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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

BANANA: Processing & Value addition

Article id: 11130

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INTRODUCTION

Banana (*Musa spp.*) is a perennial plant, which is grown in almost all countries and considered as the fourth most harvested agriculture product after rice, wheat, and maize. It is an important fruit crop of many tropical and subtropical regions of India. It is cultivated in an area of 830.5 thousand ha and total production is around 29,779.91 thousand tons in India. Tamil Nadu, Maharashtra, Gujarat, Andhra Pradesh and Karnataka are the main banana growing states.

Banana has a high nutrition value and is a good source of energy due to its high level of starch and sugar, as well as being a source of vitamins A and C, potassium, calcium, sodium and magnesium. It is easy to digest, free from fat and cholesterol. Banana powder is used as the chief baby food. It helps in reducing the risk of heart diseases when used regularly and is recommended for patients suffering from high blood pressure, arthritis, ulcer, gastroenteritis and kidney disorders.

The main commercial products made from bananas are canned or frozen puree, jam, jelly, juice, wine, halwa, dried figs, powder, flour, flakes and chips. Banana fiber is used to make items like bags, pots and wall hangers. Good quality paper and rope can be prepared from banana waste. Banana leaves are also used as healthy and hygienic eating plates.

BANANA PROCESSING

India is known as a fruit basket of the world. India has been considered as the second largest producer of fruits after China. Due to poor cold storage facilities, trained workforce deficiency, and inefficient post-harvest management and minimal technological interventions, India is the second largest grower contributes only 1% of the global market of the fruit processing industry. In India, the wastage of raw fruit, produce has been estimated to be of a very high order, i.e. around 30-35% of the whole production during harvest, storage, grading, transport, packaging, and distribution due to challenges involved in the industry. With the creation of adequate specialized cold storage facilities, logistics infrastructure, skilled workforce and modern technological interventions, post-harvest losses can be minimized resulting in higher returns to the major stakeholders of the whole fruit supply chain i.e. farmers and the consumers.

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Now a day's both ripe and unripe (green or firm) bananas are mostly used to converting into various commercial products. Mostly good qualities and varieties of bananas are used to complete international demand in various forms (Fig. 1) by applying high-level technology.

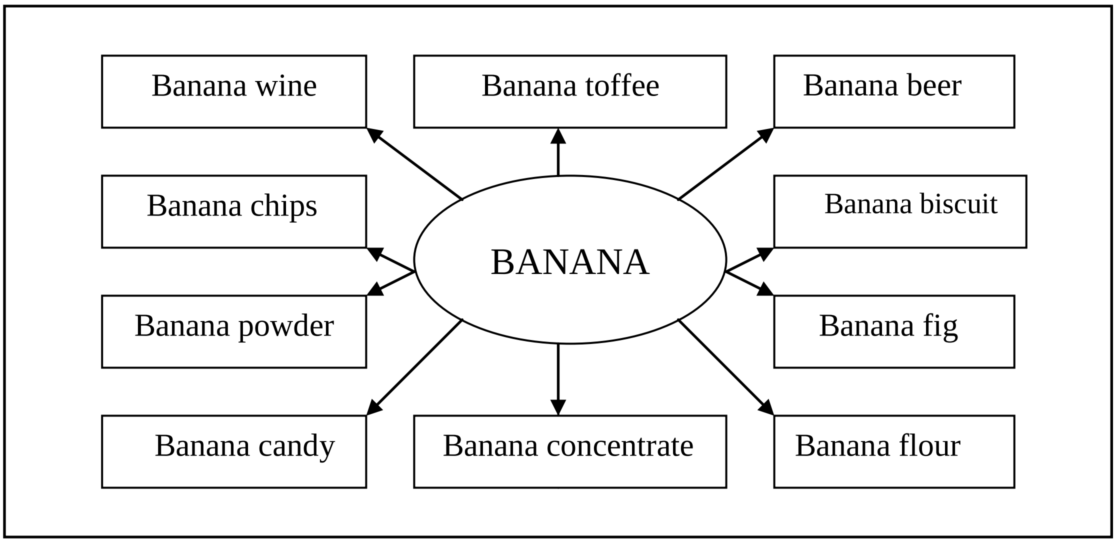

Fig. 1 Food Applications of Banana

By-Products from Banana:

- **Chips/Crisps:** Fruits of approximately 80% maturity are harvested and demanded. The fingers are peeled and then treated with 0.1% potassium meta-bisulphite and cut into slices of 1-2 mm thickness and deep fried in suitable cooking oil, preferably coconut oil. Upon frying slices will yield crisp, yellow colored chips, which are sprinkled with common salt and packed in polyethylene bags. Generally, the storage life of the chips will be of 30-35 days under ambient conditions. Packing the chips in laminates with nitrogen gas will extend its life up to 4 months. Several other verities of banana chips like flavored, sweet, sweet and sour, tomato flavored with pepper, etc. are also catching up in the market.

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- **Banana Fig:** Banana figs are dried or dehydrated banana fruit with sticky consistency and very sweet taste. Fully ripe banana fruits are peeled, treated with 0.1% potassium metabisulphite solution and dried either in sun or oven at 50ºC. These figs are packed in polyethylene bags or any other suitable containers. They have a storage life of about 3-4 months under ambient conditions.

- **Banana Juice:** As banana puree is very thick, juice cannot be directly obtained from it. Therefore, the puree is treated with pectolytic enzyme and clear juice is obtained through filtration or centrifugation. After pasteurization and bottling, it can have a storage life of a minimum of 6 months under ambient conditions.
- **Banana Powder:** Banana powder is prepared from fully ripe banana fruits either using drum drying or spray drying method. The moisture content of the final product should be around 2-4%. This product has got high market value as it is extensively used in the confectionary industry, ice cream preparations and baby food making. When suitably packed, it will have a storage life of more than 6 months.
- **Banana Flour:** Banana flour is prepared from mature green bananas, which have high starch content. It can be used as a nutritious adjuvant in several food preparations like bread, cakes, biscuits, health drink and baby food formulations. It can also be blended with other cereal flours for making chapatis and rotis. It has some medicinal property to cure ulcers. Under cool and dry conditions the flour can be stored up to one year without any adverse change in their composition.

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- **Banana Fruit Candy/Stem Candy:** Banana fruit candy made with jaggery and ginger are widely sold in the market in Kerala state. Banana stem (true stem) can also be made into candy through osmotic dehydration process followed by sun drying.

- **Banana Biscuits:** Banana biscuits are made by mixing of 60% banana flour and 30% of maida. The dough is made using a mixture of flour and suitable proportions of sugar, saturated fat, baking powder, milk powder and essence. These biscuits are very delicious and highly nutritious.

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- **Banana Jam and Jelly:** Banana jam is prepared by cooking the banana pulp with sugar along with pectin and citric acid in right proportions till gives a good set. Several varieties of banana are suitable for preparing a jam. This is a product, which has good commercial value and a good market. Banana jelly is a semi-solid product made by boiling clear strained fruit extract free from pulp after addition of the required amount of sugar, citric acid and pectin.

- **Banana Beer:** Banana beer is an alcoholic beverage made from the fermentation of mashed bananas. As a source of wild yeast, sorghum, millet or maize flour is added.
- **Banana Wine:** Banana wine is made by fermenting the enzyme treated clear banana juice with wine yeast viz. Saccharomyces cerevisiae var. ellipaoiswua. The fermentation process is carried out for about 3 weeks followed by filtration, clarification, and bottling. The wine is stored in bottles for aging. The alcohol content of banana varies from 9-12%.

CONCLUSION

As we know that banana is mainly served as fresh fruit in India. However, it is easily degenerated, decayed, and thus storage and transportation processes are tolerable because it is a fruit with the respiration jumping property. Postharvest loss of banana is always serious and thus resulting in a situation of high-yield without high-income. To improve the marketing system, it is essential to create awareness among the growers, farm workers and managers, traders and exporters about the extent of post-harvest losses. Therefore, Processing and product development through value addition is the best alternative to reduce post-harvest losses. Processing and preservation technology also helps to save excess fruit and vegetable during the glut season (off season).

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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Utility of canopy management in cashew nut production

Article id: 11131

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Cashew, an important horticultural crop, is gaining importance as an important rain fed tree crop both in traditional and nontraditional regions of the country. The demand for raw nuts for processing by Indian Cashew Processing Factories is ever increasing and now it is around 12-13 lakh tonnes per annum. Presently more than 50% of the raw nut requirement of the country is met from imported sources especially from African countries. These cashew nut exporting countries have developed processing facilities and countries like Vietnam which are competing with India have improved their processing capabilities. Hence it is imminent to India to enhance the production so that the country will be self-sufficient in raw cashew nut requirement.

India has the potentiality to enhance the production in multifold. The area expansion and productivity enhancement are the means to achieve it. The improved production technologies including horticultural interventions have shown to enhance the productivity with which targeted nut production can be achieved. Pruning and training practices to shape the canopies and also to rejuvenate the growth enabling the plantations to remain ever productive has arose enough hopes in enhancing the cashew nut production in the country.

Canopy management

Canopy management is the ‘art’ of fruit growing - it is much more than cutting off a few branches.
Cashew is a fast growing woody perennial tree and if allowed to grow naturally the canopy will be in irregular shape with low spreading branches ultimately resulting in poor yield. Therefore managing a canopy will help to develop a strong tree that will support heavy crop loads, increase nut production and improve nut quality in the long-term.

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The Basics

There are three primary methods for managing fruit tree canopies.

- Pruning: The judicious removal of plant parts *viz.,* shoot, root, leaves, flowers, panicles or fruits so as to improve the efficiency and performance and to force the plants to behave in a way it is desired.
- Training: A method of directing the plant growth in a desired direction, to form a definite canopy shape and contain the canopy size by employing pruning techniques.
- Horticultural Practice**:** Addition of nutrients, water, etc. e.g. Rather than cutting limbs, cut back on water and nitrogen to stop excessive tree growth.

Different training systems adopted in Cashew

Modified leader system of training

Generally, Cashew grafts after planting are forced to grow with a clear single stem up to a height of 45 - 75 cm by removing side sprouts. Branching is allowed later in different directions with de topping of the central leader to a height of 3-4 m. In this training system, the central leader is de topped depending on space allotted in orchard so as to have higher leaf area exposed to sunlight. Thus, the developed canopy helps in reducing the dead wood development and water shoot development. The height of the plants in modified leader system of training can be regulated as per the space provided. The height of canopy, for the plants spaced at 5m x 5m for example may be contained at 2.5 m. Similarly in the plantations of 8m x 8m spacing, the plants are to be de topped at 4 m height.

Open centre system

In this system, the plant is allowed to grow up to a height of 30 to 50 cm from ground with a clear single stem and thereafter the terminal growing tip is pinched off to force lateral branching. The lateral branches are allowed to grow in all the directions to form an open centre vase shape. The shape needs to be maintained by minimum trimming and removal of overcrowding of branches. In this system, the light penetrates deep into interior parts of canopy and hence dead wood development is very less. There is also scope for flowering both in inner and outer surfaces of canopy as there is increased surface area for flowering and fruiting.

Central leader system

The plants are allowed to grow tall without pruning the central stem in this system of training. Only lateral branching is forced in different directions. In the initial years of orchard establishment of widely spaced orchards (8m x 8m and above) this system is good as it gets sufficient sunlight to grow and flower. In closer planted orchards in later years lower branches get shaded due to

ISSN: 2581-8317
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overcrowding of branches and drying of the branches and dead wood development begins. Therefore, the system is advisable to only widely spaced plants in an orchard.

Pruning system for high density Cashew orchards

Under high density orchard system, the canopies need to be contained within allotted space which can be done by forcing them to grow like bushes rather than trees. This needs to be attempted from the initial years of planting arid needs to be maintained by pruning. In closely planted plantations under high density system, canopy development within the manageable size is most essential. Plants can be pruned to bush shape at a height of 0.75-1.00 m. The yield of bush pruned plants is superior even at a closer spacing of 2.5m x 2.5m during several years at the beginning. Thus, a yield of more than 4 tones /ha can be achieved.

A B C

Fig. 1: Systems of training in Cashew. A. Modified system of training, B. Open centre system of training and C. Central leader system of training

A B

Fig. 2: Pruning system in Cashew orchards. A. Pruning to bush shape and B. Sprouting of pruned plants

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Canopy management in productive orchards

Cashew responds very well and gives higher yield when exposed to bright sunlight. Well maintained cashew plants need annual pruning and trimming to get proper shape and to tap maximum sunlight which leads to better photosynthesis. In a plantation, inter-mingling branches with neighboring trees need to be trimmed every year and a clear gap of minimum one foot may be maintained for tapping the intermittent light. Depending on the spacing of plantation, the height of tree canopy should be regulated so as to overcome the shading effect of plants over neighboring plants. For example, height of plants spaced at 5m x 5m and 8m x 8m are maintained at 2.5 m and 4 m.

Various plant growth factors such as number of flowering, length of the shoots, flowering intensity, number of leaves per shoot and leaf area was positively influenced by pruning in most of the cashew varieties. Pruning resulted in inducing more number of leaves and increased leaf area in extensive branching type cashew varieties. For instance, the leaf area and number of sprouts emerged increased in VTH 30/4 due to pruning. On an average only about 10 % light was found to penetrate through canopy and reach ground. Of the remaining bout 69-94 % of the incidental light was found be intercepted in top portion of the canopy, 0-% by mid portion and remaining 3-15% light by lower branches. Generally, top portion of the canopy intercepts more light because of higher number of shoots and leaf area than the interior portion. When plants were pruned, more uniformity in sunlight penetration was observed in all parts of canopy and the fruiting pattern got distributed all over canopy.

Rejuvenation of senile trees

Redevelopment of canopy is possible by heading back or by limb pruning of existing senile trees which have exhausted canopies and erratic growth resulting in reduced yield. Heading back if done at 1.0 - 1.5 m height of the trees, new flushes emerge from dormant buds on remaining trunk and develop into a vigorous new canopy. The new vigorous canopy develop into a productive growth within 6-10 months depending on the variety / genotype and hence it should be attempted immediately after the harvest of the crop yield (May to June) so as to get normal yield in ensuing fruiting season. It was noticed that cashew stem and root borer [(CSRB – *Plocaederus ferrugineus)]* problem gets worsened with the beheading of the trees. The shot holeborer also starts feeding on the cut trees. Therefore, sufficient precautions are to betaken up before taking up limb pruning in cashew.

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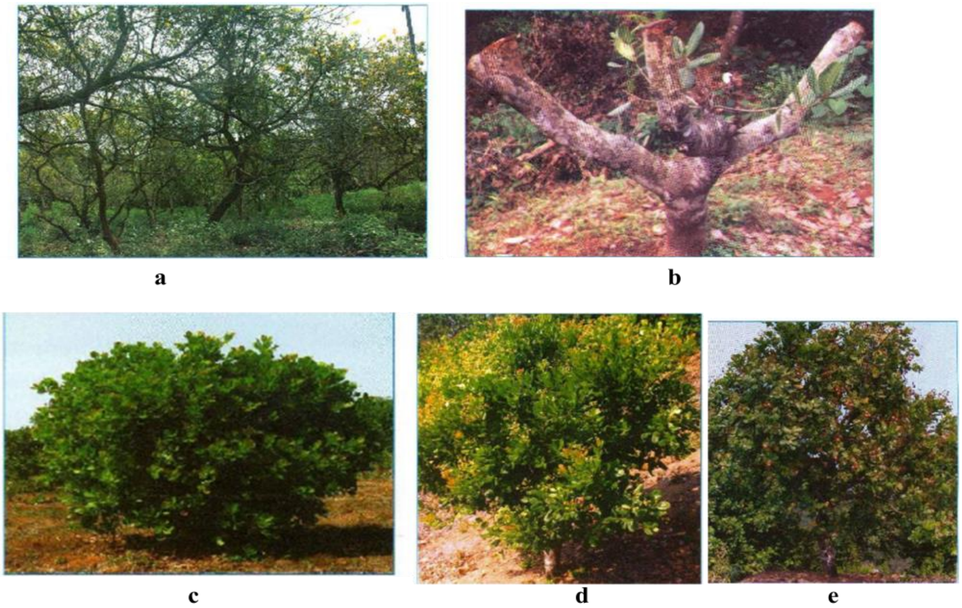

Fig. 3: Rejuvenation of old cashew tree. a. Poorly managed old orchard, b. Beheaded tree, c. Redeveloped canopy, d. Flowering in rejuvenated plant and e. Fruiting in rejuvenated plant.

Top working

Generally, old cashew plantations which are of seedling origin and become senile can be rejuvenated by top working on flushes arising from beheaded trees. Trees rejuvenated by top working start flushing and fruiting in the very next season with vigorous canopy growth. For top working, Trees should be young enough (15-20 years) to produce new flushes; preferably trees should have smooth brown coloured bark. The technique of rejuvenation of existing, unthrifty cashew plantations by top-working boosts cashew production 3-4 fold in a short span.

Fig. 4: Top working in cashew. a. Flush emergence after top working and b. Rejuvenation upon beheading.

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Pest management in the rejuvenated trees

The trees which have been top worked need to be checked for any symptoms of Cashew stem and root borer pest incidence right from the first week after top working at 15 days intervals.Normally, the fork regions and the cut ends (if uncovered) will have the pest entry and exudation of the fine frass material in small quantity. These spots of the bark should be chiseled cautiously so as not to make more damage onto the bark of the top worked trees. The chiseled surface needs to be treated using either carbaryl suspension (1.0%) or chlorpyriphos solution (0.2%). In certain cases where water logging occurs at the collar region the bark starts rotting at the collar region and the tree likely be attacked severely by the shot hole borers. In such cases, there is an immediate need for treating such trees by swabbing and drenching with monocrotophos (0.2%) (approx.2-4 l per tree) as such trees will lead to spread of infestation to the neighboring trees in a short time.

CONCLUSION

Canopy management is the manipulation of tree canopies to optimize the production of quality fruits. The canopy management, particularly its components like tree training and pruning, affects the quantity of sunlight intercepted by trees, as tree shape determines the presentation of leaf area to incoming radiation. Initially pruning and training as in several horticultural crops was not felt as important practice for cashew. The attempt on pruning gave surprisingly encouraging results and made way for adoption of the techniques in varied manner in this crop with different goals.

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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Impact of biomass burning on environmental pollution and its alternative uses.

Article id: 11132

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INTRODUCTION

India is a country mainly based on the agriculture. The residue of agricultural practice is plant material that leftover after threshing and harvesting of the crop. Mainly there are two types of farming crop residues such as field residues and process residues. In India three crops per annum are usually taken. In between two crop period, farmers have much less time or no time to set up the farm for next crop season. Furthermore, no economic technologies are available for the collection of crop residue left over the pasture. The burning of biomass seems to be an ancient farming practice, but the increase in population and the demand for farming area and food have insightful consequences on the level of biomass combustion.

Figure 1. Paddy residue burning

The combustion of agricultural waste causes serious contamination of soil and water at local and regional level. On an average, total quantity of stubble generated for paddy and wheat per acre was approximately 23 and 19 quintals, respectively. Of this, in the case of paddy, more than 85 per cent was burnt in the open field and less than 10 per cent was incorporated, while the remaining 8 per cent was used for other purposes. In case of wheat, 77 per cent of the total amount was used as animal fodder, while 9 per cent was incorporated and around 11 per cent was burnt. It is estimated that the combustion of paddy straw results in nutrient losses viz., 3.85 million tonnes of organic carbon, 59,000 t of nitrogen, 20,000 t of phosphorus and 34,000 t of potassium. This also badly affects the nutrient budget in the soil. Straw carbon, nitrogen and sulphur are completely burnt and lost to the atmosphere in the combustion process.

Air toxins released from biomass, open combustion of either jungle fires or harvest scum, include greenhouse gases such as carbon dioxide (CO_2), carbon monoxide (CO), methane (CH_4) and nitrous oxide (N_2O) as well as volatile organic compounds (VOCs), ammonia (NH_3), sulphur dioxide (SO_2), nitrogen oxides (NOx) and particulate matter (PM). The incineration of agricultural waste also releases a large quantity of pollutants into the atmosphere, which in addition to the above includes aerosols and hydrocarbons. These gaseous emissions can cause health risks, aggravate asthma, chronic bronchitis and reduce lung function. The combustion of harvest scum also indirectly contributes to the enhancement of ozone contamination. It has negative effect on the value of soil. When crop residues are burned, the minerals in the top soil get destroyed, making it difficult to grow the next crop.

Types of Biomass Burning

1. Forest fire

Forest fires are considered as the main cause of carbon monoxide (CO), carbon dioxide (CO_2), volatile organic compounds (VOC), methane (CH_4), halogen compounds and nitrogen oxides. The count of fire disasters increased in most of South and Southeast Asia in winter and spring due to large forest fires during the dry seasons. During the monsoon of the summer, due to heavy rains, the count of fire disasters in India and Indochina is very low. In the eastern part of China, the count of fire disasters increases, especially in winter and spring. In dry regions like the Tibetan Plateau, central and western China, there is very little fire.

Figure 2. CO_2 emissions from forest fire

2. Biofuel

Biofuel is produced by live processes and used for industrial or domestic energy sources. In assessing the consequences of biofuels, it should be reminded that, basically, it can be renewed so that it is "refreshing", unlike burning fat. Biomass is more dependent on heat as the foremost resource of liveliness for rural people in developing countries. In the developing world, it may be significant that for more than 50 years, it was estimated that about 70 per cent increase in biofuel global use, but it is difficult to predict in the future.

3. Agricultural/waste burning

Fossil fuel and waste disposal may be common in rural and urban areas. Most of the biomass is used for domestic purpose. Wood, damages and sawdust produces approx. 43 per cent of biomass energy, but any living organism produces biomass energy. In some biomass sources, agricultural products like plants and corn fruits can be included. Wood and saw dust is utilized to generate electricity, electrical energy sources that do waste is not dispersed by the services. Paper and saw mills have used electricity and their uses to make more use of their electricity production. However, when they use more energy, they have to to pay money for extra power from services.

Alternative uses of crop stubble

Keeping in view the increasing problems associated with crop stubble burning, several initiatives for its proper management have been taken up. Some of these alternative uses are as given below.

1. Use of crop residue as fodder for animals

The residue of rice as animal fodder is not an extremely admired practice with farmers. This is primarily due to the high silica fraction in rice residue. It was supposed that almost 40 per cent of the bhusa produced is used as dry feed for animals. However to promote the use of paddy residue as animal fodder, a pilot project on natural volatilization of paddy straw was conducted to make use of protein supplement cattle feed. Livestock fed with this feed showed progress in hygiene and milk production.

2. Use of crop residue in bio thermal power plants

Another use of agricultural residue is the utilization of rice waste for electricity generation. In the biomass power plant, the fuel has been changed from rice straw to rice husk, wood chips, cotton waste, etc., in combined form or rice husk only to conquer the preferred constraints. The total biomass requirement is estimated as 82,500 MT/annum at 100 per cent utilization capacity for optimal plant activity. In addition to generating electricity, the plant also condenses the greenhouse gas emissions. A 10 MW biomass power plant will supply energy comparable to about 417.8 million kWh to the grid in a duration of 10 years, which would result in a total reduction of CO_2 emissions of 0.32 million tonnes.

3. Use of rice residue as bedding material for cattle

The use of rice straw beds during the winter has helped to improve the value and quantity of milk, as it has reinforced to livestock welfare, udder physical condition and leg fitness. The rice straw beds helps keep the animals temperate and preserve sensible heat loss from the body. It also afford dirt free, sanitized, arid, relaxed and non-slippery environment that avoids the possibility of wound and lameness. Healthy paws and hooves guarantee the increase in milk production and the reproductive efficiency of animals.

4. Use of crop residue for mushroom cultivation

Rice residue can be made use of growing mushrooms and a kg of rice straw produces about 600 g of mushrooms. Rice residue mushrooms (Volveriella Volvacea), also branded as grass mushrooms are named after their rice straw cultivation employed in South Asia. Rice straw mushroom can be grown-up on a wide range of farm residues for substrate preparation, such as water hyacinth, palm oil cluster residue, dry banana leaves, cotton or wooden straw with rice residue, which is mainly successful. The rice straw mushroom represents for 16 per cent of total produce of mushrooms grown in the world.

5. Use of rice residue in paper production

The rice residue can be made use in combination with bhusa in 40:60 ratios for production of paper. The slush can be imposed to bio-methanization for power generation. This mechanization was now set in some paper industries that meet 60 per cent of the power generation through this method. Rice residue is also utilized as a perfect raw material for the production of paper and paper board.

6. Incorporation of paddy straw in soil

The amalgamation of rice residue into the earth has a sympathetic consequence on the physical, chemical and biological characteristics of the top soil, such as pH, organic carbon, water retention capacity and apparent solidity of the soil. It was observed that it increases the ease of use zinc, copper, iron and manganese contained in the top soil and it also avoids the leaching of nitrates. Increasing organic carbon increases bacteria and fungi in the top soil. Due to the increase in the microbial populace, the bustle of microbes liable for converting an existing mixture of nutrients also enhances. It also results in considerable reserves in irrigation and fertilizers.

7. Production of bio-diesel from straw and other agricultural waste

Bio-diesel is a high-density liquid obtained from biomass through rapid pyrolysis technology. It has a heating value of around 55 per cent compared to diesel. It can be reserved, propelled and transported as an oil-based product and burned directly in boilers, gas turbines and medium and low speed diesel engines for temperature and power applications, including transport. In addition, bio-diesel is SO_2 free and produces a low NO_2 content.

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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
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Scope for entrepreneurship in agriculture

Article id: 11133
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INTRODUCTION

Agriculture has been the dominant and important sector of the Indian economy due to its high participation in employment and as a source of livelihood for approximately 65 percent of the Indian population to date. It remains an important contributor to India's GDP. It supports more than 500 million people and provides employment for 52 percent of the workforce. Its contribution to the nation's GDP is approximately 10.5 percent in 2014-15. (statisticstimes.com, 2015).

India is managing 17.5 percent of world population on 2.4 percent of world land. During independence, more than half of the national income was contributed by agriculture and more than 70 percent of total population was dependent on agriculture (Pandey, 2013). Due to changing socio, economic, political, environmental and cultural dimensions throughout the world, the farmers 'and nations' options for survival and sustainability, and ensuring success in changing their respective economic environments, have become increasingly critical. The rapid growth of agriculture is essential not only for self-reliance but also for meeting the food and nutritional security of the people, to bring about equitable distribution of income and wealth in rural areas as well as to reduce poverty and improve the quality of life . Growth in agriculture has a maximum cascading impact on other sectors, leading to the spread of benefits over the entire economy and the largest segment of population.

The emergence of free market economies has led to the development of a new entrepreneurial spirit 'Agripreneurship' and the growing individual need for responsibility to run their own businesses (Alex, 2011). There is a need for great innovation and investments in this sector. The government of India has allowed 100 percent of FDI through an automatic route of storage and storage, and also for the development of seeds.

The social entrepreneurship ecosystem is on a growth path but is still very nascent in India. With the wave of social entrepreneurship flowing across various sectors of social impact, agriculture sector is not left untouched. Innovative social enterprises are coming up which are focusing on the problems and needs of farmers. With very few impact investment funds in India, there are even fewer, which have invested in the agriculture sector (KirtiPunia, 2013).

Need of Agripreneurship Development

There is a need of entrepreneurship in agriculture for more productivity and profitability. This is the need of the hour as the people are facing growing unemployment and poverty in rural areas. But after the inception of New Economic Reforms, adoption of liberalisation, privatisation and globalisation and accepting objective of World Trade Organisation in 1995, it is expected that rural area has the capability of growing at par with urban area.

Entrepreneurship in the field of agriculture can generate wide range of economic benefits such as increased agri productivity, creation of new business ventures, new jobs, innovative products and services, development of rural areas and increased wealth. Agripreneur is a dynamic business manager who performs various agri-based activities using different resources viz, physical resources, financial resources, human resources and information, in order to accomplish a certain goal.

Promotion of Agripreneurship in India

India is having 52 percent of total land that is cultivable as against 11 percent in the world. All 15 major climates of the world exist in India from snow bound Himalayas to hot humid southern peninsula, and desert to heavy rain areas. There are 20 agro-climatic regions and nearly 46 out of 60 soil types in the country. The sunshine hours and day lengths are ideally suited round the year for cultivation of crops.

India is ranked the second largest producer of rice and wheat in the world. It is first in pulses and fourth in coarse grains according to the data. India is also one of the largest producers of cotton, sugar, sugarcane, peanuts, jute, tea and an assortment of spices. In terms of the real value added, the Indian agriculture sector ranks third, after China and the United States. The share of agriculture in the total value added to the economy, at around 13.2 percent, is still quite high. This implies that agriculture is likely to remain a priority, both for policy makers as well as businesses, in the foreseeable future and any move to ramp up the sector calls for a multi-pronged strategy.

Challenges

Farmers need to adapt certain qualities to become entrepreneurs. They need to be innovative and look forward to accept challenges for managing their businesses as long-term ventures with a view to making them sustainable. They must learn to identify opportunities and grab them for their benefits. Some small-scale farmers do have these qualities, but they still focus on maintaining their traditional way of life. Their production decisions are based on 'what they need' and not on 'what is possible' (David Kahan, 2012). The farmers must develop an entrepreneurial spirit to cope with the risks they would face in the future. A farmer must be enthusiastic and careful enough for making different decisions about his farm in the context of the value chain that influences the profits of the farm business.

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Opportunities

Farmers may be given a specialised training to run their farms as a profit-making business and to invest profits back into the business to generate long-term growth. They also must be encouraged and motivated to develop and adapt new technologies and share them with other farmers. Extension workers can facilitate partnerships among farmers and between farmers and researchers to work together to identify, develop and test new technologies and practices to improve productivity and profitability. They must be aware of the fact that they have greater opportunities that allow them to produce beyond just surviving. However, by changing their resource mix and overcoming access and risk issues, opportunities can be expanded. They should expand their survival farming to include some economic activities and can move towards the path of developing profit-driven farming businesses (David Kahan, 2012).

1. **Dal Milling:** In a typical household in India, pulses are the primary protein source of a diet plan. Also, there are wide varieties of pulses in the Indian market. You can capitalize on this fact through a dal milling plant. Such a plan actually processes different types of pulses.There is scope to select various pulses as per the availability of raw material. Usually, you can set up a dry milling or wet milling plants as these are the conventional processing. Furthermore, you should keep in mind that this process is capital and energy intensive.
2. **Flour Milling:**The scope of a flour related business is not restricted to wheat flour. In India, the market has opened up towards the consumption of different varieties types of flour for preparing different foods. Through a flour milling plant, you can process wheat flour, brown flour, whole wheat flour, wholemeal flour, etc. You can even set up a plant with a simple machinery on a small scale basis as the production process is simple.
3. **Groundnut Oil Production:** As groundnut is readily available as a raw material across India, groundnut oil processing is a highly profitable food processing business. The required capital investment is also not heavy. Such a manufacturing unit can be set up even on a small scale basis. The market has a high demand potential for groundnut oil considering the several health benefits groundnut oil offers.
4. **Honey Processing:** This business has the scope to be set up even in a home based basis. Requiring small scale investment, it also not required any extensive marketing plans. Honey processing involves removing wax and other foreign unwanted particles from honey. Depending upon the scale of investment, you can establish a honey processing unit that has either manual system or is electrically driven.
5. **Basket Production:** Especially for the rural sector in India, you can pursue basket weaving business as a profitable and popular business. As there are modern equipment being utilized in this business, there is scope to sell a wide variety of basket products even in the urban market.

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6. **Medicinal Herb Farming:** Recently Ayurveda and yoga have regained their popularity all over India as well as the world. Cultivating herbs which are of medicinal value has a great potential in the market. As there are various companies competing in the ayurvedic medicine market, you can supply the required herbs to them and gain profit. Also, there is an option to export these herbs as the international demand is also high. You need some prior knowledge of the sector to gain profits.
7. **Vermicompost Production:** With high demand for good quality vermicompost products, this kind of production is a very profitable agro-based business idea.Furthermore, it requires no special area as you can start it even from your backyard. You must keep in mind to have an effective marketing plan to succeed in this type of business.
8. **Organic Farming:** Through organic farming, you can produce crops and livestock feed without using pesticides, fertilizers, genetically modified organisms, antibiotics and growth hormones. As people are getting increasingly conscious about what they consume, organic production offers much growth potential and it still remains a largely untapped market. You can market these organically produced products through retail stores or even e-commerce platforms.
9. **Livestock Feed Production:** With the life of rural part of India still largely dependent on livestock, you can initiate livestock feed production business with proper planning. Also, there is a significant population dependent on livestock farming, so there is a constant demand for livestock food from livestock farmers. With the right mixing formula, you can provide the right food and food supplementary product for their farm. There is a wide variety of different livestock feed that you can produce, thus scope for profitability is not a concern.
10. **Micro Irrigation System Providing:** With India trying to move from monsoon dependency to modern irrigation, being a micro irrigation technology provider has gradually emerged as a demand-driven technology in India. With 48% of the geographical area of India receiving less than 1000 mm rain and the rest 1000-2500 mm, a micro irrigation system providing startup has great scope for profitability. The scope of agro-based business ideas is not only limited to the above-mentioned ideas. Depending upon your geographical location and market demands, you can set up a small scale business with proper planning. You can also explore various non-manufacturing options that are related to the agricultural sector. These business ideas require a small startup capital investment. Keeping a tab on the profitability of such business ideas, you can grow your business with proper planning. So all you need to do is analyze the market and the agro-based business ideas to find the best suitable one for you. Also, keep in mind your skills, experience, and knowledge while exploring these business options.

CONCLUSION

Agripreneurship is the need of the hour in India to make agriculture a more attractive and profitable venture. There is a great scope for entrepreneurship in agriculture. The potentiality of the country can be tapped only by effective management of agri elements such as soil, seed, water and market needs. The youth who can bear the risk and having a quest for latest knowledge in agriculture sector can prove to be right agripreneurs. It also has a large potential to contribute to the national income while at the same time providing direct employment and income to the numerically larger and vulnerable section of the society. Agripreneurship is not only an opportunity, but also a necessity for improving the production and profitability in agriculture and allied sector.

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http://www.agrifoodmagazine.co.in
AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Precision farming and crop modeling

Article id: 11134

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INTRODUCTION: Precision farming or precision agriculture is about doing the right thing, in the right place, in the right way, at the right time. Precision farming is a farming system which adopts location specific, field specific and crop specific approach. Input application is precisely monitored i.e., in measured form to match the varying growth stage of each crop in the field. It takes adequate care of technology upgradation and marketing support.

Need for Precision Farming

- To enhance productivity
- Non- availability of labourers
- Increased cost of cultivation
- Inadequate irrigation water or availability of water in deeper soil layers
- Insufficiency of existing extension tools.
- Global climatic variation
- Reduction of chemical use in crop production

Advantages

- Use of different management practices by looking at specific requirements of crop
- It allows efficient time management
- Eco-friendly practices in crop production
- Increases crop yield, quality and make efficient use of labour, water etc.

Basic Steps in Precision Farming:

i). Assessing variation
ii). Managing variation
iii). Evaluation

Precision farming is usually done as a four- stage process:

Data collection: Collection of field data enables the farmer to overlay in formation gathered from analysis of soils and soil resistivity. It is done in two ways:

- In vehicle GPS receiver as the farmer drives a tractor around the field
- The field is delineated an a basemap derived from aerial or satellite imagery

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- *N-Sensor ALS* mounted on a tractor's canopy – a system that records light reflection of crops, calculates fertilisation recommendations

Variables

- Intra and inter field variabilty may result from a number of factors. These include climatic factors, soil, cropping practices, weeds and diseases.
- Point indicators allow farmer to track crops status. This information may come from weather stations and other sensors.
- Soil resistivity measurements combined with soil analysis make it possible to measure moisture content

Strategies:

Using soil maps farmer can pursue two strategies to adjust field inputs:

- **Predictive approach:** Based on analysis of static indicators (soil, resistivity, field history, etc.) during the crop cycle.
- **Control approach:** Information from static indicators is regularly updated during the crop cycle by:
  - **Sampling:**Weighing biomass, measuring leaf chlorophyll content, weighing fruit, etc.
  - **Remote sensing:**Measuring parameters like temperature, humidity, wind.
  - **Proxy-detection:** In-vehicle sensors measure leaf status; this requires the farmer to drive around the entire field.
  - **Aerial or satellite remote sensing:** Multispectral imagery is acquired and processed to derive maps of crop biophysical parameters.

Implementing practices:

- New information and communication technologies (NICT) make field-level crop management more operational and easier to achieve for farmers.
- Precision farming uses technology on agricultural equipment (e.g. tractors, sprayers, harvesters, etc.):
- Positioning system
- Geographic information systems
- variable-rate farming equipment

Conclusion:

- Precision agriculture, as the name implies, means application of precise and correct amount of inputs like water, fertilizer, pesticides etc. at the correct time to the crop for increasing its productivity and maximizing its yields.
- Precision agriculture management practices can significantly reduce the amount of nutrient and other crop inputs used while boosting yields.

AGRICULTURE & FOOD
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http://www.agrifoodmagazine.co.in
AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Adulteration of spices: identification measures

Article id: 11135
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ABSTRACT

The shifting interest of people from quantitative attribute to the qualitative one has put a great hindrance to adulteration in food grains and spices. Since the unit cost of spices is more, they are generally adulterated to fetch higher profit. However, adulterated spices become very tough to distinguish by naked eye, as they impart the flavor to the look like adulterant mixed in to it. This poses great demand to define certain measures to identify the degree of adulteration.
Keywords: Spices, Adulteration, Detection methods, Spectroscopy.

INTRODUCTION

Standard ISO 676: 1995 of the International Organization for Standardization (ISO) defines spices and condiments as “vegetable products or mixtures thereof free from extraneous matter, used for flavouring, seasoning and imparting aroma in foods”. The term “applies equally to the product in the whole form or in the ground form”. Spices are retrieved from different parts of the plant *viz.* from floral part (clove, saffron, *etc*.); fruits (cardamom, chilies, *etc*.); berries (black pepper, juniper); seeds (aniseed, caraway, celery, coriander); rhizomes (ginger, turmeric); roots (angelica, horse raddish and lovage); leaves (bay leaves, mints, marjoram and tejpat); kernel (nutmeg); aril (mace); bark (cinnamom and cassia); bulbs (garlic, onion, *etc*.).

The spices have been treated valuably because of their rare but beneficial health and sensory attributes. They are used for increasing the sensorial properties of food like taste, appearance, flavour etc due to the presence of volatile / essential oil and resinous compounds. In addition; spice extracts are also used in medicinal, pharmaceutical, perfumery, cosmetics and several other industries due to their functional properties like antioxidants, preservatives, anti-microbial, antibiotic, etc. For instance, some are used for soothing pain, cleansing oral cavities when applied, while some others are helpful in curing viral flu, reducing inflammation and joint pain etc when ingested. Some of them are also used as class one preservatives in some foods like chutneys, pickles etc. These are also widely used for making ‘herbal’ teas and other medicinal applications.

Since ancient times, India has been a leading spice producer and exporter to the world. Total production of spices of India in year 2017 according to DSDA is 7075500 tonnes under the cultivation area of 3529200 ha. Of around 109 types of spices grown in different parts of the

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ISSN: 2581-8317
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world, almost all are grown in India. However, 52 spices are identified as commercially important, considering their domestic requirement, export demand by Spice Board of India.

Table 1: Production of spices in India

S. No.	Spices	Area (ha)	Production (MT)
1	Pepper	131230	57000
2	Cardamom (small)	69357	17990
3	Cardamom (large)	26617	5572
4	Chilli	830770	1872010
5	Ginger	164850	1081430
6	Turmeric	193395	1051160
7	Coriander seed	662345	609350
8	Cumin seed	760130	485480
9	Celery seed	4010	5510
10	Fennel	74660	124610
11	Fenugreek seed	218430	220160
12	Ajwan seed	24230	13820
13	Garlic	274550	1271220
14	Tamarind	49020	190700
15	Cloves	2350	1220
16	Nutmeg	23080	15460
17	Cinnamon	320	70
Total (including others)		**3529200**	**7075500**

(Source: Anon., 2017)

Food adulteration

Food adulteration is a major public health hazard that risks the life of public when consumed. In order to ensure the quality of food available to the consumer the Government of India enacted the Prevention of Food Adulteration Act (PFA), 1954. It has become mandatory for all the food processor to meet the standard set by the Govt. before marketing them. Many a times, inspections are carried out in food processing units by the teams of experts under FSSAI, Ministry of health and welfare etc. Various state/union territory laboratories, which are implementing the act, also collect the food samples that are sold in the markets and analyze them for PFA standards and document the findings. These findings are published by Directorate General of Health Services every year. These include the percentage of adulteration, number of prosecutions and convictions.

ISSN: 2581-8317

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Adulteration of food commonly defined as; "Undesirable changes in the natural composition and quality of food product/substance by adding some look like adulterants or subtracting any of its vital component." The substance that is used to lower the quality is known as adulterants. Adulteration of food is performed to fetch higher profit of the low quality product being sold.

As per the regulations provided by the Federal Food, Drug and Cosmetic (FD&C) Act (1938); food is said to be "adulterated" if it meets any one of the following criteria. These characteristics were later adapted by Prevention of Food Adulteration Act, 1954:

1. It bears or contains any "poisonous or deleterious substance" which may render it injurious to health.
2. It bears or contains any added poisonous or added deleterious substance (other than a pesticide residue, food additive, color additive, or new animal drug, which are covered by separate provisions) that is unsafe.
3. Its container is composed, in whole or in part, of any poisonous or deleterious substance which may render the contents injurious to health.
4. It bears or contains a pesticide chemical residue that is unsafe. (Note: The Environmental Protection Agency [EPA] establishes tolerances for pesticide residues in foods, which are enforced by the FDA.)
5. It is, or it bears or contains, an unsafe food additive.
6. It consists, in whole or in part, of "any filthy, putrid, or decomposed substance" or is otherwise unfit for food.
7. It has been prepared, packed, or held under unsanitary conditions (insect, rodent, or bird infestation) whereby it may have become contaminated with filth or rendered injurious to health.
8. It has been irradiated and the irradiation processing was not done in conformity with a regulation permitting irradiation of the food in question (Note: FDA has approved irradiation of a number of foods, including refrigerated or frozen uncooked meat, fresh or frozen uncooked poultry, and seeds for sprouting [21 C.F.R. Part 179].).
9. It contains a dietary ingredient that presents a significant or unreasonable risk of illness or injury under the conditions of use recommended in labeling (for example, foods or dietary supplements containing aristolochic acids, which have been linked to kidney failure, have been banned.).
10. A valuable constituent has been omitted in whole or in part or replaced with another substance; damage or inferiority has been concealed in any manner; or a substance has been added to increase the product's bulk or weight, reduce its quality or strength, or make it appear of greater value than it is (this is "economic adulteration").

Generally adulteration occurs due to following three reasons:

i. Intentional – sand, marbles, chips, stone, chalk powder, harmful colors etc.
ii. Incidental – pesticide, residues, larvae in food etc.
iii. Metallic – arsenic from pesticides, lead from water, tin from cans etc.

According to the analysts among the foods adulterated most common ones are oils and fats, spices, milk, sweets and confectionary, cereal and cereal products and pulses.

Spice adulteration

Analysts perceive that spices are among the second high risk groups for adulteration however according to DGHS it is the 4th highest risk group. Out of all the species turmeric is being mostly, adulterated and had more number of adulterants in terms of artificial/metallic colorants and starch to impart the texture. There is at least one food borne disease reported due to consumption of food adulteration with lead chromate used as a colorant in turmeric.

Common and rare spices have their respective adulterants that either are mixed while preparation of the spices or completely replace the original spice with the fake one. Most of the locally branded spices were found containing harmful substances. For example, white chilli powder is dyed with 'Sudan red', an artificial dye to turn it into an expensive red chilli powder; whole red chillies are adulterated with coal tar to enhance their appearance. Worse still, in many cases the used and exhausted spices are mixed with fresh ones in small quantities to confuse the consumer. The major and simplest reason is to increase profit. Sudan dyes are indirect carcinogens therefore they are banned for foodstuffs. Cornet *et al*., (2006) found that, these Sudan dyes used in animal testing reveals that Sudan III isomers cause allergic reactions. To detect the presence of non-permitted food colors in edibles using preliminary color test and thin layer chromatography Purba *et al*., (2015). In addition, TLC gives rise to different retardation factor for different non-permitted colors present in spice samples.

Disease causes due to adulteration

Adulteration in foods decreases our moral and social value. In our daily life there are so many unhygienic and contaminated things which are harmful to our health. When these things enter our body (in the form of adulterants) through the food we eat, many harmful diseases like Cancer are caused.

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Table 2: Disease caused due to adulteration in some spices

S. No.	Spice	Adulterant	Disease/Disorder
1	Chilli powder	Brick	Stomach disorder
		Lead soluble salts	Metal toxicity, Cancer, Lead poisoning
		Rodamine B	Cancer
		Oil soluble tar	Heart disease, damage to liver, tumor
2	Turmeric powder	Aniline dye	Cancer
		Yellow lead salts	Cancer
		Metanil Yellow	Cancer, toxicity
		Chalk	Indigestion
		Tapioca starch	Stomach disorder
3	Coriander powder	Common salt	High blood pressure
		Dung	Stomach problem

(Source: Sen *et al.*, 2017)

Table 3: Adulteration in spices

S. No.	Spice Article	Adulterant	Detection method
1	Whole spices	Dust, straw, dirt, damaged seeds, other seeds, rodent hair and excrete	Visually examined
		Saw dust and powdered bran	Sprinkle on water surface, Powdered bran and sawdust float on the surface
2	Black pepper	Papaya seeds	Papaya seeds are shrunken, oval in shape greenish brown or brownish black in colour
		Light black berries	Float the sample of black pepper in alcohol. The black pepper berries sink while the papaya seeds and light black pepper float
		Coated with mineral oil	Black pepper coated with mineral oil gives kerosene like smell
3	Mustard	Argemone seed	Mustard seeds have smooth surface,

	seed		argemone seed have grainy and rough surface and are black and hence can be separated out by close examination. When mustard seed is pressed inside it is yellow while for argemone seed it is white (use magnifying glass for identification)
4	Cloves	Volatile oil extracted (exhausted cloves)	Exhausted cloves can be identified by its small size and shrunken appearance. The characteristics pungent of genuine cloves is less pronounced in exhausted cloves
		Coated with mineral oil	Cloves coated with mineral oil gives kerosene like smell
5	Powdered spices	Added starch	Add a few drops of tincture of iodine or iodine solution. Indication of blue colour shows the presence of starch (this test not applicable for turmeric)
		Chalk powder, yellow soap, stone powder	Take 1 g of spice powder in test tube and add 5 ml of carbon tetrachloride solvent. shake well and leave for some time. Impurities will settle at the bottom, while the spice powder will float on the surface.
		Common salt	Taste for addition of common salt
6	Turmeric whole	Lead chromate	Appears to be bright in colour which leaves colour immediately in water
7	Turmeric powder	Coloured saw dust	Take full spoon of turmeric powder in test tube. Then add a few drops of concentrated hydrochloric acid. Instant appearance of pink colour which disappears on dilution with water shows the presence of turmeric if the colour persists, metanil yellow a now permitted coal tar colour is present
		Chalk powder or yellow soap stone powder	Take small quantity of turmeric powder in test tube containing water. Then add a few drops of concentrated hydrochloric acid, effervescence (give off bubbles) will indicate the presence of chalk or yellow

			soap stone powder
		Starch of maize, wheat, tapioca, rice	A microscopic investigation reveals that pure turmeric is yellow coloured, big in size and has an angular structure. While foreign/added starches are colourless and small in size.
8	Asafoetida (Hing)	Soap stone or other earthy mailer	Shake sample with water and allow to settle. Soap stone or other earthy mailer will settle down at the bottom
		Starch	Add tincture of iodine, appearance of blue colour shows the presence of starch
		Foreign resin	Burn sample on spoon, if burn like camphor it indicate sample is pure
9	Cinnamon	Cassia bark	Cinnamon barks are very thin and can be rolled. It can be rolled around a pencil or pen. It has a distinct smell. Whereas cassia ark comprise of several layers in between the rough outer and inner most smooth layers. On examination of the ark loosely, a clear distinction can be made
10	Chilli powder	Brick powder, salt powder or talc powder	Take a tea spoon full of chillies powder in a glass of water. Coloured water extract will show the presence of artificial colour. Coloured water extract will show the presence of artificial colour. Any grittiness that may be felt on rubbing the sediment at the bottom of glass confirms the presence of brick powder/sand, soapy and smooth touch of white residue at the bottom indicates the presence of soap stone.
		Artificial colour	Sprinkle the chilli powder on a glass of water. Artificial colourants descend as coloured streaks.
		Oil soluble coal tar colour	Take 2 g of powder in test tube; add few ml of the solvent ether layer into a test tube containing 2 ml of dilute HCl (1 ml HCl+1ml

			water). Shake it, the lower acid layer will be coloured distinct pink to red indicating presence of oil soluble colour.
		Water soluble syntheticColour	It can be detected by sprinkling a small quantity of chillies powder on the surface of water contained ina glass tumbler. The water soluble colour will immediately start descending in colour streaks.
		Sudan III	Take 1 g of powder in a test tube and add 2 ml of hexane to it shake well. Let it settles for some time decant the clear solution to another test tube. Add 2 ml of acetonitrile layer is an indication of the presence of sudan III
		Sawdust	Sprinkling chilli powder on the sawdust will float on water and added surface of water.
11	Cumin seeds	Green seeds coloured with charcoal dust	Rub the cumin on palms. If palm turn black adulteration is indicated
12	Saffron	Coloured dried tendrils of maize cob	Genuine will not break easily like artificial.

(Source: FSSAI, 2012)

Sophisticated techniques to find adulteration in spices

1. Absorbance Spectroscopy

This technique investigates a food's chemical composition directly via wavelengths absorbed when light passes through it. Absorbance is most often used for liquids. Methods for confirming the quality of spices, for example, employ absorbance measurements.

2. Reflectance Spectroscopy

Like absorbance, reflectance is a nondestructive method and yields the most information from food samples when near-infrared (NIR) and visible reflectance are over the 400-2500 nm wavelength range. Another device, the Flame-NIR, covers 950 to 1650 nm.

For spices, reflection spectroscopy can be used to identify fillers and adulterants such as less expensive spices and dyes, which are used to mask ageing. Even sawdust has been used as an adulterant, and although it's virtually impossible to detect visually, spectroscopic analysis reveals the higher water content of sawdust compared with the spice.

3. Vibrational Spectroscopy

It is a fast, reliable, and competent analytical technique that helps to conform the authenticity of food (Bazoni *et al*., 2017; Lohumi *et al.*, 2015). Among the most studied systems based on vibrational spectroscopy are Raman, NIR, FT-IR, and HSI. Each of these systems has its particularities, advantages, and limitations. Nevertheless, all of them have shown great efficiency for authentication of herbs and spices, some more efficient than others, depending on the system that is being evaluated.

4. Hyperspectral Imaging

Hyperspectral imaging (HIS) captures thousands of images at different wave lengths in order to extract the image properties at each pixel at different wavelengths. It creates a three dimensional structure of image data (hypercube), consisting of a spectrum for each pixel in the image (Kamruzzaman *et al*., 2016a, 2016b; Velásquez *et al*., 2017). This technology analyses any heterogeneous structure to obtain the physical as well chemical information from the same imagewith the advantage of being able to observe the spatial distribution of the analyte in the matrix (Barreto *et al.*, 2018; Kamruzzaman *et al*., 2016b). It combines the advantages of image analysis and spectroscopy to analyze heterogeneous structures which enhances the value of the technique. with the advantage of being able to observe the spatial distribution of the analyte in the matrix (Barreto *et al.*, 2018; Kamruzzaman *et al*., 2016b).

5. Isotopic Techniques

Isotopes are atoms of the same atomic number but different mass number (Danezis *et al*., 2016). The most sophisticated technology of elemental analysis in today's date can determine the origin of the spices and can also sense the presence of external agents. The variation in distribution of hydrogen and oxygen isotopes in precipitation and groundwater is used to verify the origin of the high quality food product (Abbas *et al*., 2018). Although there are several types of elemental isotope studied, the H/ H ratio is mainly used with NMR analysis equipped with a deuterium probe (Kelly *et al*., 2005). Another technique widely used for the analysis of elementary isotopes is ESR spectroscopy, which has been almost exclusively used for the identification of irradiated spices and even the detection of the level of irradiation.

Governing bodies for quality control during export

Although India is a major producer of spices and holds top most position in quality of spice produced, many a times the materials prepared for export are rejected at the port due to quality issues. For export of any food product, the exporting countries have to comply with the regulations laid down by the quality regulatory agencies of the importing countries. Before the

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liberalization, exporters had to comply with the pre-shipment inspection and quality control as per the AGMARK Grade Specification prescribed by the Directorate of Marketing and Inspection (DMI).With the liberalization pre-shipment inspection and quality control was withdrawn and the exporters are free to export the spices and spice products as per the specifications prescribed by the importing countries. The most popular specifications for spices and herbs the world over is the "ASTA Cleanliness Specifications for Spices, Seeds and Herbs". The unified ASTA, USFDA Cleanliness Specifications for Spices, Seeds and Herbs was made effective from 1-1-1990. Major producing countries have built up their facilities to meet the requirements as per ASTA Cleanliness specification. European Spice Association (ESA) comprising of the members of the European Union (EU) has come out with the "quality minima for herbs and spices". This serves as a guideline specification for member countries in European Union.

In addition to the cleanliness specification, the importing countries insist on the specification for parameters like pesticide reduces, aflatoxin, trace metal contamination and microbial contamination. Individual member countries in European Union have fixed maximum residue Levels (MRLs) for pesticide residues. European Union has prescribed limits for aflatoxin as 5 ppb, for Aflatoxin B1 and l0 ppb for Aflatoxin total. Member countries in EU and others have fixed limits for aflatoxin varying from 1 ppb to 20 ppb. USA and Japan has prescribed the MRLs in spices. Under the codex, MRLs for pesticide residues have not been prescribed. India has taken initiative to fix the MRLs for spices at the Codex level.

Importing countries are also cautious on the microbial contamination in spices at the time of import. Almost all the importing countries have fixed the limits for Samlonella as absent in 25g. Specifications have been prescribed by major importing countries for the microbial parameters such as Total Plate Count (TPC), E. Coli, Yeast, Mould, Coliforms, etc. The limits for the above parameters vary from country to country. The cleanliness specification, the limits for pesticide residues, aflatoxin and microbial contaminants prescribed by the major importing countries are given in spice board website online (https://www.indianspices.com/html/s/s1490qua.html).

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ISSN: 2581-8317
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Hydroponic green fodder production - Increase in milk production and income

Article id: 11136

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INTRODUCTION

Green fodder is one of the main raw material and plays an important role in feeding dairy cows. Green fodder provides the nutrients and minerals needed to produce milk and the health of dairy cows or livestock. Controlling the cost of feeding dairy animals has an impact on profits and leads to successful dairy activity. Generally, in most places of country, feed costs account for around 70-75% of total milk expenditure, and green fodder account for 30-35% of total raw materials. In India, rapid urbanization and mining areas have resulted in the shrinkage of pastures and the presence of land that produces green fodder. This situation has led dairy owners to seek an alternative and sustainable method of producing quality green fodder.

Figure 1. Hydroponic green fodder feeding to sheep

Due to high labor costs, lack of irrigated areas and high land prices, the dairy sector faces many challenges to meet the growing demand for milk in the country. It is very clear that with an increase in costs and the depletion of natural resources, a sustainable technology such as hydroponics will be the main driver of the future of the dairy industry. The use of hydroponic technology to produce quality green fodder would be a revolutionary step in the production of green fodder in the country. The availability of limited irrigation facilities also requires the application of hydroponic technology in the production of green fodder.

Greenhouses or shade nets would be the right choice for executing hydroponic technology. Many states of country grant subsidies for the construction of greenhouses and shiny shade nets. These greenhouse and shade net subsidies can be put into practice for hydroponic production of quality green fodder. Fodders grown in hydroponic manner can feed on sheep, goats, cattle and other animals.

Why Hydroponic Green Fodder?

- *Saves water.* It consumes 98% less water than conventional methods, and waste water can be recycled.
- *Reduce growth time.* From seeds to fodder takes only 8 days, and for conventional feeding it takes about 45 days.
- *Nutritional value enhancement.* Since the feed contains fodder seeds, the crude protein content is higher than that of conventional green fodder.
- *Marginal land use.* Up to 1000 kg of green fodder can be grown in 480 square feet per day equivalent to conventional fodder (Co4) produced on 25 acres of land.
- *Natural and organic.* Food can be grown naturally without the use of pesticides.
- Requires minimum time and labor.

Major Requirements of Hydroponic Fodder Production

- 480 sq.ft area for production of 1000 kg of green fodder daily.
- Hydroponic machine.
- Uninterrupted power supply.
- Clean water.
- Seeds with good germination capacity.
- Good sanitation.
- Two to three labours for continuous observation.

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Construction of Hydroponic Fodder System

In order to obtain high-quality feed, it is necessary to control the temperature and humidity. Fodder easily grows in semi-controlled environmental conditions in a temperature range of 15 to 32 °C and a relative humidity of 80 to 85%. In addition, it is necessary to control the intensity of light in order to produce the fodder, so it is necessary to build a small shade net or a low cost greenhouse. For erecting shade net or greenhouse, bamboo wood or iron rod or a hard plastic pipe, as well as shade net, are required.

Figure 2: Low cost hydroponic fodder production unit

Depending on the amount of fodder demand, a hydroponic feeding system has to be built. Little space is required to build this hydroponic system. For the most part, farmers use a greenhouse for hydroponic feeding. It is better to choose the location of the hydroponic shed near the livestock shed because it is easy to use. To ensure ventilation, space should be left between the roof and the side walls. The storage facility is well ventilated to maintain temperature and humidity.

To grow hydroponic fodder, a medium tray of 1.5 x 3 ft size, made from high-quality plastic is needed to withstand weight on the fodder. To avoid oxidation, avoid metal trays and use plastic trays. Make 15-20 small holes in the trays to drain excess water.

Inside the shed, the trays should be placed on the bamboo support, the plastic or metal support with a three to four layer support and it is necessary to ensure that the height of the support is low for spraying water and removing the trays. Enough space must be left between the two layers to easily seed the seeds and create a slight slope for each layer on one side of the support to drain

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water from the trays quickly and easily. A small drainage pipe should be built on the inclined side of the grid to drain the water properly.

Hydroponic Fodder Production Process

Good seed quality must be chosen for the production of hydroponic feed and avoid broken or unhealthy seeds as they do not germinate and grow properly. Seeds of corn, leguminous plants, wheat and horse gram may be used to produce hydroponics but do not use millet and sorghum seeds as these sprouted leaves contain poison that may harm animals. Most farmers use corn seeds to produce hydroponic feeds. In cold weather, wheat and oat seeds are good, while in hot climates maize seeds are suitable for hydroponic feeding.

Procedure

- Add 5 to 7 litres of warm water and seed in a plastic bucket and remove the impurities and seed that float in the water as they will not germinate.
- Then add 50 to 100 grams of salt in water to reduce the risk of spores.
- Leave the seed soaked in water for about 12 hours.
- After 12 hours drain the water and clean the seed with clean water.
- Move this washed seed into a jute bag and let it germinate.
- In cold climate it will take more than 24 hours to germinate, while in warm climate the seed will take about 24 hours.
- Before using back the trays, wash them properly, check all obstacles and remove them if necessary.
- Move the germinated seeds from the bags into the trays distribute them evenly and place the trays in the holder.
- Spray water on sprouted seeds daily using water cans or irrigation systems.
- To maintain humidity, spray the water every two hours in warm climates and after 4 hours in cold weather.

Feeding of Hydroponic Green Fodder

The fodder is ready to harvest for six to seven days by removing the feed trays from the shelf and cut into small pieces before feeding the cattle, which facilitates adequate animal feed. Avoid keeping feed for more than nine days in trays because after nine days the nutritional value of the feed begins to slow down and the fiber begins to grow. The farmer can give a combination of semi hydroponic feed and semi-dry feed simultaneously.

CONCLUSION

Hydroponic green fodder is the key to reduce feed costs in milk production. Due to the lack and high price of land, the minimum use of livestock feed can provide more land for other crops, thus improving the economy and land sustainability. Conditions for optimal growth with guaranteed yield per day. The process of hydroponic growing of green fodder allows control of climatic conditions for optimal growth with guaranteed yield per day. In this scenario, there is the demand for dairy owners such as low lands, lack of water, salt water, labor and higher land costs. It has been proven that the production of green fodder with hydroponic technology can be a real alternative source of shortage of fodder.

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MAKHANA – *The Black Diamond*

Article id: 11137

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Makhana is botanically known as *Euryale ferox* and it belong t the family Euryalaceae. Makhana have a wide diversity in is distributed in tropical and subtropical regions of south-east and East Asia. The other names of makhana are fox nut, gorgon nut and thangzing. Makhana easily grows in shallow water bodies and is an important aquatic cash crop. This is the reason why makhana is very popular in Northern part of Bihar, North Bengal, Assam and other north eastern states of India. Makhana is profitably cultivated in water a body which does not have huge current or water velocities. It is cultivated in ponds, lakes, tanks and other aquatic bodies. Makhana have potential to be a very profitable crop for farmers and increase the income of the people where it is grown.

Botany of makhana: Makhana is a perennial, stem less, prickly, aquatics herb with short and thick rootstock. The leaves are large, round, submerged, oblong, orbicular corrugated about 6-100 cm in diameter. The above portion of the leaves is reddish-green in colour whereas it is purple below. The leaves are densely spinous.

Flowers are borne solitary and grow in submerged condition. The ovary is epigynous in nature. There are four (4) rigid thorny sepals inside which there are numerous petals. In most of the cases the flowers are cleistogamous (Shankar *et. al*., 2010).

The ovary is inferior in nature which develops into a spongy berry like fruit. The fruit is densely prickly. The fruit is of a size of an orange and contains 30-40 pea sized seeds. The seeds are surrounded by a tough blackish coloured seed coat. Inside the seed coat, mucilaginous substances are present. The pulpy aril helps the seeds to float in water.

Fig 1: Makhana growing in stagnant pond

Fig 2: Pure Makhana seeds **Fig 3: Puffed makhana**

Climate preferred: Makhana prefers a tropical and sub tropical climate for its growth and fruiting. Temperature between 20-35^{O}C and humidity 50%-90% is conducive for makhana growth, development, flowering and fruiting. High annual rainfall ranging from 100-300cm is always tolerable (Dutta, 1984).

Flowering & Fruiting: Flowers are solitary and is pinkish in colour. Flowering starts from mid-March to April followed by abundant fruiting. The fruit coat raptures after maturation of fruit resulting in spread of the seeds at the bottom of the waterbody. The maturity occurs during end of October.

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Makhana products: Makhana seeds are consumed after proper processing and removal of peel and mucilage. Makhana seeds are not only nutritious but also very delicious in nature. Makhana seeds are that's why called as *"Black diamond"* (Sundaram*et. al*., 2014). Food items made of makhana are used in religious purpose in Bihar, Assam and Manipur. Popped makhanais used in preparation of several delicious and rich sweet dishes and milk based sweets. Makhana is eaten in puffed form or mixed with vegetables.

Makhana have a high amino acid index (89%-90%). Makhana is rich in amino acids like arginine and lysine. Calorific value of makhana is also high i,e., 3.62 Kcal/g (Jha*et. al*., 1991).

Medicinal properties of makhana:

Makhana also have nutritional and medicinal significance. Makhana have wide application in ayurveda as well. In Ayurveda disease like *Raktapitta, Daha* and low quality of semen are cured by makhana consumption. In Chinese medicine treatment of diabetes mellitus *Makhana* have wide applications.

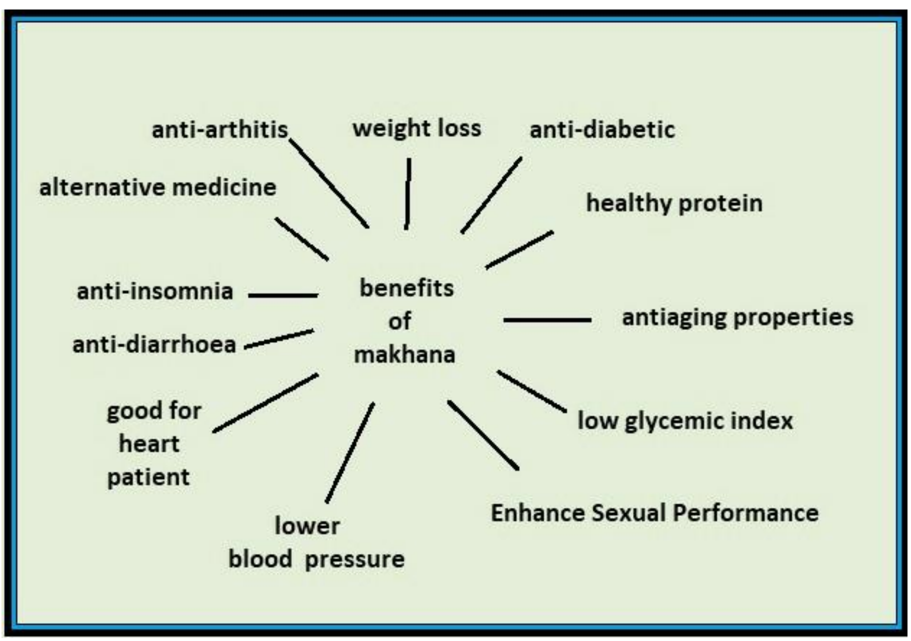

Fig 2: Health benefits of makhana consumption [(Puri*et. al.,* 2000); (Ho *et. al.,* 1953); (Song *et. al.*, 2011)]

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Manure application technology

Article id: 11138

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INTRODUCTION

India is an agriculture based country and agriculture is the most important sector of Indian Economy, where more than 50% of population is depend on agriculture, it is said that agriculture in India is a backbone for Indian Economy. India's production of food grains has been increasing every year and India is among the top producers of several crops such as wheat, rice, pulses, sugarcane and cotton. However, the agricultural yield (quantity of a crop produced per unit of land) is found to be lower in the case of most crops, as compared to other top producing countries such as China, Brazil and the United States. Although India ranks third in the production of rice, its yield is lower than Brazil, China and the United States. The same trend is observed for pulses, where it is the second highest producer.

Key issues affecting agricultural productivity include the decreasing sizes of agricultural land holdings, mechanisation in agriculture, availability and quality of agricultural inputs such as land, water, seeds and fertilizers, continued dependence on the monsoon, inadequate access to irrigation, imbalanced use of soil nutrients resulting in loss of fertility of soil. There are three major types of nutrients used as fertilizers: Nitrogen (N), Phosphatic (P), and Potassic (K). It has been observed that urea is used more than other fertilizers. While the recommended ratio of use of the NPK fertilizers is 4:2:1, this ratio in India is currently at 6.7:2.4:1.6.

The excessive reliance on chemical fertilizers and the negligence shown to the conservation and use of organic sources of nutrients have not only caused the exhaustion of soil of its nutrient reserves but also resulted in soil health problems not conducive to achieving consistent increase in agricultural production. Moreover, Indian soils are poor in organic matter and in major plant nutrients. Soil organic matter is the key to soil fertility and productivity. Organic manure provides all the nutrients that are required by plants but in limited quantities and also it helps in maintaining C: N ratio in the soil and also increases the fertility and productivity of the soil.

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Major organic sources

Carbon present in soil is in the form of organic matter. The organic materials most commonly used to improve soil conditions and fertility include farm yard manure (FYM), animal wastes, crop residues, urban organic wastes (either as such or composted), green manures, bio-gas spent slurry, microbial preparations, vermicompost and biodynamic preparations. Sewage sludge and some of the industrial wastes also find application in agriculture.

When comes to the farm yard manure, FYM refers to the decomposed mixture of dung and urine of farm animals along with litter and left over material from roughages or fodder fed to the cattle. On an average well decomposed farmyard manure contains 0.5 per cent N, 0.2 per cent $P_2O_5$and .0.5 per cent K_2O.

As we mentioned above, mechanization is another aspect with a significant impact on agricultural productivity. The use of agricultural machinery in agriculture enables agricultural labour to be used in other activities. It makes activities such as tilling, spreading of seeds and fertilizers and harvesting more efficient, so that the cost of inputs is offset. It can also make the use of labour in agriculture more cost-effective.

The status of mechanization in agriculture varies for different activities, although the overall level of mechanization is still less than 50%, as compared to 90% in developed countries. The highest level of mechanization (60%-70%) is observed in harvesting and threshing activities and irrigation (37%). The lowest level of mechanization is found in seeding and planting and also in application of fertilizers.

FYM application methods followed in India

In India, the application of manure is done using tractor trailer/bullock carts are used to transport the FYM from the storage pit to the field and manure is stacked piled in the field. FYM is mainly being applied through manual broad casting, resulting more labours and time per unit area with poor application uniformity and wide variation of the application rate. The spreading of stack piled manure is performed manually with spades, which involves human drudgery. Farm yard manure can be applied in field by manual way as described below.

Manual method

Broadcasting is a common way to apply solid or liquid manure. Sometimes this is followed by incorporation with a tillage operation.

Mechanical method

Manure spreaders

A manure spreader is an agricultural machine used to distribute manure over a field as a fertilizer. A typical (modern) manure spreader consists of a trailer towed behind a tractor with a rotating mechanism driven by the tractor's power take off (PTO).

History

The first successful automated manure spreader was designed by Joseph Kemp in 1875. Manure spreaders began as ground-driven units which could be pulled by a horse or team of horses. Many of these ground-driven spreaders are still produced today, mostly in the form of small units that can be pulled behind a larger garden tractor or an all terrain vehicle (ATV). In recent years hydraulic and PTO driven units have been developed to offer variable application rates.

Types of manure spreaders

1. Animal drawn manure spreaders
2. Tractor operated manure spreaders

1. Animal drawn spreaders

Animal power is a renewable energy source that is particularly suited to family-level farming and to local transport. Animal power is generally affordable and accessible to the small holder farmers, who are responsible for much of the world's food production. Draught animals have been used in India for field operations, transport and agro-processing. There are about 79 per cent small and marginal farmers who have limited land holdings and resources. These farmers rely on draught animals and human power for farm operations. Even today, taking 2.5 ha as command area per animal pair, over 57 per cent of the farming area is being commanded by draught animals. The importance of livestock in India is based on their production both in terms of milk and work. The bullocks are the main source of work in all the field operation and carting on the road. Bullocks are the major source of power of Indian villages for performing various field operations. The primary use of animal husbandry in India has been the draft utility of bullocks for different kind of agricultural operation. With the modernization of agricultural, the use of mechanical power in agricultural has increased but draught animal power (DAP) continuous to be used on Indian farms due to small holdings and mix cropping agriculture.

Many research studies have conducted for developing the animal drawn manure spreaders. Manure spreaders designed have the capacity of 1000 kg in India. Opening of the manure spreader was developed for better adjustment of manure application rate in the field. Manure spreader was

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developed in such a way that it can also be used as cart in the field when manure application was not necessary.

Fig.1 in field recording of pull and speed of operation with and without rotation of manure spreading auger

It has been proven that the developed animal drawn spreaders have worked satisfactorily and achieved uniform application rate of farm yard manure in the field with reduced human drudgery. The manure applicator is useful to marginal and small scale farmers and in organic farming, animal drawn manure applicator or spreader is promising solution for uniform spreading of farm yard manure over the field.

2. Tractor drawn farm yard manure spreaders

As it mentioned above, a manure spreader is an agricultural machine used to distribute manure over a field as a fertilizer. A typical (modern) manure spreader consists of a trailer towed behind a tractor with a rotating mechanism driven by the tractor's power take off (PTO). Tractors help in reducing the time required for many agricultural operations. It is also used as power source in farms for different farm works hence; it has become the integral part of mechanized agriculture. The development of tractor drawn farmyard manure spreader have reduced the drudgery of field works and improved the mechanization status for the farming community. The FYM spreader have reduced the cost of operation and ensured timeliness of operation with uniformity in spreading.

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Spreaders for solid manure are divided mainly by several characteristics:
1) Coupling - trailed, mounted or semi-trailed spreaders;
2) Spreading direction - rear or side spreading;
3) Feeding system – conveyor or pushing plate;
4) Spreading systems – beaters, discs, flails, or rotors;
5) Beaters positions – vertical, horizontal or longitudinal;
6) Beaters construction – teeth, auger, paddle or flail;

In India, The performance of developed tractor operated manure spreader till date have shown acceptable performance as for as application rate, uniformity etc. as for as Solid manure concern, It is advised to spread solid manure with a spreader with vertical beaters and spreading discs which are getting popular now a days. It gives a wider and more even manure distribution than spreaders with horizontal beaters and without discs. It is recommended to use spreaders with rear walls or doors to avoid manure loss during transportation.

CONCLUSION

Agriculture tractors are widely used as prime mover to pull or drive the implements in the farms, apart from custom made equipments like transplanter, manure spreader, combine harvester, cotton picker, mobile irrigation etc. which are used for particular operations in large production capacities. For small farms like in India, the productivity requirement was offset by the verstality of the equipment. Also, the farming practice varies in India due to geographical conditions such as soil types and demographic conditions such as crop types. Hence, the mechanization level of matured market was not yet achieved in India, though the technologies are available for implementation.

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e - Newsletter

http://www.agrifoodmagazine.co.in

AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Farm machinery accidents in Indian agriculture

Article id: 11139

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The contribution of agriculture and allied sectors in national GDP (Gross Domestic Product) is about 14%., about 52% of the Indian work force depends on agriculture for its livelihood and agricultural export constitutes 10 per cent of the country's exports. India has become the world's second largest producer of rice and wheat, and transformed from a food importer to a food exporter today. The success story is a vivid example of the contribution of science and technology in agriculture sector—advances in cropping systems, fertilizer responsive high yielding crops, expanding irrigation, land reclamation and selective mechanization. There is an apprehension that additional input has to come from better field operations in sustaining the self-reliance. This equation is confounded by the need for pragmatic approach to core safety and health issues of the vast population engaged in agriculture. The crop production encompasses seedbed preparation, sowing, planting, weeding, spraying, harvesting, threshing, livestock and materials handling, tools as well as machinery operation and maintenance, fertilizer and pesticide application, water lifting and irrigation, crop processing, storage and transport, and other jobs. A multitude of farm machinery including manually operated machines, hand tools, animal drawn implements, tractor and other powered machinery (Power take-off—PTO shafts, hydraulic oil pressure, electrical power, engine power, and ground traction) have been used.

Accidents and Injuries

The accidents and injuries are natural hazards to everyone who are working in the farm environment and these happen as a culmination of multiple factors, e.g., man, machine, crop, toxic chemicals or environmental factors. Since the farming sector is unorganized in character, there is an absence of nationwide repository on farm related accidents and injuries, which could be useful to quantify the health and safety, and economic consequences.

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Tractor accidents

Tractor, apart from its use in farm activities, it is a common mode to transport agricultural materials as well as people in the rural areas. The types of tractor-related incidents recorded are the rollover/overturning, falling from the tractor and run over, and also the incidences of PTO entanglements. The improper tractor and tractor trailer stability and lack of driving skill and maneuvering of farm implements by the operators have been reported as the major reasons of accidents. The locations of seat and controls on the tractor makes difficult for one to operate the controls in emergencies, and/or egress from the tractor. Since no rollover protective structures have been provided on the tractors, the operators are at risk of being crushed during a rollover. The incidences of tractor accidents might partly due to the improper coupling and uncoupling of implements and/or lack of training to the operator to do the hitching job.

Grain threshing and chaff cutting hazards and accidents

The age-old methods of threshing of grain from the paddy pinnacle are—rubbing the earheads with one's feet, beating of the harvested crop on a plank, animal treading, etc. The mechanical as well as pedal threshers are available today for threshing of paddy and wheat crops. In manual threshing by beating, one can separate about 100 kg of grain/h, whereas by using a pedal thresher (oscillating or rotary mode) one can separate about 150 kg of grain/h from medium sized paddy/wheat plants. However, the pedal threshing is a strenuous activity with high muscular strain due to speedy pedalling and holding of paddy plants on the rolling drum. The ergonomics improvement in the pedal thresher might allow a rhythmic legwork in sit-stand position.

The mechanical threshers, chaff cutters and winnowers are known for its high accident risks, due to lack of adhering to safety gadgets on the machinery. In a mechanical thresher running at full PTO speed, the farmer holds onto crop material to put into the machine. The accidents occur when crop material plugs the intake point of the machine and one attempt to unplug it with the PTO engaged. The hands and feet got injured by the rotor and the feeding chute, and also the injuries caused by the belt powering the thresher. Often the workers stand on unstable platform and in the event of a jerk or loss of balance the torso weight might push the hands and feet into the threshing drum. Also, the manual and power driven chaff cutters carry high accident risks when the workers attempt to feed the fodder into the rollers of the cutter.

Responding to the public uproar of the thresher accidents, the government of India enacted the Dangerous Machines (Regulation) Act (1983), advocating compulsory installation of safe feeding chutes and feeding systems on the threshers. The safety requirements of the mechanical threshers

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have been specified in the standards (IS 9020, 9129 and 10618), but many of the threshers used in the villages do not meet the safety requirements. The primary protection is to provide a master shield over the PTO stub shaft and also, the design optimization of the feeding chute is essential to keep it at the elbow level and the workers stand on a stable base.

Hazards of pesticide application

During the different stages of crop production, storage, packaging and transport, the pesticides are applied in the form of liquid sprays, mists, dusts, fogs, smokes, aerosol canisters and granules, thereby to protect crops from weeds, pests and diseases. The sprayer equipment may be manual, tractor operated or power operated. The small sprayers are mostly hydraulic energy type manually operated sprayers, e.g., compression or lever operated knapsack sprayers, hand or foot operated bucket sprayer, rocking sprayer, duster and power knapsack sprayer. Nearly 5 million plant protection appliances are in use in rural India, of which about 3 million are lever operated knapsack sprayers. The sprayer operators experience fatigue mainly due to carrying of the sprayer load as well as continuous lever operation. The vibration arising out of powered sprayers also causes discomfort to the operator. The pesticide applicators, mixers and loaders are at risk of exposure to toxic chemicals. It is not uncommon that the farmers broadcast pesticides or prepare pesticide solution with bare hands. Improper handling of pesticides, spraying without wearing personal protective equipment, oral poisoning of pesticides, etc. led to many sprayer related accidents in India. The health and safety concerns demand institutional measures for comprehensive training on pesticide safety, dress code, emergency assistance in case of exposure.

Hand tool injuries and design changes

The high rate of work, awkward work posture and design deficiencies of the hand tools result in cumulative musculo-skeletal strain and injuries in farm activities. Since the most hand tool injuries (e.g., cuts on the hands, feet and shins) have been classified as minor, they often go unnoticed; however, their consequences are often painful and disabling because of delayed treatment.

Other Hazards and Injuries

Snakebites

Snakebite accidents are common when the farmers work in open fields, threshing yards, barns, irrigation work and storage sheds, particularly during night work. Special hats and foot wear that are capable of deflecting snakes should be worn in locations where there would be trees,

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shrubs, crop plants, etc. Non-availability of emergency accessibility of medical assistance in case of snakebites might be attributed to the higher fatality rate in the rural areas.

Falls and falling objects, and other hazards

The farmers are exposed to potential injury from slips and falls from slippery and uneven surfaces, unguarded roofs and raised platforms, tipping over objects or being pushed by a moving object, climbing ladders, silos, tractors, etc. During loading or unloading, collapse of unsecuredly stacked foodstuffs and overhead materials often causes injury. In rural areas where the wells are not constructed with parapet walls, accidents happen in large numbers due to fall and drowning in wells, or fall of stones on workers while working in wells, etc.

