soil micro-flora, Provide food for micro-organisms
3. Plant pathogenic fungi are controlled to some extent by altering the balance of micro- organisms in soil
4. Helps to build up disease resistance and no toxic effect to human beings.
5. Enhance/speed up the crop maturity date. Improves head size and colour/texture of leaves. It is environmentally friendly.
6. The plant can absorb about nutrients 20 times fast through the leaves than applied through the soil.

Conclusion

From the foregoing discussion, it can be concluded that the application of liquid organic preparations can be prepared easily by locally available materials in rural areas and contains higher number of bacteria, fungi, actinomycetes, N fixers, P solubilizers, growth hormones as well as macro and micro nutrients. Liquid organic manures as soil or foliar application shows profound effect on growth, yield and quality of crops, improves biological and chemical properties of soil and helps in achieving higher income when applied alone or in combination with organic manures or reduced amount of chemical fertilizers.

References

1. Reshma. S., Sujith. G. M., and Devakumar. M.(2015). Growth and yield of Cowpea [Vignaunguiculata (L.) Walp] as influenced by jeevamrutha and panchagavya application. Legume Research :1-5.
2. Sadhukhan. R., Bohra. J. S. and Choudhary. S.(2018). Effect of Fertility Levels and Cow Urine Foliar Spray on Growth and Yield of Wheat. International Journal of Current Microbiology and Applied Sciences 7(3): 907-912.

Enhancing Livelihood through Sugarcane Production in Bihar

Article ID: 11652
Shiva Pujan Singh[1], Md Minnatullah[1], Ajeet Kumar[1]
[1]Sugarcane Research Institute, RPCAU, Pusa.

The development in agriculture sector is necessary factor for improving economic strength of the state. An increase in agricultural production is not a sufficient factor for accelerating growth but there is an urgent need to promote agro-based and agro- processing industries for accelerating agricultural growth in Bihar.

Sugarcane is only agro-based industrial cash crop in Bihar. The state is a traditional sugarcane producer in the country. In early sixties, sugarcane area constituted more than 3 per cent of gross cropped area in the state but sugarcane area declined to about one lakh hectares after closure of the majority of sugarcane factories in Bihar which observed increasing trend during recent past few years. There were 33 sugar factories in 1940s which declined to 28 in late nineties out of which only 11 (eleven) are operating in recently however the majority of these factories are either closed or functioning much below their respective capacities.

The marketing of agricultural produce is the most important component which needs to be addressed properly for faster agricultural growth in Bihar. In the last season, farmers were harassed at procurement centres for selling their paddy and a group of middlemen emerged at every procurement centres who had hand- in-glove with officials of procurement centres and cornered a huge amount of farmers' money. But small and marginal farmers sold their surplus produce at Rs 550 to 700 to middlemen and farmers of Bihar lost more than Rs 500 to 600 crore due to defective system and corruption at procurement centres. The marketing scenario is also not encouraging for medicinal and aromatic plants which emerged as an important cash crop in some areas of Bihar.

The marketing of sugarcane has been systematized and there is no chance of harassment of farmers by middlemen. Keeping in view the available and proposed infrastructure for sugarcane industries, inherited skill of farmers 'in sugarcane production and hassle-free marketing system, sugarcane production has better promise for farmers in Bihar. Presently there are 6 lakh farmers and 50 thousand agricultural labours who are engaged in sugarcane farming in Bihar. Sugarcane cultivation generates annual labour employment of more than 155 lakh man days. The wage earning of agricultural workers and labours engaged in sugarcane cultivation is worked out at Rs 1350 million which is main source of livelihood to these workers through sugarcane production. Besides, more than 15 lakh man days are generated in transportation and Gur making in Bihar. State Government has taken a sincere initiative for revival of sick and establishment of new sugar factories in Bihar. Government of Bihar to device way for promotion of ethanol production, would take step to reopen closed sugarcane mills in the state.

A traditional sugar mill provides employment to 700 persons hence after revival of all the sugar factories and establishment of proposed factories will generate employment of more than 25 thousand persons whereas a multi-product sugar factories (Ethanol, power etc.) are likely to generate employment for about 45 thousand persons. Area under sugarcane will also. increase-due to revival of existing and establishment of new sugar factories in Bihar which will generate employment of agricultural labours and other person engaged in production and marketing chain of sugarcane. Ethonal production will boost sugarcane farming in the state and farmer will get higher price for yield.

However, sugarcane production and transportation are likely to generate more than 305 lakh man days of seasonal employment and annual employment for more than 50 thousand persons. After revival and establishment of proposed sugar factories, it is likely to emerge as a main source of livelihood in future, particularly in sugarcane growing area of Bihar.

Livelihood security of poor section of society can be strengthened through providing them employment opportunities. Sugarcane production not only provides comparatively more employment but provides employment in lean agricultural season which provide regular wage-earning opportunity to agricultural labours and facilitates strengthening of livelihoods of weaker section of society.

Sugarcane is a labour-intensive crop of long duration (12 months) in subtropical region and 12-18 months in the tropical region) which requires 160-180 mandays per hectare in subtropical and around 250-300 mandays in tropical south regions. The human labour component accounted for 32.50% of the total cost of sugarcane cultivation, because majority of work carried out manually and use of machinery is limited to operation like, field preparation by a majority of for farmers.

The survey report assesses the employment generation under four sugarcanes based inter cropping system in Bihar, CS-I (Sugarcane potato), CS-II (Sugarcane + Musterd), CS-III (Sugarcane + green gram) and CS-IV (Sugarcane sole crop) with respect to employment generation, CS-I generated highest employment (251.56 manday/ha) followed by CS-III (221.30 mandays/ha), CS-II (209.57 mandays/ha) and CS-IV (206.64 mandays/ha) in sole crop.

Availability of fuel is also an important aspect for improving livelihood, particularly in rural area of Bihar, in rural Bihar, fuel & light constitutes comparatively high share in household expenditure than any non-food items. It has also been observed that sugarcane by- products provide fuel, particularly to weaker section of society in Bihar.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Special Economic Zones of India

Article ID: 11653

Bandi Srikanth[1]
[1]Ph.D. Holder, Department of Agricultural Economics, College of Agriculture, Parbhani, VNMKV, Maharashtra.

Introduction

Special Economic Zone is the most discussed topic in India. For the economic development and to encourage export of various things and to take place in globalization all the countries are contributing themselves and trying for it consciously and SEZ is one of the parts of this.

Special Economic Zone means to give special facilities to the entrepreneur. In SEZ special facilities are provided to the industrialist, who starts their business in this sector. Special facilities for taxes, visa will require in this zone.

"SEZ is a specifically delineated duty-free enclave and shall be foreign territory for the purposes of trade operation and duties and tariffs."

1. The concept of SEZs is improve over the concept of export processing zones (EPZs).
2. Asia's first EPZ set up in Kandla in 1965.
3. In India, 436 SEZs are formally approved of which 347 are notified SEZs and 199 exporting SEZs.

Objectives of SEZ's

1. Generation of additional economic activity.
2. Promotion of exports of goods and services.
3. Promotion of investment from domestic and foreign sources.
4. Creation of employment opportunities.
5. Development of infrastructure facilities.

Panchagavya

Panchagavya or panchakavyam is a mixture used in traditional Hindu rituals that is prepared by mixing five products of cow. The three direct constituents are cow dung, urine and milk; the two derived products are curd and ghee. These are mixed in proper ratio and then allowed to ferment. The Sanskrit word panchagavya means "mixture of five cow products".

Salient Features and Benefits of SEZs

1. Unlike most of the international instances where zones are primarily developed by governments, the Indian SEZ policy provides for development of these zones in the government, private or joint sector. This is meant to offer equal opportunities to both Indian and international private developers.
2. 100 per cent FDI is permitted for all investments in SEZs, except for activities included in the negative list.
3. SEZ units are required to be positive net foreign-exchange earners and are not subject to any minimum value addition norms or export obligations.
4. Goods flowing into the SEZ area from a domestic tariff area (DTA) are treated as exports, while goods coming from the SEZ into a DTA are treated as imports.
5. In addition to the duty exemptions, the units in the Indian SEZs do not have to pay any income tax for the first five years and only pay half their tax liability for the next two. SEZ developers also enjoy a 10-year "tax holiday". The size of an SEZ varies depending on the nature of the SEZ. At least 50 per cent of the area of multi-product or sector-specific SEZs must be used for export purposes. The rest can include malls, hotels, educational institutions, etc. Besides providing state-of-the-art infrastructure and access to a large, well-trained and skilled workforce, the SEZ policy also provides enterprises and developers with a favourable and attractive range of incentives.

6. Facilities in the SEZ may retain 100 per cent foreign-exchange receipts in exchange earners foreign currency accounts.
7. 100 per cent FDI is permitted for SEZ franchisees in providing basic telephone services in SEZs.
8. No cap on foreign investment for small-scale-sector reserved items which are otherwise restricted.
9. Exemption from industrial licensing requirements for items reserved for the small-scale-industries sector.
10. No import licence requirements.
11. Exemption from customs duties on the import of capital goods, raw materials, consumables, spares, etc.
12. Exemption from central excise duties on procurement of capital goods, raw materials, consumables, spares, etc. from the domestic market.
13. No routine examinations by customs for export and import cargo.
14. Facility to realize and repatriate export proceeds within 12 months.
15. Profits allowed to be repatriated without any dividend-balancing requirement.
16. Exemption from central sales tax and service tax.

