AGRICULTURE & FOOD E-NEWSLETTER

ISSN : 2581-8317

VOLUME 05 - ISSUE 05
MAY 2023

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

WWW.AGRIFOODMAGAZINE.CO.IN

AGRICULTURE & FOOD E-NEWSLETTER

ISSN : 2581-8317

VOLUME 05 - ISSUE 05

MAY 2023

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

WWW.AGRIFOODMAGAZINE.CO.IN

INDEX

Agriculture & Food: e-Newsletter Volume 05 – Issue 05 – May 2023
www.agrifoodmagazine.co.in

INDEX

Agriculture & Food: e-Newsletter Volume 05 – Issue 05 – May 2023
www.agrifoodmagazine.co.in

INDEX

Agriculture & Food: e-Newsletter
Volume 05 – Issue 05 – May 2023
www.agrifoodmagazine.co.in

INDEX

Agriculture & Food: e-Newsletter Volume 05 – Issue 05 – May 2023
www.agrifoodmagazine.co.in

INDEX

Agriculture & Food: e-Newsletter
www.agrifoodmagazine.co.in
Volume 05 – Issue 05 – May 2023

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

Advances in Breeding for Plant Architecture in Crop Plants: A Review

Article ID: 40800

K. G. Kugashiya[1], R. A. Gami[1], Dr. P. T. Patel[1], S. J. Vaghela[1]

Introduction

Plant architecture is defined as the three-dimensional organization of the plant body. It is of major agronomic importance as it determines the adaptability of a plant to cultivation, its harvest index and potential grain yield (Reinhardt and Kuhlemeier, 2002). Domestication of various crop leads to many desirable changes in plant architecture compared to their wild progenitor. One of the great successes of the Green Revolution, which led to major increases in productivity, was based on the modification of plant architecture. Wheat and Rice varieties with shorter and sturdier stems (lodging resistance) resulted in plants that can carry more yield.

Plant architecture results from the repetitive functioning of meristems (SAM and RAM) which can engage in three basic activities: Division, Expansion and Differentiation. The Plant architecture developmental process is further regulated by phytohormones (Auxin, GA, Cytokinin, Strigolactones etc), genetic and environmental factors. The decomposition, geometrical and topological information regarding plant can be utilized to form representation of plant architecture.

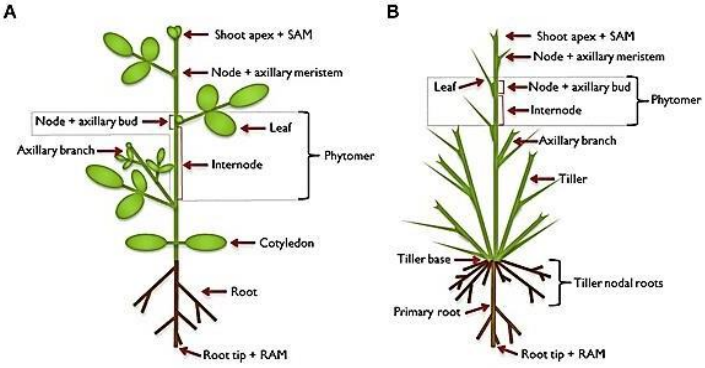


Fig. 1. Typical architecture of (A) Dicot plant and (B) Monocot

Shoot architecture refers to the structure and organization of the aboveground components of a plant, reflecting the developmental patterning of stems, branches, leaves and inforescences/fowers. Root system architecture is essentially determined by four major shape parameters like growth, branching, surface area and angle. Modified plant architecture can be used to create an unfavourable microclimate for disease development resulting in disease escape or disease avoidance. Manipulation of plant architectural trait can lead to lodging resistance, nutrient use efficiency and stress resistance in plant resulting in greater yield.

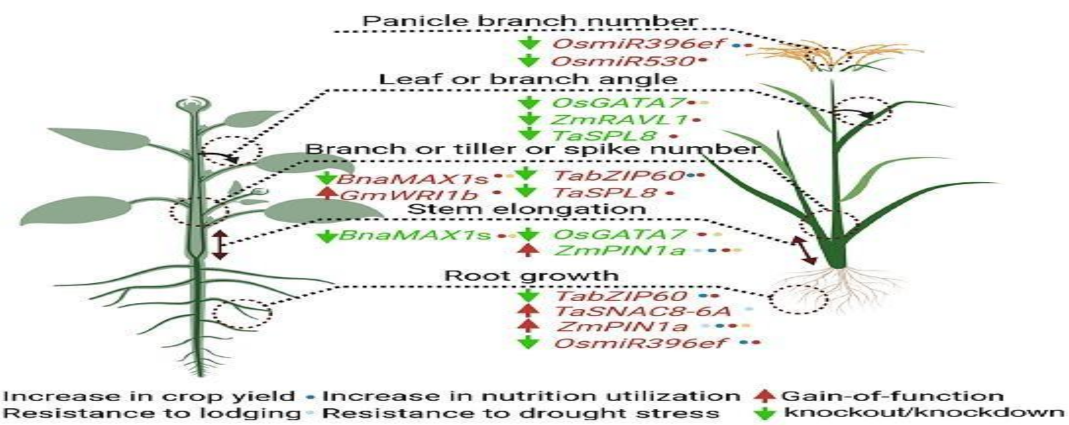


Fig. 2. An Overview of Current Progress on the Modifications of Plant Architecture Traits for Better Crop Yield and Stress Resistance

Genes with positive (red) or negative (green) effects on indicated traits are shown.

Control of Root System Architecture by Deeper Rooting 1 Increases Rice Yield Under Drought Conditions {Uga *et al.* (2013)}

Uga *et al.* (2013) performed cloning and characterization of *DEEPER ROOTING 1* (*DRO1*), a rice quantitative trait locus controlling root growth angle. Higher expression of *DRO1* increases the root growth angle, whereby roots grow in a more downward direction resulting in line which can avoid drought by increasing deep rooting, which ultimately gives high yield performance under drought conditions.

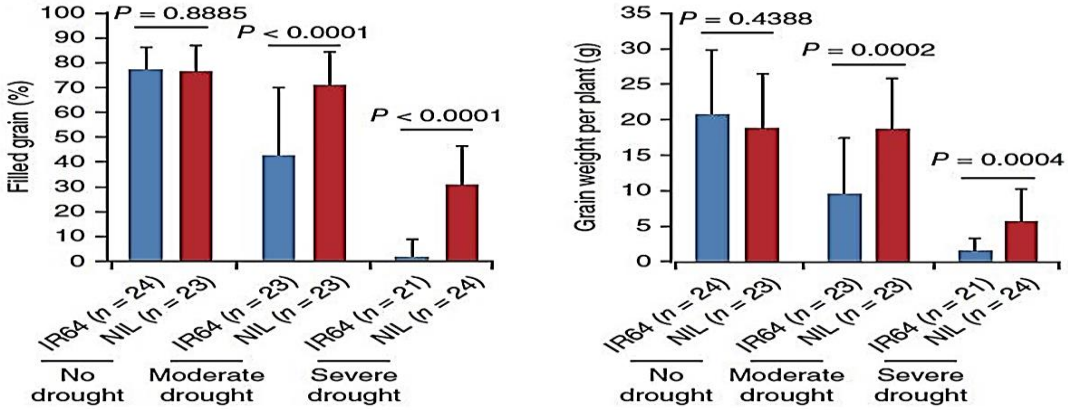


Fig. 5. Effect of *DRO1* on the response to drought-induced stress

Correlation and Path Analysis of Agronomic and Morphological Traits in Maize {Silva *et al.* (2016)}

Silva *et al.* (2016) studied correlation and path analysis of eleven agronomic and morphological traits in 13 synthetic maize population. Seed yield showed significant negative association with Lodging and culm breakage. The correlation of RFM (Root Fresh Matter) and RDM (Root Dry Matter) with GY (0.457 and 0.511, respectively), were the highest values among the positive correlations but non-significant. The selection of plants with higher RFM and RDM had representative direct effect on the increase of the GY. It was also observed that effects of all traits on the GY occur indirectly through these two traits which suggested their use in selection indexes.

Shortened Basal Internodes Encodes a Gibberellin 2-Oxidase and Contributes to Lodging Resistance in Rice {Liu *et al.* (2018)}s

Liu *et al.* (2018) reported a new rice semi dominant lodging-resistance gene SBI (Shortened Basal Internodes) from a somaclonal mutant (SV14) of a rice variety Zhu1S. SBI, which is predominantly expressed in rice culm, encodes an OsGA2ox that reduces the content of bioactive gibberellin in culm, especially in the basal internodes. The SBI allele exhibiting higher activity of OsGA2ox resulted in rice height reduction and hence lodging resistance.

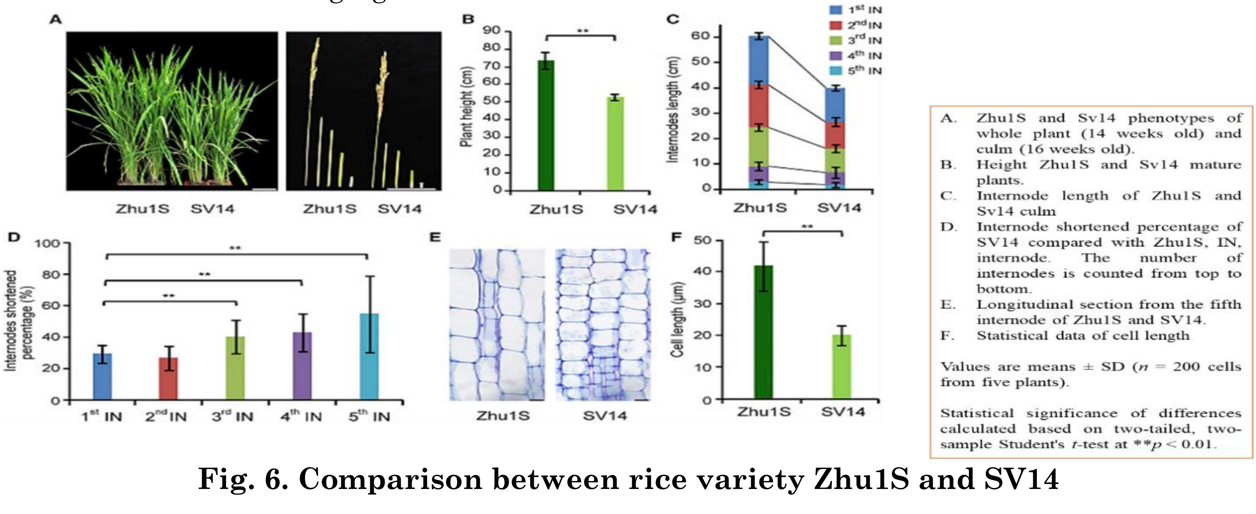
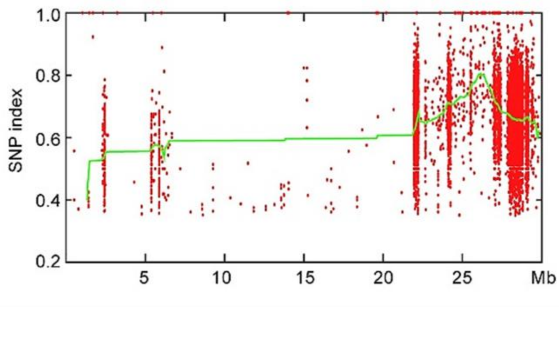
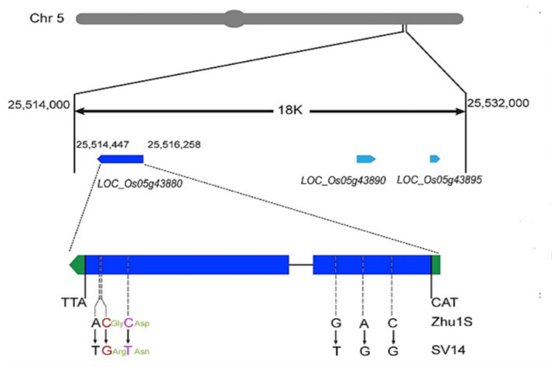


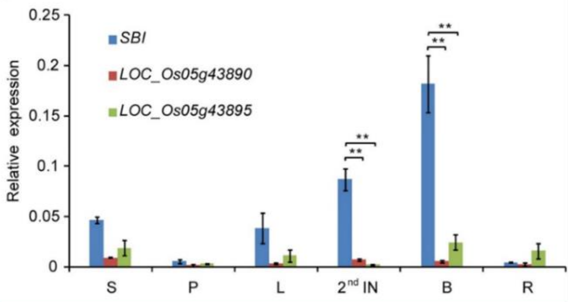
Fig. 6. Comparison between rice variety Zhu1S and SV14



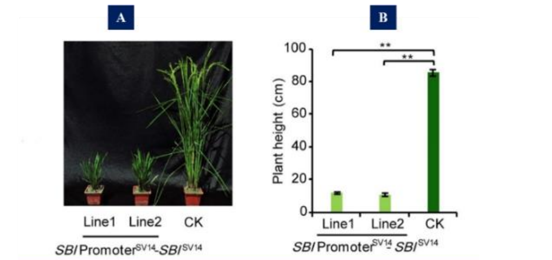
SNP linkage analysis to localize *SBI* to a region on chromosome 5



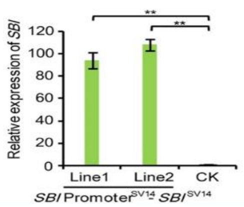
SBI structure and variations between SV14 and Zhu1S.

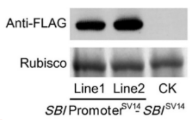


Expression pattern of candidate genes.
S, seedling; **P**, panicle; **L**, leaf blade; **2nd IN**, second internode; **B**, basal internodes; **R**, root.



A. Morphology of *SBI*^{SV14} overexpression plants.
SBI^{SV14} cDNA driven by its native promoter from SV14 was transferred into ZH11. CK, transgenic negative control. Scale bar, 10 cm. Plant height
B. qPCR analysis of expression of *SBI*^{SV14}





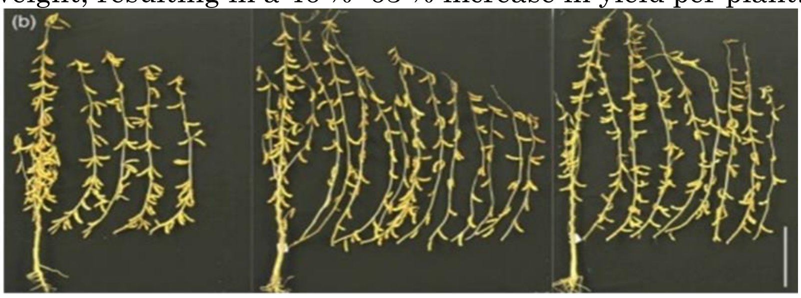
Transgenic negative control. Rubisco (stained with Coomassie brilliant blue) shows equal amount of total protein loading.
Statistical significance of differences calculated based on two-tailed, two-sample Student's t-test at **p < 0.01.

Protein blot detection of exogenous SBI^{SV14}- FLAG protein in transgenic lines

Fig. 7. Identification of *SBI*

Genetic Improvement of the Shoot Architecture and Yield in Soya Bean Plants Via the Manipulation of *GmmiR156b*

Sun *et al.* (2019) achieved substantial improvements in soya bean architecture and yield by overexpressing GmmiR156b. GmmiR156b modulates architectural traits mainly via the direct cleavage of SPL (Squamosa Promoter Binding Protein-Like) transcripts which regulate axillary bud formation and branching. Transgenic plants produced significantly increased numbers of long branches, nodes and pods and they exhibited an increased 100-seed weight, resulting in a 46 %–63 % increase in yield per plant.

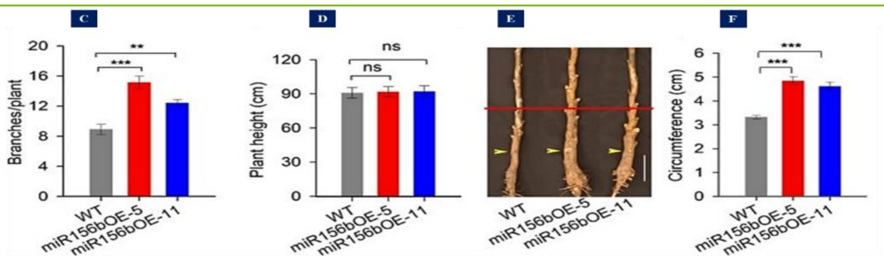


(A) Architecture of miR156bOE and wild-type plants at the harvest stage. Scale bar, 20 cm.

(B) Branching ability of the miR156bOE lines and wild type after harvest. Scale bar, 20 cm.

Fig. 8. Characteristics of miR156bOE transgenic soya bean plants at the harvest stage

E-ISSN: 2581 - 8317



(C) The mean total numbers of branches per miR156bOE plant and wild-type plant (n = 20). (D) Heights of the miR156bOE lines and wild-type controls. (E) Stem morphology of miR156bOE and wild-type plants at the harvest stage in the field. Yellow arrows show the sites of cotyledons at the postgermination stage. Red lines indicate the sites used to measure stem circumference in the transgenic and nontransgenic plants. (F) Statistical comparison of the stem circumference values of miR156bOE and wild-type plants.

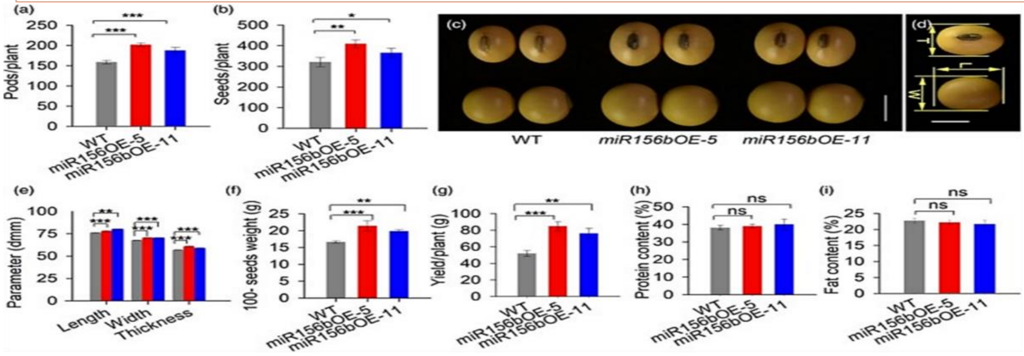
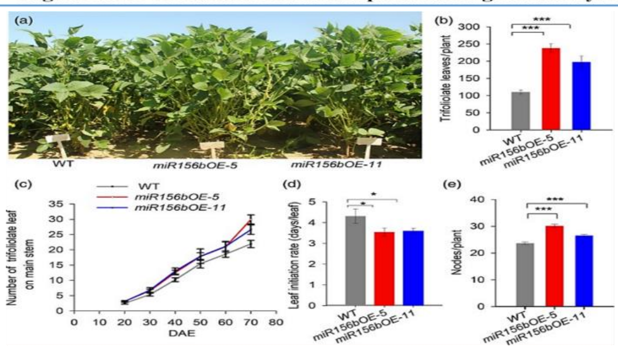
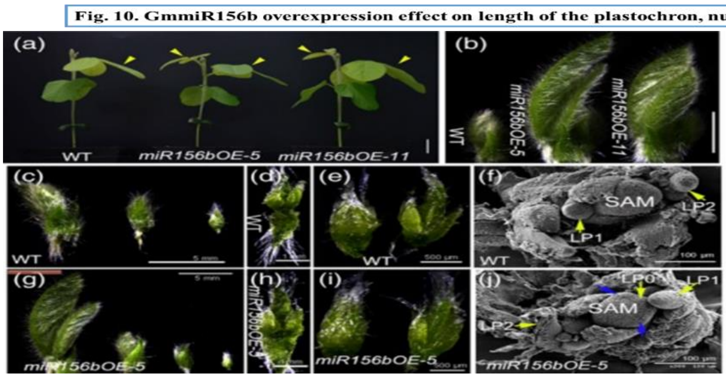


Fig. 9. Effect of GmmiR156b overexpression on grain seed yield per plant and seed quality parameter.



(a) Transgenic miR156bOE-5, miR156bOE-11 and wild-type control plants were grown in a field at 70 days after emergence (DAE).
(b) The total trifoliate leaf number per transgenic and wild-type plant.
(c) Dynamic changes in the trifoliate leaf number on the main stem in wild type and miR156bOE transgenic lines.
(d) The leaf initiation rates were significantly increased in the miR156bOE lines.
(e) Average node number per transgenic and wild-type plant.

Fig. 10. GmmiR156b overexpression effect on length of the plastochron, number of trifoliate leaves and nodes per plant.



(a) Leaf phenotypes of miR156bOE lines grown in a growth room for 15 days after emerging from soil. Yellow arrows indicate trifoliolate leaves.
(b) Shoot apical tissues from miR156bOE lines after removing two visible and mature leaves under a stereoscopic microscope.
- Dissected immature leaves from wild-type **(c, d, e)** and miR156bOE-5 **(g, h, i)** soya bean shoot apical tissues.
- **(f and j)** Scanning electron microscopic images of the shoot apical meristem (SAM) in wild-type (f) and miR156OE-5 (j) plants.
- Yellow arrows indicate leaf primordia (LP). The numbers represent LP at different developmental stages. Blue arrows show initiated stipule primordia.

Fig. 11. Enhanced meristematic activity due to GmmiR156b overexpression in transgenic plants at the vegetative growth stage

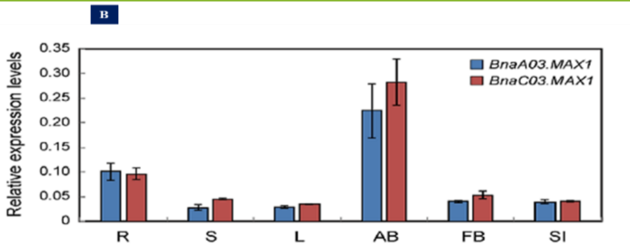
Knockout of Two *Bnamax1* Homologs by CRISPR/Cas9- Targeted Mutagenesis Improves Plant Architecture and Increases Yield in Rapeseed (*Brassica napus* L.)