The use of electricity in rural areas with overhead electrical lines is a common sight. There are also transformers and distribution points located in some fields. In case of some electrical fault, the farmers go directly to such transformers and fiddle it to check/repair the fault. The electrocution accidents are common in such cases. Accidents also happen because of touching of irrigation pipes to overhead lines inadvertently.

During handling and transportation of agricultural products, such as hay, straw, vegetables, grains and feeds, the farmers are at risk of respiratory disorders, due to exposure to dusts, gases, toxic chemicals, fungal spores and endotoxins. The lung disorders, such as farmer’s lung, green tobacco sickness, organic dust toxic syndrome, and bronchitis and airway obstruction have been reported bymany researchers.

In the open-field farming, the solar heat radiation particularly in the summer months is a health hazard and can be life-threatening. The farmers must be well-informed of recognizing the heat stress and disorders, and immediate remedial measures. The change in the work timings and schedule, and optimized work-rest ratio might avoid high heat load.

Suggestions for making agriculture farm a safer place to work include:

1. Regularly walk around your farm and assess potential dangers.
2. Consult with farm safety advisers.
3. Create a safe and contained play area for young children close to the house and away from hazards.
4. Make sure everyone working on the farm is properly educated on farm risks and trained in first aid.
5. Keep all equipment in good repair.
6. Store dangerous items such as machinery, firearms and chemicals behind locked doors and remove keys to a safe place.

7. Devise ways to improve safety, such as fitting roll-over protection (ROPS) and seatbelts to tractors, or replacing dangerous chemicals with less toxic varieties.
8. Keep a log of injuries and near-misses to pinpoint areas for improvement.
9. Consult with other workers and family members on how to improve safety.
10. Write a safety plan together that includes ways to identify hazards and minimize potential risks.
11. Always use appropriate safety equipment, such as machinery guards and shields, helmets, gloves, goggles or breathing apparatus.
12. Make sure everyone understands and uses safety procedures, especially children.

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AGRICULTURE & FOOD
e - Newsletter

http://www.agrifoodmagazine.co.in

AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Health benefits of *Moringa oleifera* leaves

Article id: 11140

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INTRODUCTION

Moringa (Moringa oleifera Lam) is a type of local medicinal Indian herb which has turn out to be familiar in the tropical and subtropical countries. Moringa oleifera is a small native tree of the sub-Himalayan regions of Therefore, herbal plants in medicine or known as phyto-medicine are still trustworthy and widely applied as one of the alternative way in medicinal field due to its affordable cost. *Moringa oleifera* is the most widely cultivated species of a monogeneric family. The scientific name of this tree is *Moringa oleifera.*The Moringa that is native to the sub-Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan. Presently, one of the most important trends in food and pharmaceutical industries is the growing demand for valuable natural sources of nutritional compounds. Green leafy vegetables are good sources of vitamins and minerals. It is a sub-tropical species that is known by different regional names as benzolive, drumstick tree, kelor, marango, mulangay, saijhan, mooringai and sajna.

It has very high nutritional properties that would be useful as a food supplement, especially in those relegated communities. Besides its nutritional and medicinal applications, *M. oleifera* is very useful as an alley crop in the agro-forestry industry. The micro-nutrient content is even more in dried leaves; (ten times the vitamin A of carrots), (17 times the calcium of milk), (15 times the potassium of bananas), (25 times the iron of spinach) and (9 times the protein of yogurt). *Moringa oleifera* is not only an important source of naturally occurring antioxidant. It is also an important Indian medicinal plant and an important ingredient of the Indian cuisine.

Therefore it is necessary to increase the utilization of *Moringa leaves* consumption by the different communities. It should be consumed either fresh or dry. Dried leaves can be stored for a long time and can be used regularly. Many companies across the world manufacturing various products of *Moringa* leaves such as *Moringa* Tea, *Moringa* Tablets, *Moringa* Capsules, *Moringa* leaf Powder, *Moringa* Soaps and *Moringa* Face wash. Some beverages are also available in market prepared by *Moringa* leaves. So it is necessary to hygienically drying and processing of *Moringa* leaves for further uses. Moringa oleifera also consist of anti-inflammatory, anti-spasmodic, anti-hypertensive, anti-tumor, anti-oxidant, anti-pyretic, anti-ulcer, anti-epileptic, diuretic, cholesterol

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lowering, renal, anti-diabetic and hepato protective activities. It has also long been labeled for its great cosmetic value in which in recent years, the Moringa has commonly been found to be used in various health care products including body and hair moisturizers and conditioners. It was also discovered that Moringa oil was used in skin ointments ever since the Egyptian times. The Moringa was claimed to be 'the most nutrient-rich plant yet discovered'.

Moringa (*Moringa oleifera Lam*) leaves and powder

- **Nutritional Composition:** The Moringa's incredible medicinal usage which is claimed by many cultures and communities based on real-life experience are now slowly being confirmed by science. Through research, the Moringa was found to contain many essential nutrients, for instance, vitamins, minerals, amino acids, beta-carotene, antioxidants, anti-inflammatory nutrients and omega 3 and 6 fatty acids. Nutrition content of a plant plays an essential function in medicinal, nutritional, and therapeutic properties. It is believed that Moringa leave to consist high source of vitamin C, calcium, β-carotene, potassium as well as protein. It works as an effective source of natural antioxidants. Due to the presence of several sort of antioxidant compounds such as flavonoids, ascorbic acid, carotenoids, and phenolics, Moringa is able to extand the period of food containing fats. It is rare for a single plant to contain many essential nutrients and furthermore in high quantities. It was reported by several researchers at the Asian Vegetable Research and Development Centre (AVRDC) that the leaves of four of the Moringa species were rich in nutrient and antioxidants in which the nutrient content varied with a few factors such as preparation method, leaf age and harvest season. As commonly known, most vegetables lose their nutrients upon cooking. However, it was observed that Moringa leaves whether fresh, cooked or stored as dried powder for months without refrigeration, did not lose its nutritional value. The leaves which were boiled resulted in three times more bio-available iron than the raw leaves. These results were also seen in the powdered Moringa leaves. In addition, the Moringa was found to have a group of unique compounds containing sugar and rhamnose, which are uncommon sugar-modified glucosinolates. These compounds were reported to demonstrate certain chemopreventive activity, by inducing apoptosis.

Nutritional composition of fresh moringa leaves

Sr. No.	Parameters	Percentage (%)
1.	Total solids	22.35
2.	Crude lipid	1.5
3.	Crude protein	12.8
4.	Total Ash	1.9
5.	Carbohydrate	12.5
6.	Fibre	0.9
7.	pH	6.0
8.	Antioxidant activity	52.3 activity/gm
9.	Total phenols	2.49
10.	Ascorbic acids	0.41
11.	Calcium	0.44
12.	Potassium	0.26

- **Antioxidant properties of moringa:** Naturally occurring antioxidants, particularly polyphenols are the main plant compounds that are able to decrease oxidative damage in tissues by indirect enhancement of a cell or by free radical scavenging. The leaves of the Moringa oleifera tree have been reported to demonstrate antioxidant activity dues to its high amount of polyphenols. Moringa oleifera extracts of both mature and tender leaves exhibit strong antioxidant activity against free radicals, prevent oxidative damaged to major biomolecules and gives significant protection against oxidative damage. A comparative study indicated that mature moringa oleifera leaf extract exhibited better values of enzymatic and non-enzymatic antioxidants. In the DPPH (2,2-Diphenyl1-Picrylhydrazyl) free radical scavenging activity test, both mature and tender leaf extracts showed significant reduction of DPPH radicals. The scavenging activity was suggested to be attributed to its hydrogen donating ability and was seen more in the mature leaf extract.

- **Anti fibrotic/ulcer:** Major contributors to the treatment of liver discovered to date are natural drugs. Constant efforts and studies on these naturals' drugs to treat liver fibrosis are being carried out in search for effective anti-fibrotic agents. It was recently discovered that the Moringa oleifera seed extract exhibited anti-fibrotic effects on liver fibrosis on rat.It showed significant protective effect against CC14-include liver fibrosis in rat which was confirmed by histological findings as well as biochemical analysis of a marker of collagen deposition in liver known as hydroxyproline. Treatment with Moringa was found to stimulate hepatoprotective effects against hepatocellular injury by blocking the increase of two serums, aspartate aminotransferase (AST) and alanine aminotransferase (ALT), which are indicators of liver health conditions.

- **Anti-inflammatory effects:** Moringa has been practically used in medicinal field,throughout the decades to heal a huge amount of acute and chronic conditions. In vitro and in vivo studies with the plant have recommended its effectiveness in treating inflammation, hyperlipidemia, and hyperglycemia. The properties of its phyto-chemicals, such as flavonols and phenolic acids were related to the anti-inflammatory, anti-oxidant and anti-bacterial activities. The hepatoprotective properties of Moringa seed extract which was discovered from the anti-fibrotic study indicated that the moringa also possessed anti-inflammatory properties against CC14-induced liver damage and fibrosis. This finding was confirmed by the decrease of globulin level in serum and the myeloperoxidase activity in liver.
- **Antimicrobial effects of moringa:** The assorted extracts of moringa's morphological part such as seeds cotyledon, seeds' coat, stem bark, leaves, root bark are possess antimicrobial potential. The aqueous and ethanolic moringa leaf extracts indicated promising potential as a treatment for certain bacterial infections. The antibacterial activity of the Moringa extract was observed to be greater against gram-positive species (*S. aureus* and *E. faecalis*) than against gram positive species (*E. coli, Salmonella, P. aeruginosa, V. parahaemolyticus* and *A. caviae*) which was also indicated in several other studies.
- **Anti-hyperglycemic of moringa:** Diabetes mellitus (DM) is a chronic metabolic disorder. Diabetes patients exhibit a stage of chronic hyperglycemia and glucose tolerance impairment. Moringa oleifera is well known for its pharmacological actions and is used for the traditional treatment of diabetes mellitus. The anti-diabetic effects of some medicinal plant were strengthened by scientific data as herbal remedies for diabetes are recognized in different societies. Hypoglycemic activity of Moringa oleifera, with significant blood glucose lowering activities has been confiremed. Methanol extract of its dried fruit powder has produced N-Benzyl thiocarbamates, N-benzyl carbamates,

ISSN: 2581-8317
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benzyl nitriles and a benzyl; which prove to trigger insulin release significantly from the rodent pancreatic beta cells and have cycloxygenase enzyme and lipid peroxidation inhibitory activities.

- **Antioxidant properties of moringa:** Naturally occurring antioxidants, particularlypolyphenols are the main plant compounds that are able to decrease oxidative damage in tissues by indirect enhancement of a cell or by free radical scavenging. The leaves of the Moringa oleifera tree have been reported to demonstrate antioxidant activity dues to its high amount of polyphenols. Moringa oleifera extracts of both mature and tender leaves exhibit strong antioxidant activity against free radicals, prevent oxidative damaged to major biomolecules and gives significant protection against oxidative damage. A comparative study indicated that mature Moringa oleifera leaf extract exhibited better values of enzymatic and non-enzymatic antioxidants. In the DPPH (2,2-Diphenyl1-Picrylhydrazyl) free radical scavenging activity test,bothmature and tender leaf extracts showed significant reduction of DPPH radicals. The scavenging activity was suggested to be attributed to its hydrogen donating ability and was seen more in the mature leaf extract.
- **Anti-cancer properties of moringa:** Moringa is revealed to possess potential therapeutic effect to fight cancer, rheumatoid arthritis, diabetes, and some other ailments. Particularly in South Asia, it works as treatment for different diseases in the indigenous system of medicine. Moringa oleifera Lam pod could be a potential chemopreventive agent. The dose dependent administration of boiled Moringa oleifera (bMO) caused the incidence and multiplicity of tumors to decrease especially at the highest dose (6.0%) of bMO. The presence of fatty acids could have attributed to the chemopreventive effect of bMO which modulates apoptosis in colon carcinogenesis. In addition, the presence of niazimicin and glucomoringin which have been reported to inhibit tumour cell proliferation, were also mentioned as possible compounds contributing to the anti-colon carcinogenic effects of bMO. For the effect of bMO on several protein expressions, it was reported that in a dose dependent expression were down-regulated which concluded the chemopreventive effect of bMO. Properties of the Moringa oleifera that relates closely to its potential as a chemopreventive agent was confirmed through phyto-chemical screening of the pod extract. Together with this, the hepatoprotective effect Moringa oleifera through the restoration of aspartate transaminase (AST), alanine transaminase (ALT) and alkaline phosphatase (ALP) was also testified.
- **Anti-tumour properties of moringa:** A study to isolate several bioactive compounds from the Philippine grown Moringa oleifera Lam to examine the anti-genotoxic and anti-inflammatory activities, also reported the effect of several isolates as anti-tumour promoters, the function of mainly one of these bioactive compounds, niazimicin, as an inhibitor against the two-stage mouse

tumourigenesis. The results from in vitro screening suggested that several of the test compounds, particularly 4-(α-L-rhamnosyloxy) benzyl isothiocyanate, niazimicin and β-sitosterol-3-0-β-D-glucopyranoside were strong anti-tumour promoters. Niazimicin is a potent anti-tumour promoter in chemical carcinogenesis.

- **Anti-clastogenic properties of moringa:** In recent years, there has been a new interest in the clastogenicity and anti-clastogenicity of Moringa oleifera pod establishing its health benefits.Boiled moringa did not possess any clastogenic activity in mice upon consuming a diet consisting of 1.5%, 3.0% and 6.0%. The Moringa oleifera demonstrated free radical scavenging properties that directly indicate anti-clastogenic effects which was found to be due to its rich vitamin C content. The anti-clastogeniticity test in this study showed activity against both direct mitomycin C (MMC) and indirectacting DMBA clastogens. It was finally concluded that boiled moringa at 2, 1, 4, 3, 5 and 8 g/kg BW doses did not show clastogenic effects whilst its anti-clastogenic potential is modulated by the direct acting carcinogenesis process.

SUMMARY

In conclusion, it is proven in numerous cases that the Moringa oleifera tree possesses a wide range of medicinal and therapeutic properties. For instance, in this paper, it views the general nutrition contents of the Moringa up to several specific remedial properties including its anti-fibrotic, anti-inflammatory, anti-microbial, anti-hyperglycemic, antioxidant, anti-tumour and anti-cancer properties. Further studies for the mechanism of action and constituents of the Moringa plant may provide incredible capabilities to develop pharmacological products. The further studies should emphasis on probable mode of action of the isolates and possible structural-activity relationship as the chemical constituents of Moringa oleifera are very well investigated and documented. In conclusion, Moringa oleifera has numerous applications in medicinal field.

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AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Production of stevia based chocolates fortified with sesame seeds

Article id: 11141

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INTRODUCTION

Chocolate is a sweet, brownish food made from roasted &ground *Theobroma -cacao* seeds. Itis a dense suspension consisting of sugar particles between 40-50%, coca solids & milk power dispersed in the cocoa butter in a continuous phase. The development of sugar-free chocolates is a challenge for food industries, since sugar is a multifunctional component with properties of a sweetener, a bulking & texturizing agent deterring its replacement.

A high glycemic index of sucrose is unsafe for diabetic people & therefore they cannot consume large quantities of such food products. Hence the products apt for diabetics should be formulated with sucrose replacements. However these replacements should mimic the functional properties of sucrose including the chemical stability provided to foodstuffs. The addition of sweeteners like Stevia, a natural sweetener which has a low calorific value &a sweetening power 200-300 times greater than that of sucrosecharacterizes a good alternate as a sucrose substitute. Regular consumption of extracts of *Stevia rebaudiana*promotes various beneficial effects on certain physiological systems such as cardiovascular & renal, lowers the content of sugar, radionuclides& cholesterol in blood, improves cell regeneration and blood coagulation, overwhelms neoplastic growth, strengthens blood vessels & has an important effect as antioxidant. Fig. 1 depicts Stevia based chocolate fortified with sesame seeds and market chocolate.

Fig.1: (a) Stevia based chocolate fortified with sesame seeds (b) Market Chocolate

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Health Benefits of Chocolate:

1. Helps Support healthy Blood Pressure
2. It has a powerful antioxidant action
3. It contains serotonin, which acts as an anti-depressant.

STEVIA:

Stevia is a sweetener & a sugar replacement extracted from the leaves of the plant species *Stevia rebaudiana* which is native to Brazil &Paraguay. The active compounds are steviol glycosides (mainly stevioside and rebaudioside) which have 30 to 150 times the sweetness of sugar , are heat-stable, pH-stable & is not fermentable in nature.

Benefits of Stevia:

1. Aids Weight Loss: Stevia leaf has zero calories and is therefore beneficial for weight loss when used as a sugar substitute over time. Fig. 2 depicts stevia and its extract.

Fig.2: Stevia and its Extract

2. Diabetic Friendly: The glycosides in stevia leaf are not absorbed into the bloodstream instead get engrossed by the colon bacteria. This helps in handling diabetes by keeping the blood sugar levels in check. Moreover while the glycemic index of sugar is 62-65, stevia has zero GI.

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Method of abstraction of stevia extract:

Ingredients

- Leaves from stevia plant
- ¼ cup pure homegrown stevia
- 1 cup hot filtered water

Method of preparation:

1. Reap the stevia plant by cutting off the branches at the base of the plant.
2. Wash the branches/leaves in clean filter water.
3. Pick leaves off the stevia plant, discard the stems & dry the leaves for 12 hours in the sun.
4. Once the leaves are dry, grind them in a food processor to make pure stevia.
5. To make liquid stevia, dissolve ¼ cup pure stevia powder with 1 cup hot filtered water.

Sesame seeds: Sesame (*Sesameindicium*) is a flowering plant in the genus *Sesamum*. Sesame plant is a tall annual herb in the Pedaliaceae familywhich tends to grow widely in Asia, mainly in Burma, China, and India. One of the first oil seeds known to humankind the sesame seeds have been widely hired in culinary as well as in traditional medicines for their nutritive, preventive, and curative properties. Sesame is a key source of phytonutrients such as omega-6 fatty acids, flavonoid phenolic anti-oxidants, vitamins, and dietary fiber with latent anti-cancer as well as health promoting property

Health benefits of sesame seeds:

1. The seeds are incredibly rich sources of many essential minerals like Calcium, iron, manganese, zinc, magnesium, selenium, and copper. Many of these minerals have a vibrant role in bone mineralization, red blood cell production, enzyme synthesis, hormone production, as well as directive of cardiac and skeletal muscle activities.

2. It is also a good source of dietary fiber &also helps in lowering cholesterol & triglycerides.

Methodology of preparation:

Cacao Tree
↓
Harvesting of cacao pods
↓
Cacao bean fermentation
↓
Drying & Storage
↓
Testing & Cleaning
↓
Roasting
↓
Cracking & Winnowing
↓
Nibs (Dutch Process)
↓
Grinding to produce Chocolate Liquor
↓

Cocoa Powder ← → Chocolate

Pressed in to cakes (Dutch Process) → Cocoa Butter → Addition of Ingredients
↓
Pulverizing
↓
Sifting
↓
Cocoa Powder
↓
Storage & Shipping

Addition of Ingredients
↓
Cocoa Powder-25 gm, Milk powder-50gm, Butter-20gm
Liquid Stevia-25gm, Sesame seed Powder-20gm)
↓
Refining
↓
Conching
↓
Tempering & Molding
↓
Storage at ambient temperature

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Table showing Nutritive value: (Amount per 100gm)

Ingredient	Calorie (kCals)	Protein (gm)	Unsaturated Fats (gm)	Saturated Fats (gm)	Carbohydrate (gm)
Cocoa Powder	196	16.9	6.9	3.9	49.8
Milk Powder	496	26	17	8	38
Stevia Extract	0	0	-	-	33
Butter	717	0.9	51.37	21.02	0.1
Sesame seeds	573	18	7	3	8

CONCLUSION:

Chocolate is one of the most popular food types and flavors in the world, and many foodstuffs involving chocolate exist, particularly desserts, including cakes, mousse, chocolate brownies & chocolate chip cookies. Chocolates have always been the most popular among all the age groups. These chocolates rich in sesame seeds & stevia will be a great alternative for diabetics & cardiovascular patients around the globe. Stevia help control blood sugar & insulin levels & also help in lowering the blood pressure. Sesame seeds are a good source of fiber& also help lower cholesterol & triglycerides. Whole sesame seeds are rich (20% or more of the Daily Value) in several Vitamins and dietary minerals, especially iron, magnesium, calcium, phosphorus, and zinc.

AGRICULTURE & FOOD e-Newsletter

http://www.agrifoodmagazine.co.in

AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Emerging trends in food processing

Article id: 11142

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INTRODUCTION

Food trends are widespread changes in food preferences. Some such trends prove to be long-lasting. Food trends are often discussed in magazines devoted to cuisine, and around the internet. A genuine food trend isn't just an exciting development but also an opportunity to try something new.The Indian food industry is one of the largest industries and ranked fifth in terms of production, consumption, export and expected growth. Also, the food processing industry plays a major role in the growth of Indian economy in terms of contribution to GDP, employment and investment.

Chemical free, natural and unprocessed or minimally altered are a few new words amongst the health aware new age consumer and will be the guide for food processing technologies in the years to come. A growing desire to incorporate healthier alternatives to their diet, the Indian consumer is driving an innovation trend where nutrition is key. Fig. 1 depicts a complete nutritious food pyramid (plate). Many multinationals are reworking even their best sellers to accommodate the Indian palate and focusing on nutritive values and wellness. Keeping this in mind new technologies that are expected to dominate will be an interesting mix of Indian traditional knowledge and innovative new technologies. Following are a few trends expected to emerge in the coming years-

Fig. 1 Food Pyramid

- **Developing innovative indigenous food processing technologies:** India has a vast numbers of indigenous foods that are nutritionally dense and are also best incorporated into the Indian diet. As we adopt quinoa from Mexico the world is fast embracing our naturally gluten free and rich cereals such as ragi, millet and jowar. A blend of traditional indigenous technology and modern processing techniques is also making possible the wide availability of traditional foods such as Chaach, mishtidahi, thandai etc.

- **Innovation using deep rooted knowledge about ingredients:** No spice box in an Indian home is complete without its turmeric just as no list of super foods is complete without the ubiquitous chia. Recently, extensive research into their attractive health benefits has made these native superfoods popular and their addition in conventional or packaged foods such as that of turmeric in milk orthat of chia in breads, cookies and shakes have helped them become one of that important ingredients on the list.
- **Emergence of Fusion Products:** Emphasis on health and taste is leading to an emergence of new product categories and even existing ones are being modified to enhance their nutritive values. Newer alternatives to sugar such as the all-natural **Stevia (Fig. 2)**and its incorporation in the drinks is such a great example. Combinations of coconut water with aloe vera or strawberry and sugarcane juice with ginger or cumin not only offer a different taste profile but also add to its nutritive values.

Fig. 2 Stevia- Natural Sweetener

- **Innovation using age old rich knowledge of processing techniques: Fermented foods (Fig. 3)** are becoming popular as more and more people are realising its beneficial effects on intestinal heath and the immune system. These simple techniques such as pickling and sun drying are seeing a global revival as they are not just eco-friendly but also commercially viable. In the case of many foods, these techniques boost their nutrient profile and flavour while extending shelf life and making them widely available.

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e - Newsletter

http://www.agrifoodmagazine.co.in

AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317

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Fig. 3 Examples of Fermented Foods

- **Plant-Based Anything:** Vegan and vegetarian options are quickly becoming popular with increasing consumer awareness and growing emphasis on sustainable food sources. Even plant-based drinks are becoming very popular as an alternative to dairy products, for example – soy drinks, oat based drinks, rice, grain and seed drinks etc.

- **Innovative packaging and storing:** As the awareness about detrimental effects of conventional packaging such as plastic and tetra packs grows, there has been a shift towards eco-friendly and recyclable materials that are more environmental friendly. Finding innovative solutions for these problems enhances the feel good experience of a product. Recently a sugarcane juice packaged in glass bottles (Fig. 4) with pull out caps was launched, the first of its kind in India, it’s not only convenient but has a novelty factor that enhances the entire experience of the consumer.

Fig. 4 Packed Sugar Cane Juice in Glass Bottles

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CONCLUSION

Food trends change with time. Food trends are the changes in food preferences. They vary with the group of people, region, culture, etc. Food trends are changing for the betterment of human health as now more and more people focus emphasis on nutritious and wholesome food. Food industries are making use of traditional ingredients and knowledge in their products. For example- Use of highly nutritious chia seeds in baked goods such as cakes, biscuits, etc.

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http://www.agrifoodmagazine.co.in

AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317

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Vegetable seed production in DPR Korea: Current status and way-forward

Article id: 11143

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The Problem:

Malnutrition continues to be a public health concern particularly affecting women and under-five children in DPR Korea. Increasing production and consumption of vegetables can be a highly cost-effective approach in reducing existing mal-nutrition. This was emphasized by FAO in the "State of Food Insecurity in the World 2012 (SOFI)" drawing attention to important role of vegetables for combating malnutrition, involving smallholders, especially women and galvanizing "nutrition-sensitive" approach in order to reduce various forms of malnutrition. Vegetables along with fruits play a vital role in providing nutritionally balanced diets by virtue of their rich nutrient contents, vitamins and minerals, such as calcium, iron, zinc, folic acid and pro-vitamin A, antioxidants as well as fibers. In DPRK vegetables (mainly cabbage, spinach, radish, cucumber, eggplant and tomato) are grown on 0.05 million ha with annual production of 1.50 million tonnes which falls short by 1.0 million tonnes from the annual demand estimated at 2.50 million tonnes based on per day per capita requirement of 300 g excluding potato. But there is considerable opportunity for increasing production of vegetables in DPRK through improving productivity and strengthening vegetable value chains because unlike cereals vegetables are grown in both cooperative farms and household gardens. Each of the country's 1.7 million-farm household is entitled to 100 m^2 home garden and a significant proportion of urban households also own kitchen gardens of smaller size. The total area under household gardens in the country is estimated at 25 000 ha. A typical pattern of cultivation in these gardens is an early crop of potatoes and green maize, followed by vegetables such as cabbage, peppers, radish, beans and garlic, all mainly for home consumption. There are several constraints that stand in the way of rapidly improving productivity and production of vegetables in DPRK. Foremost among them is weak vegetable seed production system in the country to hampering domestic supply for quality seed. Knowledge and skills to implement innovative agricultural practices including protected vegetable production (plastic tunnel, net-house and greenhouse) and seed processing and conditioning are also considerably lacking.

Efforts have been made to address these issues through implementation of TCP/DRK/3503 project – "Technical Support for Vegetable Seed Production" in close collaboration with the Ministry of Agriculture (MoA), DPR Korea, to strengthen seed producing agencies, namely, Seed Production

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ISSN: 2581-8317

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Cooperative Farms and Seed Management Department, MoA to improve production and supply of better quality vegetable seed to the end users. The project operated from Sep. 2016 to Aug. 2018 at a total budget provision of USD 324,000.

Vegetable seed scenario in DPRK

No precise information on vegetable seed quantity produced is available. The information on open-pollinated varieties and hybrids too is meager. As per interaction with the concerned personnel, hybrids are available only in Chinese cabbage, cabbage and radish to the extent of 50 % of the required seed. Chinese cabbage and cabbage together account for approximately 44 percent of the total area and are thus the major crops accounting for the bulk of the seed produced and consumed. OP seed of Chinese cabbage is produced in spring season but the hybrid seed of Chinese cabbage based on self-incompatibility is produced in autumn season. Same is the case with cabbage. Radish hybrid seed based on self-incompatibility and CMS system is produced in autumn and the OP seed in spring season. Based on the information available on acreage and seed rate, an approximate seed requirement could be calculated as shown in the Table 1.

Table 1: Vegetable certified seed requirement in DPRK

Vegetable	Area (ha)	Seed rate (kg/ha)	Calculated seed (kg)
Chinese cabbage	10050	3.0	30150
Cabbage	11030	0.5	5515
Radish	3300	10	33000
Spinach	5390	40	215600
Cucumber	4330	5	21650
Hot-pepper	4280	2	8560
Tomato	820	0.5	410
Eggplant	3730	0.5	1865
Others (carrot, pumpkin, watermelon, Welsh onion, crown daisy, melon)	5570	5	27850
Total	48500		344600 kg =344.6 tons

The nucleus and breeder seed is produced by the concerned breeders. Foundation seed is produced on basic seed farms under the control of Academy of Agricultural Science (AAS) and the certified seed is produced under the control and supervision of Ministry of Agriculture (MoA) on State Cooperative Seed Farms who produce primarily certified seed but also carry out some commercial

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crop production as per directive of MoA. The calculated seed requirement of vegetable seed of 344 tons is close to 300 tons of vegetable seed actually produced annually in DPRK on an average basis.

Outcome of seed project

The production of high quality vegetable seeds increased substantially in the four beneficiary farms as follows: Sukchon Foundation Seed Farm, Sukchon County (31.65%), South Pyongan, 2) Joyang Farm, Hamju County (34.38%), South Hamgyong, 3) Ripsong Farm, Ryonggang County, Nampo City (36.48%), and 4) Madu Farm, Unchon County, South Hwanghae (38.63%) (Table 2). The project achieved a production of 16.31 tons of quality vegetable seeds in 2018 as against 12.12 tonnes in 2016 showing an increase of 34.57 %. Per capita improved vegetable seed share per annum has increased overall to 2.93 kg registering 34.59% increase within two years. The increase of per capita seed share and production between farms was Sukchon Foundation Seed Farm (2.63 kg and 31.65% increase), Joyang Farm (2.66 kg and 34.38% increase), Ripsong Farm (10.24 kg and 36.48% increase) and Madu Farm (0.83 kg and 38.63% increase). The project directly benefitted a total of 2 965 farm households with 5 562 farmers (male 2 629 and female 2 933) and indirectly the farmers and rural/urban households living in proximity with the project areas.

Seeds were also produced under protected environment in 20 greenhouses (8300 m^2) of which 8 were provided by the project. The agriculture inputs from the project were improved varieties of seeds, equipment and machineries such as two wheeled power tillers with trailer (2 units per farm), green house materials (2 units per farm), shade net, rolls of plastic sheet for protected cultivation (53 rolls), solar driers (1 unit per farm) and seed driers (1 unit per farm).

The training Manuel entitled "Vegetable Seed Production and Certification Draft Manual - was prepared by FAO's international consultant. National, local and field level trainings were provided for around 219 farmers, managers and officers to enhance the seed producing capacity of the provinces and one study tour to Nepal for 4 senior officers was organized to improve the leadership skills and managerial capacity in improved seed production. Species-specific innovative hybridization technologies, integrated nutrient management and hi-tech nurseries were introduced in the four beneficiary farms for the major vegetables. During implementation of projects, the four beneficiary farms were visited and intensive discussion was held by the international consultant with the farm staff and the standing crops were visited wherever possible. Based on this holistic exercise and in depth discussion among the stake-holders including the senior government offices, the following conclusions and recommendations were drawn:

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Conclusions and Recommendations

1. **Vegetable Crops and Production Situation in DPR Korea:** DPRK grows a total of 15 vegetable crops, namely, Chinese cabbage, cabbage, radish, spinach, cucumber, chili, tomato, eggplant, carrot, pumpkin, watermelon, Welsh onion, onion, melon and crown daisy. Based on area, Chinese cabbage (10050 ha), cabbage (11030 ha), spinach (5390 ha), cucumber (4330 ha), hot-pepper (4280 ha), eggplant (3730 ha), radish (3300 ha), and tomato (820 ha) can be considered as major vegetable crops and the rest as the minor vegetable crops. Chinese cabbage, cabbage and spinach alone account for more than 50 % of the total vegetable acreage. Total vegetable requirement of DPRK with 24 million populations comes to 2.628 million tons rounded off to 2.50 million tons based on the recommended requirement of 300 g of vegetables per day per individual by the dieticians. Against this requirement, the total estimated production of vegetables in DPRK comes to 1.50 million tons based on total area of 48500 ha rounded off as 0.05 million ha and productivity of 30 tons/ha (0.05 x 30 = 1.50 tons) as communicated by personnel of MoA. Thus, there is deficit of 1 million ton of vegetables as on date and this need to be bridged by adoption of superior open-pollinated cultivars, increasing seed replacement rate of hybrids and integrated nutrient management and integrated pest management.
2. **Vegetable Seed Situation in DPR Korea:** As per estimate given in Table 1, the total vegetable certified seed requirement of DPRK comes to 344,600 kg (344.6 tons) per year. This seed quantity is close to average annual vegetable seed production of 300 tons in DPRK. As per prevailing system in DPRK, the nucleus and breeder seed are produced by the concerned breeder, the foundation seed on the seed farms under AAS (Academy of Agricultural Sciences) and the certified seed on the state cooperative seed farms under Ministry of Agriculture. In vegetables, entire planting has to be done by the certified seed produced on the seed farms under MoA as there is no other option because in the vegetables the commercial produce is altogether different and cannot be used as seed under any circumstances. This indirectly ensures high degree of seed quality if NS-BS-FS-CS seed multiplication chain is strictly flowed. However, the seed rate used by the farms for raising vegetable commercial and seed crops is about 50 % higher in most cases and that reflects poor seed vigour. Therefore, along with routine seed germination test, seed vigour test should also be used in random samples to ensure that the seed produced does not have poor seed vigour and gives substantial seedling emergence when sown in the soil even under adverse conditions.

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3. **Status of Hybrid Seed vs Open-Pollinated Seed:** As per feed-back from personnel from MoA and AAS and also from the farm managers of the seed farm visited, approximately 50 % of the seed used is hybrid seed in case of Chinese cabbage, cabbage and radish and in the rest of the cases, entire seed planted is open-pollinated seed. Chinese cabbage, cabbage and radish are major vegetable crops occupying about 50 % of the total area under vegetable crops and hybrid seed production in these crops is an on-going process and therefore considering high productivity of hybrids, there is no justification of using 50 % open-pollinated seed in these three crops. Hybrid seed production in these three crops should be scaled up and the entire crop area should be brought under hybrid seeds at the earliest. Further, there should be emphasis on hybrid breeding by AAS in case of tomato, eggplant, hot-pepper, cucumber followed by hybrid seed production to bring entire area under these crops under hybrid seed.
4. **Single Cross vs. Top Cross Hybrid seed in Chinese Cabbage and Cabbage:** Two types of hybrid seeds are being produced in Chinese cabbage and cabbage utilizing self-incompatibility mode of hybrid seed production. These are single crosses where two self-incompatible but cross-compatible inbred lines are planted side by side in a ratio of 1:1. The seed set on both the lines as a result of cross-pollination between both due to self-incompatibility and the seed set on both the lines is single cross hybrid seed and hybrid seed from both the lines is harvested (S1S1 x S2S2 = S1S2 or S2S2 x S1S1 = S1S2). The other type of hybrid is top cross hybrid (inbred x open-pollinated variety) where inbred line and the variety are planted in a ratio of three rows of inbred to one row of open-pollinated cultivar and hybrid seed set only on the inbred line is harvested. The open-pollinated line is removed from the field before harvesting the hybrid seed on inbred line. The seed set on open-pollinated line are hybrid seed and also the selfed seed and therefore cannot be used as pure hybrid seed.

In principle, single crosses are more productive than top crosses and also in top cross hybrid seed production, the seed set on open-pollinated variety goes as waste, therefore it is strongly recommended that top crosses should be phased out and entire hybrid seed of Chinese cabbage and cabbage should be single cross hybrid seed (existing hybrids and new ones).

5. **Hybrid Seed Status in Tomato, Eggplant, Hot-Pepper and Cucumber:** These are major vegetable crops of DPRK and no hybrid seed is being produced in these crops. Globally, substantial seed on an average more than 50 % seed under these crops is hybrid seed because the hybrids in these crops have been found to be more productive than the open-pollinated cultivars and it is easy to produce hybrid seed in these crops using manual method of hybrid seed production involving

ISSN: 2581-8317
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hand emasculation and pollination. Use of hybrid seed in these crops is further facilitated by the fact that single fruit set after pollination contains about 100 seeds in chili, 200 seeds in cucumber, 300 seeds in tomato and eggplant and seed requirement for commercial panting is also less (about 500 g/ha in tomato, eggplant and chili and 2 kg/ha in cucumber. Therefore, it is strongly recommended to develop high yielding hybrids in these crops followed by hybrid seed production manually to start with. The DPRK farmers will not disappoint anybody and will be able to produce hybrid seed manually with some technical guidance from scientists from AAS.

6. **Minimum Genetic Purity in Seed Classes:** Genetic purity can be ascertained by grow-out test (GOT) which does not seem to be in practice as it is not possible to raise off-season vegetable crop in the temperate climate of DPRK. Therefore, sophisticated lab test involving seed protein electrophoresis and/or DNA markers need to be developed to distinguish hybrid seed from the parental lines and also to ensure that the open-pollinated seed produced are genetically uniform and pure. Using the lab test, the following genetic purity must be adhered to.

Breeder seed:	**100 %**
Foundation seed:	**99 %**
Certified seed of open-pollinated varieties:	**98 %**
Certified seed of hybrids:	**95 %**
Certified seed of tomato and eggplant:	**90 %**

7. **Import of Elite Lines of Chinese Cabbage, Tomato, Hot-Pepper and Cucumber from AVRDC-Taiwan:** Asian Vegetable Research and Development Centre (AVRDC) now called as World Vegetable Centre located at Shanhua, Tainan, Taiwan has done tremendous research and development work on several vegetables and has been recognized as global germplasm base centre for tomato, sweet-pepper and hot-pepper. This centre has developed several advanced breeding lines and has taken proactive role in distributing the seed of advanced breeding lines on nominal handling charges and signing of material transfer agreement 2 (MTA 2). After going through the list of the advanced lines available at AVRDC, the International Consultant recommended the import of following advanced breeding lines of Chinese cabbage, tomato, hot-pepper and cucumber by Academy of Agricultural Science (AAS), Pyongyang particularly Pyongyang Crop Genetic Resource Institute with financial support from FAO-DPRK. The imported lines after testing can be used directly as open-pollinated cultivars initially but as parental lines in hybrid development and seed production subsequently. The list of lines to be imported is as follows:

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Best Widely Adapted Selections for Commercial Release Available at AVRDC and to be Imported by Pyongyang Crop Genetic Resource Institute:

i. **Chili**

AVPP 9813, 9905, 0206, 0506, 0514, 0105, 9813, 0303, 0409, 0411, 0512 = 11

ii. **Fresh Market Tomato**

AVTO 1219, 1429, 1314 = 3

iii. **Chinese Cabbage**

060641, 060642, 060643, 060644, 060645, 060646, 060647 = 7

iv. **Cucumber**

AVCU 1202, 1203, 1205, 1206, 1302 = 5

v. **Grand Total = 26 lines**

A few photographs are shown in Figs 1-3 for illustration of eggplant seed production crop and poly-house facilities for vegetable seed production in DPR Korea.

Fig. 1: Purple, long fruited open pollinated eggplant cultivar at Janghung Farm

Fig. 2: Poly-house facilities for vegetable seed production at Janghung Farm

Fig. 3: Open pollinated eggplant cultivar under seed production in poly-house at Janghung Farm

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ISSN: 2581-8317
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ORGANIC FOODS

Article id: 11144

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INTRODUCTION

The word "organic" means that something comes from living matter. But organic foods are grown and processed with organic farming methods, which exclude certain practices that are normal in conventional agriculture. Fig. 1 depicts example of organic foods.

The "no go" list for organic farming include:

- No synthetic fertilizers.
- No fertilizers derived from sewage sludge, the material left over after human sewage is processed.
- Minimal use of synthetic pesticides.
- No genetically engineered crops, more commonly known as genetically modified organisms, or GMOs.
- No irradiation to kill diseases or pests, or to extend shelf life.
- No growth hormones or antibiotics to raise livestock

Fig. 1 Organic Fruits and Vegetables

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Processed organic food

Processed organic food **(Fig. 2)** contains only organic ingredients. If non-organic ingredients are included then they must not be more than 5% which means that 95% of the ingredients must be organic. Organic foods must be

- Free of additives
- Processed without the use of artificial methods
- Must not use chemical ripening, food irradiation, and genetically modified ingredients.
- Some pesticides may be permitted to be used but only if they are non synthetic

Fig. 2 Processed Organic Food

Why organic foods?

According to some research, **organic foods** may have higher nutritional value than conventional food. The reason: In the absence of pesticides and fertilizers, plants boost their production of the phytochemicals that strengthen their resistance to bugs and weeds.

Organic foods are richer in nutrients and antioxidants and lower in heavy metals, especially cadmium, and pesticides. Good soil nutrition increases the production of cancer-fighting compounds, called flavonoids, and that conventional farming practices like pesticide and herbicide use disturb their production.

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ISSN: 2581-8317
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Benefits

a) **Organic produce contains fewer pesticides-** Chemicals such as fungicides, herbicides, and insecticides are widely used in conventional agriculture and residues remain on/in the food we eat.
b) **Organic food is often fresher** because it doesn't contain preservatives that make it last longer. Organic produce is often (but not always, so watch where it is from) produced on smaller farms near where it is sold.
c) **Organic farming is better for the environment-** Organic farming practices reduce pollution, conserve water, reduce soil erosion, increase soil fertility, and use less energy. Farming without pesticides is also better for nearby birds and animals as well as people who live close to farms.
d) **Organically raised animals are NOT given antibiotics, growth hormones, or fed animal byproducts-** Feeding livestock animal byproducts increases the risk of mad cow disease and the use of antibiotics can create antibiotic-resistant strains of bacteria. Organically-raised animals are given more space to move around and access to the outdoors, which help to keep them healthy.
e) **Organic meat and milk are richer in certain nutrients-** Results of a 2016 European study show that levels of certain nutrients, including omega-3 fatty acids, were up to 50 percent higher in organic meat and milk than in conventionally raised versions.
f) **Organic food is GMO-free-** Genetically Modified Organisms (GMOs) or genetically engineered (GE) foods are plants whose DNA has been altered in ways that cannot occur in nature or in traditional crossbreeding, most commonly in order to be resistant to pesticides or produce an insecticide.

Fig. 3 Certification mark for Organic foods

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Organic vs. Non-Organic

Organic produce:	**Conventionally-grown produce:**
Grown with natural fertilizers (manure, compost).	Grown with synthetic or chemical fertilizers.
Weeds are controlled naturally (crop rotation, hand weeding).	Weeds are controlled with chemical herbicides.
Pests are controlled using natural methods (birds, insects, traps) and naturally-derived pesticides.	Pests are controlled with synthetic pesticides
Organic meat, dairy, eggs:	**Conventionally-raised meat, dairy, eggs:**
Disease is prevented with natural methods such as clean housing, and healthy diet.	Antibiotics and medications are used to prevent livestock disease.
Livestock must have access to the outdoors.	Livestock may or may not have access to the outdoors.

CONCLUSION

Organic foods are the foods that are grown and processed with organic farming methods. They are grown with natural fertilizers such as manure, compost, etc. organic foods have higher nutritional value. They are rich in nutrients and antioxidants. Organic foods are fresh and contain very few pesticides. Organic farming is better for the environment as this practice reduce pollution, conserve water, reduce soil erosion, increase soil fertility, etc.

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http://www.agrifoodmagazine.co.in

AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317

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Vermicompost: an eco-friendly approach of nutrient management in field crops

Article id: 11145

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ABSTRACT

The use of chemical fertilizers is increasing day by day for the sake of increasing production. By excess use of chemical fertilizers, the fertility of soil and health also deteriorate. Therefore use of organic manure is one of the alternative ways for enhancing production and improves the soil health. One of the important organic manure is vermicompost which is produced through a simple biotechnological process of composting, in which certain species of earthworms are used to enhance the process of waste conversion and produce a better end product. Application of vermicompost not only increase the growth, yield and productivity of field crops but also increase size, biodiversity and activity of beneficial microbial population in soil, influence structure, nutrient turnover and many other related physical, chemical and biological parameters of the soil. Thus, vermicompost is an eco-friendly nutrient management strategy for increasing the production and productivity of field crops without endangering the natural resource base of future generation.

Key words: vermicompost, field crops, nutrient, soil health

INTRODUCTION:

The growth and development of field crops is largely dependent upon the soil and environmental factors like temperature, humidity, intensity and duration of radiant energy. The soil provides mineral nutrients and moisture, while the carbon dioxide of the atmosphere is utilized by the crop for photosynthesis. Under certain soil and climatic conditions, the major nutrients are not readily available to the plants in optimum amount and proportion. Under these circumstances, application of nutrients through any sources is one of the prime concerns in order to achieve higher growth, yield and productivity of field crops.

In India, during the era of green revolution, there was a tremendous increase in the agricultural production by the use of heavy doses of synthetic &chemical fertilizers, resulted in pollution of soil, water and air. There also have been adverse effects on the health of human beings and farm cattle due to consumption of food products bearing toxic residues of these agrochemicals (Kumar and

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Bohra 2006**)**. Harmful effects of chemical fertilizers have shifted the interests of growers towards organic amendments like vermicompost which can increase the production of field crops without damaging and endangering the natural ecosystem. Vermicompost is not only valuable compost but also an effective way of solid waste management in terms of improving soil physical, chemical and biological properties which intern improve soil health.

What is vermicompost?

Vermicompost, important organic manure, is a type of compost in which certain species of earthworms are used to enhance the process of organic waste conversion and produce a better end-product. Earthworms feeds the organic waste materials and passes it through their digestive system and gives out in a granular form (cocoons) which is known as vermicompost. It also involve in bio-oxidation and stabilization of organic materials by joined action of earthworms and microorganisms. Although, it is the microorganisms that biochemically degrade the organic matter, earthworms are the crucial drivers of this process, as they aerate and fragment the substrate, thereby drastically altering the microbial activity needed for proper growth and development of the crop.

Table: 1 Composition of Vermicompost (Senthil Kumar *et al.*, 2000)

Particular	Content
Carbon (C)	40-57 %
Hydrogen (H)	4-8 %
Oxygen(O)	33-54 %
Nitrogen (N)	0.72 %
Phosphorous (P)	0.9 %
Potassium (K)	0.74 %
Calcium (Ca)	1.26 %
Magnesium (Mg)	0.61 %
Sulphur (S)	0.16 %
Iron (Fe)	3200 ppm
Manganese (Mn)	357 ppm
Zinc (Zn)	80 ppm
Copper (Cu)	41 ppm

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AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Vermicompost act in the following ways:

1. Vermicompost improves consistency of soil texture with a concomitant increase in porosity, infiltration and soil- water relation.
2. Vermicompost provides multifarious advantages by supplying multi nutrients such as nitrates (NO_3^-), phosphates (HPO_4^{--}, $H_2PO_4^-$), exchangeable calcium (Ca^{++}) and soluble potassium (K^+) in plant-available forms which is readily taken by the crop plant.
3. Vermicompost has high porosity, aeration and water-holding capacity as well as higher nutritional value than traditional composts. This is due to increased rate of mineralization and degree of humification by the action of earthworms.
4. Vermicompost has high microbial activity due to the presence of fungi, bacteria & actinomycetes and these favorable organisms produce plant growth regulators such as auxins, gibberellins, cytokinins, ethylene & abscisic acid and enhance the growth and development ofthe crop.
5. Vermicompost harbors certain microbial population that helps in N fixation and P solubilization. Its application enhances nodulation in legumes and symbiotic mycorrhizal associations with the roots.
6. It has immobilized enzymes like protease, lipase, amylase, cellulose and chitinese which keep on their function of biodegradation of agricultural residues in the soil so that further microbial attack is speeded up.
7. Earthworms release certain metabolites, such as vitamin B, vitamin D and similar substances into the soil. In addition to increased N availability, C, P, K, Ca and Mg availability in the casts are also found.

Fig 1: Vermicompost

Fig 2: mixing of vermicompost in field soil

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AGRICULTURE & FOOD: e-Newsletter

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Table 2: List of parameters of different field crops enhanced by vermicompost

Si. No.	Field crop	Parameter enhanced	Reference
1	Wheat (*Triticum aestivum*)	Mean plant height mean stem diameter, number of leaves per plant, number of spikes/plant, spike length/plant, number of spikelet/spikes per plant, yield/acre, protein content, fat content, carbohydrate content, dietary fibers content, ash content	**Joshi *et al*. (2013)**
2	Maize (*Zea mays*)	Number of leaves, plant height, stem diameter, root volume, Mycorrhizal colonization, P content in leaves	**Gutierrez-Miceli *et al*. (2008)**
3	Sorghum (*Sorghum bicolor)*	Mycorrhizal colonization	**Hameeda *et al*. (2007)**
4	Potato (*Solanum tuberosum*)	Plant height, tuber yield	**Alam *et al*. (2007)**
5	Groundnut (*Arachis hypogaea)*	Number of leaves, leaf area, plant weight, plant dry weight, root length, shoot length, N content, Mg content, Ca content, K content, Pcontent, no. of seeds/plant	**Mycin *et al*. (2010)**
6	French bean (*Phaseolus vulgaris*)	Germination, height of plant, number of leaves per plant, length of leaves, width of leaves, number of pods per plant, length of root, number of nodules, above ground dry plant biomass, below ground dry plant biomass, yield per plot, number of seeds per pod	**Singh and Chauhan (2009)**
7	Urd (*Vigna mungo*) and soybean (*Glycine max*)	Germination percentage (urd), Phenol contentof leaves	**Javed and Panwar (2013)**
8	Mustard (*Brassica Spp.*)	Leaf area, leaf area ratio, Crop growth rate, net assimilation rate, harvest index	**Banerjee *et al*. (2012)**
9	Pea (*Pisum sativum*)	Number of leaves, root weight, root length	**Khan and Ishaq (2011)**

CONCLUSION

So it is clear from the above discussion that there is immense prospect of vermicompost as a nutrient management tool for several field crops. It is also an evident that application of vermicompost improves soil physical, chemical and biological properties hence an excellent organic fertilizer. Vermicompost play an important role in nutrient management aspects of field crop by enhancing growth, yield and quality parameters without endangering the ecosystem. This includes convincing rural populations to adopt vermicompost technology leading to sustainability in agriculture use that would also indirectly alleviate poverty and ultimately increase the quality of life. Lastly, we can say that application of vermicompost has a desirable effect on sustainable food production.

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AGRICULTURE & FOOD e-Newsletter

http://www.agrifoodmagazine.co.in

AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

BASIL (TULSI) - Super Herb!

Article id: 11146

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The Basil is one of the most worshiped and consumed herbs, it is a perennial, aromatic, culinary, herbaceous plant which has approx 60 species identified and categorized under *Ocimum* genus in plant family lamiaceae. It is good source of vitamin A, Vitamin C, Calcium, Zinc, Iron, Chlorophyll, it posses anti bacterial, insecticidal properties and leaves have capabilities to purify contaminated water. Scientific studies present evidences for its anti-inflammatory, antioxidant, analgesic (pain-reducer), antipyretic (fever-reducer), hepatoprotective (liver-protector) cancer-fighter, diabetes-preventer, blood vessel-protector, destresser, immune-booster etc properties.

In different parts of the world, several types of the basil are cultivated, some of the widely used varieties can be broadly categorized in to two groups for understanding holy basil (*Ocimum sanctum*) and Mediterranean basil (*Ocimum basilicum*).

1. HOLY BASIL

It is known as Tulsi and is the most revered houseplant in India where it is associated with ayurveda and hindu religion as goddess of wealth, health and prosperity. The plants have strong medicinal properties compared to second group species. There are several varieties popular based on the regional religious beliefs which are known by a several vernacular and common names such as in Sanskrit it is named as Rama Tulsi and Krishna Tulsi, in Malayalam it is called Trittavu, in Marathi as Tulshi, Tulasi in Tamil, Thulsi in Telugu and Holy Basil in English. Not to be confused with *Ocimum tenuiflorum*, it is a synonym for *Ocimum sanctum*.

- **RAMA TULSI (*Ocimum sanctum*)**

The plant has pure green leaves and better tolerance to winters, sun light, watering and fertilization than the other varieties. The Queen of herbs is one of the most worshiped aromatic herbs which is found in almost every house in India.

- **KRISHNA TULSI (*Ocimum tenuiflorum*)**

The plant has purple fringed leaves and purple stems with pungent and strong test of leaves, it has more medicinal properties than the other species.

- **AMRITA TULSI (*Ocimum tenuiflorum*)**

The plant is less commonly grown perennial, aromatic and sacred species of holy basil in India.

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- **VANA TULSI (*Ocimum gratissum*)**

It is woody type perennial, aromatic and sacred species of holy basil in India.

2. MEDITERRANEAN BASIL

It is known as Sweet basil and is the most popular variety of basil which is found all over the world including Asia, Eurpe, America and Africa. It is most consumed herb world wide and known by several common names such as king of herbs, royal herb, great basil and Saint-Joseph's-wort etc, it is used in culinary preparations and used several types of popular cuisines like Italian, Thai etc.

3. SWEET BASIL (*Ocimum basilicum*)

It is most commonly grown perennial, aromatic and culinary type species of basil, the plant has bigger green color leaves and stems.

4. THAI BASIL (*Ocimum thyrsiflora*)

It is perennial, aromatic and culinary type species of basil, the plant has green color pointed leaves, reddish purple color stem and dark purple color flowers.

5. PURPLE BASIL (*Ocimum basilicum*)

It is commonly grown perennial, aromatic and culinary type species of basil, the plant has bigger purple color leaves and stems.

6. LEMON BASIL (*Ocimum citriodorum*)

The plant is perennial, aromatic and culinary type species of basil, the plant has green color leaves and white color flowers. It has strong lemon scent and all parts of the flower, leaves and stems are edible. It is known by several common names such as Lemon basil, hoary basil, Thai lemon basil, or Lao basil etc it is a hybrid between sweet basil and american basil.

9. VIETNAMESE BASIL (*Ocimum cinnamon*)

It is perennial, aromatic and culinary type species of basil, the plant has green color leaves, reddish purple color stem and pink color flowers.

10. AMERICAN BASIL (*Ocimum americanum*)

It is perennial, aromatic and culinary type species of basil, the plant is known for its rich color, sweet flavor, cleanliness and uniformity of particle size, it is considered to be of very high quality which has green color pointed leaves, purple color stem and purple color flowers.

11. AFRICAN BLUE BASIL (*Ocimum kilimandscharicum*)

It is perennial, aromatic and culinary type species of basil, the plant has green color leaves and purple color flowers. It has strong camphor scent and all parts of the flower, leaves and stems are edible.

12. ITALIAN GENOVESE BASIL (*Ocimum basilicum*)

It is classic Italian species with large dark green leaves, it is most common grown perennial, aromatic and culinary type species of basil, the plant has bigger green color leaves and stems.

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ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Cultivation technology of citronella (*Cymbopogon winterianus* Jowitt) in South India

Article id: 11147

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The southern region of India has varying soil types and agro-climatic conditions, which offers tremendous scope for cultivation of citronella crop. Citronella is a tufted aromatic multi-harvest perennial herb with fibrous roots. In South India is cultivated in Andhra Pradesh (Visakhapatnam district and around Chintapalli area), Kerala Karnataka, Tamil Nadu, and Odisha. Production of Java citronella exceeds other essential oils. Oil of Java citronella is of superior quality. Citronella oil obtained by the method of steam distillation is useful in cosmetic industry, perfumes, soaps and detergents; also, it is used for some medicinal purpose. Thus, farmers can get good money by the cultivation of citronella grass.

INTRODUCTION

Citronella or Java Citronella (*Cymbopogon winterianus*Jowitt) belongs to Poaceae family. Citronellais a robust, aromatic, evergreen, perennial, clump-forming grass with numerous erect culms arising from a short rhizome. The culms can be up to 2.5 meters tall. Citronella is a tufted perennial grass, leaves of which on distillation give a yellowish-brown essential oil with citrus odour. Citronella oil serves as a starting material for extraction of geraniol and citronellal which can be converted into aroma chemicals such as citronellol, hydroxy citronellol, synthetic menthol and esters of geraniol (Kumar and Jnanesha, 2017a). It is native to tropical and semitropical areas of Asia, India, Indonesia, and is cultivated in South and Central America. World production of citronella oil is about 7000 tonnes/year; major producers being Taiwan, China, Indonesia and Guatemala. Chief importing countries are USA, UK, West Germany, Japan and Hong Kong. At present, world production of citronella oil is approximately 5000 tonnes out of which India produces about 300-350 tonnes of oil. The odour of citronella oil is fresh and sweet, revealing the high content of citronella and geraniol + citronellol. The major constituents of the oil are citronellal (32-45%), citronellol (11-15%) and geraniol (12-18%).

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Figure1: Photo of Citronella (*Cymbopogon winterianus*Jowitt)

Uses of aroma oil

Citronella essential oil used in cosmetics, soaps, pharmaceuticals, perfumery, confectionery, aerated waters, disinfectants, tobacco, agarbathis and a host of related products. Citronellol is used in many perfumery blends of soap and cosmetic industries when rosaceous notes are required (Kumar and Jnanesha, 2017a). Hydroxy citronellol is a key ingredient in compounding and in floralizing perfume materials. Citronellol esters like formate and acetate are used in a wide range of fragrances. Citronella essential oil is also used in manufacture of deodorants, mosquito repellent creams and allied products. it is also anti-biotic, ant flatulent. Citronella oil is used in cough syrup to remove muscle fatigue; it is also used for wound healing.

Cultivation technology

Citronella or Java citronella grows well under tropical conditions where there is abundant sunshine and moisture. Well distributed rainfall of 200-250 cm is desirable but if irrigation is available citronella can be cultivated in regions of lower rainfall also. Citronella grows best in sandy loam soils. A good amount of organic matter is desirable. Heavy clayey soils prone to water logging are not suitable for cultivation of citronella. The pH of the soil should preferably be in the range 6-8. Grass is propagated only vegetatively by slips which are obtained by dividing well grown clumps. Clumps are separated in a manner that each slip contains 1-3 tillers. Roots and leaves are trimmed off before planting. About 50 slips are obtained from a year-old healthy clump. Slips should be obtained from at least 6 months old plantation.Many varieties, CIM-Jeeva, Manjusha, Manjari, CIMAP-Bio 13, and Mandakinihave been developed by CSIR-Central Institute of Medicinal and Aromatic Plants in

AGRICULTURE & FOOD
e - Newsletter

http://www.agrifoodmagazine.co.in

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citronella. (Kumar and Jnanesha, 2017 c). With onset of monsoon, land is brought to fine tilth by ploughing and harrowing. Ridges and furrows or beds are made. Slips obtained from healthy vigorouslygrowing plants are planted in South India during June-July at 60x60 cm or 60x 45 spacing and 10 cm deep.Citronella is cultivation in agroforestry systems (up to 30% shade) with 90x90 cm spacing (Kumar, 2019). In South India, under irrigated condition March-April is also suitable for slips planting (Kumar and Jnanesha, 2017b).If properly planted about 90% survival is obtained. Plants get established within 15-20 days and after 30-40 days complete green colour appears in the field. During this time a light irrigation should be applied in absence of rainfall. Citronella leaves contain maximum oil. Citronella requires sufficient moisture for good growth and yield of herb. When there is no rain, irrigation once in 8 to 10 days will be required. The fertilizer requirement 120 kg nitrogen, 40 kg of P_2O_5 and K_2O / hector is optimum. The time of fertilizer application should be followed as under- half of the nitrogen and full P_2O_5 and K_2O at the time of plantation in first year and before hoeing and after rainfall in subsequent years, the remaining nitrogen should be applied in four equal splits after each harvest. Citronella crop should be kept weed free. 3 to 4 weeding's required till the crop grows and covers the ground. Also, one or two rounds of weeding are necessary after each harvest.Hence, only the leaves are harvested. It is highly desirable to leave 2-3cm of the leaf on the plants for faster regeneration. In the first year only two cuttings can be taken, viz., 8 to 9 months after planting and 3 to 4 months after the first harvest. From second year onwards, three harvests can be taken per year at 4 months intervals. The crop can be maintained economically for about five years. Then it has to be replanted. Slips from the same field can be used.Leaves of Citronella contains 0.8-1.2 % of aromatic oil, which varies greatly upon the fertility of the land, climatic condition of the cultivated area, cultivation method and species of Citronella and the season of harvesting. Citronella oil recovery and content is lowest in rainy season and highest in dry months, as in hot season leaves are short but the blade size is wider. Citronella gives a fresh herb yield of 20-25 t/ha/year. The average oil content is about 1%, hence oil yield of 200-250 kg/ha/year is expected.

CONCLUSION

Citronella cultivation is done on a commercial basis, for obtaining aromatic oil from the leaves. South India has a great potential for cultivation of citronella crop. The South India is also having the biggest markets for aroma oil at Bangalore, Hyderabad, and Chennai. The southern state of India has a number of aroma industries due to the availability of oil from the market as well as from collectors and farmers. In India and world markets, demand for citronella crop essential oil is increasing & going to increase in the future. Farmers of south India can earn more profit by cultivation of citronella.

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AGRICULTURE & FOOD
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http://www.agrifoodmagazine.co.in

AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317

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Enhancement of quality planting material production in cashew through soft wood grafting

Article id: 11148

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Anacardium occidentale L. (Anacardiaceae, 2n = 42), commonly known as cashew, is precious gift of nature to the mankind and cashew kernel is considered capsule of nutritional package having combination of carbohydrate, protein, fat, mineral and vitamins. Though, cashew is native to Brazil, India is the first country for exploitation of cashew as commercial horticultural crops. Portuguese travelers were responsible for introduction of cashew in India in the beginning of 16th century. Since then cashew has adapted very well to Indian conditions. Initially, cashew was considered as a crop for afforestation and soil conservation at the time of its introduction on Indian coasts, however cashew as on today, has gained special status in the international scenario, as a plantation crop of considerable foreign exchange earner.

The development of Cashew in India was mainly done through using seedling progenies in the early part of its introduction. Therefore, area expansion relied mostly on seeds and seedling progenies. Cashew is a cross pollinated crop and therefore, the seedling progenies are heterogeneous due to segregation. Hence, seed propagation leads to variability in the progenies with regard to growth and yield characters. On the other hand, vegetative propagation of elite mother plants results in the production of true to type plants which increase the production of cashew plantations. The research findings on clonal propagation in cashew by various research organizations resulted in production of genetically uniform planting materials by means of vegetative propagation. Different methods of vegetative propagation, namely, layering, grafting and budding have been tried in cashew at various research organizations. After analyzing various methods of vegetative propagation, research has identified Soft wood grafting as most commercially feasible and successful vegetative propagation technique over other methods. Hence, this technique has been recommended for taking up of commercial multiplication of cashew varieties.

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AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317
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Protocol for successful Softwood grafting

Preparation of Seed source for root stock production

The healthy cashew mother plants with high yielding, free from pest and diseases were selected. Nuts were collected, washed and sun dried. Sowing should be taken up as early as possible for better germination. The seed nuts should be soaked in water for 12-24 hours before sowing in order to get good germination. Seeds should be sown in the centre of polythene bags with stalk-end upward at the depth of 2.5cm for best germination and seedling development. Seed bed should be kept moist and loose for better germination and mulching with paddy straw may be done till germination takes place after 20-25 days of sowing. After emergence, cotyledons are protected from birds, rodents and even children being sweet and fleshy by applying malathion 5% dust, or spraying chlorpyriphos (0.05%).

Maintenance of seedlings in the nursery

The seedlings should be transplanted to nursery at 4-5 leaf stage for better rooting and survival. Too tall or dwarf seedlings should be avoided for transplanting because the chance of those seedlings emergence from zygotic embryos. Seedlings should be transplanted in polythene bags with holes on the side to avoid water stagnation. Daily watering is required during summer season. However, during rainy season, collar rot/ damping off of germinating seeds and young seedlings is a common problem which can be controlled by spraying Bordeaux mixture (l %) or carbendazim (0.1 %) at 10 days intervals. In order to control the tea mosquito bug and other sucking insect pests, quinalphoa / monocrotophos (@ 1.5ml/litre of water) may be sprayed. In order to get vigorous seedlings with single main stem, the side shoots arising from the leaf axils should be removed frequently. About two months old seedlings were selected as root stocks for grafting when the seedlings attain a height of 25-30cm.

Figure 1: Raising of root stock. A - Germination of seeds in sand bed, B. Sowing of pre-germinated seeds in poly bags, C. Uniform growth of seedlings and D. Healthy seedlings becoming ready for root stock.

Softwood grafting technique

Preparation of root stock

Two month old seedlings are used for root stock preparation. At a height of 15-20cm from ground level where soft wood portion is available on the root stock, a transverse cut is made and the terminal shoot is removed. A cleft of 6-7cm deep is made in the middle of the decapitated stem by giving a longitudinal cut. A little portion of wood is removed from the inner sides of the cleft at the top, so that after grafting, the joint will be perfect without any dead wood.

Preparation of scion

The scion is reduced to a length of l0 cm by cutting off the excess portion at the bottom. Very thin and very short scions should be discarded. The cut end of the scion is mended into a wedge shape of 6-7cm length by chopping off the bark and little portion of wood from two opposite sides taking care to retain some bark on the remaining two sides. In the case of bent scion sticks, the wedge should be prepared by chopping off the bark and wood from inner and outer sides of the bent scion stick.

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Collection of scion sticks

Preparation of scion sticks

Selection and preparation of root stock

Figure 2: Preparation of scion for soft wood grafting

Grafting

The wedge of the scion is inserted into the cleft of the root stock seedling taking care to see that the cambial layers of both root stock and the scion come in perfect contact with each other. The graft joint is secured firmly with 2.0cm wide and 30cm long polythene strip of 100 gauge thickness. A long and narrow poly tubes (20cm x 4cm size and 200 gauge thickness) is inserted on the grafted plant. This will protect the scion from drying up. The grafted plants are left in the nursery shed for about 2-3 weeks to encourage sprouting of the terminal buds. After 2-3 weeks, the poly tubes are removed gently and the grafts are shifted to open condition in the nursery. The successful grafts show the sign of growth within 3-4 weeks and about 70-80 per cent of the grafts will sprout within 3-4 weeks. The graft success can be recorded after four months of grafting.

Figure 3: Softwood grafting technique (from left to right). A. About two months old seedling, B. Two pairs of bottom leaves retained, others removed and a cleft of 6-7cm length made, C. Wedge of scion inserted into the cleft of seedling, D. Graft joint secured firmly with a polythene strip, E. A long and narrow polythene bag inserted on the scion, F. Sprouting of terminal bud on scion, G. Removal of narrow polythene bag after the emergence of new flush on scion and H. A successful cashew graft

Figure 4: Grafts covered with poly tubes

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Management of cashew grafts in the nursery

Irrigation and partial shade

Cashew grafts should be watered daily during dry periods and daily watering is not required during rainy season. Watering may be done with hose pipe fixed with a fine rose. During heavy rainy season excess water in the bags should be removed by pressing the sides of the bags or by making holes on the sides by piercing with a pointed stick. Complete shading of grafts should be avoided as it results in lanky growth. By providing partial shade during summer months, the polythene bags are protected from tearing off due to sun and watering is done on alternate days. The shade should be removed as soon as the monsoon sets in.

Trimming

The shoots arising from leaf axils on the root stock (below the graft joint) should be removed frequently. Most of the grafts produce flower panicles during normal flowering season (November-December) irrespective of age. Such panicles should be removed as and when observed in the nursery. The bottom leaves on the root stock should be removed after three months of grafting, when the scion leaves turn from bronze colour to green.

Plant protection measures and inscet pests

Bordeaux mixture spray (1%) or carbendazim 0.1 % may be given at 10days interval during rainy season as a prophylactic control measure to reduce fungal infection of young grafted plants. The insect pests and diseases in nursery should be managed with regular spraying of recommended insecticides and fungicides**.** Insecticides such as quinalphos/ monocrotophos (1.5ml/litre of water) may be sprayed to control sucking insects (tea mosquito bug, leaf miner, etc.) and leaf eating caterpillars when the damage is seen.

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Figure 5: Maintenance of cashew grafts in the nursery

CONCLUSION

A qualitative improvement in planting material production is the vital part in the development of any plantation crops. In soft wood grafting technique, grafts can be produced almost throughout the year with a mean success of 65-70 per cent than conventional budding method. Exploitation of soft wood graftingin cashew will beuseful in doubling the production of quality planting material by the shortening the nursery phase and reducing the cost of planting material production.

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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Ash gourd cultivation in India

Article id: 11149

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Scientific name: *Benincasa hispida* (Thumb.)
Family: Cucurbitaceae
Chromosome number: $2n = 2x = 24$
Origin: Java and Japan
Edible portion of ash gourd: Fruit
Toxic substances: Cucurbitacins

INTRODUCTION

Ash gourd, also known as wax gourd, winter melon and Christmas melon, is classified under cucurbits of minor importance though it is cultivated almost throughout India. Ash gourd also known as white gourd, winter melon or fuzzy melon. It is native from Southeast Asia. It is a rich source of Fat, protein, carbohydrates and fiber. Ash gourd has several medicine properties. As it contain low calories, it is good for diabetic patients. It is used to treat constipation, acidity and to kill intestinal worms. Popular "Petha" is made from Ash gourd. As its name suggests, ash gourd is grey or ash in color and is a big vegetable like pumpkin. The fruits are usually oval in shape and grow up to 30 centimeters in diameter. Propagation of ash gourd is done by seeds. This vegetable when young has thick white flesh which is sweet. By the time it reaches maturity, it loses the hairs, and a waxy coating is developed which provides a long shelf life.

BRIEF HISTORY

Ash gourd has been cultivated in China for the last 2300 years. It was introduced into India from Japan and Java by foreign navigators and missionaries. Originally cultivated in Southeast Asia, ash gourd is now widely grown in South Asia and East Asia as well.

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Distribution

Ash gourd is little cultivated outside Asia but is popularly grown in China, India, Sri Lanka, Bangladesh, Japan and Southeast Asian countries. In India, it is mainly grown in northern states especially Uttar Pradesh, Rajasthan, Punjab, Haryana, Andhra Pradesh, Tamil Nadu, Chhattisgharh and Kerala.

Food Value

Per 100 g fresh fruit contains 96.5 g moisture, 0.4 g protein, 0.1 g fat, 0.3 g minerals (30 mg calcium, 30 mg phosphorus, 0.8 mg iron), 0.8 g fibre, 1.0 g carbohydrates, 0.06 mg thiamine and 0.4 mg niacin. Ash gourd is considered beneficial for people suffering from nervousness. Recent research has shown that the fruits contain anti-cancer terpenes.

Uses

Bulk of ash gourd fruits are utilized in processing for making sweets, candies etc. A sort of commercial brand known as '*Agra Petha*' is famous throughout India. The immature fruits are also cooked as a vegetable and pickled. An extra-small fruited variety known as Vaidyakumbalam is cultivated in Kerala for medicinal purposes to cure blood disorders, urinary troubles etc. Ash gourd is said to have laxative, diuretic and tonic properties. Since it possesses considerable resistance to soil borne diseases, ash gourd is sometimes used as a rootstock for susceptible crops like melons, cucumbers and other cucurbits.

Improved Varieties

PAG-3 (PAU, Ludhiana)

It is a selection from the local material and is suitable for cultivation in north Indian plains in February-March and May-June. The fruits are attractive, globular and medium sized. The immature fruits are hairy but smooth and waxy at maturity. It takes 145 days from sowing to reach maturity. Average fruit weight is 10-12 kg and yield is 550 quintals per hectare.

CO2 (TNAU, Coimbatore)

It is a selection from the local material. It is an early maturing variety and takes about 120 days to reach marketable maturity. The fruits are small, oblong, compressed on both ends, less seedy and with light green flesh. Average fruit weight is 3 kg.

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APAU Shakthi (APAU, Hyderabad)

It is a selection from the local material. The fruits are cylindrical. It takes 140-150 days from sowing to marketable maturity. Average yield is 300-350 quintals per hectare.

Indu (KAU, Pattambi)

It is developed by selection from the local material collected from Koyilandi in Kozhikode. Average fruit weight is 4.8 kg and yield 245 quintals per hectare.PAG-3 (2003): The vines of this variety are medium long with green leaves. Fruits are attractive,globular and medium sized. It takes 145 days from transplanting to harvesting. The average fruitweight is 10 kg. and average yield is 120 q/acre.

Climate

Ash gourd is adapted to tropical and sub-tropical climates. It requires warm and humid climatic conditions. Night temperature below 10°C results in erratic germination and poor growth. Ideal temperature for optimum growth rate ranges between 24 and 30°C. It can be grown in somewhat mild climate but is sensitive to frost. Short days and low night temperature favours female flower production.

Soil

Well-drained sandy loam soils with pH range of 6.0-7.0 are ideal for ash gourd cultivation.

Sowing Time, Seed Rate and Spacing

In north Indian plains, the summer crop is sown in February – March and the rainy season in June-July. It is important riverbed crop, where it is sown in February to March. In south India, where winter is mild, sowing can also be done from September to December. Planting is done on 1.5-2.5 m wide beds with plant spacing of 60-120 cm. Two to three seeds per hill are sown on either side of the bed. Seed rate varies from 5.0-7.0 kg per hectare.

Manures and Fertilizers

Besides 15-20 tones of FYM, 50 kg each of nitrogen, phosphorus and potash are applied at the time of bed making. Another doze of 50 kg nitrogen per hectare is applied at the time of flowering and fruit setting. Method of fertilizer application is the same as described in muskmelon.

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Irrigation

Ash gourd requires less frequent irrigation than most of the other cucurbits. It requires more frequent irrigation in early stages of the crop growth but the established plants are reasonably tolerant to water stress. Depending upon the soil type and climatic conditions, ash gourd is irrigated at 7-9 day intervals during summer months. In rainy season, irrigation frequency depends upon distribution of rains. At the time of fruit maturity irrigation is applied only when it is absolutely necessary i.e. when vines show withering even in the morning. Frequent irrigation at the time of maturity reduces shelf life of ash gourd. Irrigation is applied only in water channels.

Weed Control

Ash gourd is a widely spaced crop and weeds can be controlled by tractor drawn tillers at early stages of crop growth. From spaces within the plant rows, weeding is done manually. At later stages of the crop, weeds remain suppressed due to dense foliage cover of the crop itself.

Harvesting

Ash gourd fruits attain marketable maturity 100-120 days after sowing and 30-40 days after fruit setting. Fruits are harvested when they have attained full size and ripe; and vines start drying. On maturity the fruits develop waxy coating on the surface. The immature fruits for vegetable purposes (cooking) are harvested 7-10 days after fruit setting.

Yield

Depending upon the variety and the growing conditions, yield of ash gourd varies from 250-400 quintals per hectare.

Post Harvest Handling

Ash gourd fruits are transported in trucks without any individual packing. Mature fruits of ash gourd are stored under ordinary storage conditions for their utilization by the confectioners during the ensuing winter festival season. Ash gourd is one of the few vegetables where fruits can be stored for months together at room temperature. At 13-15°C and 70-75 per cent relative humidity, mature fruits of ash gourd can be stored for over six months.

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Value Addition

Most of the ash gourd produced is used for making sweets and '*baris*'. Canned soup and dehydrated fruit slices are some of the other processed products of ash gourd.

Seed Production

In ash gourd, the seeds are mature when they are harvested at marketable maturity. A minimum isolation distance of 500 m is required between two varieties of ash gourd. Rouging of off-type plants is under taken at least three different growth stages viz. before flowering, during flowering and at fruit maturity. After extraction, the seed is cleaned and dried to 7 per cent moisture level before storage. Average seed yield is 4.0 quintals per hectare.

Insect pest and their control:

Pests-

Leaf beetles and leaf caterpillars -Leaf beetles and leaf caterpillars can be controlled by spraying Malathion 50 EC 1 ml/lit or Dimethoate 30 EC 1 ml/lit or Methyl demeton 25 EC 1 ml/lit.

Fruit fly-

1.Collect the affected fruits and destroy them.

2. The fly population is low in hot day conditions and it is peak in rainy season. Hence adjust the sowing time accordingly.

3. Expose the pupae by ploughing.

4. Use polythene bags, fish meal trap with 5 g of wet fish meal and 1 g of Dichlorvos in cotton, 50 traps are required per hectare. Fish meal and Dichlorvos impregnated cotton are to be renewed once in 20 and 7 days respectively.

5. Neem oil @ 3.0 % as need based foliar spray.

6.Aphid: Spray Imidacloprid @ 0.5 ml/lit along with sufficient quantity of stickers like Teepol, triton X100, apse etc., for better adhesion and coverage.

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Diseases-

Powdery-mildew

Powdery mildew can be controlled by spraying Dinocap 1 ml/lit or Carbendazim 0.5 gm/lit.

Downy-mildew

Downy mildew can be controlled by spraying Mancozeb or Chlorothalonil 2 g/lit twice at 10 days interval.

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AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

BIO-FERTILIZERS - A blessing to soil and challenge to mankind

Article id: 11150

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INTRODUCTION

With the advent of green revolution in the late sixties, the production of food grains soared in the coming years. India experienced huge increase in agricultural output with the use of high yielding varieties, chemical fertilizers, pesticides and irrigation facilities without being concerned of soil quality and sustainability. Excessive dependence on agrochemicals indirectly led to deterioration of soil fertility, contamination of water bodies and decrease in population of micro-organisms, ultimately resulting in loss of soil quality.

In meeting the domestic requirement of food grains and also generating exportable surpluses, the significant role played by chemical fertilizers is well recognized. Fertilizer consumption of India increased from 100.3kgha^{-1} in 2002 to 165.8kgha^{-1} in 2016 growing with an average annual rate of 3.81% making India second in the world, in terms of fertilizer consumption, next only to China.Now-a-days, it is noticed that agricultural lands under intensive monoculture system, which receives heavy application of chemical fertilizers alone, productivity is slowly declining and environmental quality is being adversely affected. It can thus be concluded that sustainability can never be achieved as long as the agricultural practices go hand in hand with the use of massive chemical fertilizers.

Bio-fertilizer

Bio-fertilizersare defined as preparations containing living or latent cells of efficient strains of microorganisms that help crop plants for the uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form which is easily assimilated by plants. Use of bio-fertilizers is one of the important components of integrated nutrient management, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture. The bio-fertilizer organisms can play a pivotal role in maintaining long term soil fertility and sustainability. Thus, bio-fertilizers are important to ensure a healthy and secured future for the generations to come. Long term use of bio-fertilizers is economical, eco-friendly, efficient, productive and accessible to poor farmers over chemical fertilizers.

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Why interest on biofertilizers

- **Input constraints**: In the manufacture of nitrogenous fertilizers, non-renewable energy sources like Naphtha, Natural gas, Sulphur etc. are used as raw materials.These sources are depleting / not available in India. *So, the country is in search of alternate source of N harvesting process.*
- **Energy crisis**: Manufacture of chemical fertilizers is an energy intensive process.
  1 kg N- 80 mega joule(11.2 KWh)
  1Kg P-12 mega joule (1.1 KWh)
  1 kg K - 8 mega joule (1 KWh)

So, we are in search of process involving less energy.