Incentives for Developers of SEZs Include

1. Exemption from duties on import/procurement of goods for the development, operation and maintenance of SEZs.
2. Income tax exemption for a block of 10 years in 15 years.
3. Exemption from Service Tax
4. FDI to develop townships within SEZs with residential, educational, health-care and recreational facilities permitted on a case-by-case basis.

Effects of SEZ

Due to SEZ industrial sector, export, employment, infrastructural facilities are increasing. But following problems will created by SEZ:

1. Farmers will be landless: In India, near about 70 per cent of the population depend on farming. It is main source of their income. Because of SEZ many farmers become landless for taking lands from the farmers. Many amenities are giving to the farmers and they are ready to give their land to the SEZ and farmers will be landless. Then landless farmers, there is not available for income, some farmers are committing suicide.

2. Increase unemployment: Due to SEZ, the employment will rise. But in SEZ's entrepreneurs and companies have invested more capital in the business and used capital-oriented techniques. Increase the unemployment. The farmers who lost their source of income and they do not get job in SEZ.

3. The existence of small-scale industries is in risk: Small scale industries create employment and it has more importance in the countries like Japan. The industries in SEZ are giving many facilities. So, they are producing in the low production cost and sale their production in fewer prices than small scale industries. The existence of small scale is in risk.

4. To neglect agricultural sector: Due to SEZ, agriculture sector area will be reduced and production will also be reduced. Available agricultural production will not be sufficient to increase population. For this purpose, agricultural grain will import.

5. To lost revenue of government for tax free facilities: The government and Reserve Bank will be giving tax free facilities to the entrepreneurs, Rs. 1,75,487 cores revenue is loss of the government. The remedies are not suggested about tax free facilities of SEZ entrepreneurs. Last to take care about this burden will not bear by the people of the country.

6. Capitalism will take birth: The industrialist of the SEZ is providing various facilities; some of the industrialist will be take benefit. They will sales their product in fewer prices and creating monopoly.

7. No rules about the construction: In SEZ there is no rules explained about construction. Roads, open space, construction area etc are not declared in detail.

8. To increase financial disequilibrium: The government is transferring their responsibility in industrial sector to the SEZ holders. Due to SEZ rich will become rich and poor will become poor. The gap of rich and poor will be increasing. For this reason, social dissatisfaction will occur.

9. Imbalance in environment: Large scale industries will establish in the SEZ. From these industries will mix unusable chemicals in the water and air and water and air pollution will be increased. The sound of big machinery in SEZ is creating sound pollution and environment will be imbalance.

10. No protection of the workers: The workers in the industries of SEZ, the worker laws will not be considered. For these reasons the industrialist will be doing increase working hours, close the work, lock-out, decrease the workers etc. and workers has no protection for their work. They will be unsatisfied about the work.

Who can Set Up an SEZ and what Requirements are there?

An SEZ can be set up jointly or individually the central government, a state government or any other body, including a foreign company, for the purpose of:
1. Manufacturing goods
2. Rendering services
3. For both of these reasons.
4. As a Free Trade and Warehousing Zone (FTWZ).

The SEZ Rules specify the minimum land area that is required for setting up an SEZ in general. This requirement depends on the type of SEZ to be established.

Minimum Contiguous Area Requirements for Certain Types of SEZs

Type of SEZ	Hectares
Multi-product: Eg- Garments and Automobiles	1,000 or more
Sector-specific or in one or more services or a port or an airport	100 or more
Sector-specific: electronics hardware or software, IT, gems & jewellery, bio-technology, non-conventional energy, including solar energy equipment and solar cells	10 or more
Free Trade & Warehousing Zone (FTWZ)	40 or more

The requirements concerning the minimum size of an SEZ are relaxed with regard to certain small states. Thus, in the states of Assam, Meghalaya, Nagaland, Arunachal Pradesh, Mizoram, Manipur, Tripura, Himachal Pradesh, Uttaranchal, Sikkim, Jammu and Kashmir, Goa or in a Union Territory, the minimum area requirement for multi-product SEZs or a sector-specific SEZ has been reduced to 200 and 50 hectares or more respectively.

Challenging Issues

There are some macro and micro issues in establishing SEZs which are stated as follows.

Macro Issues:

a. Land Acquisitions.
b. SEZs' Fiscal impact -Loss of revenue to government.
c. Relocation of IT/ITES companies.
d. Uncertainty on creation of Employment.
e. Uneven economic growth and regional disparities.

Micro Issues:

a. Operational inefficiency.
b. Infrastructural inadequacies.
c. Impediments in smooth inflow of foreign investment.
d. Exit clauses for de-notification of SEZ are not specified.

Conclusion

SEZs were established with the purpose of promoting exports from India and to provide employment. But along with the benefits they have also affected the farming community and rural livelihoods by acquiring land. Therefore, care is to be taken while notifying the area for acquisition. The land which is not suitable for cultivation has to be acquired for establishment of SEZs and government need to look towards increasing efficiency of SEZs and also strengthen the policies in the interest of farming community of the country. All over the opposition to SEZ, but for financial development, export growth, increase employment of the country, SEZ is essential. Government has passed special SEZ Act and implementation is doing. It is necessary to see the SEZ in positive view. SEZ projects should be started in backward area for development of regional equilibrium. SEZ have been acquired land from the farmers, government should be done rehabilitation and included them as shareholders of the SEZ projects as well as the family members of the farmers should be reserved some vacancies of employment. Employment should be provided to the local workers.

References

1. www.sezindia.nic.in/ about-introduction.asp
2. www.indiastat.com/sez-data.aspx
3. http://www.euroasiapub.org.
4. www.ijrcm.org.in
5. Report of CAG of India 2012-13.
6. www.ijhssi.org.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Effect of Postharvest Operations on Rice Grain Quality

Article ID: 11654

Srikanth Bathula[1], Veerendra Jaldhani[2]
[1]Crop Physiology, PJTSAU, Rajendranagar, Hyderabad.
[2]Crop Improvement Section, IIRR, Rajendranagar, Hyderabad.

Introduction

Postharvest operations, such as drying, storage, and milling, have been used to ameliorate the aging of rice grains and to achieve and maintain desirable rice grain quality, and thus play a key role in determining rice commercial quality and value. Rice drying mainly affects rice milling quality as rice kernel fissuring that may occur during drying leads to head rice yield reduction. Rice grain aging occurring during storage is inevitable and responsible for the changes in rice appearance, milling, eating, cooking, and nutritional quality. As milling significantly changes the chemical composition of rice by removing protein- and lipid-rich bran layers, milling can alter the aging process of rice and also affect rice appearance, eating, and sensory quality, but mainly affects the nutritional quality. Therefore, drying methods, storage conditions, and milling methods warrant further research to achieve and maintain the desired rice grain quality.

Effects of Drying on Rice Grain Quality

Different drying conditions such as temperature and moisture, and drying methods such as conventional heated air drying and microwave drying cause different velocities of water motion in the grains, and lead to great variation in the temperature and moisture between the surface and core of grains (Atungulu et al., 2016), which can affect milling performance and quality. Rice kernel fissures are stress fractures that develop in either the inner or outer layers of the kernel endosperm, caused by a combination of moisture, thermal, and mechanical stresses. Rice kernel fissuring could happen pre- and postharvest, particularly during the drying process. Fissured kernel was more susceptible to breakage and head rice yield (HRY) reduction, due to the alterations in kernel structure and tensile strength, bending strength, and fracture energy, which consequently reduced commodity value and economic returns for producers and processors. The fissuring rates were greatest at low (10%) and high (90%) relative humidity (RH), whereas fissuring was slight at 30% to 70% RH. The increased drying duration and decreased tempering time could increase percentage of fissured kernels while higher tempering temperatures could lower rice fissure generation. Rice drying with high temperature/low RH air conditions results in low equilibrium moisture content, apparently causing the surface of the kernel to transition from a rubbery to a glassy state, and thus reduces the drying rate. Moreover, formation of fissures may also be variety dependent. For example, Dong et al. (2010) found fewer fissured kernels in long-grain rice than short-grain rice. Therefore, proper rice drying and tempering strategies based on various rice varieties should be considered to reduce grain fissuring and maximize milling quality. Rice color is one of the important parameters to evaluate milled rice grain quality and is related to the appearance quality of milled rice. Rapid drying of rough rice with high-temperature air could increase milled rice yellowing and HRY, but the extent of impact could be moisture dependent.