Zeng *et al.* (2020) verified that the two rapeseed BnaMAX1 genes had redundant functions resembling those of Arabidopsis MAX1, which regulates plant height and axillary bud outgrowth. They designed two sgRNAs to edit these BnaMAX1 homologs using the CRISPR/Cas9 system. Simultaneous knockout of all four BnaMAX1 alleles resulted in semi-dwarf and increased branching phenotypes with more siliques, contributing to increased yield per plant relative to wild type.

A

Identity / Similarity	MAX1	BnaA03.MAX1	BnaC03.MAX1
MAX1		88.9%	88.5%
BnaA03.MAX1	93.8%		98.5%
BnaC03.MAX1	93.2%	99.4%	

(a) Amino acid identities and similarities of MAX1 proteins in Arabidopsis and rapeseed.



(b) qRT-PCR analysis of the expression of *BnaMAX1s* in diverse tissues. R, root; S, stem; L, leaf; AB, axillary bud; FB, flower bud; SI, silique.

Figure 12. BnaMAX1 homologs in rapeseed genome

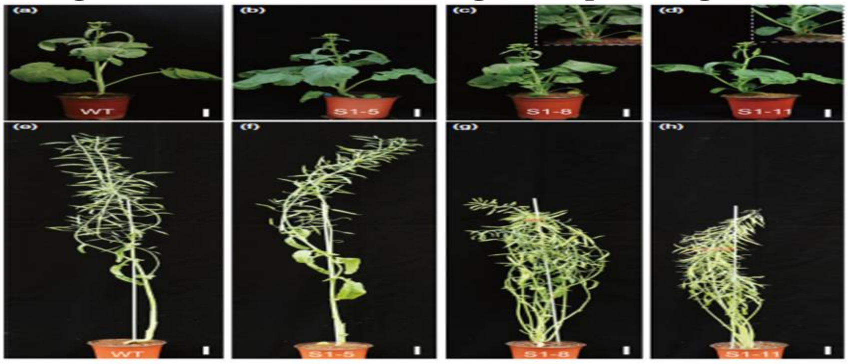


Fig. 13. Morphological comparison of wild-type (WT) and BnaMAX1 homozygous mutant plants at various developmental stages

Conclusion

1. Plant domestication plays a crucial role in the improvement of architectural traits.
2. Plant architecture is highly divergent between different plant taxa but it is determined by common developmental processes and principles based on meristems (SAM & RAM) and phytomers.
3. Shoot modification involves bud initiation, activation and expansion as well as sustained branch growth, which is regulated by a complex network involving phytohormones (GA, BR, auxin, cytokinin and SLs), environmental signals and gene expression.
4. Canopy porosity alone can play significant role in disease avoidance / disease escape.

Future Thrust

1. New genes to provide optimal light interception, resource allocation, planting density, robustness and ease of harvesting in a range of crops should be characterized at the molecular level.
2. Future research should be directed toward understanding the regulation and mode of action of key genes influencing architecture for simultaneous improvement of several trait.
3. Combining architectural ideotype along with genetic resistance can lead to further development in stress breeding.
4. Powerful breeding systems based on integrated information from functional genomics, genetic resources and molecular markers and knowledge of valuable architectural traits both will facilitate breeding of defined architectural ideotypes in more crops.

References

1. Liu, C., Zheng, S., Gui, J., Fu, C., Yu, H., Song, D., Shen, J., Qin, P., Liu, X., Han, B., Yang, Y., & Li, L. (2018). *Molecular Plant,* 11, 288-299.
2. Reinhardt & Kuhlemeier C. (2002). *EMBO Reports*, 3(9), 846-851.
3. Silva, T. N., Moro, G. V., Moro, F. V., Santos, D. M. M. & Buzinaro, R. (2016). *Revista Ciencia Agronomica,* 47 (2), 351-357.
4. Sun, Z., Su, C., Yun, J., Jiang, Q., Wang, L., Wang, Y., Cao, D., Zhao, F., Zhao, Q., Zhang, M., Zhou, B., Zhang, L., Kong, F., Liu, B., Tong, Y. & Li, X. (2019). *Plant Biotechnology Journal,* 17, 50-62.
5. Uga, Y., Sugimoto, K., Ogawa, S., Rane, J., Ishitani, M., Hara, N., Kitomi, Y., Inukai, Y., Ono, K., Kanno, N., Inoue, H., Takehisa, H., Motoyama, R., Nagamura, Y., Wu. J., Matsumoto, T., Takai, T., Okuno, K., & Yano, M. (2013). *Nature Genetics,* 45(9), 1097-1106.
6. Zheng, M., Zheng, L., Tang, M., Liu, J., Liu, H., Yang, H., Fan, S., Terzaghi, W., Wang, H. & Hua,
7. W. (2020). *Plant Biotechnology Journal,* 18, 644-654.

Plasma Technology in Food Engineering: Advancements, Applications, and Challenges

Article ID: 40801

Sapna Birania[1], Sachin Ghanghas[1], Ajay Kumar[1], Kumari Nisha[1]
[1]College of Agricultural Engineering and Technology, CCS Haryana Agricultural University, Hisar.

Plasma technology is a rapidly developing area of research in the field of food engineering. This technology has the potential to revolutionize the way we preserve and modify food products. One of the most exciting applications of plasma technology is its ability to inactivate microorganisms, which can improve the safety and shelf life of food products. Additionally, plasma technology can modify the surface properties of food materials, enhancing their functionality and improving the sensory properties of food products (Cullen et al., 2018). Generating reactive species, such as ozone and hydrogen peroxide, can also remove contaminants and oxidize food components. While there are still challenges to be addressed, plasma technology has the potential to play a significant role in improving food safety and quality (Yepez et al., 2022).

Plasma technology has emerged as a promising tool for improving the safety and quality of food products. There are several types of plasma technologies that can be used in food processing, each with their own unique characteristics and potential applications. Atmospheric pressure plasma operates at low temperatures and can be used for surface sterilization and modification of food materials. Low-pressure plasma, which operates at reduced pressure, can be used for surface modification, sterilization, and decontamination of food products (Domonkos et al., 2021). Dielectric barrier discharge (DBD) generates plasma between two electrodes separated by a dielectric material, and is effective for surface modification, sterilization, and decontamination of food materials. Plasma-activated water (PAW) involves the use of plasma-treated water for the decontamination and preservation of food products. The different plasma technologies offer distinct advantages for various applications in the food industry. For example, atmospheric pressure plasma is well-suited for surface sterilization of food packaging materials, while low-pressure plasma can be used for the decontamination of food products. DBD is effective for surface modification of food materials, while PAW can be used for the preservation of fresh fruits and vegetables (Feizollahi et al., 2021). However, there are still several challenges that need to be addressed, including the optimization of plasma parameters, the development of cost-effective and scalable plasma systems, and the assessment of potential impacts on food quality and safety. Further research is needed to fully understand the potential applications and limitations of these different plasma technologies in food processing.

Plasma technology is a promising tool for improving the safety and quality of food products. However, there are still several challenges that need to be addressed before plasma technology can be widely adopted in the food industry. One of the main challenges is the optimization of plasma parameters, including the gas composition, flow rate, and discharge power (Shao et al., 2018). The choice of these parameters can affect the efficacy of plasma treatment and its potential impact on food quality and safety. Another challenge is the development of cost-effective and scalable plasma systems that can be integrated into existing food processing facilities. The high cost and complexity of plasma systems can be a barrier to their adoption by small and medium-sized enterprises (Priyadarshini et al., 2019). Additionally, the scalability of plasma technology needs to be considered, as it may be challenging to apply plasma treatment to large volumes of food products. Finally, the potential effects of plasma treatment on food quality and safety need to be thoroughly assessed. While plasma treatment has been shown to be effective in inactivating microorganisms and modifying the surface properties of food materials, there is still a need to investigate its potential impact on the nutritional and sensory quality of food products. The potential formation of harmful by-products during plasma treatment also needs to be considered, and appropriate measures should be taken to ensure the safety of plasma-treated food products (Sarangapani et al., 2018).

Plasma technology has been shown to be effective in inactivating a wide range of microorganisms in food products. These include bacteria such as Escherichia coli, Salmonella, Listeria monocytogenes, and

Staphylococcus aureus, as well as yeasts and molds (Varilla et al., 2020). Plasma treatment works by generating reactive species such as free radicals, ozone, and UV radiation, which can damage the cellular structure and DNA of microorganisms, leading to their inactivation. In addition to its antimicrobial properties, plasma treatment can also modify the surface properties of food materials, improving their wettability and adhesion properties, which can be beneficial for food processing and packaging applications (Ganesan et al., 2021). However, further research is needed to fully understand the mechanisms by which plasma treatment inactivates microorganisms and to optimize plasma parameters for maximum efficacy and minimal impact on food quality and safety. Additionally, it is important to ensure that plasma-treated food products are safe for consumption and do not contain harmful by-products as a result of plasma treatment.

References

1. Cullen, P. J., Lalor, J., Scally, L., Boehm, D., Milosavljević, V., Bourke, P., & Keener, K. (2018). Translation of plasma technology from the lab to the food industry. Plasma Processes and Polymers, 15(2), 1700085.
2. Yepez, X., Illera, A. E., Baykara, H., & Keener, K. (2022). Recent advances and potential applications of atmospheric pressure cold plasma technology for sustainable food processing. Foods, 11(13), 1833.
3. Domonkos, M., Tichá, P., Trejbal, J., & Demo, P. (2021). Applications of cold atmospheric pressure plasma technology in medicine, agriculture and food industry. Applied Sciences, 11(11), 4809.
4. Feizollahi, E., Misra, N. N., & Roopesh, M. S. (2021). Factors influencing the antimicrobial efficacy of dielectric barrier discharge (DBD) atmospheric cold plasma (ACP) in food processing applications. Critical reviews in food science and nutrition, 61(4), 666-689.
5. Shao, T., Wang, R., Zhang, C., & Yan, P. (2018). Atmospheric-pressure pulsed discharges and plasmas: mechanism, characteristics and applications. High voltage, 3(1), 14-20.
6. Priyadarshini, A., Rajauria, G., O'Donnell, C. P., & Tiwari, B. K. (2019). Emerging food processing technologies and factors impacting their industrial adoption. Critical reviews in food science and nutrition, 59(19), 3082-3101.
7. Sarangapani, C., Patange, A., Bourke, P., Keener, K., & Cullen, P. J. (2018). Recent advances in the application of cold plasma technology in foods. Annual review of food science and technology, 9, 609-629.
8. Varilla, C., Marcone, M., & Annor, G. A. (2020). Potential of cold plasma technology in ensuring the safety of foods and agricultural produce: a review. Foods, 9(10), 1435.
9. Ganesan, A. R., Tiwari, U., Ezhilarasi, P. N., & Rajauria, G. (2021). Application of cold plasma on food matrices: A review on current and future prospects. Journal of Food Processing and Preservation, 45(1), e15070.

Unlocking the Potential of Millet Crops: Novel Genetic Strategies for Sustainable Agriculture

Article ID: 40802

Naveen Sihag[1]
[1]Department of Genetics and Plant Breeding, COA, CCS Haryana Agricultural University, Hisar.

Millets are a group of small-seeded grasses that have been traditionally grown in many parts of the world, particularly in the semi-arid regions of Asia and Africa. These crops are rich in essential nutrients, such as protein, fiber, vitamins, and minerals, and are an important source of food for millions of people. Millets are also known for their low water requirements, high drought tolerance, and ability to grow on marginal lands, making them an ideal crop for smallholder farmers in resource-poor regions. However, millets face several challenges that limit their productivity and yield potential. These challenges include biotic stresses, such as pests and diseases, as well as abiotic stresses, such as drought, heat, and soil salinity. In recent years, several genetic improvement and novel breeding technologies have been developed to address these challenges and enhance the food security of millets (Sunil et al., 2022).

One of the key genetic improvements in millets has been the development of high-yielding and stress-tolerant varieties through conventional breeding and marker-assisted selection. For instance, several improved varieties of pearl millet have been developed in India and Africa that offer higher yields, better disease resistance, and improved grain quality. Similarly, the development of stress-tolerant varieties of finger millet and foxtail millet has led to increased production and enhanced food security in several regions of the world (Sharma et al., 2021). Another important genetic improvement in millets is the use of genetic engineering and genome editing technologies to introduce desirable traits, such as insect resistance, disease resistance, and improved nutrient content. Researchers have used gene editing techniques to develop millet varieties that are resistant to downy mildew, a common fungal disease that affects pearl millet (Tara Satyavathi et al., 2021). Similarly, transgenic pearl millet varieties that express a gene from Bacillus thuringiensis (Bt) have been developed to provide resistance against stem borers, a major pest that causes significant yield losses. In addition to genetic improvements, several novel millet varieties and products have been developed to enhance food security (Bengyella et al., 2021). One example is the development of dual-purpose millet varieties that can be used for both grain and fodder production (ICMV 167005 and ICMV 167006). These varieties have been successfully developed and implemented in several regions of India, including Karnataka, Maharashtra, and Tamil Nadu (Tonapi et al., 2022). This variety offers higher biomass production, improved soil fertility, and enhanced animal productivity, thereby contributing to overall food security. Another successful example of a scientific novelty in millets is the use of gene editing techniques to develop millet varieties that are resistant to pests and diseases. For example, researchers used CRISPR-Cas9 gene editing to develop a pearl millet variety that is resistant to downy mildew, a common fungal disease that affects pearl millet. This variety showed a significant reduction in disease severity compared to the non-edited control plants. In addition, the development of millet-based food products has been successful in enhancing food security (Ceasar, 2022). Similarly, several millet-based snacks and breakfast cereals have been developed and successfully marketed in India, offering a nutritious and affordable alternative to traditional wheat-based products. Genetics plays a crucial role in the development of improved and novel millet varieties that enhance food security. Through genetic markers, genetic engineering techniques, and breeding strategies, desirable traits such as stress tolerance, disease resistance, and improved nutrient content can be introduced into millet varieties, improving their adaptability to challenging environmental conditions and their nutritional quality (Mbinda and Masaki, 2021). Genetic markers are powerful tools for identifying and selecting for specific traits, while genetic engineering techniques like CRISPR-Cas9 allow for targeted editing of specific genes in plant genomes. Genetics has the potential to contribute significantly to the production of more resilient and nutritious millet crops (Deb et al., 2022).

Genetic improvements and novelties in millets have the potential to enhance food security, improve agricultural sustainability, and provide healthy and sustainable food options. Advances in gene editing technologies and genomic research will enable faster and more precise breeding programs. Millets' resilience to harsh growing conditions also makes them a promising crop for climate-resilient agriculture. As such, the future prospects for genetic improvements and novelties in millets are bright, with the potential to make significant contributions to global food systems.

References

1. Sunil, C. K., Rawson, A., & Anandharamakrishnan, C. (2022). Millets: An Overview. *Handbook of Millets-Processing, Quality, and Nutrition Status*, 1-21.
2. Sharma, S., Sharma, R., Govindaraj, M., Mahala, R. S., Satyavathi, C. T., Srivastava, R. K., ... & Kilian, B. (2021). Harnessing wild relatives of pearl millet for germplasm enhancement: Challenges and opportunities. *Crop Science*, *61*(1), 177-200.
3. Munaweera, T. I. K., Jayawardana, N. U., Rajaratnam, R., & Dissanayake, N. (2022). Modern plant biotechnology as a strategy in addressing climate change and attaining food security. *Agriculture & Food Security*, *11*(1), 1-28.
4. Tara Satyavathi, C., Ambawat, S., Singh, S., Lata, C., Tiwari, S., & Siddaiah, C. N. (2021). Genomic Designing for Biotic Stress Resistance in Pearl Millet [Pennisetum glaucum (L.) R. Br.]. *Genomic Designing for Biotic Stress Resistant Cereal Crops*, 257-294.
5. Bengyella, L., Hetsa, B. A., Fonmboh, D. J., & Jose, R. C. (2021). Assessment of damage caused by evolved fall armyworm on native and transgenic maize in South Africa. *Phytoparasitica*, *49*, 1-12.
6. Tonapi, V. A., Ganapathy, K. N., Hariprasanna, K., Bhat, B. V., Amasiddha, B., Avinash, S., & Deepika, C. (2022). Small Millets Breeding. In *Fundamentals of Field Crop Breeding* (pp. 449-497). Singapore: Springer Nature Singapore.
7. Ceasar, A. (2022). Genome-editing in millets: current knowledge and future perspectives. *Molecular Biology Reports*, *49*(1), 773-781.
8. Mbinda, W., & Masaki, H. (2021). Breeding strategies and challenges in the improvement of blast disease resistance in finger millet. A current review. *Frontiers in Plant Science*, *11*, 602882.
9. Deb, S., Choudhury, A., Kharbyngar, B., & Satyawada, R. R. (2022). Applications of CRISPR/Cas9 technology for modification of the plant genome. *Genetica*, 1-12.

E-ISSN: 2581 - 8317

Role of Composting in Organic Farming

Article ID: 40803

Vaishali H. Surve[1], Pintu Sankhla[2], A. D. Raj[3]
[3]Associate Professor and [1] and [2]Assistant Professor, College of Agriculture, NAU, Bharuch.

Composting - An Overview

Composting is the natural process of 'rotting' or decomposition of organic matter by microorganisms under controlled conditions. Raw organic materials such as crop residues, animal wastes, food garbage, some municipal wastes and suitable industrial wastes, enhance their suitability for application to the soil as a fertilizing resource, after having undergone composting.

Composting is essentially a microbiological decomposition of organic residues collected from rural area (rural compost) or urban area (urban compost.

Principles of Composting

1. Narrowing down of the carbon: nitrogen ratio to a satisfactory level.
2. Total destruction of harmful pathogen and weed seeds ensured by high temperature evolved during decomposition and stabilization.
3. At the optimum temperature of 60-65 degree Celsius required for decomposing all harmful pathogen are destroyed.

Technique of Composting

Cold Composting:

a. Cold composting is one of the easiest forms of composting.
b. Many beneficial nutrients in cold compost remain uncompromised by high temperatures.
c. The process is slower.
d. Once established, the cold composting bins will provide you with a continuous supply of lawn and **garden** food.

Hot composting:

a. A hot pile requires enough high-nitrogen materials to get the pile to heat up.
b. Microbial activity within the compost pile is at its optimum level, which results in finished compost in a much shorter period of time.
c. It requires some special equipment, as well as time and diligence.
d. Temperatures rising in a hot-compost pile come from the activity of numerous organisms breaking down organic matter.

Material Required for Composting

1. Farm refuse:

a. Weeds
b. Stubbles
c. Crop residues
d. Remnants of fodder.

2. Animal dung:

a. Cow dung
b. Buffalo dung
c. Poultry dung.

3. Town refuse:

a. Night soil
b. Street refuse
c. Municipal fuse.

Types of Composting

Aerobic composting:

a. This means to compost with air.
b. Organic waste will break down quickly and is not prone to smell.
c. This type of composting is high maintenance, since it will need to be turned every couple day to keep air in the system and your temperatures up.
d. It is also likely to require accurate moisture monitoring
e. This type of compost is good for large volumes of compost.

Anaerobic composting:

a. This is composting without air.
b. Anaerobic composting is low maintenance since you simply throw it in a pile and wait a couple years.
c. Compost may take years to break down.
d. Anaerobic composts create the awful smell most people associate with composting.
e. The bacteria break down the organic materials into harmful compounds like ammonia and methane.

Method of Composting

In Coimbatore method, composting is done in pits of different sizes depending on the waste material available. A layer of waste materials is first laid in the pit. It is moistened with a suspension of 5-10 kg cow dung in 2.5 to 5.0 I of water and 0.5 to 1.0 kg fine bone meal sprinkled over it uniformly. Similar layers are laid one over the other till the material rises 0.75 m above the ground level. It is finally plastered with wet mud and left undisturbed for 8 to 10 weeks. Plaster is then removed, material moistened with water, given a turning and made into a rectangular heap under a shade. It is left undisturbed till its use.

Indore Method: In the Indore method of composting, organic wastes are spread in the cattle shed to serve as bedding. Urine-soaked material along with dung is removed every day and formed into a layer of about 15 cm thick at suitable sites. Urine-soaked earth, scraped from cattle sheds is mixed with water and sprinkled over the layer of wastes twice or thrice a day. Layering process continued for about a fortnight. A thin layer of well decomposed compost is sprinkled over top and the heap given a turning and reformed. Old compost acts as inoculum for decomposing the material. The heap is left undisturbed for about a month.

Bangalore method of composting, dry waste material of 25 cm thick is spread in a pit and a thick suspension of cow dung in water is sprinkled over for moistening. A thin layer of dry waste is laid over the moistened layer. The pit is filled alternately with dry layers of material and cow dung suspension till it rises 0.5 m above ground level. It is left exposed without covering for 15 days. It is given a turning, plastered with wet mud and left undisturbed for about 5 months or till require thoroughly moistened and given a turning. The compost is ready for application in another month.

Nadep Method:

a. This method of making compost involved the construction of a simple, rectangular brick tank with enough spaces maintained between the bricks for necessary aeration. The recommended size of the tank is 10 ft(length), 5 ft(breadth), 3 ft(height). All the four walls of NADEP tank are provided with 6 vents by removing every alternate brick after the height of 1 ft from bottom for aeration. Tank can be constructed in mud mortar or cement mortar.

Method of Filling Tank

1. Slurry made of cow dung and water should be sprinkled on the floor and the walls of tank. The filling of tank follows these step
2. FIRST LAYER
3. Vegetable residue are spread evenely in layer up to 6 inches (5 to 100 kg) in tank.
4. SECOND LAYER
4. 4 to 5 kg Cattle dung of gobber gas- slurry in 70 litres of water should be apply on the first layer
5. THIRD LAYER
6. 50 to 60 kg sieved soil added on the second layer of tank.
7. In this way, the tank is filled layer by layer up to 1.5 feet above the bricks level of taank.
6. Filled tank should be covered and sealed by 3 inch layer of soil (300 to 400 kg)

7. It should also be pasted with a mixture of dung and soil.

Advantages of Composting

1. Volume reduction of waste.
2. Final weight of compost is very less.
3. Composting temperature kill pathogen, weed seeds and seeds.
4. Matured compost comes into equilibrium with the soil.
5. During composting number of wastes from several sources are blended together.
6. Excellent soil conditioner
7. Saleable product Improves manure handling
8. Reduces the risk of pollution
9. Pathogen reduction
10. Additional revenue.
11. Suppress plant diseases and pests.
12. Reduce or eliminate the need for chemical fertilizers.
13. Promote higher yields of agricultural crops.