- **Nutrient fixation / reversion**: Costly inputs (P fertilizers) are subjected to fixation in acid soil and reversion in alkali soil. *So, it is desirable for the unavailable nutrient be solubilised in-situ.*
- **Quick decomposition**: Crop residues are potential source of almost all plant nutrients, as 30-40 % the plant nutrients remain in the crop residues alone.*We need quick decomposition and release of nutrients.*
- **Growth regulators / hormones**: Growth regulators are required for quick growth, proper establishment, flowering and fruiting of the crop plants. *So, we want in situ secretion of these substances.*
- **Crop protection**: For optimum yield, the crop plant should be protected against disease and pests.*So, we want these substances to be secreted in situ.*
- **Quality produce**:The quality of the produce should be high (Nutritional and keeping).
- **Environmental quality**: For healthy living we need no/less polluting environment. Chemical fertilizers more or less cause environmental pollution when used injudiciously.*So, we want nutrient supply system should be eco-friendly.*

Bio-fertilizers can fulfill or augment all the above requirements to many extent as they are-

a. Self-generating sources
b. Nutrient fixer: *Rhizobium, Azolla, Azotobacter, Azospirillum*, BGA etc.
c. Nutrient solubilisers: PSM (Phosphorus Solubilising Bacteria)
d. Nutrient mobilisers: *V.A. Mycorrhiza*
e. Cellulose decomposers: *Trichoderma* spp.
f. Secretor of growth promoting substances: *Azotobacter*

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g. Secretor of antibiotics and fungistic substance: *Azotobacter*

h. Eco-friendly with a lot of positive residual effect.

Favorable conditions required for better efficiency of bio-fertilizers

- **Soil reaction**: Usually 6.5 to 7.5. This is achieved by ameliorating acid soils by lime and FYM and amending alkaline soils by gypsum/pyrite application
- **Soil organic matter status**: It should be medium to high in status. It is the food for non-symbiotic microorganisms.
- **Soil moisture:** It should be between 30-40 per cent. Moisture below or above this range affects microbial population activity.
- **Soil temperature**: Optimum between 28-30^{o}C.
- **Strain of microorganisms:** It should be efficient and adaptable to place of application.

Application techniques used

- **Seed treatment (Most effective method)**

  A slurry of 200 g BF (solid) is prepared in 400-500 ml water (stickers can be used as rice gruel or gum Arabic). Over 10-12 kg treated seeds is poured in it and mixed properly to form a coat.Liquid cultures can be mixed directly. They are dried over clean cloth/paper under shade for one to two hours. The inoculated seeds are sown during afternoon hours.
- **Seedling root dip/set treatment**

  Looking at the size of the material to be treated slurry should be prepared in water. For sugarcane set treatment 2-3 kg BF in 50-75 litre of water. The sets are dipped for 15-20 minutes before planting. Seedling roots need to be dipped for 10-15 minutes before transplanting.
- **Soil Treatment (Incubated FYM)**

  The bio-inoculants should be mixed with well decomposed FYM in 1:25 ratio. It has to be incubated for 5 to 7 days under shed at 50 % moisture. Apply it just before sowing or planting of crops. This method is widely advocated to the farmers.

Constraints of Biofertilizer

A. Production constraints

- Non-availability of suitable facilities for production.
- Lack of essential equipments and power supply.

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- Lack of technically qualified staff.
- Inadequate facilities for quality control.
- Unavailability of appropriate and efficient strains.
- Unavailability of suitable carriers.

B. Market level constraints

- Poor transport, inadequate distribution and storage facility.
- Lack of awareness of farmers...
- Lack of quality assurance.
- Seasonal and unassured demand.
- Lack of strong promotion and insufficient publicity.
- Lack of availability of quality products in time.

C. Field level constraints

- Adverse soil and climatic factors (pH, Temp. NO_3-level, P, Mo, Ca, S, B and K deficiency).
- Competition from native microbial population.
- Use of substandard inoculants.
- Faulty inoculation technique.
- Poor crop management.

CONCLUSION:

Unquestionably, bio-fertilizers are the potential source of many nutrients and aids in sustainability in global level. The use of bio-fertilizers rather than chemical fertilizers are more accepted considering soil quality and fertility parameters. As, the use of bio-fertilizer, still so far, is grossly inadequate in India, more emphasis on its production, consumption and also proper distribution is to be taken into consideration. The Government of India has taken initiatives in research fields but more vision is required to achieve the target. The problems related to are adverse climatic situation, soil condition, production technologies, storage, awareness among the farmers are also some of the important areas that need to be addressed. Hopefully with more awareness and demand from the consumers for bio-fertilizer produce will result in farmers opting for bio-farming.

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ISSN: 2581-8317

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Scientific cultivation of bitter gourd

Article id: 11151

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Scientific name: *Momordica charantia*L.
Family: Cucurbitaceae
Chromosome number: $2n = 2x = 22$
Origin: India
Edible portion of Bitter gourd: Fruit
Toxic substances: Cucurbitacins
Sex forms: Monoecious

INTRODUCTION

Bitter gourd, also known as a balsam pear in the United States and karela in India, is a fast growing, warm season, and climbing annual.Its juice is useful for diabetic patients. It is extensively grown all over India for its bitter, immature ridged fruits. In addition to culinary use, it is also used as a raw material for wine making.It is a rich source of proteins, minerals, fiber, carbohydrates, calcium, phosphorus and iron. The fruits vary in size, shape, colour and degree of bitterness. The characteristic bitter taste of the fruit is due to the bitter principle 'momordicin'.

Distribution

Bitter gourd is thought to have originated in the old world tropics possibly in India and/or Africa. It is now widely grown throughout the tropical regions of the world. It is a popularvegetable of India, China, Taiwan, Vietnam, Philippines, Indonesia, Sri Lanka, Malaysia, theCaribbean and South Africa. Area and production wise, the important bitter gourd states ofIndia are Tamil Nadu, Uttar Pradesh, Maharashtra, Kerala, Andhra Pradesh and Odisha.

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Food Value

Bitter gourd is a good source of vitamins A, B1, B2 and C. It also contains appreciableamounts of minerals like calcium, phosphorus, iron, copper and potassium. Per hundredgrams of fresh fruit contains 92.4 g moisture, 1.6 g protein, 0.2 g fat, 4.2 g carbohydrates, 0.8g fiber, 20 mg calcium, 70 mg phosphorus, 0.6 mg iron, 88 mg vitamin C and 0.5 mg niacin.

Uses

Bitter gourd is grown mainly for immature fruits, although the young leaves and shoottips are also edible. The most popular method of cooking is to hollow out and stuff. It is alsostir fried, curried and pickled. Bitterness is reduced by applying salt on peeled or cut fruits.Biochemicalcompounds such as 'saponin' and 'charantin' present in bitter gourd possess the propertiessimilar to those of insulin and thus help in lowering the blood sugar level.

Improved Varieties

Pusa Hybrid-4 -This is the firstgynoecious based bitter gourd hybrid developed by ICAR-IARI,New Delhi and released by Delhi State Seed Sub-committee for Agricultural and Horticultural Crops for commercial cultivation. The average fruit weight is 60g and its average yield is 22.26 t/ha.

Kalyanpur Baramasi (CSAUA &T, Kanpur) - Fruits long (30-35 cm), light green, thin and tapering, tolerant to fruit fly and mosaic, yield 20 t/ha in 120 days.

Punjab Kareli-1 (PAU, Ludhiana) -Fruits are long (30 cm), thin andmridged. First picking is possible 65 days after sowing. Average fruit yield is 175 quintals perhectare.

ArkaHarit (IIHR, Bangalore) -The fruits are attractive green, spindle shaped, small in size with regular ribs. Average yield is100-120 quintals per hectare.

VK 1 Priya (KAU Vellanikkara) -It bears on anaverage 50 fruits per plant. Average fruit weight is 225 g and yield is 250-300 quintals perhectare.

Pusa Do Mausmi (IARI, New Delhi) - It is a selection from the local material and is suitable for sowing in spring-summer andrainy seasons. Average fruitweight is 100-125 g and yield is 120-150 quintals per hectare.

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Coimbatore Green (TNAU, Coimbatore) - It is a selection from the local material. The fruits are extra-long (up to 60 cm) and darkgreen, each weighing 300-400 g. Average yield is 150-200 quintals per hectare.

Priyanka (KAU, Thiruvalla) - It is a selection from the local material. The fruits are white, spindle shaped, medium longwith dented ridges. Average fruit weight is 300 g and average yield is 280 quintals perhectare.

Phule Green (MPKV, Rahuri) - It is developed from the cross between Green Long and Delhi Local. The fruits are darkgreen, 25-30 cm long and dented. Average yield is 230 quintals per hectare. It is tolerant todowny mildew.

Pusa Hybrid 1 (IARI, New Delhi) - First picking is possible 50-55 days aftersowing. Average fruit weight is 100 g and yield is 220 quintals per hectare.

Climate–

It a warm season crop, but has a wide range of adaptability and can be grown in a region with comparatively low temperature. - At temperatures between 25°C - 30°C, the growth is normal and yields are high.When the temperature is less than 18°C, the growth is slow leading to poor yield. If the temperature goes above 40°C, more male flowers are produced, and plants become prone to mosaic disease.

Soil–

The crop can be grown in all types of soils, but sandy loam and silt loam soils are most suitable. The best pH would be 6.5 – 7

Sowing Time–

In north Indian plains, the summer crop is sown in February – March and the rainy season one in June-July. In mid-hills of north India, sowing is done from April to July. In south India, the best planting time is September to December.

Seed Rate–

The seeds are sown 2.0-2.5 cm deep. The seed is to be treated with @ 2 gm / 1 kg of seed by soaking the seed for 6 hours. This will facilitate germination and protect from seed borne disease and insect pests. The seed rate varies from 4.5-6.0 kg per hectare.

Spacing–

Bed × plant spacing is maintained at 2.0-2.5 m × 60 cm. Closer spacing is required for less vigorous varieties like Pusa Vishesh. Planting is done on both sides of the beds. When the seedlings attain 3-4 leaf stage, thinning is done to retain two seedlings per hill.

Manures and Fertilizers–

FYM: 20-25/ha N:-100 kg/ha P:-50 kg/ha K:-50 kg/ha Method of fertilizer application is same as described in muskmelon. Two more dozes of nitrogenous fertilizer of 20 kg each are applied, first after one month of sowing and the second after two months of sowing.

Irrigation–

Bitter gourd is sensitive to water stress. Apply irrigation only through furrows at 10 days intervals in the beginning when the temperature is low and later at 7-day intervals when the weather is hot and dry.

Weed Control–

Weeds in bitter gourd are controlled either by hand weeding or by using mulches**.** Incorporation of the herbicide 3-5 cm deep into the soil increases its efficiency.

Harvesting–

Flowering starts in Bitter gourd by 45 - 55 days after planting and the first picking could be taken in 60 – 70days after planting depending upon variety, planting season, soil types, management practices etc. Immature, tender fruits are harvested; the color of tender fruit is light green or dark green or whitish green depending on variety.

Yield–

It can yield 100-150 q/ha depending upon the variety and time of planting.

Post Harvest Management–

Bitter gourd fruits harvested at 12 days maturity (12 days after pollination). The storage life of fruits at room temperature (25-30°C) is 3 days. The storage life of bitter gourd fruits is extended to 6 days at room temperature (25-32°C)

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Value Addition–

Bitter gourd fruits are cut into thin slices and dehydrated. The dehydrated slices are stored for longer periods and used in the off-season. The fruits are also processed to make pickles. Bitter gourd is exported to Europe.

Seed Production–

At seed harvest maturity, colour of bitter gourd fruits turns deep yellow or orange and split open at the blossom end. The flesh is pale and firm. The jelly surrounding the seeds becomes very soft and deep red. If harvesting is further delayed, the fruits will split open. The seed crop is raised only in the summer season. An isolation distance of 500 m is maintained between two varieties of bitter gourd. Introduction of 5-7 beehives improve fruit setting and seed recovery. Rouging of off-type plants is under-taken at least at three different growth stages viz. before flowering, during flowering and at fruit maturity. After extraction, the seed is cleaned and dried to 7 per cent moisture level before storage. Average seed yield is 3.0-4.0 quintals per hectare.

Plant Protection Insect Pest:

Red pumpkin beetle (*Aulacophora foveicollis, A. lewisii*)

Nature of Damage-

Adults feed on the foliage, buds and flowers, Grubs feed on roots,Beetles damage the leaves, flowers and fruits. Making irregular holes and causing death and retardation of growth.

Control Measures.

Spraying with 0.05% malathion or dusting with 5% malathion dust @ 10 kg/ha

Melon Fruit fly (*Dacus cucurbitae*)

Nature of Damage - Active during March-May attack fruits, Reddish dark brown flies with hyaline wings, lay eggs under the skin of the fruits, Maggots feed on the pulp of fruits Infested fruits start rotting and rendered them unfit for human consumption

Control Measures- Spraying with 0.05% Malathion or 0.2% carbaryl at flowering

Diseases:

Powdery Mildew: Powdery mildew caused by the fungus Erysiphecichoracearum, affects cucumber, muskmelon, pumpkin, and squash. It is caused by a fungus that appears as a white powdery growth on leaves.

Downy Mildew: Downy mildew on cucumber and muskmelon is caused by the fungus *Pseudoperonospora cubensis*. Irregularly shaped yellowish to brown spots appear on upper sides of leaves, usually at the center of plants.

Management: Removal of badly infested leaves followed by chemical spraying prevents spread of the disease. Spray Mancozeb (0.2%) at 8-10 days interval.

Health benefits of Bitter gourd

- Bitter melon is very low in calories, carrying just 17 calories per 100 g. Nevertheless, its pods are rich sources of phytonutrients like dietary fiber, minerals, vitamins, and anti-oxidants.
- Bitter melon notably contains phytonutrient, polypeptide-P, a *plant insulin* known to lower blood sugar levels. Also, it composes hypoglycemic agent called Charantin. *Charantin* increases glucose uptake and glycogen synthesis inside the cells of the liver, muscle, and fatty (adipose) tissue. Together, these compounds may have been thought to be responsible for blood sugar levels reduction in the treatment of type-2 diabetes.
- Fresh pods are an excellent source of folates, carrying about 72 µg/100g (18% of RDA). Vitamin folate when taken by mothers during their early pregnancy time, would help reduce the incidence of neural tube defects in the newborn babies.
- Fresh bitter melon is an excellent source of vitamin-C (100 grams of fresh pod provides 84 mg or about 140% of RDI). Vitamin-C is one of the powerful natural antioxidants which helps scavenge harmful free radicals from the human body.

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ISSN: 2581-8317

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Doubling farmer Income: Modern agriculture irrigation systems & practices

Article id: 11152

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INTRODUCTION –Agriculture include a wide range of disciplinary such as crop production, land and water management, animal husbandry, fishery and forestry. Agriculture in India today is described by a net sown area of 141 million hectares, with field crops continuing to dominate, as exemplified by 55 per cent of the area under cereals. In India agriculture is one of the largest enterprises. An enterprise can sustain only if it can grow persistently. And this growth is depending upon savings &investment; both of this is an outcome of positive net returns from the enterprise. The net returns resolved the level of income of an entrepreneur; in this case farmer is entrepreneur. So on the basis of this, on 75 years Independence Day (15 august 2017) celebration, the Prime Minister Narendra Modi decided to launch double the farmer's income project by 2022. Niti Aayog provided investment for irrigation, seeds, fertilizers and modern technology collaboration with horticulture, poultry and dairying for doubling farmer's incomes. Doubling farmer's income is a key challenge to the scientists, researchers and all agriculturists. This goal is achieved if farmers uses and adopt modern technology, increased milk and honey production and use of solar light in the field of agriculture like uses of drip irrigation systems for maximum utilization of water with minimum cost and minimum wastage. The Prime Minister said Water is like God, we have no right to waste it. For increased the agricultural production main focus will be given on the More crop per drop, Hark khet ko pani (water for every farm), Doubling farmers' incomes. In this respect, Government of Madhya Pradesh increased the afforestation to reduce the soil erosion during flood condition and decreased drying up the river by planting more trees; it is organized by Narmada Yatra. By this way Narmada would not go dry even after 100 years.

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Agriculture has suffered due to absence of modern capital and modern knowledge.Low level of absolute income as well as large and deteriorating disparity between income of a farmer and non-agricultural worker constitute an important reason of decreased of farmer's conditions. The low and highly fluctuating farm income is causing detrimental effect on the farmer's interest in farming and farm investments, and is also forcing more and more cultivators, particularly younger age group, to leave farming. This can cause serious adverse effect on the future of agriculture in the country. So for reducing this serious cause different methods are to be used such as agronomic practices like precision farming to raise production and income of farmers, zero tillage, raised bed plantation and ridge plantation, modern machinery such as laser land leveler, drip irrigation, sprinkler, precision seeder and planter. ICAR and SAUs should develop models of farming system for doubling farmer's income.

Sources of Growth in Farmers' Income -

Sources within agriculture sector	Sources outside agriculture
Improvement in productivity	Shifting cultivators from farm to non-farm occupations
Resource use efficiency or saving in cost of production	Improvement in terms of trade for farmers or real prices received by farmers.
Increase in cropping intensity	
Diversification towards high value crops	
Effectively and efficiently use of water for irrigation.	

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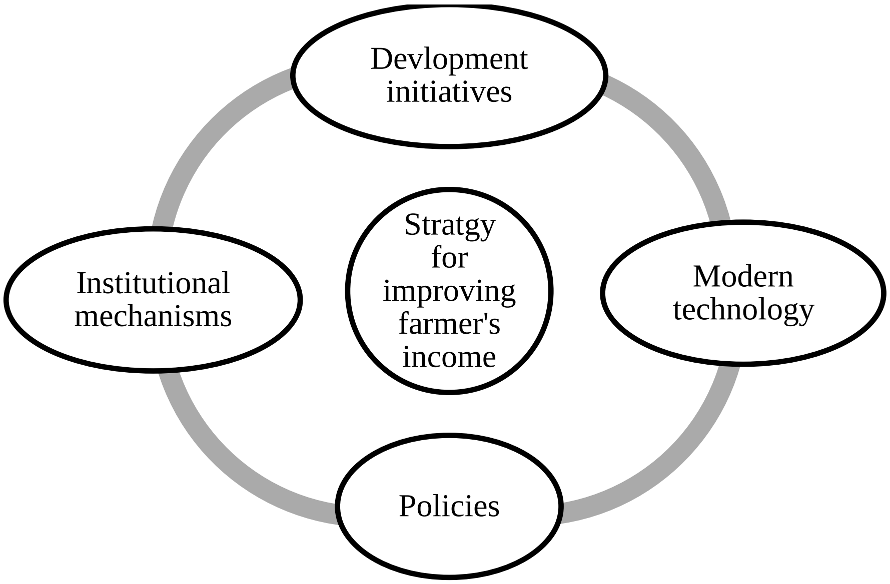
Strategy for Improving Farmers' Income -



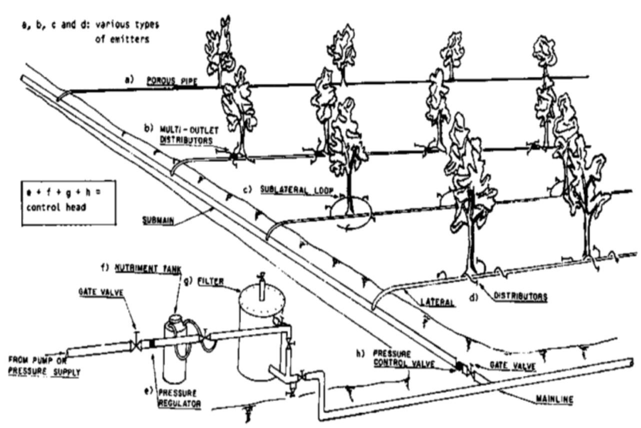
Role of modern irrigation techniques for increasing farmer's income – Irrigation is the artificial application of water to the land, to increased agriculture production with minimum losses of water. The main reason for reducing the farmer's income is scarcity of water. In this situation only irrigation played an important role. Basically irrigation is used to improve food security, reduce dependence on monsoon, improve agricultural productivity, create rural job opportunities,to leach or dilute salts in soil, helps in cooling the soil and atmosphere to create more favorable environment for crop growth,dams used for irrigation projects help produce electricity & transport facilities as well as provide drinking water supplies to a growing population, control floods & prevent droughts, development of desert area, optimum use of water

In Independence day Prime minister Narendra Modi introduce Israel's Model to reduce the water stress problem. In this model mainly focus on the use of drip irrigation practices instead of using the flooding irrigation. In drip irrigation technique water is directly applied to the crop roots to reduce the excessive use of water.

In modern irrigation techniques mainly focus on selling the output, machine intensive and not depend on the rain. In modern irrigation technique which is able to used water at minimum cost and efficiently utilization of water, is drip irrigation technique and sprinkler irrigation. These are methods is to be used instead of using other method for preserving the water.

Drip irrigation -Drip irrigation is sometimes called trickle irrigation and involves dripping water into the soil at very low rates (2-20 litres/hour) from a system of small diameter plastic pipes fitted with outlets called emitters or drippers. It is most efficient & effective way of irrigation.Water is applied close to plants so that only part of the soil in which the roots grow is wetted, unlike surface and sprinkler irrigation, which involves wetting the whole soil profile. It is suitable for high value row crops.

Drip irrigation method can be either high tech computerized or labor intensive. Water is applied frequently but at a slow rate (<14lit/hr). Diameter of pipe & Emitters are small compared to Sprinkler Irrigation. In this not required for separate drainage System.



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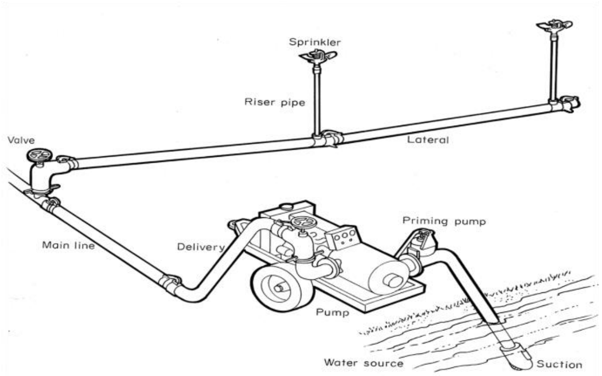
DRIP IRRIGATION SYSTEM LAYOUT

In drip irrigation system discharge rate is varied, for low (Q < 4lit/hr), medium (4 <Q <10Lit/hr) and high (Q < 15lit/hr).

Sprinkler Irrigation - Water is piped through different locations in the field and is then distributed by high pressure sprinklers or guns.Sprinklers are mostly installed on permanent risers.Some sprinklers which rotate are called rotors.Consists of a network of pipes & sprinklers spaced at suitable places.At the nozzle Pressure head is converted to Velocity head.Area of wetted land used in sprinkler irrigation is depends on velocity of water jet, angle of flow, type of sprinkler & it's design and wind Speed & direction. Adaptability in the land is depend on irregular topography (unsuitable for surface irrigation),gradient is steeper, highly sandy soil, high water table, seasonal water demand is low for that area. Crops having following factors required humidity control (tobacco), having shallow roots, required high & frequent irrigation.



LAYOUT OF SPRINKLER IRRIGATION SYSTEM

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CONCLUSION – Irrigation sector play a vital role to increase the farmer's income.Day by day lowering of farmer's income can cause serious damage to the future of agriculture and reduced economy of our country. To secure future of agriculture and to improve livelihood of half of India's population, adequate attention needs to be given to improve the welfare of farmers and raise agricultural income. Achieving this goal will reduce persistent disparity between farm and non-farm income, alleviate agrarian distress, promote inclusive growth and infuse dynamism in the agriculture sector. So for doubling farmer income till 2022 efficient modern technology will be used to save water and maximum production. For the irrigation system mainly focus on the uses of sprinkler and drip irrigation system, by using this we conserve water and obtain maximum production.

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AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317
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Transplanting of cotton – An innovative technique

Article id: 11153
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Cotton is a soft fiber that grows in boll around the seeds of cotton plant. Its genus *Gossypium* and it belongs to the family *Malvaceae.* In India, it is grown majority of states such as Gujarat, Maharashtra, Karnataka, Telangana, Andhra Pradesh, Madhya Pradesh, Haryana, Tamil Nadu *etc.* Cotton is a kharif crop which requires 6 to 8 months to mature. Its time of sowing and harvesting differs in different parts of the country depending upon the climatic conditions. In southern region of the country, there are several reasons for the low yields in cotton such as imbalanced fertilizers application, late planting, and improper pest management *etc*. where the rainy season starts probably during second fortnight of June to even in the August month. Therefore, there is very large yield gap between the average productivity of the country and also in the southern regions of the country. Here, planting time plays major role which also decides growth and yield, pest incident, disease attack. In India, dibbling method of sowing in cotton is mostly practiced. In late onset of monsoon, the farmers undertake late sowing of cotton, which leads to improper germination in the beginning of sowing, slow growth of the crop and heavy pest attack especially sucking pests such as thrips, mites and bollworms to certain extend, reddening in cotton *etc.* which ultimately lowers the growth and yield of cotton. This ultimately leads to the total production of the country. To tackle this problem of late sowing of cotton, transplanting of cotton crop will help to sow the seeds on proper time and avoid the drawbacks of late sowing in cotton.

Late onset of monsoon makes farmers helpless to sow the cotton crop late probably after second fortnight of July instead of sowing on time on first or second fortnight of June. This late sowing of cotton results in lower growth, bad germination, higher insect and pest prone, reddening in cotton due to lower anthocynin content and other problems that ultimately results in lower seed cotton yield and quality of fiber. To avoid the bad effects of late sowing of cotton, transplanting can be a best method that avoids late growth, higher plant population, healthy crop that help in increasing the seed cotton yield and quality of fiber.

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Importance of transplanting in cotton

Transplanting in cotton catch proper timing of sowing, avoid pest attack at greater rate that ultimately helps in progressive yield. Growth of transplanted cotton crop will be higher when compared over direct seeding as sowing can be conducted at the precise time in the nursery by adjusting soil temperature and humidity. Transplanting is not a new practice; vegetable crops are usually sown using transplanting method especially in small seeded crops such as in chilli, brinjal, capsicum *etc.* In the same way, cotton crop can also be transplanted for higher germination and the major advantage here in transplanting cotton is, the weak, diseased, damaged seedlings can be avoided while transplanting in the field to ensure 100% germination.

During establishing seedlings of cotton in nursery, one should take care of three things majorly, they are:

1. Rising of cotton seedlings in proper way in plastic bags using healthy soil and weed seed free farm yard manure to avoid disease and weed infestation in cotton seedlings.
2. Care should be taken in the nursery such as irrigation, application of 2% of urea as spray for good growth of cotton seedlings.
3. Care should be taken during transplanting of seedlings in the field to avoid damage of seedling especially the roots.
4. Management practices should be taken properly after transplanting of seedlings for better growth of the crop.

Procedure for cotton seedling nursery:

- Take healthy fine soil and farm yard manure or compost.
- Mix well the soil and farm yard manure in equal proportion.
- Fill the mixture of soil and farm yard manure in plastic bags for transplanting.
- Sow the cotton seeds in the plastic bags.
- Provide water to the bags preferably sprinkler method of irrigation. Irrigation can be given alternate days or once in three days.
- After germination of cotton seeds, thinning should be done to maintain the single seedling in each plastic bag and discard poorly grown seedlings.
- Spray 2% urea to the seedlings for good growth in the beginning.
- After 25-30 days after sowing in the plastic bags, the seedlings are ready for transplanting in the field.

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Advantages of transplanting over direct seeding in cotton:

- Catch the right sowing time with proper temperature and humidity.
- Higher growing degree days over direct seeding.
- Good initial growth of cotton crop.
- Gap filling can be done using the seedlings to ensure 100% plant population in the field.
- Seed rate is reduced since single seedling is used to transplant in each hill.
- Incidence of insect, pest and disease can be reduced in the crop.
- Uptake of water and nutrients is increased due to good root growth in transplanted plants.
- Higher number of sympodial branches which results in higher number of bolls in crop.
- These results in higher yield of seed cotton over direct seeded crop.
- Less biotic and abiotic stress to the transplanted crop.
- Yield and quality of the crop is increased.
- Increased net returns. Since yield and quality is enhanced in transplanting method of establishment.


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Disadvantages of transplanting in cotton:

Transplanting of cotton plants is labour intensive procedure. Transplanting shock is one the problems during the beginning of transplanting of seedlings in the crop field.

Simplified transplanting method reduced the labour cost and increases the net returns. Transplanting method of cotton crop establishment will be a good technique that ensures higher yield of seed cotton and quality fiber. The biotic and abiotic stress such as insect, pest, disease salt stress, drought during reproductive stage is reduced using 25-30 days old transplanted cotton seedlings.

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Women empowerment

Article id; 11154

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Women's empowerment is the process in which women elaborate and recreate what it is that they can be, do, and accomplish in a circumstance that they previously were denied. Empowerment can be defined in many ways, however, when talking about women's empowerment, empowerment means accepting and allowing people (women) who are on the outside of the decision-making process into it. “This puts a strong emphasis on participation in political structures and formal decision-making and, in the economic sphere, on the ability to obtain an income that enables participation in economic decision-making.

Empowerment is the process that creates power in individuals over their own lives, society, and in their communities. People are empowered when they are able to access the opportunities available to them without limitations and restrictions such as in education, profession and lifestyle.

Women empowerment is importance

- Reduce under employment & unemployment
- For a overall development of society
- For economic independence of women

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- To completely remove domestic violence & sexual exploitation
- To get rid of poverty & illiteracy
- Promote gender equality & healthy environment
- Promote women to lead & use their talent resource
- Economic benefits with more earning hands

Benefits of Women Empowerment:

Women empowerment adds to confidence of women in their ability to lead meaningful and purposeful lives. It removes their dependence on others and makes them individuals in their own right.

- An educated housewife proves more proficient in teaching her children, and in imparting values to him. An educated working woman experiences various affirmative effects. The impact is further facilitated to the family, society, and ultimately to the nation.
- As females are a different sex, their diverse viewpoints about various things differ as of man. This attribute arises multiple solutions, benefitting the society in greater extent. Only men's perceptions of envisaging things can get humdrum. Leading this, we might miss a peripheral approach on things.
- *'Women are better managers',* it's true. Their significant roles in the organizations, signs the importance of women's literacy.
- To maintain the equilibrium in our society, their participation is a significant feature for a family circle. With their effective views and decisions, they have promoted various fields like- politics, education, entertainment, social service, hospitality, etc.
- Women's education also gives stimulus to those males, who do not hold positive opinion regarding women's empowerment through education.

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Some Indian government schemes for women empowerment

The Indian government has also recognized women issues and their contribution to the country's economy. Here are some of the women empowerment initiatives available to women in India:

1. Mahila E-haat

Mahila E-haat It is a direct online marketing platform launched by the Ministry of Women and Child Development to support women entrepreneurs, Self Helf Groups (SHGs) and Non- Governmental Organizations' (NGOs) to showcase products made and services rendered by them. This is a part of the 'Digital India' initiative. Women can register themselves at www.mahilaehaat-rmk.gov.in and leverage technology for showcasing their work to a broader market.

2. Beti Bachao, Beti Padhao

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Beti Bachao, Beti Padhao This is a social campaign aimed at eradication of female foeticide and raising awareness on welfare services intended for young Indian girls. The "Save the Girl Child" movement was launched on 22 January 2015, it is a joint initiative run by the Ministry of Women and Child Development, the Ministry of Health and Family Welfare and the Ministry of Human Resource Development.

3. One Stop Centre Scheme

One Stop Centre Scheme Popularly known as 'Sakhi,' it was implemented on 1st April 2015 with the 'Nirbhaya' fund. The One Stop Centres are established at various locations in India for providing shelter, police desk, legal, medical and counselling services to victims of violence under one roof integrated with a 24-hour Helpline. The toll-free helpline number is 181.

4. Working Women Hostels

Working Women Hostels The objective of the scheme is to promote the availability of safe and conveniently located accommodation for working women, with daycare facility for their children, wherever possible, in urban, semi-urban, or even rural areas where employment opportunity for women exist. Further details of the Working Women Hostel Scheme can be accessed on the Department of Women and Child Development's official website.

5. Swadhar Greh

Swadhar Greh The Swadhar scheme was launched by the Union Ministry of Women and Child Development in 2002 for rehabilitation of women in difficult circumstances. The scheme provides shelter, food, clothing and care to the marginalized women/girls who are in need. The beneficiaries include widows deserted by their families and relatives, women prisoners released from jail and without family support, women survivors of natural disasters, women victims of terrorist/extremist violence etc. The implementing agencies are mainly NGOs.

6. STEP

STEP The Support to Training and Employment Programme for Women (STEP) Scheme aims to provide skills that give employability to women and to provide competencies and skill that enable women to become self-employed/ entrepreneurs. A particular project will be for duration of up to 5 years depending upon the nature, kind of activities and the number of beneficiaries to be undertaken. Sectors include Agriculture, Horticulture, Food Processing, Handlooms, Tailoring, Stitching, Embroidery, Zari etc, Handicrafts, Computer & IT enable services along with soft skills and skills for the workplace such as spoken English, Gems & Jewellery, Travel & Tourism, Hospitality, etc.

7. Nari Shakti Puruskars

The Nari Shakti Puruskars are national level awards recognizing the efforts made by women and institutions in rendering distinguished services for the cause of women, especially vulnerable and marginalized women. The awards are presented by the President of India every year on 8 March, International Women's Day at Rashtrapati Bhavan in New Delhi.

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Scientific cultivation of cucumber

Article id: 11155

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Botanical name: *Cucumis sativus* L.

Family: Cucurbitaceae

Chromosome number: 2*n* = 2*x* = 14

Origin: India

Edible portion: Fruit

Toxic substances: Cucurbitacin

INTRODUCTION

Cucumber, Cucumis sativus, is part of the Cucurbitaceae family and is thought to have originated in Nepal. Cucumbers are frost sensitive and are cultivated in the open or in greenhouses, depending on the type. Greenhouse cucumbers are parthenocarpic (produce fruit without fertilisation of ovules), and the fruit are usually seedless.

Brief History

Cucumber is believed to have originated in India, where it had been under cultivation for the last 3000 years. It also has a long history in China which is considered its secondary centre of origin. Cucumber is known from descriptions in Iraq around 600 BC and in Mediterranean region around 200 BC. From India it had spread to Italy and Greece. USA growing cucumbers in 1539. They were grown in Brazil before 1650.

Distribution

Cucumber is extensively grown throughout the world especially the slicing types. China is the largest producer of cucumbers and produces 51 per cent of the total world production. The other important cucumber producing countries include Iran, Turkey, the USA, India and Russia. In north Europe and Japan, most of the cucumber cultivation is in green houses. Pickling types are not

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popularly grown in India but are grown in Europe, North America and Japan. However, some farmers grow these types in South India on contract basis for export to Europe.

Food Value

Cucumbers taste great and are fat-free, cholesterol-free and sodium-free. One hundred grams of fruit contain 96.3 g moisture, 0.4 g protein, 0.3 g minerals (140 mg calcium, 30 mg phosphorus and 0.6 mg iron), 0.4 g fiber, 5.7 g carbohydrates, 0.04 mg riboflavin, 0.4 mg niacin and 4.0 mg vitamin C.

Uses

Slicing cucumbers are usually served raw in salads and sandwiches but they can also be cooked. Cucumbers are common ingredients in facial creams, masks, cleansers etc. Sliced cucumber applied on the skin helps to soothe skin irritation and swelling.

Improved Varieties

Poinsette (Introduction, USA)

The fruits are dark green, cylindrical, 20-25 cm long with very few white spines. It is early maturing and first picking is possible 60 days after sowing. Average yield is 100-120 quintals per hectare.

Himangi (MPKV, Rahuri)

It is developed from the cross between Poinsette and Kalyanpur Ageti. Its fruits are greenish-white with very tender and juicy flesh. It is free from bronzing and takes 100-110 days to reach marketable maturity. Average yield is 175 quintals per hectare.

Sheetal (KKV, Dapoli)

The fruits are green and medium long. It is suitable for cultivation in both summer and rainy seasons. First picking is possible 65 days after sowing. Average fruit weight is 300-350 g and yield is 300-400 quintals per hectare in rainy season and 200-230 quintals per hectare in spring-summer season.

Japanese Long Green (Introduction, Japan)

Fruits are 30-40 cm long, straight and whitish-green with dark green stripes. Flesh is light green and crisp. It is an extra early variety and first picking is possible 45 days after planting. Average yield is 220 quintals per hectare.

Straight Eight (Introduction, USA)

It is also recommended for cultivation in cooler climates. The fruits are medium long, thick, straight and cylindrical with rounded ends. Skin is medium green with white spines.

Balam Khira (Primitive type)

Its fruits are non-bitter, small, oval shaped, tender and pale green with brown spines. It is popular in Saharanpur region of Uttar Pradesh.

Punjab Kheera-1

Released in 2018. It has dark green color fruits which are bitter less having an average weight of 125gm and average length of 13-15cm. harvesting can be done after 45 and 60 days of sowing in September and January month sown crop.

Punjab Naveen:

The variety is developed in 2008.This variety of plant has dark green color leaves, fruits are uniformly cylindrical in shape and are light green in color with smooth surface. The fruits are crispy, bitter free and contain soft seed.It gives an average yield of 70 quintal/acre.

Other state varieties:

Pusa Uday:

The variety is developed by Indian Agricultural Research Institute (IARI). The fruits of this variety are light green in color, medium sized and are 15cm in length. Use 1.45 kg of seed in per acre of land. The variety gets mature within 50-55 days. It gives an average yield of 65 qtl/acre.

Pusa Barkha:

The variety is developed for Kharif season. It is highly tolerant to humidity, temperature and downy mildew disease. It gives an average yield of 78 quintal/acre.

Climate

Cucumber is a warm season crop but requires slightly milder climate than muskmelon and watermelon. It is successfully cultivated in tropical, sub-tropical and temperate regions of the world but is sensitive to frost. Optimum germination temperature 25-28°C, night temperature not lower than 20°C. Optimum growth temperature25-30°C, night temperature not lower than 18°C.

Soil

Well-drained light loamy sand with pH range of 6.0-7.0 is ideal for cucumber cultivation. Sandy soils are preferred for early maturity. Cucumber is sensitive to herbicidal residues in the soils especially to Atrazine and Tafazine. Therefore avoid planting in soils where these chemicals have been used in the previous crop.

Time of sowing:

It is sown in the month of February-March. In riverbeds, where cucumber is grown mixed with other cucurbits, sowing is done from November to January. In south and central India, sowing is done almost throughout the year due to milder winters.

Spacing:

Sow two seeds per place of bed which is 1.5-2.5m wide and use spacing of 60cm between seeds.

Sowing depth:

Seeds are sown at the depth of 2-3cm.

Method of sowing:

Low tunnel technology:

This technology is used to produce early yield of cucumber in early summer. It helps to protect the crop from cold season i.e. in the month of December and January. Beds of 2.5m width are sown in the month of December. Seeds are sown both sides of the bed at the distance of 45cm. Before sowing supportive rods of 45-60cm length are fixed in the soil. Cover the field with plastic sheet (100 gauge thickness) with the help of support rods. Plastic sheet should be removed mainly in the month of February when temperature is suitable outside.

Seed rate:

Seed rate of 2.5-3.5 kg is sufficient for one acre of land.

Seed treatment:

Before sowing seeds, treat them with the suitable chemical to protect them from disease and pests and to increase viability. Seeds are treated with Captan@2gm before sowing.

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Manures and Fertilizers

Apply FYM 40 t/ha as basal and 35 kg of N/ha at 30 days after sowing.Apply Azospirillum and Phosphobacteria 2 kg/ha and *Pseudomonas* 2.5 kg/ha along with FYM 50 kg and neem cake @ 100 kg before last ploughing. For slicing cucumber, the method of application is the same as for the muskmelon. For pickling cucumber, all the fertilizers are applied at the time of sowing.

Irrigation

Returns for pickling cucumbers may increase with proper irrigation. With irrigation, it is possible to ensure more uniform emergence and plant development under dry soil conditions. Weed control chemicals are also more effective when followed by a light irrigation.**Drip irrigation** Install drip system with main and sub-main pipes and place the inline lateral tubes at an interval of 1.5m. Place the drippers in lateral tubes at an interval of 60 cm and 50 cm spacing with 4 LPH and 3.5 LPH capacities respectively.

Weed Control

Weeds from in-between plant spaces are removed manually. For chemical weed control in cucumber, apply Roundup (glyphosate) @ 1.0 litre or fluchloralin @ 1.2 litres per hectare at least three days before sowing. Cucumber is sensitive to herbicidal injury; therefore the chemical and the doze should be very specific. Weed can be controlled by hand-hoeing and also controlled by chemically, use glyphosate@1.6litre per 150 litre of water.

Harvesting

Most slicing cucumbers are harvested when they are 15-20 cm long and pickling types when they are 6-10 cm long. Depending upon variety, season and location, slicing cucumbers take 45-70 days from sowing to reach marketable maturity and pickling cucumbers take 30-35 days. To ensure fruit setting over longer periods, regular harvesting at 2-3 day intervals is important. Over-mature fruits turn yellow or brownish and upon cutting in transverse section show carpel separation.

Yield

Depending upon the variety, climate and bee activity, yield of slicing cucumbers varies from 200-400 quintals per hectare. Yield of pickling cucumbers varies from 150 quintals per hectare in machine harvest to 300 quintals per hectare in manual harvest.

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Post Harvest Handling

Fruit quality in cucumber suffers from fruitfly damage and crooked neck. The latter is due to improper pollination or fertilization. Such fruits are culled before marketing. Slicing cucumbers are graded according to size, diameter, shape and colour of the fruits. Pickling types are graded according to fruit diameter. The fruits are packed in baskets/plastic crates before marketing. To improve post-harvest shelf life, cucumber fruits are hydro cooled immediately after harvesting. Hydro cooling removes field heat. They are kept in shade before marketing to avoid water loss. Cucumber can be stored for about two weeks at 10-13°C and 90 per cent relative humidity. Below 10°C, cucumber is sensitive to chilling injury. Cucumber fruits should not be transported or stored along with fruits that emit ethylene.

Value Addition

Cucumber is one of the important vegetables processed on a large scale especially for making pickles. The fruits are preserved in vinegar and acetic acid. There is a well-developed pickle processing industry in Japan, Europe and the USA. Such type of industry is lacking in India. The pickling cucumber grown in south India is exported on pre-determined terms and conditions.

Seed Production

For seed production of cucumber, the fruits are allowed to ripen on vines. At seed maturity, fruits turn yellow, orange or brownish yellow. Transversely cut fruits show carpel separation. Mature seeds separate easily from the pulp. Like other cucurbits, cucumber is a highly cross-pollinated crop and requires an isolation distance of 500 m between varieties and 1000 m between hybrids to produce genetically pure seed. Selection of true-to-type or rouging of off-types is under-taken atleast at three different growth stages viz. before flowering, during flowering and at fruit maturity. Introduce 5-7 beehives per hectare to ensure better fruit set and consequently higher fruit and seed yield. This also improves fruit quality of slicing cucumbers, where improper pollination and fertilization results in crooked neck fruits. Avoid pesticide sprays in the morning hours as long as bees are active. After harvesting, the fruits are stored at room temperature for 4-5 days. The fruits are cut longitudinally and the seeds are scooped out from the fruits. They are rubbed with sand or ash to remove pulp before washing. Otherwise the pulp is allowed to ferment for 24-48 hours before washing. The seeds are washed and cleaned. Floating or empty seeds are removed during washing. The seeds are dried to the moisture level of 5-10 per cent. Average seed yield Varies from 4-7 quintals per hectare.

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DISEASES AND THEIR CONTROL

- **Powdery mildew (*Spaerotheca fuliginae* and *Erysiphe cichoracearum*)**

All cucurbits are susceptible to powdery mildew but watermelon is least affected. The leaves after 2-3 weeks of unfolding are the most susceptible. It is serious under dry weather conditions. The symptoms first appear as pale yellow spots on leaves and stems. Later on, the fungus develops a whitish powdery mass on leaves, stem and other plant parts..

Grow resistant varieties especially in muskmelon, cucumber, summer squash and pumpkin. Remove alternative weed hosts from vicinity of the crop fields. The pathogen can be controlled by application of Karathane @ 125-200 ml per hectare or Benlate @ 300 g per hectare. The spray is repeated at 2-week intervals.

- **Downy mildew (*Pseudopernospora cubensis*)**

The disease is serious under cool and humid weather. Usually, the older leaves are affected first and then the younger ones. The disease appears as water soaked lesions on leaves. These lesions appear yellowish on upper surface of leaves and develop greyish downy growth of the fungus on under-surface of leaves.

Use drip irrigation and avoid flooding of fields. Grow resistant varieties especially in cucumber and muskmelon. Destroy over-wintering vines of cucurbits. Spray the crop with Indofil M-45 or Kavach @ 750 g-1.5 kg per hectare before appearance of the disease symptoms.

- **Cucumber mosaic virus**

It is one of the most widely distributed and important diseases of cucurbits. The virus is spread by aphids and cucumber beetles and it over-winters on perennial weeds. The plants remain stunted and the foliage is mottled with dark green areas followed by wilt and defoliation.

Remove the alternate host perennial weeds from vicinity of the crop fields. Use disease free seed, rogue out the virus infected plants, control the insect vectors by spraying chemicals and grow resistant varieties, especially in cucumber and summer squash.

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Pest and their control:

- **Fruit fly:**

  It is serious pest found in cucumber. Females fly lay eggs below epidermis of young fruits. Later on maggots feed on pulp afterward fruits starts rotting and get drop. **Treatment**:

- Foliar application of Neem oil @3.0%is given to cure the crop from fruit fly pest.

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Forage production - Constraints and strategies

Article id: 11156

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Agriculture sector is considered as backbone of Indian economy which contributes nearly 17.9 % of GDP. Furthermore, 52 % of the population is directly or indirectly dependent on agriculture and its allied activities for their livelihood. Agriculture and animal husbandry are the two faces of a coin which go hand in hand. Both are integral part of village culture, tradition, business, and livelihood. Livestock play an important role in the rural economy of India by providing employment and supplementary family income. It plays an important role in Indian agriculture and a source of livelihood security for more than 20.5 million people in rural areas (Economic survey of India- 2018).

But, the fodder production in the country is not sufficient to meet the requirements and at the same time, it is not appropriate in terms of quality. At present, the country is facing a net deficit of 35.6% green fodder, 10.95% dry crop residues and 44% concentrate feed ingredients. At the current level of growth in forage resources, there will be 18.4% deficit in green fodder and 13.2% deficit in dry fodder by the year 2050.

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Common constraints in forage production

The following bare the main constraints in enhancing the green fodder production:

- Population explosion forced as to grow more grain crops rather than the fodder crops
- Green revolution given much concentration on grain crops at the same time neglecting the fodder crops.
- Lack of adoption of the improved production technology of fodder crops
- Livestock farmers are small (21.75%) and marginal farmers (69.4 %) are not paying much importance and feeding poor feeds for the animals.
- Regional variations in fodder availability lead to the reduction of yield.
- High transport cost and burning of the crop residue
- Non availability of skilled human resource in fodder production
- Lack of availability of quality seeds
- Lack of knowledge of fodder production technology

Strategies to improve the forage production

1) Seed production and availability:

- Seed availability of forage crops is 15-20 % of national requirement.
- Development of seed standard and seed production technology for the fodder crops and grasses
- Fodder production must be encouraged @ ICAR institution and SAUs
- Dairy cooperatives must be involved in seed production and distribution of the seeds at the farmers.
- Proper seed processing and storage facilities

2) Production technology of fodder crops:

- Till now there around 200 varieties of fodder crops has been developed, further suitable varieties for lean periods, good quality seeds has to be developed
- Adoption of fodder crops in contingency crop planning, alley cropping/catch crop as well as in proper cropping systems
- Dissemination of the adequate package of practices for the farmers and also farmers have to spread themselves
- Need to highlight and economic viability of the round the year green production in comparison with agriculture crops to bridge the gap in demand and availability.

3) Conservation of the fodder:

- Development of equipments for processing of the feed and fodder
- Use of the chaff cutter to minimize the wastage of fodder
- Conversion of the fodder blocks into the feed blocks during the glut periods
- Conservation of fodder in the form silage and hay for the lean periods
- Enrichment of the stovers with the urea

4) Transfer of technology:

- On farm evaluation of the fodder
- Hay and silage demonstrations as a front line

5) Research:

- Development of the fodder production technology
- Development of the new cultivars of fodder crops
- Development of varieties with less anti-nutritional factors

6) Area expansion and policy:

- Adoption of food-fodder systems in balanced form
- Making the provision for the subsidies for the inputs and processing instruments

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Conclusion

Silage and hay making are the successful techniques for conservation of fodder crops fresh without deteriorating the quality for using in the lean periods. At present there are number of technologies in the market for silage and hay making with respect to mechanization, technologies, and methods of making them.

Keeping in mind the constraints of forage production, we should plan to enhance the forage for increasing the dairy production. Implementing the suitable technologies in forage production, one can improve the dairy sector of the country. Awareness is still lack among the farmers and government sectors should work on the required things in dairy sector.

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AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317

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Using Global Positioning Systems (GPS) and Geographic Information Systems (GIS) for Forest Conservation

Article id: 11157

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INTRODUCTION

Precision agriculture is a key part of the third rush of present-day rural transformations. The principal rural upset was the expansion of motorized agriculture, from 1900 to 1930. Every farmer delivered enough nourishment to sustain around 26 individuals amid this time. The 1990s prompted the Green Transformation with new strategies for genetic change, which prompted each farmer feeding around 155 individuals. It is normal that by 2050, the worldwide populace will reach about 9.6 billion, and sustenance generation should successfully twofold from current dimensions so as to nourish each mouth. With new mechanical headways in the agriculture insurgency of exactness cultivating, every farmer will almost certainly feed 265 individuals on a similar ground. The main rush of the exactness rural unrest will come in the types of satellite and elevated symbolism, climate expectation, variable rate manure application, and harvest wellbeing pointers. The second wave will total the machine information for considerably increasingly exact planting, geographical mapping, and soil information.

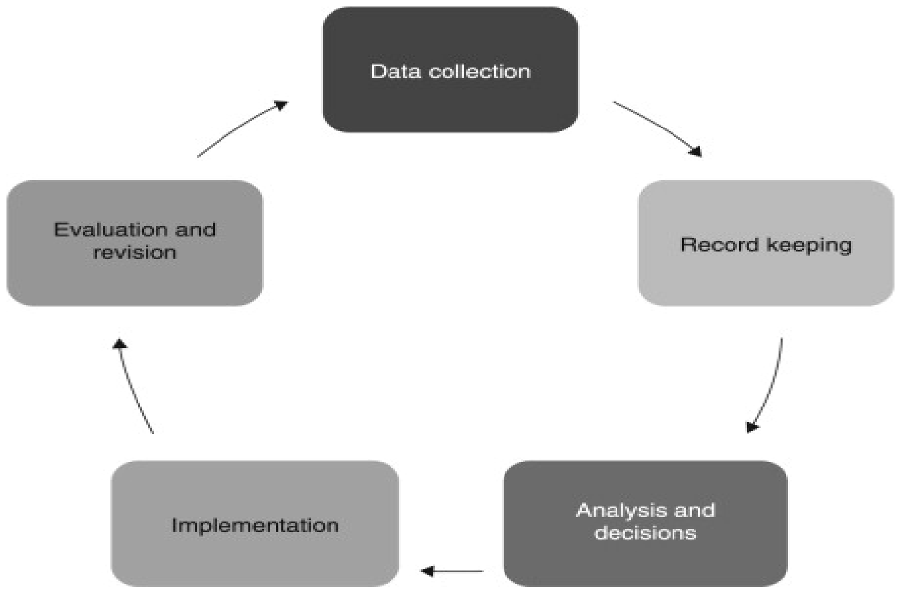

Fig.1 The decision-making cycle

Precision agriculture aims to optimize field-level management with regard to:

- Crop science: by matching farming practices more closely to crop needs (e.g. fertilizer inputs);
- Environmental protection: by reducing environmental risks and footprint of farming (e.g. limiting leaching of nitrogen);
- Economics: by boosting competitiveness through more efficient practices (e.g. improved management of fertilizer usage and other inputs).

Precision agriculture also provides farmers with a wealth of information to:

- Build up a record of their farm
- Improve decision-making
- Foster greater traceability
- Enhance the marketing of farm products
- Improve lease arrangements and relationship with landlords
- Enhance the inherent quality of farm products (e.g. protein level in bread-flour wheat)

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Precision farming aims to optimize field-level management with regard to:

- Crop Science: matching farming practices more closely to crop needs
- Environmental Protection: reducing environmental risks
- Economic: increasing competitiveness through more efficient practices

Precision farming also provides growers with an abundance of information to:

- Build farm records
- Improve decision making
- Enhance marketing practices
- Improve landlord relationships

It has been said farmers were the principal land stewards. They use to examine climate designs, soil temperature and humidity, development, and different variables. They rotate harvests to improve assorted variety, and screen water system rates with the goal that salts don't aggregate. They likewise use accuracy farming practices to apply supplements, water, seed, and other agricultural contributions to develop more yields in a wide scope of soil conditions. Exactness ag can enable farmers to know how much and when to apply these sources of info. There is a great deal of innovation used to make present-day agribusiness increasingly productive. For instance, a few farmers utilize worldwide situating frameworks (GPS) and GPS-PC guided tractors and harvesters.

Other geo-referenced site-specific practices may include:

- Electromagnetic soil mapping
- Soil sample collection
- Crop yield data collection
- Aerial imagery
- Crop or soil color index maps
- Soil types
- Soil characteristics
- Drainage level
- Potential yields

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Each of these geo-referenced information layers subdivides a huge field zone into littler administration zones. Utilizing little administration zones diminishes squander while expanding creation potential. One case of an exactness agribusiness practice is to assess the characteristic soil changeability of a field. In the event that the dirt in one region holds water better, yields can be planted all the more thickly and water system can be saved. Or on the other hand, if the plot is utilized for nibbling, more steers can brush than a comparative zone of less fortunate quality soil. The vast majority are familiar with GPS since the innovation basically helps in finding and finding focuses on the globe. This is so in light of the fact that it has turned out to be a lot simpler with the presentation of cell phones in the market today.

Tools and Equipment

Global positioning system (GPS) GPS is a navigation system based on a network of satellites that helps users to record positional information (latitude, longitude, and elevation) with an accuracy of between 100 and 0.01 m [3]. GPS allows farmers to locate the exact position of field information, such as soil type, pest occurrence, weed invasion, water holes, boundaries, and obstructions.

Sensor Technologies

Various technologies such as electromagnetic, conductivity, and ultrasound are used to measure humidity, vegetation, temperature, texture, structure, physical character, humidity, nutrient level, vapor, air, etc. Remote sensing data are used to distinguish crop species, locate stress conditions, identify pests and weeds, and monitor drought, soil and plant conditions. Sensors enable the collection of immense quantities of data without laboratory analysis.

Geographic information system (GIS)

This system comprises hardware, software, and procedures designed to support the compilation, storage, retrieval and analysis of feature attributes and location data to produce maps. GIS links information in one place so that it can be extrapolated when needed. Computerized GIS maps are different from conventional maps and contain various layers of information (e.g. yield, soil survey maps, rainfall, crops, soil nutrient levels, and pests). GIS is a kind of computerized map, but its real role is using statistics and spatial methods to analyze characters and geography.

A farming GIS database can provide information on filed topography, soil types, surface drainage, subsurface drainage, soil testing, irrigation, chemical application rates, and crop yield. Once analyzed,

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this information is used to understand the relationships between the various elements affecting a crop on a specific site.

Global Positioning System (GPS)

Global Positioning System satellites broadcast signals that allow GPS receivers to calculate their position. This information is provided in real time, meaning that continuous position information is provided while in motion. Having precise location information at any time allows soil and crop measurements to be mapped. GPS receivers, either carried to the field or mounted on implements allow users to return to specific locations to sample or treat those areas. Uncorrected GPS signals have an accuracy of about 300 feet.

CONCLUSION

Precision farming is still just an idea in many creating nations and key help from the general population and private areas are fundamental to advance its quick reception. Effective selection, in any case, involves something like three stages including investigation, examination, and execution. Precision agriculture can address both financial and ecological issues that encompass generation agriculture today. Questions stay about cost viability and the best approaches to utilize the mechanical devices we presently have, yet the idea of "making the best choice in the ideal spot at the ideal time" has a solid natural intrigue. In the light of the present pressing need, there ought to be a hard and fast exertion to utilize new innovative contributions to make the 'Green Transformation' as an 'Evergreen Upset'. Eventually, the achievement of exactness Precision agriculture depends to a great extent on how well and how rapidly the information expected to direct the new advances can be found.

Precision farming gives another arrangement utilizing a frameworks approach for the present farming issues, for example, the need to offset profitability with ecological concerns. It depends on cutting edge data innovation. It incorporates depicting and demonstrating variety in soils and plant species and coordinating farming practices to meet site explicit prerequisites. It goes for expanded monetary returns, just as at diminishing the vitality input and the natural effect of farming.

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http://www.agrifoodmagazine.co.in

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Role of Actinomycetes in agriculture

Article id: 11158

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Abstract

Actinomycetes are one of the promising candidates as PGP and biocontrol agents for use in agriculture. During an investigation by previous researchers on actinomycetes from various resources, actinomycetes recovered potential for their antimicrobial activity and ability to produce various PGP activities like phosphate solubilization, indole acetic acid, ammonia, siderophore and enzyme production. Actinomycetes use as biofertilizer can bealternative source for organic farming in the agriculture field.

Introduction

Status of agriculture in the global scenario

Natural resource base of agriculture, which provides for sustainable production, is shrinking and degrading, and is adversely affecting production capacity of the ecosystem. However, demand for agriculture is rising rapidly with increase in population and per caput income and growing demand from industry sector. There is, thus, an urgent need to identify and control severity of problem confronting agriculture sector to restore its vitality and put it back on higher growth trajectory. The problems, however, are surmountable, particularly when new tools of science and technology have started offering tremendous opportunities for application in agriculture.Synthetic chemicals for enhancing crop yield have largely affected food quality, human and environment. According to Lai, 1997study, traditional practices of slash and burn has been reported to negatively affect soil quality

Actinomycetes

Actinomycetes are prokaryotic Gram-positive bacteria, high G+C (guanine and cytosine) content, mycelia-forming characterized with substrate and aerial mycelium. Morphological feature of actinomycetes are common to both fungi and bacteria, in growth habit actinomycetes resemble fungi. Actinomycetes grow slow, hard and sticky colony, branching growth pattern. They are the most abundant in the soil and responsible for naturally “earthy” smells of soil. Actinomycetes are found in various habitats including soil, water, plants etc.; they are dominant in soil. The most common genus of actinomycetes is *Streptomyces* sp. The rhizosphere refers to the area narrow

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region of soil that is directly influenced by root secretions, and associated soil microorganisms. The rhizosphere region contains abundance of microorganisms and produce agriculturally and industrially important compounds. Actinomycetes are also found as endophytes (Endo means inside; phyte means plant). Endophytic actinomycetes are actinomycetes colonize inside the living tissues of plants without causing any problems to the host. Endophytic actinomycetes are considered as potential sources of novel bioactive compounds.

Isolation of actinomycetes

Rhizospheric actinomycetes is isolated from soil with serial dilution spread plate technique, where 0.1ml of suspension at dilutions of 10^{-2} and 10^{-6} were plated onto several different agar media plates Starch Casein Agar, Actinomycetes Isolation Agar, Streptomyces Project 5 Agar). To minimize the growth of fungal and bacterial contaminants, 50µg/ml cyclohexamide, 50µg/ml nystatin and 20µg/ml nalidixic acid were added into the isolation medium. Inoculated plates were incubated at 28 ± 2°C for 2-4 weeks. Dry, sticky, filamentous colonies were observed. Colonies of actinomycetes were selected according to Bergey's Manual of Determinative Bacteriology (Holt *et al*., 1994). Morphologically identified actinomycetes were subjected to further identification based on 16S r RNA sequencing.

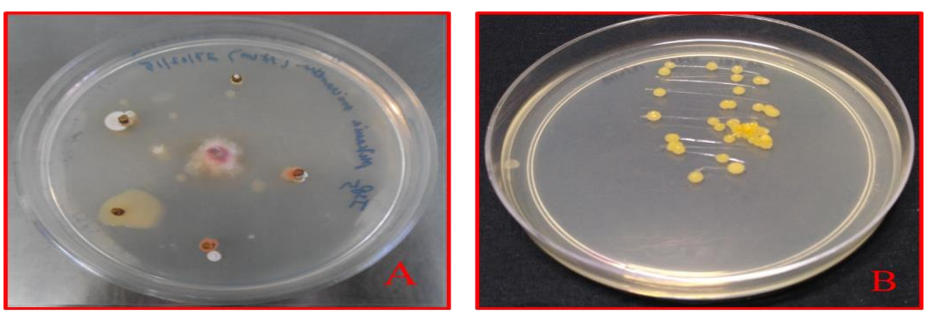

Fig.1. A- representative of endophytic actinomycetes colonies around the plant tissues,
B-representative of rhizosphere actinomycetes pure culture plate.

Significance of actinomycetes

Actinomycetes are one of the most potent microorganisms capable for producing various secondary metabolites. In natural forest, actinomycetes play major role in decomposition of organic material degrade plant litter and animal. Various beneficial sources that actinomycetes produce today for useful in the agriculture fields. Actinomycetes play an important role in plant growth promoting activities. Actinomycetes have potential in preventing the growth of phytopathogens. Apart from their biocontrol potential, actinomycetes are recognised as their ability to solubilized phosphate,

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produce siderophore, Indole-acetic acid, ammonia, extracellular enzymes and some fix nitrogen. These organisms have been used widely for plant growth promoting and as biocontrol agents in agriculture. Applications of actinomycetes as bioinoculants were reported by many researchers, *Streptomyces* spp. were reported to enhance PGP of crops such as tea (Phukan *et al*., 2012), wheat (Hamdali *et al*., 2008), rice (Gopalkrishnan *et al*., 2014), bean (Nassar *et al*., 2003), tomato (El-Tarabily, 2008) and pea (Tokala*et al*., 2002). Actinomycetes bio-inoculants produce beneficial effects on the plant growth and their improvement. Microorganisms have become potentially important alternative sources for sustainable agricultural developments.

Conclusion

Utilization of microorganisms bioinoculants with the ability to promote plant growth are environmentally friendly technologies. This technique involved to find cheaper and this may encourage farmers to use in agriculture, ultimately increase crop yield and quality crop production. It is noteworthy to investigate more potential bioinoculants in the future.

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Value added products of soybean

Article id: 11159

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The soybean plant (Glycine max) belongs to legume family. An average, dry soybean contains roughly 40% protein, 20% oil. Humans can easily digest soy protein and in the prevention of disease has received increased products. About 92-100% of soy protein is digestible in scientific and commercial interest. Foods made from soybean may be divided into four classes namely, soy ingredients, traditional soy foods, second-generation soy foods, and foods where soy is used as a functional ingredient. Traditional soy foods include soy milk, tofu, tempeh, natto, miso and soy sauce. Soy milk is a protein-rich, milky liquid obtained from the soaking and grinding of whole soybeans with water, or from hydrating whole, full-fat flour, cooking the resultant slurry, and filtering all or part of the soy pulp or fiber from the cooked liquid. Second-generation soy foods include meat extenders, soy burgers, soy sausage, imitation chicken and soy cheese. Foods in which soy is used as functional ingredient include baked goods to which soy flour is added. Soy ingredients are the processed soybean protein products which include soy flour (defatted and full fat), soy concentrates, soya isolates, texturized vegetable soy protein and hydrolyzed soy protein.

Table 1. Some food uses of soybean and its derivatives

Soybean and its derivatives	Food/Feed/Fuel uses
Whole soybean (Containing all nutrients & Phytochemicals)	Soybean dairy analogs, full fat soy flour, snack foods, sprouted bean, Tempeh, Miso, Natto and Sauce.
Soybean Oil (20% of wholegrain)	Cooking/shortening oil, salad oil, margarine, bread spread, and soy lecithin
Soy proteins (About 50% in edible soy meal)	Texturised soy protein, soy protein concentrate, hydrolysates & isolates, defatted soy flour, and dietary fibre.
Soybean byproducts (hull & okara)	Single cell protein (SCP), dietary fiber, livestock feed, snacks.
Soybean crop residue (leaf, branches & stems)	Animal feed, fuel and manure.

Table 2: Major soya food products and its uses

Soy products	Uses
Soy flour	Full fat soy flour: Ten percent addition of soyflour is recommended to start with and can be increased upto 20%. Preparation and use of recipes from soy-cereal/pulse blended flour does not demand any change in the traditional food habits of the people. Soy flour can be used for preparation of chapati, poori, paratha, etc. and in bakery products. *Alternatively the soy flour can also be mixed with besan in 1:1 proportion and used in preparation of conventional snack foods like sev, chakli, pakoda, etc.*
	Medium fat soy flour: Production of medium fat soyflour involves expelling of about 70% oil from the beans. It, therefore, contains less fat (4-6%) and more protein (45-50%). It can be used in food products in the same manner as that of the fullfat soyflour.
Soy milk and other dairy analogue	Soymilk is a water extract of soybean and it is the base material for making soy paneer, soy-yogurt and other dairy analogs. One kilogram of dry soybean yields 6 -8 litres of milk. Special features of soymilk are low cost, good nutritive and suitability for lactose intolerant people. Soymilk contains about 90% water, 2.5% fat and 3.5% protein, etc.Soy paneer, popularly known as TOFU in the orient, is a coagulated and pressed soy-protein. At 72% moisture, it contains about 14% protein and 9% fat. Soy paneer is used in vegetable curry, *paneer-pakoda* and *paneer-paratha*. Process technology has been developed for preparation of good quality *Soy-shrikhand / amrakhand* can be prepared using soy milk as a base.
Soy fortified bakery Products	Good quality biscuits can be prepared by incorporation of 12-15% soy flour in the recipe. Protein content of soy fortified biscuit is about 12% against 7-8% in commercially available product. Soy biscuits have great potential for combating protein calorie malnutrition at low cost. Process for making soy fortified biscuits has been standardized for adoption at home and industry level. Soy fortified muffins, bread and buns can also be prepared.
Soy based snacks	Products like soy-nuts (roasted, fried), *laddu, sev, chakli*, etc. can be prepared using properly processed soy flour. Variety of soy products can be manufactured and made available to population Soy-sattu: It is a ready to eat product prepared by incorporation of soybean

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	for nutritional improvement. This can be easily prepared on cottage scale and made available to population.
Fermented Soy foods	The various fermented soy foods are soy-yogurt, tempeh, soy-sauce, miso, natto, etc. Out of these tempeh and soy-sauce are very popular in the Far-East. Soy based *idli, dosa, vada* are also finding the place.
Texturized soy-protein Product	Texturized soy-protein (TSP) can be prepared from defatted flour, concentrates and isolates and using extruder. These are available in textured form with fibrous and chewy properties like meat. TSP contains 45-50 percent protein
Soy meal / extruded soybean as feed	Soybeans and its products are used in animals and poultry feeds. Soybean hulls are a source of rumen digestible fiber and low in starch. Because of this characteristic, hulls can replace some of the feed grains such as corn and barley in dairy cattle diets. Soybean meal is a major source of plant protein fed to dairy cattle as it is usually economical and blends well with other feeds.
Soy-protein concentrates, Isolates and hydrolysates	It is extracted from defatted soy flour. The concentrate contains not less than 70 percent protein on a moisture-free basis. Yield of protein concentrate is about 65 per cent of the total weight of the flour. Soy-protein isolate contains more than 90 percent protein.

New findings on the role of soybean in human health will boost the direct food uses of soybean globally and boost its utilization pattern in 21st century for direct food uses, the strategy would be for the complete utilization of soybean constituents for food, feed and pharmaceutical products. This would require need-based high-quality research & development in soybean production to consumption value chain.

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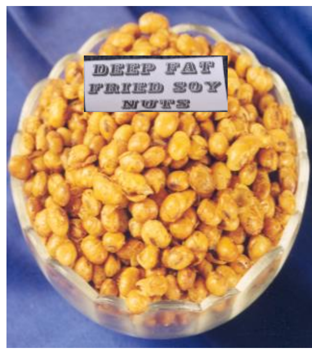

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Table 4: Nutrition composition of various soy foods

Soy-products	Protein (%)	Fat (%)
Full fat soy flour	38-41	19-20
Medium fat soyflour	45-48	6-8
Defatted soy flour	52-53	0.5-0.9
Soy milk	3.5	2.4
Tofu (Soy*Paneer)*	14	9
Soy shrikhand	10-13	8-11
Soy amrakhand	7.3-8.7	9.4-13.0
Soy biscuits	11-12	24
Soy nuts	45	26
Soy sattu	22	8.6

Table 5: Average composition of milk (%) from various sources

Constituents (%)	Sources of milk			
	Human	Cow	Buffaloo	Soybean
Water	87.43	87.20	82.76	93.00
Fat	3.75	3.70	7.38	2.00
Protein	1.63	3.50	5.48	3.00
Lactose	6.98	4.90	5.48	0.00
Ash	0.21	0.70	0.78	020
Other Carbohydrates	00.00	00.00	00.00	1.8

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Future trends

Consumers are becoming more and more interested in healthy foods. Soy beans and soy products have gained significant consideration for their potential role in improving health hazards such as risk factors for cardiovascular disease. Soy foods such as soymilk, tofu, natto, miso, and tempeh, textured vegetable protein like soy burger, soy nuts and whole soybean offer various health benefits. Besides soy proteins are very versatile and a rich source essential nutrients such as polyunsaturated fats, fiber, vitamins and minerals. These new trends will also offer opportunities for developing the soybean processing industry. This kind of product reduce under nourished people, since these products are rich in protein and also the developed soy based value-added products are suitable for all age group of peoples.

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Preparation of dahi (curd) and its nutritive value

Article id: 11160

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ABSTRACT

Dahi is the traditional fermented milk product. The prepared Dahi samples were tested through physical, chemical and microbiological analysis to evaluate their qualities. Data on different parameters were recorded and analyzed. In India, curd is regarded as very good for stomach as it aids digestion and gives a cooling relief from spicy foods. But because curd and its bacterial strength vary from one home to the other, it is not a standardised product. So the good bacteria present in curd may or may not reach the intestines alive to give the expected health benefits. A good dahi should possess firm body, consistent quality with equal ration of sweetness and sourness.

1.1 DAHI MAKING PROCESS:-

1.1.1 By Traditional method

In traditional method of dahi preparation, milk is heated intensively to boil for 5 to 10 min and then it is cooled to room temperature. cooled milk is added with previous day's curd or buttermilk, stirred and allowed to set undisturbed usually for overnight.

At halwai's shop milk is considerably concentrated before being inoculated with starter culture. So that the total solid content of milk gets increased, particularly increase in the protein content of milk. Concentration of milk results in custard like consistency of dahi and keeps the product from wheying off.

1.2 Definition: - Dahi is a fermented milk product prepared from milk after boiling, cooling, mixing of starter and incubation.

Or

Dahi or curd is a semi solid product, obtained from pasteurized or boiled milk by souring, using harmless lactic acid or other bacterial cultures. It should have the same minimum percentage of fat and solids-not-fat as the milk from which it is prepared. the standards prescribed for Dahi prepared from buffalo milk shall apply.

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2.1 Selection of milk: - Clean and fresh milk obtained from healthy animals having acidity below 0.17% be selected. It should be strained through clean muslin cloth to remove visible dirt and other matter.

Homogenization: 175 Kg/cm²

The standardized milk is subjected to homogenization after heating to 60°C to increase the efficiency. Homogenization reduces the cream layer formation during incubation, Single stage homogenization with 175kg/cm^2 pressure would be sufficient to improve texture of dahi.

3.1 Heating of milk: - milk is heated at 80°C for 20-30 minutes, to destroy all micro-organism preferable in the same utensils in which dahi is to be made to avoid post heating contamination.

3.2 Cooling of milk: - Then heated milk is cooled to 25°C.

Adding starter: - Dahi culture is streptococcus lactic; *lactobacillus acidophilus.* Its acidity should be 0.7 to 0.8%.

Rate of adding: - 1.5-2.0%

Incubation period: - The milk is kept in dark palace at 22°C temperature and take about 10-12 hours for milk to set as dahi.

Storage

Dahi is normally stored at 4°-5°C. Storage area should be maintained clean and tidy to avoid any cross contamination

Flow chart of dahi making-

Receiving milk

↓

Selection of milk

↓

Preheating

↓

Standardisation (SNF= 9-11%,)

↓

Homogenization (176kg/cm^2)

↓

Pasteurization at 80°C for 15-30 min.

↓

Cooling (25°C Temp.)

↓

Starter (1-2%)

↓

Packing

↓

Incubation (22-25°C) for 10-12 hrs.

↓

DAHI

↓

Cooling and storage

4.1 Chemical composition of dahi:-

S. No.	Components (Whole milk)	Nutritive Value in %
1	Water	84%
2	Fat	7.5%
3	Lactose	4.6%
4	Protein	3.45%
5	Mineral	0.55%
6	Lactic acid	0.5-1%
7	Calcium	0.10%
8	Ash	0.75
9	Phosphorus	0.11%

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5.1 Some incredible health benefits of curd:-

1. Good for digestion: curd is a great probiotic . These good and beneficial bacteria are known to improve gut activity, soothe inflamed digestive systems and treat an upset stomach.

2. Immunity: The live active cultures found in Curd fight disease-causing germs and intestinal tract protected. A scientific study conducted by a team of researchers at the University of Vienna in Austria found that eating a 7-ounce dose of dahi (about 200 grams) was just as effective in boosting immunity as popping pills.

3. healthy skin: Curd has a moisturizing effect on your skin and it heals your dry skin naturally. A lot of people suffer from acne due to certain gastrointestinal problems. Dahi is an excellent beauty ingredient for face packs too as it contains lactic acid that acts as an exfoliator and clears off all dead cells.

4. Reduces high blood pressure: A research presented at the High Blood Pressure Research Scientific Sessions of the American Heart Association (AHA) showed that people who ate more non-fat yogurt were 31 percent less likely to develop high blood pressure than others. The special proteins in yogurt along with nutrients like potassium and magnesium help in lowering high blood pressure and promoting a healthy heart.

5. Prevents Vaginal Infections: Dahi may be particularly good for women as it helps in discouraging the growth of yeast infections. The lactobacillus acidophilus bacteria found in curd is known to control the growth of infection in the body.

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CONCLUSION:

Curd is in great demand, especially in summer season. Curd is used to make multiple Dahi dishes, which have their own significance from health point of view. Curd is consumed as dahi rice, Lassi, Chapatis, Dahi Bhalla, Cucumber raita, Bottle gourd raita, Shrikhand, etc. Curd, the dairy product, has many health benefits and used as beauty aids to fair complexion. The fermentation of milk leads to the formation of curd. Consuming curd is great in maintaining healthy heart.

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Impact of climate change on plant diseases and disease management

Article id: 11161

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INTRODUCTION

Climate change refers to a change in climate that is attributed directly or indirectly by human activity that alters the composition of the global atmospheric and climate variability observed over comparable time periods. Climate change refers to earth become warmer. Plant diseases are major problem for food production including quality and safety of food. More than 50% of variation in the yield of a crop is due to climate change. Climate change directly affects rate of physiological process and biochemical processes. Climate change is affecting our agriculture due to 0.74^{o}C average global increase in temperature in the last 100yrs and atm.CO_2 concentration increases from 280ppm in 1750 to 400ppm in 2013. Simultaneously, these changes will also affect the reproduction, spread and severity of many plant pathogens, thus posing a threat to our food security. Disease management strategies should be reoriented in changing conditions with amalgamation of new strategies for sustainable food production. Disease is malfunctioning of host tissue which is due to interaction of susceptible host, virulent pathogen and favourable environmental condition called as a disease triangle. Interaction of host, pathogen and environment at a specific time result in more severity of the disease.

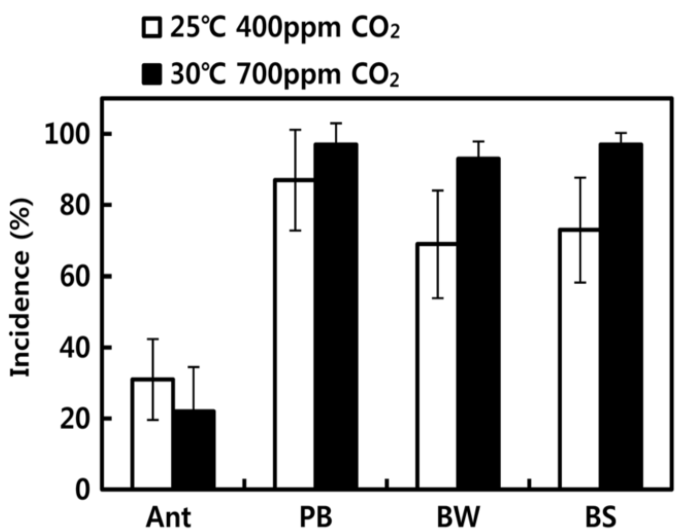
Effect of various components of climate change on plant disease-

1) Effect of CO_2 concentration- The effect of CO_2 concentration on plant disease can be +ve or –ve. An increase in CO2 levels may encourage the production of plant biomass resulting in increase in carbohydrate content which provides food for fungus automatically increases in disease severity. It promotes bio-trophic fungi such as rust fungi. Elevated CO_2 increases plant density will tend to increase leaf surface which regulate temperature and create microclimate thus increase infection by foliar pathogens like rust and powdery mildews. Higher CO_2 can increase the fertility of fungi, which may produce more spores.

Changes brought by high CO_2 concentration stomatal density are reduced. The reduction in stomatal opening can inhibit stomata-invading pathogens ultimately the host resistence is increased. For example, reduction in the rate of primary penetration of *Erysiphe graminis*on barley and the lengthening of latent period in *Maravalia cryptostegiae* (rubervine rust) has been observed under elevated CO_2.

2) Elevated temperature-Increase in temperature can modify the host physiology and resistance. Changes in temperature and precipitation alter the growth stage, development rate and pathogenicity of infectious agents. Temperature change might lead to appearance of different races of plant pathogens hitherto not active but might cause sudden epidemic. Increase in temperature reduces plant stress during the winter but increase stress on plant during summer. Wheat and oat become more susceptible to rust disease with increased temperature. Higher risk of dry root rot has been reported in *Fusarium* wilt chickpea-resistant varieties in those days when the temperature exceeds 33^{o}C. Increase temperature and more frequent moisture increase incidence of dry root rot of chick pea *(Rhizoctonia bataticola).*

Example: Influence of elevated co_2 and temperature effects on the incidence of four major chilli pepper disease.



Anthracnose (Ant), Phytophthora blight (PB), bacterial wilt (BW), and bacterial spot (BS).

Effect of Moisture-Moisture affects disease development by affecting the susceptibility of the host to infection and increase level of infection. High moisture favours most of the foliar

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diseases and some soil borne pathogen such as *Phytophthora, Pythium, Rhizoctonia* etc. Some pathogens such as apple scab, late blight and several vegetable root pathogens are more likely to infect plants with increased moisture content. Other pathogens like the powdery mildew species tend to thrive under conditions with lower moisture.

Effect of climate change on vector borne diseases-

Climate change may affect both host plant and insect vector populations, thereby affecting the spread of plant viruses. Global warming may influence the primary infection of the host, spread of infection within host and transmission of viruses to new host. Modification of the geographical range of the potential vector, vector phenology, overwintering, density and migration activity can follow. Elevated CO_2 level affect on natural enemies of insect herbivores, alter the size and composition of population of prey insects available to predators or by disrupting developmental synchrony for parasitoids.

Impaction disease management

Host Resistance- Cultivar resistance to pathogens may become more effective because of increased static and dynamic defenses from changes in physiology, nutritional status, and water availability. Durability of resistance may be threatened, however, if the number of infection cycles within a growing season increases because of one or more of the factors i.e. increased fecundity, more pathogen generations per season, or a more suitable microclimate for disease development. This may lead to more rapid evolution of aggressive pathogen races.

Chemical Control- Changes in temperature and precipitation may alter the dynamics of fungicide residues on the crop foliage. Globally, climate change model project an increase in the frequency of intense rainfall events, which could result in increased fungicide wash-off and reduced control.