Effects of Storage on Rice Grain Quality

The changes of rice grain quality during storage are strongly associated with endogenous enzymatic reactions on starch, proteins, and lipids. Such changes are also dependent on storage conditions (temperature, humidity, and duration) and rice type (paddy, brown, or polished rice). These changes in physical and chemical properties occurring during storage are affected by the aging process. In particular, storage temperature and duration are significantly correlated to HRY and result in great changes in rice physicochemical properties and functionality. Rice color darkening phenomenon often occurs during storage. Hayashi and Yanase (2016) found that red rice often changed to a darker reddish-brown hue during postharvest storage, as a result of changes occurring in pre-existing chemical species, especially the decreasing polyphenol contents and oxidative degradation of proanthocyanidin pigments. The decrease in whiteness and increase in yellowness of the rice grain during storage was considered to be related to

Maillard-type nonenzymatic browning. These changes may be due to the formation of carbonyl and amino compounds from breakdown of glycosidic and peptidic linkages through Maillard reaction.

The mechanism of kernel postharvest discoloration found during storage may also include fungal involvement as well as changes within the kernel owing to moisture content, temperature, and storage duration. The aging kinetics of paddy rice varieties stored at ambient temperature (30 °C) for nine months showed that aging would result in an increase in HRY. The increase of HRY may be due to more agglomeration of starch granules, thus enhancing the endurance of the rice kernels during milling. Changes in storage conditions could also influence rice cooking quality. A significantly longer cooking time for red and brown rice, and a reduction in cooking time for black rice after six months of storage were found. The increase in cooking time of stored rice is a result of interactions among components such as amylose–amylose, amylose–amylopectin, and starch–protein that hamper the water absorption ability of rice grains and subsequently increase the time required for starch gelatinization.

The mechanism of reduction in cooking time during storage for black rice could be attributed to the natural occurrence of protein and starch breakdown by endogenous enzymatic attack, which facilitates water intake and starch gelatinization. Gelatinization temperature (GT), as another parameter that influences rice cooking quality such as cooking time, is dramatically affected by rice storage temperature and duration.

Storage conditions may cause changes in composition, such as for proteins, lipids, and polysaccharides, which comprise the nutritional quality in a broad sense. Nutritional quality or health benefits of whole grain rice (brown rice) have attracted more attention by breeders, processors, and consumers recently. Significant reductions of 37.1% to 52.1% and 26.4% to 64.7% in the content of disaccharides (sucrose) and polysaccharides (raffinose), as well as significant increases of 33.1% to 79.9% in the content of monosaccharides and 54.0% to 107.1% in the content of glucose and fructose, in brown rice stored for six months at room temperature (15 to 18 °C) were reported.

A decreasing trend for the content of sucrose (from 0.750 to 0.176 mg/g) and maltose (from 0.401 to 0.163 mg/g) in milled rice, but an increasing trend for fructose (from approximately 0 to 0.246 mg/g) and glucose (from 0.192 to 0.249 mg/g) was found. Decrease in the disaccharide (sucrose and maltose) contents and increase in the monosaccharide fructose were found during the whole storage period of paddy rice, indicating that the hydrolysis of disaccharides continues during rice storage. The monosaccharide glucose content decreases first and then increases in the later stage of storage, indicating the glucose may bond together to form macromolecules. It was reported that the lipid peroxidation and sugar hydrolysis were coupled to the Maillard reactions during seed storage.

Thus, the Maillard reactions may occur to lower monosaccharides such as glucose during rice storage. Rice proteins can be divided into four categories: albumin, globulin, prolamin, and glutelin. It was found that less water-soluble proteins and free amino acids after 12 months storage in dried paddy rice compared to a lot stored immediately after harvest, although proteolytic activity was lower in the dried samples. Reduction in free amino acids such as glutamic acid and aspartic acid of japonica, hybrid, and indica brown and milled rice stored at room temperature was observed, which may directly influence the umami taste of cooked rice. The processes involved in the hydrolysis of lipids to produce FFA and the oxidation of lipids to produce hydroperoxides could be responsible for changes occurring in lipid profile during storage. The lipids and lipolytic enzymes are mainly present in the outer layers of the rice grain and hence more likely to be disturbed during processing and storage. The amount of free fatty acids would rise due to the increase of the activities of lipase and lipoxygenase during rice storage.

Effects of Milling on Rice Grain Quality

Milling as a mechanical procedure to yield milled rice results in significant variations in rice grain quality characteristics. Different methods, milling conditions (duration, temperature) and degree of milling (DOM) have great effects on milled grain quality. Fissures alter kernel structure and kernel tensile strength, ultimately resulting in kernel breakage and HRY reduction. Milling temperature has an effect on the HRY. High milling temperature led to increased fissured grain rates and decreased HRY. An over-milling could cause low HRY without any further improvement in the whiteness or DOM, whereas an under-milling could result in high HRY with darker appearance in the milled rice. Study on the mechanical strength distributions of brown rice kernels showed the breaking force of grain milling was significantly correlated with kernel thickness, but not significantly related to kernel width or length.

Conclusion

Postharvest processes are critical to produce high-value rice grains and significantly influence rice grain quality. It is certain that various drying and storage conditions, milling methods, and DOM have significant impacts on rice grain quality (appearance, cooking, eating, nutritional quality, and others). Drying processes can affect rice kernel fissure formation, and mainly affect the milling quality. Milling at different DOM results in differential loss of major nutrients, macro- and micro-elements in particular, and so milling strongly affects the nutritional quality of rice.

Rice aging is a complicated process during storage. Aging affects rice grain chemical composition and physicochemical properties, so all aspects of rice grain quality will be affected. Although numerous studies have been published concerning the effect of postharvest processing on rice components and qualities, the information related to the impact of drying, storage, and milling technologies on human health benefit related traits (such as vitamins and antioxidant activities) is still limited.

For rice storage, priority should be given to understanding the mechanism of aging so that technologies could be developed to stabilize lipid, protein, and starch for producing milled rice with stable and consistent quality. For rice milling, further investigation should be focused on the optimization of suitable milling methods for different rice varieties. Due to greater hardness of cooked brown rice, light milling techniques may be developed to supply milled rice with greater nutritional values.

References

1. Atungulu, G. G., Smith, D. L., Wilson, S. A., Zhong, H. M., Sadaka, S., & Rogers, S. (2016). Assessment of one-pass drying of rough rice with an industrial microwave system on milling quality. Applied Engineering in Agriculture, 32(3), 417.
2. Dong, R. J., Lu, Z. H., Liu, Z. Q., Koide, S., & Cao, W. (2010). Effect of drying and tempering on rice fissuring analysed by integrating intra-kernel moisture distribution. Journal of Food Engineering, 97, 161–167.
3. Hayashi, S., & Yanase, E. (2016). A study on the color deepening in red rice during storage. Food Chemistry, 199, 457–462.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Post-Harvest Diseases of Maize Crop

Article ID: 11655

Chindam Swathi[1], Vijaykumar S.[1]
[1]Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana-500030.

Introduction

Maize (*Zea mays* L.) is one of the important cereal crops of the world. It is the world's third leading cereal crop, after wheat and rice. The maize kernel includes pericarp (6 %), endocarp (82 %) and germ (12 %). Maize acquired a well-deserved reputation as a poor man's nutricera. It is cultivated in tropics, sub- tropics, and temperate regions under irrigated to rainfed conditions.

The most important losses in agriculture production which involves the greatest costs on the farm economy occurs at post-harvest. It is estimated that worldwide losses are between 10-40% of agriculture produce after post-harvest. Losses are more in developing nations than developed nations. Several species of fungi participate in post-harvest deterioration and rots of maize cobs.

These include species of *Aspergillus, Fusarium, Cladosporium, Diplodia, Pencillium, Gibberella* cob rot amongst several others which cause losses to the post-harvest maize cobs. This fungus causes severe problems in developing countries, where subsistence farmers don't have the necessary technology and resources for adequate grain testing, to find out whether the grains are contaminated (or) not. Ear rots can be classified into two groups:

1. Toxin producing ear rots: *Gibberella, Fusarium* (vomitoxin, zearalenone, trichothecene and fumonisin), *Aspergillus* (aflatoxin), and *Penicillium* (ochratoxin).
2. Non-Toxin producing ear rots: *Diplodia* and *Cladosporium*.

Fusarium Cob Rot (Ear Rot)- *Fusarium verticillioids*

Symptoms: Individual (or) groups of infected kernels are scattered at random on the cobs but, in the severe cases, the entire cob can be affected. Whitish pink lavender fungal growth occurs on and between the kernels. Often at the tip of the cob as the result of insect damage. Individual kernels may also exhibit a "star burst" symptom where white streaks radiate from the point of attachment.

Favourable conditions: Warm, dry weather at (or) after flowering, Minimum tillage, damaged kernels and ears, cob characteristics such as pericarp thickness and the extent that the husk covers the end of the cob also play a role and abundant nitrogen fertilization.

***Fusarium* effect on cobs:** *Fusarium* species synthesise a wide range of mycotoxins of diverse structure and chemistry (Flannigan, 1991). The most important from the point of view of animal health and productivity are the trichothecenes, zearalenone, moniliformin and the fumonisins (D'Mello et al., 1997). The trichothecenes are subdivided into four basic groups, with types A and B representing the most important members. The type A trichothecenes include T-2 toxin, HT-2 toxin, neosolaniol (NEO) and diacetoxyscirpenol (DAS), while type B trichothecenes include deoxynivalenol (DON, also known as vomitoxin) and its 3acetyl and 15-acetyl derivatives (3-ADON and 15-ADON, respectively), nivalenol (NIV) and fusarenon-X.