Disadvantages of Composting

Agricultural use of composts remains low for several reasons:

1. The product is weighty and bulky, making it expensive to transport.
2. The nutrient value of compost is low compared with that of chemical fertilizers, and the rate of nutrient release is slow so that it cannot usually meet the nutrient requirement of crops in a short time, thus resulting in some nutrient deficiency
3. The nutrient composition of compost is highly variable compared to chemical fertilizers.
4. Agricultural users might have concerns regarding potential levels of heavy metals and other possible contaminants in compost, particularly mixed municipal solid wastes. The potential for contamination becomes an important issue when compost is used on food crops.
5. Long-term and/or heavy application of composts to agricultural soils has been found to result in salt, nutrient, or heavy metal accumulation and may adversely affect plant growth, soil organisms, water quality, and animal and human health.

E-ISSN: 2581 - 8317

Seed Storage Techniques in India

Article ID: 40804

Digamber[1], Rahul Kumar[2], Gagandeep Singh[3]
[1]Technical Assistant, Chaudhary Charan Singh Haryana Agricultural University, Hisar.
[2,3]Ph.D. Scholar, Chaudhary Charan Singh Haryana Agricultural University, Hisar.

Seed storage may be defined as the preservation of viable seed from the time of collection until they are required for sowing. Seeds should be stored in such a manner, that its germination capacity and vigour should not decline.

Importance

1. To preserve seeds finer conditions that best retain germinative energy during the interval between collection and time of sowing.
2. To protect seeds from damage by rodents, birds, and insects.
3. To preserve qualities of seeds collected during a year of heavy seed crops to furnish a supply during years of little or no crop.

Principles

1. Seed storage conditions should be dry and cool
2. Effective storage pest control
3. Proper sanitation in seed stores
4. Before placing seeds into storage, they should be dried to safe moisture limits.
5. Storing of high-quality seed only i.e., well cleaned treated as well as high germination and vigour.

Purpose

The purpose of seed storage is to maintain the seed in good physical and physiological condition from the time they are harvested until the time they are planted. It is important to get adequate plant stands in addition to healthy and vigorous plants.

Objectives

To maintain initial seed quality viz., germination, physical purity, vigour etc., all along the storage period by providing suitable or even better conditions.

Different Stages of Seeds Storage

The storage of seeds is initiated at the time of attainment of physiological maturity and maintained till the next sowing season. Hence, the different stages involved in seed storage are as follows:
1. Period from physiological maturity to harvest
2. Period from harvest to packaging
3. Period from packaging to storing
4. Period from storing to marketing of seeds.
5. On farm storage (Purchased seeds used for planting in the field). Storage in the godown is highly influenced by external environmental conditions. All other stages should be monitored, and care should be taken to ensure the physical purity, germination viability and vigour of the seeds.

Steps in Seed Storage

The major steps involved in seed storage are:
1. Store only new, mature, healthy and well-dried seeds.
2. Keep them in dry and cool place to extend their viability.
3. Seeds easily re-absorb moisture. To maintain dryness, keep seeds in air-tight containers like tin cans or glass jars with tight fitting lids.

4. Put in some moisture absorbing material. Dry wood ash, dry charcoal, powdered milk, toasted (cooled) rice, or small pieces of newspaper are all good. The drying material should take up about one-fourth of the container space.
5. Label the containers with the type of seed, place, and date of collection.
6. If possible, include the initial percent viability of the seeds. To do this, plant some seed to see how many germinate. If 8 of 10 germinate, for example, percent viability is 80%. This information will help you to learn about how much each type of seed loses viability between collection and planting.
7. Protect seeds from insects and fungi. Before storing in containers, mix with dry ash, powdered seeds of black pepper or neem leave. Or use extract of neem, peanut, castor bean, or cotton: 1 teaspoon oil/1 kg seed or use naphthalene balls: 1 or 2 pieces/10 kg seed.
8. Protect from rodents and birds during storage.

Factors Affecting Storage

1. Biotic factors

a. Factors related to seed

i. Genetic make-up of seed
ii. Initial seed quality
iii. Provenance
iv. Seed moisture content.

b. Other biotic factors

i. Insects Fungi
ii. Rodents
iii. Mishandling during sampling, testing.

2. Abiotic factors:

a. Temperature
b. Relative humidity
c. Seed store sanitation
d. Gaseous atmosphere
e. Packaging material
f. Seed treatment.

Biotic Factors

1. Seed type and variety: The types and variety of seeds have a big impact on seed storage. Some seeds have a short storage life (e.g., groundnut, soyabean), others have a medium storage life (e.g., wheat, cotton), while still others, such as rice and beans can be stored for a long time.

2. Moisture content of seeds: It is the most important factor influences the storability. The amount of moisture in the seeds is the most important factor influencing seed viability during storage. Generally, if the seed moisture content increases storage life decreases. If seeds are kept at high moisture content the losses could be very rapid due to mould growth very low moisture content may also damage seeds due to extreme desiccation or in some crops. According to Harringtom's thumb rule, a 1% decrease in seed moisture content doubles the potential of the seed. This rule is applicable only at a moisture range of 5-14%, because moisture level below 5% causes physiochemical changes in the seeds, whereas above 14% it is prone to insect and mold attack. The safe moisture content depends on the storage period, type of storage structure, variety of seeds and type of packaging materials used. The safe moisture levels of some seeds are as follows:

Crop	Maximum moisture content
Millets	12%
Paddy	13%
Cowpea	9%
Pulses	9%
Maize and sorghum	12%

3. Activity of insects and other microorganisms: Bacteria, fungi, mites, insects, rodents and birds may affect the seeds in storage. Bacteria do not show any significant effect on the stored seeds, since it needs water for its proliferation. Storage fungi like aspergillus and penicillium infect the seeds and produce mycotoxins that will deteriorate the seed quality. Insects and mites cause severe damage especially in warm and humid conditions. Birds and rodents cause huge loss of seeds during storage period.

External Factors

1. Temperature: Temperature also plays an important role in life of seed. Insects and moulds increase as temperature increases. The higher the moisture content of the seeds the more they are adversely affected by temperature. Decreasing temperature and seed moisture is an effective means of maintaining seed quality in storage.

2. Relative humidity (RH): Seeds are naturally hygroscopic hence they attain specific moisture content when subjected to a given level of atmospheric humidity at a particular temperature. This is called moisture equilibrium content. At equilibrium moisture content there is no net gain or loss in seed moisture content. Seeds should be stored in a dry, cool environment to maintain their quality while in storage. Equilibrium moisture content for a particular kind of seed at a given Relative Humidity tends to increase as temperature decreases. Thus, the maintenance of seed moisture content during storage is a function of relative humidity and to a lesser extent of temperature.

3. Gas during storage: Increase in O_2 pressure decrease the period of viability. N_2 and CO_2 atmosphere will increase the storage life of seeds.

Classification of Seeds

Based on storage seeds can be categorized into three types based on the longevity of the seeds during storage

1. Orthodox seeds: Seeds that can be dried, without damage to low moisture contents (5 – 10%). They can be stored at subfreezing temperature 2 to 5 OC. Their longevity increases with reductions in both moisture content and temperature. Eg. Rice, Maize etc.

2. Intermediate seeds: These seeds can also be stored for longer period, but it cannot withstand low temperature. It tolerates the drying to low moisture level.Tolerate desiccation to about 10-12 % moisture content. Eg.Legumes, Papaya,Citrus etc.

3. Recalcitrant seeds: These seeds do not survive drying to any large degree and are thus not amenable to long term storage. Recalcitrant seeds killed by desiccation to 15-20% moisture content. e.g., Mango, Jack etc.

Storage Godowns & their Maintenance

Seeds undergo deterioration due to aging in storage. This is accelerated by climatic factors and external biotic factors like insects and pathogen. Clean and hygienic godowns protect the seed from external insects and preserve the seed. Hence care should be taken in construction of godown.

Selection of Storage Godown

For loading and unloading operations, the storage area should be freely accessible. The seed moisture content must be maintained; hence the storage environment must be reasonably moisture proof. It is necessary to keep the godown clean and dry. Termite and rodent proof storage should be provided. There should be no fractures or holes in the storage godown's wall or floor.

Spraying a neem oil solution using 200 ml of neem oil and 2 litres of water will eliminate the infestation. It is recommended for a single 200-square-feet storage space. After spraying neem oil solution, the rooms can be fumigated with the powder of sweet flag rhizome (Acorus calamus). Before stacking the seeds or grains, the storage godowns or rooms and storage structures or receptacle should be cleaned and made free from insects.

Seed Storage Structures

1. For good seed storage, always use sealed containers
2. After seed has been dried properly, store it in tin cans, metal boxes, glass jars, or plastic bags or container with lids that can be sealed.

Points to Remember when Using Sealed Containers

1. Never seal in moist seed
2. Use airtight containers
3. Make sure that the container is clean
4. Open the seed containers only when necessary.

Seed storage is an important process in maintaining the viability and vigour of the seeds during storage period. Different storage structures are available based on the duration of the seed storage. Storage structures can be classified into indigenous structures and modern structures.

Indigenous Methods/ Structures

1. Gourd casing
2. Kuthir
3. Kodambae
4. Thombarai
5. Earthen pots
6. Mara thombai
7. Kalangiyam
8. Puri
9. Gunny bag

Modern Storage Structures

1. Pusa bin: It is constructed from unburned brick. To make it airtight, a polyethylene sheet is inserted between two brick walls. For loading and unloading, the inlet is at the top of the bin, and the outlet is at the bottom. To prevent rat damage, bins are made of a few layers of burnt bricks plastered with cement at the bottom.

2. Storage in metal drums: Metal drums are used by farmers to store sorghum, maize, millets, and groundnuts. The drum's capacity is 600 kg, and it should be clean and dry before being stored. A funnel is used to load the drum with seeds, which are then snugly sealed with a cap. Seeds can be secured from rodents, and the drums can be readily fumigated to keep pests away from the seeds.

3. Pucca kothi: It's an indoor building made from charred bricks and cement. It is built on an elevated floor, and after embedding the polythene sheet, the walls should be plastered to make it airtight. The structure's inlet is at the top and its outflow is at the bottom. For wall reinforcement, the inner layer should be reinforced with iron bars. This structure is utilised to keep the stored product's moisture level at the same level as when it was first stored. The capacity of rural houses varies depending on the amount of space available.

4. Gharelu thekka: This structure has a storage capacity of 1 to 3 metric tonnes. Metal base with fabricated 22-gauge sheets, rubberized cloth container, and bamboo poles for lateral support make up the structure. The construction stands at a height of 2 metres. The building is waterproof and airtight, and it may be fumigated on a regular basis.

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

Plant Growth Hormone: Discovery and Physiological Effects of Plant Growth Hormone

Article ID: 40805

Khangembam Memchoubi[1], Yumnam Sanatombi Devi[1]
[1]Department of Agronomy, South Asian Institute Of Rural And Agricultural Management (Sairam), Langjing Achouba , 795140.

Importance

Growth hormone are natural compound that are available within the plant at lesser concentration to inhibit their biological process. The phytohormone was the term introduced by Thimann in the year 1948. Phytohormone are plant hormone to regulate their growth.Plant hormone is named as phytohormone . Plant Growth Regulator (PGR) is regared as natural or synthetic compund which means it is found naturally in plants or it can be applied to plants respectively to inhibit or promote the growth and development. PGR are classified into 2 groups – AUXIN, GIBBERELLIN (GA), CYTOKININ are growth promoter and ETHYLENE & ABSCISIC ACID (ABA) are growth inhibitors.

Discovery of Plant Growth Hormone

F.W Went, a Dutch biologist discovered the existence of Auxin. Auxin was isolated by him from tips of coleoptiles of oat seedling. Auxin were the first growth hormone to be identified in plants. Ethylene was the first gaseous hormone that was determined in plants.

Physiological Effects of Plant Growth Hormone

1. Auxin: Auxin are plant hormone that helps to promote the stem elongation. Indole acetic acid (IAA) is a naturally occuring auxin in plant while 2,4-D (2,4 –dichlorophenoxyacetic) and NAA (naphthalene acetic acid) are synthetic auxin. The growing of apical bud obstructs the growth of axillary bud is considered as Apical dominance. Auxin helps in cell elongation and helps in prevention of abscission. It induces parthenocarpy. It promotes flowering. It is used for weed control. Eg: 2,4-D.

2. Gibberellins: Gibberellin promote shoot growth and developmental processes. It prevents senescence and breaking dormancy. Rosette plants show a bolting effect when treated with gibberellins. When gibberellin is sprayed to sugarcane plant the length of the stem increase, thus increase the sucrose yield.

3. Cytokinins: Cytokinin helps in breaking dormancy, promote the seed germination. The two-adenine type cytokinins are Kinetin and Zeatin.Kinetin is synthetic cytokinin which is a modified form of adenine, purine while Zeatin is a naturally occuring cytokinin. Cytokinin is most synthesis in root and promote cell deferentiation of root and shoots.

4. Ethylene: Ethylene was the first gaseous hormone to be identified in plant. Ethylene is considered to be most important effect on fruit ripening. Thus, promotes senescence and abscission on leaves and flower. It is most widely used hormone in agriculture that regulates biologcal process. Ethephon is the chemical which release ethylene as it promotes femaleness in cucumber. Ethylene also helps in acquiring yellow colour of citrus and bananas, thereby increase in marketability.

5. Abscisic Acid: Abscisic acid regulates biotic and abiotic stress responses within the plants. It is the common growth inhibitor. It reduces transpiration by closing stomata in epidermis under water stress condition, therefore it is called stress hormone. It caused seed dormancy, and inhibit their germination.

Objectives

Depending upon plant growth hormone, it can inhibit growth in plant or promote their growth. eg ABA or AUXIN respectively. Growth hormone control seed dormacy by hindering growth process Growth is undetermined in higher plants. Plant hormone made naturally within plant which is required to control growth. 2,4-D and NAA (naphthalene acetic acid are broadly used in agriculture.

References

1. Yu Hua Wang and Helen Irving. Developing a model of plant hormone intearaction, 6(4): 494 – 500
2. Meyer BS, Anderson DB. Plant Physiology. 2nd ed. Canada: D.Van Nostrand Company , Ltd ; 1952 . Pp 709 -715
3. Kim GT, Tsukaya H. Regulation of the biosynthesis of plant hormone by cytochrome P450s J Plant Tes. 2002; 115: 169- 177.

Promising Technologies in Plant Genetic and Breeding: A Roadmap to Sustainable Agriculture

Article ID: 40806

Naveen Sihag[1]
[1]Department of Genetics and Plant Breeding, COA, CCS Haryana Agricultural University, Hisar.

Plant genetic and breeding technologies have rapidly advanced in recent years, with the development of novel techniques that allow breeders to precisely modify and select for desirable traits in plants. These advancements have resulted in the creation of new varieties with improved disease resistance, drought tolerance, and increased yield. In this context, this response outlines some of the most promising novel technologies in plant genetic and breeding, including CRISPR-Cas9, RNA interference, marker-assisted selection, and genomic selection (Hasan et al., 2021). These technologies hold tremendous potential for meeting the growing global demand for food and developing sustainable agriculture practices.

Plant genetic and breeding technologies allowed breeders to develop new varieties with improved traits such as disease resistance, drought tolerance, and enhanced yield. One of the most novel technologies is CRISPR-Cas9, a gene editing technology that uses a sequence-specific RNA molecule to guide the Cas9 enzyme to a specific location in the plant's DNA, where it can precisely modify or insert new genetic material. This technology has been used to improve resistance to pests, increase nutritional value, and enhance yield in crops (Bao et al., 2019). Marker-assisted selection (MAS) is another technology that uses molecular markers to identify plants with desirable traits and selectively breed them to create new varieties. Genomic selection (GS) takes this approach further by using genome-wide markers to predict the performance of different plant varieties, allowing breeders to select the best candidates for further breeding. RNA interference (RNAi) is a gene silencing technology that allows breeders to selectively turn off genes responsible for undesirable traits in plants, such as susceptibility to disease or poor yield (Simko et al., 2021; Hasan et al., 2021). High-throughput sequencing (HTS) is another technology that allows for rapid sequencing of plant genomes, enabling breeders to identify key genes and genetic markers associated with desirable traits. Synthetic biology is a field that combines genetics, engineering, and computer science to design and construct new biological systems and organisms with specific traits. This technology can be used to create new plant varieties with enhanced photosynthesis or resistance to drought (Ke et al., 2021). Metabolic engineering is another technology that enables breeders to manipulate the metabolic pathways of plants to produce desired products, such as biofuels or pharmaceuticals. Transgenic technology involves inserting genes from one organism into another to create new varieties with specific traits, such as herbicide resistance or increased nutritional value. Overall, these novel technologies offer exciting opportunities for plant genetic and breeding research, enabling breeders to create new plant varieties with improved traits to help meet the challenges of global food security and sustainability (Arya et al., 2020). The novel technologies in plant genetic and breeding have both advantages and limitations that need to be considered in their application. CRISPR-Cas9 and other gene editing technologies offer precise and targeted modification of plant genomes, allowing for the creation of new plant varieties with specific traits such as resistance to pests or increased yield. Similarly, marker-assisted and genomic selection techniques allow breeders to select for desirable traits with increased accuracy and efficiency. These technologies can also accelerate the development of new crop varieties, leading to a more sustainable and resilient agricultural system. One of the most promising technologies, CRISPR-Cas9, has been used to create wheat and tomato varieties that are resistant to fungal diseases, improving yield and reducing crop losses. Marker-assisted and genomic selection techniques have been successful in the breeding of soybean and maize varieties with enhanced yield, pest resistance, and improved nutritional content (Tyagi et al., 2021). Similarly, RNA interference has been used to develop potato varieties that are resistant to devastating fungal diseases, while transgenic technology has led to the creation of cotton varieties with resistance to bollworm pests, increasing cotton yields in some regions. These technologies not only improve plant health and productivity but also have the potential to reduce the use of harmful pesticides and herbicides, leading to more sustainable agricultural practices (Kuo et al., 2020). On the other hand, some concerns exist regarding the potential risks of these technologies. For example, some critics worry that CRISPR-Cas9 and other gene editing tools may have unintended and unpredictable effects on the environment and human health. In addition, the use of synthetic biology to create new plant varieties could lead to the accidental release of genetically modified organisms into the ecosystem, with unknown consequences. Moreover, the high cost of some of these technologies could limit their widespread use, particularly in developing countries, where access to technology and resources is often limited (Shinwari et al., 2018; Gómez-Tatay and Hernández-Andreu, 2019).

In conclusion, novel technologies in plant genetic and breeding have the potential to revolutionize agriculture by addressing the global challenges of food security, sustainability, and climate change. However, it is essential to carefully consider the benefits and limitations of these technologies and ensure their safe and ethical use. By harnessing the power of these technologies, researchers and breeders can develop new plant varieties with improved traits, leading to a more resilient and sustainable agricultural system that can meet the growing demand for food in the face of environmental pressures.

References

1. Hasan, N., Choudhary, S., Naaz, N., Sharma, N., & Laskar, R. A. (2021). Recent advancements in molecular marker-assisted selection and applications in plant breeding programmes. *Journal of Genetic Engineering and Biotechnology*, *19*(1), 1-26.
2. Bao, A., Burritt, D. J., Chen, H., Zhou, X., Cao, D., & Tran, L. S. P. (2019). The CRISPR/Cas9 system and its applications in crop genome editing. *Critical reviews in biotechnology*, *39*(3), 321-336.
3. Simko, I., Jia, M., Venkatesh, J., Kang, B. C., Weng, Y., Barcaccia, G., ... & Foolad, M. R. (2021). Genomics and marker-assisted improvement of vegetable crops. *Critical Reviews in Plant Sciences*, *40*(4), 303-365.
4. Ke, J., Wang, B., & Yoshikuni, Y. (2021). Microbiome engineering: synthetic biology of plant-associated microbiomes in sustainable agriculture. *Trends in Biotechnology*, *39*(3), 244-261.
5. Arya, S. S., Rookes, J. E., Cahill, D. M., & Lenka, S. K. (2020). Next-generation metabolic engineering approaches towards development of plant cell suspension cultures as specialized metabolite producing biofactories. *Biotechnology Advances*, *45*, 107635.
6. Tyagi, S., Kumar, R., Kumar, V., Won, S. Y., & Shukla, P. (2021). Engineering disease resistant plants through CRISPR-Cas9 technology. *GM Crops & Food*, *12*(1), 125-144.
7. Kuo, Y. W., & Falk, B. W. (2020). RNA interference approaches for plant disease control. *BioTechniques*, *69*(6), 469-477.
8. Shinwari, Z. K., Tanveer, F., & Khalil, A. T. (2018). Ethical issues regarding CRISPR mediated genome editing. *Current Issues in Molecular Biology*, *26*(1), 103-110.
9. Gómez-Tatay, L., & Hernández-Andreu, J. M. (2019). Biosafety and biosecurity in synthetic biology: a review. *Critical Reviews in Environmental Science and Technology*, *49*(17), 1587-1621.

Vegetable Nursery

Article ID: 40807

B Ashwin Kumar[1], K Nirosha[1]
[1]Assistant Professor, College of Horticulture, SKLTSHU, Rajendranagar, Hyderabad, Telangana State.

A nursery is a place, where seedling and other plant materials are grown and maintained until they are placed in a permanent place.

Importance of Nursery

The young plants can be easily maintained in the nursery. Similarly, it is easy to look after the young and tender seedlings in the nursery rather than in the field. Propagation of plants by asexual means require special skill and care of plants before transplanting in the field, which can be easily done in nursery. Many plants do not respond to direct sowing (Cabbage, Tomato, and Brinjal *etc.*,) in the field as compared to transplanting of seedling raised in the nursery. Cuttings of different horticultural plants for rooting are first planted in the nursery for better care and management. For hardening of seedlings/grafts/layers, nursery is a pre-treatment place. Seasoning of the seedlings against natural calamities is only possible in the nursery.