Microbial Interaction- Changed microbial population in the phyllosphere and rhizosphere may influence plant disease through natural and augmented biological control agents. A direct effect of elevated CO_2 is unlikely in the soil environment as the micro flora there is regularly exposed to levels 10-15 times higher than atmospheric CO_2. Lower nitrogen status of plant tissue under increased CO_2 results in more mycorrhizal colonization, this improve plant health. Changes in temperature may have highly non-linear effects on interaction of host, pathogen and bio control agent.

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Quarantine And Exclusion- Management of climate change will put additional pressure on agencies responsible for exclusion as a plant disease control strategy. Use of Geographical Information Systems and climate matching tools may assist quarantine agencies in determining the threat posed by a given pathogen under current and future climates.

CONCLUSION

1. Rise in co_2 level lead to increase or decrease in plant disease by changing pathosystem genetically and ecologically.

2. Similarly, temperature and relative humidity affect the plant metabolism which leads to mortality of plant.

3. Ozone will lead to detrimental effects on growth and productivity of crop plants by decreasing their resistance which allows minor disease to be come epidemic.

4. So, there is a need of proper modules in accordance to rapid change in pathogen dynamics under varied climatic parameters.

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Soil testing for nematode control - Mandatory for polyhouse growers

Article id: 11162
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In India, agricultural and horticultural production is greatly hampered by parasitism and predation of different pests. The farming trend is shifting towards the protected cultivation because it offers an excellent opportunity for the cultivation round the year of high value vegetables and ornamentals crops. Major crops grown in polyhouses are capsicum, cucumber, tomato, carnations, melons, roses, gerbera, etc. Major problems faced by polyhouse growers are of sucking pests, foliar diseases and nematodes. Plant parasitic nematodes represent them as formidable pests for different crops in open field as well as in protected cultivation. As most of the nematodes feed on plant roots and underground plant parts, farmers, nurserymen and orchardists remain ignorant about their infestations and disseminations through soil, planting material, which turns to be the biggest impediment in their management aspects.

Root knot and reniform nematodes are of major concern and it is very important for farmers to know about the symptoms caused by nematodes, biology and management aspects to curtail crop losses in polyhouse crops. Most of the nematodes feed on plant roots, therefore, the farmers, nurserymen and orchardists remain ignorant about their infestations. Checking the dissemination of nematodes through infected planting material is the biggest impediment in their management. In protected cultivation due to continuous availability of warm, humid and abundant food and due to absence of natural enemies makes an excellent stable environment for the nematode development. The damage level depends upon type of nematode, season and most importantly type of crop.

Among the nematodes the root knot nematode problems is of major concern. Generally Indian farmers especially polyhouse growers skip the control of root knot nematode as these nematodes thrive in the soil and feed within the plant root tissues. The females of root knot nematode produce galls on the roots due to their continuous feeding for their growth, as a result the plants become wilted and stressed for heat, water and nutrition under severe infestations because nematode infestations reduce the flow of water and nutrients. The first

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stage juvenile remains inside the eggs and it reaches the second stage; juveniles hatch and start the infestations. The J2 enter into the root and moves through the tissues until its head is near the vascular cylinder. During feeding some substances are secreted in the saliva, which induce to the formation of multinucleate giant cells and galls. As a result the healthy tissues are destroyed leading to the severe dysfunction, because in this case vascular cylinder is affected and vessels becomes blocked or disrupted.

Site selection for protected cultivation

Site selection is most crucial step for taking up the protected cultivation. Fungal diseases and sucking pests are more at places with more rainfall and high humidity and wind velocity. As far as nematodes are concerned the soil should be tested before the construction of new polyhouses. Well drained soils with good percolation capacity are suitable for growing the vegetable crops in polyhouses. The type of soil plays a very important role in the occurrence of nematode and disease complex *e.g.*, coarse particle soils increase the synergistic interactions between root knot nematodes and certain fungi. Green houses should situated to avoid introduction of nematodes via downstream movement of drainage or run off water and soil.

Also, preliminary sampling prior to the harvest in established polyhouses or after destruction of the previous crop is necessary for quantifying the nematode population otherwise this type problems develops in newly planted crops because at present no host plant corrective measures are available to rectify the problems completely once established. The sample will be consisting various nematode genera and accordingly the control recommendations can formulated. Hence nematode density and distribution within the selected area must therefore be accurately determined before planting. It is especially important to guarantee to testing officer that a representative sample is collected from the same field. If the sample is positive for root knot or reniform nematode then at least the growers can opt for resistant cultivars, non-host crops, or go for rotation schemes.

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How to collect the sample?

Since root knot nematodes are concentrated in the crop-rooting zone, samples should collected to a soil depth of 15 to 30 cm and sample should be taken only in that place where soil moisture is appropriate avoiding extremely dry or wet places. Growers can also submit the roots and soil cores from 10 to 20 suspect plants avoiding dead and dry plants as they contain only few nematodes. They can also submit additional samples from the adjacent areas of good growth for comparative analysis. Once all the samples are collected from the single location, the entire samples are pooled carefully in the plastic covers/ bag with proper labeling along with the details of previous operations and crops undertaken on same area. Polythene bags will prevent the drying of the sample and the sample will remain intact. Also it should not be subjected to freezing or overheating, drying and exposure to sunlight. Always sample should be submitted fresh immediately to the commercial laboratory. And in the laboratory the samples should be stored in refrigerator if needed and should not be kept at hot places.

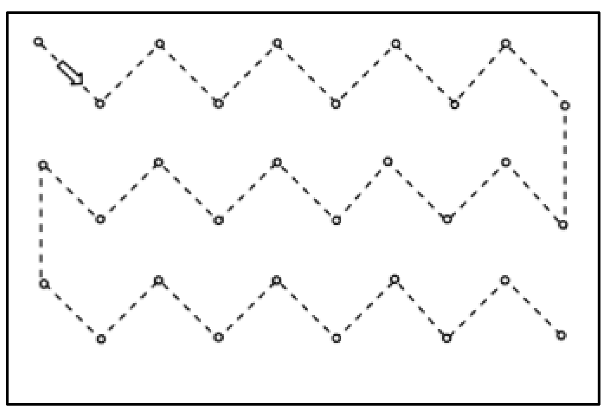

Fig: Sampling on fallow land in a systematic and zigzag pattern

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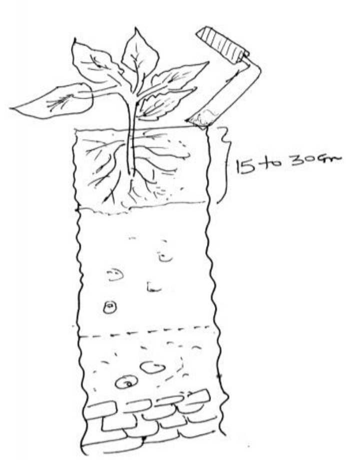

Soil Sampling strategy

Materials required for sampling

Double bag sampling

Information on label

The label should have the following information regarding the name of the farmer/owner, location/site number, and date of sampling, crop present at the time of sampling. Hence, if all the polyhouse growers go for soil testing before the erection of net house or polyhouse and make it mandatory then the highly nematode sensitive crops like cucumber, tomato etc. can saved from felling into the clutches of nematodes.

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Soil Conservation: Today's Need for Sustainable Development

Article id: 11163

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ABSTRACT

Soil are not only integral component of natural and converted ecosystems (cropland, pasturelands, woodlands) but also most precious asset of nature for all life on earth. Only a productive soil base can ensure prosperous agriculture which in turn forms the basis of economic advancement and a higher standard of living in a society. Erosion is one of the biggest concerns of earth's land surface. It has many impacts on agricultural production. The causes of soil degradation are not only faulty agricultural activities but also other human-induced activities such as land clearing and careless management of forests, deforestation, over-grazing, improper management of industrial effluents and wastes, surface mining, and industrial development. Soil erosion has become a serious problem in both rainfed and irrigated areas of India, thus it becomes imperative to raise awareness about soil erosion and their reclamation / restorative and conservation /management methods so that future land management decisions can lead to more sustainable and resilient agricultural systems. Soil conservation includes all such measures that help in protecting the soil from erosion and exhaustion. There are numerous methods such as agronomical methods, mechanical methods, reclamations of gullies, afforestation, *etc*. that can be adopted for conservation of this vital resource.

INTRODUCTION:

Soil is the basis of our life, not only because we are standing on it, but also provides a food and habitation for a wide range of organisms. Soils not only reflect natural processes but also record human activities both in the past and present thus it is part of our cultural heritage. Soil may look immobile and lifeless, but this impression couldn't be hidden further from the truth. It is constantly changing and developing through time. Soil is always responding to changes in environmental factors, along with the influences of man and land use. Soil, as formally may be defined as the unconsolidated mineral or organic material on the immediate surface of the earth that serves as a natural medium for the growth of plants and other organisms. It forms the surface of land – thus we can say it is the "skin of the earth." The success of ancient

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civilization was mainly dependent on the availability of fertile soil and water. Initially, human beings used to respect and worship the nature, but however with the passage of time, they started developing socio-economically and became powerful. They even started exploiting the natural resources and environment for their own needs. The changes in the attitude had led to environment degradation to a greater extent. As our father of nation Mahatma Gandhi had said that “there is enough on earth for everybody’s need but not enough for everybody’s greed”. The human greed has deteriorated the soil health due to improper land resource management, the inappropriate agricultural practices, imbalanced used of chemical fertilizers and deforestation.

India has total 329 million hectares of land out 130 million hectares of land, *i.e.,* 45% of total geographical surface area, is affected by serious soil erosion through gorge and gully, shifting cultivation, cultivated wastelands, sandy areas, deserts and water logging (Kothyari, 1996). The soil is eroded in India, at an average annual rate of 16.35 tons per hectare which means 5334 million tons per year for the country as a whole. Out of this, about 29 per cent is permanently lost to the sea, while 61% is simply transferred from one place to another and the remaining 10% is deposited in reservoirs (which mean the storage capacity is reduced by 1-2 per cent annually (Narayana and Ram Babu, 1983). Land degradation has a negative impact on agricultural economy and the natural environment. The major causes of land degradation are the rapid increasing population, soil erosion, deforestation, improper land resource management, low vegetative cover, imbalanced used of chemical fertilizers, the inappropriate agricultural practices and conversion of marginal land into cultivation or grazing land have led to severe land degradation. The increased soil erosion and runoff of water and soil in the country have resulted in declining agricultural productivity, water scarcity and food insecurity. As it is estimated that by 2025 the India’s population will be up to 1.4 billion and according to this population's requirement, we have to produce 300 million tones of grains from same land. As soils are in danger due to expanding cities, deforestation, unsustainable land use and management practices, increasing pollution and climate change the fulfillment of this goal is big challenge in front of us.

The current rate of soil degradation threatens the capacity to meet our goals, to achieve our food and nutrition security, to battle climate change and to ensure overall sustainable development. To take this issue seriously, the food and agriculture organization (FAO) had declared the year 2015 as the “International Soil Year” and 5th December as World Soil Day with

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an aim to raise the awareness about the importance of healthy soils and their sustainable management for protection of this precious natural resource. The Government of India has also launched Soil Health Card Scheme in Feb 2015. In which soil cards are issue to farmers which carries crop-wise recommendations of nutrients and fertilizers required for their individual farms. This will help the farmers to improve their crop productivity through judicious use of inputs and also help in soil fertility management.

The problem of land degradation cannot be solved immediately so continuous long term effort is needed for sustainable management and protection of the soil. This can be achieved by adopting the soil conservation methods. Soil conservation mainly deals with solving the problems of land degradation, particularly accelerated soil erosion. Accelerated soil erosion is a result of the operation of the physical forces of wind and water on soil, which has become vulnerable, usually because of human interference with the natural environment. The soils are not easy to fix once they degrade, as it can take up to one thousand years to form one centimeter of top soil. So soil must be conserved and managed sustainably as the pressure on soil is bound to increase in near future. There are many ways to conserve the soil such as agronomical measures, mechanical measures, reclamation of gullies and other soil conservation methods. Some general techniques/ methods adopted for soil conservation are as follows.

1. Mechanical Measures:

i. Bunding- Bunds are small earthen barriers built on agricultural lands with slopes ranging from 1%–6% slope. They are used in agriculture to collect surface *run-off*, increase water infiltration and prevent soil erosion. Graded bunds-constructed in medium to high rainfall areas of ~600 mm year^{-1}. Contour bunds- either mechanical or vegetative barrier created across the slope. A study conducted at Doon valleys in the northwestern hills region indicted that contour bunds decreased runoff 25%–30% compared to field bunds (CSWCR&TI Vision, 2011).

ii. Terracing: It is a method of erosion control in which broad channels are constructed across the slope of the rolling land. A horizontal strip of length, either raised or more or less level, usually constructed on or nearly on a contour is called the terrace. It helps to decrease the length of the slope, thereby reducing soil erosion and runoff. Terraces are more effective than contour plowing alone in minimizing soil erosion and facilitating infiltration of rainfall into the soil. Italters the shape of the slope to produce flat areas that provide a catchment for water. Terraces are mainly two types such as broad base terraces and bench terraces.A broad base terrace is a broad surface channel or embankment constructed across the slope of the rolling land having upto 10% slopes only. Bench terrace and half moon terrace- adopted where soil depth is >1.0 m. Half-moon terraces are level circular beds having 1 to 1.5 m diameter cut into half-moon shape on the hill slopes. Beds are used for planting and maintaining saplings of fruit and fodder trees in horticulture/agro-forestry land uses

iii. **Contour Plouhging:** Tilling the field at right angles to the natural slope after drawing up the elevation contour lines is called contour ploughing in soil. This prevents excessive soil loss as gullies are less likely to develop and also reduce run-off so that plants receive more water compared to the land plowed along the slope. Contour ploughing follows the “natural shape” of the slope without any change in shape.

iv. **Grassed Waterways:** They are channels laid out preferably on natural drainage lines in the watershed. They force storm runoff water to flow down the center of an established grass strip and can carry very large quantities of storm water across a field without erosion.

v. **Water harvesting ponds-**dug-out embankment type of water harvesting structure used for creating seasonal and perennial ponds at the foot of a micro watershed for irrigation and fish farming purposes.

vi. **Check dam:** A check dam is a small, sometimes temporary dam constructed across a swale, drainage ditch or waterway to counteract erosion by reducing water flow velocity. A check dam is designed to control the run off velocity of water so that the area below is prevented from eroding. Check dams help not only in reducing the velocity but also the overall amount of water lost as runoff. It thus contributes to not only soil conservation but also to water conservation.

vii. **Retaining walls:** Retaining walls are structures designed to restrain soil to unnatural slopes. They are used to bound soils between two different elevations often in areas of terrain possessing undesirable slopes or in areas where landscape needs to be shaped severely.

2. **Agronomical measures:** We can preserve this valuable soil by bringing some changes in agricultural practices such as.

i) **Crop Rotation:** Continuously taking a single crop year after year on same piece of the land will make it barren, less fertile and more susceptible to the forces of erosion. In order to avoid this crop rotation should be practice. Crop rotation involves growing different crops in sequence or at different times in same field. Through proper crops rotation, different goals

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can be achieved such as: increase soil organic matter, improvement in soil structure, increase or decrease the content of some soil nutrients, and breakdown of disease and pest cycles. In crop rotation cereal crops such as wheat, rice, barley, maize etc., can be rotated with pulses crops such as peas, beans, pigeon pea, gram, cowpea etc. and after that vegetable or oilseed crops can be grown as alternatives. Rotating crops with deep roots followed by shallow roots crop helps to improve soil stability and reduce soil erosion. Thus Crop rotation is an integral part of a sound soil conservation and crop management program.

ii) **Green manure/cover crops:** Green manure/cover crops (GMCCs) are plants that are grown in order to provide soil cover and to improve the physical, chemical, and biological characteristics of soil. GMCCs may be sown independently or in association with crops. The practice of growing plants on the site and incorporating it into to soil by turning (tilling, plowing, spading) it into the soil while it is fresh is called as green manuring and the plant material used is called a green manure. GMCCs promote soil protection, by reducing soil erosion, either by preventing the direct impact of raindrops on soil and/or by reducing the velocity of surface runoff. It lowers temperature, therefore reduces evaporation of water from the soil and increases water infiltration. These conditions favor greater microbial activity in soil's and improves nodulation of legumes. It also increases the availability of nutrients in soil and helps in weed control. The examples of green manure crops are Sunhemp, Dhaincha, Cluster bean, Urid, Mung, Cowpea, Berseem, Senji, Gliricidia, wild Dhaincha, *etc.*

iii) **Reduced Tillage:** Reduced tillage is any farming practice which involves fewer cultivations operation than used in conventional methods. Reduced tillage consists of minimum tillage, zero tillage and reduced cultivation operations. Tillage is an important factor that decreases soil quality. Reduce tillage practices could increases soil organic matter and moisture content of the soil, improves the soil food web and reduces the soil erosion. It also reduce the effect of raindrop impact on the soil surface, surface sealing of soils, runoff from the soil surface, wind and soil erosion, increase infiltration of water into the soil and provide a better soil environment for crop growth .Reduced tillage often leads to retention of crop residues and reduction in the emission of carbon dioxide to the atmosphere.

iv) **Strip cropping:** It is a technique in which alternate strips of different crops are planted in the same field. There are three main types: contour strip cropping, field strip cropping, and buffer strip cropping. If the strips are planted along the contour, water damage can be minimized; in dry regions, if the strips are planted crosswise to the contour, wind damage is also minimized.

v) **Alley Cropping System:** Alley Cropping is agricultural practice where agricultural or horticultural crops are grown in the alleyways between widely spaced rows of trees or shrubs. Alley Cropping reduce surface water runoff and erosion, improve utilization of nutrients, reduce wind erosion, modify the microclimate for improved crop production, improve wildlife habitat and enhance the aesthetics of the area. It also contributes to the reconstruction of soil fertility and increased soil productivity.

vi) **Crop Residue:** Crop residues are materials left in an agricultural field after the harvest of crops. These residues include stalks and stubble (stems), leaves, roots and seed pods. The amount of soil lost to erosion each year is directly proportional to the amount of crop residue remaining on the surface as it helps to reduce the raindrop impact and the velocity of runoff water. Crop residues incorporation in soil enhances nutrient cycling, soil and water conservation, and subsequent crop yield. The crop residue management play important role in soil and environment conservation, and its continuous removal would increase the present level of soil erosion.

vii) **Agroforestry:**Agroforestry systems are an appropriate management tool for eroded soils, because perennial woody vegetation recycles nutrients, maintains soil organic matter (Das *et al.,* 2017; Sarkar *et al.,* 2017a & b; Das *et al.,* 2019), and protects soil from surface erosion and runoff. Tree vegetation in an agroforestry system serves two major purposes: (i) the fine root system holds soil in place, reducing susceptibility to erosion; and (ii) plant stems decrease the flow velocity of runoff, enhancing sedimentation.

viii) **Organic Amendments:** Organic amendments consist of farm yard manures, various types composts, green manures, vermicompost, biofertilizers, concentrated manures, Distillery wastes, *etc.* The application of organic manures in soil not only adds organic matter and nutrients but also improves its overall soil health and making them fit for long term agricultural production. Theses manures maintain the nutrient balance in the soil and increased its microbial activity (Gore *et al.,* 2011a & b), reduce soil erosion, thereby increasing the soil fertility and the yield of the crop.

ix) **Bio fertilizer:** Biofertilizer are organic in nature containing an effective particular microorganism in a concentrated form which originated either from the plant root nodule or from the soil of the rhizosphere. They have potential to solubilize and mobilize plant nutrient elements from insoluble form through biological process and also fix atmospheric

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nitrogen. The examples of biofertilizers are rhizobium, azotobacter, azolla, blue green algae (BGA), phosphate solubilizing microbes (PSM), *etc.* Biofertilizers have emerged as potential environment-friendly inputs that are benefited for agricultural crop production system. They hold vast prospective in fulfilling the plant nutrient requirements, which are reducing the chemical fertilizer application, minimizing environmental pollution and helps in maintaining soil quality.

x) **Prevention of faulty practices:** The cultivation practices such as shifting cultivation, over usage of chemical fertilizers, pesticides and herbicides, over grazing, burning of crop residues and excessive tillage operations should be checked and controlled.

3. **Reclamation of Gullies**: Reclamation of small gullies can be done through leveling and safe disposal of water, by Protection from biotic interference, peripheral bunding, safe disposal of runoff, terracing and gully plugs with plantation of locally adapted tree, shrub and grass species, wire meshes, sand bags, boulders, live hedges (vetiver), *etc.* Medium gully can be reclaimed by clearing and leveling the bed, sodding, constructing a series of composite earth and brick masonry, check dams at 1.2 m vertical interval, and terracing the side slopes. For deep ravines the best land use is to put them under permanent vegetation, comprising locally adapted grass, shrub and tree species.

4. **Other Soil Conservation Methods:**

- **Afforestation:** Afforestation means planting trees. The tree roots helps to hold the soil layers firmly and prevent soil erosion. We should plant more and more tress in order to prevent the top layer of soil from erosion. Thus increasing the area under forests is the most effective technique to checking soil erosion and conserving it. Efforts should be made to stop the indiscriminate felling and plant more and more trees in barren areas; this will ultimately increase area of forest cover of our country to more than 33% of its total area.

- **Shelter Belt and Windbreaks:** Shelter Beltconsisting of several rows of trees established at right angle in order to deflect air currents, to reduce the velocity of winds, to protect the leeward areas from desiccating effects of hot winds and wind erosion, and to provide fuel, fodder timber etc. Windbreaks are linear plantings of air-resistant trees and shrubs, which protects fields, homes, canals or other surrounding areas from the strong winds and

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blowing soil or sand. Wind-breaks should be-raised at right angles to the direction of wind. N - S direction is good compromise.

- **Checking of overgrazing:** overgrazing results in decreased infiltration rate and accelerated runoff and soil erosion. Due to overgrazing, soil loss is 5 to 41 times greater than normal at the mesoscale and 3 to 18 times greater at the macroscale (Sharma, 1997). Over grazing cannot be completely stopped, but a system of restricted and rotational grazing may be helpful in checking soil erosion to some extent.

- **Other methods:** Such as Flood control, Proper land utilization, Maintenance of soil fertility, Land reforms, reclamation of wasteland, Establishment of soil research institute and training of soil scientists and effective agencies for soil management, etc can be adopted.

By adopting all these practices in integrated method, we can maintain the biodiversity, fertility and productivity of the soil. To increase the agricultural production and to maintain the nature balance, it is necessary for the soil to be healthy in the present and future conditions. Soil conservation techniques are very simple, it is necessary to implement them so that the adverse effects on the environment can be reduced. Before it's too late, let's all come together and play our role for keeping the soil healthy and protected for the future generations.

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Soil Solarization – An eco-friendly option for nematode management

Article id: 11164

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Nematodes are microscopic round worms, whichare very abundant and diverse in the soil ecosystems. Plant parasitic nematodes are considered pests when they feed on our cultivable crops. There are also many types of nematodes i.e. beneficial and predators of other nematodes feed on fungi, bacteria, or are omnivores in the rhizosphere. Apart from nematodes under protected cultivation insects, fungi, weeds, etc. also infect plants, which are also soil borne like root knot nematode. Hence anaerobic soil management practices as flooding, soil solarization, *etc*. should employed.

Nematodes especially root knot nematodes are controlled better using organophosphorus nematicides. But application in large quantity will lead to residual problems. So, this should be replaced with less destructive and non-chemical alternative methods like soil solarization. This should be involved in package of practices *i. e.* Integrated pest management. Most of the farmers skip this simple technique. Solarizationis farmer friendly approach and this method is cheap, possessability, excellent chemical resistant, flexible, and free from odor and toxicity.

What is soil solarization?

Soil solarization is the use of plastic traps placed on the surface of the soil to a level that kills the soil borne pathogens,weeds and other soil dwelling pests. This technique is applicable in areas with high summer temperatures, *i.e.* effective only where summers are predictably sunny and warm. Solarization is well documented as an appropriate technology for the control of soil borne pathogens and nematodes but the economics in purchasing and applying plastic restricts its use in high value crops. This method was first used in Israel in 1970 to control root knot nematode, which is now wide spread all over world.

Polythene reduces the heat convection and water evaporation from the soil to the atmosphere. This forms the water droplets on the inner surface of the polythene film as a result

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its transmittivity to the long wave is highly reduced, resulting in better heating which will increase the thermal sensitivity of resting structures.

How to solarize the soil?

This is done on smooth beds which are free from debris or clods. The large clods should be broken up to enhance the heat conduction in soil. The soil surface should be slightly moistened and covered with the transparent thin polythene sheet of 25-30 µm of thickness for 2-4 weeks period to heat the non-cropped soils and make the temperature lethal to nematodes. The edges should be placed by bricks or heavy objects so that plastic cover is held tightly in place from blowing away.

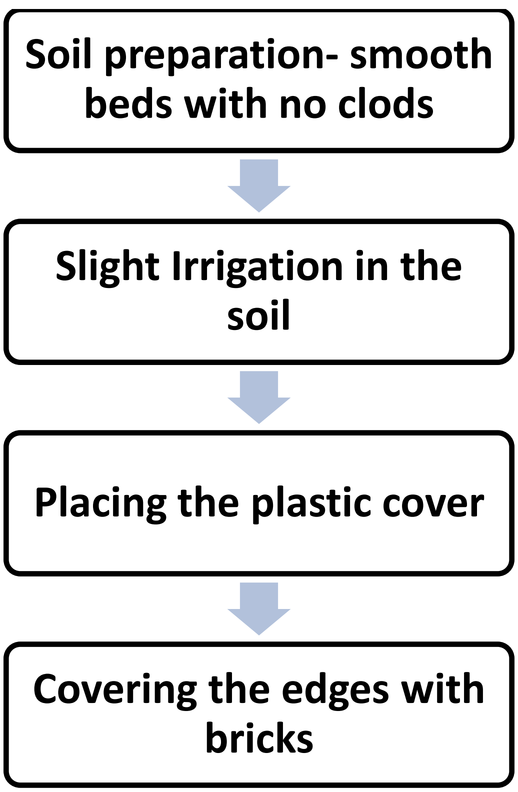

Fig: Flow chart of steps involved in soil solarization

Control by solar heating is high in upper 30 cm of the soil and is very effective for shallow rooted and short season plants. As a result this technique is not effective for those nematodes which are residing in deeper soils *i.e*. below 12 inches soil because nematodes are mobile and can recolonize soils quickly. Hence this application therefore requires yearly application.

Soil solarization effectiveness depends upon total sunshine hours, soil type, soil moisture, soil texture, colour of soil, nematode species, thickness and transparency of polythene sheet *etc*. The thin polythene sheets are more effective than thick sheets due to better radiation transmittance. Black polythene sheets gets heating by itself and is therefore less efficient in heating the soil than the transparent ones. The maximum temperatures attained in upper layer of soils.

Soil solarization is quite compatible with other methods of control like application of pesticides or a biopesticides and these combinations havereported to prolong the efficacy of solarization.

Fig: Soil solarization and mulching

Summer solarization is very effective in managing nematodes in polyhouses. During peak summers of every year the crop debris should be removed, thoroughly ploughed, surface should leveled, slightly watered and covered with the transparent polythene sheet. For 2-3 weeks, the polyhouses should not opened and in the meantime, the nursery preparation or biocontrol agent's multiplication should carried out. This technique is so effective that f it done so effectively then, there will be no need to the farmers to go for chemical applications.

Advantages

Low application of fungicides, herbicides, etc. can combined with soil solarization to achieve better pest control. The elevated temperatures seem to be increase the activity of the above active compounds. It can also combined with the application of crop residues, green and animal manures and inorganic fertilizers. These materials will release the volatile compounds in the soil that kill the pests by stimulating the growth of beneficial soil organisms. e.g. root knot nematode can almost be completely controlled by combining the above two techniques resulting in larger yields.

Disadvantage

The main drawback that lies with this method is that it is possible only in tropical and subtropical regions of the world and is economical in disinfecting small areas like nursery beds for producing nematode free seedlings, polyhouses and microplots. For example, the transparent plastic film of 25 µm thickness laid on the slightly irrigated soil two weeks during the month of May is recommended to control root knot nematodes and weeds in the nurseries growing tomato to increase the transplantable seedlings.

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Volume 1 – Issue 5 – May 2019

Characteristics of submerged soil

Article id: 11165

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Submerged soils are soils that are saturated with water for a sufficiently long time in a year to give the soil the following distinctive grey horizons resulting from oxidation-reduction processes:

- A partially oxidized 'A' horizon high in organic matter
- A mottled zone in which oxidation and reduction alternate and
- A permanently reduced zone which is bluish green in colour.
- The soil is intermittently saturated with water, oxidation of organic matter is slow and it accumulated in the 'A' horizon.
- In the second horizon, Fe and Mn are deposited as rusty mottles or streaks if the diffusion of O_2 into the soil, if the diffusion is rapid, they are deposited as concretions.

Waterlogged soils:

Waterlogging refers to the saturation of soil with water. Soil may be regarded as waterlogged when the water table of the groundwater is too high to conveniently permit an anticipated activity, like agriculture. In agriculture, various crops need air (specifically, oxygen) to a greater or lesser depth in the soil.

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Paddy soils:

A paddy field is a flooded parcel of arable land used for growing semiaquatic rice. Paddy cultivation should not be confused with cultivation of deep water rice, which is grown in flooded conditions with water more than 50 cm (20 in) deep for at least a month.

Coverage

- Submerged soils cover 5% to 7% of earth land surface.
- The total global waterlogged soil is approx. 700 to 1000 Mha.
- North America and Russia (34%of total area),
- Tropical swamps,(14%)
- Tropical flood plains(10%);
- Temperate and tropical rice fields (4% & 12%).

Present scenario of India:

States	Waterlogged soil(ha)	States	Waterlogged soil (ha)
Andhra Pradesh	10654	Maharastra	0
Arunachal Pradesh	0	Manipur	8517
Assam	46021	Meghalaya	1606
Bihar	188070	Mizorum	0
Chhattisgruh	521	Nagaland	0
Goa	0	Orrisa	242838
Gujrat	0	Panjab	0
Haryana & Delhi	0	Sikkim	0
Himachal pardesh	0	Rajasthan	4108
Jammu&kasmir	0	Tamilnadu	0
Jharkhand	3321	Tripura	14721
Karnataka	0	Utterpradesh	131428
Kerala	0	Uttranchal	0
Madhya Pradesh	333	West bengal	240480

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India waterlogged soils:

The major waterlogged soils are present in West Bengal, Orrisa, Bihar and Uttar Pradesh.

Kinds of submerged soils

- Continuous submergence soils
- Alternate submergence soils which are important for rice cultivation

Continuous submergence at a static 2.5-7.5 cm provides the potential to produce optimum rice yield.

Generally continuous submergence at 15 cm depth or more less has the potential to produce yield similar to those at 2.5 cm water depth.

However, in some dry seasons a 15 cm depth or more may reduce grain yield.

Characteristics

- Greater amount of soil solution
- Reduced oxygen level
- Reduced aerobic microbial activity,
- An altered chemical status of soil

Submerged profile

Waterlogged soils are soils that are saturated with water for a sufficiently long time annually to give the soil the distinctive grey horizons resulting from oxidation-reduction processes: (Robinson, 1949).

(a) a partially oxidized A horizon high in organic matter,

(b) a mottled zone in which oxidation and reduction alternate, and

(c) a permanently reduced zone which is bluish green .

(d) Plough sol sub soil

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Properties of Submerged soil:

1) Physical

I. **Oxygen depletion:**

Due to lack of aeration , Water fills the pore spaces and replaces the air, Oxygen diffusion in the water layer above the soil is very slow, Rate of oxygen consumption in reduced soil is high Surface soil profile differentiates into two distinct layers are An oxidized or aerobic layer near soil surface Reduced or anaerobic layer below soil surface

II. **CO2 accumulation:**

Accumulation of carbon dioxide and methane and may escape as bubbles if pressure builds up.

III. Compaction

IV. Increasing BD

V. Massive structure

VI. Lowering diffusion coefficient of gases

2) Electro-chemical

I. Soil-pH

Soil pH is a measurement of hydrogen ions in the soil and it indicates whether soil is acidic or basic. Submergence of soil typically causes a shift towards a more neutral soil pH. This is a result of the change in chemical compounds when soil is reduced

II. Increase specific conductance

Specific conductance is related to the ionic content, Differ with respect to the type of soil, Alkaline soils : increase in specific conductance by Ca2+ and Mg2+Organic matter enhances the solubility of $Ca^{2+,}$ Mg^{2+}, and Fe^{3+} and increase specific conductance.

III. **Decrease redox potential (Eh**)

The single electro-chemical property that serves to distinguish a submerged soil from a well-drained soil is its redox potential. The course, rate and magnitude of the Eh decrease depend on the kind and amount of organic matter, the nature and content of electron acceptors, temperature and the duration of submergence.

3) Chemical

I. Soil reduction
II. Micronutrient toxicity (cationic)

4) Biological

i. Reduced aerobic microbial activity
ii. Mineralization
iii. Immobilization

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Need to conserve natural resource in Rice- wheat System of Indo-Gangetic Plain

Article id: 11166

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During the past 30 years, agricultural production growth in Indo-Gangetic region has been able to keep pace with population demand for food in the country mainly due to adoption of green revolution technologies, followed by area expansion. But, this opportunity is ceasing very fast due to limited scope for increasing the availability of arable land and natural resources. The other issue is the conservation of the basic resources of land and water for sustainability of agriculture in this region. It is generally believed that the rice wheat system has strained the natural resources in this region and more inputs are required to attain the same yield levels (Swarup and Singh, 1989; Kumar and Yadav, 1993; Lal *et al*., 2004). Rice-wheat cropping systems alone occupy 13.5 million hectares in the Indo-Gangetic Plains (IGP) of South Asia (Gupta and Seth, 2007). The Indo-Gangetic Plain is one of the world's major food grain producing regions. Water is one of the most precious natural resources for agricultural production and agriculture accounts for 70 percent of water use (FAO, 2002). It is predicted that by 2025 water consumption will exceed "blue water" availability if current trends continue.

Excessive pumping of water for puddling causing problems of declining water table and poor quality water for irrigation on one hand. Groundwater table is falling at a rate of 0.7 meter per year in Punjab due to intensive irrigated agriculture (Aulakh, 2005). However, the decline of freshwater resources is due not only to increased consumption, but to careless management. Agriculture contributes to the problem by wasting water and by sealing and compacting the soils so that excess water cannot infiltrate and recharge the aquifer, one of the causes of the growing number of flood catastrophes (DBU, 2002). In regions where water is already the limiting factor for agricultural production, this wasteful practice threatens the sustainability of agriculture. Rising temperatures and evapo-transpiration rates combined with more erratic rainfall further aggravate the water problems in rain fed agriculture (Met Office, 2005).

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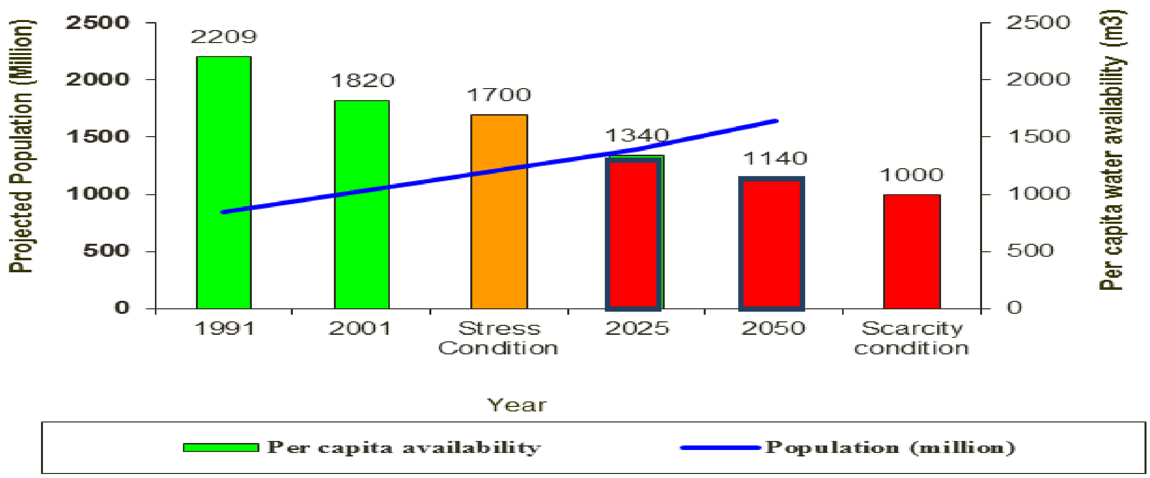

Per capita water availability and population pressure in India

Soil affects not only production, but also the management of other natural resources, such as water whereas, in eastern IGP rice transplanting depends mainly on monsoonal rains. Traditionally rice is grown by hand transplanting of 25-30 day old seedling after puddling (PTR). Puddling require lot of tillage and water (>300 mm). Puddling destroys soil structure, which affects growth and development of succeeding upland crops in the rotation, thereby reducing system productivity. Excessive pumping of water for puddling in peak summers in north west IGP causing problems of declining water table and poor quality water for irrigation on one hand of pounded water for customary practice of puddling delays rice transplanting by one to three weeks on the other. Delayed transplanting of rice affects growth and yields not only of rice but also succeeding crops, thereby reducing system productivity and profitability.

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Table1: Sector wise projected water demand in India (Billion cubic meters BCM)

Sector/Year	2000	2010	2025	2050
Irrigation (Agriculture)	**541 (85%)**	**688 (84 %)**	**910 (83 %)**	**1072 (74 %)**
Domestic	42	56	73	102
Industry	8	12	23	63
Energy	**2**	5	15	**130**
Others	41	52	72	80
Total	634	813	1093	1447

The traditional system of hand-transplanting rice is based on the premise of cheap and readily available labour. However, in present scenario, rapid labour migration from agriculture to non-agriculture sectors like construction, industries etc. are seen in India. Country is currently experiencing an impressive phase of economic development causing drastically reduced availability of farm labour, especially for drudgery like transplanting and weeding in rice. More over ever increasing energy prices for pumping water and running tractors for puddling and other operations, limited water and labour availability for transplanting, stressed the farmers as well as researchers to develop alternative production systems for rice.

Farmers need technologies that can conserve natural resources, reduce their costs of cultivation, improve their returns and are favorable to our environment. Resource-conserving technologies (RCT) have been developed in order to reduce the use of and damage to natural resources through agricultural production; and increase the efficiency of resource utilization. Most of these technologies target the two most crucial natural resources: water and soil, but some also affect the efficiency of other production resources and inputs (e.g. labour, farm power and fertilizer).

Residue management in Indo-Gangetic is another threat of crop production as burning or removal of straw from the field have deleterious affect on soil physical, chemical and biological processes hence degradation of land. Therefore there is a need of suitable technology for straw incorporation in the field to enhance soil fertility and productivity.

Indo-Gangetic plain is the major contributor of food grain production in India which is mainly based upon rice –wheat cropping system which contributes maximum share of residue generation over other crops. Cereal crops especially rice and wheat crop share 70% residue generation out of which 58% is subjected to unutilized either due to its removal or burning.

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Table No 2: Residue generation and % share of unutillzed residues in Indo-Gangetic plains of India

Crops	Residue generation (%) by different crops in India	The % share of unutilized residues in total residues generated bydifferent crops in India
Cereal Crops (Rice & Wheat)	70	58
Sugar cane crops	2	2
Pulses	3	2
Fiber Crops	13	23
Oil Seed Crops	6	7
Other Crops	6	8

Table 3: End use of stubble by the farmers in Punjab State

End Use	Rice (percentage of total stubble Production	Wheat (percentage of total stubble production)
Fodder	7	45
Soil Incorporation	1	<1
Burnt	81	48
Rope Making	4	0
Miscellaneous	7	7

In Punjab state of Trans-Gangetic plain, 81% and 48% of rice and wheat residue respectively was being burnt during 2008 and only 1 and less than 1 % respectively is being incorporated in to the soil. So residue burning is a big issue in Indo-Gangetic plains especially in Trans-Gangetic plains.

Table 4: Quantity of nutrients in rice-wheat residue and % loss via burning

Nutrient	Quantity (kg)		Total	% loss via burning
	Rice residue (7t)	Wheat residue (5t)		
N	42	25	67	82
P	7	4	11	44
K	105	50	155	40
S	10	7	17	81
Ca	20	15	35	52
Mg	12	6	18	47
Carbon	2900	2000	4900	80

It is, therefore, imperative now to promote alternative technologies that would help conserve the much needed but gradually depleting natural resources while boosting productivity growth in the long-run by maintaining soil health and environment. As a part of this strategy, resource conserving technologies (RCTs) play a major role in sustaining and enhancing the productivity of the rice-wheat system at a lower cost of production.

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http://www.agrifoodmagazine.co.in

AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317

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Seed production in fodder crops: A promising approach towards doubling farm income for small and marginal farmer's

Article id: 11168

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ABSTRACT

Seed is the most critical and important input to enhance the production potential of all agricultural crops, including fodder crops. Seed is the crucial input of agriculture and most essential component for enhancing the production and productivity of agricultural crops. The non-availability of quality seed and insufficient quantities is one of the major drawbacks in fodder production in our country. As per an estimation only 25-30 % of required quantity of quality seed is available in cultivated fodders and <10% in range grasses and legumes. In India, fodder is produced from 9.38 million ha^{-1} of cultivated and 11.04 million ha^{-1} of permanent pasture land with an average yield of 40.0 and 0.75 tonnes ha^{-1} respectively, which is much lower than the potential yield. Inadequate production and supply of quality fodder seeds of high yielding varieties and hybrids is the main reason for this low fodder yield. In India IGFRI, NDRI, NDDB and other institution are assisting dairy cooperatives to facilitate production and marketing of quality fodder seed.

Keywords: Dormancy, lodging, forage, range grass, and shattering.

INTRODUCTION

The importance of Green fodder and livestock sector is being increasingly realized in recent times due to their multifaceted role in sustainable production, employment generation, drought proofing, natural resource conservation, nutritional security and export potential. As per 19th Livestock Census of 2012, the total livestock population in India was 512.05 million in 2012. Currently, India is deficit by 62.76% in green fodder and 23.46% in dry fodder. The demand of green fodder will rise to 1012 million tonne by the year 2050. To meet out the deficit, green forage supply has to rise at 1.69% annually. The supply and production of green fodder is a challenge faced by farmers and entrepreneurs due to poor availability of quality fodder seeds. To bridge the gap between fodder demand and supply, intensive production system with improved inputs is desirable. The fodder crops are represented by several cereals, legumes and grasses, out of these only few crops are under proper seed chain. During Kharif season about seven crops and during Rabi season four crops are under seed multiplication programs. Out of these crops sorghum, berseem, lucerne, maize and bajra occupy more than 90% of area under fodder cultivation. The efficiency of other inputs is largely dependent on availability and timely sowing of quality seeds of improved genetics. Propagation of improved fodder production technologies specially the improved varieties has not reached to the farmers mainly because of the non-availability of good-quality seeds. The availability of good-quality seeds is estimated to be around 15-25% only for cultivated fodders. With the development of a number of improved and high yielding varieties in forage crops, it has become important that quality seed should be readily available and supplied to the farmers at reasonable price.

The Need for Seed Production

The development of improved and high-yielding varieties in forage crops, it has been realized that truthful labelled (TFL) and certified seed should be supplied to the farmers. Shortage of improved technologies in the field of seed production of forage crops will have to be overcome by launching a participatory seed production programme. Apart from the seed production techniques, seed processing and handling techniques need to be developed for maintaining the quality of forage seeds. Sorghum, maize, cowpea, *guar* (cluster bean), pearl millet, berseem, oat and lucerne are the important cultivated fodder crops and *Cenchrus, Panicum, Pennisetum, Brachiaria, Chrysopogon,* stylo, etc are the important rangeland species covering the large acreage under forage cultivation. The demand of quality seed of these crops is increasing day by day. This can be achieved only through identification of high seed-producing forage crop varieties and through sufficient production of quality seeds with the participatory programme of researchers, farmers, NGOs, seed growers and farmers.

Important Tips for Successful Operation in Participatory Seed Project

Based on the experiences of participatory seed project at the Indian Grassland and Fodder Research Institute, Jhansi, the following points are suggested for successful operation of participatory seed project.

- The participating farmers must be selected after focused participatory rural appraisal (PRA).
- Memoranda of understanding should be developed and agreed by the farmers.

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- The farmers should be selected keeping in view their interest in producing seed.
- The required resources to produce forage seed of a new activity should be made availble.
- The production areas should be in the proximity and easy access.
- Staff must give priority to their responsibilities and activities within the project.

Seed Quality and Quality Control Measures

Fodder seeds of improved varieties should have good germination and vigour, resistance to diseases and have potential to give a high and stable yield. The seeds properly treated, bagged and labelled should have safe levels of moisture content, be relatively free from physically damaged and diseased seeds and also be free from seeds of other fodder varieties, crops and weeds as well as inert material. The quality control measures taken up by state seed certification agencies, production agencies include field inspections and laboratory tests. Field inspections are carried out at different stages of the seed crop to ensure genetic purity and maintain the minimum standards for isolation distance, off-type plants/ear-heads, other inseparable crop plants, objectionable weed plants and plants affected by seed-borne diseases. The processed seeds are tested in any of the approved seed testing laboratories of state governments to maintain the seed standards for physical purity, other crop seeds and other distinguishable varieties, weed seeds, objectionable weed seeds, germination and moisture.

Seed Treatment

- Seed treatment with 100 ppm GA3, hydration for 18 hours + dry dressing of Thiram and osmo-conditioning in PEG solution (-10 bars), increased seed germination, field emergence and seed yield in *Cenchrus ciliaris, Clitoriaternatea*, siratro, and stylo.
- Seeds of *Clitoria*, siratro and stylo soaked in hot water (60^{o} C) for half an hour gave maximum germination.
- Soaking of *Cenchrus ciliaris* seeds in fresh water from 8-10 hours before sowing was found effective for improved germination.
- Pretreatment of seeds with 0.2% potassium nitrate (KNO_3) has improved seed germination in *Cenchrus ciliaris, C. setigerus* and *Panicum maximum.*
- The treated seeds of lablab bean and maize with Bavistin and Malathion @ 1g kg^{-1} seed (1:1) were stored up to 20 months in polythene bags without any loss in germination.

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Foliar Spray

- Foliar application of α-naphthalene acetic acid (NAA) along with K and diammonium phosphate (DAP) at flower initiation stage increased panicle length, seed setting, seed retention and seed yield in *Panicum maximum,Dichanthium annulatum & Cenchrus ciliaris*
- Foliar application of Tresol @ 2.5 litre ha^{-1} significantly increased seed yield to 5.4 q ha^{-1} in berseem.
- Foliar application of KNO3 @ 4 kg ha^{-1} in *Clitoria*, stylo, cowpea and berseem at flowering initiation stage increased the seed yield by 20 –25% over the control.

Seed storage

Bavistin and Malathion, @ 1g kg^{-1} seed (1:1), treated seeds of lablab bean and maize can be stored safely up to 20 months in polythene bags without loss in germination. Among the botanicals, extract of *Croton tiglium* and *Acorous calamas* @ 1.0 ml kg^{-1} seed used as seed treatment gave 100 % protection against storage bruchid and *Trichoderma* infestation

Transfer of technology

Extension of developed technologies have an important role to play in evaluating *ex ante* the benefits and costs of different technologies under various conditions and on different farm types and, identifying appropriate uptake pathways for effective dissemination of technologies. At this juncture, the natural resources accounting and ecological economics will be most pertinent to identify sustainability parameters.

Role of organizations in quality fodder seed production and marketing

1. **National Dairy Development Board**: Supports production agencies by organizing supply of breeder seeds of improved varieties from the Union Ministry of Agriculture/Indian Council of Agricultural Research, arranging for funds to create the necessary infrastructure and in training manpower. It also assists production agencies to market surplus certified/truthfully labelled seeds.
2. **Production agencies**: They are organizations that produce and market quality fodder seeds on a financially self-sustaining basis e.g. state dairy federations, milk unions and NDDB managed farms viz., Animal Breeding Centre, Salon and Sabarmati Ashram Gaushala. They carry out the following activities:

- Collect advance data from milk producers regarding their requirement for fodder seeds for a five-year span.
- Ascertain annual requirement of breeder/foundation seed on the basis of the above data and send indent for breeder seed to NDDB three years in advance.
- Arrange for procurement of breeder and foundation seeds and organize their further multiplication–breeder seed into foundation seed and foundation seed into certified/truthfully labelled seed–through registered seeds growers under a buy-back arrangement.
- Provide technical guidance to seed growers to produce quality seed.
- Own and manage seed storage godown, office-cum-seed testing laboratory and seed processing area containing equipment such as seed-cleaner-cum-grader, specific gravity separator, seed treater, machines for weighing and packing and other miscellaneous facilities.
- Organize field inspection and procurement of raw seed.
- Undertake seed processing, grading, treating, packing, weighing, labeling, certification and storage. Supervise and approve the production of truthfully labelled seed and market certified/truthfully labelled seed to milk producers at a reasonable price.

3. **Seed growers:** They are farmers and organized farms having adequate irrigated land–which are registered with seed production agencies and produce quality seeds under a buy-back arrangement.
4. **State seed certification agencies**: They are autonomous bodies of state governments set up in 21 states to monitor and approve the quality of foundation and certified seeds at the request of production agency. In other states, this responsibility is with state agriculture departments.

Benefits of quality fodder seed production and marketing

a. <u>To Farmers</u>

- Farmers get quality fodder seed in time at a reasonable price.
- Quality fodder seed ensures increase in fodder production leading to improved milk production and reduced feeding cost.
- Better agro-climatic suitability of the locally produced fodder seed ensures good fodder yield. It is advisable for farmers to go for outside purchase of only those seeds which require specific agro-climatic zones for production.

b. <u>To Seed Growers</u>

- Increases their income as they get a premium on production of fodder seed.

c. <u>To Production Agencies</u>

- Reduces the cost of seed by minimizing long-distance transport.
- Ensures self-sufficiency in quality fodder seed supply.
- Enables earning a small profit from this programme.

Constraints in fodder seed production

- **Indeterminate growth:** The range species under natural conditions are acclimatized for indeterminate growth leading to non-synchrony in reproductive and vegetative growth. This is one of the major impediments for commercial or large scale cultivation and mechanization.
- **Uneven maturity:** The maturity varies from plant to plant and from branch to branch within a plant. Even within inflorescence/panicle starting from anthesis to see ripening is observed. This highly non uniform maturity makes it impossible to realize the full potential of seed production and difficulty in harvesting.
- **Seed shattering:** In range species the easy shredding of this immediately after maturation leads to loss of seed during harvesting.
- **Seed dormancy:** Most of the range species have varying degrees of either physical or physiological dormancy. In nature it is highly useful trait but for commercial cultivation it is a negative trait.
- **Climatic factors:** Seed production in range species is highly influenced by the photoperiod, thermoperiod, humidity etc. The quality and quantity will be affected under varying climatic conditions.
- **Low density of bearing tillers:** Profuse tillering is observed in many range species. But all the tillers won't flower and only30-50% tillers possess inflorescence at the time of peak flowering.
- **Lodging:** Due to prolonged and vigorous vegetative growth lodging of seed crop is a common problem.
- **Poor Harvest index:** The harvest index is low mainly *because* of higher biomass production. Only2-3% harvest index is observed in many tropical grasses.
- **Lack of seed production technology:** The cultivated as well as range species lacks specific seed production technology. In case of cultivated fodder since the varietal development is

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focused on fodder production, seed production technology is not well studied. In range species lack of large scale production and because of above said problems no specific seed production technology is available.

Strategies for increasing fodder seed production

- Creating awareness to use quality seed of improved varieties.
- Increasing the seed replacement rate from the present 2-3% to at least 20%.
- Seed chain should be followed to produce sufficient quantity of certified seed for farmers
- Improvement of seed chain network
- Seed production through farmer participatory approach
- Improvement of proper marketing facilities
- Research to increase the ovule to seed ratio in forages
- Scientific studies on management practices to increase the seed yield.
- In depth studies on grass seed germination and dormancy problems.
- Research on development of cultivable pasture varieties.
- Channelizing the existing demand towards entrepreneurship development
- Village Seed Banks are to be developed.

Table.1 Fodder Seed Production Agencies in the Cooperative Sector

State	Production Agency	Fodder Seeds
Andhra Pradesh	Guntur Dist. Milk Producers' Mutually Aided Co-op. Union Limited, Vadlamudi, Guntur	Sorghum Sudan hybrid (multi-cut), Cowpea
Bihar	Mithila Dugdh Utpadak Sahkari Sangh Ltd., Harpur Alowth, Samastipur	Oats, Maize
Gujarat	Baroda District Co-operative Milk Producers' Union Ltd., Vadodara, Sabarmati Ashram Gaushala, Bidaj Farm, Bidaj	Sorghum, Cowpea, Maize, Oats, Lucerne
Karnataka	The Bangalore Urban & Rural Dist. Co-op. Milk Producers' Societies Union Ltd., Bangalore. The Kolar District Co-operative Milk Producer's Societies Union Ltd., Kolar	Maize
Madhya	Bhopal Sahakari Dugdh Sangh Maryadit, Bhopal	Berseem, Oats

Pradesh		
Maharashtra	Solapur Zilla Sahakari Dugdh Utpadak Va Prakriya Sangh Maryadit, Solapur	Maize, Sorghum
Punjab	The Punjab State Co-operative Milk Producers Federation Ltd., Fodder Seed Processing Plant, Bassi Pathanan	Maize, Cowpea, Guar, Berseem, Oats, Chinese cabbage
Rajasthan	Rajasthan Co-operative Dairy Federation Ltd., Unit Seed Processing Plant, Bikaner.	Guar, Cowpea, Oats, Sorghum, Berseem, Lucerne
Uttar Pradesh	Seed Production, Processing and Marketing Unit, Pradeshik Cooperative Dairy Federation Ltd., Aligarh and Animal Breeding Centre, Salon, Raebareli.	Cowpea, Sorghum, Oats, Berseem and Maize

SUMMARY

Most of our farmers are involved in animal husbandry activities; their livelihood mainly depends on agriculture-based activities and fulfilling the demand, training to farmers in fodder production seed for growing year round green fodder production is important. Fodder based enterprises could be a sustainable option for income generation. Although much of work in livestock farming is practiced by farmer but scientific knowledge of seed production is necessary to boost the production, they have very limited awareness about new technologies which can enhance their knowledge, skills, practices and productivity. Improved varieties and fodder production technologies of the leguminous forages are available now, which may be adopted for enhancing fodder production in the region. A greater attention may be paid to produce more leguminous forages from cultivated crops. Enhance fodder seed production. Healthy fodder will lead to healthy livestock and better quality livestock products.

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ISSN: 2581-8317
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Potential of Short Rotation Forestry (SRF) in production of second generation biofuels

Article id: 11170

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INTRODUCTION:

Human activities like deforestation and fossil fuel burning has led to the continuous rise in the global atmospheric temperature posing a threats to natural resources, which in turn contribute to the deterioration of human health. Therefore, finding a possible alternate ways for reducing the global warming as a concern for sustainment of life has become a worldwide interest. The replacement of fossil fuels through the production of biofuels has been considered as an alternate green solution, and by efficient biofuelproduction it can mitigate global warming (Ramakrishnan, 2015).

One essential component of environmental sustainability is the establishment of biomass-derived energy sources such as lignocellulosic portion of plants to supplement and eventually displace energy generated from petroleum, and thus offer environmentally sustainability (Mansfield, 2015).

Biofuels are renewable fuels and we can make use of fast rotation plants, producing fewer emissions than fossil fuels and generates no net carbon dioxide, and is compatible with current fuel distribution infrastructure.

Forest trees are potential alternative as sources of energy, and are integral to attaining a sustainable renewable energy economy (Mansfield, 2015).

Short Rotation Forestry (SRF)

The silvicultural practice under which high-density, sustainable plantations of fast-growing tree species produce woody biomass on agricultural land or on fertile but degraded forestland is known as Short Rotation Forestry. Trees are grown either as single stems or as coppice systems that reach their economically optimum size between eight and 20 years old with an annual woody production of at least 10 tonnes of dry matter or 25 m^3 per hectare. They are usually felled when they are around 15 cm wide to produce woody biomass that can be used to generate energy (McKay, 2011).

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Common Name	**Botanical Name & (Family)**	**Rotation Years**	**Photos**
Black wattle	*Acacia mangium* (Leguminosae)	8	 
Northern Black wattle	*Acacia auricuiformis* (Leguminosae)	8-12	 
Mulberry	*Morus spp* (Moraceae).	9-14	

Indian lilac	*Melia azedarach* (Meliaceae)	5-10	
Indian willow	*Salix spp.* (Salicaceae)	10-12	
Gamhar, White teak	*Gmelina arborea* (Verbenaceae)	8-21	

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Poplar	*Populus spp.* (Salicaceae)	10-12	
Subabul	*Leucaena leucocephala* (Mimosoideae)	3-5	
Babur	*Acacia nilotica* (Fabaceae)	9-14	

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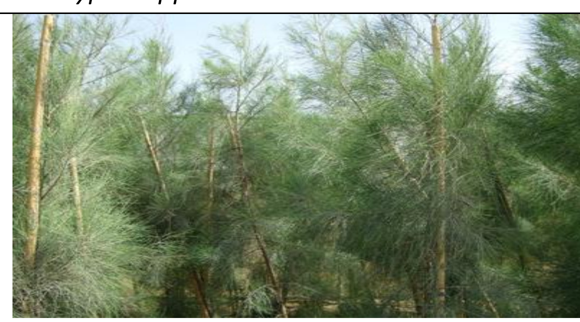
Black locust (False acacia)	*Robinia psedoacacia* (Papilioniodeae)	20-25	
Safeda Blue gum	*Eucalyptus terericotnis* *E. globulus* (Myrtaceae)	7-12 8-15	 *Eucalyptus spp.*
Beef wood	*Casaurina equisetifolia* (Casaurinaceae)	7-5	

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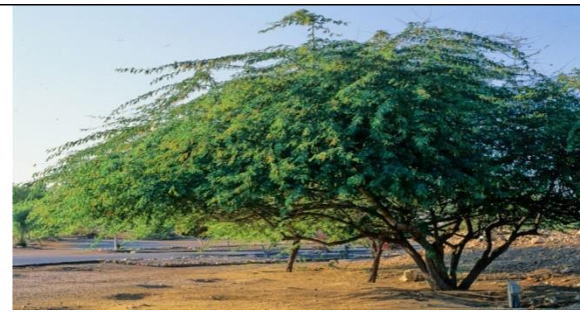
Algaroba	*Prosopis juliflora* (Fabaceae)	9-14	

Table: Potential Trees Species that can come under Short Rotation Forestry in India

WHAT IS SECOND GENERATION BIOFUELS?

- Second generation biofuels are those produced from cellulose, hemicellulose or lignin.
- It is truly carbon neutral or even carbon negative in terms of its impact on CO_2 concentrations.
- Made from lignocellulosic materials
- Biomass that is generally not edible.
- Larger fraction of the plant is converted to fuel.
- Plants can be bred for energy characteristics (high yield, low inputs).
- Two generic processing routes: biological or thermochemical.
- Can blend with petroleum fuels in most cases.
- Substantial energy/environment benefits compared with first generation biofuels primarily due to greater biomass usability per unit land area.
- Greater capital-intensity than first generation biofuels, but lower feedstock costs.

Why second generation biofuels?

- The production of biodiesel from food crops in first generation system is extremely expensive and first generation biofuel increases the costs of those food crops as it compete with food crops.
- Abundant plant biomass can be obtained in the form of agriculture waste, SRF and industrial waste which make it very efficient and help mitigate global warming by replacing fossil fuels (Christersson, 2006).
- Tree species for raw material can be grown in marginal land.
- Improved GHG performance as compared to first generation.

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WHY short rotation forestry for production of second generation biofuels?

- They grow rapidly and produce mature wood more rapidly. Thus sequestrate carbon faster.
- SRF are managed plantations and have the potential to reduce demand for natural forests and fossil fuels.
- SRF are potential alternative sources of energy, and energy derived from biomass can supplement and eventually displace energy generated from petroleum.
- Planting of trees is carbon negative or even carbon neutral in case of SRF while fossil fuel burning causes increase in CO_2 level of atmosphere.

CONCLUSION

The world frightening problem have long been recognized as a Global warming which affects the basic natural resources like land, water and air thus results in long lasting irreversible gas for human and other organisms which will be depleted in a short span of time.

The recent report in U.S Energy Information administration, estimated that 2.4 billion metric tons of CO_2 per year are released into atmosphere for electricity production, as well as average passenger car produces 11,450 pounds of CO_2 every year globally. But, absorption of carbon through natural resources like plants and ocean are lesser and this is further decreased by recent anthropogenic global change and deforestation. Ocean can absorb at the maximum of 6.6 billion tons per year and a tree can absorb 48 pounds of the CO_2.

Typically, biofuel produce lesser amount of CO_2 as compared to fuel from fossils. Most importantly, biodiesel and bioethanol emit and absorb CO_2 during production, thus it does not increase the global CO_2 level. By adopting biofuels it can drastically reduce the GHG emission (Zarrilli, 2007).

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http://www.agrifoodmagazine.co.in
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Artificial intelligence in agriculture

Article id: 11171

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ABSTRACT

Artificial Intelligence (AI) is a computer based program that can adapt itself to execute tasks in real time situations using cognitive processing as the human mind without constant supervision. Gradually the application of this technology is getting prominent in agriculture starting from land preparation till its harvest and storage. It will not only enable the farmer to do more with fewer resources but will also improve the quality of his produce. Considering the importance of AI in modern agriculture the article deals with a brief introduction to AI, its application in agriculture, advantages and disadvantages.

Key words: Artificial intelligence, Advantages, disadvantages.

INTRODUCTION

"Farming is on the cusp of a major change," said Gayle Sheppard, vice president and general manager of Intel® AI. "The industry will be transformed by data science and artificial intelligence. Farmers will have the tools to get the most from every acre."

Lets close our eyes for a while and just imagine for few minutes, an ordinary Indian farmer going to his field on a tractor which is supported by a GPS. The moment he reaches his land and switches on the GPS receiver fitted on his tractor and the GIS in his computer again attached in his tractor shows entire detail of his work to be done. He doesn't need to consult anyone for amount of fertilizers to be given, seed rate or have to run to any soil testing laboratory. All he has to do is just switch on his GPS receiver and sit comfortably of the driving seat of his tractor. Doesn't it look utopian?? lets imagine one more scene a farmer went for a picnic with his family and back at his green house a digital camera zooms in to a plant among several other hundreds of plant. The Images of the plant flow into an artificial intelligence algorithm that predicts precisely what is the condition of the particular plant weather it needs water, fertilizer or any other specific attention. And does all the activity which is needed to be done for its healthy growth all by itself without bothering the picnic of the farmer and his family. Now surely it looks out of science fiction movie of Hollywood, isn't it? But is not exactly the truth it is possible by involvement of artificial intelligence (AI) in farming. Various companies like Intel has already started working on such technologies which will make all these dreams come true.

From various studies and surveys it has been predicted that the world will need to produce 50% more food from what is being produced now by 2015 to feed the then population which will be around more than 2 billion. And considering the recent doctrine changes in climate and its effect on farming it looks quite daunting to achieve this target by using our conventional methods of farming. But here Artificial intelligence can render a great help for agriculture. Artificial intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and reacts like humans. It surely doesn't mean that it can replace the humans totally but will be a great assistant when handles with care.

In past few years agriculture round the world has introduced various technological tools based on AI viz., GPS (Geographical Positioning System), GIS (Geographical Information System), remote sensing, Variable Rate Technology (VRT),Computer Based Applications, Yield monitoring and Mapping, Crop Scouting with the use of drones etc. and this indicates the growing potential of AI in agriculture. The AI in agriculture is focused on monitoring and forecasting the farm productivity. The devices sensors collect data and analyze them to provide the most precise way of executing any tasks. Various field trials are also been conducted to know the actual potential of this techniques. In India in an experiment conducted by Microsoft with 175 farmers in Andhra Pradesh, resulted in 30% higher yield per hectare on an average compared to previous year. This result became possible because these interconnected technologies compute high-performance analytics to help farmers understand real time data such as weather and temperature. It also helps the farmers to insights on how to increase crop yield, improve farm planning, make environmentally intelligent decisions on the level of resources needed and where to distribute them.

Various application of AI includes; Crop health monitoring- gather information on land cover performance and farmland resource conditions. It evaluate individual plots or plants and tracks the changes throughout the growing cycle using near infra red waves and produces 3D images.; Warning system for disease and pest out breaks- The system consists of wireless GSM networks that capture long-term and real-time natural environmental fluctuations in the farms. When the system detects any potential outbreak sign, it sends a warning message to farmers and government officials via GSM networks.; Automation of irrigation; yield prediction; Identification of optimal mix for agronomic products; soil health monitoring etc.

Before adopting any technologies it is very important to briefly go through its prospects and limitations & pros and cons, analyze them and then come to any conclusion.

Advantage:

- Crop yield and product quality can be enhanced by analyzing and correlating large amount of data from multiple sources to extract actionable insights.
- Pragmatic assessments of demand and supply, market intelligence, crop competitiveness and regional crop planning can be done easily.
- Save resources, moisture requirement and fertilizer requirement of specific patch of land can be easily predicted using the AI and accurate amount of the resources will be used rather than blindly irrigating or spreading fertilizers throughout the field.
- loss of resources by leaching is reduced
- Curb ground water contamination with farm chemicals as there will be no leaching loss of fertilizers and chemicals.
- Crop moulding will become easy.
- Quality harvest can be done.
- Precautionary measures could be taken early for various weed, disease and pest infestation.
- Generation of new employment to provide AI based help to farmers.

Disadvantages

- Costly and not affordable by poor farmers of India.
- Not understood by everyone
- Learning is a bit difficult and requires professional help
- Need a lot of data to train machines and to make precise predictions
- Not economically feasible for small land holdings.
- Requires time to build a specific model for a given area.
- Need a charging platform and battery life strong enough to survive hours of operating in the field

CONCLUSION

The future of farming depends on adopting new and advanced technologies having less or no harmful impact on ecology. AI is one among those technologies which not only does saves the resources along with improving the outcome but also is sustainable for environment. According to a study digital farming and connected farm services can impact 70 million Indian farmers in 2020 and will add $9 billion to farmer incomes. There are some successful AI startups too viz., Prospera, Blue river technology, Farmbot etc who are working in this direction and making people aware of this new technology. Thus it could be assumed that introducing the digital farming to the rural farmers could be a great weapon to double the farmers income.

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MARICULTURE- A scrupulous source of livelihood in marine ecosystems

Article id: 11172

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Mariculture is a special branch of aquaculture that involves cultivation of marine organisms for food and non-food products in an open or enclose of ocean, tanks, ponds, etc. with seawater. It is an *offbeat to aquaculture* as it is cultured in freshwater while *mariculture is carried out in seawater*. It was first developed by *Kokichi Mikimoto* in *Japan* in *1896*. The primary organisms reared in it are seaweeds, molluscs, crustaceans and finfish.The cultivation practices are different for each and every species to be cultivated. Incase of mollusc culture,*bivalve mollusc larvae* is used as a propagating material while in seaweed culture *micro* and *macro algae* are cultured which have numerous uses like production of food ingredients such as omega-3 fatty acids, food colourants, food fertilisers, bioplastics. It contributes a lot in pharmaceutical industries. It also acts as a pollution indicator and controlling agent.

Mariculture is a way of sustainable fishing farming which is both economically feasible and environmentally sustainable. Moreover, fishes are more healthy and nutritious and are cultured in a wide range of species. In this practice, waste is being recycled like the effluents from intensive fed culture of finfish and shrimps are taken up by bivalves and plants, which ultimately curtails the financial risks. It provides an alternative source of livelihood to the rural people.The residues of the intensive culture of fishes and shrimps leads to eutrophication due to presence of higher amount of nitrogen and phosphorous. The effluents of the farming have high N/P ratio leading to algal bloom. This algal bloom hinders the activities of other aquatic organisms sometimes resulting to their death. The fishes from those affected hatcheries are harmful for human consumption as it has toxic contents. Sometimes, there is chance of diseases occurrence, it may spread if the propagating material is being selected from the affected hatchery. Another major demerit is that it requires a large arena for cultivation so it results in habitat degradation.

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In India, mussels, oysters and seaweeds are the prior components of mariculture including some crabs and lobsters fattening. This practice is usually carried in the coastal areas. It is practiced mostly in Kerala region with oyster and mussels which have been commercialised in the recent times. India's production of marine fishes is 4.5 million tonnes while the in states of Gujarat and Odisha, 133.48 tonnes and 688.93 tonnes, respectively is the annual production. Mariculture acts as one of the alternative measures to root out the pressure of burgeoning population from Earth for food. It not only provides food but also creates employment to the people of coastal areas along with maintaining the environmental integrity in the region. Hence, it can be inferred that there is a need to strengthen the market driven cultivation process in concordance with present day technology and sustainability oriented policy action in this regard.

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Lethal effects of plastic waste on animal health, human health and environment

Article id: 11173

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ABSTRACT

The English word "plastic" or "plastics" originated from the Greek word "*plastikos*" which means to "grow" or "form.” The name "plastic" directly means the "capability to be formed" one of the features of plastics. A plastic is widely used now days as plastics are the cheapest substitutes for natural resources. But because of their non-biodegradability, plastics can be life threatening not only to animals but also to the human beings. And they can be the best source of environmental pollution. Plastic pollution can afflict land, waterways and oceans. It is estimated that 1.1 to 8.8 million metric tons (MT) of plastic waste enters the ocean from coastal communities each year. Living organisms, particularly marine animals, can be harmed either by mechanical effects, such as entanglement in plastic objects or problems related to ingestion of plastic waste, or through exposure to chemicals within plastics that interfere with their physiology. Humans are also affected by plastic pollution, such as through disruption of various hormonal mechanisms. As of 2018, about 380 million tons of plastic is produced worldwide each year. From the 1950s up to 2018, an estimated 6.3 billion tons of plastic has been produced worldwide, of which an estimated 9% has been recycled and another 12% has been incinerated.

Keywords: Bisphenol, carcinogens, Polycarbonate, Polystyrene and Non-biodegradability.

INTRODUCTION

Plastic is material consisting of any of a wide range of synthetic or semi synthetic organic compounds that are malleable and so can be molded into solid objects. Due to their low cost, easy to manufacture, versatility, and imperviousness to water, plastics are used in a multitude of products of different scale. The versatility of these materials has lead to a great increase in their use over the past three decades, and they have rapidly moved into all aspects of everyday

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life. Plastic material is gaining notable importance in different spheres of day to day life. The plastic Industry is making significant contribution to the economic developments and growth of various key sectors in the country like Infrastructure, Agriculture, Horticulture, Healthcare, Automotive and construction industry. In developed economies, about a third of plastic is used in packaging and roughly the same in buildings in applications such as piping, plumbing or vinyl siding. Other uses include automobiles, furniture, and toys. In the developing world, the applications of plastic may differ 42% of India's consumption is used in packaging. Plastics have many uses in the Agriculture, Medical, Veterinary and Industrial field. Plastic is made from petroleum, a product of oil, using heat and a catalyst to change the propylene into polypropylene. Since these are unnatural products, not found in nature, there are no organisms capable of decomposing the material, so it will not degrade as does other plant and animal waste. They don’t rot, they last for centuries possibly forever they are non-biodegrade.

Types of Plastic Debris

There are three major forms of plastic that contribute to plastic pollution: micro plastics as well as mega- and macro-plastics. Mega and micro plastics have accumulated in highest densities and concentrated around urban centers and water fronts. Plastic can be found off the coast of some islands because of currents carrying the debris. Both mega and macro-plastics are found in packaging, footwear, and other domestic items that have been washed off of ships or discarded in landfills. Fishing-related items are more likely to be found around remote islands. These may also be referred to as micro, meso and macro debris.

History and Indian Scenario

Development of plastic is believed to have started around 1860, when Phelan and Collander, a U.S pool and billiard ball company, offered a prize of $10,000 to the person who could design the best substitute for natural ivory. One of the entrants, although not the winner, was John Wesley who developed a cellulose derivative for contest. Leo Hedrick Baekeland, a Belgian American chemist, developed first completely synthetic plastic which he sold under name Bakelite. And further innovations were made and other polythenes were evolved like PVC, polystyrene etc. According to The World Economic Forum study done on plastic pollution, if plastic pollution continues to rise then oceans will have more plastics than fish by 2050. India's contribution to plastic waste that is dumped into the world's oceans every year is a massive 60%. India generates around 56 lakh tonnes of plastic waste annually; More than 15,000 tonnes

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of plastic waste are generated in India every day, of which 6,000 tonnes remain uncollected and littered. India has an open garbage system, which means open garbage and dust bins on the roads with stinking waste. Dogs, monkeys, and cows eat whatever they can find to survive. In cities and towns, large numbers of cows on the roads eat from garbage bins, foraging for fruit, vegetable leftovers, anything edible and anything smelling like food. Most of India's cows are owned by dairy farmers who let them loose in the city streets to look for free food instead of feeding them. People put vegetable peels, dirt, etc in a plastic cover and then throw it. No One bothers organic waste from plastic and glass. Plastic utensils, covers and even razors mix with vegetable and fruit peels and leftover food, many cows ingest the entire package plastic bags, rotten food and garbage. These bags spill out either on the road or from municipality dustbins. Since the plastic bags are knotted at the mouth, cows, unable to undo the knot, eat food leftovers including the plastic. Slowly, over time, they build up a huge amount of plastic inside their stomachs. It gets entangled with different materials and it becomes hard like cement inside their rumens, which is the first belly of the cow. This results in a drastic reduction in their milk production ability, and even death of the animals.

Reason behind Eating of Plastics by Animals

The bovine species does not have highly sensitive prehensile organs, such as lips and tongue, nor are a discriminating sense of taste and ingestion of foreign bodies common due to indiscriminate feeding habits. In almost all urban and pilgrim towns of India, tourists visiting the city in which hundreds of bovines are residing on the roads and feeding on leftover food, which is covered with plastic bags, plastic polythene and plastic bottles. The areas where animals are confined to zero grazing units (No grazing land) and animals are not well supplemented with minerals, in such condition animals become mineral deficit/starved and get attracted to tasty materials or licking something near them such animals will swallow plastic polythene bags that hang around. Some animals are also tethered along the roads while others are left to graze openly. During this time of grazing, they get exposed to these dangerous plastic materials and are forced to scavenge for food in garbage areas. Plastic bags contain polymers and toxins chemical like lead, cadmium, mercury and carcinogens etc. The direct contact with these substances over a long period can lead to serious consequences. With time, used polythene bags get carried away by wind and gradually get settled in drains and animals are eventually drink water from such sources, where plastics are accidently ingested by them. These plastic bags remains intact even after the death and decomposition of the animal.

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Classification of Plastic

Plastics are classified in different categories based on different criteria.

1. Based on polymerization:- As addition and condensation.
2. Based on process ability:- As thermoplastics and thermosetting.
3. Based on chemical nature.

a. Polycarbonate:- bisphenol-A/BPA.
b. Polystyrene:- styrene.
c. PVC:- vinyl chloride and sometimes phthalates.

Harmful Effects of Plastics on Animal

The coming known examples of hazardousness produced by plastic are responsible for that mainly polythene and PVC because both of these two are using for food grade application at very large scale. Though, there is no such systematic study on polythene and plastics induced pathological lesions in animal. However there are scattered reports in literature and that too in popular media. An attempt is made to collect information from various sources and present in consolidated form.

Pathological conditions

1. Indigestion:- the polythene and other material do not degrade in rumen or reticulum as such causing hindrance in orifice between rumen and reticulum. When it's mixed with feed the ingredients are also trapped in between polythene which becomes tight due to ruminal movements. This whole process also affects the rumen micro flora leading to indigestion of feed.
2. Impaction:- rumen becomes impacted due to presence of large quantities of polythene bags/plastics in rumen accumulated over a period of time. Leads to rumenatony and decrease in rumen motility.
3. Tympany:- when polythene is present in rumen and reticulum, they partially or completely occlude the orifice of reticulum and omasum leading to accumulation of gases in rumen. The situation is worsening if such animal is fed with legumes or other gas forming feed/concentrates. Accumulation of gases in rumen give rise to bloat or tympany which becomes fatal, if the gases are not properly removed, sometimes poly bags also occlude oesophagial orifice leading to hindrance in eructation, giving rise to dyspnoea and death.

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4. Polybezors: - the formation of stones in digestive tract and around polythene is known as polybezors. In this the principle constituents is polythene and material, around which salts deposited that gives rise to the formation of hard stone like mass in stomach.
5. TRP:- many times nails wires or other sharp objects are also disposed in poly bags as waste and dropped in waste pits, from where they may be eaten up by cows along with food/feed items and get trapped in reticulum causing damage. With the passage of time and ruminal movements sharp objects penetrate wall of reticulum and diaphragm to invade heart leading to TP.
6. Immunosuppressant:- leads to increased sensitivity to various infections particularly of pasturellosis. Besides, due to lack of proper nutrition animal becomes weak and immunodeficient, such animal are also prone to develop cancer. The presence of toxic chemicals may also damage epithelial lining that leads to urolithiasis particularly in kidneys.

Harmful Effects of Plastics on Environment

Plastic industries contributes nearly 1/10th toxic releases of toxic chemicals including trichloro ethane, acetone, methylenechloride, methyl ethyl ketone, styrene, toluene, benzene, 1,1,1-trichloroethane etc. Plastic pollution is a global problem. The majority of plastic winds up in landfills where it remains indefinitely. No one exactly knows how long plastic takes to break down, but it is believed to take hundreds or even thousands of years. It is not just the accumulation of plastics that harms the environment it is also the fragments and toxins released during photo-decomposition that pollute our soil and water. Some plastics are designed to degrade quickly, such as Oxo-Degradable and while they may become less noticeable, they are still present in the environment. For example, in ocean environments, plastic fragments are taken in by filter-feeding organisms. When tiny plankton ingests plastic, animals up the food chain can bioaccumulation in larger quantities. So while some plastic may be designed to degrade quickly, it is still present in the environment. Floating plastic waste that can survive thousands of years in water can serve as a transportation device for invasive species that disrupt habitats.

Harmful Effects of Plastics on Humans

Three plastic chemicals have been shown to leach toxic chemicals when heated, worn out or put under pressure which have got harmful effects on human health. Due to the use of chemical additives during plastic production, plastics have potentially harmful effects that could prove to be carcinogenic or promote endocrine disruption. Some of the additives are used

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as phthalate plasticizers and brominated flame retardants Through bio-monitoring, chemicals in plastics, such as BPA and phthalates, have been identified in the human population. Humans can be exposed to these chemicals through the nose, mouth, or skin. Although the level of exposure varies depending on age and geography, most humans experience simultaneous exposure to many of these chemicals. Average levels of daily exposure are below the levels deemed to be unsafe, but more research needs to be done on the effects of low dose exposure on humans. A lot is unknown on how severely humans are physically affected by these chemicals. Some of the chemicals used in plastic production can cause dermatitis upon contact with human skin. In many plastics, these toxic chemicals are only used in trace amounts, but significant testing is often required to ensure that the toxic elements are contained within the plastic by inert material or polymer which causes following effects.

a. Thyroid Hormone Axis

Bisphenol A affects gene expression related to the thyroid hormone axis, which affects biological functions such as metabolism and development. BPA can decrease thyroid hormone receptor (TR) activity by increasing TR transcriptional corepressor activity. This then decreases the level of thyroid hormone binding proteins that bind to triiodothyronine. By affecting the thyroid hormone axis, BPA exposure can lead to hypothyroidism.

b. Sex Hormones

BPA can disrupt normal, physiological levels of sex hormones. It does this by binding to globulins that normally bind to sex hormones such as androgens and estrogens, leading to the disruption of the balance between the two. BPA can also affect the metabolism or the catabolism of sex hormones. It often acts as an antiandrogen or as an estrogen, which can cause disruptions in gonadal development and sperm production.