The synthesis of the two types of trichothecenes appears to be characteristic for a particular *Fusarium* species. For example, production of type A trichothecenes predominates in F. sporotrichioides and possibly also *F. poae,* whereas synthesis of type B trichothecenes occurs principally in *F. culmorum* and *F. graminearum*.

The grain quality of maize crops affected by *Fusarium* is significantly reduced as well as yield. Fumonisins produced by *Fusarium* are fatal for Horses and Pigs, but can also damage the organs of other mammals and are carcinogenic in human beings has increased concern over the possibility that Fusarium mycotoxins may be transferred into milk, eggs and meat.

Gibberella Cob Rot (or) Pink Ear Rot- *Gibberella zeae; Fusarium graminearum*

Symptoms: Reddish pink (or) whitish pink fungal growth that appears at the tip of the cob and grows down. Husks tends to bind to the kernels and there may be black fruiting bodies on external husk leaves. Infection occurs from wind borne spores.

Favourable conditions: Cool, moist conditions at flowering more common in wetter, cooler growing regions.

Mycotoxin: Mycotoxins produced by *Fusarium graminearum* including Zearalenone and trichothecene group which are harmful to a wide range of livestock especially pigs. Zearalenone can affect the reproduction and have adverse effect on the hormone estrogen cycle. This fungus consumes dry matter in the grain. The test weight is lower which reduces the grain price, grain quality and the entire yield is also reduced. The storage life of corn affected by this fungus is also reduced. The kernels may be unsuitable for food products, Animal feed and even for ethanol production if mycotoxins are produced.

Diplodia Cob Rot (or) Ear Rot

Symptoms: Infection occurs after flowering. The husks covering the cobs are bleached. Cobs are usually shrunken, lighter than normal and covered in a white grey fungal growth. Black fruiting bodies develops in the husks and cobs towards the end of the growing season. White mold over kernels. Survives in residues and spores produced in fruiting bodies are splashed on the silk which remain susceptible to infection as they are drying.

Favourable conditions: Wet weather favours infection of cobs and leaves.

Diplodia effect on cobs: Kernel size is significantly lower, which effects the grain quality and yields. If the infection occurs early, some ears may even not produce any harvestable grain. The growth of the fungus is most common during the milk, dough and dent stages.

Aspergillus Ear Rot

Symptoms: Olive green (or) yellowish tan fungal growth on and between kernels. Fungal growth is frequently seen near the ear tips. It can also be seen in hybrids with an incomplete husk and thus unprotected from injuries caused by insects, hail and other factors that may cause damage.

Favourable conditions: The disease is favoured by hot, dry weather survives in the winter on plant debris, high temperature and high humidity favours the development of fungus. Drought, nutrient deficiencies (or) insect attack are favourable causes for disease development.

Toxin production: It may produce aflatoxin, which is a liver toxin and carcinogen and can potentially be dangerous to live stock. Yield is usually reduced because of the drought stress. Fungus may reduce the weight of the infected kernels. There is no method to eliminate the toxin from infected corn. It strongly affects the commercial value of the yield.

Cladosporium Ear Rot

Symptoms: Dark grey to greenish black fungal growth causes kernels to appear blotched or streaked. Initial discoloration appears where kernels are attached to the cob. Infection eventually progress upward and infected kernel can be seen scattered over the ear. It completely colonized, ears are dark and light weight.

Favourable conditions: Often associated with damage due to insects, hails (or) frost. The disease is more likely to be found on plants that are stressed.

Nigrospora Ear Rot

Symptoms: Infection tends to begin at the base of the ears and may not be noticeable until harvest. Black spore masses can be seen in the pith of the cob. The cobs are badly infected, often shredded during harvest. Kernels may be somewhat bleached and grey fungal growth may be present.

Penicillium Ear Rot

Symptoms: Infection usually begins at the ear tip and primarily occurs on ears with mechanical (or) insect damage. Powdery green to blue green mold develops on and between kernels. Infected kernels may become bleached and streaked. "Blue eye" occurs when the embryo becomes discoloured due to the presence of fungus spores.

Trichoderma Ear Rot

Symptoms: Dark green fungal growth is found on and between kernels and husks, often covering the entire ear. The disease usually occurs on ears with mechanical (or) insect damage.

Gray Ear Rot: *Physalospora zeae*

Symptoms: Hot, humid weather for several weeks after pollination favours development of this ear rot. Early symptoms are very similar to those caused by Diplodia ear rot; a white-gray mold develops between kernels, and husks become bleached and glued together. In later stages of Infection, the two fungi can be readily identified:

Gray ear rot: Ears have a distinct black color; mold is also dark and develops small sclerotia (specks) scattered throughout the cob.

Management:

Cultural control:

i. Crop rotation, correct plant densities and the minimisation of stress.
ii. Adequate soil moisture during silking and right up to harvest.

Before planting:

i. Choose varieties that are known to have tolerance to kernel rot.
ii. Ensure that seed is treated with fungicide.

During growth:

i. Make sure that the plants have adequate nutrients and irrigate plants during dry times.
ii. Control of ear worms and corn borers, insect damage increases kernel rots caused by fungi.
iii. Harvest as soon as the ears are mature, and dry them properly before storage.
iv. Moisture contents below 18% for cobs and 13-15% for seed are necessary.

After harvest:

i. Drying harvested maize for instance to 18.5% moisture content within 48 hours after harvesting reduce the risk of mould growth on them.
ii. Clean the ears, seeds and storage bins before use.
iii. Removing any dirt, dust (or) grain left in bins from their last use and protect grains from insects.

Resistant varieties:

i. Probably, none of the hybrid maize varieties are totally resistant to kernel rot, but some dark orange seeds of maize will show tolerance, and this is the best method of managing disease.
ii. Early harvesting has been advocated to reduce the risk of mould build-up and mycotoxin contamination in susceptible produce.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Functional Properties of Fruits and Vegetables

Article ID: 11656

Dr. Kumari Sunita[1], Dr Ajeet Kumar[2], Y Prabhabati Devi[3]
[1]SMS (Home science), KVK Madhopur, West Champaran 845454 DRPCAU, Pusa (Samastipur).
[2]Assistant Professor –Cum –Scientist, Department of Soil Science, SRI, DRPCAU, Pusa Samistipur 848125.
[3]KVK Chandel, Manipur Centre.

Introduction

It is becoming increasingly clear that there is a strong relationship between the food we eat and our health. Scientific knowledge of the beneficial role of various dietary components like dietary fiber, antioxidants, flavanoids, fatty acids etc for the prevention and treatment of specific disease is rapidly accumulating. Living longer and better is on the mind of most people and diet is one of the most important factors of a healthy life. Therefore, it seems very likely that the concept of 'functional foods' which are defined as any food that has a positive impact on individuals health, physical performance or state of mind in addition to its nutritive value, enables the consumer to exercise a level of self-health maintenance. Functional foods reflect the recent consumer preoccupation with convenient food and healthy eating. During the last few years, the diet-health message has evolved and initiated the development of functional foods. This recently developing area of nutrition and health will most certainly revolutionize the food industry.

The whole issue of functional foods essentially relates to ingredients, which provide both nutritional and health benefits of the foods. The functionality of many familiar and new food components is being established by clinical and epidemiological research. The field of functional foods has evolved rapidly and many new terminologies such as neutraceuticals, clonic food, prebiotic, probiotic, health food and foods for specified health use (FOSHU) have emerged. However, the domain of functional foods is promoting health, not suing disease.

FDA (Food and Drug Association of America) defines food as "article used primarily for taste, aroma and nutritive value." In comparison functional foods are the food that provide an additional physiological benefit that may prevent disease or promote health.

A plethora of terms have been used interchangeably to describe foods for disease prevention and health promotion most notably as designer foods and neutraceuticals.

Designer foods: it was coined in 1989 to describe foods that naturally contain or are enriched with nonnutritive, biologically active chemical components of plants(eg.Phytochemicals) that are effective in reducing the risk of cancer.

Nutraceuticals: refers to "any substance that may be considered as food or part of food and provides medical or health benefit including prevention and treatment of disease."

More recently, the Instute of medicine of U.S National Academy of Sciences Has defined functional foods as those that "encompass potentially healthful products including any modifie3d food or food ingredients that may provide a health benefit beyond the traditional nutrients it contains.

Medical food: as defined as "special dietary food included for use solely under medical supervision to meet nutritional requirements in specific medical condition."

Cause of involvements of functional foods:
1. Scientific advances.
2. Consumer demand.
3. Increasing health care cost.
4. Aging population.
5. Technical advances in food industry.
6. Changing regulatory environment.

Scientific advances support that the vital role of diet in overall health and well-being. Six of the ten leading cause of death are believed to be related to diet i.e., Cancer, CHD, Stroke, Diabetes, Atherosclerosis, and liver disease.