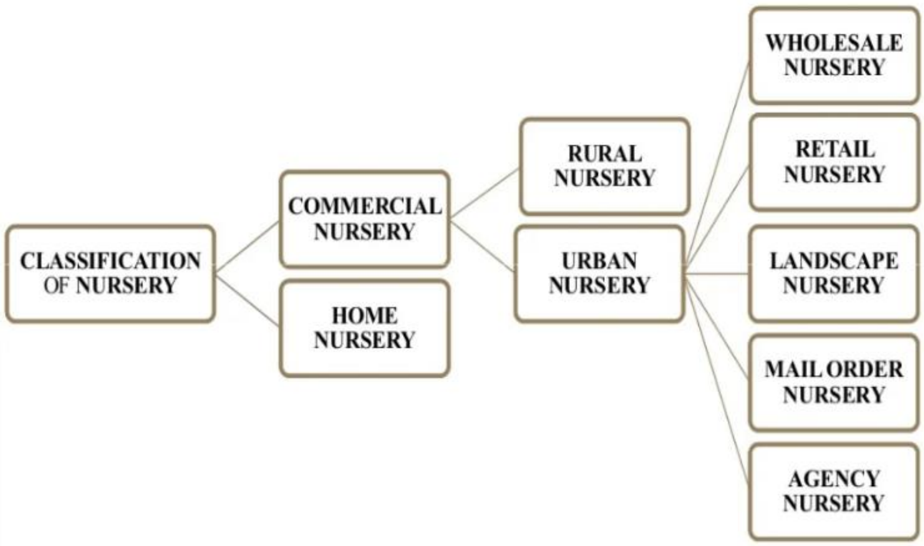
Pre- Requisites for Establishment of a Nursery

1. Nursery should be located in the important production areas.
2. The site should not be shady, water logging, congenial for pest and disease incidence and must be well protected from hot winds and stray animals.
3. The soil should be deep. Fertile, well drained and free from soil borne pathogens.
4. The locality should have adequate supply of irrigation.
5. Climatic conditions should be favorable for the plants to be propagated.
6. The site should be well connected by different means of communication and must be easily accessible.
7. Sufficient labor, budder and grafters should be available to handle different operations.
8. The materials like fertilizers, pesticides, growth regulators, grafting wax, lanolin paste and equipments, *etc.* should be readily available.
9. There should be sufficient provision for different propagation structures like Green house, polyhouse, glasshouse, lath house *etc.*
10. The nursery should have its own resources to provide parent material (mother plants) for propagation.

Advantages of Nursery

1. Uniform, Vigorous and healthy planting materials can be raised for better growth, development and yield.
2. Economy of seed rate which cut down the cost of cultivation particularly for hybrids.
3. Seedlings can raise in off- season vegetable forcing.
4. Favorable growing conditions can be provided to the seedlings in nursery bed through convenient protection against biotic and abiotic stresses.
5. Efficient time management for the preparation of main field.
6. Improvement in land use efficiency by increasing the cropping intensity.
7. Facilities for intercropping and relay cropping
8. Easy adjustment of date of planting according to pest and disease vulnerability and market demand.
9. Maintenance of desired plant density in field.
10. Efficient management of weed, pest and diseases.

Classification of a Nursery



Types of nursery beds


1. Raised nursery beds


2. Flat nursery beds


3. Sunken nursery beds


Growing media for raising seedlings
Soil media
Soil less media
Mixture of both
Coco peat
Perlite
Vermiculite

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

Space Farming

Article ID: 40808

Srivijay S Malipatil[1], Sadashiva Tippimath[2]
[1]Department of Genetics and Plant Breeding (Ph. D Scholar), Keladi Shivapppa Nayaka University of Agricultural and Horticultural Science, Navile, Shivamogga. 577204.
[2]Department of Entomology (Ph. D Scholar), Keladi Shivapppa Nayaka University of Agricultural and Horticultural Science, Navile, Shivamogga. 577204.

Introduction

Space Farming is a cutting-edge science that combines astronautics with agricultural sciences, aiming to grow plants in space at an altitude of approximately 200–450 km above sea level. Space, also known as outer space, is the near-vacuum between celestial bodies. This is where all the planets, stars, galaxies and other objects are found. Extreme temperatures are seen from 2.6 Kelvin to 5.5 trillion Kelvin (Stankovic B, 2001).

A space station, also known as an orbital station or an orbital space station, is a spacecraft capable of supporting a human crew in orbit for an extended period and is therefore a type of space habitat where they live and grow plants for research and food purpose (Anonymous, 2023). There are three types of space stations:

1. Mir: Operated by the Soviet Union and later by Russia. Mir was the first modular space station and was assembled in orbit from 1986 to 1996. Mir was at an altitude of 354 km and total mass of 129,700 kg.

2. ISS (International Space Station): Collaborative project involving five participating space agencies: NASA (United States), Ros cosmos (Russia), JAXA (Japan), ESA (Europe), and CSA (Canada). Launched on 20 November 1998, it took 10 years and 30 missions to complete the whole model. ISS is at an altitude of 418 km and total mass of 419,725 kg. Length of 73.0 m and width of 109.0 m. The number of orbits per day is 15.54 (Fig 1&2).

3. Tiangong space station: Chinese large modular space station is a space station placed in low Earth orbit between 340–450 km. Launched on 29 April 2021 with and total mass of 100,000 kg.

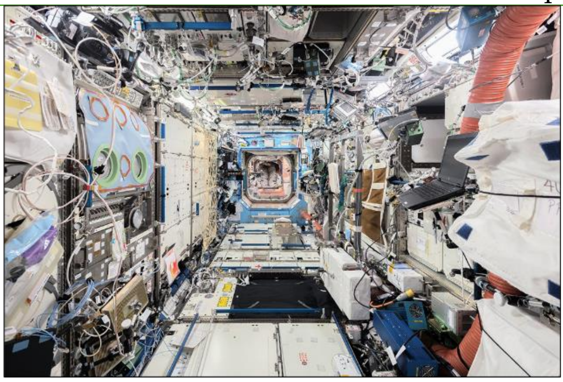


Fig 1: Inside view of ISS

Fig 2: ISS with the blue background of earth

Space farming is a combination of astronautics and agriculture for the cultivation of crops for food and other materials in space or on off-Earth celestial objects. In outer space, plants are typically grown in microgravity (weightlessness). Plants will play a critical life-supporting role in the survival of human beings on long-duration space missions, probably beginning pretty soon with a mission to Mars.

Several early investigations in plant space biology led to morphological and physiological modifications that showed up as cellular and phenotypic aberrations, chromosome breakage, inability to form seed, altered or nonviable embryos, changes to the content and characteristics of cell walls, an increase in the breakdown of xyloglucans, adjustments to polar auxin transport, or other morphological abnormalities are a few examples (Wolff *et al.*, 2014 and Soga *et al.*, 2002).

The first seeds launched into space and successfully recovered were "ordinary corn seeds", launched on July 30, 1946 (Morrow, 2014). The first example of seed-to-seed-to-seed (i.e., two consecutive life cycles) of a plant (*Arabidopsis thaliana*) in space was completed in 2000-2001 (Link *et al.*, 2014). The first flower in space was 13 petaled zinnia on January 20, 2016. The first fruit to be grown on ISS was *Capsicum annuum* in 2019.

Need for Plants in Space

1. Food: Space food is highly engineered, thermostabilized, and irradiated with intermediate moisture. Space food quality deteriorates over time, so growing plants in space will solve this problem. Every 90 days food is sent to ISS for astronauts. The first plant grown and eaten in space was Red Romaine lettuce on 10 August 2015 by Expedition 44 crewmembers Scott Kelly, Kjell Lindgren and Kimiya Yui (Stankovic *et al.*, 2018).

2. Mental well-being: Plants generally act as a form of emotional sustenance sometime called Plant therapy or horticultural therapy. Including human well-being, social development, health support, overcoming boredom and mental fatigue, and stress reduction and recovery. Fresh crops are also expected to have a positive impact on crew psychological health (Stankovic *et al.*, 2018).

3. Bio-regenerative life support systems: The concept of bio-regenerative life support systems is to use photosynthetic organisms and light to generate oxygen and food. Learning to grow plants in space is thus an essential goal since crop growth in space will aid with air regeneration, food production and water recycling for astronauts during long-term space missions (Stankovic *et al.*, 2018).

Plant Growth Chambers for Space

Because of lethal hazards of Extreme temperatures, high vacuum, electromagnetic radiation, particle radiation, magnetism, and lack of suitable plant minerals and water like on earth. So, plants should be grown in special growth chambers. NASA has built space growth chambers like ADVASC and VEGGIE.

1. ADVASC (ADVanced AStroCulture): Hydroponics is the principle used in this growth chamber. It has all the controlled environmental parameters like temperature, relative humidity, light, nutrient supply, water, carbon dioxide and ethylene. Software and cameras are used to maintain all the required conditions. Arabidopsis was the first plant grown in this chamber. The main disadvantage of this system is hypoxia i.e., lack of oxygen to the root system. Before returning to Earth, Arabidopsis plants were germinated, grown, and cultivated on the ISS (Zhou *et al.*, 2002). Later, some of these seeds were successfully utilized to establish a second (back-to-back) generation of Arabidopsis in microgravity (Fig 3).

2. The Vegetable Production System (Veggie): It is a plant growth unit on the International Space Station. The veggie is made of Plant pillows, a Teflon-coated black kevlar which contains the growth media (calcined clay – often used to condition baseball infields), controlled release fertilizer and water (injected through a quick-disconnect valve). Kevlar is a strong synthetic fiber that is flame- and heat-resistant (Fig 4). the seeds are glued into wicks, which are white flaps emerging from the top of a plant pillow. Red and blue LED lights are used to provide light to the chamber (Hanford *et al.*, 2018).

Fig 3: ADVASC at ISS

Fig 4: Veggie at ISS

Plant Growth Chambers for Space

1. Lunar Martian greenhouse: NASA and the University of Arizona are building this greenhouse for the moon and mars environment (Whitaker, 2010).

2. EDEN ISS greenhouse: European Space Agency, Wageningen University and 15 other institutes are building this greenhouse and is under trial in Antarctica for 4 years (Zabel *et al.*, 2020).

Conclusion

As one of our civilizations' greatest intellectual endeavors, the hunt for alien life, it is a tremendously exciting period for space research. A good understanding of the rich biodiversity and adaptability of life on Earth is a component of this continuum, too. There should be consistent conditions for plant development in future space research. Also, it is the only field in space research where you may taste the results of your experiment. Last but not least, it is not out of the question that specific plant species may be genetically modified and remotely managed to provide food, clean air, and drinkable water while also serving as a source of raw materials and tiny pharmaceutical factories thousands of miles from Earth.

References

1. Anonymous, 2023. https://en.wikipedia.org/wiki/Space_station
2. Hanford, A., Anderson, M., Ewert, M. and Stambaugh, I., 2018. Potential Evolution of Crop Production in Space Using Veggie. 48th International Conference on Environmental Systems.
3. Link, B.M., Busse, J.S. and Stankovic, B., 2014. Seed-to-seed-to-seed growth and development of Arabidopsis in microgravity. *Astrobiology*, 14(10): 866-875.
4. Morrow, R., 2014. A brief history of growing plants in space. *Resource Magazine*, 21(3): 17-19.
5. Soga, K., Wakabayashi, K., Kamisaka, S. and Hoson, T., 2002. Stimulation of elongation growth and xyloglucan breakdown in Arabidopsis hypocotyls under microgravity conditions in space. *Planta*, 215: 1040-1046.
6. Stanković, B., 2001. 2001: A plant space odyssey. *Trends in Plant Science*, 6(12): 591-593.
7. Stankovic, B., Russomani, T. and Rehnberg, L., 2018. Plants in space. Into space: A journey of how humans adapt and live in microgravity, pp.153-170.
8. Whitaker, R., 2010. NASA-Lunar Plant Growth Chamber Educator Guide.
9. Wolff, S.A., Coelho, L.H., Karoliussen, I. and Jost, A.I., K., 2014, Effects of the extraterrestrial environment on plants: recommendations for future space experiments for the MELiSSA higher plant compartment. *Life,* 4: 189-204.
10. Zabel, P., Zeidler, C., Vrakking, V., Dorn, M. and Schubert, D., 2020. Biomass production of the EDEN ISS space greenhouse in Antarctica during the 2018 experiment phase. *Frontiers in plant science*, *11*: 656.
11. Zhou, W., Durst, S.J., DeMars, M., Stankovic, B., Link, B.M., Tellez, G., Meyers, R.A., Sandstrom, P.W. and Abba, J.R., 2002. Performance of the Advanced Astroculture plant growth unit during ISS-6A/7A mission. *SAE Technical Paper*, pp.01-2280.

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

Invasive Fall Armyworm, *Spodoptera frugiperda* (J. E. Smith) and their Natural Control by Red Weaver Ant, *Oecophylla smaragdina* (Fab.)

Article ID: 40809

Sadashiva Tippimath[1], Srivijay S Malipatil[2]
[1]Department of Entomology (Ph. D Scholar), Keladi Shivapppa Nayaka University of Agricultural and Horticultural Science, Navile, Shivamogga. 577204.
[2]Department of Genetics and Plant Breeding (Ph. D Scholar), Keladi Shivapppa Nayaka University of Agricultural and Horticultural Science, Navile, Shivamogga. 577204.

Introduction

Invasive insect pests are non-native or exotic organisms that occur outside their naturally adapted habitat and dispersal potential. These Invasive species are the major and most rapidly growing threats to agricultural biodiversity, livelihoods, human and animal health, forestry and biodiversity and result in huge economic losses. However, some of the invasive insect pests invade and outcompete native species.

Invasive Fall Armyworm, *Spodoptera frugiperda*

The fall armyworm, *S. frugiperda* (J. E. Smith, 1797) (Lepidoptera: Noctuidae), is an invasive species that has caused havoc on commercial crops in large parts of the world. Being first detected in the African continent in 2016 (Goergen et al. 2016), the pest has affected at least 28 sub-Saharan African countries by the end of 2017 (Day et al. 2017). *S. frugiperda* continued its spread across South Asia (Kalleshwaraswamy et al. 2018).

Asian Weaver Ant, *Oecophylla smaragdina*

The Asian weaver ant, *Oecophylla smaragdina* (Fab.) is a social and arboreal ant recognized by its nest-building behavior. The workers of *O. smaragdina* are very active and fierce and they are serious predators feeding on the early larval instars of many lepidopteran insects.

The arboreal habit of *O. smaragdina* is extensive foraging for carbohydrate-rich plant secretions as well as insect exudates. Due to its highly aggressive predatory and far-reaching foraging habit, *O. smaragdina* is usually used as a biological control agent against all major pests of economically important crops.

Natural Control of Fall Armyworm

Several natural enemies of FAW including parasitoids, predators, and pathogens have been reported in many countries. Among these Natural predations by the weaver ant is a recent one. Utilization of these ants as predators of pests has been developed in China, Vietnam, and Thailand.

Weaver ant, *Oecophylla smaragdina* a Natural Predator

Ants may be an underappreciated pest control agent in tropical agricultural systems, as they are important insect predators in natural ecosystems, but their role in pest control has not been well investigated.

Preference for prey type: The early instar larvae of *A. mylitta* were preferred by *O. smaragdina* as they cannot resist the attack of predatory ants and within a few minutes, these were ingested. The late instar larvae tried to escape from the predatory attack by *O. smaragdina* but once caught, it leads to death. The fifth and sixth instar larvae oppose the predator ant as they have some defense power to fight against the predator but sometimes, they were also captured by groups of a predator.

Damage caused by *O. smaragdina* on Fall Armyworm: Fall Armyworm is the major insect devastating maize crop in recent years. Natural control of *S. frugiperda* by *O. smaragdina* in the field condition is very promising. The attack of the weaver ant is very aggressive, one or very few ants attack the larva of *S. frugiperda* and then other ants nearby join the group feeding. As the feeding started, the ants tear the larva by using strong mandibles due to which an excessive amount of haemolymph oozes out and causes larval mortality. Usually, *O. smaragdina* attacks the first to third instars of *S. frugiperda* larvae whereas its attack is also lethal to the late instars.

Fig 1: Group of weaver ants feeding on *Spodoptera frugiperda* on maize whorl

Fig 2: Group of weaver ants carrying *Spodoptera frugiperda* larva to nest

Conservation Techniques for *O. smaragdina* and Other Natural Enemies

Intercropping: Intercropping maize crop with tree or plantation crops provide a habitat for generalist predators like ants. Maize crop intercrop with forest plantations or fruit trees for management of *S. frugiperda* damage in maize ecosystem.

A significant advantage of agroforestry is the multi-functionality of trees (Sida et al., 2018b), for example, improving soil health, providing shade for livestock, protecting crops against temperature stress and reducing transpiration, and supplying woodfuel, timber, and fodder, as well as providing a pest control benefit. However, the use of trees within cropping systems needs to consider potential trade-offs in tree-crop interactions, especially concerning competition for light and water (Ndoli et al., 2018; Sida et al., 2018a). Nonetheless, agroforestry is being widely promoted within the concept of climate-smart agriculture and hence there is ample opportunity to establish trials and determine the efficacy of trees in the management of FAW and other pests.

Nest site provision: Nest site provisions for predatory ants could be used to enhance the local abundance of insect predators. Nest site provision can be a low-cost approach to traditional biological control involving *in situ* augmentation of native natural enemies rather than the typically expensive programs focusing on laboratory rearing and releasing. So, it stands to reason that nest site provisioning could enhance the local abundance of beneficial insects. The risk is low, but the cost-benefit relationship of this approach of FAW management needs to be investigated.

Management of weaver ants (*Oecophylla* spp.) in forestry plantations (Offenberg et al., 2004) and on fruit trees (van Mele, 2008) suggests the provisioning of ant nest boxes might be an effective pest management tool for arable crops. Social wasps are important predators of lepidopteran larvae and efficient predators of FAW (Held et al., 2008), even burrowing down into the maize whorl to extract larvae.

Spraying with a sugar solution or fish soup: Spraying with a sugar solution or fish soup may be a low-cost option for encouraging natural enemies into the crop. Sugar on leaves attracts natural enemies like ants, solitary wasps, parasitoids, etc, while the fish soup is specifically for attracting ants. The effectiveness of such a measure will depend on the availability of natural enemies around the field. The effectiveness of such a measure will depend on the availability of natural enemies around the field.

In Honduras, sugar-solution-treated maize had significantly higher densities of natural enemies, 18% lower FAW infestation and 35% lower leaf area damage than water-only treatments (Canas and O'Neil, 1998). In a comparison of spraying (i) water only, (ii) water plus sugar (10%) and (iii) water plus molasses in the Parana state (Brazil), Bortolotto (2014) found that there was no difference among treatments in predator densities, but the rate of FAW parasitism was much higher in the sugar and molasses treatments (~11.5%), as compared to the water-only treatment (~6.5%).

Restoration of forest: Maintaining remnants of forest in agricultural landscapes can be effective for the conservation of arthropod biodiversity and contribute to biological control in adjacent crop fields (Landis et al., 2000; Veres et al., 2013). Forest patches near crop plantations have been shown to increase the local abundance and diversity of natural enemies, such as predatory solitary wasps and insectivorous birds and bats (Boyles et al., 2011; Jones et al., 2005b; Maas et al., 2013, 2016; Sousa et al., 2011).

Use of bioinsecticides: Broad-spectrum application of pesticides has a high potential to disrupt natural biological control in maize fields. So, the application of bioinsecticides like neem oil, Bt, NPV etc, are found to be better in managing *S. frugiperda* larvae and also, they have a negative impact on the predators like ants in maize.

References

1. Bortolotto, O. C., 2014, Sugar solution treatment to attract natural enemies and its impact on fall armyworm *Spodoptera frugiperda* in maize fields. *Interciencia*, **39**: 416–421.
2. Boyles, J. G., Cryan, P. M., McCracken, G. F. and Kunz, T. H., 2011, Economic importance of bats in agriculture. *Science*, **332**: 41–42.
3. Canas, L. A. and O'Neil, R. J., 1998 Applications of sugar solutions to maize, and the impact of natural enemies on Fall Armyworm. *Int. J. Pest Manag.*, **44**: 59–64.
4. Day, R., Abrahams, P., Bateman, M., Beale, T., Clottey, V., Cock, M., Colmenarez, Y., Corniani, N., Early, R., Godwin, J. and Gomez, J., 2017, Fall armyworm: impacts and implications for Africa. Outlooks on *Pest Manag.*, **28**: 196–201.
5. Goergen, G., Kumar, P. L., Sankung, S. B., Togola, A. and Tamo, M., 2016, First report of outbreaks of the fall armyworm *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera; Noctuidae), a new alien invasive pest in West and Central Africa. PLoS ONE, **11**: 1–9.
6. Held, D. W., Wheeler, C., Abraham, C. M. and Pickett, K. M., 2008, Paper wasps (*Polistes* spp.) attacking fall armyworm larvae (*Spodoptera frugiperda*) in turfgrass. Applied Tuffgrass Research 5.
7. Jones, G. A., Sieving, K. E. and Jacobson, S. K., 2005b, Avian diversity and functional insectivory on North-Central Florida farmlands: functional Insectivory on Farms. *Conserv. Biol.,* **19**: 1234–1245.
8. Kalleshwaraswamy, C. M., Asokan, R., Swamy, H. M., Maruthi, M. S., Pavithra, H. B., Hegde, K., Navi, S., Prabhu, S. T. and Goergen, G., 2018, First report of the fall armyworm, *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae), an alien invasive pest on maize in India. *Pest Manag. Hort. Eco.,* **24**(1): 23–29.
9. Landis, D. A., Wratten, S. D. and Gurr, G. M., 2000, Habitat management to conserve natural enemies of arthropod pests in agriculture. *Annu. Rev. Entomol.*, **45**: 175–201.
10. Maas, B., Clough, Y. and Tscharntke, T., 2013, Bats and birds increase crop yield in tropical agroforestry landscapes. *Ecol. Lett.,* **16**: 1480–1487.
11. Ndoli, A., Baudron, F., Sida, T.S., Schut, A. G. T., van Heerwaarden, J. and Giller, K. E., 2018, Conservation agriculture with trees amplifies negative effects of reduced tillage on maize performance in East Africa. *Field Crop. Res.*, 221, 238–244.
12. Offenberg, J., Havanon, S., Aksornkoae, S., MacIntosh, D. J. and Nielsen, M. J., 2004, Observations on the ecology of weaver ants (*Oecophylla smaragdina* Fabricius) in a Thai mangrove ecosystem and their effect on herbivory of *Rhizophora mucronata* Lam. *Biotropica,* **36**: 344–351.
13. Sida, T. S., Baudron, F., Hadgu, K., Derero, A. and Giller, K. E., 2018a, Crop vs. tree: can agronomic management reduce trade-offs in tree-crop interactions? *Agric. Ecosyst. Environ.*, **260**: 36–46.