Preventive Measures

The simple steps of REDUCE, REUSE AND RECYCLING can be applied to mitigate the harmful effects of the plastics on the environment as well as the animals and human being. Plastic bags are being openly used by vendors, especially by small vendors like vegetable and fruit shops as well as grocery shops. These are mainly low-quality bags. Following steps must be taken to address this concern:

- In order to save the life of cattle, residents should not throw the food items in plastic bags.

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- Rearing of the livestock in urban and semi-urban areas near to market places and roadsides is to be discouraged as the animals try to feed upon the road side waste and garbage pits.
- The dietary supplementation should have enough mineral if the animals are stall feeded.
- The livestock grazing areas should be away from industrial areas and must be well protected from pollution of wastes and plastic materials.
- Popularize the slogan "No to carry bags when you can carry things in your hand" can be another way to avoid the incidence of the problem.
- The open garbage system should be discouraged and is possible should be penalized by the competent authorities.
- Creating awareness among city residents regarding indiscriminate use and disposal of plastic bags will be a good option to overcome the problem in future

CONCLUSION

Although plastics are the cheapest substitute for natural resources, because of their non-biodegradability they can be lethal not only to animals, environment but also to the human beings. So reduce, reuse and recycle is the only way of controlling the negative impact of toxic plastic pollution and save nature.

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Nutritional importance of underground root vegetables

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Article id: 11174

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INTRODUCTION:

Vegetables include a diverse group of plant foods that vary greatly in content of energy and nutrients. Additionally they supply dietary fiber, and fiber intake is linked to lower incidence of cardiovascular disease and obesity and supply vitamins and minerals to the diet. Vegetarian diets have been promoted since the 18^{th} century by men and women in search of physical health.[12] A wide range of plant foods is consumed, including most parts of the plant, such as fruits, seeds, leaves, roots, and tubers.[10]

Sweet potato:

Sweet potato (*Ipomoea batatas* Lam.) is cultivated throughout the tropics and warm temperate regions of the world for its starch roots, which can provide nutrition, besides energy. The edible tuberous root is either long and tapered, ovoid or round with a skin colour ranging from white, brown, purple or red and the flesh colour ranging from white, pale cream, orange or purple. Besides, the plant is also much valued for its green tops, which are a concentrated source of many essential vitamins and minerals. Many studies show that the sweet taste generated in cooked sweet potato is due to the action of endogenous amylases. Starch, being the main ingredient, constituting up to 65–70% of dry weight, undergoes gelatinization during cooking.

Sweet potatoes are a great source of beta-carotene, a powerful antioxidant that gives orange fruits and vegetables their vibrant color. Beta-carotene is converted to vitamin A in the body. Consuming foods rich in beta-carotene may reduce the risk of developing certain types of cancer, offer protection against asthma and heart disease, and delay aging and body degeneration.100 grams baked with skin contains: 90 calories, 0 g fat, 20 g carbohydrate, 3.3 g fibre, 2 g protein, 475 mg potassium, 20 mg vitamin C, 0.28 mg vitamin B_6, 11.5 mg beta-carotene.

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Beet root (*Beta vulgaris* L.) :

The Beetroot is the taproot portion of the beet plant. It is an excellent food which impart very important role for the development and growth of human body. It also act as fruits as well as vegetables. Fresh form of beetroot consumed generally as a salad and it play a role as a natural colorant in textile industries and as a medicinal plant to cure the various illness.

Beetroots main benefits are that it contains no fat, very few calories and is a great source of fiber. Young leaves of the garden beet are sometimes used for eating. The midribs of Swiss chard are eaten boiled while the whole leaf blades are eaten as spinach beet. In some parts of Africa, the whole leaf blades are usually prepared with the major as one dish[5].Nutritional value of fresh beetroots per 100g Constituents- Carbohydrates 9.96 g, Sugars 7.96 g, Dietry fiber 2.0 g, Fat 0.18 g, Protein 1.68 g, Vit A-2 µg, Vit. B_1-0.031 mg, Vit. B_2-0.027 mg, Vit. B_3-0.331 mg, Vit B_5-0.145 mg, Zinc 0.35 mg, Sodium 77 mg.

Taro:

Taro (*Colocasia esculent* Linn.) tubers are important sources of carbohydrates as an energy source and are used as staple foods in tropical and subtropical countries. It is largely produced for its underground corms contain 70–80% starch. It is an erect herbaceous perennial root crop widely cultivated in tropical and subtropical world[11].

Taro is rich in digestible carbohydrates and micronutrients[14]. Taro contains anti-nutrient factors such as: oxalate, Phytate and tannin. Taro deteriorates rapidly as a result of its high moisture and has been estimated to have a shelf-life of up to one month if undamaged and stored in a shady area[9].The carbohydrate and protein values are even higher than other root crops like yam, cassava or sweet potato[4]. Though, protein and fat content of taro are low, but is high in carbohydrates, fiber and minerals[3].It contains energy 112 K cal, Carbohydrates 26.46 g, Protein 1.50 g, Total fat 0.20mg,cholesterol 0 mg, Dietary fibers 4.1 g, folates 22 µg, Niacin 0.60 mg, Pantothenic acid 0.303 mg, Pyridoxine 0.283mg, Riboflavin 0.025mg, Thiamin 0.095 mg, Vitamin A 761 U, Vitamin C 4.5 mg, Vitamin E 2.38 mg, Vitamin K 1 µg, Calcium 43 mg, Coper 0.172 mg, Iron 0,55 mg, Magnesium 33 mg, Manganese 0.383 mg, Selenium 0.7 µg, Zinc 0.23 mg.

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AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Radish:

Radish (*Raphanus sativus*) is a root vegetable grown and consumed all over the world and is considered part of the human diet, even though it is not common among some populations. Usually, people eat radishes raw as a crunchy vegetable, mainly in salad. Radishes have different skin colors (red, purple, black, yellow, and white through pink), while its flesh is typically white. In addition, the edible root of radish varies in its flavor, size, and length throughout the world.

In Unani, Greeko-Arab, and Indian folk medicine, radish is used as a household remedy for the treatment of many diseases such as jaundice, gallstone, liver diseases, rectal prolapse, indigestion, and other gastric pains[13][7]. In general, radish contains carbohydrates, sugars, dietary fibers, protein, and even some fat and fluoride. It contains various water-soluble vitamins (B_1, B_2, B_3, B_5, B_6, B_9, and C) and minerals (calcium, iron, magnesium, manganese zinc, potassium, and phosphorous)[8].

Carrot:

Carrot (*Daucus carota* L.*)* is an essential root vegetable commonly used in the diet of human beings. It is greatly treasured as food mostly because it is the best source of carotene; a precursor of Vitamin A [15]. For many communities in developing countries, the major source of vitamin A in the diet is carotenoids especially Beta carotene [2].

Furthermore, carrot contains also abundant quantities of nutrients and minerals [6]. Salads steamed or boiled in vegetables and may also be prepared with other vegetables in the preparation of soups and stews [1]. Carrot in combination with other vegetables can produce especially healthful, tasty and refreshing drinks.100 g of carrot raw contains - Calories 41, Water 88%, Protein 0.9g, Carbs 9.6 g, Sugar 4.7g, Sugar 4.7 g, Fiber 2.8 g, fat 0.2g.

CONCLUSION:

Roots and tubers are important sources of energy as starch and nutritious. As foodstuffs, roots can be stored for long periods, have long shelf-life compared to other fruit and leafy vegetables.

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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Banana planting systems

Article id: 11174

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In most of the banana growing regions, solar radiation is abundant and thus productivity largely depends on cultivar, topography, soil fertility, duration of planting and system of cultivation. Tall cultivars are given wider spacing that the dwarf ones.

System of planting:

The common system of planting is Garden land, wet land, perennial and hill banana cultivation and Preparatory cultivation practices vary according to the system of cultivation. Population density per unit area depends on variety, soil fertility, topography, various aspects of cultivation and duration of crop.

System of planting	Preparatory cultivation	Varieties	Spacing (m)	No. of plants/ha
Garden land	Pit-planting 2-3ploughings, pit talking, forming basins and channels	Dwarf Cavendish, Robust,	1.5 X 1.5 1.8 X 1.8	4444 3086
	Furrow planting 30-40 cm furrows are made and suckers are planted	Nendran, Dwarf plant Robusta	2.0 X 2.0 1.8X 1.8 2.1 X 2.1 2.4X 2.4	2500 3086 2310 2310
Wet land	After paddy season, land is prepared- planting in small pits. Trench planting – one week after planting, 15 cm deep trenches are made both ways having 4 to 6 plants in each trench.	Poovan, Rasthali, Monthan, Ney-vannan	2.1 X 2.1	2310
Padugai	Planting is small pits, annual	Monthan,	3.0 X 3.0	1110

(Perennial)	deepening of water channels	Poovan		
Hill or Contour planting	Contour bunds are made, removal of bushes and other plants	Sirumalai, Virupakshi, Hill banana	3.6 X 3.6	772
Tissue culture plants	Pit- planting, 2-3 ploughings, planting in small pits	Rasabale Rajapuri Yelakki Red Banana Nendran	1.8X1.8 2.0X2.0	3086
High density planting	Pit planting	Nendran Robusta Palayankodan Dwarf Cavendish	2.0X3.0 (2 plant/pit) 1.2X1.2 1.5X1.5 1.8X1.8	3332 6944 4444 6944

Planting season

Planting time depends mainly on the climate and partly economic factors. Banana can be planted throughout the year except in severe winter and during heavy rains when the soil is very wet. Spring planting is the rule in subtropics. Banana should be planted in the dry season after rainfall or with pre-irrigation to facilitate better establishment. Common planting season: June / July to December / February.

1. **Wet lands**: Poovan, Rasthali, Monthan, Karpooravalli and Ney Poovan can be cultivated during February – April. Nendran and Robusta can be cultivated during April – May.
2. **Garden lands**: Banana can be cultivated in garden lands during January – February and November – December.
3. **Padugai lands**: In Padugai lands, the crop can be cultivated during January – February and August – September.
4. **Hill Banana**: April – May (lower Palani hills), June – August (Sirumalai) are the suitable seasons for cultivating hill banana.

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ISSN: 2581-8317
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Hints during planting

- In humid tropics shooting during high wind time and bunching at the rainy season may be avoided by adjusting the time of planting
- In subtropics planting time is adjusted to avoid shooting in winter season
- Suitable planting season for growing banana in Gangetic plains of West Bengal is February and August

Planting density

High density planting may be practice in monocrop culture and wider spacing is adapted for ratoon crop. High density planting in banana has advantage of utilization of better solar energy, checking excessive weed growth, reducing competition between fruits and alternate sinks, reduction in the distance the assimilates have to be translocated from source to sink and all these together leads to higher productivity. In high density planting system the pit size is 0.6 m^3 and the most suitable spacing of 2.7 X 3.0 m for tall cultivars and 1.8 X 1.8 m for dwarf cultivar (Bhan and Mazumder, 1961). 3 suckers / pit at a spacing of 3.6 x 3.6 m (4600 plants/ha) is suitable Cavendish varieties and for Nendran 2 m x 3 m occupies 5000 plants / ha.

In modified high density planting spacing of 1.8 x 3.6m with 3 suckers per hill accommodating–4630 plants / ha and produced 67% more yield than conventional planting with 1.8 x 1.8m spacing (3086 plants ha).

Examples

Cultivars	**Spacing (m)**	**Plants per hectare**
	Karnataka	
Monthan/Karibale	2.1x2.1	2267
Bontha	2.1x2.1	2267
Dwarf Cavendish	1.5x1.5	4440
Robusta	1.8x1.8	3086
Amruthapani/Rasthali	1.8x1.8	3086
Poovan	2.1x2.1	2267
Eiakkibale	2.1x2.1	2267
Safed Velchi	2.1x2.1	2267
Najangud Bale	1.8x3.0	1850

Chandra Bale	2.1x2.1	2267
Marabale	3.6x3.6	771
Ney poovan	2.1x2.1	2267
Tamil Nadu		
Rasthali	2.1x2.1	2267
Poovan	2.1x2.1	2267
Karpooravalli	2.1x2.1	2267
Monthan	2.1x2.1	2267
Robusta	1.8x1.8	3080
Nendran	1.8x1.8	3080
DwarfCavendish	1.5x1.5	4440
Ney Mannan	0.9x0.9	8100
Chakkerakeli	1.8x1.8	3080
Virupakshi	3.6x3.6	771
Sirumalai	3.6x3.6	771
Ney Poovan	2.1x2.1	2267
Red banana	2.1x2.1	2267
Sanna Chenkadalai	1.8x3.6	4600
Matti	1.8x3.6	4600
Namarai	1.8x3.6	4600
Pachanadan	1.8x3.0	1860
Lacatan	3x3	1111
Kerala		
Chenkadali/Red banana/ Kappa vazha	2.1x2.1	2267
Palayankodan	2.1x2.1	2267
Monthan	2.1x2.1	2267
Nendran	18x1.8	3080
Robusta	1.8x18	3080
Dwarf Cavendish/Morris	2.4x18	2310
Rasthali	2.1x2.1	2267
Safed Velchi	2.1x2.1	2267

Karpooravalli	2.1x2.1	2267
Kadhali	2.1x2.1	2267
Nijalipoovan	2.1x2.1	2267
Kunnan	2.1x2.1	2267
Ayrinkapoovan	2.1x2.1	2267
Hybrids		
C01	1.8x3.6	4600
Udhayam	1.8x3.6	4600
Grand Naine	1.5x15	4440
BRS1	1.8x3.6	4600
BRS 2	1.8x3.6	4600
FIHA-01	3x2	1667
Saba	3x2.5	1333
Lacatan	3x3	1111
Grand Naine	3 suckers per hill @ 2 X 3 m spacing	5000
Grand Naine	3 suckers per hill @ 1.8 X 3.6 m spacing	4629
Grand Naine	Pair row planting 0.9 X 1.5 X 2.1 m- one sucker per pit	4444

Note: - The yield per hectare was significantly higher in high density population or closer spacing. This can be attributed to increase in plant population per unit area. The higher bunch weight observed in wider spacing can partially compensated by higher yields obtained in closer spacing.


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ISSN: 2581-8317

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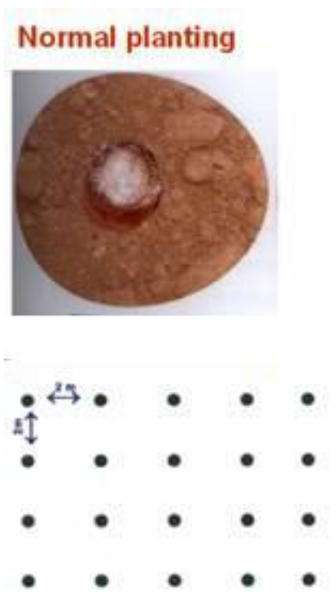
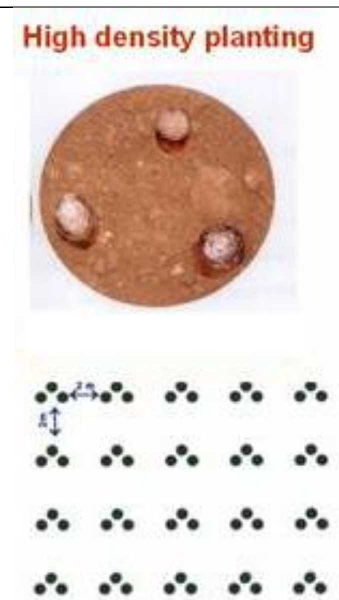
Normal planting (2.0 x 2.0 m)	3 suckers/pit (3.6 x 3.6 m)	4 suckers/pit (1.8 x 3.6 m)	3- Plants /Hill 1.8 X 3.6 m (4800 pi/ha)	Paired row system 1.2x1.2x2.0m (5200 pl/ha)

	
1 sucker / pit at 2x2 m	3 suckers / pit at 3.6x3.6 m

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ISSN: 2581-8317
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Best Air - Purifying plants for your home

Article id: 11175

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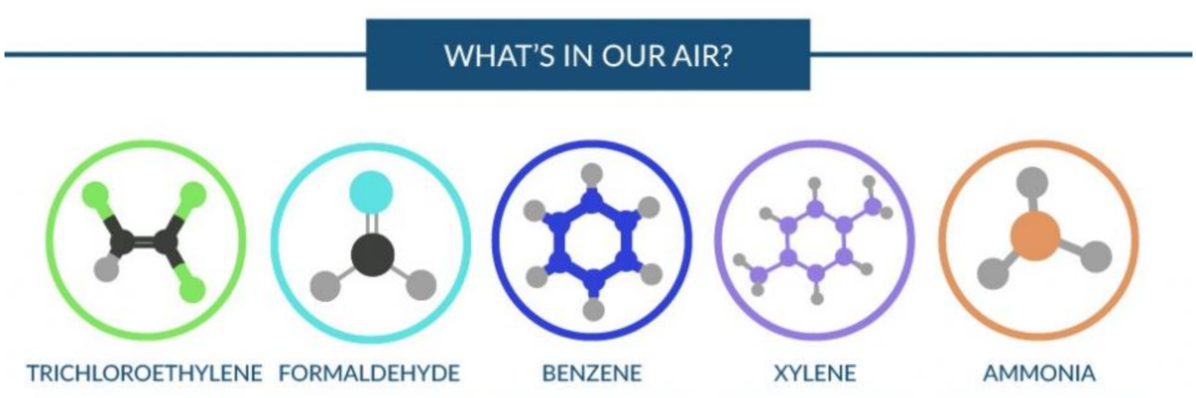
"Ecology garden to improve indoor Air Quality for Human health and well being"

Most people are aware that outdoor air pollution can affect their health. Unfortunately, indoor air pollution can also have significant health effects. Indoor pollution show that levels of many pollutants may be 2-5 times higher in indoor air and occasionally more than 100 times higher than outdoor levels. These indoor levels are of particular concern because most people spend an estimated 90% of their time indoors. A healthy home environment is vital to a person's well-being and houseplants contribute to it more than you might think. Clean Air Study that found which plants are effective at removing benzene, formaldehyde, trichloroethylene, xylene, and ammonia from the air – chemicals that have been linked to negative health effects like headaches, dizziness, eye irritation, and others.

What's in our Air?



- **Trichloroethylene**

Found in printing inks, paints, lacquers, varnishes, adhesives and paint remover/stripper.

- **Formaldehyde**

Found in paper bags, waxed papers, facial tissues, paper towels, table napkins, particle board, plywood paneling, and synthetic fabrics.

- **Benzene**

Used to make plastics, resins, synthetic fibers, rubber lubricants, dyes, detergents, drugs and pesticides. Can also be found in tobacco smoke, vehicle exhausts, glue, paint and furniture wax.

- **Xylene**

Found in printing, rubber, leather and paint industries, tobacco smoke and vehicle exhausts.

- Ammonia

Found in window cleaners, floor waxes smelling salts and fertilizers.

What are the effects on humans?

Like most chemicals, the adverse health effects you may encounter depend on several factors, including the amount to which you are exposed, the way you are exposed, the duration of exposure and the form of the chemical. Below the common symptoms associated with each toxic agent.

- Trichloroethylene

Symptoms associated with short term exposure include excitement, dizziness, headache, nausea and vomiting followed by drowsiness and coma.

- Formaldehyde

Symptoms associated with short term exposoure include irritation to nose, mouth and throat, and in serve cases, swelling of the larynx and lungs.

- **Benzene**

Symptoms associated with short term exposure include irritation to eyes, drowsiness, dizziness, increase in heart rate, headaches, confusion and in some cases can results in unconsciousness.

- **Xylene**

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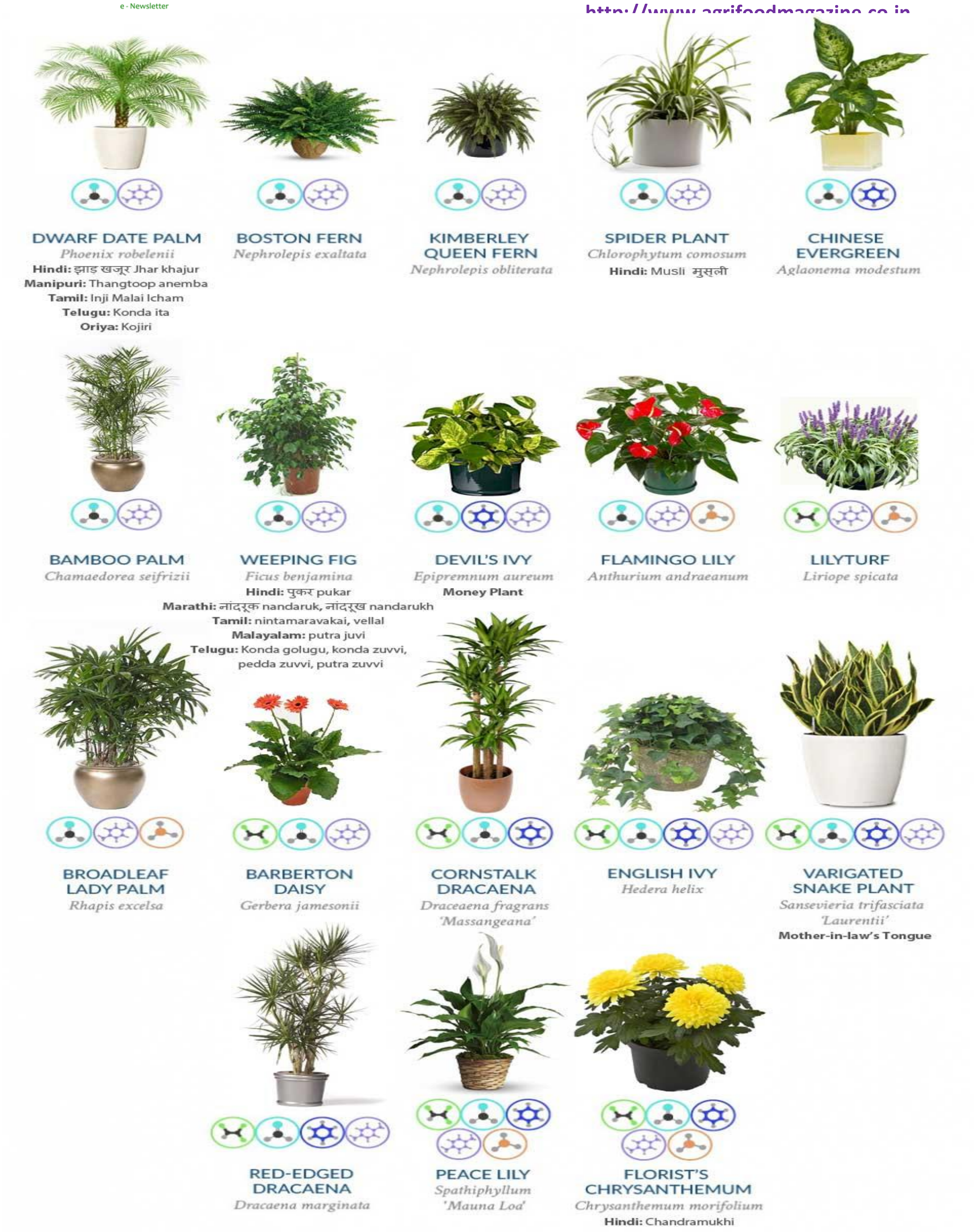
Symptoms associated with short term exposure include irritation to mouth and throat, dizziness, headaches, confusion, heart problem, liver and kidney damage and coma.

- **Ammonia**

Symptoms associated with short term exposure include eyes irritation, coughing and sore throat.

Air- filtering plants

Common name	Scientific name
Dwarf date palm	*Phoenix robelenii*
Boston fern	*Nephrolepis exaltata*
Kimberley queen fern	*Nephrolepis obliterate*
Spider plant	*Chlorophytum comosum*
Chinese evergreen	*Aglaonema modestum*
Bamboo palm	*Chamaedorea seifrizii*
Weeping Fig	*Ficus benjamina*
Devil’s ivy	*Epipremnum aureum*
Flamingo lily	*Anthurium andraeanum*
Lilytrur	*Liriope spicata*
Broadleaf lady palm	*Rhapis excelsa*
Barberton daisy	*Gerbera jamesonii*
Cornstalk dracaena	*Draceaena fragrans*
English ivy	*Hedera helix*
Variegated snake plant	*Sansevieria trifasciata*
Red edged dracaena	*Dracaena marginata*
Peace lily	*Spathophyllum*
Florist’s chrysanthemum	*Chrysanthemum morifolium*


DWARF DATE PALM
Phoenix robelenii
Hindi: झाड़ खजूर Jhar khajur
Manipuri: Thangtoop anemba
Tamil: Inji Malai Icham
Telugu: Konda ita
Oriya: Kojiri
BOSTON FERN
Nephrolepis exaltata
KIMBERLEY QUEEN FERN
Nephrolepis obliterata
SPIDER PLANT
Chlorophytum comosum
Hindi: Musli मुसली
CHINESE EVERGREEN
Aglaonema modestum
BAMBOO PALM
Chamaedorea seifrizii
WEEPING FIG
Ficus benjamina
Hindi: पुकर pukar
Marathi: नांदरूक nandaruk, नांदरूख nandarukh
Tamil: nintamaravakai, vellal
Malayalam: putra juvi
Telugu: Konda golugu, konda zuvvi, pedda zuvvi, putra zuvvi
DEVIL'S IVY
Epipremnum aureum
Money Plant
FLAMINGO LILY
Anthurium andraeanum
LILYTURF
Liriope spicata
BROADLEAF LADY PALM
Rhapis excelsa
BARBERTON DAISY
Gerbera jamesonii
CORNSTALK DRACAENA
Draceaena fragrans 'Massangeana'
ENGLISH IVY
Hedera helix
VARIGATED SNAKE PLANT
Sansevieria trifasciata 'Laurentii'
Mother-in-law's Tongue
RED-EDGED DRACAENA
Dracaena marginata
PEACE LILY
Spathiphyllum 'Mauna Loa'
FLORIST'S CHRYSANTHEMUM
Chrysanthemum morifolium
Hindi: Chandramukhi

http://www.agrifoodmagazine.co.in
AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317
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Crop residue mulching- asset for soil and water conservation

Article id: 11176

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[1] ICAR- NBSSLUP, RC, Bangalore

Crop residues are organic resource easy available with farmers and are extensively used in soil and water management for sustainable agriculture. Crop residues are generally used for animal feeding, soil mulching, biomanure making, thatching for rural homes and fuel for domestic and industrial use. Crop residue used for managing surface cover has proved a powerful means to control beating action of rainfall, detachment as well as transport of soil particles and losses of soil, water and nutrients, which are crucial for sustainable production. Improve in canopy cover by strip or intercropping, surface land cover through mulching and crop residues are known for erosion control. However, availability of mulching material due to competition for cattle fodder poses serious limitation in India.

According to Ministry of Agriculture, Gov. of India (2015) estimated a production of 93.8 million tons (Mt) of wheat, 103.6 Mt of rice, 38.4 Mt of coarse cereals, 346.7 Mt of sugarcane, 8.1 Mt of fibre crops (jute, mesta, cotton), 17.3 Mt of pulses and 26.3 Mt of oilseeds crops, in the year 2015-16. A large volume of crop residue is generated every year in the form of cereal straws, woody stalks, and sugarcane leaves/tops during harvest periods. According to a recent report by Sahai et al. (2011) total dry residue generated are estimated as 217, 239 and 253 Tg, of which 45, 60 and 63 Tg of dry biomass are estimated to be subjected to field burning of crop residues during 1994, 2005 and 2010, respectively. Wheat and rice crops together accounted for about 76% of total residue. Another estimate by Hiloidhari et al. (2014) highlighted, 686 MT gross residues is available in India on annual basis from the 39 crop residues generated by 26 crops. Out of total residue generated from agricultural fields, majority is contributed by cereals (545 MT), followed by oilseed, pulses and sugarcane crops. However, horticultural crops like coconut, banana and arecanut contribute 61 MT and other cash crops like cotton and jute supply 80 MT of stubble. Thus among various crop categories, cereal contributes the highest amount of 368 MT (54%) followed by sugarcane 111 MT (16%). At individual crop level, rice contributes the highest amount of 154 MT gross residues followed by wheat (131 MT). Among the different states of India Uttar Pradesh (22.25 Mt) followed by Punjab (21.32 Mt), Haryana (9.18 Mt) and Maharashtra (6.82 Mt) burn maximum amount of crop residues. Oil seed

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residues were burnt in Rajasthan and Gujarat while burning of fibre crop residue was dominant in Gujarat (28.6 Mt) followed by West Bengal (24.4 Mt) Maharashtra and Punjab (Jain et al., 2014).

Role of CR in soil and water conservation

(a) ***Soil moisture conservation:*** Crop residues used as mulching materials is an efficient way to reduce the exchange of water vapor between the soil surface and the atmosphere. As much as 50% of total evapotranspiration from a crop can be lost through evaporation from the soil surface. Consequently, the evaporation of water from a mulched soil decreases relative to a bare soil, and more water is available for beneficial crop transpiration. CR is of much importance in conservation of soil and water resources which is of paramount importance for sustaining cropland productivity in many semiarid environments. Mechanism for effectiveness of mulch in restricting water movement can be attributed to: (i) physical impedance of the movement of water vapour from the soil to the atmosphere; and (ii) modification of the soil surface energy balance via the interception of solar radiation and consequently, a reduction in the rate of loss of water from Stage 1 evaporation. Study carried out in Punjab reported that application of crop mulch reduced evapotranspiration by decreasing evaporation in rice-wheat cropping system (Prihar et al. 2010). Among various agronomic measures, mulching is one of the suitable methods to maintain optimum moisture and thermal environment in soil, increase water use efficiency through reduction in evaporation and subsequently higher grain yield. Application of rice straw mulch increased wheat grain yield, reduced crop water use by 3-11% and improved WUE by 25% compared with no mulch treatment. They also reported 40% higher root length densities in mulch treated plots in lower layers (>0.15 m), probably due to greater retention of soil moisture in deeper layers (Chakraborty et al. 2008, 2010). Reduced evaporation from the upper strata of soil coupled with improved soil characteristics essentially leads to higher crop yield in many cropping and climatic situations.

(b) ***Soil temperature maintenance:*** Besides saving soil moisture, mulching with plant residues raises the minimum soil temperature in winter due to reduction in upward heat flux from soil and decreases soil temperature during summer due to shading effect. Crop residue retention on the soil surface slows the runoff by acting as tiny dams, reduces surface crust formation and enhances infiltration. The channels (macro pores) thus created by earthworms and old plant roots, when left intact with no-till, improve infiltration and help to reduce runoff and soil loss.

ISSN: 2581-8317
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(c) ***Reduce sediment transport and runoff:*** Crop residue used as mulch provides the first covering for bare soil against rain water and protects it from splash erosion. These not only obstruct soil disintegration but reduce erosion and runoff to a large extent. Thus leaving substantial amounts of crop residues evenly distributed over the soil surface reduces wind and water erosions, increases water infiltration and moisture retention, and reduces surface sediment and water runoff.

(d) ***Improves soil properties:*** Incorporation of crop stubble into soil or retention on the surface has several positive influences on physical, chemical and biological properties of soil. Application of CR as mulches is known to improve physical properties like hydraulic conductivity and reduce bulk density by modifying soil structure and aggregate stability. Some of physical properties like reduces wind and water erosions, increases water infiltration and moisture retention, and reduces surface sediment and water runoff. In a study by Bhattacharyya et al. (2012) conducted a 6-year field experiment with a lentil - finger millet rotation on sandy loam soil comparing different tillage systems with residues incorporated or left on the soil surface. They found that year-round no-tillage (NT–NT) and one seasonal no-tillage followed by conventional tillage (NT–CT) treatments, where crop residues were left on the surface, had significantly higher water-stable macroaggregates in the surface layer. Thus surface applied CR retains SOC (soil orgain carbon) and aggregate stability in soils highly susceptible to erosion. Crop residue acts a source of organic carbon which acts as binding agent for soil particles and prevents soil erosion and improves C sequestration for longer period of time in soils. Thus CR plays an important role in carbon sequestration in soils which would be an added advantage in relation to climate change and GHGs mitigation.

Crop residue management either by surface application or incorporation or retention in existing cropping systems can prevent soil and water loss via erosion and will conserve the natural resources. Crop residue mulching has been demonstrated to slow down runoff, soil and nutrient loss, reduce evaporation, contributing to greater soil water content and resilience in rainfed areas of the country.

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Nematophagous Fungi

Article id: 11177

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INTRODUCTION: Nematophagous fungi are microfungi that can capture, kill and digest nematodes. Nematophagous fungi are carnivorous fungi specialized in trapping and digesting nematode. Agriculture production is affected by a number of diseases and pest organisms such as insects, fungi, bacteria, virus etc. Another important group of pest so called plant parasitic nematodes or Phytonematode have recently came into prominence.

Around 200 species are known. Nematophagous fungi can be useful in controlling nematodes *Purpureocillium* for example can be used as a bio-nematicide. Fungi like Arthobotrys, Dactylella, Dactylaria actively trap nematodes with the help of trapping devices on their mycelium.

Nematophagous fungi also called as predacious fungi or nematode destroying fungi or nematode trapping fungi. *Harposporium anguillulae, Haptogloss a mirrabillis, meria coniospora, catenaria anguilulae* etc. Are the endoparasites of nematodes whose spore are injected by nematodes and develope inside the body.

Crop losses cause due to nematode

How does nematode depress crop yields?

- Phytoparasitic nematodes feed on plant parts by piercing stylet and absorbed nutrients, which required for its growth and development.
- Cause Mechanical injury to plant parts during feeding and these feeding sites serve as points of entry for other pathogenic fungi and bacteria.
- Secrete enzymes in the plant tissue during feeding and plant show abnormal growth responses to these secretions.
- Act as vectors of important fungal, bacterial and viral pathogens of plants e.g. *Xiphinema index* transmitting grapevine Fanleaf virus in grapevine.

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Estimated overall average annual yield loss in major crops of the world due to nematodes is 12.3 per cent. For the 20 major crops which serve as the man's primary food source, annual yield loss of 10.7 per cent was estimated, while for another group of 20 crops mainly of commercial importance a 14 per cent annual yield loss was assessed. In India, the annual lossed due to cereal cyst nematode, *Heterodera avenae* in wheat and barley was estimated to be Rs. 32 million and 25 million, respectively; in Rajasthan alone. For seed gall nematode, *Anguina tritici* (alone or in combination with a bacterium), the annual yield loss amounting to Rs 70 million was estimated in wheat in North India . An annual loss of Rs. 20 million was assessed in coffee due to lesion nematode *Pratylenchus coffeae*. in an area of about 1,000 ha in Karnataka alone.

Mechanism of action of predatory fungi against Phytonematodes

1. Trap induction

In pure culture nematode trapping fungi rarely produce trapping organs, but traps are abundantly produced within 24 hours if nematodes are added. Predatory fungi secretes substances called 'Nemin' which are able to induce trap formation. Trap formation began within 2 hr and reached a maximum trap density within 5 hr, independent of nematode density.

2. Attraction

Attraction can be mediated by chemical substances secreted by the mycelium. The mycelium of nematode trapping fungi secretes chemical substances which attract nematodes. Field and Webster (1977) found that nematodes were attracted towards mycelium only when trap had been produced.

3. Adhesion

The attraction of nematodes to mycelia with adhesive traps was significantly higher than to hyphae without traps. Adhesive material is present on the surface of traps before the interaction between fungus and nematodes occur. In some of the fungi there is now evidence for a molecular interaction between a carbohydrate binding protein located on the trapping structure binding to a carbohydrate on the surface of the nematode.

4. Cuticle penetration

The cuticle of living nematodes can only be penetrated after the firm anchoring of the infection structure to the nematode surface either by an adhesive or mechanically as in the constricting ring. The protease secreted by fungi generates peptides which degrade the host cuticle during penetration.

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5. Toxification

The predacious fungi produce nematicidal toxins which paralyzes nematodes and their movement is arrested within 10-15 min. The production of ammonia and high molecular weight carbohydrate containing substance by the fungi toxic to nematodes.

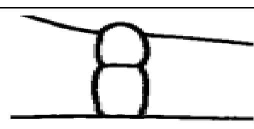
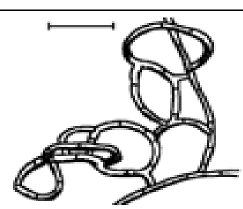
6. Digestion

The digestion of the nematodes by predatory fungi is often completed within 48-72 hours. After penetration of the cuticle, formation of an infection bulb and the tropic hyphae develop throughout the nematode body. After consumption new loops are formed on the traps and later large number of conidiophores and conidia develop.

Type of trapping device

Trapping device	**Example**
Sticky knobs	*Dactylella ellipsospora*
Sticky columns	*Dactylella cionopaga*
Three dimensional	
Sticky network	*Arthrobotrys superba*
Constricting rings	*Dactylella bembicoides*
Non constricting rings	*Dactylella lysipaga*

Table No. 1. Trap types of predaceous Nematophagous fungi

Trap types		**Nematophagous fungi**
Adhesive columnar branches		*Monacrosporium cionopagum*, *Monacrosporium gephyropagum*, *Dactylella lobata*
Adhesive three dimensional network		*Arthrobotrys superba*, *Arthrobotrys oligospora*, most of the rest of *Arthrobotrys* species.

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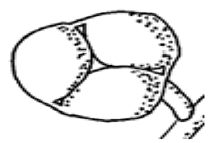
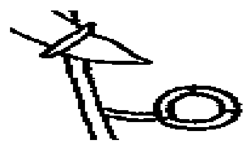
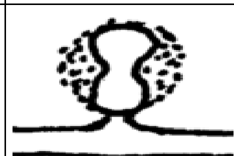
Trap types		Nematophagous fungi
Constricting rings		*Arthrobotrys dactyloids, Dactylaria brochopaga Monacrosporium doedycoides.*
Non-constricting rings		*Dactylaria candida, Dactylaria leptospora*
Spherical or oval adhesive knobs		*Dactylaria candida, Dactylaria leptospora Monacrosporium ellipsosporum.*
Hourglass shaped adhesive knobs		Teleomorphs *Hohenbuehelia/ Resupinatus* with anamorph (Form genus) *Nematoctonus* examples: *Nematoctonus leiosporus, Nematoctonus geogenius, Hohenbuehelia petalodes.*

Toxin Producing Fungi

***Pleurotus ostreatus*:**

Nematode has been paralyzed by the nematode toxin ostreatin produced by secretory appendages on the hyphae of *Pleurotus ostreatus.* The directional hyphae from the fungus have located the nematode and grown into the mouth to colonize and digest the body.

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CONCLUSION

- Nematophagous fungi are ubiquitous organisms with the capacity to attack, infect and digest living nematodes at all stages, adults, juveniles and eggs.
- The fungi may use trapping organs, spores and appressoria to initiate infection of their nematode hosts.
- The nematophagous fungi may not only infect nematodes, but may also infect other fungi as mycoparasites, and colonize plant roots endophytically.
- These various capabilities of nematophagous fungi, the latter in particular, may render them good candidates for biological control of plant root diseases.

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AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

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Involvement of women in dairy enterprise

Article id: 11178

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INTRODUCTION

India is the second largest producer of milk in world. The country produces nearly 50 to 60 million tonnes of milk every year and currently contributes around 9.5 percent of the global milk production. India is also the largest consumer of milk in the world. So dairy enterprise is a good business in our country to improve the economic condition of farmers. Dairy enterprise plays a crucial role in our country to create employment and to generate income of the people. In India, most of the women are actively participate in crop production, livestock management. In India the rural women play a significant role They are capable to take care of the dairy farming. But they are not so much aware about modern technologies to take care of the livestock, lack of availability of veterinary literature, marketing channel. Though women play a significant role in dairy farming but their control over livestock and its products is very minimal. The income incurred from dairy animals neither remains in hands of women nor the decision making regarding sale and purchase of the various items required in a dairy unit(Kaur,2015). The rural women play a significant role in animal husbandry and are indulged in practices like feeding, breeding, management and health care. Women spend most of their time in care and management of the dairy animals. Being key players in flourishment of the dairy industry, women are a helping hand in dairy enterprise. They constitute 71 per cent of the labor force in livestock farming. In India, about 75 million women are engaged as against 15 million men in dairying (Thakur and Chander, 2006).

Dairy enterprise:

The dairy sector today provides 80 million farm households with the triple benefits of nutritive food, supplementary income and productive employment for family labor, mainly for women. The nation's milk supply comes from millions of small producers, dispersed throughout the rural areas. A wide range of milk producers (around 70 million rural households) viz. landless laborers, marginal, small, medium and large farmers are engaged in dairy farming in India.

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Dairying is closely interwoven with the socio-economic fabric of rural people in India. Traditionally, dairy animals have performed multiple functions of producing milk for household consumption, dung as manure and fuel, and male livestock providing a source of draught power in agricultural operations. As a result of a gradual transition from subsistence to the market system, the economic dimensions of livestock keeping have assumed increasing significance in farm household behaviour .

Possibly, the most desirable economic feature of India's small-scale dairy industry in the present era is low energy consumption in milk production compared to developed countries. This is mainly because of:

• The use of animal and human power in producing fodder and feed;
• Feeding of crop by-products such as straw, rice bran, cottonseed and oilseed cakes whose production does not require any additional energy;
• The predominance of grazing over stall-feeding;
• The use of human power for milking, tending and disposal of animal wastes including dung;
• Keeping animals in low-cost sheds or in the open;
• Relatively low consumption of concentrated feeds.

Marketing and disposal of milk is particularly difficult for small-scale producers. In general, the small-scale milk production system in India could be broadly classified into four main categories:

• Dairying for home consumption; specialized milk production for home consumption where milk is an essential part of the household diet.
• Dual purpose for animals (for milk and draught) where seasonal surpluses of milk are converted into market sales of storable household products.
• Small-scale dairy farming where milk and milk products are converted into market sales.
• Commercial dairy farming where the animal holding is comparatively large and milk and milk products are converted into market sales.

Milk disposal throughout the country is carried out according to four methods:

• Through *dudhias* (small traders); traders buy good quality milk from producers at a lower price and then adulterate it by adding water to increase the quantity and sell it in the urban markets at a higher rate, earning more profit, none of the margin returning to the producers;

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• Through private enterprises owned and run by an individual or in partnership as a private business, such enterprises make huge profits and exploit small producers by buying their milk through agents or middlemen;
• Through state-owned city dairies; these dairies also depend on traders and cannot benefit producers, mainly because the producers do not have a direct link with such dairies;
• Through collective ownership; for example self-help groups/milk bulking groups/dairy cooperatives. This method was better than others, but because of organizational and managerial defects, the desired progress could not be achieved and producers could not get remunerative returns until the launching of 'Operation Flood' (OF).

Opportunities and challenges of women in dairy enterprise:

The importance of dairying in our country hardly needs emphasizing. The vast resources (more than 50 percent of the world's buffalos and 20 percent of its cattle) of livestock in the country play an important role in the national economy as well as in the socio-economic development of millions of rural households. Despite the drastic growth of service and industrial sector in India, still majority of the people nearly 70 percent living in rural areas. Thus Higher growth of economy is impossible unless and until the rural areas developed well in all aspects. Under these circumstances the governments have introduced many schemes and programmes for rural development. But it failed to succeed in achieving its targets. Livestock sector aroused as major sub-sector in agriculture by providing major source of income to the majority of the people in rural areas, especially in dry land and drought prone areas. The marginal and small farmers are the major beneficiaries of the dairy industry in rural areas. It providing employment to the nearly 18 million people, more importantly 60 to 70 percent are women. Dairy farming plays a significant role in sustaining the rural livelihoods.

The problems faced by the dairy farmers are mention below:

- Shortage of feed: Shortage of green fodder is the root cause of poor performance of poor performance of dairy sector to the genetic milk production potential of crossbreed cow could not be exploited fully in absence of proper nutrition.
- Insufficient veterinary services: Due to lack of proper veterinary extension system there is poor perception to the farmers towards dairy enterprise as a viable alternative to crop husbandry.

- Lack of marketing facilities: Due to lack of marketing facilities and extension services, there is poor perception of the farmers towards commercial dairy enterprise as an alternative to other occupation.
- Prevalence of middleman: Unorganised fragmented market for milk and milk products involved a chain of middleman who reaps the actual benefit depriving the producers from their share.
- High medical costs.
- Huge initial infrastructure cost.
- High attrition of skilled labor.
- Male calves are burden.
- Limited access to services such as health, credit and training.

Women entrepreneurship:

The concept of women entrepreneurship is of recent origin. Skill, knowledge and adaptability in business are the main reasons for women to emerge into business-ventures. According to government of India, "An enterprise owned and controlled by a women having a minimum financial interest of 51% of capital and giving at least 51% of the employment generated by the enterprise to women." "Women Entrepreneurship" means an act of business ownership and business creation that empowers women economically increases their economic strength as well as position in society. "Women Entrepreneur" is a person who accepts challenging role to meet her personal needs and become economically independent. A strong desire to do something positive is an in built quality of entrepreneurial women, who is capable of contributing values in both family and the social life". With the advent of media, women are aware of their own traits, rights and also the work situations. They have established their own successful business empires. They are contributing towards the growth of economy and improvement of their socio economic conditions. Government of India has given due importance to women empowerment in the country and several schemes has been introduced for the upliftment of women entrepreneurs. Women workforce ratio in the country is increasing due to the increase in the women literacy rate in India. In rural India, agriculture and allied industrial sectors employ as much as 89.5% of the total female labor. Women constitute 51% of the total employed in forest-based small-scale enterprises.

Reasons for women becoming entrepreneurs:

Many women start a business due to some traumatic event, such as divorce, discrimination due to pregnancy or the corporate glass ceiling, the health of a family member, or economic

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reasons such as a layoff. They are flourishing as designers, interior decorators, exporters, publishers, garment manufacturers and still exploring new avenues of economic participation. Following are the reasons for women becoming entrepreneurs.

- Freedom to take own decision and be independent.
- Employment generation.
- New challenges and opportunities for self fulfilment.
- Innovative thinking.
- Self-identity and social status.
- Education and qualification.
- Support of family members.
- Need for additional income.
- Family occupation.
- Success stories of friends and relatives.
- Government policies and procedures.

Role of women as an Entrepreneur:

1) **Imaginative**: It refers to the imaginative approach or original ideas with competitive market. Well-planned approach is needed to examine the existing situation and to identify the entrepreneurial opportunities. It further implies that women entrepreneurs have association with knowledgeable people and contracting the right organization offering support and services.
2) **Attribute to work hard**: Enterprising women have further ability to work hard. The imaginative ideas have to come to a fair play. Hard work is needed to build up an enterprise.
3) **Persistence:** Women entrepreneurs must have an intention to fulfill their dreams. They have to make a dream transferred into an idea enterprise; Studies show that successful women work hard.
4) **Ability and desire to take risk:** The desire refers to the willingness to take risk and ability to the proficiency in planning making forecast estimates and calculations.
5) **Profit earning capacity:** She should have a capacity to get maximum return out of invested capital.

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A Woman entrepreneur has also to perform all the functions involved in establishing an enterprise. These include idea generation, and screening, determination of objectives, project preparation, product analysis, determination of forms of business organization, completion of formal activities, raising funds, procuring men machine materials and operations of business.

Constraints faced by the Women Entrepreneurs in India:

Women in India are faced many problems to get ahead their life in business. The major barriers encountered by women entrepreneurs are:

i. The greatest deterrent to women entrepreneurs is that they are women. A kind of patriarchal- male dominant social order is the building block to them in their way towards business success. Male members think it a big risk financing the ventures run by women.
ii. The financial institutions are skeptical about the entrepreneurial abilities of women. The bankers consider women loonies as higher risk than men loonies. The bankers put unrealistic and unreasonable securities to get loan to women entrepreneurs.
iii. Lack of self-confidence, will-power, strong mental outlook and optimistic attitude amongst women creates a fear from committing mistakes while doing their piece of work. The family members and the society are reluctant to stand beside their entrepreneurial growth.
iv. The women entrepreneurs are suffering from inadequate financial resources and working capital. The women entrepreneurs lack access to external funds due to their inability to provide tangible security. Very few women have the tangible property in hand.
v. Indian women give more emphasis to family ties and relationships. Married women have to make a fine balance between business and home. More over the business success is depends on the support the family members extended to women in the business process and management. The interest of the family members is a determinant factor in the realization of women folk business aspirations.
vi. Women in India lead a protected life. They are even less educated, economically not stable nor self-dependent which reduce their ability to bear risks and uncertainties involved in a business unit.

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vii. The old and outdated social outlook to stop women from entering in the field of entrepreneurship is one of the reasons for their failure. They are under a social pressure which restrains them to prosper and achieve success in the field of entrepreneurship

viii. Another argument is that women entrepreneurs have low-level management skills. They have to depend on office staffs and intermediaries, to get things done, especially, the marketing and sales side of business. Here there is more probability for business fallacies like the intermediaries take major part of the surplus or profit. Marketing means mobility and confidence in dealing with the external world, both of which women have been discouraged from developing by social conditioning. Even when they are otherwise in control of an enterprise, they often depend on males of the family in this area.

ix. High production cost of some business operations adversely affects the development of women entrepreneurs. The installations of new machineries during expansion of the productive capacity and like similar factors discourage the women entrepreneurs from venturing into new areas.

x. Lack of knowledge of availability of the raw materials and low-level negotiation and bargaining skills are the factors, which affect women entrepreneur's business adventures.

Following efforts can be taken into account for effective development of women entrepreneurs.

1. Encouraging Women's participation in Decision-Making.
2. Vocational Training to be extended to Women Community that enables them to understand the production process and production management.
3. Better educational facilities and schemes should be extended to women folk from government part.
4. Training on professional competence and leadership skill to be extended to women entrepreneurs.
5. Skill Development in Women's Polytechnics and ITI's.
6. Counselling through the aid of committed NGOs, psychologists, managerial experts and technical personnel should be provided to existing and emerging women entrepreneurs.
7. Activities in which women are trained should focus on their marketability and profitability.

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8. Making provision of Micro-Credit System and enterprise credit system to Women Entrepreneurs at Local Level.
9. State finance corporations and financing institutions should permit by statute to extend purely trade related finance to women entrepreneurs.
10. Women's development corporations have to gain access to open-ended financing.
11. Repeated gender sensitization programmes should be held to train financiers to treat women with dignity and respect as persons in their own right.

Conclusion

Dairy enterprise is a effective entrepreneurship for the women in India to develop theor socioeconomic condition. The knowledge level of the women should increase by giving proper training about the livestock management and marketing process. The government should take more initiatives to awe the women to involve in dairy enterprise.

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Disease detection and its organic management of early blight of Tomato

Article id: 11180

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Introduction:

Early blight is a fungal disease which is caused by *Alternaria solani.* The organisms survive between plant on infected plant residues and on solanaceous host weeds. These fungi can also spread through infected seed. Early blight commonly affects the solanaceae vegetables, and it occasionally infects brinjal. It causes reduction in the overall plant growth and yield. The disease is favoured by warm temperatures and longer periods of leaf wetness from frequent rain, overhead irrigation, or dew. The fungal spores can be spread by various means like wind, rain, irrigation water, insects, workers, and also with the infected tools and equipment. Once the primary infections have occurred, they become the most important source of new spore production and are responsible for rapid disease spread. The disease can develop quickly mid- to late season and is more severe when plants are under stressed conditions by poor nutrition, drought, other diseases, or pests.

Symptoms:

The disease symptoms first appears as small brown-to-black lesions on older foliage. The area surrounding the primary lesions may become bright yellow, and when lesions are enlarges, entire leaves may become chlorotic. As the lesions enlarge, they often develop concentric rings giving them a bull's-eye or target-spot appearance. When conditions are favourable for disease development, lesions can become numerous and plants defoliate, reducing both fruit quantity and quality. Fruit can become infected either in the green or ripe stage through the stem attachment. Lesions have characteristic concentric rings and can become quite large, involve the whole fruit. Infected fruit often drops which affects the yield of the plant. Fruit on defoliated plants are also subject to sunscald. Stems and petioles affected by early blight have elliptical concentric lesions, which severely affects the growth and development of the plant. If the symptom arises consecutively on many seedlings, it may indicate contamination of tomato seeds or soil used for planting.

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ISSN: 2581-8317
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Disease Cycle:

The fungus survived on infected parts of plants, seed, or in the soil. It can live for 1 year on infected parts of plants. If the spring is warm and wet you get more early blight. Early varieties of tomatoes are more likely to get early blight.

Disease Management:

- Early blight survives between crops in or on the residue from diseased plants, so it is important to remove diseased plants or destroy them immediately after harvest.
- Rotate your crops every 3-4 years and in that year do not plant any tomatoes, peppers, potatoes, or other crops in the solanaceae family.
- Use pathogen-free seed and transplants. Hot water treatment at 50-55ºC for 25 minutes is recommended to control early blight on tomato seed.
- Staking and mulching are important practices in an early blight control program since staking keeps foliage and fruit away from the soil surface, and mulching cuts down on soil splash onto lower parts of the plant.
- Since soil particles often contain the early blight fungus, therefore the use of biopesticides like *Trichoderma viride and Trichoderma harzianum* as soil incorporation shows good result in controlling the disease.
- Incorporation of good quality organic amendments like compost and vermicompost help in maintaining a good amount of favourable microorganisms in the soil which reduce or prevent the growth of the fungus *A. solani*.
- Avoid planting in low areas that remain wet in the early spring. Use drip or early morning sprinkler irrigation to reduce wetness of leaf.
- Maintain plant vigour through adequate irrigation and fertilization to increase disease resistance.
- Early detection is important in disease management, so it is important to inspect the fields regularly for the incidence of disease if any.
- Disease forecasting is another important practice used to predict the probability of disease incidence.
- Deep summer ploughing and soil solarisation can be practised.
- Use of resistant varieties is the most provident, effective and sustainable control measure of early blight of tomato.

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Physiological disorders of Mango (*Mangifera indica* L.)

Article id: 11181

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Introduction

Physiological or a-biotic disorders are mainly caused by changing environmental conditions such as temperature, moisture, unbalanced soil moisture, inadequate or excess of certain soil minerals, extremes of soil pH and poor drainage. The distinction between physiological or abiotic disorders from other disorders is that they are not caused by living organisms (viruses, bacteria, fungi, insects, etc.), but they are the result of abiotic situations (inanimate)i.e. their agents are non-living in nature which causes deviation from normal growth. They results in physical or chemical changes in a plant which is far away from what is normal and is generally caused by an external factor. Non-infectious disorders in some cases are easy to identify, but others are difficult or even impossible to recognize. Most of them are non-reversible once they have occurred. For the identification of physiological disorders it is important that one must know that:

- Physiological disorders are often caused by the deficiency or excess of something that supports life or by the presence of something that interferes with life.
- Physiological disorders can affect plants in all stages of their development.
- They are non-transmissible because they occur without or in absence of infectious agents.
- Plant reacts differently to the same agent and sometimes response in seen as a little reaction to death.

Factors implicated in occurrence of physiological disorders include:

- Relative humidity (RH): Low RH accompanied by high or excess of temperature will generally occur as a problem.
- Atmospheric conditions: Atmospheric conditions overall play havoc with fruit plants in some parts of the world.

- Heat stress / scorch injury: This is one of the major physiological disorders especially in hot climates and it is caused by injury from direct sun exposure / intensity or just simply from too hot climate.
- Winter/cold injure and frost: Depending on severity, frost injury may cause browning of fruit tissues, deformation and damaging of fruit parts to complete death of a frit.
- Wind injury: Wind injury can also aggravate cold injury or winter injury, especially if the humidity is low at the time of the wind/cold period. Wind damage can be as simple as plant parts rubbing together causing surface scarring which also serve as entry points for pathogens.
- Chemical injury: Any kind of foreign chemical applied in the wrong dosage or at the wrong time is capable of doing physical damage to the fruit plants. Most chemical injuries will come from pesticides applied at too high rates, at wrong time or during very hot parts of the day.
- Mechanical or physical injury: This occurs where plants are physically damaged by people, wind, animals, equipment, etc.
- Water stress: This is the situation when the plant gets to much or not enough water to function properly. The water stress situations include heat where the plant cannot take up water fast enough for its needs, improper maintenance of irrigation equipment such as plugging of sprinkler heads for prolonged period of time or breakdown with long repair times.
- Nutrient deficiency or excess: Imbalance of different nutrients will give different reactions and an excess of one nutrient can make another one unavailable or non-functional. Every plant reacts different to excessively high or levels of nutrients, some reactions being quite evident, others less. Plants can be stunted, deformed or symptoms may occur as leaf tip or leaf margin burn.

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Mango

Scientific name: *Mangifera indica* L.
Family: Anacardeaceae

1.) Mango malformation

Mango malformation is of three types-vegetative, floral and mixed. The seedlings and young plants in the nursery are affected by vegetative malformation, whereas, the bearing plants are affected by floral malformation.

A.) Vegetative malformation: In this type of malformation, a compact leaf bunch is formed at the terminal portion of the shoot or in the axils of leaves and/or on the lower nodes of the seedlings. The buds get swollen and get converted into a thick and short shoot let bearing numerous small scaly leaves. Shoot lets arise from the axils of scaly leaves giving abnormal rosette appearance. Many such shoots may arise to form a bunch, hence known as 'bunchy top'.

B.) Floral malformation: In the floral malformation the panicles (inflorescence) are affected. The floral branches are formed as crowd of cone and compact masses of sterile flowers form a bunch. The flowers are crowded; enlarge with thick pedicels, enlarged petals and stamens.

C.) Mixed malformation: In mixed type there is development of leafy structures in the panicle making it malformed.

Causes

- This is due to imbalance between growth promoters and inhibitors in plants. There is auxin depletion and formation of malformin like substances.
- Poor cultural practices such as un-ploughed land, improper tilth, etc. lead to this disorder.
- It is due to use of imbalanced fertilizer mixture such as N, P, K and non-availability of the essential nutrients in soil.
- Factors such as unsuitable condition of humidity, temperature, rainfall, etc are all responsible for this malady.
- The fungus *Fusarium moniliformae* var. subglutinans has been isolated from malformed panicles. Fungus may not show any symptoms of disease until there is any injury on top of plant.
- It is also considered that attack of mites is another cause of malformation.

Control

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- All the infected shoots should be pruned off. Then a mixture of fungicide 0.1% captan, miticide Akar 33.8 (0.1%) should be thoroughly sprayed and repeated after every 10-12 days.
- Balanced fertilizer mixture containing high proportion of N in NPK (9:3:3) reduces the incidence of this disorder.
- One spray of 200ppm NAA in Oct (at the time of bud differentiation stage) is effective.
- Prune off the affected panicles and shoots soon after they appear and bury them in the soil or burn them immediately.

Mango malformation

2.) **Fruit drop:** Fruit drop is another serious problem in mango which causes great losses to the mango growers. The magnitude of the incidence can be realized from the fact that hardly 0.1% flowers after pollination and flower set reaches up to maturity. Maximum fruit drop occurs in the last week of April or first week of May.

Causes

- Formation of abscission layer at the point of attachment of fruit with the twig.
- Sometimes low carbohydrate content leads to the leaf, flower and fruit abscission.
- It may be due to embryo abortion.
- Degeneration of ovule may be another cause.
- Poor soil also creates condition for fruit drop.
- Attack of insect, pest and diseases.
- Pollination from inferior variety is another cause.
- Depletion of nutrients is also a factor.
- Inadequate irrigation water leads to fruit drop.
- Hormonal imbalance particularly auxin, etc are responsible for fruit drop.

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Control

- Irrigation is beneficial when the fruiting has taken place.
- Pollination from amenable variety by planting such plant in orchard.
- Proper application of nitrogen as it retards and reduces abscission.
- Two sprays of NAA@ 10-20 ppm during April to May is useful.
- Fruit drop can be controlled to some extend by spray of 20ppm of 2, 4-D in last week of April or in first week of May in Langra and Dusehari cultivars.


Fruit drop of Mango

3.) Alternate bearing: This term is synonymous with 'biennial bearing'. In alternate bearing there is production of a heavy crop in one year and no crops or very little crop in the next year.

Causes

- **Climatological factors:** Adverse climatic factors like rain, high humidity and low temperature sometimes convert an on year into an 'off' year directly or by promoting the incidence of diseases like powdery mildew and anthracnose.
- **Age and size of shoots:** Vast majority of non-flowering shoots are probably lacking in some vital substances or substances necessary for flower bud formation. The tree therefore takes a year to recoup this loss, thus causing biennial bearing habit.
- **Carbon/nitrogen ratio:** It has been found by various workers that irregular bearing in mango is caused by nutritional deficiency, especially that of nitrogen. It was further found that the proportionate increase in nitrogen led to vegetative growth whereas, its proportionate decrease favours flowering. It is quite evident that higher starch reserve, total carbohydrates and C/N compounds may create favorable conditions for the synthesis and action of the substances responsible for flowering.
- **Hormonal balance:** It has been found that alternate bearing is due to imbalance between growth promoters and inhibitors in mango plant.

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- **Varieties:** Biennial bearing is a characteristic of a variety and some workers emphasized that this due to the genomic constitution of the particular variety.

Control

- Proper upkeep and maintenance of orchard.
- Induction of flowering in mango through smudging (building up slow fires, emitting smoke) is an age old practice in the Philippines. Recent work to control alternate bearing has shown possibility of using an ethylene releasing compound, ethephon, inducing flowers every year. The concentration of ethephon @ 200 ppm coupled with 0.1% urea has been found effective.
- Growing regular bearing cultivars and hybridization.
- De-blossoming: This practice has been recommended by some earlier workers with a view to obtain some crop every year by reducing the crop load in the 'on' year and it put forth panicles in the following year which would otherwise be an 'off' year.

Alternate bearing

4.) Black tip: Black tip is another physiological disorder of mango, the causes of which has been attributed to coal fumes and gases of brick kiln by the investigators. The disorder is characterized by depressed spot of yellowish tissue at distant end of fruit which increases in size becoming brown and finally black. The growth stops and after pre-mature ripening such fruits become soft which never reaches maturity and drop down earlier.

Control

- Spraying of 0.6% Borax three times i.e. before flowering, during flowering and after fruit setting is necessary.
- Caustic soda 0.8% sprayed twice between last week of March and 3rd week of April minimize the losses to a great extent.
- Bordeaux mixture 2:2:250 or 1.5kg of copper oxychloride /5oolts of water should be used.

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Black Tip of Mango

Conclusion:

Undesirable affects caused by a non- pathogenic agent is known as physiological disorder. Factors responsible for physiological disorders such as relative humidity, atmospheric conditions, cold injure and frost, wind injury, chemical injury, physical soil problem, nutrient deficiency or excess, etc. That's are controlled by, proper irrigation, pollination from amenable variety by planting such plant in orchard, proper application of nitrogen, two sprays of NAA, keeping herbicides away from flowers, delayed pruning, balancing the internal nutrient, regulating temperature, the assimilation rate and the endogenous growth regulators can control cat-face etc.

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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Food security in North East India: Does pig production holds the key?

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Summary

The hilly region of North East India comprises eight States of Indian Territory consisting of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura which have been gifted by the nature with tremendous biodiversity and widely varying agro-climatic condition forming about 4% of total population of the country. More than 70 percent of total geographical area of NER is covered by hills and about 3 million hectare is estimated to be under soil erosion hazard as a result of practice of jhum cultivation. Out of 4 million hectare net sown area of the region, about 1.3 million hectare area is estimated to be under soil erosion hazard as a result of practice of jhum cultivation (Roy *et. al.,* 2015). The hilly region of North East India, on the whole, is characterised by fragility, marginality, inaccessibility, culturally heterogeneity, ethnicity and rich biodiversity (ICAR, Vision, 2025). From the above background, this paper analysis the perspective of food security and examines the prospects and benefits of pig production system in North East India for addressing the challenges faced by agriculture sector in order to ensure food security in this region. Livestock farming, particularly pig farming is an integral part of culture and tradition for majority of the tribal population in this region. Pork consumption in this region is much higher than rest of the country. As of today, pig production system of this region has many lacunae regarding health care, food safety & zoonoses, breeding management and marketing system. In order to address the challenges, strategic plans has to be implemented despite existing constraints, by meticulously redesigning the whole process of agriculture, along with sustainable climate resilient animal farming and their distribution. There are two-prolonged clear strategies for pig system development-smallholders pig farming and industrial pig production.

Introduction

Food is the most basic human need and is central to the discussion of human rights and social development. In a country like India where more than one-third of the population is estimated to be absolutely poor and one half of all children malnourished in one way or another, ensuring food security must be an issue of immense importance (Roy *et. al.,* 2015). Food security has been promoted by the United Nations Development Programme [UNDP] and analysts of hunger and famine as the most basic human need and as a central indicator of absolute poverty and physical well being (Sen and Sengugta, 1983). Food security is not merely an adequate aggregate supply of food, in true sense it is the stage where "all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life" (FAO). In this sense, food security is a broad concept and implies not only producing sufficient food, but also making food accessible to the entire population throughout the year on a sustainable basis. Food security also connotes freedom from famine and chronic malnutrition and this requires provision of the means whereby all individuals or families can adequately meet their nutritional needs on a daily and annual basis. Food security is a right of every citizen and not merely an aspiration. The ultimate objective of food security, therefore, is to guarantee food to every citizen irrespective of his or her ability to pay. Provision of food security is essential for maintaining peace and social harmony in a country (Acharya, 1998).

North Eastern Region (NER) comprises eight states of Indian territory consisting of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura which have been gifted by the nature with tremendous biodiversity and widely varying agro-climatic condition with a total geographical area of 262180 km^2 forming 8% of the total land area. The region has a population of about 47.9 million (2014) which is about 4% of total population of the country. More than 70 percent of total geographical area of NER is covered by hills. The net sown area is highest in Assam (34.1 %) where plains account for 84.4 percent of its total geographical area, followed by Tripura (23.5%), while Arunachal Pradesh has lowest net sown area (2.1%). The cropping intensity is around 135 %, highest in Tripura (185%), followed by Manipur (145 %). About 1.67 million hectare area is under shifting cultivation (*jhum* cultivation). Out of 4 million hectare net sown area of the region, about 1.3 million hectare area is estimated to be under soil erosion hazard as a result of practice of jhum cultivation (Roy *et. al.,* 2015). The hilly region of North East India, on the whole, is characterized by fragility, marginality, inaccessibility, culturally heterogeneity, ethnicity and rich biodiversity (ICAR, Vision, 2025). Traditionally, agriculture has been the mainstay of people of this region but the agro based economy fails to flourish as it should have due to lack of proper involvement and utilization of technological aids. Most rural population (82 %) depends on agriculture and allied sector for livelihood in the absence of industries, except in the state of Assam. Mixed farming system is the order as most of the farmers want to produce his household food and nutritional need to minimize the dependency on external sources. India moved ahead from its target of production to food surplus in different phases of the post-independence era (Mandal, 2011) but the stamp of backwardness has been attached to the North Eastern hilly region suffering from food and nutritional insecurity because of complex diverse risk-prone agriculture, low cropping intensity, subsistence farming, mono cropping and undulating topography of the region.

Economic and Physical Accessibility of Food

It is now a well-known fact that the nutrition plays an important role in physical efficiency of the people and act as a device to determine the food security in a country and in different parts of the country. One of the issues pertaining to the ongoing debate on food security is the per capita availability of food. The overall trend in per capita availability of food grains, has been marginally negative though it is fluctuating year wise. It should be noted that while availability is concern, changing demand patterns, especially diversifying toward high value commodities, have to be taken into account. The concern of food security is more about the composition of overall food basket as observed from changing consumption patterns than the availability of food grains. It is frequent to observe a change in dietary patterns where people substitute cereals with high value food, as economic growth picks up. It is important to recognize that the pattern of income changes has direct reflection on nutritional and food security. If the people have enough income, they may not always choose to consume a nutritional and balanced diet at the least cost. Factors which help for diet diversification are monetization in the rural economy and changing the food habits may be responsible for the decline in the demand for food grains in recent years. In north eastern state region, where, rice and meat are the major food items in the consumption basket, the food security in terms of calories and nutrition are calculated on the basis of these two major items. Variation of per capita consumption of rice from one State to other varies substantially. Diversification of expenditure pattern of north east people clearly indicated that in the lower range of expenditure group, the percentage share on consumption expenditure is in favour for cereals. As the range of income pattern increases, the household level expenditure is more in favour of non-cereals items than expenditure on cereals. All the states in North Eastern hilly region are deficient in terms of calories and none of the state has been meeting the minimum 2400 calorie norm as the per capital intake of calories concerned in the region. It can also be said that majority of the poor who are insecure in their food are located in the north east region of the

ISSN: 2581-8317

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country despite that region being endowed with abundant natural resources. The data reveals that failure to access to food or calories is not due to failure of production but also due to distribution failure, population immigration, method of cultivation, climatic constrains, land and natural resource utilization, socio economic constrains etc. These challenges not only hinder the agricultural growth but also skew the distribution system and food availability for native population (Giribabu, 2013).

Pig production in North East India: an overview

Pig production, compared to other livestock species has a high potential to contribute to high economic gain. This is because of two folds: First the pigs have high fecundity, high feed conversion efficiency, early maturing, short generation interval and relatively small space requirement. Secondly, they are multipurpose animals providing about 40% of meat consumed in the world market, and by-products like pig dung as manure and bristle for brush industry. Simple backyard pigs, pigs living on garbage belts, family operated farms and large scale integrated pig industries with sophisticated bio safety measures are the variety of production systems that has been practised in this region. Pig is widely distributed in all the eco-regions of the country and is an important occupation of the rural society especially the tribal masses. People of certain ethnic groups prefer to keep pigs, especially black ones, for festivals and ceremonial purposes. Interestingly, these ethnic groups are mainly concentrated in the North-Eastern Region (NER) where almost every household has a small piggery unit. In general, people of this region prefer pork than other meats consequently the demand for pigs is huge here. The pig population in India is only 10.29 million, which is just 1.05% of the worlds pig population of 977.02 million (FAOSTAT, 2014). Though India is sharing only 5.23% of total pork meat production in the world, North Eastern (NE) region of India is contributing 28.0% of India's total pig population. Interestingly, about 50% pork of the country is consumed in the NER region by the way of own production as well as procurement of live pigs from other parts of the country. Majority of the pig population is held by marginal and small farmers. Further, the average pig population per thousand human populations is about 11.5. Among Indian states, Assam has the maximum number of pigs with about 15.89% of the total pigs of our country. Other NE states produce roughly <0.5 million each. About 45% pigs of this region are crossbred (24% in India). Pig population decreased by -11% in NER during 2007 & 2012 (-7% in India). Tripura (37%) and Meghalaya (4%) showed positive growth whereas the growth was negative in Nagaland (-28%) & Assam (-18%). About 33% of the total pig population of NER are cross bred (24% in India) which is a result of indiscriminate cross breeding. Cross bred population has grown by 10% in between 2007-2012 in this region (3% in India). Mizoram, Nagaland and Sikkim have more than 40% cross bred each. Manipur (47%), Tripura (43%) and Sikkim (28%) are showing higher growth in crossbreeding. In Mizoram and Sikkim, it has been reported that crossbred pigs were preferred for better growth performance, higher weight gain, larger litter size and greater back fat thickness (Nath *et. al.,* 2013).

Pigs in this hilly region are reared in intensive production system and fed on homemade cooked feed including kitchen waste, locally available plants (Kumaresan *et. al.,* 2009) and wheat bran and rice polish. The highest human-pig ratio of 3:1 was recorded in Nagaland as compared to the national ratio of 76:1, as per 2003 livestock census (Njuki *et. al.,* 2010). Generally, an average of 1-2 indigenous or crossbred pigs used to be raised with zero to minimum inputs in terms of family labour and feeding (Patr *et. al.,* 2014). Smallholder pig farming practised in NER contributes to the livelihood in many ways - income from products, insurance against drought, emergency cash requirements, household nutrition, manure for crops etc. besides direct and indirect employment potential to the farmers (Lemke and Valle, 2008). The system of pig production in North Eastern Region of India is unique and traditional (Das and Bujarbaruah, 2005). Rearing pigs and eating pork is a part of the culture of the people. Households rear pigs because they grow fast, are highly prolific, there is a ready market and proven demand which can result in the quick generation of income. Despite its importance, the smallholder pig farms are faced with a number of problems like poor technological back up including rearing with non-descriptive pigs, unbalanced nutrition, poor management, lack of knowledge about production and marketing systems (Kumaresan *et. al.,* 2007, 2009). The smallholder pig farming system is always facing challenges and thus offering ample opportunities for its improvement for better livelihood. Higher earnings from pig farming keep the market attractive even for small producers when there is a ongoing trend towards improved productivity and rapid increase in market oriented agricultural production. Simple, affordable and accessible knowledge and technologies are being used for this production system. Food from local sources is highly preferred by rural as well as urban citizens. Taken together, these aspects suggest that small pig producers are very important for North East Indian meat sector. There are enough opportunities to improve smallholder pig production systems through multi-stakeholder involvement, market linkages and more research for replication and policy support.

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ISSN: 2581-8317

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Prospects and benefits of pig production system in North East India

In comparison to other livestock species, Pig production contribute to more economic gain for rural poor, landless, small and marginal farmers of the lower socio economic strata due to its following advantages:

•This region is largely deficit in terms of pig, piglets and pork/pork products
•Felt demand at the farm gate for pork and by products
•Traditional custom, skill, knowledge, practice and food habits are conducive for growth of pigs
•Industrialization is not taking place (scope for investment) in this sector
• Pigs are having better feed conversion efficiency i.e. they achieve more unit weight gain per kg of feed consumed as compared to other meat producing animals except broilers.
• In pigs, fecundity is quite higher – In each farrowing, sows produce 6 - 12 piglets.
• Sexual maturity is attained at an early age. A sow can be bred as early as 8 - 9 months of age and can farrow twice in a year under optimal management conditions.
• As compare to other classes of livestock, generation interval is shorter in pigs.
• As the market weight of 60-90 kg can be achieved within 7-10 months, it offers quick returns.
• Almost all parts of the animal can be consumed by the farm family and/or sold.
• Besides providing meat, it also supplies bristles and manure.
• Pigs can thrive on wide variety of feed stuff viz. grains, vegetables, fruits, fodder, sugarcane and kitchen waste.
• Commercial pig farming offers employment opportunities to seasonally employed rural farmers and contributes to the upliftment of their living standards.
• It requires little initial investment on building and gear for establishment and maintenance of pig farming. The smallholders pig farming has in fact greater potential to reduce poverty (Lanada *et. al.,* 2005).
• Pigs do not contribute to loss of grazing lands as a result they can be raised for their entire lifetime in enclosure (Mpofu and Makuza, 2003).
• The wet markets of this region are largely dominated by pork (about 95%)
• Processed and frozen product’s demand is growing at a slower pace; hope to expedite. Till date their markets are limited to few major urban centres.
• Poor infrastructure for slaughtering and selling.
•More than 70% of pork retailers operate without valid licences.

Scope for export market

• Scope for export is largely limited due to poor husbandry practices and prevalence of infectious diseases.
• In South East Asia, pig system is more improved, equipped to follow international WTO regulations.
• Large scale companies are maintaining the scientific and industrial supply chains.
• Scope for supplying to Indian army is nil.
• Domestic markets should be top of focus in the immediate future.

Market access for pork and by products

• Pig production system has a ready market at the farm gate (except remote hilly terrain).
• Excellent network of market agents and informants
• Very vibrant market system in the villages
• An efficient market system can be observed where almost 80% of market price goes to producers.
• Good demand for bristles (periodically)
• Hidden expenses involved in transportation of pigs is a major problem.

Black pigs (preferably Large Black) are more preferred by producers in this region. Natural breeding is most predominant while artificial insemination is not practised in most part of the region. Indiscriminate cross breeding occurs in the field. Pure indigenous needs conservation as it is losing ground. Breeding management is very poor because of poor knowledge and capacity of the farmers.

Opportunities for improvement

In the hilly regions of North East India, pig production is the prime source of animal protein, food insurance during crop failure and routes for additional income and employment that can improve the livelihood in a sustainable manner. As of today, pig production system of this region has many lacunae regarding health care, food safety & zoonoses, breeding management and marketing system. Access to veterinary services is very poor; only about 16.1% of diseased pigs are treated by veterinarians in both rural and urban areas. Most of the animals in this region are being treated by the farmers (67.9%). Vaccination against CSF and PRRS are not readily available and deworming is not done periodically. Hygiene and sanitation practices regarding farm management, slaughtering and selling are very poor, moreover quarantine of diseased animals is not practised well. Pork samples of this region carry high microbial load and antimicrobial residues. Among the zoonotic diseases, Japanese encephalitis is endemic. Awareness about food borne diseases and zoonoses is very poor among the locals. To conquer all these drawbacks, it is necessary to acquaint both the farmers and consumers with modern and hygienic farm management and importance of food safety measures. Other inevitable drawbacks are absence of breeder farmers in sufficient numbers, tendency of the pig farmers to raise pigs with negligible inputs and fondness of the consumers for pork from crossbred and exotic breeds etc. Consequently, indigenous pigs must be improved genetically on priority for production of superior germplasm. For improving production and productivity, selective breeding and crossbreeding must be practised. There is need for strengthening the pork marketing mechanisms at the local level to the marketing channels, and integrate production programme with slaughter houses to ensure better sustainability. Piggery has the potential to create an upbeat impact on the source of revenue for millions of resource poor, deprived, landless and marginal farmers.

Conclusion

The North Eastern states (Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura) are among the poorest in India with 35% of the population below poverty line while the national average is 26%. Reducing the number of undernourished, hungry and poor people on a sustained basis must be the foremost issue and challenge in the present circumstances. Agriculture and animal husbandry is one of the dominant sectors and the main source of income and employment for the rural population. From the above background, this paper analysis the perspective of food security and examines the prospects and benefits of pig production system in North East India for addressing the challenges faced by agriculture sector in order to ensure food security in this region. Livestock farming, particularly pig farming is an integral part of culture and tradition for majority of the tribal population in this region. The demand for pork is on the rise due to escalating per capita income, urbanization and changes in lifestyle and food habits. Pork consumption in this region is much higher than rest of the country. This ever increasing demand is met by imports from other states of India, besides from Myanmar. This region has got ample resource potential to become self-reliant in the field of agriculture as well as animal husbandry predominantly for pig production. But ills in utilization, conservation and management of the precious natural resources have so far deprived the region from becoming self-sufficient. In order to address the challenges, strategic plans has to be implemented despite existing constraints, by meticulously

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redesigning the whole process of agriculture, along with sustainable climate resilient animal farming and their distribution. There are two-prolonged clear strategies for pig system development- smallholders pig farming and industrial pig production. Integration of the pig production system along with crop cultivation is another way to make it sustainable. Additionally, cost of production should be reduced, per animal productivity should be increased, disease control and prevention have to be taken care of and proper marketing strategies must be followed for increasing return to household.