Although CHD is the leading cause of death in the world but cancer may surpass CHD as leading killer in coming times. In India the magnitude of the problem of cancer warrants the close attention. It is estimated that the incidence of patients with cancer in India among males was 94.1per100000 and among females 103.6 per 100000 for the year 2020. (Cancer statistics 2020). Cancer study conducted estimated that up to 70 % of cancer is attributable to diet- an environmental risk factor over which we have significant control. After smoking dietary practices are most significant life style factor associated with cancer risk. Thus in 1982 the National Academy of science published four specific public health guidelines regarding dietary practices and cancer risk reduction. This report marked the first time that any official body has suggested that risk of cancer and could be reduced through dietary changes. One of these guidelines include inclusion of fruits, vegetables, whole grains in daily diet especially citrus fruits, and carotene rich and cabbage family vegetables as these plants food and other foods contain something other than traditional classes of essential nutrients known as functional components that may provide an important physiological effect. However, scientists identified something even better than vitamins as phytochemicals that primarily serve as a role in plant protection.

To date, most research related to phytochemicals has been on cancer prevention. Steinmetz and Potter (1991) identified more than a dozen distinct classes of phytochemicals in fruits and vegetables. their cancer fighting functions is by one of the following several mechanisms:

a. Induction of detoxification enzymes.
b. Inhibition of nitrosamine formation.
c. Provision of substrate for formation of anti-neoplastic agents.
d. Dilution and binding of carcinogens in digestive tract.
e. Alteration of hormone metabolism and anti-oxidant activity.

Summary

Thousands of biologically active phytochemicals have been identified in plant foods, of these fruits and vegetables are the most botanically diverse. Vegetables and fruits include roots, leaves, stem, fruits, and seeds .They have the potential to contribute significant variety and complexity to the human diet . Dietary guidelines can be popularized through primary health and anganwadi workers. Public education programs must also be developed to encourage and enhance the awareness of healthy dietary practices. Diet related intervention studies need to be promoted. Expected benefits of incorporating functional foods liberally into daily diet not only reduce the risk of cancer and other chronic diseases perhaps would delay the aging process.

References

1. Steinmetz KA and Potter JD(1991) Vegetables ,fruits and cancer. Epidemiology.Cancer cause control2325-2330.
2. Lampe J W (1999) Health effects of vegetables and fruits: assessing mechanisms of action in human experimental studies.Am j clin Nutr70(supple)475S-90S
3. Krishnamurthy K(1996) Indian functional foods:Role in prevention of cancer.Nutr Rev54(11)127S-130S.

AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Plant-Microbe Interaction in Rice – Rhizosphere Soil Under Different Agro Climatic Zones of Tamil Nadu

Article ID: 11657

B. Bhakiyathu Saliha[1], A. Senthilkumar[2], B. Karthikeyan[3]
[1]Associate Professor (Soil Science), Department of Soil Science & Agricultural Chemistry, Agricultural College and Research Institute, Killikulam, Thoothukudi dt-628 252.
[2]Ph.D., Research scholar, [3]M.Sc., student, Department of Soils and Environment, Agricultural College and Research Institute, Madurai-625 104.

Introduction

Rice is the staple food of over half of the world's population. The global production of rice has been estimated to be at the level of 502.2 million tons (FAOSTAT, 2020) and the area of production is estimated as 158.8 million hectares (FAO, 2021 and the demand for rice in 2025 will be 130 million tonnes.

In India, rice is cultivated in the area of 43.70 million hectare with a production of 105.42 million tonns and productivity of 2412 kg ha^{-1} (DES, 2021). In Tamil Nadu the production is 4.04 million tonns from an area of 1.44 million hectares with an average productivity of 2796 kg ha^{-1} (DES, 2021). Nutrient availability of the crop is an important criterion in deciding the crop yield.

Thus, knowledge of rhizosphere chemistry and rhizosphere process is essential for characterizing nutrient availability in soils. However, a little attention has been given to the dynamics of the rhizosphere solution and about the influence of rice plant on rhizosphere solution chemistry. Improved understanding of rhizosphere ecosystem will enhance our ability to model nutrient dynamics and thus the nutrient uptake and yield of crop.

Rhizosphere Process

Rhizosphere processes facilitates combined interactions among plants, soils, and microorganisms in both natural and managed ecosystems. In agricultural ecosystems, these interactions among different components, to some level, determine the exchange of matter and energy between plants and soils and thus upset crop productivity and ecosystem stability (Zhang et al., 2004).

A better understanding and manipulating rhizosphere process may provide an effective approach for improving nutrient use efficiency and crop productivity simultaneously through exploitation of biological potential for efficient acquisition and utilization of nutrients by crops and reducing the overreliance on increased soluble nutrients from application of chemical fertilizers.

The chemical and biological processes occur in rhizosphere not only determines the mobilization and acquisition of soil nutrients as well as microbial dynamics but also control nutrient use efficiency by crops and thus profoundly influence crop productivity and sustainability(Zhang et al., 2004).

For these reasons, the management of rhizosphere ecosystem and rhizosphere processes towards sustainable development of the plant-root system may be one of the most important approaches to enhance the utilization efficiency of nutrient resources and crop productivity in rice cropping system (Shen et al., 2009).

Rhizosphere was described for the first time by Lorenz Hiltner in 1904. It varies with the plant species and the soil, generally considered at 2mm distance from the root surface known as rhizoplane. Rice roots provide polysaccharides, amino acids and organic acids.

As a result, the community structures of soil microorganisms in the rice rhizosphere are expected to differ greatly from that in non-rhizosphere soil of the same paddy field (Zolla et al., 2013). In addition to root structure, nutrient acquisition is dependent upon biochemical changes and interactions with microorganisms in this soil zone.

Rhizosphere effects are mainly caused by root derived substrate inputs (rhizodeposition), which may account for 17% of the carbon fixed by photosynthesis (Jones et al., 2009). The rhizosphere thus functions as a hotspot of microbial activity and biogeochemical cycle in soil (Philippot, et al., 2013).

The changes in microbial biomass and community composition can lead the future changes in the microbial function in the rhizosphere. Activity of extracellular enzymes for soil organic matter decomposition and nutrient cycling are often higher in the rhizosphere than the bulk soil and microbial respiration and nitrogen mineralization tend to be higher in the rhizosphere.

Plant Microbe Interactions

These plant microbe interactions in the rhizosphere have significant implication for the soil carbon storage and nutrient availability to plants. The development of two distinct soil layers in the root zone can potentially influence N transformation.

Ammonium N in the anaerobic soil adjacent to the oxidized rhizosphere can diffuse in to the rhizosphere where it is oxidized to nitrate. Microorganisms that respond quickly to the environment changes mediate the transformations in the N cycle.

Organic manures also protect the fertility of soil by maintaining soil organic matter level and enhancing the soil biological activity. As the organic sources of nutrients are mostly drawn from local sources and developed locally viz. FYM & Vermicompost which are easy to manipulate and cheap.

Therefore, it enhances the economical way of crop production by reducing the cost of cultivation and increasing the market value of the produce. However integrated use of inorganic and organics may improve the soil productivity.

Flooded rice ecosystems present a unique microbial ecology. Soil microbial biomass, although is very small on an ecosystem basis, plays a central role in understanding changes of C, N and P cycling. Soil enzymes play a pivotal role in controlling the decomposition of soil organic matter and have been widely accepted as indicators of changes in belowground processes (Xiong, et al., 2018).

The study of different hydrolytic enzyme activities in the rhizosphere soil and their changes is important since they indicate the potential of a soil to carry out specific biochemical reactions and their hydrolytic enzymes are important in maintaining soil fertility and crop productivity.

Rhizosphere Management

The strategies of rhizosphere management are also characterized by the biological potential for efficient nutrient acquisition and use by crops than liable solely dependent on large inputs of chemical fertilizers. Fertilizer applications are used not only to provide mineral nutrition for crops but more prominently to act as regulators of root growth or other rhizosphere processes in capturing various resonres.

The nutrient inputs in the intensive farming system should be enhanced to achieve both high crop productivity and high nutrient use efficiency through maximizing root/rhizosphere efficiency in nutrient mobilization and acquisition. Hence, rhizosphere management is to maximize nutrient use efficiency, improve crop yield, and reduce chemical fertilizer inputs and environmental risk by optimizing and integrating various beneficial effects of rhizosphere interactions toward sustainable crop production.

Conclusion

At present, the rice production in India is not meeting the local demands because of increasing population. In India, the productivity of rice has to increase by adopting effective nutrient management. Nutrient management is the chief concern for maximum production of rice.

Hence, rhizosphere management and regulation of soil-root-microbial interaction is of at most significance in enhancing the availability of nutrients from soil and nutrient use efficiency thus ensuring sustainable rice production.

References

1. DES (2021). "Directorate of Economics and Statistics Department of Agriculture, Cooperation & Farmers Welfare Ministry of Agriculture & Farmers Welfare , Government of India, New Delhi, Database." March 15 :2021.