14. Sida, T. S., Baudron, F., Kim, H. and Giller, K. E., 2018b, Climate-smart agroforestry: *Faidherbia albida* trees buffer wheat against climatic extremes in the Central Rift Valley of Ethiopia. *Agric. For. Meteorol.,* 248, 339–347.
15. Sousa, E. H. S., Matos, M. C. B., Almeida, R. S., Teodoro, A. V., 2011, Forest fragments contribution to the natural biological control of *Spodoptera frugiperda* Smith (Lepidoptera: Noctuidae) in Maize. *Braz. Arch. Biol. Technol.* **54**: 755–760.
16. van Mele, P., 2008, A historical review of research on the weaver ant *Oecophylla* in biological control. *Agric. For. Entomol.,* **10**: 13–22.
17. Veres, A., Petit, S., Conord, C. and Lavigne, C., 2013, Does landscape composition affect pest abundance and their control by natural enemies? A review. *Agric. Ecosyst. Environ.,* **166**: 110–117.

A Needle in the Haystack: “Hidden Hunger”

Article ID: 40810

Fauzia Bano[1], Seema Kanojia[2], Minhaj A. Usmani[3]
[1,2]Research Scholar, Department of Food and Nutrition, Era University, Lucknow, 226003.
[3]Associate Professor, Department of Food and Nutrition, Era University, Lucknow, 226003.

Introduction

Over 925 million people worldwide are in need of food. This is an approximate estimate based on the proportion of persons who are assume to consume less energy than is necessary to maintain body weight, body composition, and levels of necessary and acceptable physical activity for long-term wellness. The fact that hunger statistics deal only with caloric intake has been heavily criticized by nutritionists and by scholars advocating for a multi-dimensional idea of food security. A strictly calorie-based approach is incoherent with the widely accepted definition of food security given at the 1996 World Food Summit, according to which, “Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life”. The stress on “safe and nutritious food”, as well as the final goal to ensure “an active and healthy life‖ calls for a broader, though more complex, analysis of people’s diet.

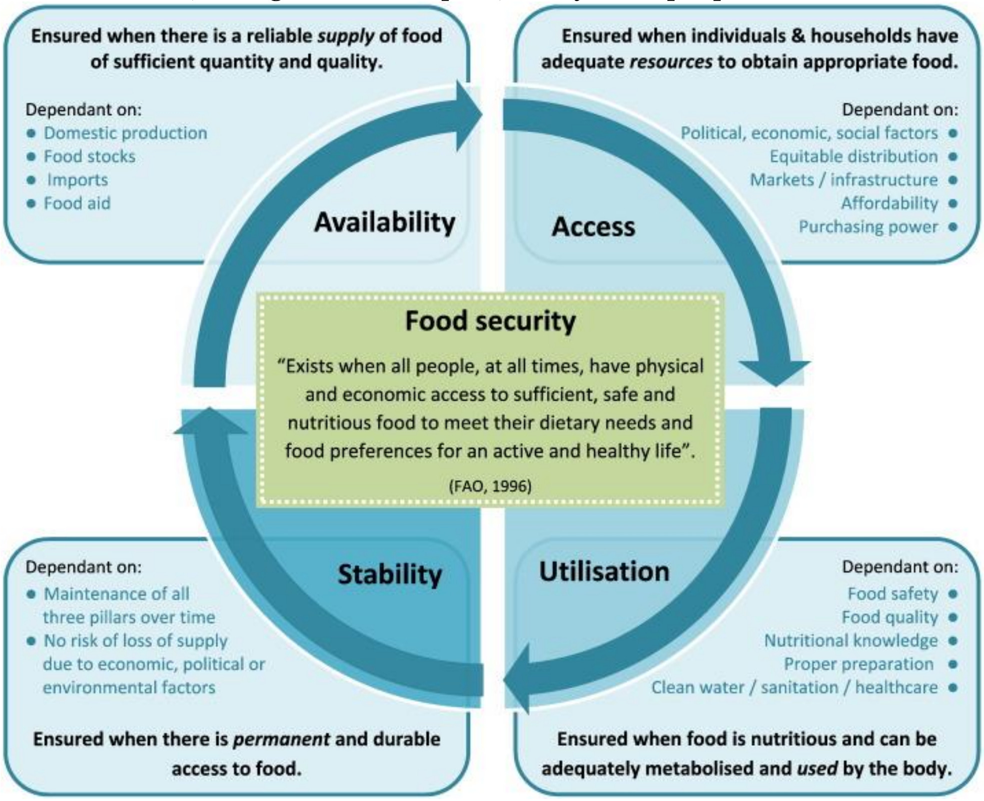


Fig: 1 Food and Nutrition Security (https://www.publichealthnotes.com/food-security-determinants-and-urbanization/)

The concept of food security goes beyond caloric intake and addresses both hunger and undernutrition. Reducing levels of hunger places the emphasis on the quantity of food, and refers to ensuring a minimum caloric intake. Conversely, ensuring adequate nutrition refers to a diet’s quality. A diet rich in proteins, essential fatty acids, and micronutrients has been proven to improve birth weight, growth, and cognitive development while leading to lower levels of child mortality.

The term **“hidden hunger”** is used to describe vitamin and mineral deficiency. When someone’s habitual diet consists of foods that lack necessary levels of micronutrients, the resulting health impacts may not always be acutely visible. A person may have access to a sufficient number of calories but lack adequate micronutrients. This phenomenon has been defined as hidden hunger because its symptoms are not always obvious and people may not even be aware of it. Its negative, sometimes lifelong, consequences on health, productivity, and mental impairment, are devastating.

Cause of Hidden Hunger

The main reason why people experience hidden hunger is because they find it difficult to include enough nutrient-dense foods in their diets, such as fruits, vegetables, legumes, meat, etc. As a result, communities without a consistent food source experience vitamin shortage. There are 19 essential micronutrients "for physical and mental development, immune system functioning and various metabolic processes". Recent data highlight that an estimated 2 billion people suffer from one or more micronutrient deficiencies, demonstrating that hidden hunger is responsible in part for the global malnutrition burden. Most development programmes have focused on three micronutrients, which have devastating consequences for many: vitamin A, iron, and iodine. Anaemia or goitre are the symptoms of micronutrient deficiencies that are the most visible. This aids in locating any hidden hunger. But more investigation is required to ascertain the severity of the issue. According to data from the National Family Health Survey V (NFHS-V), which was conducted in 2018–2019, 57.2 percent of women between the ages of 15 and 49 are anaemic, up from 49.7 percent in NFHS–4. The prevalence of anaemia is slightly lower in cities than in rural areas.

Vulnerable Populations

The overall high-calorie, low-nutrient-density makeup of the commonly consumed Western-type diet, with more processed foods and less vegetables, is one important cause of this issue.[10] Further, analyses of surveys suggest that certain populations in the US are more vulnerable to micronutrient deficiencies or may have an increased micronutrient need, including the following:

1. Individuals with low-nutrient diets or on restrictive diets
2. People of low socioeconomic status or those experiencing food insecurity
3. Women, particularly those of child-bearing age
4. Black, Indigenous, and People of Color (BIPOC)
5. Older adults
6. Individuals with certain medical conditions or disease states.

In addition, long-term users of medications may also experience interference with their body's ability to absorb and benefit from the nutrients found in foods. Potential drug-nutrient depletions have been noted for commonly prescribed pharmaceuticals, with micronutrients such as magnesium, calcium, B vitamins (including B_{12} and folate), potassium, and zinc most often mentioned as potentially impacted.

Mitigate the Hidden Hunger

Food systems, fortification, and food-based strategies have been used to describe the strategic links between health, culture, environment, agriculture, and nutrition in order to combat hidden hunger.

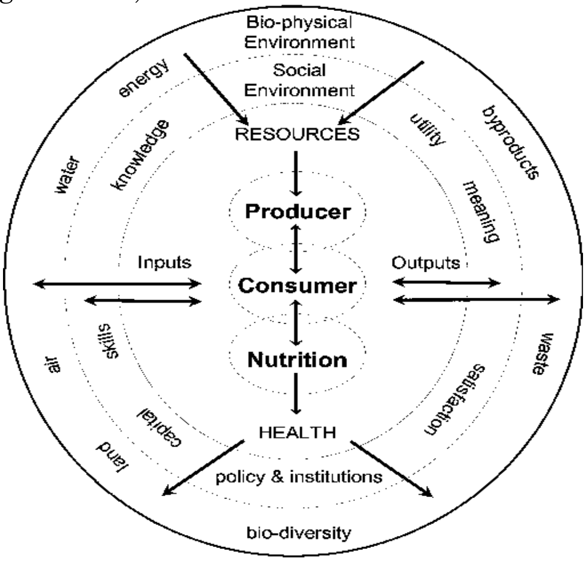


Fig.2: An integrated food and nutrition system (https://doi.org/10.1016/S0277-9536%2898%2900104-X)

Food and Nutrition System: People, as consumers, are at the core of a resilient food and nutrition system. This system also ensures and emphasises environmental integrity, economic self-sufficiency, and social well-being. A healthy food and nutrition system is self-sufficient, controlled, accessible, safe, sustainable, resilient, and food-secure. The food and nutrition system are composed of three components: **producer, consumer,** and **nutrition**. This enables a visualisation of a potential sequential order of activities, beginning with food production and ending with food transportation and utilisation, with a health outcome.

The **producer subsystem** is based on farmers and those engaged in food gathering, herding, fishing, processing, distribution and marketing, products derived from food commodities as well as types of food processor and distribution services.

The **consumer subsystem** consists of consumers and food preparers, as well as products, foods, dishes, and meals. Access to these foods (whether grown or purchased), safe and nutritious food preparation, and consumption (with equal distribution across a household) are all critical components of improved nutrition within the consumer subsystem. Poor households typically eat monotonous staple-based diets. They often lack access to micronutrient-rich foods, such as fruits, vegetables, animal source foods (fish, meat, eggs, and dairy products) for consumption. Traditional local foods of high nutrient content and wild food are often underutilized and neglected.

Lastly, the **nutrition subsystem** is made up of food components including macro and micronutrients, fiber, water, and non-nutrient factors. The status of the nutrition subsystem is reliant on the health state of an individual, which is determined by the proper digestion of food, along with the absorption and utilization of nutrients within the body.

1. Nutrition Education: Eliminating hidden hunger will not be easy. Challenges lie ahead. A focus on nutrition education programme regarding hidden hunger will be an impactful tool. Awareness regarding hidden hunger will be established though different education programme on different extents.

2. Supplementation: A technical approach, supplementations deliver nutrients directly to the population through syrup or pills. Its main advantage is that it can supply the specific number of nutrients in a highly absorbable form. It should be noted that supplementation is a short term method eventually replaced by food-based measures in order to increase food and nutrient diversity. Supplementation programs in India are focused on providing iron to pregnant women and vitamin A to children under 5.

3. Food fortification: Food fortification is the addition of micronutrients in processed foods. Enrichment and fortification are some of the methods used. Enrichment restores lost nutrients during food processing, while in fortification, those nutrients are added which are not originally found in the food being processed. Depending on the requirements, food fortifications is done to fulfill the following objectives -

a. Maintain nutritional quality of foods
b. Prevent nutritional deficiencies in the population
c. Provide technological functions in food processing
d. Food fortification plays a crucial role in enhancing nutritional improvement programmes and are considered as part of a hands-on approach to mitigate hidden hunger.

4. Diet Diversification: Through diet diversification the quantity and the range of micronutrients-rich foods can be increased. It requires different types of foods such as fruits, vegetables, pulses, dairy products etc. to be readily available and that too in appropriate quantities. With diversity in diet, many food constituents like antioxidants, and probiotics can be taken, thus improving the nutrient intake of the population as such. Hence, diet diversification is the preferred method of combating hidden hunger. Communities play an important role as well. Food and nutrition security in communities and households is dependent on underlying social, economic, and institutional factors, which ultimately affect food quantity, quality, and affordability, as well as nutrition, health, and wellbeing. By providing resources to communities and the ability to make choices, a resilient food and nutrition system that ensures environmental integrity, economic self-sufficiency, and social well-being can be developed.

Conclusion

Developing nations such as India not only have to contend with hidden hunger but also with problems like inadequate healthcare, insufficient education or abysmal sanitation. Thus, focusing on a single micronutrient deficiency is not the most effective strategy. A new approach must be taken to address the long-term causes of nutrition insecurity and hidden hunger. Interventions addressing food and nutrition security must be prioritised as part of a larger multi-sector strategy tailored to the diverse conditions of major agroecological, socioeconomic, and epidemiological situations. While the underlying causes of undernutrition have been well understood for decades, the development and implementation of more holistic multi-sectoral packages that combine child care and disease control interventions with food system and livelihood-based approaches has been limited.

References

1. Allen, L.H. Ending Hidden Hunger: The History of Micronutrient Deficiency Control; Background Paper of the World Bank-UNICEF Nutrition Assessment Project; World Bank: Washington, DC, USA, 2000.
2. Svedberg, P. Poverty and Undernutrition, Indian ed.; Oxford University Press: New Delhi, India, 2002.
3. Habicht, J.P. Malnutrition kills directly, not indirectly. Lancet 2008, 24, 1749-1750; Available online: http://www.micronutrient.org/english/View.asp?x=573 (accessed on 5 December 2010).
4. Ruel, M.T. Is Dietary Diversity an Indicator of Food Security or Diet Quality? A Review of Measurement Issues and Research Needs; International Food Policy Research Institute: Washington, DC, USA, 2002.
5. Bouis, H.; Welch, R.M. Biofortification—A Sustainable Agricultural Strategy for Reducing Micronutrient Malnutrition in the Global South. Crop Sci. 2010, 50, S20-S32.
6. Ruel, M.T. Can Food-Based Strategies Help Reduce Vitamin A and Iron Deficiencies? A Review of Recent Evidence; International Food Policy Research Institute: Washington, DC, USA, 2001.

E-ISSN: 2581 - 8317

Legume Intercropping in Young Citrus Orchards: A Sustainable and Profitable Land Use System

Article ID: 40811

Priyanka Irungbam[1], N. Devachandra[1], T. Malemnganbi[1], Kumar Sambhav Giri[2]
Assistant professor, College of Horticulture & Forestry, Central Agricultural University (Imphal), Pasighat, Arunachal Pradesh, 791102
[1]Research scholar, School of Agricultural Sciences and Rural Development, Medziphema, Nagaland, 797 106.
[2]Assistant professor, Faculty of Agricultural Sciences, Siksha 'O' Anusandhan Deemed to be University, Bhubaneswar, 751003.

Importance of Intercropping in Orchards

Fruit crops like orange, lemon, mosambi, pummelo, etc. are some of the major horticultural crops grown in Arunachal Pradesh. Shortage of man power, resources, prolonged wet spell during monsoon and negligence by the farmers lead to heavy infestation of weeds in the citrus orchards which become almost unmanageable with time. The challenges of citrus cultivation in the state of Arunachal Pradesh include many factors like improper spacing, heavy and long spells of rainfall, soil erosion, lack of desirable planting materials, heavy weed infestation, nutrient deficiencies, rainfed cultivation, lack of proper orchard management, limited control of insect pests and diseases, lack of marketing facilities, problems of processing and non-availability of well-trained manpower and extension support. The citrus farmers in this region are also facing a major problem of citrus decline and heavy weed infestation is one of the main reasons. The farmers usually go for sole cropping of these fruit crops in jhoom areas without proper after care. The inter spaces in between the fruit trees laying vacant and unutilized become heavily infested with weeds especially during the kharif season. The vacant land in between the fruit trees can however be utilized profitably for the cultivation of various intercrops like vegetables, cereals, pulses, oilseeds, etc. but preferably leguminous crops during the first few years of their non-bearing life or until the trees have grown to a big size. Due to wider spacing and different rooting pattern, the large unutilized interspaces can be successfully exploited for cultivation of various intercrops.

Weed infested orchard (before)

Legume intercropping (after)

Intercropping is one of the techniques of efficient land/resource utilization for optimum production which is both beneficial to the farmers and is eco-friendly. Moreover, Agri- horticultural system is one among various land use systems, which is the most important in terms of subsistence and economic returns to the farmers. The tree and legume crop components help each other, by creating favorable condition for their growth in such a way that the Agri-horticultural systems provide an efficient land use and better economic return than the sole crop during early phase of orchard establishment and the interaction between the component is complementary in nature and advantageous under rainfed condition.

When the trees reach their bearing stage, the practice of intercropping can be discontinued as it would disrupt with the normal growth and bearing of the orchard trees. The organic matter of the soil can also be replenished by incorporating the leguminous intercrops after their harvest. The biologically fixed nitrogen from the roots of legumes can be transferred to the root zone of companion crops and can reduce the need of nitrogen from commercial fertilizers. Short duration crops may be intercropped with an objective to make the best use of resources (inherent as well as applied) in an agro-horticultural system in which perennial fruit trees and annual crops are grown together. Besides the efficient resource use, the techniques used for crop production in Agri-horticultural trees also share the benefits. For example, interculture, weed control, tillage, mulching etc. applied to the intercrop also benefits the trees in the agroforestry system (Dhyani *et al*., 2009). Fruit trees if integrated under suitable farming system could add significantly to overall agricultural production including conservation of soil and water with stability in production and income.

The Main Advantages of Legume Intercropping in Fruit Orchards are

1. Additional income to the farmers during the juvenile phase of the fruit trees.
2. Increase in total productivity per unit land area.
3. Judicious utilization of resources such as land, labour and other inputs.
4. Reduction of soil erosion and loss of valuable nutrients.
5. To check the growth of weeds as intercrops act as cover crops.
6. Increase in the activities of beneficial soil microorganisms.
7. Increase in soil organic matter as the legumes are incorporated into the soil after harvest.
8. Overall improvement of the soil in terms of nutrient content, soil structure and water holding capacity.

Some Important Points to be Considered While Selecting an Intercrop

1. The main and component crop should have different growth habit. Tall and erect crops may be intercropped with short and bushy crops.
2. Shallow rooted crops to be intercropped with deep rooted crops so that there is no competition for moisture and nutrients in the soil.
3. Long duration crops must be intercropped with short duration crops.
4. Slow growing crops should be intercropped with fast growing crops so that their peak nutrient demand stages do not overlap.
5. One of the crops should preferably be a legume.
6. The crops should be of different families to avoid increased incidence of pests and diseases.
7. The selected crops should not have any allelopathic effect against each other.
8. Preference of the local people and market availability.

Conclusion

The farmers of Arunachal are reluctant to use chemicals like fertilizers and herbicides in their field. Lack of proper nutrition and heavy weed infestation are also one of the many reasons of citrus decline in the state. Pulse/legume crops have the capability for high biomass production in a short duration of time. They act as cover crops reducing weed population and prevent nutrient loss which is more important for areas like Pasighat where heavy and prolonged rainfall is a regular climatic feature. Apart from giving additional income to the farmers, the problem of weeds, which is practically unmanageable in orchards, can be mitigated through intercropping. In addition, due to their nitrogen fixing capability, they also increase the soil fertility status which will be benefitted by the citrus trees in the long run. The success of an intercropping system depends mainly on the selection of suitable intercrop. Therefore, there is a need to identify suitable intercrops which will remain compatible with the main crop throughout the growth phases while considering the local taste and preference too.

Reference

Dhayani, S.K., Ram Nevar and Sharma, A.R. 2009. Agroforestry: its relation with agronomy, challenges and opportunities. Indian Journal of Agronomy, 54(3): 249-266.

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

Spray Induced Gene Silencing (SIGS)

Article ID: 40812

Gaurav Rakhonde[1], Debjeet Sharma[2], Aravind. T[3], Shivani[4], Karibasappa CS[5]
[1]Ph.D Scholar, Department of Plant Pathology, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka, India-560065.
[2]Ph.D Scholar, Department of Plant Pathology, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Himachal Pradesh, India-173230.
[3]Assistant Professor, Department of Plant Pathology, M. S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Odisha, India -761211.
[4]Ph.D Scholar, Department of Plant Pathology, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India- 263145.
[5]Assistant Professor, Department of Plant Pathology, Palar Agricultural College, Kothamarikuppam, Tamil Nadu, India-635805.

Introduction

RNAi is in accountable for regulating crucial processes like cell development, tissue differentiation, heterochromatin formation, and cell proliferation. Pathogen genes (RNA) are used (just like pesticide spray). The SIGS controls the production of foreign pathogen protein coding genes such as pathogen virulent genes, plant susceptible genes, and vector control. SIGS is a transdermal dsRNA/siRNAs spray used to combat particular diseases. It is anticipated that by silencing the genes without adding hereditary alterations in the genome, they will not be controlled as GM products.

Features of SIGS

1. Reduces the time and processes for the release of transgenic plant as well as potentially improving the public acceptance.
2. As a cellular mechanism, the gene specific dsRNAs which are sprayed on the plant surface can be processed into siRNAs.
3. This siRNAs can guide the targeted cleavage of homologous RNAs at post transcriptional level in the cytoplasm of plant or pathogen.