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AGRICULTURE & FOOD e-Newsletter
http://www.agrifoodmagazine.co.in
AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Refrigerated transport systems for fruits and vegetables handling and its future prospect

Article id: 11183

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Introduction

The principle of the refrigerated preservation of foods is to reduce and maintain the temperature of the food in order to control, reduce or stop the rate of deterioration of food. The food deterioration might occur due to physical changes (such as moisture loss), biochemical changes (e.g. browning reactions, lipid oxidation, and pigment degradation), due to microbiological parameters (*i.e.* growth of microorganisms) and also due to physiological (e.g. ripening, senescence, and respiration). The effective refrigeration process reduces the effect of these changes; preserve the food with a long shelf-life and quality. The objective of cold chain management is to achieve the desired shelf life of a fresh product without the commonly perceived quality deterioration resulting from ice crystal formation.

Food transport refrigeration is a critical link in the food chain not only in terms of maintaining the temperature of perishable products but also its impact on energy consumption and CO_2 emissions. Road transport refrigeration systems are required to operate reliably in much harsher environments than stationary refrigeration system. Reefer vehicles are the insulated vehicles and bodies like motor vehicle/panel van, rigid box, lorry, semi-trailer, and container or insulated tanker attached with or operated by refrigeration system. As specified in ATP agreement, the refrigeration equipment of the reefer vehicle must have a heat extraction capability of at least 1.35 times the heat transfer through the walls in a 30°C ambient temperature and 1.75 times if the refrigeration unit is tested separately outside the vehicle to determine its effective cooling capacity at the prescribed temperature. The factors considered in the design of the envelope of a refrigerated transportation unit include extremes of external weather conditions, desired interior environmental conditions, insulation properties, infiltration of air and moisture, difference between construction cost and operating costs and physical deterioration from shocks and vibrations during transport. The different types of refrigeration systems used to operate the reefer van/ containers are briefed here.

Different types of refrigeration systems used in transport vehicles

a) Ice cooling/ Icing method

Ice cooling is particularly effective for perishable items that cannot be readily cooled by other methods. Top icing, liquid icing, package icing and bottle icing are the different methods of icing. Storage containers which are suited for icing applications has to remain stable if being wet, such as waxed fibreboard cartons, wooden wire-bound creates, baskets, hampers and perforated plastic liners. Top icing a truck loaded with already cooled produce is a good way to provide additional assurance that the load will arrive properly cooled. However, icing in any form is not recommended for all types of fresh fruits and vegetables. Some items like strawberries, blueberries, and brambles cannot tolerate wetting. Other items, such as squash and tomatoes, can be injured by chilling to near freezing.

b) Vapour compression system

It is most common refrigeration system for refrigerated food transport applications at present. In a vapour compression refrigeration system, refrigeration is achieved as the refrigerant evaporates at low temperatures. The mechanical energy is used to run the compressor hence; it is also called as mechanical refrigeration systems. Mechanical refrigeration system with the vapour compression cycle offers a wide range of options for compressor drive methods. The choice may be based on duty required, weight, noise requirements, maintenance requirements, installation cost, environmental considerations and fuel taxation. The performance and power requirements of vapour compression system are normally assessed at full load. The majority of medium to large vehicles use self-contained refrigeration units which include a self-contained diesel engine. At -20°C and running at full capacity, the fuel consumption of the auxiliary diesel engine driving the compressor can be 1-5 lit/h depending on the size of the unit.

c) Absorption systems for food transport refrigeration

In absorption systems, the refrigerant is absorbed by the surface of absorbent on the low pressure side of the system and is given up on the pressure side. Its major difference to the vapor compression cycle, lies in the process by which the low-pressure refrigerant vapor is absorbed into a solution at low-pressure condition, subsequently pumped to a higher pressure, and then heated to produce a high-pressure vapor. The advantage of this cycle is that, less mechanical input is required than for the pumping of the gaseous medium in the vapor compression cycle. Koehler *et al*. (1997) designed, built and tested a prototype of a single-stage ammonia/water absorption system for truck refrigeration powered by the exhaust gases of the

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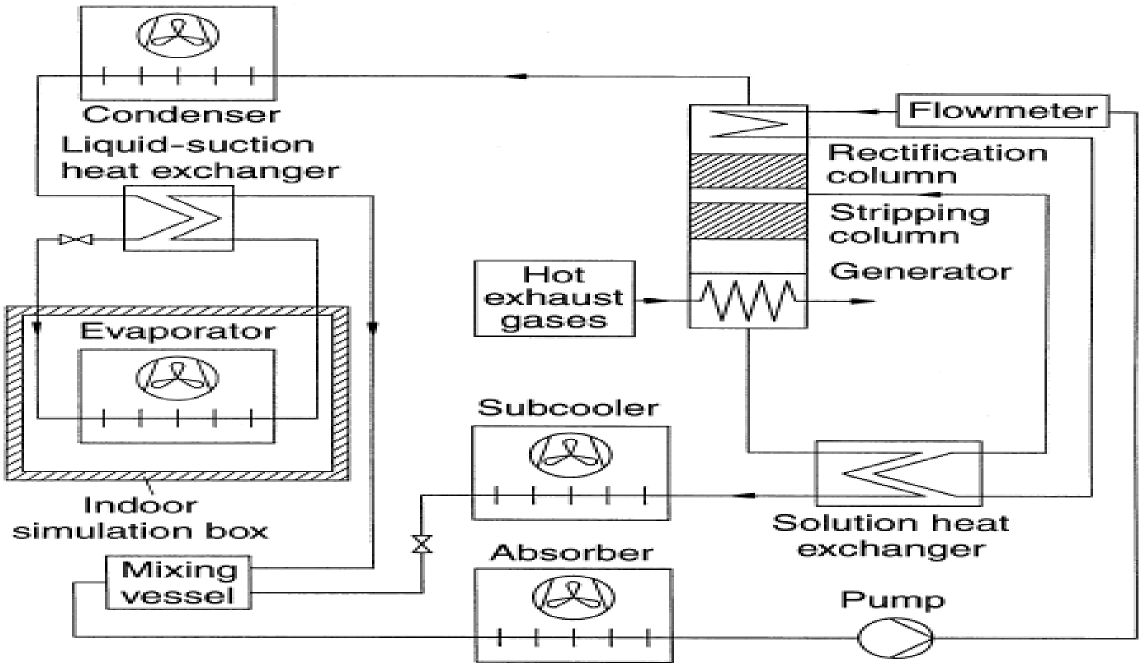
tractor. The cooling capacities were in the range 6-10 kW and COPs between 0.23 and 0.3 were obtained. A schematic diagram of this prototype is shown below.



d) Adsorption systems for food transport refrigeration

In adsorption system, the working fluid molecules adsorb onto the surface of a solid instead of dissolving into a fluid. The step in which heat is added results in working fluid molecules desorbing from the solid. Adsorption systems can be activated by a heat source with a temperature as low as 50°C (122°F), while the heat source temperature for an absorption system should be at least 90°C (194°F). Also, adsorption systems have less corrosion issues for the adsorbent−refrigerant working pairs when they incorporate high temperature heat sources compared to an absorption system. The major drawbacks of adsorption systems are their low energy efficiency, the COP (coefficient of performance: the ratio of cooling capacity to thermal energy supplied to the system) is usually less than 0.4, due to the thermal coupling irreversibility. Christy and Toossi (2004) designed and tested trailer refrigeration and bus air-conditioning ambient-air cooled adsorption system using activated carbon sorbent beds and ammonia (R717) as a refrigerant. Practical COP values used for system design were in the range 0.6 to 1 and specific cooling power rates (measure of the evaporator cooling load per mass of

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sorbent material) were considered to be around 614 W per kilogram of carbon for ammonia refrigerant and 198 W per kilogram of carbon for R134A refrigerant.

e) Eutectic (phase change material) systems: Eutectic systems consist of hollow tubes, beams or plates filled with eutectic solution (phase change material) to produce a cooling effect whenever necessary to maintain the correct temperature in the refrigerated container. The Eutectic concept is different to conventional refrigeration systems in that a cold source (heat absorption) is provided by phase change material rather than direct expansion of refrigerant gas. The plates or beams that contain the eutectic are charged (frozen down) at night using other refrigeration system. Once the beams containing eutectic material are frozen, they operate silently and provide reliable, rapid cooling for a specific duration of time.

Systems for food transport applications can be based solely on eutectic thermal energy storage or can be a combination of eutectic and vapour compression system. The eutectic cooling systems can be suitable for small deliveries, where the heat loss through frequently opening doors can be a major problem. They can offer considerable savings by using a small refrigeration system running relatively efficiently or if coupled with a mechanical refrigeration device can offer efficiency savings by reducing the number of on/off control cycles.

f) Cryogenic Cooling Systems

Cryogenics is the production and application of low-temperature phenomena. The cryogenic temperature range has been defined as from −150 °C (−238 °F) to absolute zero (−273 °C or −460 °F). Cryogenic temperatures are usually described in the absolute or Kelvin scale. The compounds that are processed within the cryogenic temperature region are sometimes called cryogens. There are only a few of these materials; they are generally small, relatively simple molecules, and they seldom react chemically within the cryogenic region. All of the cryogens except hydrogen and helium have conventional thermodynamic and transport properties. Now days, use of cryogenic substances such as liquid nitrogen, carbon dioxide in refrigeration systems is being considered as an effective alternative to mechanical refrigeration. The cryogenic cooling systems mostly use safe cryogen like liquid nitrogen (LIN), which is liquid at a temperature of -196ºC in the cooling process. The LIN is stored on-board in an insulated tank, its cooling energy is harnessed when it is piped through a heat exchanger with a large surface area. High velocity fans then circulate the chilled air throughout the compartment,

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providing a safe and efficient temperature pull down. The characteristics of selective cryogens are given below in table.

Advantages of cyro-coolings are rapid pull-down of temperature, lower maintenance; potentially zero GHG emissions and relative silence. However, for longer journeys, Cryogenic cooling systems are expensive to operate; so cryo-mechanical systems exist which combine the rapid pull down of a total loss refrigerant with the more economical steady running of a mechanical system.

Characteristic temperatures of cryogens

	Temperature (°C)		
Cryogens	**Triple point (°C)**	**Normal boiling point (°C)**	**Critical point (°C)**
Nitrogen	-210.1	-195.9	-147.0
Oxygen	-218.8	-183.0	-118.6
Methane	-182.5	-161.6	-82.7
Ethylene	-169.15	-103.76	9.55
Helium	-271.1	-269.0	-268.0
hydrogen	-259.4	-252.8	-240.0

Limitations

- Operating costs of the two systems will largely depend on the relative cost of diesel fuel and liquid CO_2.
- The uncertainty in diesel and CO_2 prices makes investment in CO_2 systems difficult on economic grounds alone. It is therefore likely that in the short term investment decisions on CO_2 systems will be based primarily on environmental considerations.
- Handling and storage of cryogenic gases can be dangerous
- Low temperature hazard and oxygen enrichment/deficiency hazard (Asphyxiation)

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Recommended refrigeration guidelines for fresh fruit and vegetable

Product	Temperature		Ventilation setting CMH	Relative Humidity (%)	Approximate Storage days
	° C	° F			
Apples	-1 to +4	+30 to +40	10 to 60	90 to 95	2 to 7 months
Bananas, green	+13 to +14	+56 to +58	25 to 60	85 to 95	18 - 22
Beans	+4 to +7	+40 to +45	20 to 30	95 to 98	7 – 10
Cabbage (early)	0	32	20 to 60	90 to 98	21 - 42
Carrots	0	32	10 to 20	90 to 95	28-180
Cauliflower	0	32	20 to 60	90 to 98	14 - 21
Eggplants	+8 to +12	+46 to +54	10 to 15	90 to 95	7 – 14
Figs (fresh)	-0.5 to 0	+31 to +32	0 to 5	85 to 90	7 – 10
Garlic	0	32	0 to 15	60 to 70	6 to 7 months
Ginger	+13	55	10 to 15	65 to 75	4 to 6 months
Grapes	-1 to 0	+30 to +32	10 to 15	90 to 95	1 to 5 months
Lemons	+11 to +15	+52 to +60	15 to 25	85 to 95	1 to 3 months
Lychees	+2 to +6	+36 to +43	10 to 15	90 to 95	21 - 35
Mandarines	+4 to +8	+39 to +46	15 to 25	90 to 95	21 - 56
Mangoes	+10 to +14	+50 to +57	25 to 30	85 to 95	14 - 21
Onion (dry)	0 to +2	+32 to +36	10 to 15	65 to 75	6 to 9 months
Oranges	+2 to +10	+36 to +50	15 to 25	85 to 90	1 to 3 months
Papayas	+10	50	25 to 30	85 to 95	7 – 21
Pears	0	32	15 to 25	90 to 95	1 to 6 months
Pineapples	+8 to +12	+46 to +54	15 to 25	85 to 90	7 – 21
Plums	0	32	15 to 25	90 to 95	15 - 20
Potatoes (table)	+4 to +8	+32 to +54	15 to 25	85 to 95	2 to 12 months
Strawberries	-0.5 to 0	+31 to +32	10 to 15	90 to 95	3 – 8
Tomatoes	+7 to +15	+45 to +60	15 to 30	65 to 90	7 – 28

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Future prospects of refrigerated transport systems

- Globalization has made the relative distance between regions of the world much smaller. Highly perishable food and fruit and vegetable freights mainly damages due to greater physical damage or due to temperature variations. It takes time and coordination to efficiently move a shipment and every delay can have negative consequences, notably if this cargo is perishable.
- To provide safe, high-quality refrigerated food products, attention must be paid to every aspect of the cold chain from initial chilling or freezing of the raw ingredients, through storage and transport, to retail display.
- Consumer food retail sector is the fastest growing in the country, worth around 15 billion USD 40% of fresh produce is wasted due to lack of satisfactory handling in the supply chain Indian cold chain business is fragmented in a big way.
- In the case of home deliveries using small reefer trucks, one vehicle could deliver fresh and/or frozen foods to 50 customers per day, as compared to 50 customers driving individual passenger vehicles to shop at the food market
- Due to the ubiquitous lack of cold storage, small-scale farmers are eager to sell their produce as close as possible after the time of harvest since the market value of vegetables decreases.
- The reported data indicates that, the post-harvest losses of horticultural produce in India are still around 20-25%. Using cold chain system, these losses can be brought down and more produce could be available for sale at the retail level. Even for lower value produce, this increase in marketable volume will have a major positive result on earnings of farmers.

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RICE RATOONING - A technology for higher production

Article id: 11184

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Rice (*Oryza sativa* L.) is considered as the global grain as it is the second largest source of food to many people especially in Asia. It is the major staple food for more than half of the global population. The world's total estimated area under rice production is 159 M ha with a production of 670 MMT with an average yield of 3889 kg ha-1. Out of 2234 calories day-1 capita-1 food intake, rice accounts for 30 per cent in Indian and it could be as high as 75% of the total calories intake for more than 3 billion Asians. India with 42.50 M ha area and 100.12 MMT of production with a productivity of 2400 kg ha-1 stands second after China where rice continues to hold the key to sustain food production by contributing 20–25% of agriculture and assures food security in India for more than half of the total population.

Nevertheless, increase in food production is the most emerging challenge of new century especially in developing country due to unhindered population explosion in the face of dwindling resources and inclement climate. So far substantial production use to accrue from second crop of rice in the tropics, but the production of a second rice crop is becoming difficult due to failure of rains and consequent lower water in the reservoirs and underground aquifer. Harvesting re-growth of planted crop after main crop harvest is called rationing.

Ratooning is the agricultural practice of harvesting a monocot crop by cutting most of the above-ground portion but leaving the roots and the growing shoot apices intact so as to allow the plants to recover and produce a fresh crop in the next season. This practice is widely used in the cultivation of crops such as rice, sugarcane, banana, and pineapple.

In rice it is considered an alternative for double rice cropping because of its short growth duration, low water requirement and high water use efficiency. A ratoon crop may also fit well in rainfed areas on residual moisture left after wet season rice crop or in irrigated areas with limited duration of available water or growing season. Harvesting of rice twice from the same single crop is practiced in the United States, Switzerland, India, Thailand, Taiwan, the Philippines and China.

Here, the production costs are lower than main crops due to the minimized cost for land preparation, transplanting and crop maintenance. However, performance of ratoon apart from varietal potentiality depends on tillering behaviour, duration of main crop, plant height, cultural practices, land preparation, spacing, seedling age, harvesting time of main crop, cutting height, fertilizer, water and pest and disease management and also external factors like temperature and light intensity. The amount of Total Carbohydrate Content (TAC) in the stem base, at early growth also found to influence ratoon growth. If everything is optimum not less than 50 per cent of main crop yield is well assured with less than 50 % of the resources used in the main crop.

Advantages:

- The main advantage of rice ratooning is that in areas where rice is the main crop, double crop of rice can be grown for additional returns.
- The ratoon crop matures earlier, it has been reported that days to maturity of the ratoon crops are 65 per cent less than the main crop.
- It requires 50 to 60 per cent less labour.
- Lower production costs because of savings in land preparation and plant care during early growth;
- This system requires short duration, creating possibility for growing another crop in the same cropping year and offers an opportunity to increase cropping intensity per unit of cultivated areas.
- Possible maintenance of the genetic purity of a variety or hybrid rice through several seasons;
- Low irrigation water requirements; 60% reduction in the amount of water needed to compare to a second crop of transplanted rice;
- The yield is up to 50 per cent of the main crop.

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ISSN: 2581-8317

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RATOON CROP PRODUCTION:

Eco system:

Based on land and water management, rice ecosystem is mainly divided into lowland, upland and deep water or floating rice. Rice ratooning is mainly practiced on lowland rice ecosystem. In India, out of the 40mha under rice, about 18.9mha constitute the ratooning under lowland.

Rice ratooning can be practised as an alternative to double cropping in areas of available water after the main crop season, particularly it is suited to hilly, tropical areas with heavy rainfall and under rain-fed conditions to tide over moisture stress because no other crops except rice can be grown under the climate and moisture limitations.

Variety:

Selecting the right variety is one of the most important and critical steps in obtaining high crop yields from ratoons. An ideal cultivar for rice ratoon cropping should have the following traits:

· Produces ratoon tillers after and not before harvest;
· Tillering from basal, not upper, nodes;
· Sixteen ratoon tillers/hill at 20 x 20 cm spacing;
· At least 3 leaves/tiller;
· Resistance to major disease and insects;
· Synchronized flowering and maturity;
· More than 60 growth duration from cutting to maturity; and
· High grain yield.

However, intermediate to late maturing cultivars are required for raising a good crop. The general trend is that intermediate to late maturing varieties produce higher yields than early maturing varieties. Many factors like variation in soil, water, light, and temperature greatly influences the ratooning ability. These interactions are needed to be studied properly for manipulating ratooning ability agronomically.

Rice ratooning depends on the ability of dormant buds on the stubbles of the crop to remain viable, the buds may be at different stages of development or similar in length. Auxiliary buds that developed at those bud nodes grew into ratoon tillers. Tillers regenerated from higher nodes formed more quickly, grew faster and mature earlier. The panicles from ratoon coming from lower nodes produced more grains per panicle than those from upper nodes, but their fertility percentage decreases. However panicles from upper nodes contribute more to ratoon yields than those from lower nodes.

Land Preparation:

Recommended land preparation practices for the main rice crop are undertaken only once because the ratoon crop does not require another round of land preparation. Deep ploughing (25 cm depth) increases yield of the ratoon.

Crop establishment:

Crop establishment in the main crop may either be by transplanting or direct seeding. Planting density is a more important factor in determining yield: the more plant/sq.m. the higher the yield (if no lodging occurs). Direct seeding usually results in a higher plant density than does transplanting at 20 cm x 20 cm distances but if the triple row transplanting method is used, plant density is about the same and less lodging occurs.

Fertilizer requirement

Fertilization of the main crop is essential for good yields in the ratoon crop. Deep placement of N fertilizer, if feasible, should be practiced as yields in the ratoon crop are increased by this practice. Green manuring practices and Nitrogen rates recommended for the first crop should be followed. N should be applied immediately at the harvest of the main crop to stimulate tillering of the ratoon crop. Suggested rate is 15-45 kg. N/ha.

Ratooning is a viable option for those farms where a second rice crop is not profitable and upland crops are either not profitable or cannot be grown due to poor drainage or other factors.

Water management

For proper growth and to promote ratooning, the field should be moist but not flooded for two weeks at the end of main-crop ripening. Draining the field several days after harvest also encourages ratooning. Irrigation water must be shallow in early ratooning stages, but irrigation is essential immediately after the first fertilizer application. One week later, the field should be drained and weeded, followed by intermittent irrigation.

Other management practices

The success of a good ratoon crop depends on the care with which the main crop is cultivated in the growing season. Agronomic practices and the care with which the main crop is protected against insect pests and diseases determine the success of ratooning and crop yields in ratoonable cultivars. Reduction in tillering ability and yield of the ratoon significantly are reported by low temperature at post maturity, similarly, blast incidence on the main crop can carry over to the ratoon resulting in total failures. Ratooning provides higher resource use efficiency per unit time and per unit land area. However, better yield of ratoon crop is possible by adopting appropriate management practices for main crop as well as for ratoon crop.

These management practices include land preparation, adequate plant density and spacing, use of appropriate cultivars, water management, application of adequate rate of fertilisers, appropriate height of cutting, and control of diseases, insects and weeds.

Cutting height

The effect of cutting height on ratoon grain yield performance varies. Cutting the main crop at ground level gave lower ratoon yields than cutting at 50% of the height of the main crop. Cutting the plants 35 cm above ground level (50% of the height of the main crop) gave maximum yield as against plants cut close to the ground. It has been observed 15-20 cm as the optimum cutting height above ground. It varies with the varieties planted, some cultivars tiller better when cut high above ground, while others produce better tillerswhen cut at lower levels.

Effect of growth regulators

To obtain higher ratoon grain yields, the percentage of productive tillers has to be increased. Growth regulators have been reported to stimulate growth and stem elongation and to inhibit lateral bud development. Applying gibberellic acid (GA3), indole acetic acid (IAA), naphthalene acetic acid (NAA), or 2,4-dichloroc-phenoxyacetic acid (2,4-D) at main crop flowering and late milk stage increased panicle number/hill . Benzyladenine (BA), 2-chloroethyl trimethyl ammonium chloride, GA3, kinetin and NAA on ratoon tillering, increased ratooning. Five ppm GA3 and 100 ppm BA induced bud sprouting most effectively. Foliar application of growth regulators at milk stage produced a higher percentage of sprouted buds than application at any other stage.

Harvesting of ratoon crop

The best time to harvest the main crop for raising a good ratoon crop is when its culms are still green; stalks should be cut before the main crop is fully matured. The better yield from ratoon crop is reported if main crop stubble is left with 2-3 nodes. Sowing time, temperature, day length and other factors have a profound influence on main crop duration, harvest date of the main crop and its effect on the rice ratooning also vary. Very little work has been done on this aspect. However, any delay in planting the main crop will delay the harvest and effects ratoon crop yield as well.

Strategies to be followed for improvement of rice ratooning crop:

The prospects of ratooning should be studied under rain-fed conditions to over moisture stress during later growing phases of the crop than irrigated rice.

Major emphasis and systematic breeding efforts should be undertaken to synthesise cultivars especially for ratooning. Cultivars suitable for different climate, altitude and purpose should be identified to optimise ratoon rice yields.

Efforts should be made to screen for ratooning ability of rice resistance to insects, pests and diseases, tolerance for low temperature especially during early seedling stage and for drought during later stages of the crop.

Post harvest technologies including seed viability and milling quality should be studied. Development of low-cost technology in terms of bio-fertilisers, weed management to minimise cultivation cost is necessary to make ratoon rice a profitable enterprise.

CONCLUSION

Ratooning is a viable option for those farmers where a second rice crop is not profitable and upland crops are either not profitable or cannot be grown due to poor drainage or other factors. It can also be adopted in areas where rice is cultivated mostly as a monocrop, and the resources go waste during the off-season. If we assume that the entire lowland rice area can be put under ratooning, the total production from ratoon cropping in Asia could be as high as 35.95 million tons annually.

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http://www.agrifoodmagazine.co.in
AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Diverse roles of Paclobutrazol

Article ID: 11185

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India ranks second in area and production of fruit crops in the world and exhibits wide variations in growth habit, flowering and fruiting. Orchard efficiency and productivity of fruit crops is affected by problems of biennial bearing, high fruit-drop during initial stages of fruit development and unfavourable environmental conditions resulting in low fruit set. Plant growth retardants especially paclobutrazol, has been found beneficial in combating some of the production-related problems. Paclobutrazol is triazole plant growth regulator that inhibits gibberellin and sterol biosynthesis. Paclobutrazol is considered as one of the important plant growth retardants which restricts vegetative growth and induces flowering in fruit crops.

Paclobutrazol has been extensively used in the horticulture industry to regulate the growth of fruit trees and ornamentals. Also there is a considerable interest in using it to regulate the growth of grass and trees in amenity areas. Because paclobutrazol is very active at low rates, the potential for error and crop damage is much greater. Usually as a spray, is applied at the rate of 2 to 90 ppm. It is new growths retardant developed by U.K. and have very large range of use in plant species.

Molecular Formula:	$C_{15}H_{20}ClN_3O$
Molecular Weight:	293.80 g mol^{-1}
Density:	1.19g/cm3
Chemical Class:	Triazole
Chemical Name:	N-dimethyl amino succinamic acid, -tetra -Butyl- (4-chlorobenzyl) 1H-1,2,4-triazole-1-ethanol
Common Names:	Paclobutrazol is also known as PP333, Cultar, Boltar, Austar, Bonzi, Cripper, Perfect.

Mode of action:

Plant growth regulator taken up into the xylem through the leaves, stems, or roots, and translocated to growing sub-apical meristems. It enhances flowering and fruiting. Paclobutrazol is taken passively by roots (xylem), stem tissues and foliage. Movement of paclobutrazol within plant is acropetal (base to apex). It moves in xylem vessels towards leaf. PBZ is absorbed by roots and translocated in the xylem only.

Its principle mode of action is inhibition of gibberellins biosynthesis. It results in retardation of vegetative growth and diversion of assimilates to reproductive organs giving increase in yield potential.

How does paclobutrazol act?

Available evidence strongly suggests that flower initiation depends on the presence of an unknown flower promoting factor or factors synthesised in the leaves. At the same time, there are other factors in the shoots which work against the flowering factor or factors. It is believed that a group of plant hormones called gibberellins act as inhibitors to flowering. When paclobutrazol is applied to the soil, it moves up through the roots into the shoots and, due to its anti-gibberellin properties, blocks the synthesis of flowering inhibitors, thereby allowing the flower-promoting factor(s) to work.

Methods of application of paclobutrazol

a. Soil application:

- Uptake of Paclobutrazol is most efficient when it is applied to soil which receives adequate water and where there is a high density of feeder roots.
- The application rate per tree is determined by the application rate per ha dividing by the number of trees per ha.
- The volume of diluted drench required for even application without run off will vary with the size of the tree and with soil type and moisture content. Use the higher volume on larger trees.
- Ensure that trees are adequately irrigated following treatment under dry conditions. Individual trees which are smaller than average should be left untreated or given a proportionally smaller dose of Paclobutrazol.
- Example :

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Dosage of Paclobutrazol **to different age of mango tree:**

a. 7-15Year=>15ml

b. 16-25Year=>20ml

c. 25 Year => 25-40ml

Foliar application:

Apply in a sufficient volume of water to ensure penetration of the spray and good coverage of target tissue, new green stem tissue in case of apples. Apply in a minimum volume of 1000 liter of water per ha. Surfactant (such as Agrol 600 or Wet spray 600) at 18 ml per 100 l of water must be added to the final spray volume. It is not normally necessary to re-apply the spray if rain follows soon after application. For best results, foliar spray after the sunset.

Time of application:

Seasonal cycle	Application Effect	Associated Benefits
Foliage Growth	Controls Tree Vigour	Reduces pruning costs Allows higher density planting Easier to achieve optimum tree shape Rejuvenation of older trees
Flowering	Earlier flowering Cycle Increased flowering uniformity Increased flowering intensity	Escape some pest and disease cycles Higher Yields
Fruiting	Increased Yields Higher sugar content Improves Fruit Colour Reduction in picking frequency	Improves palatability Improves early yield return Better presentation

For Example

Applied after the harvest of fruits will be ideal method of application. Recommended quantity of Paclobutrazol to be diluted in clean water of 5-10 liters and applies in a furrow 5 cm deep about 2 to 3 feet away from the trunk fill up with soil after application or apply as soil drench.

Role of Paclobutrazol

- Gibberellin inhibiting tree growth regulators such as Paclobutrazol (PBZ) have been shown to reduce shoot elongation, leaf expansion and stem diameter of many tree species.
- Paclobutrazol formulations such as Bonzi, effectively reduce internode extension on various plant taxanomy. This facilitates the production of more compact, denser canopied plants.
- More recently, PBZ has been shown to increase root growth of trees in certain landscape situations.
- PBZ has promise as a tool for improving the health and vitality of trees.
- It have expressed concerns that mycorrhizae could be reduced by PBZ treatment because PBZ is closely related to triazole fungicides and exhibits fungicidal properties.
- Carbohydrate content of various plant tissues can be increased by PBZ. The Increase in total carbohydrates in fibrous roots of apple seedlings because mycorrhizal fungi receive carbohydrates from the plant, increased carbohydrates in the plant could result in increased mycorrhizae.
- The application paclobutrazol aimed to reduce plant height to attain bushy structure.
- It also results in the high reservation of photosynthetic assimilates in temporary sinks (stem, leaves, and branches) when the crop had increased in girth of stems and branches.

Storage and disposal of PBZ packs:

- Store the PBZ in a closed and well ventilated cool condition in original container.
- Do not store it for prolonged periods in direct sunlight.
- Do not dispose of undiluted chemicals on site.
- If not recycling break, crush or puncture and bury empty containers.
- Empty containers and product should not be burnt.

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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Soil erosion and land degradation

Article id: 11186

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1. Introduction

Soil is a dynamic natural body on the surface of the earth and is a critical resources for supporting plant growth. The word "erosion" is derived from the Latin "erosio", meaning to "to gnaw away". In general terms soil erosion implies the physical removal of topsoil by various agents, including rain, water flowing over and through the soil profile, wind, ice or gravitational pull. The consequences of soil erosion can be seen both on-site and off-site. On-site effects are the loss of soil, the breakdown of the soil structure and a decline in organic matter. Erosion also reduces available soil moisture, resulting in more draught-prone conditions.

2. **Soil Erosion:** Soil erosion is a naturally occurring and slow process that refers to loss of field's top soil by water and wind or through conversion of natural vegetation to agricultural land.

"Soil erosion is one form of soil degradation. Soil erosion is a naturally occurring process on all land. The agents of soil erosion are water and wind, each contributing a significant amount of soil loss each year. Soil erosion may be a slow process that continues relatively unnoticed, or it may occur at an alarming rate causing serious loss of topsoil. The loss of soil from farmland may be reflected in reduced crop production potential, lower surface water quality and damaged drainage networks."

The process of soil erosion is made up of three parts:

- Detachment: This is when the topsoil is actually "detached" from the rest of the ground.
- Movement: This is when the topsoil is relocated to another area.
- Deposition: Where the topsoil ends up after this process.

Although soil erosion is a natural occurrence on all land, there are certain factors that call accelerate erosion making it more noticeable and problematic. While there are many different factors that can cause soil erosion, most can be broken down into two main categories: Well-structured soils are less prone to break up, and the impact of raindrops is minimised if the soil

AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
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surface is protected by plant or litter cover. The vulnerability of soils to water erosion depends on:

- Rainfall intensity (erosivity)—high intensity rainfall creates serious risk as heavy drops on bare soil causes the soil surface to seal
- Nature of the soil (erodibility)—clay soils vary in their ability to withstand raindrop impact.
- Slope length—if a slope is long, water running down the slope becomes deeper and moves faster, taking more soil with it
- Slope steepness—the speed of runoff increases on steep slopes, which increases the power of water to break off and carry soil particles.

3. **Types of soil erosion:** Mainly there are two type of soil erosion.

   I. **Water erosion:** It is the removal of soil from the land surface by water, including runoff from melted snow and ice and is one of the major causes of soil degradation. Water erosion has been sub divided into various types in relation to progressive concentration of surface runoff.

Forms of water erosion

1. **Sheet erosion**

   It is the uniform removal of surface soil in thin layers by sheet, or over land flow of water. The breaking action of rain drop combine with surface flow is the measure cause of sheet erosion. It is the first stage of erosion and is least conspicuous.

2. **Rill erosion**

   When runoff starts, soil is lost from small but well defined channels or streamlets (rills) by water when there is concentration of surface flow. This is the second stage of erosion. Rill erosion occurs when runoff water forms small channels as it concentrates down a slope. These rills can be up to 0.3m deep. If they become any deeper than 0.3m they are referred to as gully erosion.

3. **Gully erosion**

   Gully erosion happens when runoff concentrates and flows strongly enough to detach and move soil particles. Gullies may develop in watercourses or other places where runoff concentrates. In cultivation or pastures, advanced rill erosion can develop into gully erosion. This type of erosion is highly visible and affects soil productivity, restricts land use, and can damage roads, fences and buildings. Gully depth is often limited by the depth of the underlying rock which means gullies are normally less than 2m deep. However, gullies may reach depths of 10–15m on deep alluvial and colluvial soils.

4. **Stream bank erosion**

Stream banks are eroded by water either flowing over the sides of stream or scouring at the base. The major cause of stream bank erosion is the destruction of vegetation on river banks (generally by clearing, overgrazing, cultivation, vehicle traffic up and down banks or fire) and the removal of sand and gravel from the stream bed.

Fig. 1

Forms of water erosion

II. **Wind Erosion**: Wind erosion is a serious environmental problem attracting the attention of many across the globe. It is a common phenomenon occurring mostly in flat, bare areas; dry, sandy soils; or anywhere the soil is loose, dry, and finely granulated. Wind erosion damages land and natural vegetation by removing soil from one place and depositing it in another. It causes soil loss, dryness and deterioration of soil structure, nutrient and productivity losses and air pollution.

Suspension, **saltation**, and **surface creep** are the three types of soil movement which occur during wind erosion. While soil can be blown away at virtually any height, the majority (over 93%) of soil movement takes place at or below one meter.

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1. **Suspension**

   Suspension occurs when very fine (less than 0.1mm) dirt and dust particles are lifted into the wind. They can be thrown into the air through impact with other particles or by the wind itself. Once in the atmosphere, these particles can be carried very high and be transported over extremely long distances. Soil moved by suspension is the most spectacular and easiest to recognize of the three forms of movement.
2. **Saltation**

   The major fraction of soil moved by the wind is through the process of saltation. In saltation, fine soil particles (Less than 0.5 mm) are lifted into the air by the wind and drift horizontally across the surface increasing in velocity as they go. Soil particles moved in this process of saltation can cause severe damage to the soil surface and vegetation. They travel approximately four times longer in distance than in height. When they strike the surface again they either rebound back into the air or knock other particles into the air.
3. **Surface creep**

   The large particles (Larger than 0.5-2.0 mm) which are too heavy to be lifted into the air are moved through a process called surface creep. In this process, the particles are rolled across the surface after coming into contact with the soil particles in saltation.

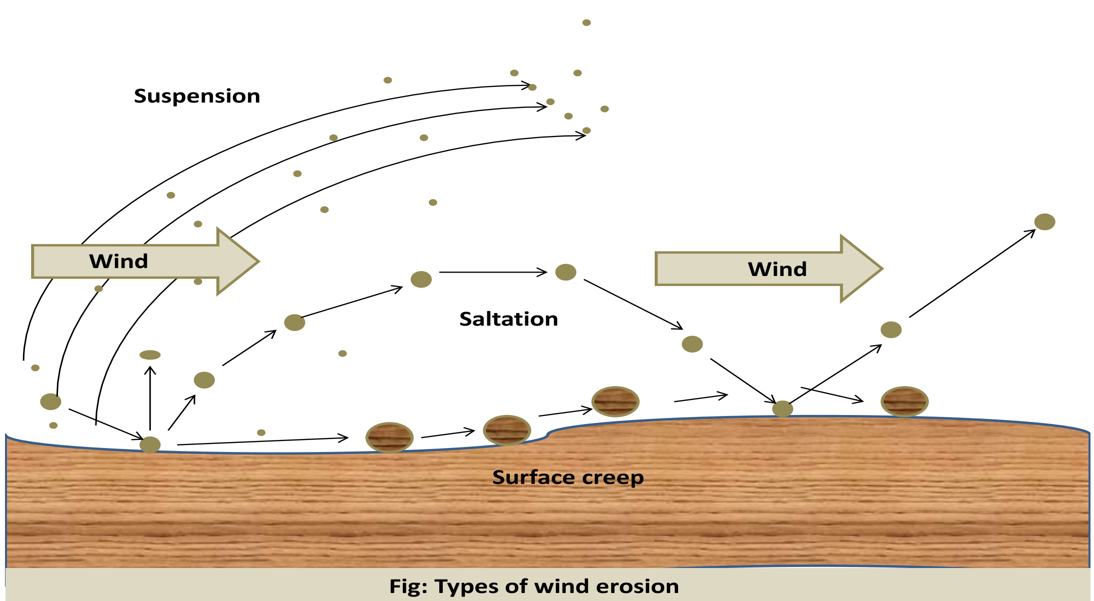

Fig. 2 Types of wind erosion.

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4. Some of the greatest effects of soil erosion include:

- Loss of topsoil: Obviously, this is the biggest effect of soil erosion. Because topsoil is so fertile, if it is removed, this can cause serious harm to farmer's crops or the ability to effectively work their land.
- Soil compaction: When soil under the topsoil becomes compacted and stiff, it reduces the ability for water to infiltrate these deeper levels, keeping runoff at greater levels, which increases the risk of more serious erosion.
- Reduced organic and fertile matter: As mentioned, removing topsoil that is heavy with organic matter will reduce the ability for the land to regenerate new flora or crops. When new crops or plants can't be placed successfully in the area, this perpetuates a cycle of reduced levels of organic nutrients.
- Poor drainage: Sometimes too much compaction with sand can lead to an effective crust that seals in the surface layer, making it even harder for water to pass through to deeper layers. In some ways, this can help erosion because of the densely packed soil, but if it perpetuates greater levels of runoff from rainwater or flooding, it can negatively impact the crucial topsoil.
- Issues with plant reproduction: When soil is eroded in an active cropland, wind in particular makes lighter soil properties such as new seeds and seedlings to be buried or destroyed. This, in turn, impacts future crop production.
- Soil acidity levels: When the structure of the soil becomes compromised, and organic matter is greatly reduced, there is a higher chance of increased soil acidity, which will significantly impact the ability for plants and crops to grow.
- Long term erosion: Unfortunately, if an area is prone to erosion or has a history of it, it becomes even harder to protect it in the future. The process has already reduced the soil structure and organic matter of the area, meaning that it will be harder to recover in the long run.
- Water pollution: A major problem with runoff from soils – particularly those used for agricultural processes – is that there is a greater likelihood that sediment and contamination like the use of fertilizer or pesticide. This can have significant damage on fish and water quality.

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5. Consequences of soil erosion

Soil erosion has both onsite and offsite effect is the severest form of land degradation which has assume nation as well as global importance. There are some consequences of soil erosion.

I. Land degradation
II. Soil degradation and loss in soil productivity
III. Siltation of reservoirs
IV. Floods and flood plains
V. Environmental pollution
VI. Changing forest cover
VII. Loss of biodiversity

6. **Land degradation**: Land degradation means loss in the capacity of a given land to support growth of useful plants on a sustained basis. Land degradation is a big loss to economy as the land loses its production potential and gets converted into wastelands. Hence shrinking of land resource base is a big problem before developing country like India. The per capita man land ratio in India is hardly about 0.48 hectare, which is lowest in the world.

Types of land degradation: Land degradation is categorized into three types i.e. (i) Physical degradation (ii) Biological degradation (iii) Chemical degradation. Physical degradation refers to deterioration in physical properties of soil whereas biological degradation refers to reduction in soil organic matter, decline in biomass carbon and decrease in activity and diversity of soil fauna. Chemical degradation is basically due to the nutrient depletion.

Extent of land degradation: Degraded land includes eroded lands, saline / alkaline lands, water logged lands and mined lands. The total land area of India is 329 million hectares of which about 178 million hectares (54%) is converted into wastelands for one or other reasons. This also includes about 40 million hectares of degraded forest. The total cultivable land of the country is about 144 million hectares of which 56% (80.6 million hectares) is degraded due to faulty agricultural practices and the dense forest cover has been reduced to 11% (36.2 million hectares) of the total geographical area. Watershed areas, river corridors and rangelands have been extensively disturbed. Situation is frequently so bad that even cessation of abuse may no longer lead to self-restoration of biological diversity, stability and productivity of the ecosystems. In India about 25% of the land area is suffering from the problem of water erosion.

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Soil erosion by water in the form of rill and sheet erosion is a serious problem in the red and lateritic soils of South and Eastern India where about 40 tonnes per hectares of top soil is lost annually. Out of 70 million hectares of the black soils of Central India about 6.7 million hectares are already unproductive due to development of gullies. Over 4.4 million hectares of land is degraded due to shifting cultivation practiced largely by tribals in North-eastern India. Ravines are system of gullies or gorges worn out by torrents of water running more or less parallel to each other and draining into a major river or its tributaries after a short distance with development or deep and wide gorges. In fact ravine lands are manifestation of extreme form of water erosion occupying approximately 3.67 million hectares of land chiefly distributed in Uttar Pradesh, Madhya Pradesh, Rajasthan and Gujarat. It has been estimated that the production potential of ravine areas in Uttar Pradesh, Madhya Pradesh and Rajasthan alone would amount to 3 million tonnes of food grains annually besides fruit, fodder and wood. On a conservative estimate the country is losing a total output worth about Rs.157 crores a year by failure to reclaim and develop the ravine lands. Furthermore, these ravine lands have been creating problem of law and order maintenance in states of Uttar Pradesh and Madhya Pradesh as the notorious dacoits take refuge in these eroded lands and conduct their unlawful activities. Wind erosion in chiefly the problem of arid and semi-arid regions of the country where the soil is sandy with scanty vegetation or even without vegetative cover. In India about 50 million hectares of land area is affected from wind erosion most of which belongs to Rajasthan and Gujarat. The over-grazing is the main cause of soil erosion in these areas. It is estimated that a programme for the control of wind erosion covering 50 million hectares would cost about 3,000 crores of rupees.

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AGRICULTURE & FOOD: e-Newsletter **ISSN: 2581-8317**

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Aeroponic: a novel system of seed potato production

Article id: 11187

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ABSTRACT

High yielding varieties and sound planting materials are prerequisites for a sound seed potato production. Low multiplication rate, high seed (tuber) rate, dynamic amassing of degenerative infections, perishability and massiveness are the inherent issues in seed potato production. This may results in non-accessibility/non-availability of sufficient amounts of value seeds at reasonable cost and seed cost alone reflects 40% which is half to the aggregate expenses of development in potato. Ongoing advancements in robotization of minitubers generation have additionally upgraded flexibility of these systems in potato seed creation. Additionally to quality assurance through plant tissue culture, aeroponic technique of minitubers production ensures high multiplication rate at initial stages of quality seed potato production.

Keywords: Aeroponic, *in vitro*, soil-less production, virus-free, seed potato

Introduction

Aeroponic techniques are a good tool for the production of seed crop. For instance: “they offer the potential to improve potato seed production and reduce costs compared to conventional methods or to the other soil-less method of hydroponics (growth in water). Aeroponics effectively exploits the vertical space of the greenhouse and air-humidity balance to optimize the development of roots, tubers, and foliage. The basic difference is the sequential seed harvests in aeroponic plants. In the conventional system, there is only one final harvest. Depending on the potato cultivar, with aeroponics we can have up to 10 or more harvests”. Seed constitutes a major and important input in potato (*Solanum tuberosum* L.) cultivation. On account of vegetative propagation, the requirement of seed potatoes (tubers) is voluminous and accounts for 40- 50% of the total production. Potato productivity in India is low in comparison to developed countries due to the non-availability of quality seed in required amounts. Seed potato production involving micro-propagation (tissue culture) techniques can overcome many of the problems associated with the conventional multiplication system. The everlasting shortage of seed potatoes in most of the potato growing nations can be overcome through aeroponic techniques on account of faster rate of multiplication. Besides, rapid multiplication, disease freedom on account of multiplication of disease free mother stocks under controlled conditions followed by reduced number of field exposures as compared to conventional multiplication system is an added advantage of seed potato production through aeroponic techniques. Due to these numerous advantages, the new system of seed potato production involving this technology is finding favour among the seed potato entrepreneurs.

The multiplication rate of potatoes is very low compared to other crops, from between four to six times under optimal conditions. For this reason, a large portion of crop area is devoted to the production of seed tubers and it takes a considerable time to build up a sufficient amount of commercial tubers. With every field multiplication the build-up and transfer of pathogens can increase, leading to seed degeneration. Therefore it is essential to investigate methods of increasing the number of minitubers (G0) produced from disease free in-vitro plantlets. Therefore, aeroponic technique offers many interesting opportunities for developing enhanced production systems, mainly for mini-tubers. Although requiring a degree of technical sophistication to design, establish and run, the benefits offered are sufficient for such systems to have been widely adopted by seed production companies worldwide.

The technique of aeroponic culture is an optional device of soil-less culture methods in growth-controlled environments such as greenhouses. This method consists of enclosing the root system in a dark chamber and supplying a solution of water and mineral nutrients with a mist device. The aeroponic system mainly consists of an electrical unit, two light proof (dark) growth chambers, a nutrient solution chamber, a high pressure pump, filters, and spray nozzles.

Healthy seed potato production through aeroponics

Preparation of virus-free in vitro planting material: Being a clonally propagated potato crop, it is sensitive to perpetual viral diseases over the successive generations. Therefore, quality seed potatoes are produced under aeroponic using virus-free *in vitro* plants, which are regenerated through various tissue culture-based techniques including meristem tip culture.

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Figure 1: Step-wise view of aeroponic seed production system

Aeroponic growth system: This technology consists of plant growth with enclosed root system in dark chamber by spraying nutrient solutions on roots with mist/spray devices that includes aeroponic chamber, pump, spraying tube, timer and nutrient solution reservoir. Potato production and utilization of mini-tubers using aeroponics have been reviewed by Buckseth et al., (2016). A tube with several nozzles passes through the aeroponic chamber and sprays nutrient solution on root zone of plants. The aeroponic chamber has a removable top with holes for holding potato plants. Front of the aeroponic chamber is fixed with hinges and can be opened to harvest mini-tubers of optimum size repeatedly at different time intervals. *In vitro* plantlets are planted in the holes and fixed by sponge. The nutrient solution is sprayed for 30 seconds after every 3 minutes in initial growing stages. After one week, root system starts developing inside the growth chamber. The nutrient solution spraying interval is prolonged upto once in 15 minutes with progressive growth of the plants. Stolon and tuber formation is initiated at different intervals depending upon the variety. Harvesting of the tubers starts after

ISSN: 2581-8317
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45-50 days of planting when some of the tubers attain 15-17 mm diameter size. Once the first flush is harvested, formation of additional tubers is triggered resulting into more minitubers/plant. In this system, harvesting is done after every one week, and about 10-12 harvests are taken. On an average 45-50 minitubers can be harvested from a single plant as against 8-10 minitubers under the net-house. These harvested minitubers are stored at 2-4^{o}C and are used for planting in the next season (Figure 1).

It is essential to maintain pH (6-7) of the nutrient solution at the desired level throughout the crop period and its change at weekly interval. In aeroponic system, it is possible to produce 2094 minitubers per square meter as compared to 771 minitubers per square meter in soil/substrate-based nursery beds. Therefore, aeroponic technique offers many new insights for developing enhanced seed potato production systems, mainly for minitubers. Although this technique requires a high degree of technical expertise in design, establishment and running costs and standardization of genotype-responsive nutrient solutions, the benefits offered are quite high while producing healthy quality seeds. Hence this technology offers worldwide large scale adoption by seed potato producing companies.

Benefits of the technology:

a) Aeroponics is one of the most rapid methods of propagation for seed potato production using *in vitro* plants. The technique allows to produce large numbers of healthy mini-tubers in one generation, thus eliminating the need for more field multiplications thereby reducing costs and saving time.

b) An individual plant can produce over 40-50 mini-tubers in a single row as opposed to conventional method that create approximately 8 daughter tubers only in the course of a year while only 5 to 6 tubers per plant are produced using soil in the greenhouse in 90 days.

c) In the view of favourable results with respect to repeated harvesting and considering the characteristics of aeroponic culture, the combination of both techniques seems to be particularly useful for mini-tubers production in potato.

d) Production of potato through aeroponic promotes availability of healthy seed potatoes. In addition, aeroponic allows easy identification and rouging of diseased plants. Furthermore, potato seed produced through this method could enjoy accelerated growth due to improved aeration of the roots and optimal nutrient uptake obtained from an atomized nutrient solution.

e) Aeroponic based potato mini-tuber production is increasing in India due to more number of mini-tuber productions per unit area and time (Scheme I) as well desired temperature manipulation through controlled conditions round the year.

f) The Aeroponic system uses nutrient solution recirculation; hence, a limited amount of water is used.

What we know and what remains to be known in aeroponic?

Aeroponic was first used for vegetable production. It is a relatively new technique, especially for seed potato production. Initial tests provide us with the following information's:

- Potato seed production can be increased dramatically in the greenhouse.
- Potato cultivars respond differently to aeroponic. Tuberosum type cultivars tend to produce less than cultivars with andigena genes. This is also observed when grown in substrate.
- Aeroponic production is particularly sensitive to climate.
- Sequential harvests are needed.
- Vegetative period of plants is increased by 1–2 months.
- Aeroponic seed yields the same as conventional seed in the field.
- Initial investment can be recovered rapidly.
- Bacterial inoculation to nutrient solution seems promising in increasing seed production using aeroponic. This is under cur-rent investigation at CIP.
- Aeroponic can significantly increase income or reduce the production costs of quality potato seed to make it more accessible to growers.
- Non-conventional energy sources (solar, wind) seem promising for aeroponics.

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Conclusion: In mitigating the problem of shortage of good quality seeds, strategies to rapidly multiply the seed tubers such as tissue culture in conjunction with aeroponic systems have been tried. Technologies adopted and perfected by the Vertical Farming industry have opened doors for other industries that are not necessarily food production, such as the production of seeds and medicinal crops. These technologies needs to be given serious thought and should be promoted in most developing countries so as to increase potato yields. In terms of greater efficiency of seed potato production and reduced energy input, research into soil-free techniques will continue to be the subject of focus in both established and developing potato-producing areas in near future.

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ISSN: 2581-8317

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Various fruit harvesting devices and its benefits

Article id: 11188

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What is harvesting?

Harvesting is one of the most important operations in fruit production. Traditional harvesting of fruits is either carried out by hand plucking or using traditional harvester. In both traditional harvesting and hand plucking methods, there are chances of fruit damage which results in reduction in return and traditional method is also tiring and drudgery prone. People harvested fruits by hand until relatively recent time. Later, they learned knock fruits down with sticks or rocks shaking small trees and climbing on to trees with the aid of crude ladders to position themselves better for picking. Other existing methods of fruits harvesting are manual harvesting of fruits with use of mechanical aids, mechanical detachment of fruits by direct contact devices, vibratory mechanism for the harvesting of fruits etc.

Importance of fruit harvesting

Harvesting is one of the most important activities in fruit production, handling and preservation cycle. Fruits are generally damaged due to lack of a suitable harvesting device. Presently, fruits harvesting operations in the country is being done traditionally by hand picking or by climbing on ladder on tree directly. These traditional methods are labour, time and drudgery oriented and also affects the quality of the fruit and reduced margin of profit for the farmers. Moreover, acute neck and shoulder pain to the workers has been reported during fruit harvesting at the upper periphery of the tree that restrict them for continuous work. Workers also got injuries during operation either falling from the tree or ladder.

Effect of harvesting methods on fruit quality

In India harvesting of fruits is mostly done manually plucking or by means of bamboo sticks having hook. These method results high labour, high energy requirements, drudgery, and damage to fruits and branches etc. The damage and bruising of fruits are also serious problems. Fruits harvested with 8-10 mm long stalks look better on ripening as undesired spots on the skin caused by sap burn are prevented. Such fruits are less prone to stem-end rot and other storage diseases.

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ISSN: 2581-8317

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Mechanical and automatic harvesters have been developed or attempted by many researchers. Mechanical harvesting systems are designed to achieve mass removal of the fruit during the harvesting season. This method has been practiced using such as canopy/limb/truck shaker or air blast with chemical mechanics of abscission as pre-harvest agents to loosen the mature fruits. There are few drawbacks in mechanical harvesting system viz. the quality and size selection, the damage to the fruit and trees in some cases and the layout of the grove design for mechanical harvester. However, the mechanical system operates blind when it come to removing quality ripe fruit. Almost in all these methods, damages to the fruits, leaves and consistency of the performances are the major issues. Manual harvesting has many advantages compared with the mechanical harvesting of most fruit crops. The most important advantage is visual image processing ability which enables workers rapidly to detect fruit suitable for harvest and direct their hand to the fruit selected for detachment.

Present scenario of harvesting devices in India

Harvesting of fruit is a labour-intensive operation, worldwide, which accounts in many cases for about 50 percent of total production costs. In addition, it is a tedious, stoop type job, which is needed to be performed on a seasonal basis during a relatively short time. These combined factors, in addition to the costly operation may contribute detrimentally to the issues of safety, health and quality of picking. While in many less developed countries with, still, cheap and abundant labour, the issue of fruit harvesting does not present yet a major problem, the declining labour availability and increasing labour costs in the developed countries, combined with more awareness to health and safety issues, make it mandatory to mechanize the fruit harvesting operation. Many mechanized solutions already exist and even commercially used. However, they are utilized primarily for harvesting fruit, which are destined for processing, or are not mechanically damaged during the harvesting operation. Fruits are highly perishable and utmost care must be taken in handling them at harvest.

In country like India declining labour availability and increasing labour cost is a major problem but still 90 percent of harvesting is done through traditional method which causes loss in total marketable yield, including all the harvest and post harvest loss of India's major agricultural produce is estimated at Rs 92,651 crore, according to data published by the ministry of food processing on August 9, 2016.

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Different types harvesting devices

- **Manual Fruit Harvester**

It consists of one fixed blade and another moving blade actuated by a spring. There is a net basket attached to it to collect plucked mango fruits. The long handle facilitates reaching fruits from ground. During harvesting, the fruit pedicel is adjusted to rest on fixed blade and pressing the lever at the grip end of the handle actuates the moving blade.

Fig 1 Manual Fruit Harvester

- **Hold on and twist type**

It is a manual-harvesting tool with which individual fruit is first held between two jaws of the device and then twisted to shear off the stock. The jaws are made of 14 gauge mild steel sheet. These are held together by a tension spring on a pivot fitted on 10 mm mild steel rod. A handle can be fitted to the tool. One of the jaws has a lever bracket and rope arrangement for operating the jaw. Three mm thick rubber sheet padding is provided on inside of the jaws to avoid any skin damage while holding the fruits. After its detachment, fruit is released by pulling the cord in to a ring. A cloth conveyor or net is provided below the jaws for collection of harvested fruits at ground level without any damage. The tool is suitable for harvesting peach, pear and orange. Its field capacity is 250-300 fruits /man-h.

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Fig 2 Hold on and twist type

- **Manually operated sapota harvester**

The harvester is used for harvesting of small fruits like lemon, sapota etc. It consists of main body of PVC having cylindrical shape. The upper end of the body is closed while bottom end is open to which nylon net for collecting the fruits is tied. A stretched string closes the other end of the net. A gate is made on the body for entry of the fruits to be harvested. On the lower surface of the body a metal holder is fixed to hold the bamboo of required length. Two fingers cut in V-shape and with small sharp blades are provided at the closed end of the body of the harvester. The fingers help to select and hold the fruit to be harvested from the bunch. By pulling the harvester, fruit is detached from the bunch, which falls in the body and rolls into the net. To unload the harvested fruits in the net a stretched string at the closed end of the net is loosened.

Fig 3 Manually Operated Sapota Harvester

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Mechanical harvester

Mechanical harvesting of tree crops is becoming increasingly important due to the cost of manual harvesting. Competitiveness in the global market demands efficient harvesting systems to reduce harvesting costs. Many mechanical harvesters for fruits and nuts have been developed over the past five decades, but few of them have been successfully adopted and commercialized (Futch et al., 2004). Many commercialized harvesters for fruits and nuts are designed to induce either free vibration or forced vibration to the trunk or tree limbs and canopy (Fridley et al., 1971; Peterson et al., 1972; Markwardt et al., 1964; Halderson, 1966). These vibrations are then transmitted throughout the tree, creating the forces necessary to cause fruit detachment. These harvesters are essentially comprised of two parts: the mechanical system that generates vibratory motions, and the mechanical interface that transmits vibrational energy to the tree. Examples of mechanical interfaces include movable tongs that grip the trunk or limbs and force them to vibrate, or a vibrating rod that impacts the tree limbs to cause them to vibrate freely.

The current mechanical harvesting system used to harvest citrus fruits in Florida is a continuous canopy shaker, which is an enhanced version of the design proposed by Peterson (1998). There are two versions of this system: (1) the continuous canopy shake and catch harvester (fig. 4), which has a catch frame for collecting harvested fruits, and (2) the tractor-drawn canopy shaker (fig. 5), which is only equipped to detach the fruits; the detached fruits are then picked up from the ground manually or by pickup machines. The principle mechanism used to detach the fruits is the same in both harvesters and is accomplished by periodically impacting the tree limbs with sinusoidally vibrating tines. The tines are 198.12 cm (78 in.) long and arranged radially on 12 wheels mounted on a cylindrical frame, as shown in figures 2 and 3. The sinusoidal motion of the tines is provided by a slider crank mechanism, which is powered by a hydraulic motor.

Fig 4:Continuous canopy shake and catch harvester

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Fig 5:Tractor-drawn canopy shaker harvester

- **Limb shaker**

An early limb shaker was represented by Coppock and Jutras using inertia developed by Adrain and Fridley. An eccentric weight about 85 pounds was rotated in the mechanism to produce the shacking action after the shaker was attached to the tree limb. Notably some damage was made to the bark of the tree by the clamping mechanism. An alternative tree shaker was represented using fixed stoke, inertia, and direct impact on trees limbs. The issues from this practice included such as fruit damage due to fall foliage, lower removal rate in earlier and mid of harvesting season, and large or small immature fruit removal.

- **Air Blast**

The application of force generated by air blast to remove the fruit started in 1961. An oscillating air blast machine was tested and practiced by Jutras and Patterson. Fruit removal was maximized by the oscillation rate. The air blast model and all the subsequence models were made and named after FMC (Food Machinery Corporation). The performance of FMC series was dependent on factors such as structure of tree, size and weight of fruits. Later, an air shaker was designed and constructed to alleviate issues such as the high power requirement. However still damages to the fruits and leaves were the major issues addressed in the project.

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Fig 6 Air Blast harvester

- **Abscission Chemical**

Abscission chemical agent was designed to loosen the mature fruit and improve the rate of removal of fruit in harvesting season. There are many kinds of abscission agent such as Ethephon and 2-chloroethyl phosphoric acid. The use of abscission agent was applied as pre-harvest process and constituted part of harvesting such as air shaker. Air shaker was tested with applying abscission agent in advance on FMC-3 by Wilson et al. Limb shaker used abscission to loosen the fruit on stem. It was noted that abscission chemical was inconsistent in practical use. The abscission use was subjective to many factors such as weather factors, tree injury, and cost of using chemical such as equipment.

Advantages of mechanical harvesting

- Mass removal of the fruit during the harvesting season.
- Easy to use.
- Reduce drudgery.

Disadvantages of mechanical harvesting

- Unable to select size and quality of fruit.
- May cause damage to fruits and trees.
- The mechanical system operates blind when it come to removing quality ripe fruit.
- Poor labourers had to face the loss of jobs and starvation because single machine could do the work of scores of labourers.
- The poor farmers, machines brought misery. Many of them took bank loans to buy machines. They could not pay back their debt and deserted their farms.

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AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Vermiwash: A nutritional tonic for crops

Article id: 11191

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Indiscriminate use of chemical fertilizers is a tradition of Indian farmers now a day. They believe that use of high amount of chemical fertilizers will increase the crop production. They do not aware about negative effects of chemical fertilizers. Continuous and unbalanced use of chemical fertilizers ultimately destroys the soil fertility which is the key of crop production. Soil health of Indian soils decreases day by day due to poor soil health management system. Chemical fertilizers not only hampered soil health but also affects the environmental conditions. If our farmers do not stop to excess uses of chemical fertilizers the situation will be very drastic in future. There are very simple and effective ways to control the hazardous effect of chemical fertilizer by using of organic fertilizers. In this way, one of the good source of organic fertilizer is vermiwash.

Vermiwash: Vermiwash is liquid fertilizer, which contains high amount of enzymes, vitamins and hormones like auxins, gibberellins etc. along with macro and micronutrients used as foliar spray (Nardi *et al.,* 2004)

Properties of vermiwash

Vermiwash is a liquid contains several plant growth hormones like cytokinins, gibberlines, enzymes and vitamins along with macro and micro nutrients (Buckerfield *et al.,* 1999). It buildup the disease resistant capacity of plant. It is reliable biopesticide and ecofriendly soil conditioner. The nutrients that are present in vermiwash are water-soluble which are readily available to the plants. In vermiwash, there is collection of excretory product and mucus secretion of earthworms along with macro and micronutrients from the soil organic molecules. These nutrients are then transported to the aerial parts such as leaf, shoots and other parts of the plants in the natural ecosystem. (Ismail,1997). Vermiwash contains high quantities of nitrogen, phosphorus, potash, calcium, magnesium zinc and are alkaline in nature. Freshly collected vermiwash contains many beneficial microbes that promotes the plant growth and prevents infections. It is one of the most cost efficient and environmentally friendly methods of waste disposal (Jayashree, 2006).

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Effect of vermiwash on growth of crop

Vermiwash is very good liquid fertilizer which significantly affect the crop growth. Vermiwash have ability to improve germination rate as well as enhanced seedling growth in plants. It is a product that collected from excretory of earthworms, along with plant growth nutrients of the soil and soil organic compound that are useful for plants. Zambare *et al*. (2008) conclude that vermiwash contains various beneficial enzymes like protease, amylase, urease and phosphatase as well as it also contains nitrogen fixing bacteria like *Azotobacter sp*., *Agrobacterium sp*., and *Rhizobium sp*. and some *phosphate solublizing bacteria* which trigger the plant growth. Vermiwash is not only a liquid fertilizer but also a mild bio- pesticide. Vermiwash contains enzymes, secretion of earthworms, essential nutrients which would enhance the vegetative growth, yield of crops as well as develop resistance in crops. It has significant 'growth promoting' as well as 'pest killing' properties. (Benitez *et al*, 1999)

Methods of preparation : (Dhok, 2013)

- Take one big drum along with a mug.
- Set up tap on the lower most part of the bucket for collection of the wash.
- Put a layer of broken bricks, pieces of stones in the bucket.
- Over this layer put another layer of sand.
- After the layer of sand put a layer of partially decomposed cow dung having 30-45 cm thickness over it.
- Then put layer of soil having 2-3 cm thicknesses.
- Now open the tap of the bucket and when the materials taken in the bucket.
- Then put 100-200 nos. of earthworms in the bucket. – After that, a layer of straw having 6 cm thickness is given.
- Now open the stop cork of the bucket and spray water regularly for a period of 7-8 days.
- After 10-15 days the liquid vermiwash will be produced in the bucket.
- Hang one small container with a bottom hole over the bucket in such a way so that water falls drop by drop.
- Every day poure 4-5 litres of water in the hanging container.
- Put one more container under the tap to collect the vermin wash. Every day 3-4 litres vermiwash can be collected.

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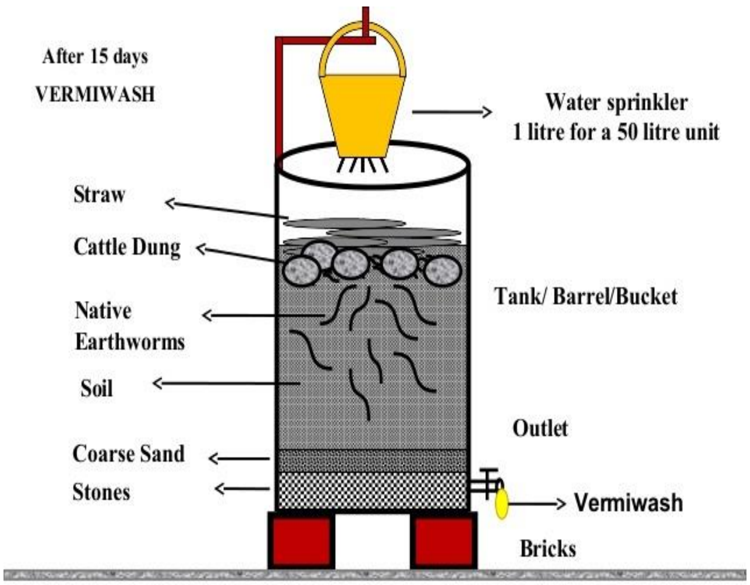

Collected Vermiwash

Dosage for use (Kaur and Kaur, 2017)

Root dip/stem dip: The seedlings of the plants are dipped in minutes before transplantation. The solution needs to be diluted after they can be transplanted. In this way the cuttings of plants can also be dipped in the solution.

Foliar spray: The Vermiwash is diluted with water for 5 times and then sprayed on the crops. It enriches the soil with nutrients as well as helps in controlling and minimizes the incidence of plant disease.

Soil drenching: Vermiwash is diluted about 10 times with water and the soil is drenched with the solution to prevent some of the soil borne pathogens as it as anti microbial properties.

Conclusion: Use of chemical fertilizers increasing day by day which is very harmful for plants, soil, environment as well as human also. So it is necessary to us, adopt organic sources for raising the healthy crops in sustainable manner. Vermiwash is a organic, non-toxic, eco-friendly, nutrient rich and low cost product. It is good choice for avoiding high use of chemical fertilizers. It serves as a boon and its application in farming practices can also lead to significant increase in crop yield production.

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AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

RAPID multiplication of banana through macro propagation techniques

Article id: 11191

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INTRODUCTION

Banana cultivation is confined to the tropical and sub tropical regions of the world and is an important staple food and a source of income for small holding growers. Banana is considered to be one of the oldest fruit crop cultivated by men since time immemorial. The advantage of banana cultivation over other fruit crops is that banana is an all season fruit crop. It can be regularly harvested throughout the year. Bananas are often referred to as '*Kalpataru – the plant of virtues'* owing to its socio economic significance. However, the productivity and lifespan of banana has drastically reduced due to lack of proper scientific cultivation, inadequate quality planting material, pests and diseases pressure etc. These problems are escalating because farmers usually rely on natural regeneration for the supply of planting materials which failed to meet the high seedling demands.

Quality planting material is the key to successful cultivation of all crops. Sucker is the primary as well as the major source of propagation material in banana. One of the most persistent worries of banana growers has been the lack of quality planting material in sufficient number. Today, banana can be successfully propagated ascetically through tissue culture techniques and its advantage is that it eliminates all suckers transmitted pests and diseases. Although the technology is highly efficient the initial cost of establishing tissue culture laboratories is very high and involves complex protocols (Vuylsteke and Talengera, 1998) and tissue culture plants are not readily available to poor farmers especially in the Indian context and north eastern region in particular. Therefore, in order to increase the production level, there is a need for affordable and simple techniques for quality planting material production at farm level itself ((Lopez, 1994)). Macro-propagation is one such simple and user friendly technique which can enhance the banana production through rapid multiplication of planting materials. This technique can boost the income level among small scale farmers especially the jhumias if properly adopted for ensuring sustainability through banana based farming system.

ISSN: 2581-8317
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Macro-propagation is a relatively easy technique that can be carried out in a shed or even in open shed. It consists of generating suckers from clean planting material by removing the apical dominance and includes (Njukwe *et al*, 2006):

1. Decapitation (False and complete decapitation)
2. Corm technique (whole, split and excised corms)

1. Decapitation:

In false decapitation, a small hole is cut in the pseudostem of six month old plants to destroy the actively growing point i.e. the meristem. The hole is made about 20 cm above the ground by removing the central part of the plant and the hole should slightly slope downwards so that water and plant sap collect in the hole, further killing the meristem.

In complete decapitation, the pseudostem of six month old plants is completely cut down at ground level, leaving out the emerging suckers. The meristem is destroyed by using a clean knife and removing 5 cm diameter growing part in the middle of the pseudostem (Fig. 1). However, there is a tendency for the meristem to sprout again therefore, one need to make sure that the meristems do not sprout again. Both the plants from false and complete decapitation are left to stand for atleast one month to allow sprouting. About 4-8 suckers depending on banana cultivars will sprout in three weeks after removal of apical dominance (Fig. 2). Sprouted suckers are detached immediately once they attain 3-4 leaves. Detached suckers are the transferred directly to the field.

2. Corm techniques:

In whole corm, roots are removed and the leaf sheets are cut one by one exposing the buds. Fungicides may be applied. The corm is scarified at the top (by cutting an X). the entire corm is planted at 30 cm spacing in the propagator (constructed of bamboo and polythene sheet of 1.5 m x 5.0m x 0.5 m size) well covered with saw dust and watered immediately after planting.

In split corm, the corm is fragmented into two or more bits and planted in the propagator for buds to sprout. Prepared corm pieces are planted at 10 cm interval and covered with 2 cm sawdust. Water immediately after planting.

In excised corm, buds are directly cut out from the corm in pieces of 50-100 g as minisetts and planted in the propagator or polyethylene bags to sprout.

Macro-propagation provides an affordable, simple relatively rapid technique for vegetative multiplication of banana which supported with the right training to farmers have the potential to overcome challenges faced by farmers like increasing unavailability of planting materials at farm level with the assurance of affordable, quality, true to type and choice of cultivar planting materials to farmers.

Fig. 1. Complete decapitation carried out at sub tropical mid hill condition of Arunachal Pradesh

Fig. 2. Production of banana plantlets after complete decapitation

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Acknowledgement

Project Name: Improvement of Jhum through Horticulture Intervention

Project code: IXX09826

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ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Prospect and application of biosensor in plant disease management

Article id: 11192

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INTRODUCTION

Humankind has been performing bio analysis since the dawn of time, using the sensory nerve cells of the nose to detect the scents or the enzymatic reactions in the tongue to taste food. As time has progressed, so has our level of understanding about the function of living organisms in detecting trace amounts of biochemical in complex systems. Because biological organisms are some of the most efficient machines ever created, scientist have sought to apply and copy their efficiency for use in man made creations. Using bioreceptors from biological organisms or receptors that have been patterned after biological systems, scientist have developed a new means of chemical analysis that often has the high selectivity of biological recognition systems. These biorecognition elements in combination with various transduction modes have helped to create the rapidly expanding fields of bioanalysis and related technologies known as biosensors.

Principle of Biosensor

1. Immobalization of biological material

The biological components are suitably immobilized on the transducer surface. Enzymes are usually immobilized by glutaraldehyde onto a porous sheet like lens tissue paper or nylon net fabric and the enzyme membrane thus produced is affixed to transducer.

2. Surface treatment to transducer

The transducer surface may be treated with 3-aminopropyltriethoxysilane. The biological components may now covalently linked to this cross-linked silane via the reactive amino group remains free.

3. Interaction of analyte with biological material

The biological component interacts specifically to the analyte, which produces a physical change close to the transducer surface. This physical changes may be heat released or absorbed by the reaction, production of electrical potential due to change distribution of the electrons, movement of electrons

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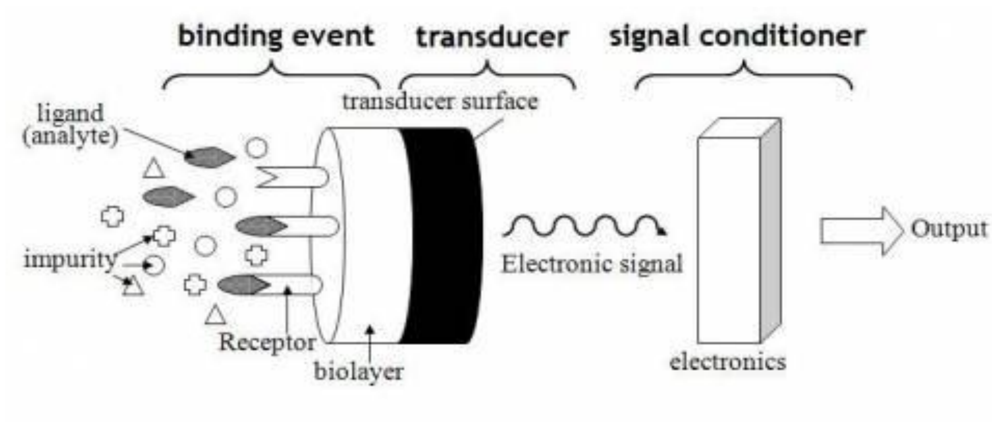
due to redox reactions, light produced or absorbed by the reaction, change in the mass of biological components as a result of the reaction.

4. Conversion of biological signal

The transducers detect the signal and convert into the electrical signals.

5. Amplification of signal

This signal is necessarily very small, and is amplified by the amplifier before it is fed into the microprocessor. The signal is then processed and interpreted and is displayed into the suitable units.



Schematic configuration of a Biosensor

Methods of detection

1. Electrochemical method of detection-

Production of electrical potential due to change distribution of the electrons.

2. Amperometric method of detection-

Movement of electrons due to redox reactions.

3. Thermistor method of detection-

Heat released or absorbed by the reactions.

4. Optical method of detection-

Light produced or absorbed by the reaction.

5. Piezoelectric method of detection-

Change in the mass of biological components as a result of the reaction.

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Types of Biosensors

1. Electro-chemical biosensor

Electrochemical biosensors are normally based on enzymatic catalysis of a reaction that produces or consumes electrons (such enzymes are rightly called redox enzymes). The sensor substrate usually contains three electrodes; a reference electrode, an active electrode and a sink electrode.

2. Potentiometric biosensor

Such biosensors are screen printed, conducting polymer coated, open circuit potential biosensors based on conjugated polymers immunoassays.

3. Amperometric biosensor:-

It measures the reaction of analyte with enzyme and generate electrons directly or through mediator. It consists of either enzyme-electrode or without mediator.

4. Thermistor containing biosensor:-

Use to record temperature changes during biochemical reaction using enzymes like cholesterol oxidase, invertase , tyrosinase. Also use to study antigen-antibody with very high sensitivity in ELISA. It shows a very high sensitivity.

5. Whole cell biosensor

In this biosensor whole cell or organelles use as a biological component. The cells are cheaper, have longer active lifetime, and are less sensitive to inhibition, pH, temperature variationsthan enzymes.

6. Colorimetric test strips

The simplest form of biosensor is the colorimetric test strips. In this biosensor strips of cellulose is use which coated with appropriate enzyme and suitable reagents which gives colour change in the reaction. An example of such strips is the one used to detect glucose in blood.

7. Optical biosensor

It detects how much light is produced or absorbed during the biochemical reaction. A most promising biosensor is luminescence biosensor for detection of bacteria in food and clinical samples.

8. Acoustic wave biosensor

In this biosensor piezoelectric crystals are used to assay the mass of analyte that bind to the biological components immobilized on the crystal surface.

Biosensors in Agriculture

Agriculture includes the production of crops and the rearing of livestock producing various products which are used in daily life. These elements have always been susceptible to damage in the form of pests and diseases causing a loss in the profits (Fletcher et al., 2006). Hence, a way of increasing

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ISSN: 2581-8317
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profits would be to reduce the loss of crops and livestock by such natural threats. With the advancement in bioterrorism, the need for biosecurity becomes very necessary the need for biosecurity is essential when agricultural produce or any living object is to be transported across the international borders. A biosensor has been developed for the detection of the fungus *Phakopsora pachyrhizi that* causes Asian rust or Soybean rust, using the SPR technique. In this case, antibody against *Phakopsora pachyrhizi* was used as the biological recognition element. Such rapid and simple methods can be developed for world's most acute crop diseases thus preventing damage and spread. It is also important to develop biosensors for monitoring agricultural by-products. A biosensor for the detection of aflatoxin in olive oil has been developed (Amine et al., 2006). Aflatoxins produced by molds *Aspergillus flavus* and *Aspergillus parasiticus* are carcinogenic to humans. Aflatoxin has inhibitory effect on acetylcholinesterase (AchE) and its detection is coupled with the decrease in the activity of AchE which is measured using a choline oxidase amperometric biosensor.

Concentrations of herbicides, pesticides and heavy metals in agricultural lands are increasing and this is a matter of concern. Biosensors can also be used to forecast the possible occurrence of soil disease, which has not been feasible with the existing technology. The biological diagnosis of soil using biosensor means opening the way to reliable prevention and decontamination of soil disease at an earlier stage the biosensor offers an innovative technique of diagnosing soil condition based not on experience but on numerical data. Nitrate biosensor has been developed for the detection of amount of nitrate present in soil.

Biosensors in plant disease detection

Stepping away from hormonal control systems, there are many other areas of plant science for which biosensors could be rewarding. Systemic signalling could be amenable to any of the sensor systems described above and recent peroxide sensors could help study stress responses but there are also possibilities in disease detection and diagnosis. Label free biosensors that can detect and quantify specific plant pathogens on-field might enable farmers to target application of pesticides precisely, reducing their use

Currently antibodies are the preferred detection systems since they offer all the advantages noted above and many pathogen-specific antibodies are available. However, most transducing technologies remain lab-based instruments requiring specialist technicians, such as surface plasmon resonance (SPR), quartz crystal microbalance (QCM) and cantilever-based sensors. Field units need development.

1. Use in health and medicine

The initial impetus for advancing sensor technology came from health care area, where it is now generally recognized that measurements of blood gases, ions and metabolites are often essential and allow a better estimation of the metabolic state of a patient.

2. Use in Industrial Process

Biosensor monitored the pH, temperature, gases in bioreactor and improves the quality of the product, increase product yield because it maintain the optimum condition throughout process.

3. Environmental Monitoring

Biosensor is use for air and water monitoring. The primary measurement media here will be water or air, but the variety of target analytes is vast. The possible analytes include biological oxygen demand (BOD) which provides a good indication of pollution, atmospheric acidity, and river water pH, detergent, herbicides, and fertilizers.

4. Military Application

Biosensor detects the toxic gases including the chemical warfare Agents.

5. Applications in Agri-food Industry

The biological, chemical and/or physical threats may be the result of contamination or failures during food handling, processing, packing and distribution. Food Security refers to the availability and continuous, timely and permanent access to food. Management systems to ensure food safety.

Biosensors in microbiology

1. Bacteria, fungi, viruses and other microorganisms are found widely throughout nature and the environment.
2. Bacterial pathogens are distributed in soil, marine and estuarine waters, the intestinal tract of animals, or water contaminated with fecal matter.
3. Biosensors for bacterial detection generally involve a biological recognition component such as receptors, nucleic acids, or antibodies in intimate contact with an appropriate transducer.

Biocatalytic electrochemical biosensors

Biosensor advances have been led by the glucose sensor, now sold globally for blood glucose monitoring by diabetics. Glucose oxidase has an FAD cofactor and, in early electrodes, the redox transfer of electrons from glucose was channelled via FAD into hydrogen peroxide in the presence of molecular oxygen. Peroxide was then detected at a platinum electrode.

Biosensors based on similar oxidases or coupled enzymic reactions record current as peroxide is oxidised back to oxygen at the electrode at an operating potential of around 600 mV. They have been adopted widely, from sensors for pathogen detection, food quality testing (eg using lactate oxidase) through to environmental monitoring, although there are few applications in plant biology.