2. FAO. (2021) "The state of food security and nutrition in the world." : Published by Food and Agriculture Organization of the United Nations, Rome, Italy
3. FAOSTAT. (2020). "Food and agriculture organization statistical database." Retrieved February 27:2020.
4. Jones, D. L., Nguyen, C., and Finlay, R. D. (2009). Carbon flow in the rhizosphere: carbon trading at the soil–root interface. Plant Soil 321, 5–33.
5. Philippot, L., Raaijmakers, J.M., Lemanceau, P., and VanDer Putten,W.H. (2013).Going back to the roots: the microbial ecology of the rhizosphere. Nature Rev.Microbiol. 11:789.
6. Shen, J. B., Mi, G. H., and Zhang, F. S. (2009). Rhizosphere processes and management of cropland ecosystems. In "Rhizosphere Ecology: Processes and Management" (F. S. Zhang, J. B. Shen, and G. Feng, Eds.), pp. 152–168. China Agricultural University Press, Beijing
7. Xiong, W., Jousset, A., Guo, S., Karlsson, I., Zhao, Q., Wu, H., et al. (2018). Soil protist communities form a dynamic hub in the soil microbiome. ISME J. 12, 634–638.
8. Zhang, F. S., Shen, J. B., Li, L., and Liu, X. (2004). An overview of rhizosphere processes related with plant nutrition in major cropping systems in India. Plant Soil 260, 89–99.
9. Zolla G, Badri DV, Bakker MG, Manter DK, Vivanco JM (2013) Soil microbiomes vary in their ability to confer drought tolerance to Arabidopsis. Appl Soil Ecol 68:1–9.

E-ISSN: 2581 - 8317

Problems in Rural Development

Article ID: 11658

P. Radhakrishnan[1]

[1]Teaching Assistant, Institute of Agriculture, National Pulses Research Centre (NPRC) Campus, Vamban, Pudukkottai, 622 303, Tamil Nadu, India.

Introduction

Rural development in general is used to denote the actions and initiatives taken to improve the standard of living in non-Urban neighbourhoods, countryside, and remote villages. These communities can be exemplified with a low ratio of inhabitants to open space.

Agricultural activities may be prominent in this case whereas economic activities would relate to the primary sector, production of foodstuffs and raw materials. About 75% of the Indian population lives in rural areas and about 80% of this population is dependent on agriculture for its livelihood. Agriculture accounts for about 37% of the national income.

The development of the rural areas and of agriculture and its allied activities thus becomes vital for the rapid development of the economy as a whole. In this regard, India has succeeded in developing one of the largest rural banking systems in the world. Various regulatory measures have been taken enabling the banking system to play an important role in the economic development of the rural areas.

Literacy and Education

The simple literacy (basic reading, writing and numeracy) and the functional literacy had been presented as panaceas in the 1950s and the 1970s, respectively, with a view that if everybody learned how to read and write or learned this would enhance development.

The literacy, also including functional computer literacy, is still being presented as panacea by the governments of developing countries, UNESCO, World Bank, IMF and numerous aid organizations, with a view that this will solve development problems.

On the other hand, education plays an important role in the progress of an individual's mind and country. Ignorance and poverty, the two major speed-breakers in the swift developing country, can be overcome easily through education.

Construction of Link Roads

Though unknown, a potentially important share of the benefits to the poor from rural roads cannot be measured in monetary terms. This is extremely important if the benefits of development have to move beyond the limited confines of cities to the vast hinterland so that the millions of toiling farmers can also become partners in progress. Urban-rural Road links play a vital role for carrying urban prosperity into the heartland of a developing economy.

Self-Employment Generation

Employment generation, especially the self-employment generation in rural sector attach great importance to poverty alleviation and mitigation specifically of the wide variations across States and the rural-urban division.

A set of prudentially selected programmes of self-employment in rural sector plays as the panacea to remove multi-dimensional nature of poverty through helping a lot the anti-poverty strategy's three broad components promotion of economic growth, promotion of human development and targeted programmes of poverty alleviation.

Health Awareness

The goal of health awareness programme of rural development is to create awareness, a stirring of both heart and mind, about health care conditions, challenges, and solutions among the rural people.

Giving Awareness of Opportunities Availability for Them

Awareness of opportunities availability in rural sector means to provide relevant and usable information to the rural youth regarding (both the skilled and the unskilled) labour markets and access to relevant training to help them make decisions about the labour market options available to them.

Family Planning

Population growth is through a global problem but in heavily populated developing countries the problem is rather acute. An effective family planning programme is necessary there so as to curb high population growth that erodes the increase in employment opportunities and per capita income begot on account of the therein launched development programmes.

Land Reforms

Land reform means deliberate change in the way agricultural land is held or owned, the methods of its cultivation, or the relation of agriculture to the rest of the economy. The most common objective of land reform is to abolish feudal or colonial forms of landownership, often by taking land away from large landowners and redistributing it to landless peasants.

Extension of Rural or Agricultural Credit

An Integrated Rural Development Programme (IRDP) needs to identify the poor, give them credit and subsidy to purchase a productive asset to raise their earnings, recover loans, and recycle loans progressively to help poor villagers.

There is a need to popularise banking facilities and make villagers account-holders. New type of accounts to suit their requirements should be considered. Moreover, the main problem in rural credit is not mere credit but the way in which it is spent.

Therefore, the agencies providing rural credit should aim to promote sustainable and equitable prosperity of the villagers through effective credit support, related services, institution development and other innovative initiatives.

Extension of Canal Irrigation

Irrigation is an essential component of progressive agriculture. In fact, development of irrigation has become synonymous with agricultural development and rural prosperity. Canal irrigation system is much more challenging than the groundwater irrigation systems. It is the dominant water transfer technique in developing countries and is performing well in many parts of the world.

Rural Electrification

It is the process of bringing electrical power to rural and remote areas. Electricity is used not only for lighting and household purposes, but it also allows for mechanization of many farming operations, such as threshing, milking, and hoisting grain for storage; in areas facing labour shortages, this allows for greater productivity at reduced cost. One famous program was the New Deal's Rural Electrification Administration in the United States, which pioneered many of the themes still practiced in other countries.

Agricultural Productivity

Even though India occupies the first or second position in the world in several crops in terms of area and production, it's rank in terms of productivity per hectare in the world is 52 for rice, 38 for wheat and much low in several other crops.

The productivity of some crops is not only low but also remained stagnant over the years. The yield gap needs to be bridged through an integrated package of technology and agricultural policies to reap the untapped production potential, particularly, in rain-fed and other low productivity areas.

Future Perspectives

Agriculture, with its large dependent population has to thrive and flourish, in order to secure rural prosperity. To ensure orderly and vigorous growth of agriculture policy and structural issues need to be addressed quickly. Some of the important issues that need to be addressed are:

1. Improving profitability of agriculture, through yield improvements, diversification and reform of agricultural marketing.
2. Strengthening backward linkages and expanding irrigation coverage.
3. Providing forward linkages especially for post-harvest management, processing, transport, storage and market infrastructure.
4. Securing a stable long-term policy on agricultural commodities trade, including the role of private sector.
5. Encouraging emergence of a market mechanism for agricultural commodities such as a commodities exchange.
6. Streamlining the cooperative credit structure for facilitating hassle free flow of credit.
7. Implementing watershed development projects in the rain-fed and dry-land areas.

Osmoregulation Mechanism in Freshwater & Marine Teleost Fish

Article ID: 11659

Deepa Bhatt[1]
[1]Department of Aquaculture, College of Fisheries, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana -141004, Punjab.

Introduction

Osmoregulation is the active regulation of an organism's body fluids' osmotic pressure, as measured by osmoreceptors, in order to maintain fluid balance and concentration of electrolytes (salts in solution) in order to avoid the body fluids becoming too diluted or concentrated. In both aquatic and terrestrial environments, organisms must maintain proper solute and water concentrations in their body fluids, which necessitates excretion (the removal of metabolic nitrogen wastes and other substances such as hormones that would be toxic if allowed to accumulate in the blood) through organs such as the skin and kidneys. Aquatic ecosystems have a wide range of salinity and osmolarity.

Fish have evolved ways to keep fluid and electrolyte equilibrium in a variety of salinities. For osmoregulation, marine teleosts, freshwater teleosts, and marine elasmobranches use various physiological mechanisms. Although the kidneys are involved in osmoregulation, extrarenal processes are more crucial in maintaining osmotic equilibrium.

The gill tissue, the alimentary tract, the rectal gland (elasmobranches), and the urine bladder are all extrarenal locations. The consequences of any injury or disease on fluid and electrolyte balance can be explained by studying osmoregulatory physiology in these three types of fish (Greenwell et. al., 2003). Teleost fish keep their plasma osmotic concentration at roughly one-third that of seawater, whether in freshwater or seawater.

Types of Osmoregulation

The osmoregulation process can be divided into two categories:

Osmoconformers: Osmoconformers are organisms that try to adapt their body's osmolarity to that of their environment. In other words, inside the body, these organisms retain the same osmotic pressure as outside water. They conform in one of two ways: actively or passively. Osmoconformers are marine creatures like starfish, jellyfish, and lobsters.

Osmoregulators: Osmoregulators are organisms that actively control their osmotic pressure without relying on their surroundings. Humans, like many other vertebrates, are osmoregulatory. The majority of freshwater fish are also osmoregulatory.