Mechanism of SIGS: (Hu *et al.*, 2020)

1. Sprayed dsRNA particles move in to plant via wounds caused by abrasives like carborundum/ celite.
2. The ds RNA entered and get cleaved into siRNAs (21-25nt long) by cellular dicer-like proteins (DCLs)-RNase III activity.
3. Generated siRNAs then bind to the argonaute protein and start unwinding the duplex RNAs.
4. Out of the two strands, one strand known as guide strand remains bound to argonaute protein to form an RNA-induced silencing complex (RISC), guiding to cleave cellular mRNAs which have complementary sequences with the siRNA.
5. Secondary siRNAs amplified by RDR6 and DCLs will then move through phloem to induce systemic RNAi in upper unsprayed leaves.

dsRNA Entry into Plant: Symplastic and Apoplastic Delivery

The ds RNA sprayed using formulation on the plant and entered through the wounds or natural openings like stomata. Then entered in mesophyll and the phloem and xylem and become systemic. The application can be done using trunk injection, bait method, irrigation, foliar spray, seed coating, *etc.*

Procedure Involved in dsRNA Production

1. Identification of target sequences from coding regions of the pathogens.
2. Selection of target regions for ds RNA production.
3. Cloning of target sequences for ds RNA production.

Factors Affecting ds RNA/ siRNA/ hpRNA Spray

1. Stability and protection period: Despite the potential usage of dsRNA in crop protection and improvement, the short-term stability of this type of molecule in environment is one of key limitations to practical application. The stability of dsRNA can be increased by developing RNA formulations with nanoparticles that protect the dsRNA/sRNA from degradation. Mixing of a double-layered hydroxide (LDH) nanoparticle with dsRNA molecules (BioClay) resulted in protection of tobacco plants from virus infection for up to 20 days compared with five to seven days using naked dsRNA. Chitosan and carbon dot-based nanoparticles have also been used to enhance self-life and uptake of dsRNA. Nanoparticle based formulations promise enhanced delivery of exogenous dsRNAs by increasing their stability and uptake. However, the main concern associated with nanoparticle-based formulation is that they are quite expensive or difficult to synthesize (Mitter *et al.*, 2017).

2. RNA Length and Concentration: The effectiveness of topically applied dsRNAs can be affected by concentration and length of dsRNAs. In one of the first reports utilizing SIGS technology, *N. benthamiana* leaves were treated with 200 bp and 700 bp dsRNA, 21-nt sRNA, or 21-mer anti-sense ssDNA targeting an endogenous PHYTOENE DESATURASE (PDS) gene, resulting in bleaching of leaves within ten days leaves were treated either with carborundum or Silwet L77 surfactant as an adjuvant before dsRNA application.

3. Application and Translocation Method: Following patent WO 2011/112570 describing that dsRNAs, small interfering RNAs (siRNAs) and single stranded DNA oligonucleotides can trigger efficient local and systemic silencing of *N. benthamiana* endogenes, foliar application of dsRNA for targeting endogenous genes has attracted interest in the agricultural community. However, low-pressure spraying of siRNA GFP on transgenic *N. benthamiana* 16C plants did not result in GFP silencing, probably owing to failure in achieving symplastic entry. This problem was overcome by using high pressure spraying of siRNAs targeting GFP, although silencing was only achieved in a few cells. Further research is essential to establish whether high-pressure spraying is functional in targeting plant endogenous genes, or if dsRNA uptake from spray application can be improved through addition of adjuvants to the dsRNA formulation. Syringe infiltration is one of the simplest methods for introducing transgenes in model plants. In addition to carrier-based formulations, mechanical inoculation through spreading of dsRNA with soft sterile brushes and gentle rub inoculation also has been shown to aid dsRNA delivery to induce RNAi. However, application of dsRNAs through rub inoculation, or infiltration-based methods are not suitable at a large greenhouse or field scale. Such limitations can be overcome through irrigation or spray-based technologies. Delivery of dsRNAs via irrigation would be particularly well suited to crops grown under hydroponic conditions. Further research in these areas could be helpful for the application and delivery of dsRNAs for RNAi-based plant disease control and improved crop performance.

4. RNA Modification: Many times, single target is not enough to mitigate the disease. Many factors are involved in the disease invasion and its development. So, three or more ds RNA are prepared and a mixture of it is prepared and thus sprayed.

5. Formulation: Most fungicides can be made into wettable granules. The mixture typically includes 20 to 80% finely powdered mineral diluent. (i.e., bentonite, talc, kaolinite, *etc*). The primary purpose of this filler is to prevent fungicide particle agglomeration during grinding or storing. This is also how ds RNA is used, with various formulations to enhance its efficacy. **Example:** Bioclay, Silvet L77

Difference Between Naked ds RNA and Ds RNA with Formulations

Naked ds RNA:	Formulations/carriers:
• Natural biopesticide molecule • Unstable • Easily get washed off from plant spray	• Increased persistence • High cellular uptake efficiency • Potential implications for biosafety

Application

Sl No	Organism	Crop	Targeted genes	Reference
1	PRSV-Tirupati and New Delhi isolates	Papaya	CP, Hc-Pro	Vadlamudi *et al.*, 2020

2	TYLCV	Tomato	AC4. AV2	Melita *et al.,* 2021
3	PSTVd, CEVd, CChMVd	Tomoto, Gynura, Chrysanthemum		Carbonell *et al.,* 2008
4	*M. oryzae*	Paddy	MoDES1	Sarkarand Roy-Barman (2021)
5	*B. cineria*	Grape vine	BcCYP51, Bcchs1& BcEF2	Nerva *et al.,*2020

Conclusion

Given the political and public pressure for sustainable solutions to current agricultural problems, the exogenous application of dsRNA molecules has the potential to play a multi-role in triggering local and systemic RNAi in plants and is a very powerful tool in modern crop protection and improvement platforms. SIGS offers a lot because of its total technological flexibility, paving the way for a better world with no agrochemicals and a healthy ecosystem.

Future Prospects

1. Researchers need to address the effects of ds RNA under field conditions with less focus on greenhouse and laboratory studies.
2. Moreover, information is lacking regarding the combined effect of dsRNA and pesticides as it is almost impossible to totally eradicate or control various pests alone with ds RNA or pesticides application.
3. The precise mechanism by which dsRNA modulates plant physiology through potentiation of host defense mechanisms still needs further investigation at the genomic and proteomic levels.

Reference

1. Carbonell, A., Lisón, P., and Daròs, J. A. (2019). Multi-targeting of viral RNAs with synthetic trans-acting small interfering RNAs enhances plant antiviral resistance. *The Plant Journal*, 100(4), 720-737.
2. Hu, B., Zhong, L., Weng, Y., Peng, L., Huang, Y., Zhao, Y., and Liang, X. J. (2020). Therapeutic siRNA: state of the art. *Signal transduction and targeted therapy*, 5(1), 101.
3. Melita, O., Kaldis, A., Berbati, M., Reppa, C., Holeva, M., Lapidot, M., and Voloudakis, A. (2021). Topical application of double-stranded RNA molecules deriving from Tomato yellow leaf curl virus reduces cognate virus infection in tomato. *Biol. Plant*, 65, 100-10.
4. Mitter, N., Worrall, E. A., Robinson, K. E., Li, P., Jain, R. G., Taochy, C., and Xu, Z. P. (2017). Clay nanosheets for topical delivery of RNAi for sustained protection against plant viruses. *Nature plants*, 3(2), 1-10.
5. Nerva, L., Sandrini, M., Gambino, G., and Chitarra, W. (2020). Double-stranded RNAs (dsRNAs) as a sustainable tool against gray mold (Botrytis cinerea) in grapevine: Effectiveness of different application methods in an open-air environment. *Biomolecules*, 10(2), 200.
6. Sarkar, A., and Roy-Barman, S. (2021). Spray-induced silencing of pathogenicity gene MoDES1 via exogenous double-stranded RNA can confer partial resistance against fungal blast in Rice. *Frontiers in plant science*, 12, 733129.
7. Vadlamudi, T., Patil, B. L., Kaldis, A., Gopal, D. V. R. S., Mishra, R., Berbati, M., and Voloudakis, A. (2020). DsRNA-mediated protection against two isolates of Papaya ringspot virus through topical application of dsRNA in papaya. *Journal of virological methods*, 275, 113750.

Why should Farmers Go for Crop Insurance and How does it Help them in Averting Risk?

Article ID: 40813

Katta Sravan Naga Parimala Kumar[1], Vanya Vartika Ram[2]
Research Scholar[1] and Research Scholar[2]
[1]Department of Agricultural Communication, G.B. Pant University of Agriculture & Technology, Pantnagar – 263145, Uttarakhand, India.
[2]Department of Agricultural Extension, Indira Gandhi Krishi Vishwavidyalaya, Raipur – 492012, Chhattisgarh, India.

Introduction

Farming is a significant source of livelihood for many people around the world. However, farming is not without its challenges, including unpredictable weather patterns, pests, diseases, and other uncontrollable events that can cause substantial losses to farmers. Crop insurance has been gaining popularity among farmers in recent years. It is an insurance policy that provides protection to farmers against crop losses. Despite the numerous benefits associated with crop insurance, some farmers are still skeptical about its importance. This article aims to explore the reasons why farmers should consider crop insurance.

Why should Farmers Go for Crop Insurance?

Crop insurance is an essential risk management tool that provides financial protection to farmers against crop losses due to natural disasters, such as droughts, floods, hurricanes, and other weather-related events. Crop insurance is also helpful in protecting farmers against market risks, such as price fluctuations, and other economic factors that could lead to crop losses.

In addition to protecting farmers' incomes, crop insurance also provides benefits to the broader economy. For example, crop insurance helps maintain a stable food supply, which is essential for the well-being of the population. Crop insurance also helps support the agricultural industry, which is a vital sector of many economies worldwide.

How does Crop Insurance Help Farmers in Averting Risk?

Protection against yield loss: Farming is an inherently risky venture, and farmers face several uncertainties that could affect their yields. Crop insurance provides farmers with protection against yield losses resulting from natural disasters such as floods, droughts, and hurricanes. Additionally, it offers protection against losses resulting from pests and diseases, ensuring that farmers do not suffer financially from these events.

Protection against price volatility: The prices of agricultural commodities are volatile and are subject to market forces that farmers have no control over. Crop insurance can protect farmers from the impact of price volatility by providing a guaranteed price for their crops. This means that farmers can have peace of mind knowing that they will receive a predetermined payout if the market prices fall below a certain level.

Access to credit: Crop insurance can also improve farmers' access to credit by providing lenders with a level of confidence in the borrower's ability to repay the loan. With crop insurance, farmers can secure loans to invest in their farms without worrying about the risks associated with crop losses.

Risk management: One of the most significant advantages of crop insurance is that it helps farmers manage risk. By transferring the risk of crop loss to the insurer, farmers can focus on their farming operations without worrying about the financial implications of unforeseen events. This can help reduce stress and anxiety, leading to improved mental health for farmers.

Government support: Governments across the world have recognized the importance of crop insurance in protecting farmers' livelihoods. As a result, many governments provide subsidies and other forms of support to farmers who purchase crop insurance. This can significantly reduce the cost of the insurance policy, making it more accessible to farmers.

Conclusion

Crop insurance is an essential risk management tool for farmers. It provides financial protection against crop losses due to natural disasters, market risks, and other economic factors. Crop insurance helps farmers manage their risks better, secure loans from banks, recover quickly after a loss, and adopt sustainable farming practices. Additionally, crop insurance benefits the broader economy by supporting the agricultural industry and maintaining a stable food supply. Therefore, it is recommended that farmers consider crop insurance to mitigate the risks associated with farming.

Reference

1. Agricultural Marketing Service. (2020). Crop Insurance. Retrieved from https://www.ams.usda.gov/services/crop-insurance
2. Miranda, M. J., & Glauber, J. W. (1997). Systemic Risk, Reinsurance, and the Failure of Crop Insurance Markets. *American Journal of Agricultural Economics*, 79(1), 206-215.
3. Mishra, A. K., & El-Osta, H. S. (2005). Role of Government in Providing Crop Insurance. *Journal of Agricultural and Applied Economics*, 37(3), 571-580.

E-ISSN: 2581 - 8317

Alternative Energy Sources

Article ID: 40814

Monika Moond[1], Sushila Singh[1], Jyoti Rani[1], Anuradha Beniwal[1], Pinki Matoria[1]
[1]Department of Chemistry, CCS Haryana Agricultural University, Hisar 125004, Haryana, India.

Introduction

Alternative energy sources are regarded as "clean," which refers to the fact that they don't emit harmful pollutants or increase carbon footprint. It comprises all forms of renewable energy. These energy sources will overtake the use of coal and fossil fuels as the primary means of producing energy in the coming decades. The phrase "alternative energy sources" officially refers to energy sources that aren't environmentally friendly but are more environmentally friendly and will significantly improve the environment. Alternative energy technology has the key benefit of not running out and not requiring the same costly and destructive extraction methods (Farret & Simões, 2006).

Types of Energy Sources

1. Renewable energy sources: Renewable energy sources are flow-limited but naturally replenishing. Although they have an almost endless lifespan, they have a finite amount of energy available per unit of time. Solar, wind, biomass, ocean waves, hydroelectricity, and geothermal heat are some of these sources (Devabhaktuni *et al.*, 2013).

2. Non- renewable energy sources: Natural resources that cannot be renewed quickly enough to meet demand are known as non-renewable energy sources. Coal, gas, and oil are the main types of fossil fuels that are used as non-renewable energy sources. While fossil fuels are also used for numerous domestic uses, non-renewable energy sources account for about 70% of the energy used in industrial processes (Blander *et al.*, 1989).

Alternative Energy Sources

1. Solar energy: Given their constantly improving output efficiency and versatility, solar technologies are among the most promising renewable energy sources. Solar energy is advantageous due to its inherent properties, particularly for developing nations that are situated in areas with easy access to the sun's rays. Through the use of photovoltaic cells, solar energy is captured straight from the Sun and transformed into electrical energy. Solar-thermal power is the use of sunlight's heat to generate electricity in particular circumstances.

2. Wind Energy: is one of the most readily available and cleanest energy sources. It is produced by air movement, whereby the wind spins massive wind turbines to produce power. Wind energy is environmentally friendly and has no by-product carbon emissions. Wind does not produce a constant, uninterrupted supply of power because wind intensity varies. Wind farms need a huge land area where no other activity could be carried out because the wind speeds are seasonal. Birds could be harmed by wind farms. Wind turbines that are somewhat higher off the ground than others could produce more energy.

3. Wave Energy: Water is heavier than air, therefore even a stream that moves slowly can produce a lot of energy. As some of the wind's energy is transferred to the water via friction between air and water molecules, waves are created on the surface of lakes and oceans. Larger waves result from stronger winds. Another sustainable and alternative energy source is wave energy. It is possible to harness the waves' up and down motion to produce power. This method of generating energy is still very new and has so far only generated a tiny amount of energy.

4. Biomass: A minimum of 80% of the amount of biomass comes from resources produced from live organisms that were harvested during the ten years prior to its creation. It is also referred to as "organic matter" and includes anything that is or once was alive. The fact that biomass must be cultivated, gathered, dried, fermented, and burned is a problem.

The following three forms of biomass exist:

a. Solid biomass includes: wood, straw, animal waste, cotton, rice, peanuts, and other crops, as well as dry, compressed peat. Burning wood produces heat that is frequently comparable to that of a central heating system, and doing so typically costs less than using fossil fuels in a home.

b. Liquid Biomass: Biodiesel, a fuel based on vegetable oil, may be used in current diesel engines without requiring any hardware changes. It is nontoxic, sustainable, and less expensive than oil. Sugarcane and maize can be used to make ethanol. It serves as a petrol and car fuel additive. Biomass can also be used to make methanol, which is currently manufactured from natural gas.

c. Gaseous Biomass: Biomethane produced by natural decomposition of waste or dung. Hydrogen produced by gasification Carbon monoxide produced by gasification. Biogas is a gas that may be used to cook food and light dwellings that is created when trash is burned. Many organic materials, including wood, can create gas when subjected to high pressure, high temperature, and anaerobic conditions (Mulvaney, 2011).

Conclusion

Those nations that currently rely heavily on fossil fuels should put all of their efforts into developing renewable energy sources. Despite the fact that the cost of production is still high, further effort would lower this figure. Utilizing renewable energy sources would also decentralise energy distribution to the household level, ending the position of energy supply as a political problem.

Reference

1. Farret, F. A., & Simões, M. G. (2006). *Integration of alternative sources of energy* (Vol. 504). Piscataway, NJ, USA: IEEE press.
2. Devabhaktuni, V., Alam, M., Depuru, S. S. S. R., Green II, R. C., Nims, D., & Near, C. (2013). Solar energy: Trends and enabling technologies. *Renewable and Sustainable Energy Reviews*, *19*, 555-564.
3. Blander, M., Sinha, S., Pelton, A., & Eriksson, G. (1989). *Calculations of the influence of additives on coal combustion deposits* (No. CONF-890401-8). Argonne National Lab., IL (USA).
4. Mulvaney, D. (Ed.). (2011). *Green energy: an A-to-Z guide* (Vol. 1). Sage.

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

Precision Agriculture

Article ID: 40815

Mo Naushad[1], Nivedita Prasad[2]

[1]M.Sc. Scholar, Department of Agronomy, United University, Jhalwa, Prayagraj (U.P.).

[2]Assistant Professor, Department of Agriculture & Allied Sciences, United University, Jhalwa, Prayagraj (U.P.).

Introduction

Precision agriculture is one of many modern farming practices that make production mon efficient. Farmers use precision agriculture practices to apply nutrients, water, seed and othe agricultural inputs to grow more crops in a wide range of soil environments. Precision agricultur can help farmers know how much and when to apply these inputs. It reduces the misapplication of inputs and increases crop productivity and farm efficiency.

Precision Agriculture Work

To do its job, precision agriculture relies upon specialized equipment, software and IT services. This includes accessing real-time data about the conditions of the crops, soil and ambient air, along with other relevant information such as hyper local weather predictions, labor costs and equipment availability.

The real-time data is collected via sensors in fields that measure the moisture content and temperature of the soil and surrounding air. Satellites and robotic drones can also provide farmers with real-time images of individual plants.

Importance of Precision Agriculture

Farmers can control all the processes remotely with a precision agriculture system. Even small farms can manage large fields or a group of small areas.

It dramatically improves the efficiency of crops and saves financial costs while increasing production. The last aspect is essential since it seems that precision agriculture technologies are costly at first glance. However, the savings are significantly higher than with traditional agricultural methods in the long run. So, growers can accurately sum the required fertilizer amount, determine effective fertilizer types for a particular area. Moreover, the importance of precision farming technologies is that they improve the planning of agricultural operations for an extended period, adjusting the real-time strategy during force majeure.

Benefits of Precision Agriculture

1. After data is collected, predictive analytics software uses the collected data to provide farmers with guidance about crop rotation, optimal planting times, harvesting times and soil management.
2. Agricultural control centers can integrate sensor data and imaging input with other data to provide farmers with the ability to identify fields that require treatment and determine the optimum amount of water, fertilizers and pesticides to apply.
3. This helps the farmer avoid wasting resources and prevent run-off, ensuring that the soil has just the right number of additives for optimum health while also reducing costs and controlling the farm's environmental impact.
4. **Minimizing the cost of materials and resources**, like water, seeds, fuel, etc.;
5. **Maintaining soil health** by reducing the number of pesticides;
6. Lowering agriculture's dependence on weather conditions;
7. Maximum **realization of the genetic potential** of the produced crops.

Farmers Today Need to Take Up Precision Farming

An information and technology-based farm management system identifies, analyses and manages variability in fields by conducting crop production practices at the right place and time and in the right way, for optimum profitability, sustainability and protection of the land resource.

Although a considerable research effort has been expended, it is still only a portion of farmers who have practiced any type of precision agriculture (PA) technologies system approach to re-organize the total system of agriculture towards low-input, high-efficiency and sustainable agriculture.

Precision farming is an approach where inputs are utilized in precise amounts to get increased average yields, compared to traditional cultivation techniques. In India, one major problem is the small field size. More than 58 per cent of operational holdings in the country have size less than one hectare (ha).

Challenges

Research suggests educational and economic challenges as the two most important in the application of precision agriculture. Among the variables that contribute to educational challenges, lack of local experts, funds, knowledgeable research and extension personnel have more of an impact compared to others. PA and initial costs have more of an impact among the economic challenges compared to the other issues.

Why Precision Farming?

1. To increase agriculture productivity
2. Prevents soil degradation
3. Reduction of chemical application in crop production
4. Efficient use of water resources
5. Dissemination of modern farm practices to improve quality, quantity and reduced cost of production
6. Developing favorable attitudes
7. Precision farming changing the socio-economic status of farmers.

Advantages

1. Agronomical perspective
2. Technical perspective
3. Environmental perspective
4. Economic perspective.

Scope of Precision Farming

Examples of Precision Farming include the adoption of an exact set of practices that use smart farming technologies to cater to the needs of individual plots and crops. Big data analytics software such as Crop in Grow or robots such as drones can get detailed information on the plot, soil type, suitable crops, irrigation, and fertilizer needs. The information obtained is used to tailor a very unerring selection of crops, fertilizer quantity, and watering needs. Precision agriculture helps farmers live a debt-free life as production costs and losses are reduced and overall environmental impact is also minimized.