Conclusions

1. In India, this technology, which has already made some imprints in many areas of plant pathology and is the second craze after biotechnology for innovative research? .
2. Biosensors combine the selectivity of biological system with the processing power of modern microelectronics.
3. Furthermore, antigen-antibody interactions are efficient and selective, and the detection speed will depend on the sensitivity of the transduction system and on the method used for signal amplification.
4. Pesticides, fertilizers, and heavy metals can be quickly detected in small quantities with biosensors, facilitating *in situ* implementation in pre- and post-harvest processes..
5. The main reasons for this are both technology and market related. It is a challenge to create biosensors with the necessary properties for reliable and effective use in routine applications.
6. Research usually proceeds without a defined specification that is adhered to. There are a number of practical and technical issues which must be overcome in the development of bacterial biosensors for their commercialization.
7. Obviously, enhancing the specificity of biosensor systems and incorporation of all the features in within one bacterial biosensor device is a very complicated task.

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Emerging trends and role of biotechnology in the development of agriculture sector: An Indian perspective

Article 11193

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"Transformation of agriculture must be the top priority concern of our public policies, including science and technology policies."

—Dr. Manmohan Singh

INTRODUCTION

BIOTECHNOLOGY, a broad area of biology, is a technology that involves the use of living organisms to transform our world and our lives. It may be defined as any technique that uses living organisms such as bacteria, fungi, yeast, viruses, plant cells, animal cells etc. to make or modify a product, to enhance the productivity of crops, to improve plants or animals or to genetically engineer micro-organisms for specific uses.

Agricultural biotechnology, also known as Agritech, is a collection of scientific techniques used to improve plants, animals and microorganisms. In agriculture it is now observed that modern biotechnology has offered opportunities for the production of more nutritious and better tasting foods,higher crop yields and plants that are naturally protected from disease and insects. With the use of genetic engineering, transfer of one or more desirable genes can be done, thereby permitting scientists to develop crops with specific beneficial traits and reduce undesirable traits.

India is currently facing one of its most forbidding economic challenges- addressing the widening demand-supply gap in food grain production. In a survey it was seen that India has the highest number of hungry people in the world(The Times of India,http://articles.timesofindia.indiatimes.com/2013-11-12/gurgaon/43979214_1_surplus-food-india-food-banking-networkurban-areas). With a growing population and scarcer resources, India needs to produce more with less input. Thus biotechnology is seen helping to improve the effectiveness of agriculture inputs, bring down input costs and increase output.

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Realizing the immense potential of biotechnology in the fields of agricultural production especially in our country's context, India has been devoting special attention over the past two decades to biotechnology and its applications.

Biotechnology in Agriculture

Biotechnology holds considerable promise to meet challenges in agricultural production. It makes use of life sciences, chemical sciences and engineering sciences in achieving and improving the technological applications of the capabilities of the living organism of their derivate to make products of value to man and society. Biotechnology offers multiple innovative techniques to develop high-yielding crops that can counter the biotic and abiotic stress associated with Indian agriculture.

A) Plant Biotechnology

Plant biotechnologies an play a key role in the massive production of improved crop varieties

a) Tissue culture

Tissue culture is a collection of techniques used to grow or maintain plant or animal cells, tissues or organs under sterile conditions (in vitro) on a nutrient culture medium of known composition. In agriculture plant tissue culture is widely used for mass multiplication of crops and plants. It is based on the concept of totipotency- genetic potential of a plant cell to produce the entire plant. Plant tissue culture is widely used to produce clones of a plant in a method known as micropropagation- an advanced technology involving vegetative propagation for producing a large number of genetically superior and pathogen free transplants in a limited time and space. Examples are multiplication of bamboos. In general, it takes a long period to flower in bamboos. It has been reported that bamboos can be induced to flower through tissue culture in relatively lesser time. Moreover mass multiplication of many ornamental plants like Fiscus, Heliconi, Xanadu, Dieffenbachia, Garbera, Carnation etc. and field crops like Tomato, Bringal, Chillies etc. is carried out which have shown that the use of this fully mechanized procedure of multiplication, distribution and transfer is suited to commercial micro propagation.

b) Transgenic plants

A breeding approach in which plants that have been genetically engineered, using recombinant DNA techniques to create plants with new characteristics. They are identified as a class of genetically modified organism (GMO). Bio agriculture yields better results than traditional techniques while maintaining the stability and fertility of soil.

High yielding seeds significantly enhance the productivity potential and provide resistance from adverse environmental stress such as drought and salinity. They are particularly effective and relevant for a country like India that suffers from water scarcity and drought every year. High yielding seeds also protect crops from diseases and insects. Figure 1 shows genetic engineering technologies and their applications.

B) Animal Biotechnology

Animal biotechnology is the use of science and engineering to modify living organisms. The ultimate goal is to generate animals with useful novel properties for dairy, meat, or fiber production. Molecular biology techniques can help drive breeding programs by directing selection of superior animals.

C) Animal Husbandry

Biotechnology when applied to animals focuses on livestock breeding and husbandry, nutrition and health, and the production of transgenic animals. Biotechnology can greatly accelerate the speed at which desirable characteristics (e.g. better growth rates or increased milk production) can be in traduced into animals.

D) Biotechnology in Fisheries and Aquaculture

Due to the increase in growth rate of the world population, the demand for fish is soaring worldwide and it appears unlikely that the increasing demand can be met through increased natural harvests as many of the oceans and natural freshwater fisheries are being harvested to their limit. Aquaculture, being the fastest growing food sector, is the farming and husbandry of aquatic organisms. Biotechnology options seem to be good potential for increasing aqua cultural productivity, food security and environmental quality. In India, experimental transgenic *rohu, zebra fish* and *singhi* have been produced recently. Genes, promoters and vectors of indigenous origin are available only for two species (*rohu* and *singhi*) for engineering growth.

Though protocols are available for transformation of a few fish species, infrastructure for transgenic fish production is highly limited and biosafety testing procedures, specific toaquatic animals, are not in place.

E) Composting

Composting is process that converts organic wastes into stable sanitary humus like material driven by anaerobic microbial activity and can then be safely returned to the natural environment. Composting is actually a low moisture, solid substrate fermentation process.

It has long been recognized not only as a means of safely treating solid organic wastes, but also as a technique of recycling organic matter. This method plays a significant role in waste management schemes, as it enables the reuse of organic material derived from domestic, agriculture and food industry wastes.

G) Bio fertilizers-

Biofertilizers are the living organisms, which bring about nutrient enrichment of soil. Bio fertilizers comprises of bacteria, cyanobacteria and fungi having the ability absorb gaseous nitrogen and phosphorous

F) Bio fortification-

"Bio fortification" or "biological fortification" refers to nutritionally enhanced food crops with increased bioavailability to the human population that are developed and grown using modern biotechnology techniques, conventional plant breeding, and agronomic practices. Staple crops like rice, wheat, maize, sorghum, lupine, common bean, potato, sweet potato, and tomato are most of the crops targeted by transgenic, conventional breeding, and agronomical approaches. A useful gene once discovered, can be utilized for targeting multiple crops making transgenic-based approach a advantage. Some important genes like phytoene synthase (*PSY*), carotene desaturase, nicotinamide synthase, and ferritin have been utilized in multiple events including multiple crops.

Conclusion

Biotechnology could help solve many problems like limiting crops and livestock production in the developing countries. The development of genetically modified foods and other agricultural biotechnology products has generated significant role in Agricultural development. Public acceptance of transgenic products and awareness of the benefits and safety of technology is much needed.

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AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Food allergens and its effect on human health

Article id: 11194

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ABSTRACT

Allergy is a hypersensitivity disorder of the immune system of the human body. Allergic reactions occur when a person's immune system reacts abnormally to the normally harmless substances, present in the environment. Any substance that causes a reaction is called an allergen. Allergic diseases comprise of asthma, rhinitis, anaphylaxis, drug, food and insect allergy, eczema and urticaria and angioedema. Over 90% of food allergies are caused by eight common allergens; namely: eggs, peanuts, cow's milk, soy, nuts, shellfish, fish, or wheat. The involvement of food allergy in patients with allergic disorders is complex, there should be proper diagnose of allergen as incorrect diagnosis of food allergy can lead to inappropriate treatment.. Food allergy is an increasing problem in the society nowadays. It can be developed by many of the complex host factors and properties of food. Allergen can be any protein in the food which act as antigen or foreign particle to the body and trigger the defense mechanism of immune system. Its symptoms can be vary from minor itching to life threatening conditions such as anaphylaxis. So, it is very important to know the causative allergen in the diet as the only. It is very necessary to have the right diagnose for the allergen as unnecessary removal of food from diet can leads to bad health effects. To avoid the food allergy reaction, the only and best way is to avoid having allergenic foods. Read the labels of food before eating it to avoid food allergy

INTRODUCTION

Allergy is a hypersensitivity disorder of the immune system of the human body. Allergic reactions occur when a person's immune system reacts abnormally to the normally harmless substances, present in the environment. Any substance that causes a reaction is called an allergen. Allergy is formally called type-I (or immediate) hypersensitivity and is one of four or more forms of hypersensitivities. The burden of allergic diseases in India has been on an uprising trend in terms of prevalence as well as severity. These allergic diseases comprise of asthma, rhinitis, anaphylaxis, drug, food and insect allergy, eczema and urticaria and angioedema. Approximately, 20% to 30% of total population suffers from at least one of these allergic diseases in India (Prasad and Kumar, 2013).

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Food allergy represents a substantial health problem in childhood. The prevalence appears to be increasing in both developed and transitional countries, however a true increase has been difficult to demonstrate. Over 90% of food allergies are caused by eight common allergens; namely: eggs, peanuts, cow's milk, soy, nuts, shellfish, fish, or wheat. On the whole, food allergy affects approximately 6% of infants younger than three years (Mazzocchi *etal*., 2017).

Food additives also function as pseudoallergens and can cause non-IgE- mediated allergic reactions. Allergic reactions can occur in sensitive groups of consumers who are exposed to foods or food additives, that have been previously treated with certain pesticides and herbicides (Nyambok and Rabinson, 2016) .

Nutrition plays a key role in the development, maintenance, and optimal functioning of immune cells. Nutrients, such as zinc and vitamin D and nutritional factors, such as pre- and probiotics, can influence the nature of an immune response and are important in ensuring appropriate functioning of the immune system (Mazzocchi *etal*., 2017).

The involvement of food allergy in patients with allergic disorders is complex, there should be proper diagnose of allergen as incorrect diagnosis of food allergy can lead to inappropriate treatment. There are some scientifically sound methods of testing to diagnose food allergy are skin test, food elimination diets, RAST(Radio Allergo Sorbent) test and DBPCF (Double- Blind, Placebo-Controlled Food Challenge) test.

Allergens detection in food stuffs can be a very hard task, due to their presence usually in vestigial amounts in the food.. Several methods have been successfully applied to evaluate the presence of allergens in foods such as immunological assays (ELISA, RAST,SDS, PAGE,RIE etc), cell based methods and DNA based methods. Several types of biosensors have been developed and used for allergies detection, in particular, three major groups, namely optical, electrochemical and piezoelectric biosensor (Alves *etal*., 2016).

There are some adverse reactions of food which are not classified as food allergen it may include food intolerances secondary to metabolic disorders, reactions to toxic contaminants or pharmacologically active food components. There are some conditions where the symptoms are like food allergy but it is just the related condition to food allergy like food intolerance which includes Eosinophilic Esophogitis, Food Protein-induced Enterocolitis Syndrome, Oral Allergy Syndrome, Food Intolerances, Lactose Intolerance, Celiac Disease. Adverse food reactions can be classified as follow

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ISSN: 2581-8317
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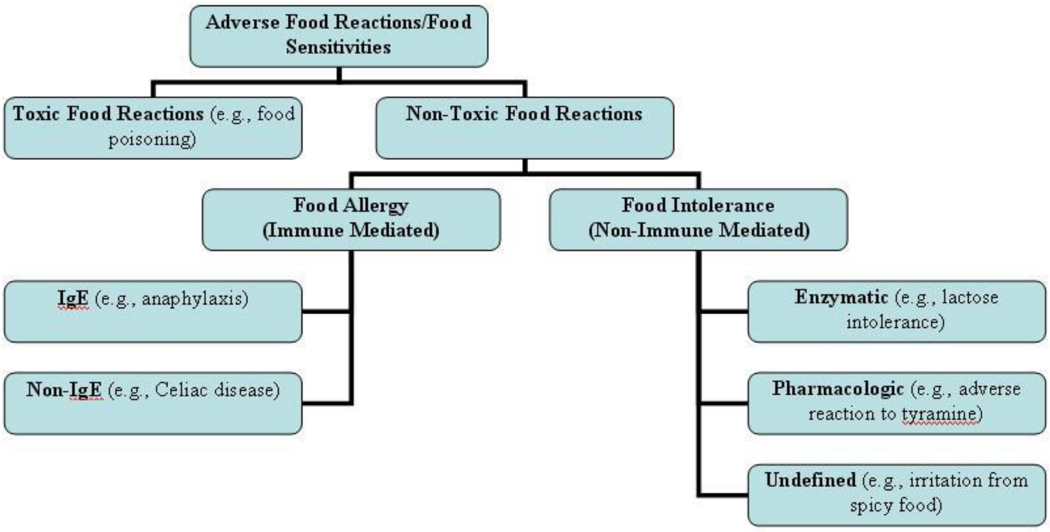
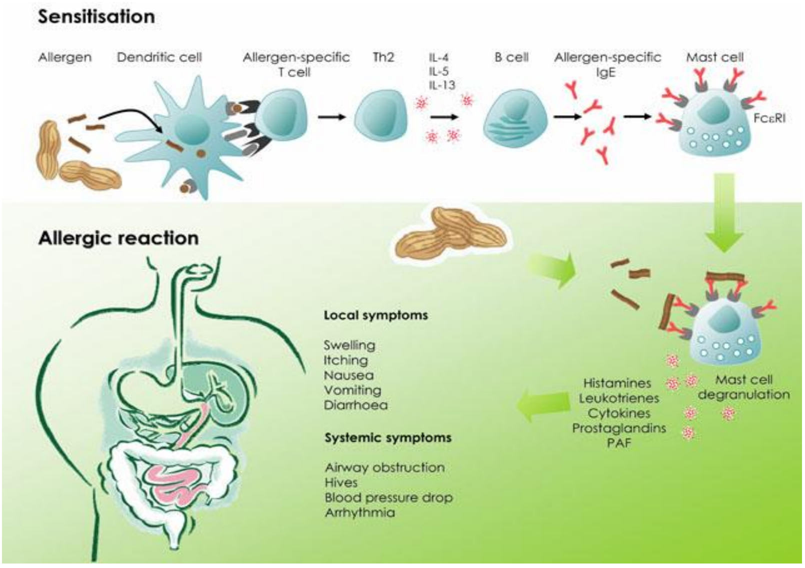


Classification of individualistic adverse reactions to foods

Mechanism of food allergy

The Food Allergy mechanism involves cytokines IL-4, IL-5 and IL-13 that are associated with the T-helper 2 response. The immune system of the body is biased towards this response and therefore induces IgE towards allergens via Bcells. This is followed by degranulation of mast cells when IgE receptors present on these cells are binded by the IgE. Thus, the body experiences itchiness, sneezing, etc when the mast cells release its mediators



Mechanism of food allergy

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Types of food allergy

According to FARE (Food Allergy Research and Education) there are eight foods that are responsible for 90% of food allergies. They are,

s

Types of food allergies

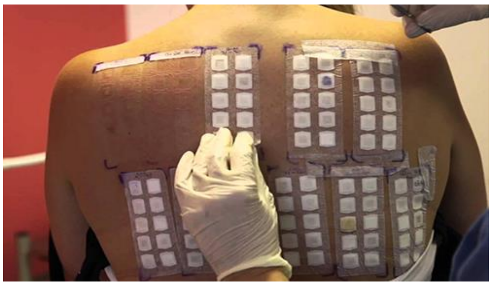
Milk allergy: Generally children are prone to this allergy. Proteins present in cow's milk such as casein or whey are reacted upon by the body. Atopic diseases such as asthma, allergic rhinitis or eczema may also be found in people with this allergy.
Egg allergy: Children are the victims of this allergy, however the problem may resolve at a very young age. The people may also carry this allergy for their entire lives. A person may be prone to either the egg white or the yolk or both.
Peanut allergy: This disorder persists for an entire life and is very serious. Anaphylaxis may occus. In severe cases a person may get restricted to breathing or it might lead to a cardiac arrest.
Other common allergies: Very little is known about the rest of them however, soy, wheat and tree nuts allergies are also considered to be life long disorders

Tests to diagnose food Allery

It is very important to have right diagnosis of food reactions. There are some scientifically sound methods of testing to diagnose Food allergy or food intolerance.

Skin Test

The tests involve placing on the skin extracts of a particular food which is suspected as allergen. It is then pricked or scratched into the skin to look for a reaction of itching or swelling

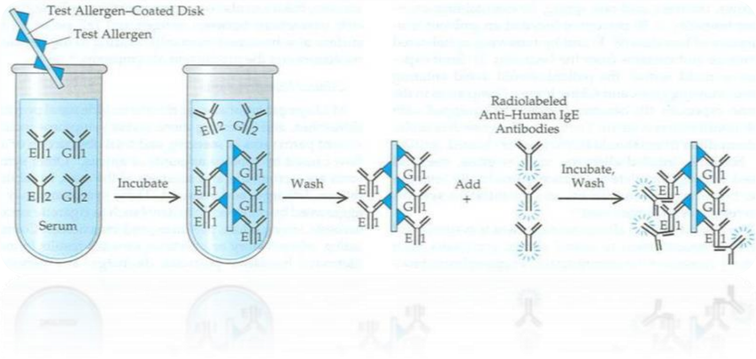


Food Elimination Diets

Suspect foods may be removed from the diet for around 2 weeks prior to a food challenge and symptoms of allergy are observed if symptoms disappear then the food is avoided in the diet

RAST (Radio Allegro Sorbent) Tests

This is an identification test for allergy where blood sample of the patient is mixed with the food in a test tube. If the blood produces antibody which can be detected then the food is cause of allergy.



Double-Blind, Placebo-Controlled Food Challenge Tests (DBPCF)

In this allergy test, a suspected allergen is placed in a capsule or hidden in a food and is fed to the patient under strict clinical conditions and the adverse effect of the food is observed by the doctors specialized in allergies and food intolerance

ISSN: 2581-8317

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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
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Impact of climate change on crop-weed association

Article id: 11194

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Environmental pollution is a contamination of air, water and land from man-made wastes which leads to ozone depletion, global warming & climate change which vulnerably affecting our agriculture sector. The climate change refers to changes to long-term weather patterns, such as temperature, rainfall or snowfalls whereas global warming refers to increases in the earth's average temperature because of greenhouse gas build up in the atmosphere. Global warming is a cause of climate change. There are two main causes of climate change- first is anthropogenic causes (e.g., fossil fuel burning, land use changes like deforestation and urbanization, industrialization etc.) and the another one is natural causes which includes volcanic eruption, natural oscillation like ocean currents influence ocean temperature, fluctuations in sun's intensity etc.

Experiments on elevated temperature and CO_2 shows that by 2030, yield of principal cereals will decline up to 3-7 %. The IPCC (Inter Governmental Panel on Climate Change) in 2007 has mentioned that carbon dioxide, methane, chloroform carbon and nitrous oxide are the main cause of global warming and climate change, have increased markedly as a result of human activities since 1750 and now far exceeding pre-industrial value. Global mean temperature by the end of the 20th century was 0.7^{0}C above than those recorded at the end of 19th century and likely to increase further by 1.8^{0}C to 6.4^{0}C by the end of 21st century. Nitrous oxide concentrations have risen from a pre-industrial value of 270 ppb to 319 ppb in 2005.Current CO_2 concentration (380 ppm) and projected increase in CO_2 concentration (600 ppm) by the end of 21st century in the atmosphere and the primary source of increase in carbon dioxide is fossil fuel, but land-use changes also make a contribution.

Climate change directly or indirectly affects the plants but the response of plant is not uniform, it depends on species, growth and photosynthetic behavior. Rising CO_2 has been shown to help vegetables and grain crops, grow more quickly, become more draught resistant and produce potentially higher yields. However, the impact of rising CO_2 seems to be far more pronounced in the weeds that compete with crops than in the crops themselves. Climate change directly affects geographic range of species, the timing of species life cycle, the population dynamics of species, the decline and extinction of some species and the invasion of the other species. Increase in carbon dioxide concentration may also affect growth and combustibility of many invasive weeds and changing fire ecology. *Avena fatua* matured two weeks in advance under elevated CO_2. Plants with C_3 photosynthetic pathway are expected to benefit more than the C_4 plants from CO_2 enrichment. However, rising global temperature may give competitive advantage to C_4 plants than C_3 plants. This differential response of C_3 and C_4 plants will alter crop-weed interaction because of the fact that out of 18 world's worst weeds 14 are C_4(e.g., *Cynodon dactylon*, *Cyperus rotundus*, *Euphorbia hirta*, *Elusine indica*, *Setaria glauca* etc.) and by contrast, of the 86 plant species that contributes 90% of national per capita food supplies worldwide, only 5 are C_4(e.g., *Zea mays*, *Saccharum*spp., *Sorghum bicolor*, *Pennisetum typhoides* and *Penicum miliaceum*). The photosynthesis is increases by the doubling of CO_2 concentration in C_3 plants but no change in C_4 plants at elevated CO_2.

C_4 plants have higher water use efficiency (WUE) and nutrient use efficiency than C_3 plants such as increased WUE by 54 % in *Zea mays*, 48 % in *Glysine max*, 128 % in *Ambrosia artemisiifolia*, 76 % in *Amaranthus retroflexus*. Higher levels of CO2 could stimulate the growth such as leaf density thickness or specific leaf weight and higher root/shoot ratio of some weed species and due to greater production of rhizome and tubers in perennial weeds making them difficult to control by mechanical weeding. At doubling ambient CO_2 level biomass yield of C_3 plants increased by 40 % however in C_4 plants 11 %. In *Oryza sativa* (C_3), elevated CO_2, alone enhanced the crop competitiveness against *Echinocloa glabrescens*, but simultaneous increase in CO_2 and temperature favored *E. glabrescens*. The efficacy of herbicides is greatly influenced by environmental variables such as temperature, precipitation, wind and relative humidity. At elevated CO2 the days required for death of weed plant is extended like in *Chenopodium album* it is delayed by 3 days, in *Phalaris minor* by 9 days, in *Avena fatua* by 7 days and in *Amaranthus* spp. by 13 days.So, rate of application of herbicides may be necessary to increase or certain surfactants may have to be added to enhance the efficacy of weed control. To mitigate impact of global warming on adoption of new agricultural practices & strategies such as conservation agriculture, use of new herbicide and change in time of application of herbicide should be studied. Similarly, efficacy of bio-control agents also influenced by change in the growth, development and reproduction of target weeds. So, we should take care of selection of bio-agents as well as of appropriate crop species/cultivar according to the climate.

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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
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In situ rain water harvesting techniques and multiple use of water

Article id: 11195

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Introduction

Due to increasing population pressure and climatic fluctuations over the last 75 years, soils have increasingly lost their productivity. The natural vegetation cover has gradually been reduced through deforestation, overgrazing, extension of cultivated land and reduced fallowing. For the future, projections of climate change show that temperatures will increase, mean annual rainfall will either decrease or increase depending on the region, while rainfall variability will become more pronounced in all regions. These changes put additional pressure on agricultural production and the already degraded natural resources. Higher temperatures mean higher water requirements for plants and animals. Increased temperature reduces the humus content of soils due to faster mineralization. Further losses of fertile topsoil occur through water and wind erosion. Degraded soils infiltrate less water, have lower water storage capacities and produce less food and fodder. Restoring soils, improving soil fertility and enhancing water availability therefore increases and stabilizes agricultural production.

Sustainable and increased productivity depends solely on natural resources of land, water and vegetation, which need to be judiciously managed to meet the growing needs of food requirements and maintain environmental security for our future generations. Shrinking and degrading natural resources, and changing climate, however, limit the ability to attain the consumptive lifestyle (Fig. 1).

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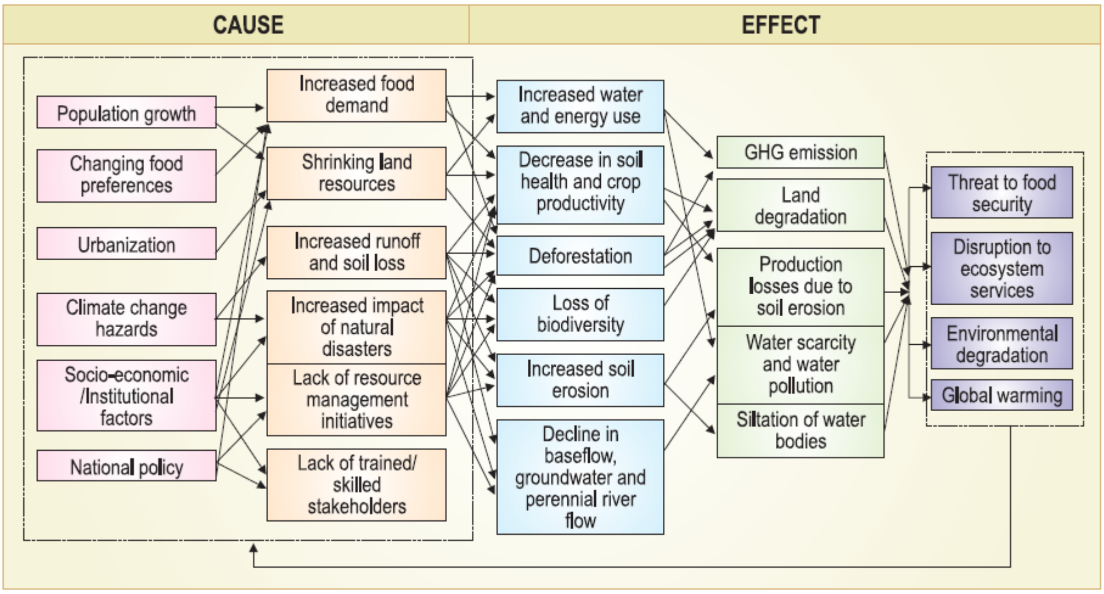

Fig. 1: Complex process of resource degradation and its driving forces (IISWC Vision document 2050).

Several soil and water conservation (SWC) measures have been developed for improving livelihood and resilience of the ecosystems /farm households against the effects of climate change by maintain and restore production potential of resources. Some of the general In situ rain water harvesting techniques are given below.

A. In situ rain water harvesting techniques

- **Mulching**

Mulch is a protective covering, usually of organic matter such as leaves or straw, placed around plants (Fig. 2). It prevents the evaporation of moisture, the growth of weeds. It can have a positive effect on the fertility of the soil. Salinity, an offshoot of water logging, adversely affects the crop yield. The rate of soil salinity is fastest during periods when soils are bare and potential evaporation is high. During such periods, mulching will be helpful in reducing rate of evaporation at the soil surface thereby curtailing accumulation of salts in the root zone. Mulching films are most commonly used to save water, produce earlier, higher and healthier yields, and to produce plants with a better commercial appearance. Mulching has beneficial effects on soil, and on the environment. These include moisture retention, maintaining a proper structure, better use of fertilizers, protection of growing plants, less product damage and elimination of weeds when using opaque plastics.

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All the plastics used for mulching increase soil temperature during the day, apart from the white and aluminized plastics which reflect light. Black plastic is best for preventing the growth of weeds. Inside greenhouses, white plastic is used as a reflective mulch to increase the quantity of light available for the plants.

Fig. 2: Residue mulch application in vegetable

- **Tillage**

All agricultural operations such as ridging, ploughing, harrowing, sowing, trenching, etc., are recommended to be done on the contour wherever possible or at least generally across the direction of the slope where holdings are very small. Even though the operation is very simple, it plays a major role in retarding the process of soil erosion through runoff. It also conserves soil, and due to increased time of concentration, more rainwater seeps through the soil profile to recharge ground water. Summer ploughing leaves the soil highly absorbent of initial rains.

In the land having 4% slope, minimum tillage with crop residues was found to be the best management practice in reducing the runoff, soil and nutrient losses at Dehradun. There was an increase in Maize + soybean yield by 15%. Contrary to this, in plain areas at Agra, where average annual rainfall is less than 700 mm, deep tillage is found to be good for production of pearl millet (28 q/ha) over zero tillage (7 q/ha) due to higher moisture conservation and better soil environment for root growth. The deep tillage also lowered down the runoff (20.5%) as compared to zero tillage (34.0%). Net returns were almost 50 % higher in deep tillage over farmers' practices in plain areas.

- **Vegetative barrier**

Vegetative barriers are narrow strips (1-3 feet wide) of stiff, erect densely growing plants, usually grasses, planted across the slope perpendicular to the dominant slope. Erosion can be controlled in two different ways. 1) The surface can be protected or reinforced by residue or through vegetation such as pastureland or a grass waterway. 2) The surface or slope can be flattened through benching or terracing. These barriers inhibit surface runoff, slowing and ponding water and capturing and preventing sediment from flowing downhill (Fig. 3).

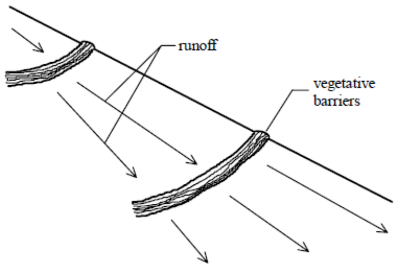

Figure 3: Vegetative barriers as growing plants, usually grasses, planted across the slope perpendicular to the dominant slope

Vegetative barriers inhibit the flow of water because of their dense concentration of thick stems, thus slowing and ponding water and causing sediment to deposit in back of them (Meyers et al. 1994). Over time these deposits can develop into benched terraces (Aase and Pikul, 1995). These barriers function to diffuse and spread the water runoff so that it slowly flows through them without erosion. Vegetative barriers are resilient to failure because water passes over a broad area secured with perennial root reinforcement.

The main purpose of vegetative barriers is to:

1) Retard and reduce surface runoff by promoting detention and infiltration.
2) Disperse concentrated flow and prevent ephemeral gully development.

Secondary benefits that sometimes can be realized are:

1) Entrap sediment-borne and soluble contaminants and facilitate their transformations.
2) Reduce soil loss by causing deposition of eroded sediment on hill slopes.
3) Facilitate benching of sloping topography.
4) Provide valuable wildlife habitat.

A study on 2% sloppy red soil revealed that vegetative barrier of *Vetiveria zizaniodes* planted at 11m horizontal interval in sorghum crop has produced less runoff (24.2%) and soil loss (1.74 t/ha) as compared to 47.2% and 4.6 t/ha respectively from plot having sole sorghum crop. It has also increased the sorghum yield by 9.9 % (21.0 q/ha) than sorghum without barrier (19.0 q/ha), in spite of the fact that there was reduction in the sorghum area by about 5.4 %.

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ISSN: 2581-8317
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- **Judicious use of harvested water: Micro-irrigation system**

Various type of flood method of irrigation is commonly and traditionally followed in almost whole India. This system offers liable to loss of water conveyance, distribution and evaporation. Therefore, about 30-40 % of applied water is being utilized by the crop rest is leached out; evaporated, or lost through surface run off. Micro Irrigation System (MIS) is panacea in irrigation related problems. In this technology, field is irrigated in the close vicinity of root zone of crop. It reduces water loss occurring through evaporation, conveyance and distribution. Therefore high water use efficiency can be achieved (**Table 1).** The unirrigated rainfed cropped area, could be irrigated with the water saved with this technology become a potential source of food production for the benefit of country's food security.

Table 1: Irrigation efficiency under different methods of irrigation

Irrigation efficiencies	Methods of Irrigation		
	Surface	Sprinkler	Drip
Conveyance efficiency	40-50 (canal) 60-70 (well)	100	100
Application efficiency	60-70	70-80	90
Surface water moisture evaporation	30-40	30-40	20-25
Overall efficiency	30-45	50-60	80-90

Micro-irrigation system is the best available way to utilize water and fertilizer efficiently under farm conditions. The type of Micro irrigation system may vary with the type of crop selected and amount of water available for irrigation (Table 2). However, modern technology was developed in Israel. Since MIS is a well-planned and scientifically designed way of farming, it also provides option for Crop diversification. Unlike surface irrigation, drip irrigation is more suitable and economical if it is introduced in water scarce areas having undulated topography, shallow and sandy soils barren and for wide spaced high value crops. It reduces cost of cultivation, increases productivity and reduces energy (electricity) consumption.

Table 2: Crop group wise advisable Micro Irrigation System

Crop group wise advisable micro irrigation system		
Crop	**Crop Spacing**	**Adjustable Micro Irrigation System**
Horticulture Crop	12 m to 3 m between crop raw. (wide spaced)	Drip Irrigation System
Crops fruit part underground like Potato, Groundnut, Turmeric, Ginger, Vegetables, Medicinal Crops etc.	Less than 1 m between crop raw. (Narrow)	Drip Irrigation / Sprinkler Irrigation / Raingun
Field Crops like Cotton, Castor, Tobacco, Pulses, Sugarcane, Banana, Vegetables etc.	Less than 3 m between two crops	Drip Irrigation
Fodder Crops / Nursery Raising of Vegetables, Ornamental Crops etc.	-	Sprinkler Irrigation / Raingun

- **Intercrop and cropping sequences**

Maize + cowpea intercropping was found very much promising in not only reducing the runoff and soil loss but also in enhancing maize equivalent yield (MEY). A study conducted at Dehradun revealed that runoff and soil loss is reduced by 15 and 7.3% and 25 and 21.2% in maize (90×20 cm) + cowpea (45×30 cm) and maize (90×20 cm) + cowpea (Double row, 45×30 cm) intercropping than pure maize (90×20 cm), respectively. The MEY was recorded 10 % higher in maize (90×20 cm) + cowpea (45×30 cm) than pure maize (Table 4). Wheat yield was also found higher than the normal during the subsequent *rabi* season (CSWCRTI, Annual Report 2010-11).

Table 3: Effect of cropping system on runoff, soil loss and Maize + cowpea yield at Dehradun

Cropping System	**Runoff (%)**	**Soil loss (t ha^{-1})**	**Yield (q ha^{-1})**		**Maize Equivalent Yield* (q ha^{-1})**
			Maize	**Cowpea**	
Maize (90×20 cm)	44.2	21.2	22.4	-	22.4
Maize (90×20 cm) + cowpea (45×30 cm)	37.5	15.9	21.1	100.0	24.6
Maize (90×20 cm) + cowpea (Double row, 45×30 cm)	41.2	16.7	18.1	200.0	23.1

*for calculation of MEY, prevailing market rate of maize and cowpea during 2012 was taken.

CONCLUSION

Micro-irrigation system is the best available way to utilize water and fertilizer efficiently under farm conditions. The type of Micro irrigation system may vary with the type of crop selected and amount of water available for irrigation. MIS is a well planned and scientifically designed way of farming; it also provides option for Crop diversification. Unlike surface irrigation, drip irrigation is more suitable and economical if it is introduced in water scarce areas having undulated topography, shallow and sandy soils barren and for wide spaced high value crops. It reduces cost of cultivation, increases productivity and reduces energy (electricity) consumption. The main objective of SWC measures are to increase the time of concentration and thereby allowing more runoff water to be absorbed and held in the soil profile. The loss of fertile topsoil and fertilizer is reduced, and more water and nutrients are available for plant growth

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AGRICULTURE & FOOD
e - Newsletter

http://www.agrifoodmagazine.co.in

AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Mass production method of *Trichoderma spp.*

Article id: 11196

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What is*Trichoderma*?

- *Trichoderma i*s a cosmopolitan fungi found in almost everywhere in the environment especially in soil with huge species diversity.
- This fungus has unique capability to survive on other fungi by destroying their cell wall and hence it is used widely as fungal bio-control agents.
- Besides this, the fungi can produce antibiotic which also inhibit the growth of other pathogenic fungi.
- So far there are no reports of diseases caused by *Trichoderma*in plants except in mushroom.

Benefits of *Trichoderma*

- It produces enzyme which degrade the cell wall of pathogenic fungi.
- It competes for food and space hence suppress the growth of pathogenic fungi.
- It can produce antibiotics which are able to suppress growth of other pathogenic fungi.
- It induces Auxin production helping luxurious growth of plants at early stage of the crop.
- Stimulate plant defense system against plant pathogens.
- It mainly controls the soil borne fungi causing plant diseases while applied in systematic way.

Note:-

- Bio-pesticides are getting popular day by day. But their quality is questionable.
- With the use of concept of mass production of *Trichoderma spp.* at laboratory & farm level (based on maize / other cereal) lab/extension worker will be able to enhance farmer's ability towards organic farming. By this method, they can also produce different types of fungi (not only *Trichoderma* but also entomo-pathogenic fungi like- *Metarhizium*, *Beauveria*, *Verticillum)* at very low cost.

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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Materials required for preparation of *Trichoderma*

- Rice/Wheat/ Jower/ Maize
- Mother Culture bio-control laboratoryin media form or powder or may even use talc based available products from market).
- Cotton.
- Rubber band.
- Plastic pipe of 1 ½ " length and 1 ½ cm – 2 cm diameter having both side open. (or even a bamboo of same size and diameter can be used removing the internodes).
- Pressure cooker of 5 Lt or above as per requirement.
- Xerox envelope cartoon paper for covering cotton plug.
- Thick paper (Cartoon pack).
- Stone/wood or pressure cooker stand.
- Heating system (gas/electric heater).
- Fresh Water(filter water preferably , otherwise tap water for dust'sfiltration/draining dust (village and lab level)&Distilled water for sterilization /wetting maize etc base (lab level).
- Candle(village level) /laminar air flow (lab level)
- Spoon.
- Sprit lamp &ethanol (sprit) (lab level).
- Match box.
- BOD Incubator (lab level).

Sterilization method for laboratory/village level

- Take 200g of Rice/Wheat/Jowar/Maize in the poly plastic pack and add 200 ml of filter water (lab level) /tap water(village level) in the this pack (if grains contain dust then wash it twice before adding fresh water).Double the plastic pack bag layering if required.
- Place the plastic pipe/bamboo in the middle of the plastic pack (opening end) in such a way that level of the pipe and plastic remain equal. Tied it with the help of rubber band.
- Fill the 200ml distilled water in it (lab level)/fresh or filter water in it (village level).
- Plug the opening end of the pipe tightly with the help of the cotton/cotton plug. Wrap the Xerox envelope cartoon paper (white inside, dark outside) on cotton plug with rubber band.
- Place the stone/wood/cooker stand in the cooker and add water into the cooker just below the stone/wood/stand.

- Place the thick cartoon paper inside the pressure cooker surrounding the cooker wall to avoid contact of plastic bags with cooker wall.
- Place the plastic pack inside the cooker and put it on heating system
- Wait until 3-4 times gas release from the cooker (3-4 whistles) (about 25-30 mins for 3-4 cooker whistles).
- Remove the packet from the cooker until totally cool down

Inoculation methodat laboratory level

- Start the laminar air flow,sanitize it &sanitize own hands.
- Light the sprit lamp.
- Open the cover paper from the plastic pack.
- Take mother culture (Talc based) by using opposite end of the spoon and pour it in to the plastic pack removing cotton plug in front of candle. Plugged it again. Same process for media based (PDA/broth) mother culture will be done with cork borer & inoculating needle.
- Keep the plastic pack in room temperature for 10-12 days in Incubator /AC/Fan. The entire grain based medium will turn green due to sporulation of *Trichoderma*.
- When full green growth come on maize (or other cereal), then openthe packet;dry it in plastic/steel pan (up to about 10% moistureremains) & now grind it.
- Pack grinded powder 100gm in pouch or as per supply &demand.

Inoculation method at village level

- Place a candle at the corner of the room and wait for 3-4 min.
- Wash hand and the spoon with Dettol.
- Open the cover paper from the plastic pack.
- Take mother culture (Talc based) by using opposite end of the spoon and pour it in to the plastic pack removing cotton plug in front of candle. Plugged it again.
- Keep the plastic pack in room temperature for 10-12 days.The entire grain based medium will turn green due to sporulation of *Trichoderma*.
- Keep it in a cold place (**refrigerator preferable after sporulation**).
- Do not open the cotton plug until use & Avoid direct sunlight until use.
- After growth come, Can directly be used for soil treatment or keep it in an open tray. Cover the tray with a black cloth and keep it in shade until moisture removed. Grind it with mortar pestle to make powder form & can be used for seed treatment/soil treatment.

Uses

- Can be used for soil & seed treatment.
- Add crude product or ready powderto well rotten cow dung or organic matter forsoil treatment.

Storage

- Use before or Up to 4 months because mixture is based on cereals not artificial talcum powder).
- Store in cool, dry and well ventilated place at room temperature (24-25^{0}C).

Field application-dose

Soil Treatment

- Mix 1kg -2kg *Trichoderma* (Maize base) powder per 100kg(=1Quintal) dried cow-dung/well composed farm yard manure(FYM) and keep for 10-15 days under a polythene cover or jute bag cover. Turn over the mixture every 3 days to enable uniform multiplication of *Trichoderma* in FYM. Broadcast the FYM in 1 acre area before sowing in evening or early morning.

Nursery Bed Treatment

- Drench nursery beds with *Trichoderma* (Maize base) powder at 5-10gm per liter of water in 1 square meter in evening or early morning.

Seed Treatment

- Mix 5-10gm *Trichoderma* (Maize base) powder in sufficient water to make slurry to coat 1kg seeds. Soak in shade and sow the treated seed in evening or early morning.

Cutting & Seedling Dip

- Mix *Trichoderma* (Maize base) powder 200gm-400gm in 15-20 liter water and dip the cuttings/ rhizome/ tuber/root of seedlings for 10 minutes before planting.

AGRICULTURE & FOOD e-Newsletter

http://www.agrifoodmagazine.co.in

AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Production Technology of Mushroom

Article id: 11197

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Introduction: Mushrooms are the fruiting bodies of fleshy edible fungi, especially of Phylum Basidiomycota and Ascomycota. They are popular for their delicacy, nutrition, flavoured and medicinal food value. Fresh mushrooms contain about 90% water, 3.8% protein, 0.4% fat, 2.4% carbohydrates, 1% minerals and appreciable amounts of vitamins like thiamine, riboflavin, niacin, biotic and pentathonic acid, folic acid and vitamin B12. Hence, mushroom constitutes an ideal dish for diabetic, heart, blood pressure and cancer patients. Mushroom production is an indoor, eco-friendly, money spinner, labour intensive and highly protein-rich crop.

Table 1: Nutritive values of important mushrooms (dry Wt. basis g/100g)

Mushroom	Protein	Fibre	Carbohydrate	Fat	Ash	Energy kcal
Agaricus bisporus	33.48	20.90	46.17	3.10	5.70	499
Pleurotus sajor-caju	19.23	50	63.40	2.70	6.32	412
Pleurotus ostreatus	30.40	8.70	57.60	2.20	9.80	265
Volvariella volvaceae	37.50	5.50	54.80	2.60	1.10	305
Calocybe indica	17.69	3.40	64.26	4.10	7.43	391

Table 2: Temperature requirements of important mushrooms and their growing season in U.P.

Common name	**Scientific name**	**Temp. requirement**		**Growing season in UP**
		Spawn run	**Cropping**	
White button mushroom	*Agaricus bisporus*	23-25	14-18	Oct-Feb
Summer white button mushroom	*Agaricus bitorquis*	28-30	25-28	Sep.-Nov. & Feb-April
Dhingri	*P. sajor caju & P. flabellatus*	25-32	22-26	Sep.-March
Dhingri (Florida)	*P. florida*	25-30	18-22	Sep-March
Kabul Dhingri	*Pleurotus eryngii*	18-22	14-18	Nov. –Feb
Milky mushroom	*Calocybe indica*	25-30	30-35	March-April & July-Sep.
Paddy straw mushroom	*Vovlariella volvacea*	30-35	28-32	July-Sep.

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AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

There are four types of mushrooms are commercially cultivated in India:




1.Button Mushroom (*Agaricus bisporus*) 2.Oyster mushroom (*Pleurotus spp*) 3. Milky Mushroom (*Calocybe indica*) 4. Paddy straw mushroom (*Volvariella volvacea*)

Spawn Production Technology: Spawn is the seed of mushroom, required for its cultivation. Spawn can be produced on any kind of cereal grains like wheat, maize, pearlmillet, sorghum etc.

Method of preparation of master spawn/ commercial spawn: The grains of cereals are cleaned and boiled in water for 20-25 minutes. The excess water is removed by sieving. Then the grains are dried under shade for 4-6 hrs. $CaCo_3$ (0.5%) and $CaSo_4$ (2%) are mixed thoroughly and then about 300 g mixed grains are filled in glucose /milk bottle in case of master spawn, while in case of commercial spawn heat resistant polypropylene bags are used. It is plugged with cotton and autoclaved at 22 psi for 1.5 to 2 hours. The grain mixture is inoculate with mycelium of desired strains using laminar flow for master spawn production while for commercial spawn production 10-15g of grains are inoculated from master spawn bottle to pp bags containing grains under aseptic condition. Bags are kept in incubation room or BOD at 24 ˚C for *Agaricus* and *Pleurotus* spp. while *Volvariella* and *Calocybe* spp. at 30-32˚ C.

1. Cultivation of white Button Mushroom: This mushroom has a pleasing, distinct taste, aroma, and most popular mushroom in India. India produces about 85% button mushroom of the total of mushrooms production. At the global level, it also ranks first, 31% of total mushroom production.

Method of composting: Compost can be prepared by the long method, short method or indoor composting.

Composting by the Long method: Ingredients- Wheat brawn-1000 kg, Calcium ammonium nitrate - 30 kg, Urea - 12 kg, Murate of Potash - 10 kg, Super Phosphate – 10kg, Gypsum-100 kg, Wheat brawn- 100 kg and Molasses- 16.6 litres.

Composting procedure: 1. Wet the wheat straw thoroughly by spraying water up to 24-48 hrs. 2. Other ingredients except gypsum and insecticides are mixed, sprinkled with water and covered

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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
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with polythene sheet or gunny bags. 3. -1 Day- Wetting of other ingredients completed. 4. 0 Day- the day when two (wheat straw and other ingredients) are mixed and the dimension of pile kept 4X4 feet. 5. Days 6- (Ist turning) 6. Days 10- (2nd turning). 7. Days 13- (3rd turning), the required quantity of gypsum is added. 8. Days 16- (4th turning), add 400g Furadan 3G/ton of straw to check the insects and nematodes. 9. Days 19- (5th turning). 10. Days 22- (6th turning). 11. Days 25- (7th turning), spray malathion @ 0.01% for killing insects and pests or treat with 50 g carbendazim (50 %) and 1.5 litres formaldehyde (40 %) dissolved in 40 litres of water per ton of compost. 12. Days 28- Filling day.

Filling of compost: About 10 kg of prepared compost is filled in each poly bag of the size 45 x 30 cm and spawning is done in three layers @ 75g spawn/10 kg compost.

Casing and crop management: Normally about 15 days after spawning mycelium is seen as uniform white covering on compost surface. At this stage, casing soil is spread on the top of the bags with a thickness of 3-4 cm. Casing soil is prepared by mixing two-year-old compost with an equal amount of soil and it is sterilized before casing. After casing, spraying of water is done and room temperature should be maintained about 22 – 24 °C and humidity up to 85%. When mycelium emerged on the casing soil then slows down the cropping room temperature i.e.14-18 °C.

Harvesting: Small pinheads appear on the top of the casing soil after seven days of casing and within two to three days these small pinheads are converted into the fruiting bodies. Mushrooms are harvested by gently holding the fruiting body and twisting it.

2. Cultivation of Oyster Mushroom (*Pleurotus spp.*): Oyster mushrooms are commonly cultivated on wheat and paddy straw.

Chemical sterilization of substrate: Take a drum of about 200 litres capacity; it filled with 90 litres of water, in which 10-12 kg of wheat straw is slowly steeped. In a separate plastic bucket, carbendazim 7.5 g and 125 ml formaldehyde (37-40%) is dissolved and slowly poured on the soaked wheat straw in the drum, after that straw is pressed and covered with a polythene sheet and a lid. After overnight, the straw is taken out and excess water drained.

Substrate supplementation: Treated wheat bran and rice bran supplements were thoroughly mixed before spawning @ 10% on the dry weight basis of the substrate.

Spawning: Spawning is done @ 3% of the wet wt. or 10 % dry wt. of the substrate. About 4-5 kg spawned substrate is filled in polythene bags (45 x 30 cm). Small holes (10-15) should be made on bags especially in the bottom for leaching of excess water.

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Crop management: The spawned bags are kept in a pre-fumigated cropping room on a raised platform or shelves for mycelial colonization and cropping room temperature is maintained between 22-26°C according to *Pleurotus* spp. During mycelial growth, the bags should not be opened and no ventilation is needed. Moreover, there is no need for high relative humidity and watering. About 20 days of spawning when mycelium fully colonized the substrate, the colour of the bags turn white, and then the mouth of the bags may be cut and removed the polythene. Spraying of the water on compost and optimum temperature (20-26°C) and relative humidity (75-85%) are maintained. The Light is also required to initiate fruit body. Sufficient ventilation should be provided during fructification. After 7 -9 days the fruiting bodies start appearing.

Harvesting: The fruiting bodies will be plucked after twisting the head, before the spray of water on the bags. Cut the lower portion of the stalk as well as adhering debris with a knife after harvesting. Fresh mushrooms are packed in perforated polythene bags for marketing. They can also be sun-dried. The dried produce with 2-4% moisture can be stored for 3 to 4 months after proper sealing.

3. Cultivation of Milky Mushroom (*Calocybe indica*). High biological efficiency, better keeping quality, simple cultivation technique, white attractive colour, can grow on a wide range of agricultural wastes and suitable for pickle and chutney are advantages of this indigenous tropical mushroom.

Substrate and its preparation: Fresh dry wheat or paddy straw soaked in fresh water for 16-18 hrs. Sterilization can be done by hot water treatment/steam sterilization or through chemical sterilization technique as described in Oyster mushroom cultivation.

Spawning: Spawning should be done @ 4-5% wet wt. of the substrate with the layer spawning method. After spawning bags are shifted in a dark spawn running room where temperature between 25 and 35°C with 80% RH is maintained. Substrates are colonized about 20 days after spawning then bags become ready for the casing.

Casing: Casing provides physical support, moisture and allows gases to escape from the substrate. Casing soil is prepared by mixing garden soil (75%), sand (25%) and calcium carbonate @ 12% of soil. It is either sterilized about a week in advance of the casing, in an autoclave or chemically. Casing material is spread about 3-4 cm. thick on the top of the bags and slightly pressed. It takes 10 days for the case run.

Cropping: After case run, temperature 30-35 ºC, relative humidity 80-90 % and light 120-150 lux for 6-8 hr are provided in the cropping room. After 2-3 weeks of the casing, pinheads start coming up and get mature within a week.

Harvesting and Packing: Mushrooms with 7-8 cm diameter are harvested by twisting. Cleaned mushroom packed in perforated polythene/polypropylene bags for marketing.

4. Cultivation of Paddy Straw Mushroom (*Volvariella volvacea*): It is the tastiest mushroom with added aroma but it has a poor shelf life.

Substrates- Paddy straw bundles or wheat or sorghum straw are used.

Methods-The paddy straw bundles or bundles of the other substrates were moistened overnight in a water tank. The bundles were removed from the tank, left for a few hours at the composting platform to drain off extra water. The bundles were then pasteurized by steam at 65ºC for 6 hours or chemically. On cooling, the bundles were arranged into a bed over perforated shelf inside a cropping room. Each bed was made about 2 feet long and 2 feet wide, consisting of 5-6 layers. The bed was spawned in each layer on the periphery and gram powder @ 100g per bed was sprinkled to provide nutrition.

Spawning: The spawning rate is 3% wet weight of the substrate. The spawned beds are completely covered with a polythene sheet and maintained at a temperature of 30-35ºC with 85-100 % RH. The spawn run is completed in 4-5 days after that the polythene cover is removed to allow entry of fresh air for primordial/pinhead development. The pinheads developed in another 3-4 days, which grew into harvestable fruit bodies in another 3-4 days.

Harvesting and packaging: Mushrooms are harvested at egg stage when fruiting bodies are up to 2 inches in diameter. The mushrooms are packed in polythene bags for the market. This mushroom should not be refrigerated but can be stored at 15ºC for a few hours.

CONCLUSION:

It is a great realization nowadays that mushrooms is good healthy food, possess medicinal values. Climatic conditions of Uttar Pradesh are more suited to grow all the four types of mushrooms in different seasons. Plenty of various kinds of agro-residues are also available in the state which can preferably be utilized for cultivation of these mushrooms as a vocation of extra income generation for farmers and unemployed rural youth and to achieve food security.

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AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Vedik Krishi: Way for Sustainable Agriculture

Article id: 11198

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In ancient time framers using natural resources for growing the crops and they grow excellent quality crops. They utilized on farm resources for cultivation like cow dung, urine, crop residue and other products. They also use blend of 5 ingredients such as ghee, milk, curd with urine and dung as panchgavya. All these products which are prepared by cows' products come under vedic organic inputs. Decade by decade Indian farmers substitutes these products with chemical fertilizers for higher production but now days they are facing the problems like decreasing soil fertility, low productivity and pollution. Farmers over step the values of these products and they depend on chemically manufactured fertilizers, pesticide and herbicides. By using excess amount of chemically produced fertlilzers cost of cultivation increases and productivity decreases. Soil physical, chemical and biological properties are disturbed. Soil fertility which is the key for crop production is hampered. Now it is the time that the farming and scientific community realize the importance of organic products for assuring sustainability in farming. Use of these products helpful to maintain sustainable crop production as well as good soil health. No other fertilizer in the world is as cheap, harmless and eco friendly as vedic organic inputs. Hence discuss about some important products which are helpful to maximize crop productivity and maintain soil fertility.

1. Cow Dung: - Cow dung used to prepare farm yard manure which is organic manure. Well rotten farm yard manure contains 0.5 % N, 0.3 % P, 0.5 % K and micro nutrients which are helpful to maintain soil fertility. It is rich source of Soil organic carbon. By using regularly FYM it increase soil carbon status in soil which is the key indicator of soil fertility. FYM improves soil physical, chemical as well as biological properties of soil.

2 Cow Urine: - Cow urine is used in India from very long time. It has been presumed that cow urine is very useful in agricultural operations as a bio fertilizer and bio pesticide (Dharma *et al.,* 2005). It is rich source of macro, micronutrients and has disinfectant and prophylactic properties thus purify the atmosphere and improve soil fertility (Pathak and Ram, 2013). Cow urine therefore, could be an effective tool to control the multi nutrient deficiencies in almost all soils in the country. It is believed that cow urine provides nutrients to plants at low cost; therefore, it is considered an alternative for plant nutrition, metabolic activation and pest and disease control (PESAGRO-RIO, 2002). Cow urine contains many beneficial elements, which help in removing all the ill effects and imbalances of body caused by infectious agents. Cow urine contains 95% water, 2.5% urea, and the remaining 2.5% a mixture of salts, hormones, enzymes, and minerals (Bristow *et al,* 1992). It enhances the microbial and enzymatic activities in soil, hence, it can be considered as bio-fertilizer for increasing soil fertility. In general, the total N content in cow urine is 6.8-21.1 g N litre^{-1} of which about 69% is present as urea, 7.3% allantoin, 5.8% hippuric acid, 3.7% creatinine, 2.5% creatine, 1.3% uric acid and 0.5% xanthin plus hypoxanthin, 1.3% free amino acid nitrogen and 2.8% as ammonia (Bristow *et al*, 1992). It has been considered that cow urine can kill number of pesticide and herbicide resistant bacteria, viruses, and fungi (Sparks, 1996). Cow urine in combination with plant extracts is used to prepare disinfectant which is biodegradable and eco friendly with good antibacterial action (Subbiah and Asija, 1956). Application of cow urine correct the micronutrient deficiency, being organic in nature it is also likely increase the fertilizer use efficiency. The uric acid in the urine acts as fertilizer and hormone. Cow urine has antibacterial, antifungal, antiviral properties; hence it is most effective secretion of animal origin with multitudinous therapeutic values it also purifies and increase soil fertility (Pradhan *et al*., 2018)

3 Panchagavya:- The Panchagavya is an effective plant growth promoter that promote the biological efficiency of crops. Panchagavya is used to increase soil fertility and to protect the plants from diseases. It also increase the nutritional quality of fruits and vegetables. Natarajan (2007) reported that the panchagavya contains primary macro nutrients like N, P and K, essential micronutrients, many vitamins, essential amino acids, growth promoting harmone like IAA, GA, which may provide nutrition to rhizosphere microorganisms and thus help to enhance their population. It can be used as a foliar spray, application in soil, fertigation and seed or seedling treatment *etc*. 3% Panchagavya is an ideal concentration for the foliar spray. Papen *et al.,* (2002) reported that panchagavya contains *Azotobacter, Azospirillum* and *phosphobacteria* microorganism. These microorganisms help in improving plant growth, metabolic activities and resistance to pest and diseases.

4 Jeevamruth;- Jeevamruth is another source of organic manure which promotes immense biological activity in soil and makes the nutrients available to crop. Jeevamrutha is a low cost easily prepared organic input that enriches the soil with indigenous microorganisms required for mineralization of the soil (Gore *et al* 2011). Jeevamruth provide healthy environment to microbes and increase their population which helps to improve soil fertility.

5 Beejamruth;- It is a indigenous seed treatment method of Indian farmers which protect the crop from soil borne and seed borne diseases and improves seed germination. Foliar spray of beejamruth also enhance the productivity of crops (Chadha *et al*, 2012)

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AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Table 1: Different "Vedic Krishi" organic inputs and method of preparation

Sl. No.	Name of organic input	Ingredients	Uses
1.	Cow Urine	Use directly	Cow urine is a good liquid fertilizer and can be used for foliar spraying on the crop. Dilute 1 lit of cow urine with 100 lit of water and use it as foliar spray. For 1 ha of crop 500 lit of such dilute suspension will be sufficient. This can be used in any crop in all the seasons.
2.	Panchgavya	1. Cow Dung Slurry - 4Kg 2. Fresh Cow Dung –1 kg 3. Cow Urine - 3 lit 4. Cow Milk - 2 lit 5. Curd - 2 lit 6. Cow Deshi Ghee – 1 Kg	It is a blend of 5 products. Mix all the ingredients and ferment for 7 days with 2-3 time stirring every day. Dilute 3 lit of panchgavya in 100 lit water and spray over soil. For 1 ha 50 lit of pachgavya needed with irrigation water. Panchgavya can also be used for seed treatment. Soak seeds for 20 min before sowing.
3.	Jivamrut	1. Water – 50 lit. 2. Cow Dung – 5 Kg 3. Cow Urine – 5 lit. 4. Jiggery - 1 Kg 5. Gram Flour – 1 Kg	Mix all the ingredients with wooden stick in a barrel and keep this solution for fermentation for 5 to 7 days. Shake the solution regularly 2-3 times a day. Used as soil application either by sprinkling or by applying through irrigation water. 3 applications are needed. One before sowing second after twenty days of sowing and third after 45 days of sowing.
4.	Bijamrut	1. Water – 50 lit. 2. Cow Dung – 2.5 Kg 3. Cow Urine – 2.5 lit 4. Cow Milk – 0.5 lit 5. Lime powder- 125gm	Mix all the ingredients in a drum and keep the solution overnight. Sprinkle this solution over seeds for treatment. Dry the seeds and sow in the field.

Source: NCOF, Ghaziabad

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AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317
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Conclusion: Use of organic inputs in crop production is very effective tool for sustainable crop production. The Panchagavya, Jeevamruth and Beejamruth are cost effective and eco friendly in nature. They contain macro-micro nutrients, vitamins, essential amino acids, growth promoting enzymes such as IAA, GA and beneficial microorganisms. The use of organic liquid products results in higher growth, yield and quality of crops. All these traditional agricultural organic inputs hold good promise for use in agriculture and provide of safe and healthy food. Additions of organic manure not only provide healthy food but also enhance microbial activity of soil and increase fertilizers use efficiency as a final goal.

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ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

New trends and factors affecting food consumption pattern

Article id: 11199

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ABSTRACT:

During the past two decades, there have been many changes in consumers' acceptance and attitude towards food consumption.These changes not only impacts the consumption patterns but also the manufacturers of the food.Changes in food consumption have influenced the new product development process (NPD) of food companies.The changes that have occurred in the consumers attitudes and consumption pattern regarding food choice are a result of the influence of multiple factors.These factors are:1) Health 2)Urbanization 3)life style changes 4)Religion or culture (in some countries) 5)Increased income levels etc.

INTRODUCTION:

Consumer attitude towards food choice changed immensely during the last two decades.Changes in agricultural practice over the past 50 years have increased the world's capacity to provide food for its people through increases in productivity, greater diversity of foods and less seasonal dependent (Kearney, J. 2010),. Diets evolve over time, being influenced by many factors and complex interactions. Income, prices, individual preferences and beliefs, cultural traditions, as well as geographical, environmental, social and economic factors all interact in a complex manner to shape dietary consumption patterns. Data on the national availability of the main food commodities provide a valuable insight into diets and their evolution over time (Vasileska, A., & Rechkoska, G. (2012).Today consumer food choice is more complex than ever before. Consumers have developed more dynamic, complex and differentiated demands. These changes in consumer behaviour, reinforced by changes in the retailing sector, provide both threats and opportunities for the food sector (K. 2006).

Factors affecting consumption trends:

Health: More recently,food manufacturers have used the health criterion more proactively in their product development through the development of functional foods.

Urbanization: Urbanization also effects the consumption trend,as the rate of urbanization is 75% in the developing world and the process of urbanization is increasing rapidly.consumption patterns are moving more towards convenience food.The demand of traditional food is decreasing rapidly.According to (G., & O. 2014) the spending on food away from home is expected to increase by 10% per capita by 2025.

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Life style changes:
Global youth marketing consists of several interrelated and interdependent factors such as food,movies,clothes,music.Now a days nobody wants to eat at home,outside eating habits, time,occupation,income growth have changed the consumption patterns.Sometimes these habits are not very healthy and can lead to several health related problems.

Religion or culture: Food is seen more than just a means of survival. According to Barthes food is considered to be multidimensional, as something that shapes us, our identities, and our cultures and in the end, our society.People also connect to their cultural or ethnic group through food patterns. Food is often used as a means of retaining their cultural identity. People from different cultural backgrounds eat different foods. The areas in which families live and where their ancestors originated influence food like and dislikes. These food preferences result in patterns of food choices within a cultural or regional group

Increased income levels: The income level is one of the basic determinations of food choice.The changes of income level in these last decades have made the consumers to require higher quality product with specific attributes. Except this, eating out of home pattern has increased as well.Urbanization also plays an important role in income levels.Most of the youth resides in cities, according to their professions the income levels increasing rapidly.

Effects of consumption trends on human health:
The last few decades have seen fundamental changes in food consumption patterns and life styles around the world. These changes have brought about a rapid rise in overall calorie intakes, increased consumption of livestock productsrapid increase in the prevalence of overweight, obesity and related non-communicable diseases (NCDs). Initially, these problems were limited to a few developed countries. There is however, growing evidence that more and more developing countries are facing similar problems; and, more importantly, there are growing concerns that developing countries could be more adversely affected by this rapid transition in diets and lifestyles (WHO, 2003). The increased income level and urbanization combined with the busy life style of consumer have led to increased consumption of fast foods usually are unhealthy,high in fat and sugar,high in calories and poor nutrients.

However consumers around the world are becoming increasingly aware eating healthy and its impact on their health status.

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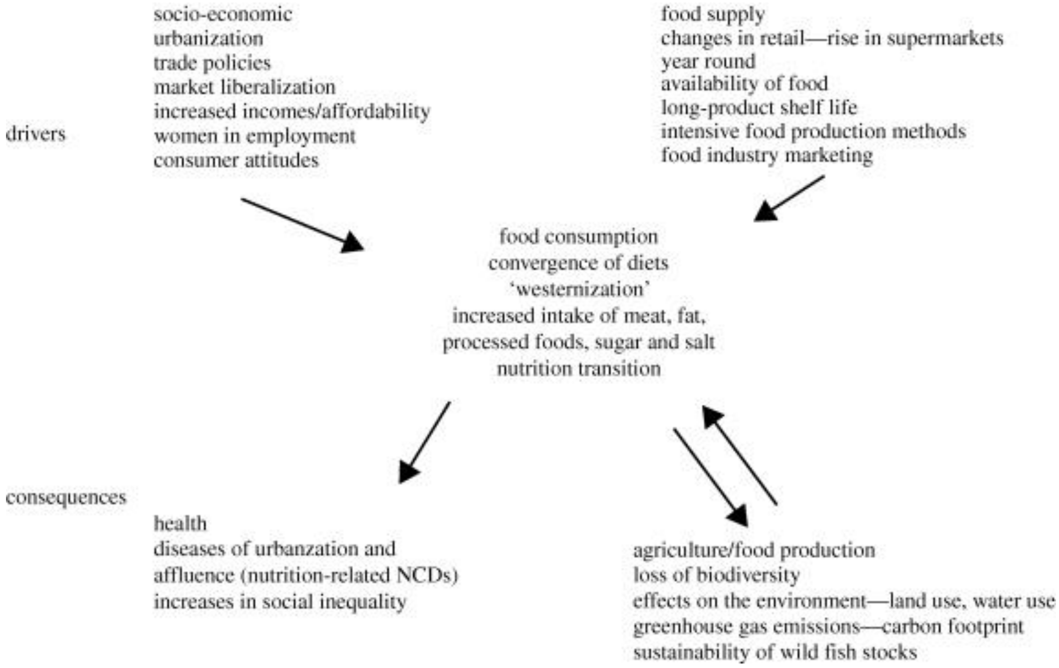

Source: (**Kearney, J. 2010**)

CONCLUSION: Food is not just a means of survival but it connects people in emotional,psychological and religious way.The pattern of food consumption is changing very rapidly.Day by day new trends are emerging with new products. Processed foods are replacing traditional foods.Urbanization changing the food consumption pattern.These changes will continue to impact the consumption as well as the food products that are going to be launched in the next ten years..

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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
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Reduction of postharvest losses in fruits and vegetales by using natural preservatives under natural condition

Article id: 11200

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INTRODUCTION

Fruits and vegetables are an indispensable part of any diet. They are rich and diverse source of vital nutrients and nutraceutical principles that include minerals, vitamins and bioactive compounds which are crucial to nutrition and health of human beings. They contribute to the fiber content of the diet; fiber is an important nutrient found only in plant foods. Keeping in view of the importance in our health, Indian Council of Medical Research has increased its earlier recommendation of 300 & 100 gm of fruits and vegetables to 500 & 100 gm respectively in the daily diet (ICMR, 2010).

India has been bestowed with wide range of climate and physio-geographical conditions which ensures production and availability of most kind of fruits and vegetables. The country is the second largest producer of the Fruits (81.285 Million tonnes) and vegetables (162.19 Million tonnes) in the world, contributing 12.6% and 14.0% of the total world production of fruits and vegetables respectively (FAO & Indian Horticultural database, 2014).

Fruits & vegetables are highly perishable in nature due to high moisture content. About 20-30% spoilage loss of harvested fruits and vegetables which is 20.32 Million tonnes of fruits and 40.54 Million tonnes of vegetables approximately each year. The loss may be due to growth of micro-organisms (bacteria, yeasts and moulds), enzyme action within the food, oxidation, mechanical damage (by bruising, rodents insects). The spoiled fruits & vegetables undergo physical and chemical changes and become unsuitable for consumption. This counts for a significant loss of food commodities of the rapidly growing population where we think for complete food security.

Preservation of fruits & vegetables is one of the important avenues to protect the food commodities from direct spoilage. Preservation is a process of drying, freezing or treating foods with substances to prevent the proliferation of microorganisms such as bacteria and fungi in order to retard or stop spoilage. Fruits and vegetable preservation methods are refrigerated storage

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(storing at temperatures near 32-34°F), cold storage (storing at temperatures below 40°F), waxing (partial coverage of the surface cells of fruits and vegetable), modified atmosphere packing (the O2 inside the package has to be lower than in air and CO2 higher). Rural poor farmers can't afford the capital to store the post harvested fruits and vegetables with the available techniques. So the preservation of whole fresh fruits and vegetables has become a challenge for rural poor farmers.

At this situation, there is a need to natural and low cast techniques of preservation. Various types of plants contain natural preservatives as antimicrobial and antioxidant. Antimicrobial compounds as biological compounds can inhibit the growth of microbes. Antioxidants are used to preserve and protect foods from rancidity, discoloration, or deterioration caused by autoxidation. Therefore can preserve some rapidly perishable post-harvested fruits and vegetable by the use of natural preservative property of certain locally available plant parts.

Moringa oleifra plant- a multi-purpose plant that is easily grown locally and one that has found tremendous use in food and medicine. The leaf and stem bark of the Moringa oleifra play a active role in preservation and able to extend the shelf life of the fruits and vegetables because it have an appreciable level of antibacterial property. For preservation purpose moringa oleifra can be use in various way e.g. fresh leaf, shed dried leaf, powder of leaf and bark. The preservation and storage of fruit and vegetable by using powder from the leaf and stem bark of Moringa oleifera, does not require any form of refrigeration or additional application of chemicals makes its use for preservation. Uninfected fruit and vegetable treated with the Moringa oleifera leaf and stem bark powders can be remain fresh after 21 days. And it reduce the rate of spoilage of infected Fruit and vegetable as well. It's a very convenient preservation method for low income earners and rural dwellers, either for market or for consumption.

Resins: Natural tree gums have been collected and coated for improving the quality and enhancing the shelf life of fruits and vegetables without the use of harmful synthetic chemicals. The absence of post harvest techniques to preserve fresh quality leads to deterioration. The waxy coat is not adequate to offer protection against water loss and high respiration rate. In order to prolong the life of fruit / vegetable, rate of respiration has to be restricted and moisture loss should be inhibited, so as to maintain the vital food elements and the same quality as in the freshly picked fruit or vegetable. The contemporary methodology of fruit and vegetable preservation is through the use of edible wax coatings to retain freshness, to inhibit mold growth and to prevent other physical damage and disease.

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Lemon juice: The acid from the lemons preserves fruits and vegetables, by inhibiting the growth of microbs. Adding an acid slows down the ability of oxygen molecules to interact with the molecules on the surface of the food. As a result of the slowdown in chemical reaction, foods age and turn brown more slowly. Lemon juice extends the life of any cut fruit, cooked fruits and, the dried fruits. A sprinkling of lemon juice keeps apples, avocados and bananas from turning brown, adding two or three extra days to their shelf life, or extra hours to their ability to stay edible in a lunchbox at room temp. Home canners add lemon juice to jams and jellies to prevent bacteria from growing and spoiling the final products and to keep the fruit from browning.

Neem: Neem is an attractive broad-leaved, evergreen tree. The neem are reputed to be remarkably pest free. More than 140 compounds have been isolated from different parts of neem. All parts of the neem tree- leaves, flowers, seeds, fruits, roots and bark have been used traditionally for the treatment of inflammation, infections, fever, skin diseases and dental disorders. The medicinal utilities have been described especially for neem leaf. Neem leaf and its constituents have been demonstrated to exhibit antifungal, antibacterial, antiviral, and antioxidant properties, which can be use to preserve fruits and vegetable.

Neem oil: extracted from neem seeds can use as edible coating agent by mixing in distilled water on the fruits and vegetables such as such as Apple, Banana, Chikoo, Papaya and Tomato. And stop post harvest losses by microbial activity and pests.

CONCLUSION: Fruits and vegetables are widely used as an excellent source of micronutrients and phytochemicals. However, as they are perishable commodities that have a shorter shelf life. Postharvest treatments are used to minimize the loss of fresh produce as well as to maintain the quality, thereby increase the shelf life. Post-harvest treatments will slow down the physiological processes in fresh fruits and vegetables such as respiration, senescence and ripening. In addition, those treatments also reduce the incidence of pathogen attacks and microbial contamination to increase the shelf life of fresh commodities.

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Prospective improvement of rice fallow lands

Article id: 11201

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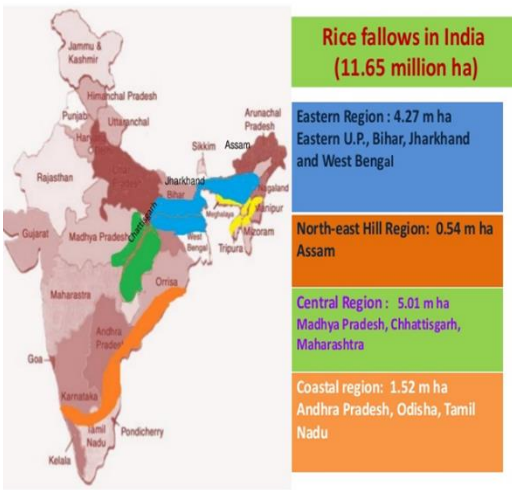
ABSTRACT: In order to meet domestic demands of edible oil and pulses, a large quantity is imported which leads to huge drain of foreign exchange. The rice fallows offer good scope for area expansion of these crops and crop intensification. Rice fallows are those lowland *kharif* sown rice areas remaining uncropped during *rabi* season due to many reasons. Rice fallows are widely distributed in rainfed ecosystem of eastern, central and peninsular India besides north-eastern hill region. Major constraints of rice fallows include lack of improved varieties, poor plant stand, weed intensification, delayed planting, no use of fertilizers, socio economic problems etc. After the harvest of kharif rice, climatic conditions of rice fallow lands in many areas are suitable for growing cool and warm season pulses profitably. Development of high-yielding varieties, improved Tillage machines, sowing methods, seed priming, higher seed rate, timely planting, seed treatment with fungicides, development of IPM modules, application of post emergence herbicides, foliar spraying of urea etc. are the technological interventions in rice fallows to improve productivity. Blooming rice fallow always bring prosperity and sustainability in agriculture and thus improve income and livelihood security of farming community.

INTRODUCTION

Rice fallows basically imply to those lowland *kharif* sown rice areas which remain uncropped during *rabi* (winter) due to various reasons such as early withdrawal of monsoon rains leading to soil moisture stress at planting time of winter crops, waterlogging and excessive moisture in November/December, lack of appropriate varieties of winter crops for late planting, and socio-economic problems like stray cattle, blue bulls etc. India accounts for 79% (11.65 million ha) of the total rice fallows of South Asia (15.0 million ha). Rice fallows are mainly spread in the states of Andhra Pradesh, Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, West Bengal and Uttar Pradesh (Subbarao *et al.*, 2001) (Table 1). Development and popularization of improved varieties of pulses and oilseeds suiting to rice fallows of different agro-ecological



regions coupled with improved agro-technologies can boost production, and thus improve income and livelihood security of farming community. Moreover, introduction of legumes can provide a sustainable production base to the continued rice mono-cropped system and obviate decline in total factor productivity and also provide much needed nutritional security.

Table 1: Area under rice fallows in India:

State	*Kharif*-rice area (m ha)		*Rabi* fallow (m ha)	Rice fallow as % of *kharif* rice area
	2001	2010-2011*	2001	
Andhra Pradesh	2.66	2.92	0.31	11.5
Assam	2.23	2.17	0.54	24.1
Bihar & Jharkhand	5.97	2.74 + 1.69	2.20	36.8
Gujarat	0.47	0.73	0.08	17.7
Karnataka	0.98	1.13	0.18	18.5
Madhya Pradesh & Chhattisgarh	5.60	1.60 + 3.70	4.38	78.3
Maharashtra	1.76	1.49	0.63	35.7
Odisha	3.88	3.93	1.22	31.4
Rajasthan	0.21	0.13	0.03	11.7
Tamil Nadu	1.70	1.74	0.02	1.2
Uttar Pradesh	6.26	5.66	0.35	5.6
West Bengal	4.62	3.57	1.72	37.2
Total (All States)	40.18	38.03	11.65	29.0

Source: Subbarao *et al.* (2001);
***Figures provided by Dr. A.R. Sharma**

Distribution of Rice Fallows

Rice fallows are widely distributed in rainfed ecosystem of eastern, central and peninsular India besides north-eastern hill region. The major districts having larger area in different states are given in Table 2.

Table 2: Major districts under rice fallows in India:

State	Major districts
Andhra Pradesh	Krishna, Guntur, East Godavari, West Godavari, Srikakulam, Nellore and Prakasham
Assam	Lakhimpur, Jorhat, Sibsagar, Dibrugarh, Golaghat, Karbi, Nagaon and Maringon

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Bihar	Kisanganj, Sahibganj, Gaya, Aurangabad, Katihar and Bhagalpur
Chhattisgarh	Surguja, Jashpur, Raigarh, Durg, Bilaspur and Baster
Jharkhand	Ranchi, Purbi Singhbhum, Paschim Singbhum, Hazaribagh, Gumala, Sahibganj, Deogarh, Palamau, Dumka and Dhanbad
Maharashtra	Dhule, Amravati, Nagpur, Wardah, Bhandara, Chandrapur and Nanded
Madhya Pradesh	Shahdol, Seoni, Balaghat, Damoh, Mandla, Rewa, Betul and Sidhi
Odisha	Koraput, Kalahandi, Sambalpur, Sundergarh, Bhadrak, Cuttack, Puri, Dhenkanal and Mayurbhanj
West Bengal	Purulia, Bankura, Birbhum, Bardhhaman, Medinapur, Murshidabad
	South 24-Parganas, Maldah, West Dinajpur, Jalpaiguri and Coochbehar
Uttar Pradesh	Gonda, Siddarthnagar, Lakhimpur, Kheri, Pilibhit, Etawah, Mirzapur and Subhadra
Karnataka	Shimoga and Belgaum
Tamil Nadu	Salem, Namakkal, Tiruchirappali, Cuddalore, Ramnathpuram, Madurai and Villupuram

Source: Policy paper on Rice Fallows of National Academy of Agricultural Sciences (2013)

Production constraints of rice fallows

A feasibility study (Pande et al., 2012) on growing chickpea in the rainfed rice fallow land (RRFL) of eight selected districts of Madhya Pradesh and Chhattisgarh elicited mixed response of farmers identifying the major constraints such as biotic and abiotic stresses, poor crop management practices, lack of awareness about modern methods of cultivation including quality seed of high yielding varieties and integrated pest management, poor linkage to market and government support price policies. Major constraints are as follows:

- **Lack of improved varieties and quality seeds**: Crop varieties especially suited for rice fallows of different regions have not been developed yet. There is an acute shortage of quality seeds of recommended varieties, compelling farmers to grow low-yielding local varieties.
- **Poor plant stand**: Under relay (utera) cropping, plant population is often low due to poor seedling emergence on account of compact soil, poor contact of seed with soil and low soil moisture in surface layer. In some areas, seed rotting due to excessive moisture is also observed.
- **Weed menace**: Weeds are a serious problem under utera cropping as there is no land preparation. Hand weeding is a difficult proposition due to fast drying of soil surface. In

many areas, cuscuta infestation is also associated with urdbean and mungbean (Satyanarayana *et al.*, 1997).

- **No use of fertilizers**: In rice fallows, generally no manure or fertilizer is applied due to no-tillage practice under relay planting, and consequently the crops suffer due to nutrient stress. Further, the physical condition of soil is poor due to transplanted puddled rice and consequently nutrient mobilization is reduced. In addition, the mono cropped rice cultivation also creates nutrient imbalance in the soil.
- **Delayed planting**: In rice fallows, planting is dependent upon duration of rice varieties, withdrawal of monsoonal rains and soil moisture status which are highly variable. Planting is often delayed which reduces crop yield.
- **Prevalence of diseases**: Powdery mildew is a serious disease of *rabi* planted urdbean and mungbean in coastal peninsula. Similarly, rust, *Stemphylium* blight and *Fusarium* wilt are common in lentil. In chickpea, dry root rot and wilt in central zone, and Botrytis grey mold and collar rot in eastern plains cause severe losses.
- **Socio-economic constraints**: Rice fallows are generally invaded by stray cattle and wild animals like blue bulls, boars etc. There is no policy support and other incentives which can motivate farmers to grow pulses in these areas.