Osmoregulation in Different Organisms

Osmoregulation occurs in a variety of ways in various organisms. Teleost fish in freshwater and teleost fish in the sea osmoregulate in distinct ways. Because they live in diverse settings with variable amounts of salinity, their osmoregulation processes are distinct. The following are some examples of osmoregulation processes in various organisms.

Osmoregulation in Freshwater Teleost

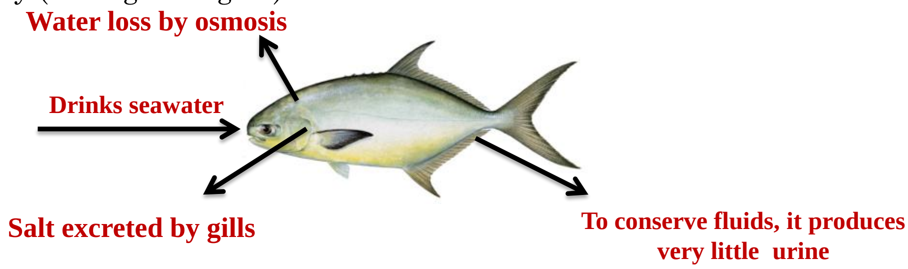
Freshwater fish are hypertonic to their surroundings, meaning that the concentration of salt in their blood is higher than in their surroundings. Through the mouth and gill membranes, they absorb a controlled amount of water.

Because they drink so much water, they create a lot of urine, which causes them to lose a lot of salt. With the help of mitochondria-rich cells in the gills, the salt is replenished. The salt in the blood is absorbed by these cells from the surrounding water.

Freshwater Fish: Salinity of freshwater much less than body fluids, so its body gains water from the surrounding environment

Osmoregulation in Marine Teleost

Marine fish, in contrast to freshwater fish, have the opposite problem. They have a higher water concentration in their blood than the rest of the population. As a result, the body has a tendency to lose water and absorb salt. To get around this problem, marine fish drink a lot of water and don't urinate very often. Another source of increased energy expenditure is the active necessity for these organisms to eliminate salt from the body (through the gills).



Marine Fish: Salinity of seawater much greater than body fluids, so its body fluids shed water to the surrounding environment

Mechanism of Action

95 percent of teleost species are stenohaline, meaning they live entirely in either freshwater or ocean (McCormick 2001). The remaining 5% are euryhaline, having the capacity to tolerate a wide range of salinities. This trait is widespread among teleost lineages and has apparently evolved many times, and may be this is one of the reasons that teleosts can be found in almost all aquatic habitats. The principal location of Na+ and Cl- transport is the gills, which actively take up salts in freshwater and excrete them in seawater. In freshwater, however, the location and methods of ion uptake through the gill are less established. Much of the current study on the endocrine control of ion transport in fish has focused on the gills. It has been known for some time that the mitochondrion-rich cell (also known as chloride cell) is the site of salt secretion (Foskett et. al., 1983). Both chloride cells and pavement cells may be involved in Na+ and Cl- uptake. Cl- is exchanged for bicarbonate (HCO3-) at the apical surface and leaves at the basolateral membrane moving downhill on an electrical gradient. Na+ may enter the gill epithelia in exchange with H+ or through an apical Na+ channel coupled to an apical H+-ATPase, and then leave at the basolateral surface through Na+, K+ ATPase (Wilson et. al., 2000).

References

1. McCormick S.D., (2001). Endocrine Control of Osmoregulation in Teleost Fish. American Zoologist 41 (4):781-794. https://doi.org/10.1093/icb/41.4.781.
2. Greenwell M.G., Sherrill J. and Clayton L.A., (2003). Osmoregulation in fish. Mechanisms and clinical implications. The Veterinary Clinics of North America Exotic Animal Practice 6(1):169-189.
3. Foskett J.K., Bern H.A., Machen T.E. and Conner M., (1983). Chloride cells and the hormonal control of teleost fish osmoregulation. Journal of Experimental Biology 106:255-281.
4. Wilson J.M., Laurent P., Tufts B.L., Benos D.J., Donowitz M, Vogl A.W. and Randall D J., (2000). NaCl uptake by the branchial epithelium in freshwater teleost fish: An immunological approach to ion-transport protein localization. Journal of Experimental Biology 203:2279-2296.

E-ISSN: 2581 - 8317

Cinnamon: Anti-Diabetic Agent

Article ID: 11660

Anjali Yadav[1], Jharana Panda[1], Usha Singh[2]

[1]MSc. Scholar, Department of Food and Nutrition, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, BIHAR – 848125.

[2]Professor cum Chief Scientist, Department of Food and Nutrition, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, BIHAR – 848125.

Introduction

Cinnamon is derived from Greek word *kinnamomon* which means *"sweetwood"*. It is the world's oldest and most frequently consumed spice, which is also used for herbal remedy. There are two types of cinnamon named as: Common cinnamon (*Cinnamomum zeylanicum)* locally known as dalchini and Cassia *(Cinnamomum aromaticum)*. Cinnamon is a spice which is obtained from the inner bark of several tree species belonging to genus *Cinnamomum*. Cinnamon is mainly used as an aromatic condiment and flavoring additive in a wide variety of cuisines, sweet and savory dishes, breakfast cereals, medicines, cosmetics, personal hygiene products, snack foods, tea and traditional foods etc. The aroma and flavor of cinnamon is derived from its essential oil and principal component cinnamaldehyde, as well as numerous other constituents are also like eugenol. It is a native crop of Sri Lanka and the Malabar Coast of India. From survey, it was found that globally, Indonesia is the largest producer of cinnamon, while in India; Meghalaya is the largest producer of cinnamon respectively.

Production

World Cinnamon Production (2017):

Country	Production (Tonnes)
Indonesia	87,130
China	79,486
Vietnam	37,126
Sri Lanka	17,255

Source: FAOSTAT of the United Nations.

India Cinnamon Production (2015-16):

State	Production (000 Tonnes)	Share (%)
Meghalaya	5.00	99.40
Maharashtra	0.02	0.40
Karnataka	0.01	0.20

Source: National Horticulture Board.

Major bioactive substance found in different parts of cinnamon:

Plant parts	Bioactive constituents
Leaves	Cinnamaldehyde: 1-5% Eugenol: 70-95%
Barks	Cinnamaldehyde: 65-80% Eugenol: 5-10%
Root	Camphore: 60%

Description of Plant

Cinnamon is a bushy evergreen tree. The cinnamon tree can reach a height of about 6-15 m, but in cultivation it is generally cut back periodically. Moreover, its individual flowers are very small about 3 mm in diameter. Its fruit is fleshy, berry, dark purple coloured and one-seeded. Hot and moist climate, temperature of 27^{o}C is suited for the cultivation of cinnamon. Cinnamon plants are harvested after three years of planting and the crop is generally harvested during the month of May and November. After rainy season cutting of the shoots is commenced. Tree with mature leaves indicates free flow of sap between bark and wood and the flow of sap stage gives the best quality of bark. About 1–2-year-old shoots give the bulk of the bark whereas; 1.5 – 2m long and 2 to 2.5 cm thick shoots are selected for cutting. Commercial bark should not be more than 0.5 cm. thick (Farooqui et al. 2003).

Health Benefits

1. Cinnamon has anti-viral, anti-fungal and anti-bacterial properties.
2. It contains antioxidants in large amount which have anti-inflammatory effects.
3. Its prebiotic properties improve the gut health among people.
4. Minimizes the blood pressure.
5. It lowers blood glucose level and reduces the risk of type II diabetes mellitus.
6. Relieves from digestive discomfort (carminative agent).

Nutritional Composition of Cinnamon

NUTRIENT	AMOUNT/100gm
Energy (kcal)	247
Carbohydrates (g)	50.59
Protein (g)	3.99
Total Fat (g)	1.24
Dietary fibre (g)	53.1
Cholesterol (mg)	0
VITAMINS	
Vitamin E (mg)	10.44
Folates (µg)	6
Niacin (mg)	1.332
Pantothenic acid (mg)	0.358
Pyridoxine (mg)	0.158
Riboflavin (mg)	0.041
Thiamin (mg)	0.022
Vitamin A (IU)	295
MINERALS	
Calcium (mg)	1002
Copper (mg)	0.339
Iron (mg)	8.32
Magnesium (mg)	60
Manganese (mg)	17.466
Phosphorus (mg)	64
Sodium (mg)	10
Potassium (mg)	431
Carotene-ß (µg)	112
Crypto-xanthin-ß (µg)	129
Lutein-zeaxanthin (µg)	222
Lycopene (µg)	15

Source: USDA National Nutrient data base.

Cinnamon Acts as Anti-Diabetic Agent

1. Type II Diabetes mellitus is the most common form of diabetes, accounting 90 to 95 per cent of all diabetic patients. The bioactive substance present in cinnamon is helpful to reduce blood glucose level.
2. According to recent estimates, the human population worldwide appears to be in the midst of an epidemic of diabetes.
3. The total number of people with diabetes is projected to rise from 171 million in 2000 to 366 million in 2030 in India. (WHO)
4. Cinnamon is potentially useful treatment for type II diabetes.