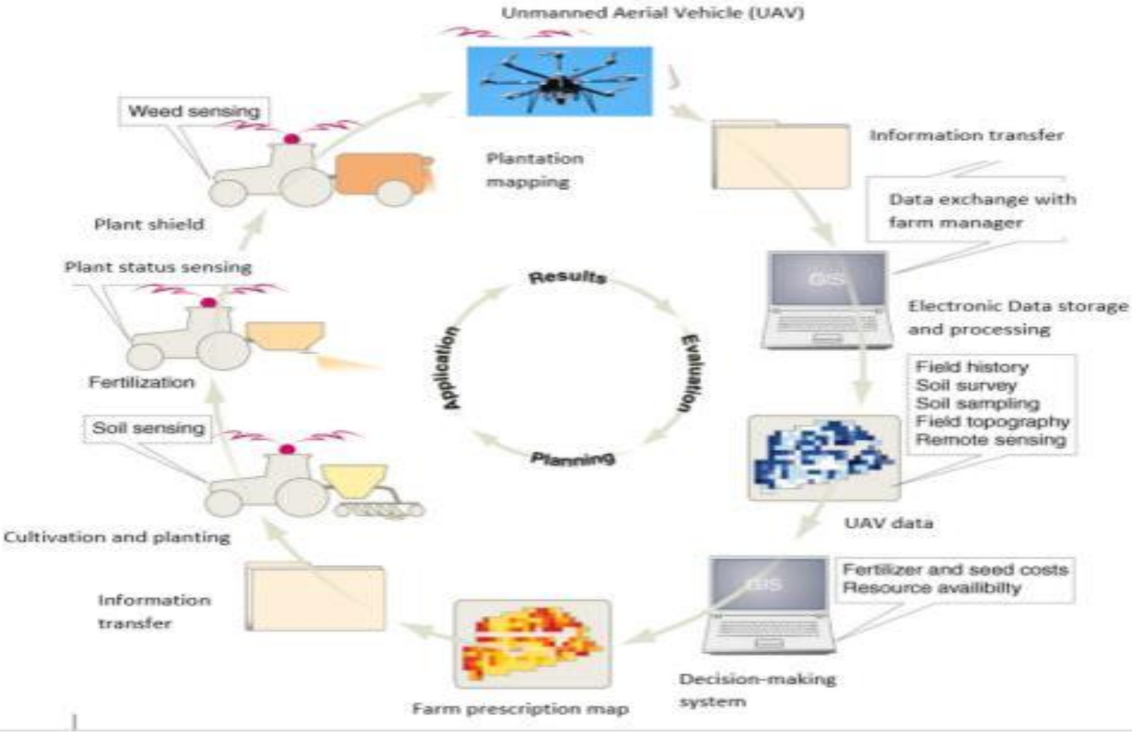
E-ISSN: 2581 - 8317

Precision Farm Management

To be able to apply the VRA method, growers need detailed and spatial data about their farms and different Variable-Rate Technology (VRT) at each stage. The following are important steps in precision farming:

1. Data collection
2. Analysis of data
3. Decision making based on analyzed data
4. Managing field operations based on the decisions.

Data Collection with Variable-Rate Technology



1. It is necessary to collect data about the field conditions, crop growth, and yield in different parts of a farm. This can be collected at the field level or through remote sensing.

2. The following new precision farming technologies are useful at different scales and mostly provide data about spatial differences:

Geospatial technologies—such as remote sensing, Global Positioning Systems (GPS), and satellite imagery—provide information on differences in soils or crop health and performance on regional scales and weather.

Multispectral imagery captures images of land in visible, near-infrared, and red edge bands of light. When analyzed by vegetative indices it provides information of the inner physiology of a crop to spot problems before we can see them. These can be collected by satellites, airplanes, or robotic drones.

Data Analytics in Precision Agriculture

Before farmers can take action, the collected data must be analyzed to determine field and crop conditions. Remote sensed imagery is often analyzed by third-party software analytic firms to give actionable insights. Many of them combine field and weather data to make the insights more accurate. The result is a report with simple statistics and an analyzed map.

These analytics use artificial intelligence (AI) algorithms and machine learning to analyze the enormous quantities of data generated by imagery and IoT sensors. They use several vegetative indices and models to spot stress due to diseases, nutrient deficiency, etc. The fields are also analyzed for water content to identify flooding or drought.

Smart Farming Using Data-Driven Decisions

When growers get their reports, they can make data-driven management decisions. The reports subdivide a larger farm into smaller homogeneous zones based on variations in crop performance. These zones can be used to provide correct and optimum levels of inputs.

For example, using biomass analysis can check for emergence success. The software divides the field based on the percentage of emergence and uses color codes to demarcate the farm, so a grower can identify areas that need replanting and the extent of investment they have to make. By replanting only where necessary, they cut costs.

Using New and Existing Machinery

In large fields, application of decisions will take place with the help of machinery or drones with GPS. Small farms can handle the application of treatments manually.

Agricultural machinery made for VRA application, like tractors, come equipped with satellite receivers to use prescription maps. For older machines, there are small devices that can be added retrospectively to access satellite signals to guide agricultural activities on the field, like plowing or application of treatments.

Applying Variable-Rate Technology

Precision farming involves using technology and data at one or more of the many stages of farming to benefit from levelling the variability in farms.

Fertilizer application – Some of the crucial steps in precision farming are determining the right amounts and timing for fertilizer application. This can improve crop yield and nutritional quality, reduce fertilizer use and cost, and result in less nutrient pollution.

Conclusion

Precision Farming is being adopted throughout the world to increase production, reduce labor time, and ensure the effective management of fertilizers and irrigation processes. It uses a large amount of data and information to improve the use of agricultural resources, yields, and the quality of crops.

Reference

1. Messina, G., and Modica, G. (2022). The Role of Remote Sensing in Olive Growing Farm Management: A Research Outlook from 2000 to the Present in the Framework of Precision Agriculture Applications. *Remote Sensing*, 14(23), 5951.
2. SR Reddy Chapter 11 Page no 748.

Nano-Fertilizer: A Smart and Sustainable Way to Modern Agriculture

Article ID: 40816

Vinodhini P.[1], Rajavarthini R.[1]
[1]Department of Agronomy, Imayam Institute of Agriculture and Technology, Tiruchirappalli District, Tamil Nadu, 621206.

Summary
On the one hand, the green revolution expanded the use of chemical fertilizers, which increased productivity, but on the other side, it also created environmental risks. The effectiveness of traditional fertilizers in using nutrients is relatively poor. Nanotechnology may offer a better approach to get beyond all of these problems. Nano fertilizers are crucial instruments in agriculture to boost nutrient usage efficiency, lower fertilizer waste, and lower cultivation costs while also enhancing crop growth, yield, and quality metrics. With nutrient matching to the crop growth stage and the potential to give nutrition throughout the crop growth period, nano-fertilizers are particularly useful for accurate nutrient control in precision agriculture. Additionally, nanodevices will be used in nanofertilizers to synchronize fertilizer-N and -P release with crop uptake. This will prevent unfavorable nutrient losses to soil, water, and air through direct internalization by crops and prevent nutrient interactions with soil, microorganisms, water, and air. Because of this, nanotechnology, especially in underdeveloped nations, has a tremendous potential for attaining sustainable agriculture.

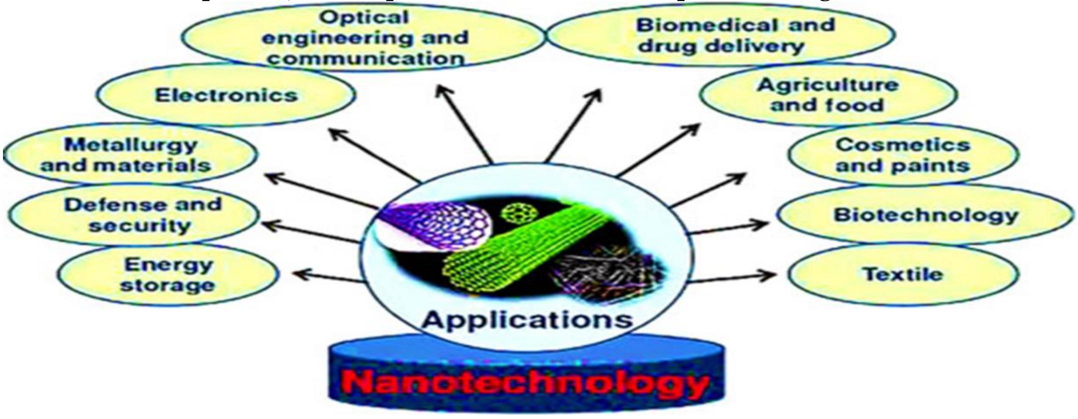
Keywords: Nanotechnology, Nanofertilizers, Nano pesticide, slow release.

Introduction
Most developing nations have long relied heavily on agriculture as their economic engine. In agriculture the main reason to use fertilizer is to give full-fledged macro and micro nutrients which usually soil lacks, 35-40% of the crop productivity depends upon fertilizers. To overcome these entire draw backs a smart way i.e., Nanotechnology can be one of the sources. Nanotechnology is the study of manipulating matter on a nanoscale. The creation, manufacturing, and use of structures, devices, and systems by manipulating their size and shape at the nanoscale. Nanotechnology deals with structure in the size range between 1- 100 nm and developing materials or devices within that size. World agriculture cropping systems intensively using large number of fertilizers, pesticides, herbicides to achieve more production per unit area but more doses than optimum level leads to severe problems like environmental pollution, low input use efficiency, decrease the quality of food materials. For solving these problems in crop production nano-fertilizers and pesticides and herbicides may effectively tools in agriculture for better pest and nutrient management because it having more penetration capacity, surface area and use effectiveness that prevent environmental contaminants. So, the value chain of the entire agriculture production system can utilize these agriculturally useful nano-particles created with the aid of nanotechnology.

Nanotechnology
Nanotechnology is the manipulation, integration or self-assembling of atoms, molecules or molecular clusters into complex form to create a material at nano scale. The Greek word for "dwarf" is where the name "Nano" derives from. One nano meter is a billionth of meter or 10^{-9} of a meter.

Nanotechnology Application in Agriculture
Worlds agriculture is now facing a lot of challenges viz., Static crop yield, low nutrient use efficiency, declining soil organic matter, multi-nutrient deficiency, shrinking arable land, water availability and shortage of labours etc.,

For this Nanotechnology, planning ultra-small particles having exponential properties. Now, it becomes an emerging and promising strategy to increase crop productivity. Now a days nanotechnology providing different Nano devices and Nano materials which having a unique role in agriculture such as Nano biosensors to detect moisture content and nutrient status in the soil and also applicable for site specific water and nutrient management, Nano-fertilizers for efficient nutrient management, Nano-herbicides for selective weed control in crop field, Nano-pesticide for efficient pest management.



Nano-Fertilizer

Nano-fertilizers are synthesized or modified form of traditional fertilizers, which are produced with the help of nanotechnology to improve soil fertility, productivity and increase Nutrient Use Efficiency. It helps in controlling nutrient loss, increase plant cell uptake because of large surface area, absorption capacity and controlled release to target site. So, it is called “Smart Fertilizer”. Due to their massive surface area and tiny size, they react strongly with other chemicals. In a variety of solvents, including water, they are extremely soluble. Particle size of Nano-fertilizers is less than 100nm which facilitates more penetration of Nano particles in to the plant from applied surface such as soil or leaves. Fertilizers encapsulated in Nano-particles will increase availability and uptake of nutrient to the crop plant.

Why Nano-Fertilizers?

Farmers typically apply fertilizers through soil by:
1. Surface broadcasting
2. Subsurface placement
3. Mixing with irrigation water or foliar spray.

However, a large portion of applied fertilizers are lost to the atmosphere or surface water bodies and pollutes the environment.

a. Nano-fertilizers are more beneficial as compared to chemical fertilizers.
b. Three times increase nutrient use efficiency
c. 80- 100 times less requirement of chemical fertilizers.
d. 10 times more stress tolerant
e. 30% more nutrient mobilization by the plant.
f. Improvement in the crop yield
g. Reduce Green house gas emission.

Difference Between Nano-Fertilizer and Conventional Fertilizer

Index	Nano-fertilizer	Conventional fertilizer
Solubility	High	Low
Dispersion of mineral micronutrients	Improved dispersion of insoluble nutrients	Lower dispersion due to larger particle size
Soil adsorption and fixation	Reduced	High
Efficiency of nutrient uptake	Increased uptake ratio; save fertilizer resource	Efficiency is low
Controlled release	Release rate and pattern precisely controlled	Excess release leading to toxicity and soil imbalance
Loss rate	Reduced loss of fertilizer nutrients	High loss rate due to leaching, drifting, runoff

Advantages of Nano-Fertilizers

1. Nano-fertilizers are advantageous over conventional fertilizers as they increase soil fertility and crop productivity through slow and controlled release.
2. Due to their small size and target specificity, they increased the Nutrient Use Efficiency (NUE) which are applied in nanoparticle form.
3. Reduce bulk requirement of traditional fertilizers and increase yield and quality of crops.
4. They are non-toxic and less harmful to environment and human as compared to conventional ordinary fertilizers.
5. Nano-fertilizers minimize the cost and maximize profit because they are used in very small quantities.

Disadvantages of Nano-Fertilizers

1. Nano-fertilizers has inhibitory effect when it exceeds the optimum concentration it causes ill-effect upon plant system viz., by it may plug the stomata pore, forming toxic layer upon the stigmatic surface, which further prevent pollen tube penetration, it may enter into vascular tissue and impair translocation of water, minerals and photosynthates.
2. The higher cost of Nano-fertilizer constitutes another hurdle in the way of promulgating them for crop production under varying Pedo-climatic conditions across the globe.
3. Nanoparticles produce waste toxic materials which if contact with soil and aquatic environment can cause contamination or pollution (eutrophication or hypoxia).

Conclusion

Nano-fertilizers have the potential to reduce environmental pollution owing to significant less losses and higher absorption rate. Moreover, nanomaterials were found to enhance fruit antioxidant content, leaf chlorophyll, plant height, root development, and number of roots. In addition, controlled and slow released fertilizers having coating of nanoparticles, enhance Nutrient use efficiency (NUE) and absorption of photosynthetically active radiation along with considerably lower wastages of nutrients. Several materials such as clay, Nano-clay, non-degradable and degradable polymers, and agriculture wastes are suitable for development of smart fertilizers by acting as carrier materials for nutrients. Nano-Fertilizers improve crop growth and yield up to optimum applied doses and concentration but they also have inhibitory effect on crop plant if concentration is more than the optimum which impacts the crop's growth and output. For a sustainable crop production, smart fertilizers having the potential to release nutrients as per plants requirement in temporal and spatial dimensions.

Reference

1. Qureshi, D.K Singh and S. Dwivedi , 2018. Nano-fertilizers: A Novel way for Enhancing Nutrient Use Efficiency and Crop productivity. International Journal of Current Microbiology and Applied Science, Vol.7 number 02.
2. Marcela Calabi-Floody, Jorge Medina, Cornelia Rumpel, Leo M. Condron, 2018. Smart Fertilizers as a Strategy for sustainable Agriculture. Advances in Agronomy, ISSN 0065-2113.
3. Veronica. N, Tulasi Guru, Ramesh Thatikunta, Narender Reddy. S, 2015. Role of Nano fertilizers in Agricultural farming. International Journal of Environmental Science and Technology,vol.1(1)Pg.no: 1-3.
4. K. S. Subramanian and J.C. Tarafdar, 2011. Prospects of Nanotechnology in Indian farming. Indian Journal of Agricultural Science, Vol. 81(10) Pg.no: 887-893.
5. S.B. Manjunatha, D.P. Biradar and Y.R. Aladakatti, 2016. Nanotechnology and its applications in Agriculture, Journal of Farm Science, Vol. 29(10) Pg.no: 1-13.

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

Nutraceutical Potential of Stone Fruits

Article ID: 40817

Anjali Langeh[1], Julie D. Bandral[1], Monika Sood[1], Skarma Choton[1]
[1]Division of Post Harvest Management, Sher-e-Kashmir University of Agricultural Sciences and Technology-Jammu, Chatha- 180009, Jammu and Kashmir, India.

Introduction

Stone fruits get their name from the pit or "stone" in their center that is encased in a fleshy outer area. Also known as drupes, stone fruits tend to have thin skins that may be fuzzy or smooth. The pit is actually a large seed, and stone fruits can be either clingstone or freestone depending on how easily the flesh pulls away from the seed. Since most stone fruits won't ripen after being harvested, they're picked at their peak and only good for a small window of time. This makes them highly seasonal, with different stone fruits arriving at different seasons.

The term stone fruits commonly refers to certain species of the genus Prunus which is a member of the rose family (Rosaceae) (Looney and Jackson, 2006). These fruits include almonds (P. dulcis), apricots (P. armeniaca), sweet cherries (P. avium), sour or tart cherries (P. cerasus), several species of commercial plums, the most important being the European plums (P. domestica) and the Asian or Japanese plums (P. salicina), peaches and nectarines (P. persica). The term stone fruits derives from the woody endocarp (stone or pit) which characterises the fruits of these species. The edible portion of stone fruits consists of the fleshy epicarp and mesocarp which encloses the stony endocarp. The exceptions are almonds and certain apricots whose seeds are consumed (Looney and Jackson, 2006). Botanically, the fruit of stone fruits is classified as a drupe.

There are many different types of stone fruit available, each of which offers its own unique set of nutrients, health benefits and uses. Here are a few of the top stone fruits examples: Peaches, Cherries, Mangoes, Apriums, Plums, Raspberries, Nectarines, Green Almonds, Apricots, Coconuts, Pluots, Olives, Dates, Lychee, Blackberries, Mulberries.

Peach: (*Prunus persica*) the most delicious stone fruit belongs to the family Rosaceae. It is temperate in nature and considered as the native of China. It has delicious taste, attractive flavor and aroma. Peaches contain about 10-14% sugar, 2% fiber and 2% protein along with vitamins of B group, ascorbic acid, folic acid, calcium, potassium and zinc. It contains vitamin A to combat the effects of aging and its ß-carotene also helps to build a strong immune system to prevent damage from free radicals, as well as to avert many skin diseases (Saleem *et al.,* 2011).

Apricot: Among stone fruits, apricot is a carbohydrate- rich commodity and is a good source of fibers, minerals and vitamins (Fatima *et al*, 2018). Carbohydrate concentration in fresh apricots ranges from 11-13% and provides 50 kcals of energy per 100g on fresh weight basis (Leccese et al. 2007).

Cherries: Sweet cherries are characterized by a higher content of simple sugar (13 g/100 g) with respect to sour cherries (8 g/100 g). Cherries contain both water soluble (C, B) and fat soluble (A, D, E and K) vitamins and some carotenoids, in particular beta-carotene, and to a lower extent lutein and zeaxantine. Sour cherries are characterized by an higher content of vitamin A and beta-carotene. Cherries contain also minerals such as calcium (14 mg/100 g), magnesium (10 mg/100 g), phosphorous (20 mg/100 g) and potassium (200 mg/100 g) (Ferretti *et al.,* 2010).

Mango: Mango (*Mangifera indica*) is a tropical fruit which belongs to family Anacardiaceae and having huge range of varieties and health benefits. It is a rich source of vitamins, polyphenols, antioxidants, carotenoids, and phenolic acids. Mango contains a high nutritional value and being rich in its nutritional and phytochemical composition it exhibits many beneficial characteristics which includes anti-inflammatory, antioxidant, cardiac protection, wound healing, anti-microbial, anti-viral, anti-tumor, anti-pyretic, anti-dysentry, as well as hypolipidemic, immunomodulatory, gastroprotective and hepatoprotective effects (Mubarik *et al.,* 2020).

Health Benefits of Stone Fruits

Stone fruits are delicious, nutritious and bursting with health benefits. Here are a few of the top reasons you should consider squeezing a few servings of stone fruit into your diet.

1. High in Antioxidants: Stone fruits are high-antioxidant foods, which are important compounds that can help fight free radicals to protect against cell damage and disease. In fact, studies show that antioxidants may play a central role in the development of chronic conditions, such as heart disease, cancer and diabetes.

Stone fruits like nectarines are an excellent source of several key antioxidants, including vitamin C, flavonoids and anthocyanins, all of which can reduce inflammation and prevent oxidative stress.

2. Promote Digestive Health: Stone fruits are loaded with fiber, an essential nutrient that is involved in several aspects of health. Fiber moves through the intestinal tract undigested, slowing the emptying of the stomach and adding bulk to the stool to support regularity. In addition to promoting better blood sugar control, lowering blood pressure and keeping cholesterol levels in check, research shows that upping your intake of fiber may also help protect against several digestive issues, including acid reflux, hemorrhoids, constipation and diverticulitis.

3. Strengthen Bones: Most types of stone fruit are high vitamin K foods, a fat-soluble vitamin that is most well-known for its role in blood clotting. However, vitamin K is also essential for bone health and can help prevent serious issues, like fractures, bone loss and osteoporosis.

4. Support Immune Function: Adding a few servings of stone fruit to your daily diet is a great way to ensure that you get enough vitamin C in your diet. Vitamin C is a water-soluble micronutrient that doubles as an antioxidant, blocking the buildup of harmful free radicals that contribute to disease.

Not only that, but vitamin C is especially important when it comes to immune function. According to one study, getting adequate amounts of vitamin C in your diet could potentially help reduce symptoms and decrease the duration of respiratory infections like the common cold.

What's more, vitamin C foods may also improve outcomes for other conditions as well, including pneumonia, malaria and diarrhea.

5. Boost Weight Loss: Stone fruits are low in calories yet high in fiber, making them an awesome addition to a well-rounded weight loss diet. Because it moves through the body slowly, increasing your intake of fiber can help keep you feeling full between meals to fight cravings and enhance weight loss. In fact, eating more fiber was linked to a reduced risk of weight gain and fat gains in women.

Other research suggests that fruit intake may even help support weight management as well. One review out of Korea reported that the anti-obesity effects of fruit may be due to the ability to promote satiety, improve gut health, decrease total caloric intake, and provide a variety of vitamins, minerals and phytonutrients.

6. Improve Vision: Boasting a wide array of antioxidants and polyphenols, enjoying a few servings of stone fruit each day may help maintain eye vision and protect against disease. In particular, studies show that stone fruit could aid in the prevention of age-related macular degeneration, a disease that affects nearly 9 percent of the global population and is considered one of the leading causes of blindness among older adults.

Conclusion

Stone fruits are good sources of vitamins, minerals, anthocyanins and polyphenols. They are a rich source of bioactive compounds. They have several health benefits and helps in reducing the chances of many diseases such as cancer, heart attack and diabetes.

Reference

1. Looney, N., Jackson, D. (2006). "Stonefruit," in Temperate and subtropical fruit production. Eds. Jackson, D. I., Looney, N. (Oxfordshire - UK: CABI Publishing), 171–188.
2. Leccese A, Bartolini S, Viti R. Total antioxidant capacity and phenolics content in apricot fruits. International Journal of Fruit Science. 2007; 7(2): 3-16.
3. Fatima, T., Bashir, O., Gani, G., Bhat, T. A. and Jan, N. 2018. Nutritional and health benefits of apricots. *International Journal of Unani and Integrative Medicine.* **2**(2): 05-09.