Potential crops for rice fallows

After the harvest of kharif rice, climatic conditions of rice fallow lands in many areas are suitable for growing cool and warm season pulses profitably. The residual moisture left in the soil at the time of rice harvest is often sufficient to raise short-season crops. Introduction of cool and warm season pulses such as lentil, mungbean, urdbean, lathyrus, peas etc. in rice fallows can increase the productivity as well as sustainability of rice. Suitable crops for different rice fallow areas are given in Table 3.

Table 3: Potential crops for rice fallows in different states:

Crop	State
Lentil	Assam, West Bengal, Bihar, Odisha, Eastern Uttar Pradesh, Chhattisgarh and Jharkhand
Grasspea (lathyrus)	*Tal* area of Bihar, Chhattisgarh and West Bengal
Pea	Jharkhand, Chhattisgarh, Eastern Uttar Pradesh and northern Madhya Pradesh
Chickpea	Chhattisgarh, Bihar and Jharkhand

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Mungbean	Odisha, Chhattisgarh, Jharkhand, Bihar, Andhra Pradesh, Tamil Nadu and Karnataka.
Urdbean	Coastal Andhra Pradesh, Tamil Nadu, Karnataka and Odisha
Clusterbean	Andhra Pradesh, Tamil Nadu and Karnataka
Lablab bean	Andhra Pradesh, Tamil Nadu and Karnataka
Mustard	Eastern Uttar Pradesh, Bihar and Jharkhand
Groundnut	*Char* area of Bihar, Mahananda of Odisha, Brahmaputra valley of Assam and coastal Andhra Pradesh

Source: Policy paper on Rice Fallows of National Academy of Agricultural Sciences (2013)

Technological interventions for improving productivity of rice fallow lands

In rice fallows, yields of *rabi* crops are generally low as explained above, and thus a large area still remains uncropped. Limited R&D efforts in the past have led to development of improved production technologies which need to be refined and validated for different eco-regions. Some efforts have been made in the past for increasing productivity of pulses in rice fallow areas in respect of identification of suitable varieties, planting methods, foliar nutrition and plant protection. Table 4 provides the suggested interventions to improve the productivity of rice fallows:

Table 4: Major technological interventions for improving productivity of pulses in rice fallows:

Issues	Interventions
Lack of suitable cultivars	Development of high-yielding varieties with appropriate maturity duration
Poor crop stand and	Tillage machines, sowing methods, seed priming, higher
establishment	seed rate, timely planting, seed treatment with fungicides
Diseases and pests	Development of IPM modules
Weed menace	Post-emergence herbicides like Quizalofop ethyl and Imazythapyr
Nutrient management	Foliar spray of urea/DAP to supplement N and P
Micronutrient deficiencies	Mo, B, Zn as seed pallets
Terminal moisture/heat stress	Residue mulching
Non-availability of quality seeds	Informal and formal seed production and supply systems
Lack of mechanization	Tillage machines, zero-till planter and harvester
Poor transfer of technology	Innovative farmer's participatory approach

Source: Policy paper on Rice Fallows of National Academy of Agricultural Sciences (2013)

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Research Work in rice fallows at Bidhan Chandra Krishi Viswavidyalaya, W.B., India

- The highest number of effective tillers of irrigated dwarf wheat after transplanted kharif rice was obtained from minimal tillage (2 ploughing) along with 120 kg N, 60 kg $P_2O_5$and 60 kg K_2Oha^{-1} (Das and Mukherjee, 1993).
- Rabi grass pea under no tillage rainfed condition gave the highest amount of seed and Stover yields followed by lentil (Das and Jha, 1997).
- Two irrigation and zero or minimal tillage was ideal for wheat cultivation after direct seeded or transplanted rice (Majumder and Das, 1985).
- No tillage mustard (as paira crop) gave the maximum grain &stover yields and maximum amount of mulch (straw mulch) gave the maximum grain and stover yields of mustard (Das, 1992).

Success stories of Targeted Rice Fallow Areas (TRFA) in India

TRFA was launched in 2016-17 by Govt. of India with 15 districts and now has increased upto 50 districts covering 5000 villages in 2018-19 with cluster approach and focused attention. Generally, per year 1 million ha area were brought under pulses and oilseeds in TRFA states during 2016-17 and 2017-18. During 2017-18, an additional production of around 1 million tons of pulses and oilseeds were produced. New states will be included in TRFA programme considering its success in eastern states. International and National institutions are getting involved in technology generation and dissemination. TRFA programme is providing support in both technical and financial terms for climate resilient agriculture and remunerative agriculture.

CONCLUSION

Discussing the facts about rice fallow lands, it is very much clear that the potential of rice fallows can't be overlooked. India is one of those developing countries where many people still suffer due to malnutrition and hunger problems. Cultivating pulses and oilseeds in rice fallows can be a much fruitful option to mitigate such hunger problems as well as to improve productivity of such important protein rich food crops. There is need for disaggregated mapping of rice fallows with respect to soil health and rainfall pattern; cropping system, crop productivity, stability and production constraints; socio-economic indices etc. There is need to critically examine the achievements, shortcomings and suggestions made for improvement in approaches and promotion of R & D efforts in other areas. Pilot projects with holistic approach on rice fallows of different regions are needed to assess the potential of different crops and available technologies. Blooming rice fallow always bring prosperity and sustainability in agriculture.

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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Agricultural waste to wealth

Article id: 11202

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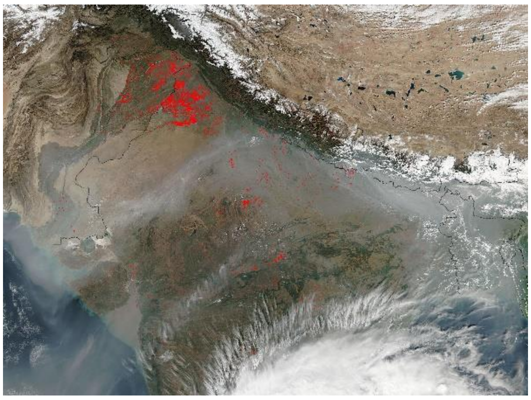
Agricultural waste and their potential:-

On 5th November 2015 when the Visible Infrared Imagine Radiometer Suite (VIIRS) on the suomi NPP satellite passed over the Punjab and nearby area, fire points were visible in widespread area. In the image, darkened red outlines captured showing there approximate location of active burning. Those were stubbles, straw of paddy and wheat i.e. so called 'Agricultural Waste'. 'So called' because there is nothing in agriculture which goes waste. They can be used either directly or in processed form for value added products.



Points of active burning-NASA

Farmers in India believes that, burning the waste on field have beneficial effect on the yield. Field burning (locally called rubbing) increases the availability of some nutrients e.g. P, K in short run (Frenstein, 2002) and increases productivity in new season (Haider,2012). These things are not totally wrong but benefit of keeping residues in field are more i.e. higher soil organic matter, increase in organic carbon, microbial biomass, increased potential of nutrient recycling and contribute to high crop yield. On other hand, because of burning the waste on field there is loss of N, K, S, negative effect on local microbial population, decrease in organic carbon etc. occurs.(Balasubramanian,2006)

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ISSN: 2581-8317
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Burning the stubbles in field

Incomplete burning producess 'Black Carbon' which is the 2nd largest contributor to global warming. Black carbon absorbs radiation and worms the atmosphere at regional and global scale. Black carbon emissions and other types of aerosols have also given rise to 'Atmospheric Brown Clouds' (ABC). ABC decrease the amount of sunlight reaching to earth surface by 10 to 15% (Dr.Gogoi) and increase atmospheric heating by 50 %. (NAYS, Sindhu). India produces 350 million tones (Pappu and Saxena, 2007) of Agricultural waste which is 78% (USDA annual report, statista) of total grain production of USA.

Waste to valuable product conversion:-

Second generation bio-fuel is another term upcoming early days. In which lignocelluloses feed stock are used. In preparation of bio-fuel (ethanol) materials used are cane sugar, sugar beet, sweet sorghum, wood of plants, corn stover. Increased sugar of sugar cane, sugar beet, increased starch content of straw and tapioca, increased cellulose content of wood corn and stover can increase the recovery of ethanol. Now days the preparation of ethanol from straw ,wood, stove etc. is too costly. This is because of recovery of ethanol is low compared with cost of synthesis. So if recovery gets increased then the ethanol preparation may become somewhat economical for commercial use. Use of genetics and genetical engineering for increasing the sugar, starch or cellulose content is possible. Specific gene for starch, sugar should be identified and introduced into the targeted crop plant e.g. protein content of maize is increased by adding the gene from egg.

Silica content of rice acts as resistance (Mishra and Panda, 2018) to stem borer but that content is not developed in the nursery stage. We can remove silica from straw and use for nursery stage plants, which will make use of silica which is not going to be used at all and protection of nursery stage plant by the stem borer. In cotton the gossypol is not get used by any way. We can remove the gossypol from the Cotton. Gossypol is effective for many purposes as birth control, killing sperm, used for HIV and many more. (www.webmd.com) We can extract gossypol by solvent extraction procedure from the seed.

Proteases, amylases, celluloses and lipases are very important enzymes for various industries and those get easily available by the waste part of plant but environmental factors such as pH, temperature affects the catalytic activity of these enzymes so processing unit should be near to the farming system. After using the required part of vegetable for kitchen very much green parts remains as such which is treated as waste e.g. In green parts of vegetable amylase is present. (Richard Hoyt) So, from these types of waste extraction of enzymes is possible. Use of ultrafiltration process for purification of enzymes technology, miniaturization and mathematical modeling are the latest and efficient technology. So these should be used for purification of enzymes

Fruits and vegetables processing waste are rich in organic matter, phytochemicals and nutraceuticals. (Singh and Devi, 2015) Because of high presence of cellulose, hemicellulose, pectin minerals, vitamins and Lignin content, this waste offers a huge potential for its conversion into useful products such as enzymes, ethanol, bio-colour. Orange peels, banana peels, cauliflower waste, peapods, apple pomace etc. have been exploited as substrates for production of industrial important enzymes such as cellulose, amylase, proteases etc. through fermentation at laboratory stage but commercial application is possible by decreasing the barriers.

Unused parts of vegetable (White Cabbage)

In mango, seeds are thrown by the farmers and processing industries also which is approximately 8% (Victor Zuazo,2012) of fruit weight. Out of Thrown seeds very few seeds germinate other contributes to agricultural waste. Seed coat of mango is very useful for making coal. Inner part of seed coat is highly nutritive which contains protein, fat, crude fiber, ash, calcium, magnesium, potassium, sodium, copper, zinc, iron, carbohydrates and energy contents. It contains protein as 7.53 gm/100 gm, Fat as 11.45gm/100 gm, 11.5% oil (Yatnattis and Bandra,2014) also can be obtained. From ‘Mango Kernel Flour’ various body cream, hair cream can be prepared. There is high requirement of small scale system for separation of seed coat from inner part and for which ‘Seed Coat Separator’ machine is required.

In coconut from the non-useful part almost 20 useful materials can be prepared. Such as fiber boards, biodegradable chairs, hydroponic planting medium, rope, erosion netting, floor mat, scrubber brush, armor dolls, activated carbon, uncomfortable brush, sports drinks, Jelly, IV fluid, natural diuretic, coconut water, biodiesel, sunscreen, nectar of coconut. We can prepare the bags from husk which can be better option for plastic bags. Among these all products many can be prepared at domestic level i.e. homemade products. Homemade products from coconut have high demand in different regions of India and other countries. There is wide scope for coir industry in the India and have high export potential. Coir is natural fiber extracted from husk of coconut. Husk of coconut is not at all used more than 15 to 20% in India for further processing. It is used for burning which is further harmful to the human being with the aspect of air pollution.

Drupe fruit endocarps (shells) of coconut, olives, black walnut have highest Lignin content and energy derived is comparable to coal. It has high demand in our country and also in other countries.

Use of biotechnology for changing the composition of crop without hampering quantity and quality of main produce for producing ‘Quality Waste’ is important. Meaning of quality waste is the waste in which high qualitative content are present which may not be the part of main produce but can give beneficial produces after processing. In case of lignin, lignin content should be increased if and only if it is used for amino acid extraction. If it is going to be decomposed then lignin content slow down the rate of decomposition. At this condition we can remove the lignin content from waste and then use for decomposition. This will give double benefit to us.

Always the 1st and easy option for farmer is to decompose the waste i.e. allow bacterial act on the manure in order to break it down before application on the farm. Organic manures are good for crop but raw animal waste can damage the field and crop also, so care should be taken that complete decomposition should be done.

Biogas is another best way to utilize agricultural waste for useful things. In biogas, methane and carbon dioxide are produced. Methane is a natural gas and used for burning. Use of methane gas for domestic purpose in common in India. When gas is not used by people for burning there is no any facility provided for store the gas for longer time. There should be a gas storing tank. Cost for this tank is very high at present but using some foreign technology and new model it is possible. Extra gas can be used for motivational energy e.g. lightening the lamp at domestic level or for

Village Street light, City Street light also. Storage of extra gas or use for motivational energy these are the alternatives for unused and extra gas which also effect on the storage capacity of biogas plant for the slurry.

Humus formed after decomposition can be used for laboratorial work i.e. as a media for culture making. Pure and high nutrient humus can be purchased by the laboratories/ Agricultural Universities/ Researchers from the farmer at high rate. In cities where the soil is not available easily for common man for growing any plant i.e. ornamental or kitchen gardening or terrace gardening, they also can purchase your humus at efficient rate. Small packets of humus are very demanding now days in big cities like Delhi, Mumbai, Bangalore, Chennai etc.

Convert waste to cash i.e. most agricultural Waste can be sold out to people for other purpose. There are vegetable farmers who can buy poultry waste so as to use it as manure on their farm. Agricultural waste such as rice bran, corn husk can be used as feed and fuel in factories. All he need to do is to search for buyers and strike a deal with them so that every time they can come and get them from his farm at a cost.

Policy and government role:

There should be a link between the farmer’s community and that can be established only by the government initiative. In one hand because of lack of feed at the time of drought farmers sale their cattles in Maharashtra, Gujarat, Rajasthan, Madhya Pradesh etc. and at another hand farmers burn the straw of paddy, wheat at large amount in Punjab, Haryana. By co-ordination of state governments this problem can be solved. Central government have to take initiative for taking some efforts for transport of waste and some financial help to needed farmers.

Most of the processing practices on the waste are not possible or economical for any individual farmer. ‘Groups of Farmers’ should be made by themselves. Those groups can purchase costly machines for processing of waste produced on their farm. Also guiding the farmer individually is not possible to technical person because of time limit.

In India there is a general tendency of farmer that, they can't relate themselves with the technical person for adopting any new technology or practice. Only one farmer can change the attitude of another farmer towards positive action for agricultural waste management. So government has to make policies for increasing contact of benefited or progressive farmers who uses the waste management practices to the normal other farmer. One committee should be prepared for consultants of people in which some technical persons and some farmers should be involved. By going to each village and using extension technology transfer methodology, they can increase the knowledge and interest of farmer in agricultural waste management.

Government has to start waste processing industry either under 'State Industrial Development Corporation' e.g. MIDC in Maharashtra or in partnership with private and public sector. Particular industry for processing of particular waste should be near to that of particular waste producing area. Cost of processing should be as low as possible. Waste processing industry will give money to farmer for their waste. Employment to other peoples working in the industry, profit to owner of factory, profit to government if the industry is governmental. Help the country for increasing economical growth and last but not the least i.e. problem of agricultural waste can be solved. These all are the advantages of 'Agricultural Waste Processing Industry' e.g.

- ❖ Extra straw of paddy and wheat sale to the factory and they will produce bio-fuel or enzymes from it.
- ❖ Sale horticultural waste to factory and they will recover enzymes, nutraceuticals and phytochemicals form it.
- ❖ Sale your mango seed and cashewnut kernel to them and they will prepare oil, powder, medicines from it.
- ❖ Sale your sugarcane waste and they will prepare ethanol.

Government should focus on the main problem that farmers are burning the waste or not using the waste properly because, they don't know what to do about waste. Economically waste processing may be not affordable, if product from waste is prepared then where to sale it, these are the problems farmers facing. Marketing facility for selling the homemade processed waste product should be available to farmer.

People should not think about agricultural waste as a loss of money or wastage of practices. We should feel it as an opportunity for earning more income, which is the main aim of committee of Central Government formed for doubling the farmer's income in India.

Agriculture do not produce any waste but the thinking that agriculture produces waste is a waste.

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AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Role of smart farming technology in Indian agriculture

Article id: 11203

Konga Upendar and Bhukya Jithender

INTRODUCTION

India is a country host abundant natural resources, and varied climatic conditions made India as a diversified country. Agriculture is the pivot of India's economy. About 70% of Indian population directly or indirectly depends on agriculture. India recorded the second highest population country after China. To meet the demand for increased Indian population suitable measures adopted in as early as possible. Smart Farming (SF) involves the incorporation of information and communication technologies into machinery, equipment, and sensors for use in agricultural production systems. New technologies such as the internet of things (IoT) and cloud computing are expected to advance this development, introducing more robots and artificial intelligence into farming. According to an India Brand Equity Foundation (IBEF) report, more than 58% of the Indian rural households depend on agriculture as their means of livelihood. As per the Department of Industrial Policy and Promotion (DIPP), the cumulative contribution of the Indian agricultural services and agricultural machinery sectors to foreign direct investment **(**FDI) equity is about $2.45 billion, during April 2000 to June 2017. According to the UN Food and Agricultural Organization (FAO), the global population is going to increase its reach up to 9.2 billion by 2050, which means in the next 33 years there will be 2 billion more people on this earth with limited resources. So only increasing plantation does not seem an option to tackle this situation, something more is needed, like the adoption of smart farming technologies in the Indian agriculture field.

Smart Farming technology (SFT): Benefits and Challenges

Creative forming techniques can modernize agriculture and initiate exponential growth in the sector. It is all set to change the way cultivation and warehousing are done. Moreover, it is expected to reduce wastage and improve profit margins remarkably. Because of agro-based economies like India heavily dependent on agriculture for growth, SFT based initiatives can contribute to national growth in a massive way.

The benefits of SFT technology are listed below

- The effective use of inputs helps in reducing wastage and thus, decreases costs incurred
- The use of water can be optimized, which in turn shall reduce water wastage.
- Losses due to diseases and infections can be reduced, by continuous and real-time crop monitoring.

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ISSN: 2581-8317

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- The use of IoT-based devices allows better management of farm activities.

The adoption and implementation of IoT-based smart agriculture solutions in countries like India have their own set of unique challenges and limitations. Firstly, there is a lack of awareness in farmers as far as technology-based farming solutions, and their applicability is concerned. This, also, stems from the lack of knowledge and fear of upgrading to a technology of a higher level. To develop commercially viable solutions, it is critical to keep these factors in mind. The answer must function in local languages and have interfaces that are easy to understand for laymen. Most of the products available in the market suffer from vendor lock-in; therefore, the customer is entirely dependent on the vendor for products as well as services. Any changes desired by the customer require him or her to switch between vendors, which can prove to be costly. Besides this, developers recommend the use of high- quality sensors given their better life and durability. Such sensors are expensive and may or may not fit into the budget requirements of farmers. Moreover, solutions offered to the Indian market must be scalable considering the variable size of farms in India. Therefore, organizations must be able to provide solutions that are scalable and cost-effective, both at the same time.

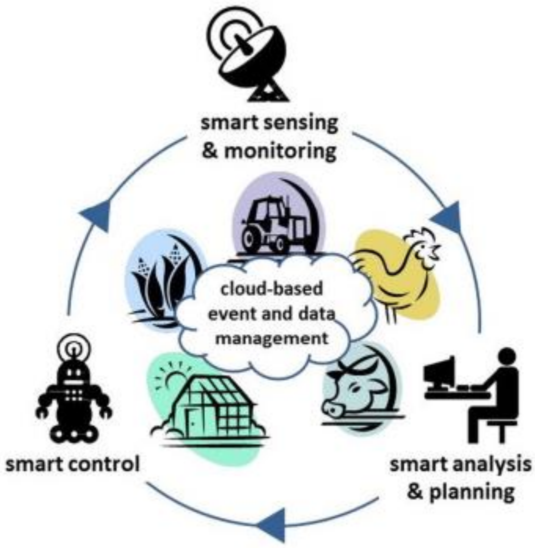

Fig.1. Cyber-physical management cycle of Smart Farming enhanced by cloud-based event and data management (Wolfert *et al.*, 2014)

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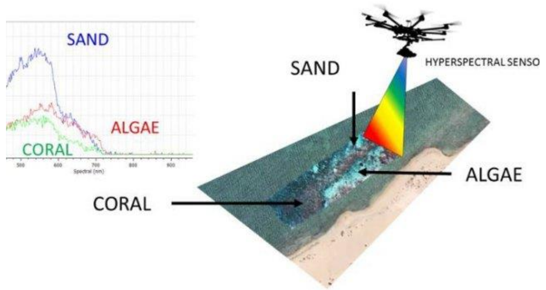
Application of smart farming technologies in Indian agriculture

Precision Farming

Practice or process followed for improving the accuracy and control over farming and livestock management is commonly referred to as precision farming. Typically, this practice makes use of electronic hardware, sensors, and robotics and control systems, in addition to other technologies, to achieve its purpose. Precision farming continues to be the most popular application of smart agriculture.

An agricultural drone **(**An eye in the sky for agriculture**)** is an unmanned aerial vehicle applied to the farm to help increase crop production and monitor crop growth. Precision farming combines sensor data and imaging with real-time data analytics to improve farm productivity through mapping spatial variability in the field. Data collected through drone sorties provide the much-needed wealth of raw data to activate analytical models for agriculture. In supporting precision farming, drones can do soil health scans, monitor crop health, assist in planning irrigation schedules, apply fertilizers, estimate yield data and provide valuable data for weather analysis (Reinecke *et al.* 2017).



(a)

(b)

Fig.2. (a) Hyperspectral drone camera and (b) Drone spraying

Data collected through drones combined with other data sources and analytic solutions provide actionable information. Multispectral and hyperspectral aerial and satellite imagery help in creating Normalized Difference Vegetation Index (NDVI) maps, which can differentiate soil from grass or forest, detect plants under stress, and differentiate between crops and crop stages (Fig.2). Crop-spraying drones or easy-to-fly devices that are designed to spray pesticides on crops can also capture high-resolution images of the whole field for further analysis (Kale *et al.* 2015). They are suitable for all kinds of complex terrain, crops and plantations of varying heights. Precise and accurate crop

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spraying ensures the best coverage and application of fertilizers or pesticides on lands (Wadke, 2017).

Driverless tractor

The tractor is the heart of a farm, used for many different tasks depending on the type of farm and the configuration of its auxiliary equipment. As autonomous driving technologies advance, tractors are expected to become some of the earliest machines to be converted. In the early stages, the human effort will still be required to set up the field and boundary maps, program the best field paths using path planning software and decide other operating conditions. Humans will also still be required for regular repair and maintenance. Nevertheless, autonomous tractors will become more capable and self-sufficient over time, especially with the inclusion of additional cameras and machine vision systems, GPS for navigation, IoT connectivity to enable remote monitoring and operation and radar and LiDAR for object detection and avoidance. All of these technological advancements will significantly diminish the need for humans to actively control these machines (Blackmore *et al.,* 2004).

Fig.3. Driverless Tractor

Seeding and Planting

Sowing seeds was once a laborious manual process. Modern agriculture improved on that with seeding machines, which can cover more ground much faster than a human. However, these often use a scattered method that can be inaccurate and wasteful when seeds fall outside of the optimal location. Effective seeding requires control over two variables: planting seeds at the correct depth, and spacing plants at the appropriate distance apart to allow for optimal growth. Precision seeding equipment is designed to maximize these variables every time. Combining geo-mapping and sensor data detailing soil quality, density, and moisture and nutrient levels take a lot of the guesswork out of the seeding process. Seeds have the best chance to sprout and grow, and the overall crop will have a greater harvest. As farming moves into the future, existing precision seeders will

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ISSN: 2581-8317
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come together with autonomous tractors and IoT-enabled systems that feed information back to the farmer. An entire field could be planted this way, with only single human monitoring the process over a video feed or digital control dashboard on a computer or tablet, while multiple machines roll across the field (Yaji *et al.,* 1998).

Automatic watering and Irrigation

Subsurface Drip Irrigation (SDI) is already an accepted irrigation method that allows farmers to control when and how much water their crops receive. By pairing these SDI systems with increasingly sophisticated IoT-enabled sensors to continuously monitor moisture levels and plant health, farmers will be able to intervene only when necessary, otherwise allowing the system to operate autonomously. While current systems often require the farmer to manually check lines and monitor the pumps, filters and gauges, future farms can connect all this equipment to sensors that stream monitoring data directly to a computer or Smartphone. Salient features are smart water management according to environmental and climate changes, reduction in scarce water and energy source wastage and weather forecast and alerts (Nahry *et al.,* 2011).

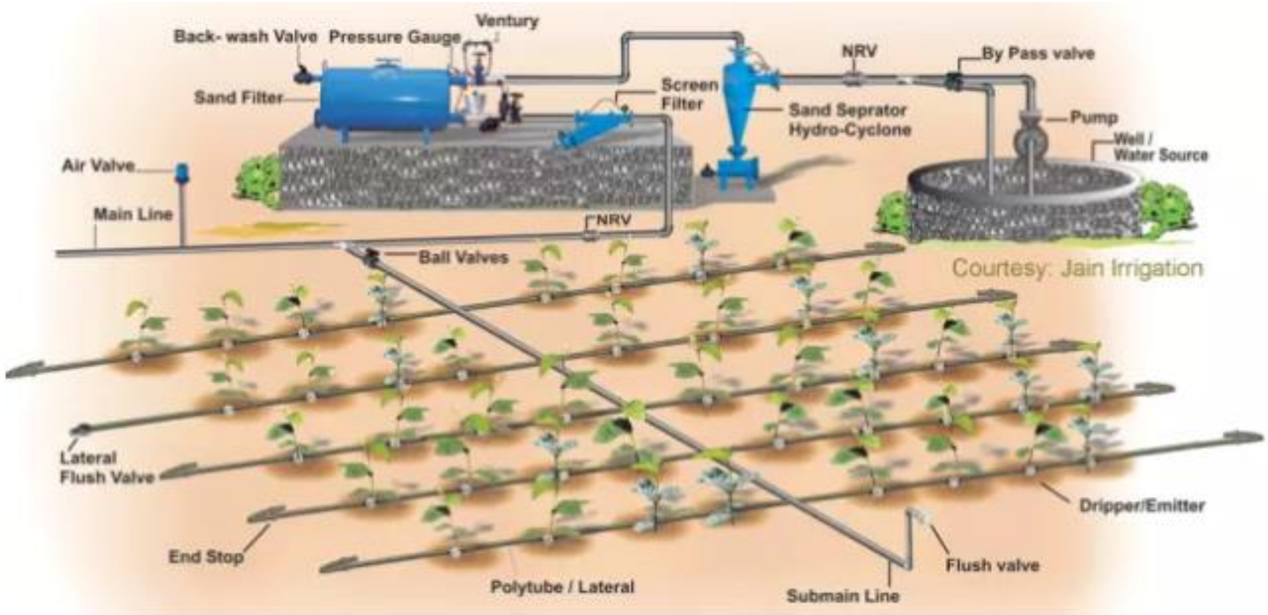

Fig.4. Example of a subsurface drip irrigation (SDI) system for agriculture. (Image courtesy of Jain irrigation)

Weeding and crop maintenance

Weeding and pest control are both critical aspects of plant maintenance and tasks that are perfect for autonomous robots. The Bonirob robot is about the size of a car and can

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ISSN: 2581-8317

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navigate autonomously through a field of crops using video, LiDAR and satellite GPS. Its developers are using machine learning to teach the Bonirob to identify weeds before removing them. With advanced machine learning, or even artificial intelligence (AI) being integrated in the future, machines such as this could entirely replace the need for humans to manually weed or monitor crops. While these examples are robots designed for weeding, the same base machine can be equipped with sensors, cameras and sprayers to identify pests and application of insecticides (Pérez-Ruiz *et al.*, 2012).

Fig.5. Bonirob farming robot (Image courtesy of Deepfield Robotics)

Variable Rate Technology (VRT)

It is the implementation of gathered information and decision for site-specific agriculture technology. It consists of the machine and system for applying the desired rate of crop production material at a specific time and a particular location. (Sawyer *et al.,* 1994)

Livestock Management

There are specialised sensors for livestock management that can be attached to every livestock animal on the farm. These sensors collect data about animal health and maintain a log of performance. Solutions like Collar and SCR by Allflex place collar tags on the animal and record data like health, activity, nutritional data and temperature. Insights on the herd can also be provided based on shared data assessment.

Yield Monitoring and Mapping

Yield mapping refers to the process of collecting geo-referenced data on crop yield and characteristics, such as moisture content, while the crop is being harvested. Various methods, using a range of sensors, have been developed for mapping crop yields. (Arslan *et al.,* 2002)

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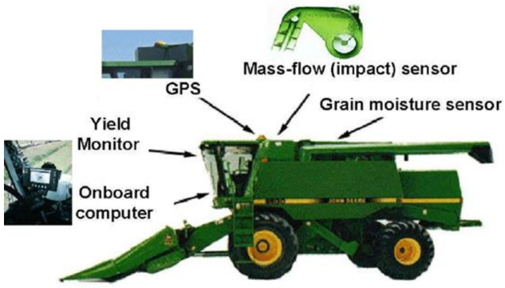

Fig.6. Variable rate technology

SUMMARY & CONCLUSIONS

Smart Farming Technology (SFT) refers to scientific, marketable, affordable, reliable and time-saving (SMART) farming technology used in production agriculture. Application of SFTs often brings an increase in revenue, a reduction in stress and labour time for the farmer and a decrease in energy use. A reduction in costs, both variable and input costs, was also often expected by the implementation of SFTs. The benefit of this technology is readily incorporated into the existing machines with finer modifications. Significant learning is required for the correct application of SFTs. The drawback of the SFT is most of the farmers are not aware of this application in agriculture, or they resist adopting SFT due to various reasons such as lack of knowledge about the deployment of technology in agriculture, inadequate IT infrastructure facilities and the landholding capacity of Indian farmers is very small as compared to developed countries. Many types of research and training programs also been conducted by research organizations on SFTs application in the field of agriculture. These initiatives accelerate the growth of SFTs in the future agriculture.

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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Soil and water conservation measures: Mitigating the effect of climate change

Article id: 11204

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INTRODUCTION

Due to increasing population pressure and climatic fluctuations over the last 75 years, soils have increasingly lost their productivity. The natural vegetation cover has gradually been reduced through deforestation, overgrazing, extension of cultivated land and reduced fallowing. For the future, projections of climate change show that temperatures will increase, mean annual rainfall will either decrease or increase depending on the region, while rainfall variability will become more pronounced in all regions. These changes put additional pressure on agricultural production and the already degraded natural resources. Higher temperatures mean higher water requirements for plants and animals. Increased temperature reduces the humus content of soils due to faster mineralization. Further losses of fertile topsoil occur through water and wind erosion. Degraded soils infiltrate less water, have lower water storage capacities and produce less food and fodder. Restoring soils, improving soil fertility and enhancing water availability therefore increases and stabilizes agricultural production.

Several soil and water conservation (SWC) measures have been developed for improving livelihood and resilience of the ecosystems /farm households against the effects of climate change by maintain and restore production potential of resources. Some of the general SWC measures are given below.

- **Bunding**

This is the most popular soil conservation structure in the country and it is practiced at large scale all over India. Bunds are small embankment type structures made up of locally available earth materials. Land slope and soil characteristics are considered for selection of bund type and design. Ideally, bunds on farms should be made on the contour line. It would lie along the boundary of the field. Bunds help to check the velocity of the run-off, to carry excessive rainfall safely downstream and to let off stream flow in natural channels. Bunding increases the time of concentration of rainwater where it fall thereby allowing rainwater to percolate into the soil. It would help to conserve the water in the field and maintain in situ moisture in the field (Fig. 1). The erosion of the field is reduced. The distance between bunds must be 30-80 m. This decision depends on the slope of the field

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Fig. 1: Contour bund at Research Farm, IISWC, Datia

- **Check dam**

Check dams are constructed across the stream flow to reduce the velocity of runoff water and to entrap the sediments. Check dams are built in a range of sizes using a variety of materials, including clay, stone and cement. Earthen check dams, or embankments, can easily be constructed by the farmers themselves. There are logwood Check Dams, loose boulder Check Dams, dryrubble check dams and concrete /masonry check dams. Masonry and reinforced cement concrete (RCC) check dams (Fig. 2) are of more permanent in nature and serve the purpose of water conservation. The sluice, spillways and other regulatory structures constructed in the drains help to regulate the flow of excess water.

Fig. 2: Water harvested at a Check dam

- **Gully plugging measures**

Gullies are a symptom of functional disorder of the land, improper land use and are the most visible result of severe soil erosion. They are small drainage channels, which cannot be easily crossed by agricultural equipments. The gully plugging measures include vegetative plantings and brushwood check dams, boulder checks, earthen bunds or a combination of both and sand bag plugs etc (Table 1).

Gully plugs can be defined as stones placed across gullies or valleys, so as to capture nutrients, silt and moisture. Stones are often embedded into the upper surface of spillway aprons and wells to provide support for the next layer. Slowing of the flow of water helps in

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ISSN: 2581-8317

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settling down organically rich soil. A well maintained gully plug creates a flat, fertile and moist field, where high value crops and trees can be grown.

Table 1: Recommended Vertical interval for different types of gully

Slope of Gully Bed %	Width of Gully Bed (m)	Location	Type of Gully Plug	Vertical Interval
0-5	4.5	Gully bed	Brush wood	3.0
	4.5-10.5	Gully bed	Earthen	2.25-3.0
	7.5-15.0	At the confluence of two Gullies	Sand bag	2.25-3.0
	7.5-15.0	At the confluence of all branches of a compound gully	Brick masonry	2.25-3.0
5-10	4.5	Gully bed	Brush wood	3.0
	4.5-6.0	Gully bed and side branch	Earthen	1.5-3.0

- **Brushwood Check Dam**

Brushwood check dams are constructed in small gullies (1.2 to 2.1 m deep) where wooden posts are abundantly available. Brushwood check dams are made of wooden posts and brush & place across the gully head. The posts are firmly placed and tied together and sufficient amount of shrubs and grasses material is packed behind the dam (Fig. 3).

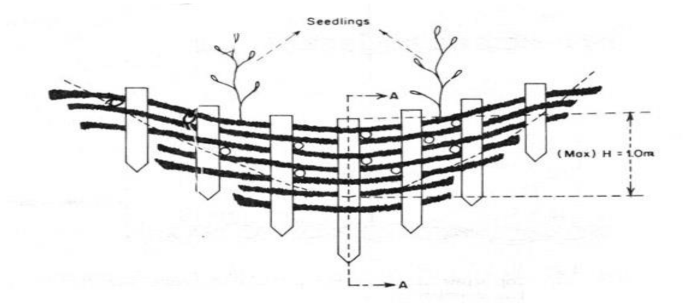

Fig. 3: Brushwood Check Dam

- **Loose Boulder Checks**

Loose boulder check dam is constructed using locally available stones and other materials across the small drainage lines or seasonal streams which have a catchment area of less than 2 ha. In active gullies the objective of gully control should be to reduce the gradient and dissipate the energy of the flowing water. To control a gully, a series of local base levels can be established through check dams. The difference in height between the crests of successive check-dams should be such that the filled-up basins form steps with a mild slope. In this way, a steep erosive gradient is replaced by a stairway of gentle and non-erosive steps. By reducing the velocity of runoff, boulder checks help in:

Reducing soil erosion:

- Trapping silt which slows the rate of siltation in water harvesting structures in the lower reaches of the watershed.
- Creating a hydraulic head locally which enhances infiltration of surface runoff into the groundwater system.
- Increasing the duration of flow in the drainage line. Therefore, the capacity of the water harvesting structures created downstream on the drainage line is utilized more fully as they get many more refills.

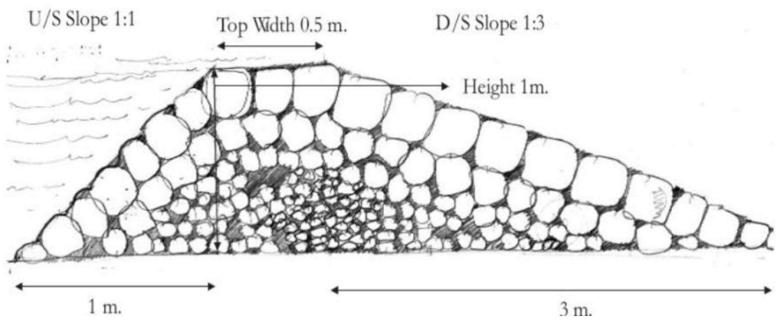

Fig. 4: Cross section of loose boulder check

- **Gabion check dams**

Stone wire crate (Gabion) as semi-permanent structures are commonly used for drainage line treatment. The gabion check dams are constructed in second or third order gully for retention of debris and soil accumulation without ponding, having the field streams with widths of 10-20 m and stream bed with no loose material.

The height of such structures should be kept around 1 to 2 meter. Stream banks should be stable and should have sufficient height on both sides. The specification of the gabions is as Top width: 1 to 2 m; Depth of foundation: 0.30 to 0.60 or up to hard strata; Height above ground level: 1-2 m; Keying into banks: 0.30 to 1.0 m into stable bank; Galvanized Iron wire: size: 10-12 gauge (Fig. 6).

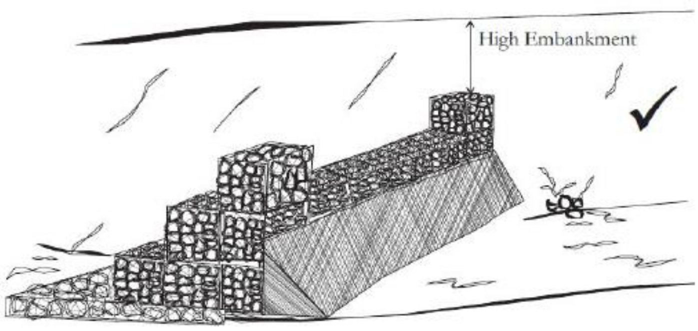

Fig. 5: Schematic diagram of gabion structure in a stream

- **Conservation Bench terrace**

The conservation bench terrace (CBT) system consists of a terrace ridge to impound runoff water on a level bench (i.e. recipient) and a donor watershed which is left in its natural slope and produces runoff which spreads on level bench (Fig. 6). The technique is practiced mostly in mild sloppy land having silty loam to silty clay loam soils of medium depth in semi-arid to sub-humid regions, in which upper 3/4th part is made sloppy and lower 1/4th part is leveled. Paddy is grown in the lower leveled part whereas maize, soybean, cowpea etc. are grown across the slope in upper part during the *kharif* season. Nearly 80 percent of rainfall is stored in the field itself and due to this, soil moisture available for crop for a longer period. The excessive rainwater is harvested in a tank which can be used either in dry *kharif* spell or during the *rabi* season.

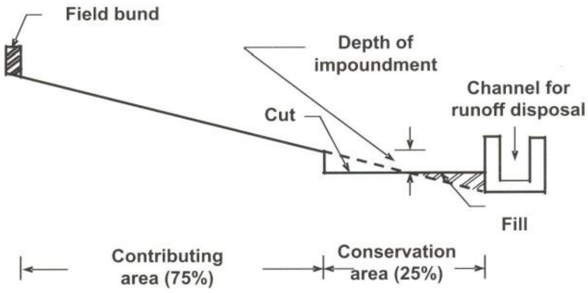

Fig. 6: Conservation Bench Terrace system

- **Farm ponds and water harvesting structures**

Farm Ponds are mainly meant for the purpose of storing the surface runoff. The farm ponds and water harvesting structures constructed in the low lying areas contributed to the conservation of excess rain water and the replenishment of ground water. The water harvesting structures are constructed as masonry structures. The impounded water also provides life saving irrigation to the lands in the ayacut. It will increase the soil moisture regime around the structure for increased crop production and recharge the ground water.

CONCLUSION

Several soil and water conservation (SWC) techniques have been developed to maintain and restore production potential, thereby improving food security and the resilience of the ecosystems and farm households against the effects of climate change. The main objective of SWC measures are to increase the time of concentration and thereby allowing more runoff water to be absorbed and held in the soil profile. The loss of fertile topsoil and fertilizer is reduced, and more water and nutrients are available for plant growth. The infiltrated water is stored in the soil or drains deeper to recharge the ground water. Hence, it is essential that soil and water conservation measures are implemented to ensure high sustainable production for economic feasibility and improve soil fertility.

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http://www.agrifoodmagazine.co.in

AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Crop residue management in organic vegetable production

Article id: 11207

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INTRODUCTION

Crop residues, in general are parts of the plants left in the field after crops have been harvested and thrashed or left after pastures are grazed. These materials have at times been regarded as waste materials that require disposal, but it has become increasingly realized that they are important natural resources and not wastes.

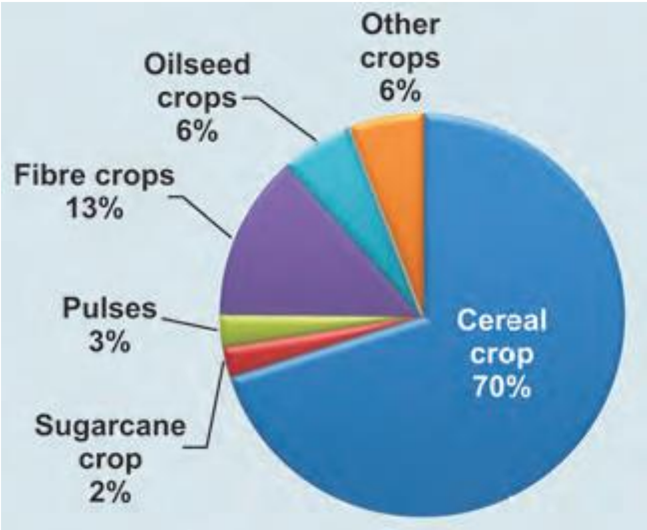
Organic materials were practically the only external source of nutrients to crops before introduction of inorganic fertilizers. As a result of advent to quick acting chemical fertilizers, a stage has reached that the supplementary and complementary role of organic materials being felt once again for sustainable agriculture and keeping the soil health in order. The recycling of various forms of residues has the advantage of converting the surplus farm waste into useful product for meeting nutrient requirement of crops, besides maintaining the soil condition and improving the overall ecological balance. Resource conservation and their regulated recycling for production is the option for sustained living.

Even after allowing considerable part of crop residues as animal feed under the demanding situations, sufficient amount of these materials remain to be utilised for land application. The available materials could either be converted into manure by composting or be directly utilised for soil improvement and crop production. Direct utilisation in the field seems to be more attractive because of the extra cost involved in the collection and transport of materials to the composting sites.

Crop residues potential

Large number of crops grown annually in India. After making use of their economic parts, the remaining portion is mostly wasted except for few crops. The adoption of mechanized farming in many advanced regions in the country has resulted in leaving a sizable amount of crop straw/ stalk in the field after harvesting. The potential of crop residues of major cereals, oil seeds, vegetable wastes and commercial crop wastes for recycling of valuable plant nutrients for sustained crop production is enormous. On national basis not more than one third of these residues are available for utilisation and in general, 50 percent of the nutrients are mineralized in the soil on decomposition in a cropping season. However , it is well recognized that in the era of intensive multiple cropping system to feed the ever increasing population, it is not possible to depend entirely on the organic sources of plant nutrients. Combined use of organic and inorganic fertilizers for increasing productivity and fertilizer use efficiency and for important of soil properties.

Recycling of crop residues is an integral part of integrated plant nutrient management, which is now being increasingly recognized as the strategy for sustain high crop crop yield levels with minimal depletion of soil fertility or fall in its other quality aspects.



Residue generation by different crops in India

Crop residue decomposition and management

The crop residues are highly carbonaceous material depending on the type of the plant. There is great variability in C;N ratio of the organic materials which determines the rate of decomposition and release nutrients. The materials with very high C:N ratio decomposes very slowly like wheat straw, rice straw and sugarcane trash, where crop residues of leguminous crops having relatively narrow C:N ratio decompose faster. Decomposition of the organic materials is an essential process for the release of nutrients that can be used by the growing or succeeding crops.

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Rating of crop residues for recycling:

Residues	Decomposition time	Remarks
Residues of all green, succulent plants	Easy decomposition	High nutrient content, low lignin content
Mature residues of leguminous crops	Easy decomposition	High nitrogen content
Oil cakes	Incorporate one week before sowing	High nitrogen content
Mature residues of non leguminous crops	Requires one month for decomposition	Micro nutrient availability is less. Good sources of potassium
Straw, sugarcane trash, bagass	late	Suitable shredding before incorporation
Rice husk, saw dust, coir dust	Very slow	Low nutrient content

The turn over organic materials in the soil are affected by the heterotrophic soil organisms, including bacteria and fungi. Their requirement for energy is met through the oxidation of the carbonaceous material in the soil. This decomposition increases with arise in temperature. It is further enhanced by adequate, although not excessive soil moisture and a good supply of oxygen. Decomposition proceeds under water logged conditions, although at a slower rate.

Effect of crop residues on physical properties of soil

The effects of crop residues on physical properties of soil are reflected in terms of productivity of land sooner or later. Even when desirable effects of certain organic wastes fail to provide any immediate grains to soil fertility and crop yields, there are definite benefits to soil physical properties.

The well decomposed and easily decomposable organic wastes generally show good effects in improving soil aggregation, while the materials relatively resistant to microbial decomposition, have a favourable effect on soil physical properties such as porosity, bulk density and water holding capacity. Application of rice husk from 10-15 tonnes per ha was highly significant in increasing the infiltrate rate of impermeable alkali soil. Decrease in bulk density of soil while total porosity and water holding capacity of the soil increased due to incorporation of legume residues in soil. Addition of fresh crop residues to soil had improved the soil aggregation significantly over when these were applied after being composted for three months.

Investigations have shown that the residues undergoing decomposition in situ produce more favourable effects on physical properties than the situation where decomposition is completed elsewhere and then the manure is added. Maize stalks incorporated in soil produced much higher effect on soil aggregation in red sandy loam than FYM. The organic materials that are relatively easily decomposable produce immediate effect on soil physical properties.

Effect of crop residues on chemical properties of soil

Soil reaction seems to be influenced differently by incorporation of organic mate al under different soil situations. Incorporation of rice straw decreased the soil pH and was found to be very effective in alkali soils.

Effect of crop residues on biological properties of soil

The living phase of soils is greatly stimulated which helps in biodegradation of organic matter, formulation of organochemicals, nitrogen, fixation, phosphorus solubilisation and in increasing the availability of plant nutrients to crops. Phosphorus is a non renewable asset and nitrogen is more mobile and subject to losses. The augmented microbial activity can tap the inert nitrogen gas from the atmosphere, reduce the leaching losses and regulate the supply of phosphorus.

Application of organics influenced bacterial population to a greater extent than fungi and actinomycetes.

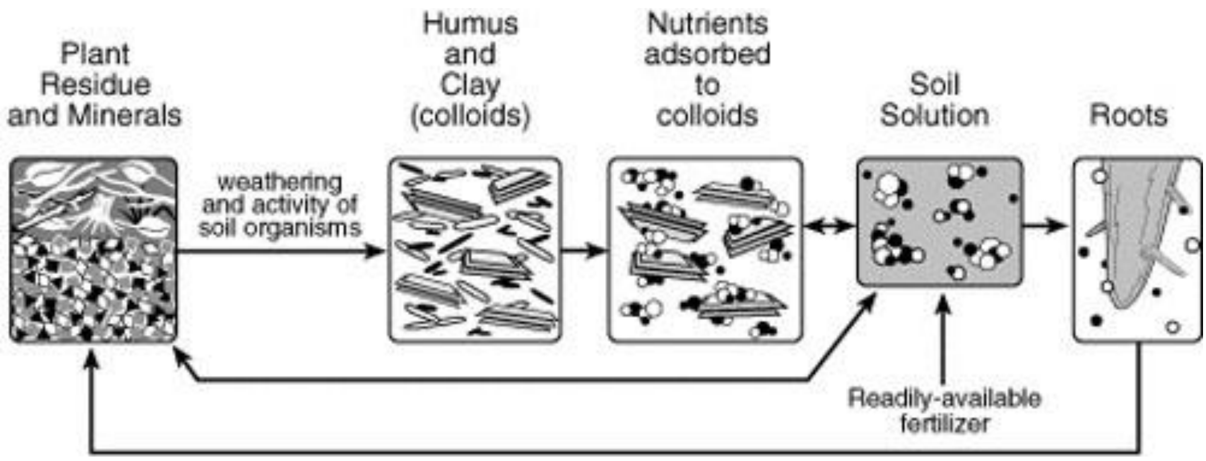
The beneficial effects of residues on soil health and crop yield

Residues act as reservoir for plant nutrients, prevent leaching of nutrients, increase cation exchange capacity (CEC), provide congenial environment for biological N fixation, increase microbial biomass and enhance activities of enzymes such as dehydrogenase and alkaline phosphatase. Increased microbial biomass can enhance nutrients availability in soil as well as act as sink and source of plant nutrients. Leaving substantial amounts of crop residues evenly distributed over the soil surface reduces wind and water erosion, increases water infiltration and moisture retention, and reduces surface sediment and water runoff.

The crop residues play an important role in amelioration of soil acidity through the release of hydroxyls especially during the decomposition of residues with higher C:N ratios, and soil alkalinity through application of residues from lower C:N ratio crops including legumes: oilseeds and pulses. The role of crop residues on carbon sequestration in the soil would be an added advantage in relation to climate change effects management.

Yield response with residue management varies with soil characteristics, climate, cropping patterns, and level of management skills. Greater yields with residue application results from increased infiltration and improved soil properties, increased soil organic matter and earthworm activity and improved soil structure in 4-7 years from when the system is established.

The actual process of crop residue utilization is :



Effect of crops residues on supply of plant nutrients

Crop residues contain elements that are required for their growth and development. The incorporation of residues after decomposition, release these elements to be utilized by other crops or to eliminate the soil fertility. Increase in N, P and K content of soil is due to application straw. Application of wheat straw and rice husk markedly increase the K supplying capacity of soil.

By application straw, available K content of soil increased significantly and the straw incorporated plots had more residual N. Increased content K due to residue incorporation has been reported by many researchers.

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The impacts of residues on pest population:

The surface residues may ensure survival of a number of insects, both harmful and beneficial. Reduced tillage systems particularly under staggered planting system of crops in monoculture may contain comparatively high levels of pest inoculums than the conventional system. The cutting height of the crops at harvest may also influence the levels of pest inoculums. Further, the decomposition of residues along with several inter-related factors like climate, crop geometry, irrigation and fertilization, cultural practices and pesticides may affect the survival of insects in crop residues. The decomposition of residue brings out a chemical change in soil which may affect the host reaction to pests. The decomposition of plant residues may produce phytotoxic substances particularly during early stages of decomposition. The effects might be severe in reduced tillage systems which incorporate huge amount of residues into the soil and extra application of N is made to hasten decomposition of residues. A change in weed ecology is expected to influence the survival of several of those insects which tend to develop on weeds particularly during fallow period. Since the zero/reduced tillage system reduces the fallow period between crops, a change in sowing period of the following crop may result in altered incidence of certain insects.

The alternative uses of crop residues:

There are several options which can be practiced to manage residues in productive manner. Besides use as cattle feed, large amount of residues can be used for preparation of compost, generation of energy and production of biofuel and mushroom cultivation.

Composting of residues for manure: The residues can be composted by using it as animal bedding and then heaping in dung pit. Each kg of straw absorbs about 2-3 kg of urine from the animal shed. It can also be composted by alternative methods on the farm itself. The residues of rice from one hectare give about 3.2 tons of manure as rich in nutrients as farmyard manure (FYM).

Energy from crop residues: Biomass can be efficiently utilised as a source of energy and is of interest worldwide because of its environmental advantages. During recent years, there has been an increase in the usage of crop residue for energy production and as substitute for fossil fuels. It also offers an immediate solution for the reduction of CO_2 content in the atmosphere. In comparison with the other renewable energy resources such as solar and wind energy, biomass is a storable resource, inexpensive, energy efficient and environment friendly. However, straw is characterized by low bulk-density and low energy yield per weight basis. The logistics of transporting the large volumes of straw required for efficient energy generation represents a major cost factor irrespective of the bio-energy technology. Availability of residues, transport cost and infra-structural settings (harvest machinery, modes of collection, etc.) are some of the driving factors of using residues for energy generation.

Ethanol from crop residues: The conversion of ligno-cellulosic biomass into bio-based alcohol production is of immense importance and is a researchable issue as ethanol can be either blended with gasoline as a fuel extender and octane-enhancing agent or used as a neat fuel in internal combustion engines. The theoretical estimates of ethanol production from different feedstock (corn grain, rice straw, wheat straw, bagasse and saw dust) varies from 382 to 471 L t^{-1} of dry matter.

Biomethanation: Biomass such as rice straw can be converted to biogas, a mixture of carbon dioxide and methane and used as fuel. It is reported that biogas of 300 m^3 t^{-1} of dry rice straw can be obtained. The process yields good quality of gas with 55-60% of methane and the spent slurry can be used as manure. This process promises a method to utilize crop residues in a non-destructive way to extract high quality fuel gas and produce manure to be recycled in soil.

Gasification of residues: Gasification is a thermo-chemical process in which gas is formed due to partial combustion of residues. The process breaks down biomass completely to yield energy rich gaseous products after initial pyrolysis. The main problem in biomass gasification for power generation is the cleaning of gas so that impurities are removed. The residues can be used in the gasifiers for the generation of producer gas. In some states gasifiers with more than 1MW capacity has been installed for generation of producer gas which is fed to the engines coupled to the alternators for electricity generation. One ton of biomass can be used for generation of 300 kWh of electricity.

Fast pyrolysis: Fast pyrolysis of crop residues requires the temperature of biomass to be raised to 400-500 ^{o}C within few seconds. This results in a remarkable change in the thermal disintegration process. About 75% of dry weight of biomass is converted into condensable vapours. If the condensate cools quickly within a couple of seconds, it yields a dark brown viscous liquid commonly called bio-oil. The calorific value of bio-oil varies 16-20 MJ kg^{-1}.

Biochar: Biochar is high carbon material produced from the slow pyrolysis (heating in the absence of oxygen) of biomass. It has got advantages in terms of its efficiency as an energy source, its use as a fertilizer when mixed with soil, its ability to stabilize as well as reduce emissions of harmful gases in the atmosphere. Biochar finds use in the release of energy-rich gases which are then used for producing liquid fuels or directly for power and/or heat generation. It can potentially play a major role in the long-term storage of carbon. Biochar increases the fertility, water retention capability of the soil as well as increasing the rate of mineral delivery to roots of the plants.

Crop residues for conservation of Agriculture:

In the areas, eastern India for example, where crop residues have competing uses as animal feed, roof thatching and domestic fuel, at least some parts of the stubble should be left in the fields to contribute to soil organic C. This technology has been successfully applied in several experiments at Bidhan Chandra Krishi Viswavidyalaya (BCKV), West Bengal.

Due to less biomass productivity and competing uses of crop residues, the scope of using crop residues for conservation agriculture is limited in dryland ecosystems. Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad, has shown that in dryland ecosystems, where only a single crop is grown in a year, it is possible to raise a second crop with residual soil moisture by covering soil with crop residues

E.g: Growing of horse gram during post-rainy season with maize residues under conservation agriculture in rainfed condition.

Vegetable waste as crop residue:

- Mineralization of nitrogen from vegetable crop residues like leek and spinach is much faster because these are more succulent in nature and contains high amount of nitrogen.
- Khol rabi, cabbage and lettuce are next to the leek and spinach.
- Mineralization of nitrogen from broccoli and cauliflower residues is somewhat slow.

If CRM is not followed, ways to reduce the deterioration of the soil resources and declining yield-

- ✓ Reduce or eliminate tillage operations
- ✓ Consider growing a cover crop
- ✓ Consider adding manure.

Main consequences of decomposition of crop residues in soil:

- Mineralisation of plant nutrients
- Transformation of inslouble inorganic elements to fully or partially soluble forms.

These processes determine to a large extent their impact on soil fertility and productivity of soils. Status of nutrient elements depends upon the nature of organic materials and their rates of decomposition. Crop residues are good sources of potassium but poor source of phosphorous. With the exception of leguminous residues which can provide net mineral N in soil, residues of cereal and other crops are generally poor in N. It is their low N content or wide C:N ratio that leads to immobilization of plant available N.

Sufficient time is allowed for residue decomposition in the soil before the crop is grown, the immobilization effect is largely reduced. Maximum plant available N is immobilized upto 25-30 days . Thus skipping over the maximum immobilization period for crop planting would usually mean definite benefits even to the succeeding crop. However, under double row cropping in tropical and subtropical conditions, 1-2 months fallow periods are available between two main crops in most situations. Residue crop incorporation along with crop planting may not yield short term beneficial effects except those of moisture conservation and temperature moderation obtained by using the residues as surface mulches.

Development activities for efficient crop residue management:

- Each university, research institutes and NGOs committed to sustainable development should start working with some selected farmers in varying situations with the knowledge embedded in CA (Conservation Agriculture) principles and observe what and how much can be achieved and what is needed to make CA a success. This experience should be used for improving the CA-technology and removing the constraints.
- The emphasis should be on recycling of any form of wastes in addition to crop residues. As the availability of such organic resources is site-specific, an inventory should be made of the potentially available materials for use in the target regions in a systematic way. Approximate composition of various residues/wastes would further help to target a proper use of these resources.
- Where crop residues have competing uses as fodder or fuel, recycling should be encouraged of the end product (dung, slurry, ash).

CONCLUSION:

The residues are of great economic value as livestock feed, fuel and industrial raw material. However, problems with the crop residues are different in different region

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ISSN: 2581-8317
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and associated with the socio-economic needs. Thus the policy in north India may not work in eastern India. In northern India, wheat straw whereas in east and south India rice straw are the major feed for livestock. The residues can be put to various uses and is possible if residue is collected and managed properly. The surplus residues must be used for CA, for which it is a prerequisite. There is a need to create awareness among the farming communities about the importance of crop residues in CA for sustainability and resilience of Indian agriculture.

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AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Azolla: A potential supplement feed

Article no: 11208

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INTRODUCTION

Scientific name – *Azolla spp.*

Family: Salviniaceae

Actually, Azolla is a fast growing aquatic fern that floats on the surface of the water. Azolla is also grown as a green manure in paddy cultivation, and sometimes it grows in a natural form in the field. With this green manure, the fertility of the land increases and there is an increase in production also. Neel green algae on the surface of azolla are finite as an inherent. This neel green algae is known as anabina azoli, which remains responsible for the permanency of nitrogen from the atmosphere. Azolla provides the necessary carbon source and environment for algae growth. Thus, this unique mutual facilitated relation develops Azolla as an umbilical plant in which high amounts of proteins are available. Naturally, it is found in hot and hot tropical areas. It is similar to algae in sight and is usually found in shallow water or in paddy field.

Properties of Azolla:-

A. Azolla is a freely floating aquatic fern on the surface. It floats like a small green group in the small group. Azolla Pinnata is found mainly in India, Azolla caste. This is largely a heat-tolerant variety.
B. It accelerates water rapidly.
C. This protein is rich in essential amino acids, vitamins (vitamin A, vitamin B-12 and beta carotene), growth additives, and calcium, phosphorus, potassium, ferrous, copper and magnesium.
D. It easily grows in wild and can grow under controlled condition also.
E. It can easily be produced in large quantity required as green manure in both the seasons – Kharif and Rabi.
F. It increases the utilisation efficiency of chemical fertilizers.

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G. It reduces evaporation rate from the irrigated rice field.
H. Due to being the best quality protein and the following ingredients, cattle easily digest it.
I. Based on dry weight, it contains 20-30 percent protein, 20-30 percent fat, 50-70 percent mineral content, 10-13 percent filament, bio-active substances and bio-polymers.
J. Its production costs are quite low
K. It yields an average of 15 kilograms per sqm per week
L. In normal condition this fern gets doubled in three days
M. It acts as an antibiotic for animals.
N. It is also suitable for green manure in order to increase the uranium strength along with the dietary appetite for animals.

Table 1: Chemical composition of azolla meal

Nutrient	% DM
Crude protein	21.5
Crude fibre	12.8
Ether extract	2.6
Ash	16.3
Potassium	1.25
Magnessium	0.35
Trace minerals	ppm DM
Copper	15.74
Zinc	87.60
Iron	750.73
Sodium	23.80

Benefits of feeding Azolla feed to animals

Azolla is a cheap, edible and nutritious supplementary animal diet. By feeding it, fat and fat-free substances are found more in the milk of animals that eat normal diet. Use of infertility in animals is useful. The problem of blood in animal urine is due to phosphorus deficiency. Due to feeding Azolla to animals, this reduction is removed. Calcium, phosphorus and iron need to be filled in animals from Azolla, which is good for the physical development of the animals. Prices of essential amino acids, vitamins (vitamin A, vitamin B-12 and beta-carotene) and minerals such as calcium, phosphorus, potassium, iron, copper, magnesium etc. are found in Azolla. In this, 40-60 percent protein, 10-15 percent minerals and 7-10 percent of amino acids, bioactive substances and polymers are found on the basis of dry

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ISSN: 2581-8317

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quantities. In this, the amount of carbonhydrate and fat is extremely low. Hence its composition makes it an extremely nutritious and effective ideal animal diet. This is proving to be an ideal fodder for cows, buffaloes, sheep, goats, chickens etc.

Experiments conducted on milch animals prove that when animals are fed with their daily diet 1.5 to 2 kg If Azolla is given daily, then milk production has registered 15-20% growth. Along with this, the quality of the milk of the cow and buffalo's milk also gets better. # Poultry farming in the state is also prevalent in abundance. It is highly remedial and it is also a favourite diet of chickens. The use of Azolla as a poultry diet increases the growth of broiler birds and egg production also. This is proving to be a very beneficial choice for poultry practitioners. Not only this, Azollas can be used as sheep, gooseberries, rabbits, ducks, as well as the diet.

Method of preparation of Azolla: -

Dig a 60 x 10 x 2 meter size on a shady spot

⇩

Setting the 120-gauge silproin sheet in kheri and arranging the soil with the coating on top of the top.

⇩

Instead of laying the cylindrical sheets, the cattle manufacturer can make keri.

⇩

Lay 80-100 kg of clean fertile soil in layers of preparation.

⇩

Make a solution of 5-7 kg dung (2-3 days old) in 10-15 liters of water and roll over the soil.

⇩

In the Kheri, fill 400-500 liters of water, in which water depth should be about 10-15 cm.

⇩

Now mix fertile soil and dung compost well in water.

⇩

After mixing two kilos of fresh Azolla on this mixture, sprinkle 10 liters of water well on Azolla so that Azolla can come in its right position.

⇩

Now cover the preparation with 50% nylon mesh and increase Azolla for 15-20 days.

⇩

From the 21st day on average 15-20 kg of Azolla can be obtained daily.

⇩

To achieve the yield of Azolla 10-15 kg a day, mix 20 grams of superphosphate and 50 kg of dung and mix it in kheri per month.

⇩

Due to feeding 30-50 grams of Azolla daily to chickens, there is an increase of 10-15% increase in body weight and egg production capacity in chickens.

⇩

Feeding of fresh Azolla in 150-200 gms of cattle and goats increases physical growth and milk production.

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Fig -1 Azolla cultivation in open condition

Fig -2 Azolla cultivation in protected condition

Maintenance

Keep the water level at 10 cm in the morning, to achieve the yield of 15-20 kg of Azolla per day, prepare 20 grams of superphosphate and 50 kg of dung slurry and mix it every month. After every 3 months, remove water and soil from Azolla and replace it Reprinted as a verb. For the good growth of Azolla, 20-35 centigrade heat is suitable. In the autumn, when the temperature drops below 60 ° C, cover the plastic mulch of Azolla cake or the old sack of sack or sheet of cloth. Keeping in mind these factors, the Azolla production cost is estimated to be less than Rs.100 / - per kg, in the Azolla production unit installation, preparation of capsule sheet, shadowy nylon mesh and Azolla seeds are not required every year. It is also effective for the farmers. It is made of various types of organic products, as well as for its cultivation, its water is used for bio from the used cultivation Hak Azolla taking on the bed Remove water work in the vegetable and flower cultivation, it serves a growth regulator. Thereby, the production of vegetables and flowers increases. Azolla serves as a great organic and green manure.

CONCLUSION

In the coming time, there can be a problem of fodder in the country, and let us in time, we will be deprived of a fodder which is ready for work costs and work in the land and is full of nutrients. Keeping an eye on all these issues, Ajola will be very effective; it can be fed to all types of animals. It can also improve the condition of the animals. Farmer friends can earn more income by cultivating this, and the biggest thing is that small people and men and women can do its cultivation.

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AGRICULTURE & FOOD: e-Newsletter **ISSN: 2581-8317**

Volume 1 – Issue 5 – May 2019

Barriers in management of women Self-Help Group

Article id: 11209

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INTRODUCTION:

In the early decades the sense of empowerment of women is totally out of sight and their condition was very poor. The whole society was unconscious about the development and empowerment of women. Self- help group (SHG) is a group of people coming together voluntarily for attaining a common goal and aim to eradication of poverty of the members. The goal could be anything like saving or meeting emergent and credit need etc. Self-help groups (SHGs) are fast emerging as powerful tool of socio-economic upliftment of the poor in rural areas. SHGs are extremely useful in generating savings, ensuring successful delivery of credit to rural poor and effecting in recovery. In addition, they serve as an ideal mechanism for bringing the women out of their homes, making them more articulate and horning their leadership qualities and their skills as motivators (Jain and Srivastava, 2003; Gupta, 2006). SHG is a small body formed by the people for meeting their specific objectives, particularly credit. It is managed by the rules and regulations formed by them and functions on democratic principles. Nirmala (2004) reveled that SHGs are the small groups, where the members enhance the -economic development of their families through employment generation and income generating activities. Before joining the SHG, the members believe that if they will join the group then there is a chance to earn some income and they can avail some financial assistance from the group or outside the group. Vadivoo and Sekar (2004) reported that the major constraints in SHGs are lack of banking data disaggregated by gender and lack of an adequate analytical framework for integrating women into credit analysis. Another problem in the SHG is that different age group among the members which has different thinking leads to imbalance in the group. Purushotham (2005) also said that lack of awareness and easy access to low cost and inappropriate technologies render several tiny micro-entrepreneurs to shy away from agro-processing in rural areas. It is seen that in many places the SHG are engaged in various enterprises and earning a good amount of income for maintain their livelihood. Nair and Girija (2005) mentioned that the major hurdle of SHGs which inhibits them from forming such groups includes their powerlessness, lack of unity and leadership qualities which act from outside

AGRICULTURE & FOOD: e-Newsletter ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

and include caste, class and ethnic stratification. The study was about on the constraints face by women Self Help Group in their group management in the rural areas.

Methodology:

The study was conducted in four villages namely Dakshin Kalarayer Kuthi, Gopalpur and Patlakhoa villages under Cooch Behar block II of Cooch Behar District of North Bengal. 80 no. of individual members of Self-Help Group from eight nos. of group were selected randomly for the study. The data were collected through well design structure interview schedule. A Focus group discussion (FGD) was also conducted in each villages to collect secondary information. The collected data were analysis using **s**tatistical tools such as frequency, percentage and ranking.

Fig. 1: Cat fish production by SHG members

Fig.2: Bamboo Basket making by SHG members

Result and Discussion:

Table 1: Individual members purpose for involvement of women SHG in rural area

Sl. No.	Purposes	Frequency	Percentage	Rank
1	Self – development	72	90.00	III
2	Earning money	78	97.50	I
3	Educating children	65	81.25	V
4	Improving social status	62	77.50	VI
5	Contact with outsider	70	87.50	IV
6	Serving the family	76	95.00	II

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ISSN: 2581-8317
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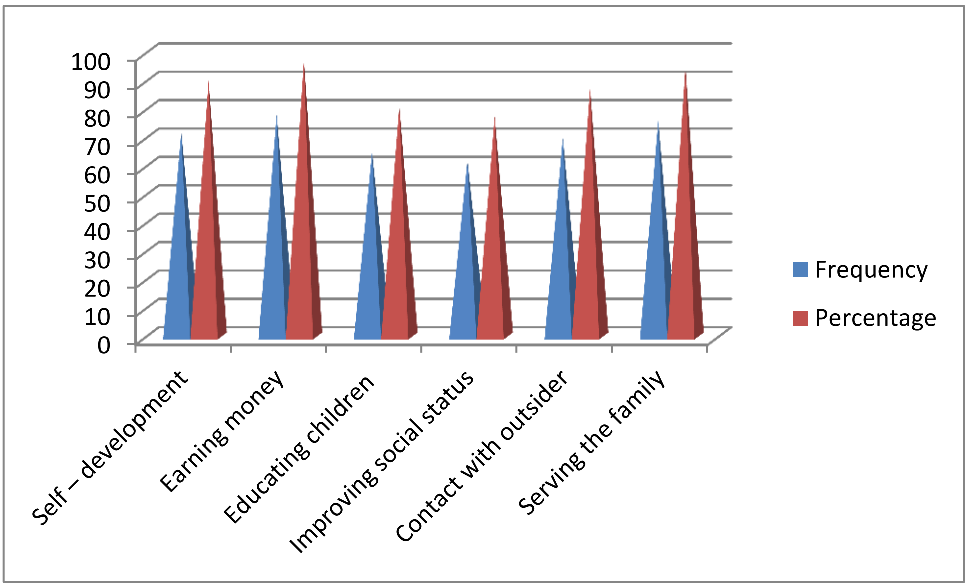
The above table (Table No. 1) shows that 97.50% of the respondent had join the Self-Help Group due to earning of money because most of the Self-Help Group members belong to poor family background and they have always financial shortage. They think that by joining in the Self-Help Group, they can earn some income with the help of the group.77.50% of the Self-Help Group members had joins the Self-Help Group for improving social status through development of entrepreneurship .

Fig. 1: Individual members purpose for involvement of women SHG in rural area



The above Figure shows the various purposes of the individual members of the Self-Help Group and their involvement.

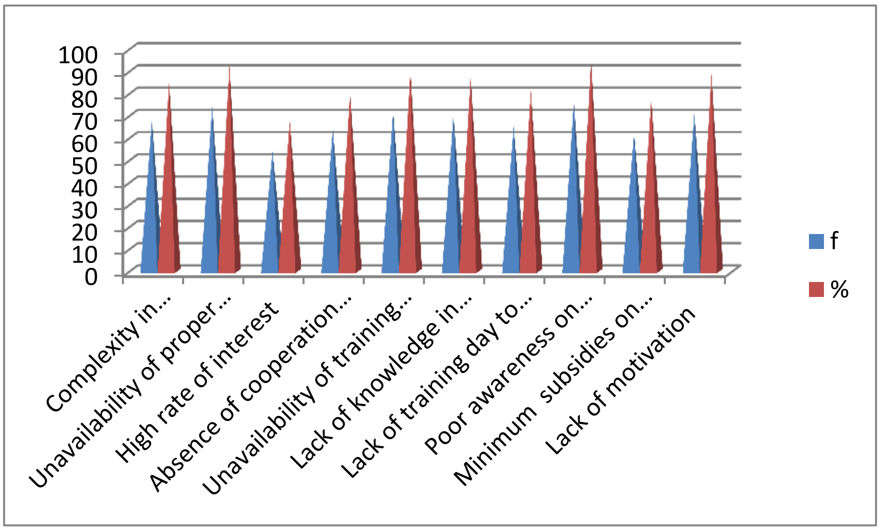
Table 2: Problems faced by SHG members in management of their group functional

Sl. No.	Problems	Frequency	Percentage	Rank
1	Complexity in procurement of loan from financial institutions	68	85.00	VI
2	Unavailability of proper information about the sources of funds	74	92.50	II
3	High rate of interest	54	67.50	X
4	Absence of cooperation	64	80.00	VIII

	among the group members			
5	Unavailability of training facility in entrepreneurship development	72	90.00	III
6	Lack of knowledge in group management	70	87.50	V
7	Lack of training day to day curriculum activity management	65	81.25	VII
8	Poor awareness on market linkage	76	95.00	I
9	Minimum subsidies on loans	62	77.50	IX
10	Lack of motivation among or between the group members	71	88.75	IV

The above table (Table No. 2) shows that 95.00% of the Self-Help Group members faced the problem on poor awareness on market linkage due to the awareness on market demand driven product and lack of guidance to sell their outputs in the assured market. The poor transportation facilities in the rural area are one of the reasons for poor market linkage to the group members. 67.50% respondents from the Self-Help Group members faced problem on high rate of interest.

Fig.2. Problems faced by SHG members in management of their group functional



The above figure shows the frequency and percentage of various problems faced by Self-Help Group members in management of their group functional.

CONCLUSION

In rural areas the women participate in creation of Self-Help Group because of to start a entrepreneurship for generating sustainable income. They can improve their present status with the support of the group. Involvement of any members in any group gives prestigious status in the society.

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http://www.agrifoodmagazine.co.in

AGRICULTURE & FOOD: e-Newsletter

ISSN: 2581-8317

Volume 1 – Issue 5 – May 2019

Paper making from banana stem

Article id: 11210

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INTRODUCTION

Today paper pulp is formed by banana stem so we can say banana stem is the source of raw material for paper pulp production. There are many types of paper which can be formed from the banana stem such as- bloating, tracing, writing, printing, tissue paper. In north-east region banana are easily available because in north east there is a large-scale cultivation of banana occurs. After harvesting farmer cuts the banana trees and throw them away think it is a waste. Because after taking out fruit there is no such use of banana tree or stem according to them. But using banana stem for the production of tissue paper help the farmers to get some amount of money and then they will have some intrest in saving the banana waste. There are many industries which are making tissue paper using bamboo, harwood and other types of woods. On this basis banana stem have alternative suitable character for the paper making because it contains very good amount of cellulose. Cellulose is the main raw material for paper making.

History of paper making from banana stem

In production of tissue paper making, kraft pulp process is basically used. It is the oldest process which is very famous for preparation of pulp.The kraft process was first introduced in Germany in 1879 and and is first applied in Swedish mill in 1855. When initial stage of paper was produced from kraft process, the obtained paper was much stronger than any bleaching process which previously manufactured. Banana stem acts as a best material for making grease proof paper, fiber, board, writing paper and tissue paper. On economic point of view the banana stem is much cheaper than any wood.

Fig no. 1- Banana Stem

After harvesting of banana fruits than the banana stems are cut into pieces [approx. size 4-5cm] so the process known as chopping of banana stem. Then drying of banana stem, upto 90% of the stem should dry in sun. The chemical composition represented sample is given in table1.1. Sulphide process is used for the making of pulp as a feed of paper machine. This process involves the removing of lignin and hemicellulose after cutting the banana stem into small pieces . The process of chemical pulping is used to separate the lignin percentage lignocelluloses from cellulose which improves the brightness of pulp. The lignin percentage of the pulp is determined by the kappa number.

The effective viscosity, rheology, and concentration of the pulp can be determined with the help of rotationalviscometer, rheometer, and consistency meter. The pulp behaves like time independent non-newtanion, pseudo-plastic flow behaviour. The pulp is used to prepapre several types of paper. But here we are using production of bloating paper, tissue and tracing paper. We have to check several properties of paper such as tear factor, burst factor, tensile strength, freeness, smoothness, formation brightness and air permeability of paper.

Table 1.1: Showing the chemical composition or banana fiber.

Sl. No.	CONTENT	BANANA FIBER (%)
1	Cellulose	69.5
2	Hemicellulose	15
3	Lignin	5.45
4	Pectin	0.5
5	Fats and waxes	1.5

Figure 1.2: Showing green and dried stem of banana.

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ISSN: 2581-8317
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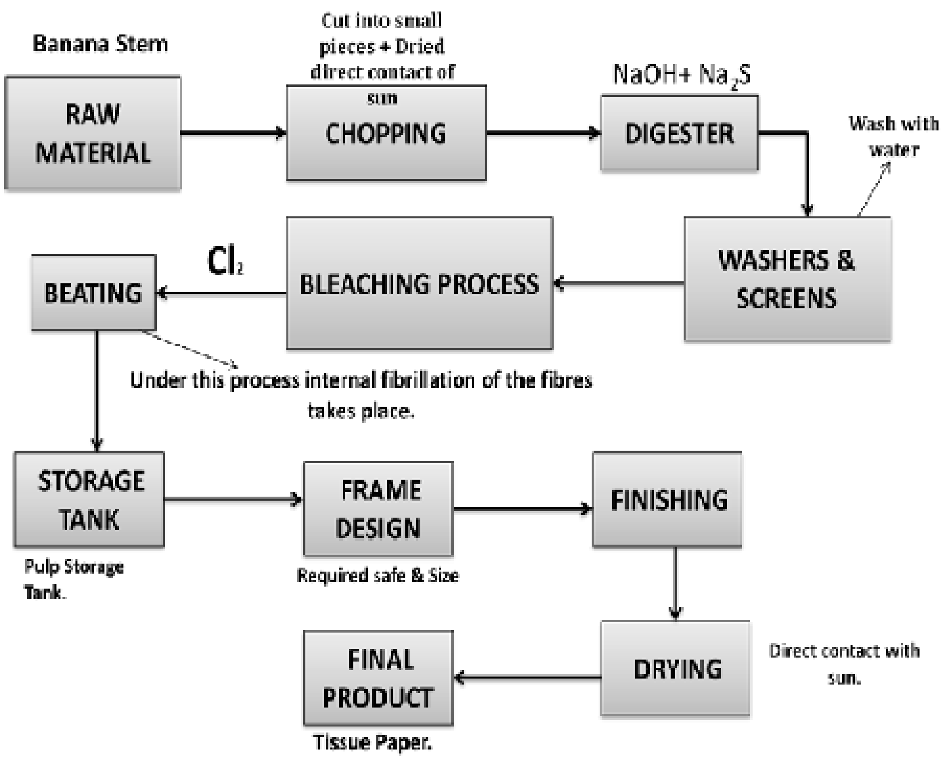
Table 1.2: Showing the equipment used to test the paper and pulp quality

Sl. No.	Properties	Name of the equipment
1	GSM	GSM tester
2	Tear factor	Tear factor tester
3	Burst factor	Mullen tester
4	Ph	Ph meter
5	Tensile factor	Alwetron TH-1
6	Roughness	Air-leak tester
7	Effective viscosity	Rotational viscometer
8	Pseudoplastic flow behaviour	Rheometer
9	Pulp consistency	Consistency meter

Pulping by Kraft Process Showing in Flow Chart-



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AGRICULTURE & FOOD: e-Newsletter
ISSN: 2581-8317
Volume 1 – Issue 5 – May 2019

Figure 1.3 Showing blotting paper

Figure 1.4 Showing tracing paper

CONCLUSION

Banana stem is easily available and cheapest raw material as a source of making paper pulp for theproduction of various types of paper. The process of making pulp is economically violable. The lignin is separated from cellulose with the help of chemical treatment.The making of paper is handmade. Sun raysare used for drying operation of papermat. So energy is consumed from nature and according to economic standpoint. It is profitable. Strength and quality (brightness, formation, softness, smoothness) of the Paper produced in this process ismarketable. Process cost is very low.