Reviews

1. Kim et al. (2006) elucidated the effects of cinnamon extract on blood glucose, insulin and lipids in a type II diabetic on mice. Cinnamon (1 kg) was extracted with 640 ml of water for 16 hours at 90°C. Cinnamon extract contained 5% cinnamonaldehyde.

All experiments were performed on mice. The room temperature was maintained under a constant 12 hours light and 12 hours dark cycle with temperature 23±3°C and relative humidity 70±10% throughout the experimental period. They were given free access to standard pellets and water. There were five groups where 10 mice in each group, group 1 was administered with placebo, group 2, 3, 4 and 5 given 50, 100, 150 and 200 mg of cinnamon extract orally once a day for six weeks.

The result showed from the study that blood glucose concentration is significantly decreased in a dose-dependent manner with the most in the 200 mg/kg group compared with the control. In addition, serum insulin levels and HDL–cholesterol levels were significantly higher and the concentration of triglyceride, total cholesterol was significantly lower after 6 weeks of the administration.

2. Soloman et al. (2009) illustrated the time course of glucose and insulin sensitivity changes of a two weeks cinnamon feeding intervention. The 14-day interventions involved cinnamon or placebo supplementation 3g/day. The oral glucose tolerance tests (OGTT) were performed on day 0, 1, 14, 16, 18, and 20 respectively. The researchers found that 3g/day supplementation for 14 days, glucose and insulin responses to OGTT were reduced, and insulin sensitivity was improved in inactive but otherwise healthy individuals. The result also revealed that cinnamon ingestion reduced the glucose and insulin responses to OGTT on day 1 and day 14.

3. Khan et al. (2010) revealed with an objective to determine cinnamon to improve blood glucose and triglyceride level in people with type II diabetes mellitus. The study had total 60 people suffering from type II diabetes (30 men and 30 women) aged 52±6.32 years were selected and was divided randomly into six groups. Group 1, 2 and 3 consumed 1, 3 and 6g of cinnamon daily and group 4, 5, 6 were consumed placebo capsules corresponding to the no of capsules consumed for three levels of cinnamon.

Cinnamon was consumed 40 days followed by a 20 days washout period. The results of this study demonstrated that intake of 1, 3, or 6g of cinnamon per day reduces serum glucose, triglyceride level in people with type II diabetes but the 6g was more appropriate one and suggest that the inclusion of cinnamon in the diet of people with type II diabetes will reduce the risk factors associated with diabetes and cardiovascular diseases.

4. Kizilaslan et al. (2019) study was aimed at investigating the effect of consumption of different amounts of cinnamon on pre-prandial blood glucose (PrBG) and postprandial blood glucose level. The study was carried out on 41 healthy adult individuals. The individuals were divided into three groups and were monitored for 40 days.

The first, second, and third groups were given 1g/day, 3g/day, and 6g/day cinnamon, respectively. Before the beginning of the consumption of cinnamon, HbA1c and PrBG blood tests of the individuals were examined on an empty stomach. The present investigation revealed that statistically significant difference was found between the average pre-prandial blood glucose measurements before the consumption of cinnamon on days 20 and 40 in the individuals consumed 6g of cinnamon per day. In case of postprandial statistically significant difference between the average postprandial blood glucose measurements before the consumption of cinnamon on days 20 and 40 in the individuals consuming 3g and 6g of cinnamon per day.

Conclusion

Cinnamon spice claimed to be a natural insulin sensitizer and its extract has significant anti-hyperglycemia effect in db/db mice moreover, 3g per day supplementation for 14 days, glucose and insulin responses to OGTT were reduced, and insulin sensitivity was improved. Presence of cinnamon in a semisolid meal reduces postprandial glucose responses in healthy subjects. Therefore, 3–6 g of cinnamon consumption was found to affect certain blood parameters of individuals positively. Cinnamon supplementation 1.5 g/d does not improve fasting blood glucose, oral glucose tolerance, or measures of whole-body insulin sensitivity in overweight, postmenopausal patients with type II diabetes mellitus.

References

1. Khan, A., Safdar, M., Khan, M. M. A., Khattak, K. N., and Anderson, R. A. (2003). Cinnamon improves glucose and lipids of people with type 2 diabetes. Diabetes care, 26(12): 3215-3218.
2. Farooqi, A. A., Sreeramu, B. S., & Srinivasappa, K. N. (2003). Tropical spice crops and their cultivation. Kavyakala Prakashana, Bengaluru.
3. Barceloux, D. G. (2009). Cinnamon (Cinnamomum species). Disease-a-month, 55(6): 327-335.
4. Kim, S. H., Hyun, S. H., & Choung, S. Y. (2006). Anti-diabetic effect of cinnamon extract on blood glucose in db/db mice. Journal of ethnopharmacology,104 (1-2):119-123.
5. Solomon, T. P., and Blannin, A. K. (2009). Changes in glucose tolerance and insulin sensitivity following 2 weeks of daily cinnamon ingestion in healthy humans. European journal of applied physiology, 105(6): 969-976.
6. Global cinnamon production (2017). Crops/Regions/World Regions/Production Quantity (pick lists)". UN Food and Agriculture Organization Corporate Statistical Database (FAOSTAT). 2018. Retrieved 20 September 2019.
7. Kizilaslan, N., and Erdem, N. Z. (2019). The effect of different amounts of cinnamon consumption on blood glucose in healthy adult individuals. International journal of food science, 2019:1-9.

AGRICULTURE AND FOOD: *e*-NEWSLETTER
ANNUAL/LIFE MEMBERSHIP FORM
WWW.AGRIFOODMAGAZINE.CO.IN
ISSN: 2581-8317

Life Membership: ______ INR
Annual Membership: _____ INR

1. Name: Dr./Mr./Ms./Mrs./Prof. ………………………………………………………
2. Date of birth (DD/MM/YY) …………………………………………………………
3. Affiliation/Institute ……………………………………………….…….
4. Designation/Position ………………………………………………………
5. Department name ………………………………………………………………..
6. Email id: ……………………………………………………
7. Mobile no. ……………………………………………………
8. Address (a) Corresponding ………………………………………………………….
   ………………………………………………………
   ………………………………………………………
   (b) Permanent ……………………………………………….
   ……………………………………………….
   ……………………………………………….
9. Subject of specialization ……………………………………………..................

- ✓ I want to register myself as an Annual/Life Member of Agriculture and Food: e-Newsletter.
- ✓ Kindly provide me unique membership number, soft copy of membership certificate and award certificate (if eligible)
- ✓ Kindly send the duly signed and properly filled form at agrifoodmagazine@gmail.com

Yours faithfully

Transaction id:
Payment date and time:
Mode of payment:
Details attached:

Awards by Agriculture & Food *e*-newsletter

Contact with agrifoodmagazine@gmail.com for details

WWW.AGRIFOODMAGAZINE.CO.IN

1. **Best Article Award**

More than 3 best articles published in a month would be awarded with best article award.
Only annual members and life members are eligible for this award.

2. **Author of the Year**

Best author in a calendar year would be awarded with best author of the year award.
Only annual members and life members are eligible for this award.

3. **Article of the Year**

More than 3 best articles published in a year would be awarded with best article of the year award.
Only annual members and life members are eligible for this award.

4. **Innovative article award**

Only 1 article would be awarded with innovative article award.
All authors are eligible for this award.

5. **Honorary award**

It is given as a gesture of respect to any person who helped in the overall development of this e-newsletter (directly or indirectly).

6. **Best Editor Award**
7. **Best Reviewer Award**

AGRICULTURE & FOOD: e-Newsletter
http://www.agrifoodmagazine.co.in
ISSN: 2581-8317

FORMAT OF ARTICLE

Articles which are sent to us without proper format would be automatically rejected

Maximum limit: 2-3 pages **(If authors exceed page limit article may be rejected instantly)**

Times New Roman, 12 font, 1 spacing

Title of article (must be short and catchy)

Author's (s) name

Author's (s) affiliation

Corresponding author's mail id

Summary of Article: 1 paragraph

INTRODUCTION: May contain multiple paragraphs, figures, tables and HD images.

***Tables which are uploaded in image form are not accepted.**

*** Reference in text must be like**

- **→ ABCDEFG HIJK LMNO PQR (Singh *et. al*., 2015)**
- **→ ABCDEFG HIJK LMNO PQR (Singh *and Mishra,* 2015)**
- **➔ Singh *et. al*., (2015) found that ABCDEFG HIJK LMNO PQR**
- **➔ Singh *and Mishra,* 2015) found that ABCDEFG HIJK LMNO PQR**

Personal opinion column can be added

Summary/ Conclusion:

HD Photographs (if available)

References format:

[1]. Dutta R.N., (1984). Comparative ecological study of makhana in Darbangha region. Ph.D. thesis. Ranchi University, Ranchi Bihar.

[2]. Ho H., Cheu Y. and Luo I., (1953). The detection of vitamin B, and C in Chinese drugs. *Journal of Taiwan Pharmacy Association*. 5(1):5-20.

AUTHOR IS SOLELY RESPONSIBLE FOR PLAGIARISM IN THEIR ARTICLE….