4. Saleem, N., Kamran, M., Shaikh, S. A.,Tarar, O. M. and Jamil, K. 2011. Studies on processing and preparation of peach squash. *Pakistan Journal of Biochemistry and Molecular Biology*. **44**(1): 12-17.
5. Ferreti, G., Bacchetti, T., Belleggia, A. and Neri, D. Review- cherry Antioxidants: From Farm to Table. *Molecules*. 15: 6993-7005.
6. Mubarik, F., Noreen, S., Farooq., F., Siddiqa, A and Khan, M. 2020. A review on Pharmacological and Nutritional benefits of mango (Mangifera indica Linn.) : A remedy for cancer, diabetes and gastrointestinal infections. *Abasyn Journal of Life Sciences*; 3(2): 82-92.

Designer Milk - Milk for Human Health Benefit

Article ID: 40818

Pranjali B. Meshram[1], Abasaheb K. Parade[1], Chetan Chougale[1]
[1]Ph.D Research Scholar, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krushi Vidyapeeth Rahuri. 413722, Ahmednagar (MH).

Among all the foods available, milk is a natural complete and balanced food, which is a rich source of fat, protein, essential vitamins and minerals. In particular, milk is a good source of calcium that is very much essential for the prevention of bone disorders such as osteoporosis and it is also necessary for the growth and development of new born young one, growing children's.

In modern era consumers are very much aware about their health. So, the demand of functional foods is increasing day by day at a global level. The optimistic views of increasing demand of Functional foods are also supported by number of institutions and health related organizations such as the American Dietetic Association.

To compete with the today's demand of human beings, milk has to be designed in such a way, which increases its properties according to the need of the changing scenario. Designer or enriched milk are those in which the content has been modified from the standard constituent of milk.

Designer milk will give improved and value added products naturally with improved neutraceuticals to meet the requirement of new generations. Now a day's biotechnologists have identified genetic markers in cows for disease or desirable traits such as milk fat synthesis.

So future perspective cow will produce low milk fat naturally, which can be achieved through combination of traditional genetics, marker assisted selection and genetic modification of dairy cattle and by farm and feed management. From Human Health point of view some of the desirable improvements are:

a. Increased proportion of unsaturated fatty acids and low-fat milk and its products
b. Low lactose content
c. Complete absence of b-lacto globulin from milk. Such type of milk may be classified as humanized milk, milk with high therapeutic purpose.

Applications of Designer Milk

The applicability of designer milk can be classified into two categories i.e. in diet and human health measures as well as in processing/technological developments. Among applications of designer milk in diet and human health is that it generates a greater proportion of Unsaturated Fatty Acids (USFA) in milk fat, reduced lactose content that benefits lactose intolerant individuals and removal of β-lacto-globulin from milk. However, it applicability in processing and technological developments includes alteration of primary structure of casein to improve technological properties of milk, production of high-protein milk, accelerated curd clotting time for cheese manufacturing, increased yield and/or more protein recovery, milk containing nutraceuticals and replacement for infant formula etc.

Relation Between Nutrition and Health

In order to strengthen the immune system for the prevention of various diseases and thereby to improve health, dietary strategies may be effective alternatives. In western and developing countries, consumption of milk and dairy products is increasing, but milk fat contains lauric, myristic and palmitic acids that increase the level of cholesterol, so it has a poor health impact, but some milk components such as conjugated linoleic acids, butyric acids and n-3 polyunsaturated fatty acids have health benefits and participates in chronic disease prevention. Whey proteins of milk also contain good amount antimicrobials, such as lactoferrin, lactoperoxidase, lysozyme, and immunoglobulins. Casein protein, vitamins A, E, K and D, probiotics, different minerals (calcium, phosphate, potassium, magnesium, chloride) and energy are also present in milk.

Nutritional Alterations to Produce the Designer Milk

Less than 10% polyunsaturated fatty acids, less than 8% saturated fatty acids and more than 82% monounsaturated fatty acids are the ideal milk fat for human wellbeing. At different stages, the milk components may be altered.

Rumen microbiota is the source of bioactive fatty acids in ruminants, which are incorporated into animal milk and meat. Dietary ingredients have an effect on milk composition of animals. Altering the composition of milk by dietary interventions is feasible.

The proportion of potentially safe milk fatty acids, oleic acid, vaccenic acid, rumenic acid, alpha-linolenic acid, and total polyunsaturated fatty acids increased in the diet of lactating cows by supplementing canola, soybean oil and linseed rich in alphalinolenic acid.

In general, ruminant foods contain Polyunsaturated Fatty Acids (PUFAs), but ruminant products such as meat or milk contain saturated fatty acids and certain quantities of Conjugated Linoleic Acid (CLAs).

This is due to the lipolysis of microbial enzymes and the bio-hydrogenation of rumen Polyunsaturated Fatty Acids (PUFA). The main rumen-grown bio- hydrogenation bacteria are Butyrivibrio fibrisolvens. Manoeuvring the rumen environment creates opportunities to alter the lipid composition of meat and milk by modifying the disposition of intramuscular and mammary tissue Fatty Acids (FA) for absorption.

Various probiotics or microbial feed supplements favourably alter lipid metabolism and modify milk composition. Phytometabolites such as tannins, polyphenol oxidase, essential oils, fatty acid oxygenation and saponins have various effects on the composition of the milk and increase the consistency of the milk.

Pastured cow milk has a higher ratio of Essential Fatty Acids (EFAs) and grass-fed cow milk has higher conjugated linoleic acid than grain-fed animal milk. A varying number of microbiota or microbial metabolites of the rumen may also alter the composition of the milk.

As the fatty acid composition of rumen microbiota is changed by the grazing regime, it can be used to change rumen microbial populations, thus changing the milk fatty acid profile. With the dietary addition of fish oils or fish meal, changes in milk fat concentration of Conjugated Linoleic Acid (CLA) are also observed.

Benefits of Designer Milk

Eating designer milk has several health benefits that are:

1. Reduce the problem of lactose intolerance by decreasing the lactose level in designer milk
2. By increasing omega- fatty acids in the designer milk lower the risk of cardiovascular disease, autoimmune disorders, allergies, obesity, and diabetes
3. By minimizing saturated fats in the milk, lowering the incidences of obesity, cholesterol l levels, and cardiovascular diseases
4. By altering protein contents, increasing casein to obtain an increase in cheese yield
5. Phytosterol-enriched vitamin A milk decreases serum levels of triglycerides, low-density lipoprotein cholesterol, and apolipoprotein-B that have a detrimental effect on health.

Conclusion

Consuming designer milk and milk products improves human health and well-being. Animal nutritional intervention, with an increasing interest in functional and nutraceutical foods, can easily help design milk with various functions and utility. Some important compounds like carotene, needed for normal body function cannot be synthesized by the human body can easily be fortified and supplemented by designer milk.

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

Health Benefits of Probiotics in Livestock

Article ID: 40819

Pranjali B. Meshram[1], Abasaheb K. Parade[1], Chetan Chougale[1]
[1]Ph.D Research Scholar, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krushi Vidyapeeth Rahuri. 413722, Ahmednagar (MH).

Introduction

Probiotics are defined as live microbial food supplements which beneficially affect the host animal by improving its intestinal microbial balance. In the last 10 years, the use of probiotics in the feed of farm animals such as pigs, poultry, ruminants, aquaculture feeds, and pet feeds has increased significantly. In the modern animal nutrition, probiotics are included in the group of feed additives for stabilizing the intestinal microflora. They are also known as **bioregulators, intestinal microflora stabilizers or direct-fed microbials**.

Once ingested, the probiotic microorganisms can modulate the balance and activities of the gastrointestinal microbiota, whose role is fundamental to gut homeostasis. It has been demonstrated that numerous factors, such as dietary and management constraints, can strongly affect the structure and activities of the gut microbial communities, leading to impaired health and performance in ruminants and monogastric animals **(Equines, pigs, poultry and fish)** as well as their implications in terms of animal nutrition and health.

Probiotics belongs to the group of lactic acid bacteria, bacillus spores and yeast. The dynamic equilibrium of the microflora is regulated by the co-existence of the various bacterial species in the open ecosystem of the gastrointestinal tract. The composition of the intestinal microflora changes with the ambient conditions in the intestine.

Probiotic bacteria modulate the metabolic activity of the gut flora. Probiotics, being able to lower the pH in the intestinal tract, may thus be able to interfere with the enzymatic activity of the flora. Protection of the intestinal mucous membrane against invading microorganisms.

Antagonistic action against invading microorganisms or against non-desirable microorganisms. Contribution to the maturation and stimulation of the host's immune system, for instance by production of immunoglobulin A. Improved digestion and absorption capacity of nutrients.

Detoxification of toxic molecules. Influence on the metabolism of bile acids and thus promoting the absorption of fat.

The probiotics were improved feed conversion for the target species, reduced morbidity or mortality and benefits for the consumer through improved product quality. Probiotics were enhanced the growth of many domestic animals, improved the efficacy of forage digestion and quantity & quality of milk, meat and egg. Probiotics protected animals against pathogens, enhanced immunity response, reduced antibiotic use and shows high index of safety.

Bacterial probiotics were effective in chickens, pigs and pre ruminant calves, whereas yeast and fungal probiotics such as Saccharomyces cerevisiae and Aspergillus oryzae has given better results in adult ruminants. The combination of probiotics strains could increase the beneficial health effects compared with individual strains, because of their synergistic adhesion effects.

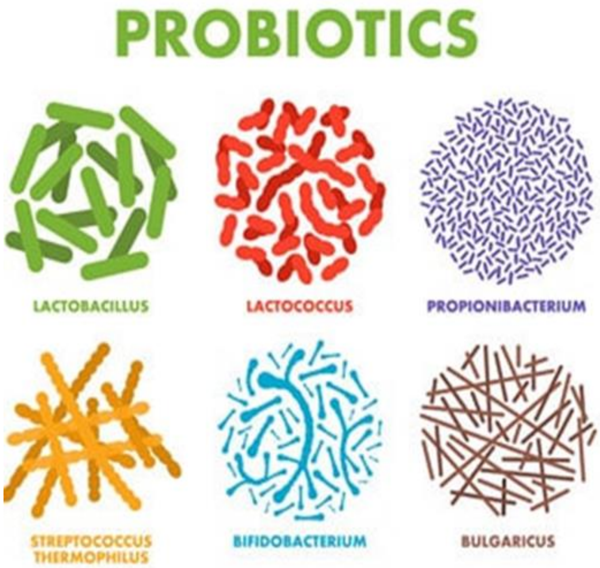
Potential Beneficial Effects of Probiotics in Animals

1. Greater resistance to infectious diseases
2. Increased growth rate
3. Improved feed conversion.
4. Improved digestion.
5. Better absorption of nutrients
6. Provision of essential nutrients
7. Improved milk yield
8. Improved milk quality.
9. Increased egg production.
10. Improved egg quality
11. Improved carcass quality and less contamination
12. Avoid hindgut disorders (acidosis, colic etc.) and increase digestibility of diet.
13. Limit stress (transportation, race etc.)
14. Limit occurence of constipation
15. Increase litter size and vitality.

Which are the Important Microorganisms being Used as Probiotics?

Probiotics are found naturally in products of the human diet, such as yogurt and other fermented foods.

Probiotics used in animal nutrition are generally produced commercially and offered to the market in liquid and solid forms. Probiotics are classified as bacteria, yeast and fungi. The most commonly used probiotic bacteria in animal feeds include ***Lactobacillus, Bacillus, Streptococcus, Pediococcus, Enterococcus, Bifidobacterium,*** and ***Propionibacterium.*** Some important are Lactobacillus acidophilus, Lactobacillus bifidus, Lactobacillus bulgaricus, Lactobacillus lactis, Lactobacillus plantarum, Lactobacillus salivarius, Streptococcus thermophilus, Enterococcus faecium, E. faecalis, Bifidobacterium bifidium species and Bacillus subtilis. Most commercially available probiotics such as these are noted to contain more than one species for maximum potency, and some also contain fungi and yeast.



Characteristics of a Good Probiotic

The culture should able to exert a positive effect on the host, it should be gram positive, acid resistant, bile resistant, nonpathogenic, nontoxic, culture should possess high survival rate and multiply faster in the digestive tract, adhesive capacity of microorganism must be firm and faster, able to resist the antibacterial activity that operate in the gut.

Probiotics in Poultry Nutrition

1. Growth rate - Probiotics have enhanced the growth rate in broilers better than Antibiotics Growth Promotor (AGP) Lavilamyon) and other substitutes for AGP, such as phytochemicals leg essential oils) Many strains of probiotic microbes improve the growth rate of poultry, but results can be inconsistent.

2. Feed Intake and feed efficiency - The effect of probiotics on feed intake and feed use efficiency may be growth phase dependent. Many prebiotics have positive effects on feed intake and feed use efficiency: However, as with other effects of probiotics, the impact on feed intake and feed une efficiency has not been consistent across studies or with different probiotics.

3. Carcass yield and quality- Few studies have seen the positive effects of probiotics on carcass yield and quality in poultry, growth rate and feed use efficiency (FCR) of poultry Tenderness & Water holding capacity of poultry meat was increased (reduced drip lons) in birds fed with the probiotic coagulans. The intramuscular fat content in breast muncle was increased in birds treated with probiotic C butyricum, while there was no effect with the probiotic E. faecium. So, the effects of probiotics on carcass quality and yeld are inconclusive.

4. Nutrient Digestibility- Probiotics can improve nutrient digestibility in poultry since strains of probiotic microbes produce enzymes, but the interaction with different feedstuffs used in poultry diets is little understood at present.

5. Intestinal histomorphology- Probiotics in poultry diets can affect the histology of the intestinal mucosa. The villus height and the villus: crypt ratio in the intestinal mucosa were increased by use of probiotics results in increase absorption of nutrients due to a larger surface area

6. Control or prevention of enteric pathogens - Probiotics could be a potential alternative to antibiotic feed additives to manage the enteric pathogen like salmonellosis, campylobacteriosis, coccidiosis, clostridium caused necrotic entents etc. load in poultry, by reducing intestinal colonization and spread of common zoonotic and other enteric pathogens.

7. Egg production and quality - While probiotics can affect the production, feed use efficiency and quality of eggs in laying hens, these effects have been very inconsistent. One of the most promising effects of probiotics on egg quality is the consistent reduction of cholesterol in egg yolk. Yolk cholesterol has been reduced by lactic acid bacteria, Bacillus spores and yeast.

Probiotics in Pig Nutrition

1. Growth rate and feed use efficiency-Probiotics can enhance the growth of pig but with less consistent results than for poultry

2. Health - Probiotics can be effective in reducing post weaning diarrhoea in piglets and morbidity and mortality in pigs •GIT microbial population-in pigs, probiotics increased lactic acid bacteria and decreased Clostridium, E. coli and Enterobacterium spp. in the GIT.

Probiotics in Ruminant Nutrition

1. Milk yield - Probiotics can improve the milk yield in dairy animals. Increased feed intake together with improved microbial digestion of feed could be the possible mode of action for improved animal performance. Growth Probiotics can increase the weight gain of ruminants. Probiotics feeding to pregnant animal results in increase dry matter (DM) intake and live weight gain during pregnancy, followed by better performance of the young ones during early lactation.

2. Nutrient digestibility- The improvement in performance by ruminants is often associated with improvement in nutrient digestibility. Probiotics feeding improves the digestibility of crude protein (CPL neutral detergent fibre (NDF) and acid detergent fibre (ADF) in lactating cow resulting in increased milk production per day without increase in dry matter intake (DM) due to a change in the rumen microbial ecosystem. Therefore, probiotic feeding improve productivity, increase milk yield induce better nutrients digestion and enhance growth rate in ruminants.

3. Health - Probiotics can reduce diseases of ruminants particularly those related to the disturbance of rumen pH. Probiotics are believed to stabilize ruminal pH by modulating rumen microbes Lactate utilizing bacteria (*Megaphora endemi*) could potentially be used to prevent the accumulation of lactic acid in the rumen. However, the establishment of such micro-organisms in the rumen is Similarly, probiotics are effective in reducing the incidence of call scours by preventing ruminal dysbiosis. Probiotics are also effective in reducing the faecal shedding of the shiga-toxin producing. However, these responses to use of probiotics are highly variable and reflect differences in micro-organisms used as probiotics and differences in animal husbandry practices (nutrition, housing etc.)

4. Rumen fermentation - It has been postulated that yeast-based probiotics in ruminants increase the number of cellulolytic bacteria, which affects the microbial fermentation, resulting in higher cellulose degradation and increased microbial protein production. Although probiotics, especially Saccharomyces cerevisiae can improve digestibility of low-quality roughage by ruminants, the results are inconsistent.

Effects of Probiotics on Animal Health & Performance

In ruminants yeast cultures can stimulate forage intake by increasing the rate of digestion of fiber in the rumen in the first 24 h after its consumption. This improvement in early digestion and intake is brought by alteration in the numbers and species of microorganisms in the rumen, results in improved feed efficiency, improved live weight gain, milk yield and milk fat content.

The use of probiotics in ruminants has primarily focused on improving ruminal fermentation efficiency stabilization of rumen ph and lactate levels, enhanced fibre digestion, reduction of methane production in rumen, thereby impacting production performance.

Probiotics are able to enhance nutrient absorption, improve gastrointestinal health, reduce diarrhoea and promote growth and development of the animals. Direct fed probiotics have been shown to reduce rumen acidosis. Lactobacillus and Bifidobacterium species have been shown to provide protection against enteric infection.

Protection against pathogens- the indigenous intestinal bacteria inhibit pathogens by competition to colonization sites and nutritional sources.

Immunomodulatory activity in gut- by stimulating the secretion of immune modulators like IgA and cytokines in intestinal mucosa and thus improved disease resistance power

Pre ruminant calves-it was suggested that probiotics are beneficial for establishing and maintaining a positive microbial balance in newborn calves by decreasing the prevalence of coliform.

Conclusion

Probiotics can anticipate a hopeful future in dairy animal diet due to its advantageous property and no marvelous result on the dairy animal yield. In India, the use of probiotics is inadequate for increased milk production in dairy animals. Probiotics can be valuable to improve the animal production and health. The farmers are dependent on grazing/meadow land and harvest residues in India. So, Proper probiotics should be used for dairy animal diet for increased milk production which is beneficial to the dairy farmers.

Probiotics are gaining value as an alternative feed supplement in this environment. Especially in the last 10 years, the use of probiotics as supplements in animal feed for health and performance reasons has increased significantly. The intestinal microflora is disturbed by stress factors such as change of feed, transportation and climate. An increased infection pressure is expected (mixing animals of different origin, climatic influences). The feed composition encourages the proliferation of pathogenic microorganisms in the digestive tract (increased content of buffer ingredients such as proteins, phosphorus, calcium and low crude fiber content). The intestinal microflora is compromised by the use of therapeutics, especially antibiotics.

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

Care and Management of Dairy Animal

Article ID: 40820

Pranjali Bhaudas Meshram[1], Abasaheb Kalyan Parade[1], Sujit Balu Bhalerao[1]
[1]Ph.D Research Scholars, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth Rahuri-413722, Ahmednagar (MH).

Care and Management of Calf

We must give good feeding and management for the calves so that they develop well and, useful for replacement stock. The feeding and care of the calf being before its birth. The dam should be dried 6-8 weeks before expected calving and should be fed well. Under fed animals will give weak and small calves.

Early Management

1. Immediately after birth remove any mucous or phlegm from those nose and mouth.
2. Normally the cow licks the calf immediately the birth. This helps' dry off the calf and helps in stimulating breathing and circulation. When the cows do not lick or in cold climate, rub and dry the calf with a dry cloth or gunny bag. Provide artificial respiration by compression and relaxing the chest with hands.
3. The Naval should be tied about 2-5 cm away from the body and cut 1cm below the ligature and apply Tr. Iodine or boric acid or any antibiotic.
4. Remove the wet bedding from the pen and keep the stall very clean and dry in condition.
5. The weight of the calf should be recorded.
6. Wash the cow's udder and teats preferably with chlorine solution and dry.
7. Allow the calf to suckle the first milk of the mother i.e. Colostrums.
8. The calf will be standing and attempts to nurse within one hour. Otherwise help too weak calves.

Feeding of Calves

1. Feed colostrums i.e. the first milk of the cow for the first 3 days. The colostrums are thick and viscous. It contains higher proportions of Vitamin A and proteins. The proteins are immune globulin which gives protection against many diseases. Colostrums contain anti trypsin which avoids digestion of immunoglobulin in the stomach and is absorbed as it is.
2. Whole milk should be given after 3 days it is better to teach to, drink the milk from the pail or bucket. Feed twice a day which should be warmed to body temperature. For weak calves feed thrice a day.
3. The limit of liquid milk feeding is 10 % of its body weight with a maximum of 5-6 liters per day and continue liquid milk feeding for 6.10 weeks. Over feeding causes 'Calf Scours'.
4. The milk replaces can be given to replace whole milk.
5. Give calf starter after one month of age.
6. Provide good quality green fodder and hay from 4'h month afterwards.
7. Feeding of antibiotics to calves improves appetite, increases growth rate and prevents calf scours. E.g. aureomycin, Terramycin etc.

Management Practices

1. Identity the calf by tattooing in the ear at birth, and branding after one year.
2. Dehorn the calf within 7-10 days after birth with red hot Iron or caustic potash stick or electrical method.
3. Deworm the calf regularly to remove worms using deworming drugs. Deworm at 30 days interval.
4. Fresh water should be given from 2 -3 week onwards.
5. House the calves in individual calf pens for 3 months afterwards in groups. After six months males and females calves should be housed separately.
6. Weigh the calves at weekly interval upto 6 months arid at monthly interval afterwards to know the growth rate.
7. Mortality in calves is more in first month due to pneumonia. Diarrhea (calf scous) and worms.
8. House them under warm condition, clean condition to avoid above condition.
9. Extra teats beyond 4 should be removed at 1-2 months of age.
10. 8-9 weeks of age, males should be castrated.
11. Keep the body clean and dry to avoid fungal infection.
12. Mineral-blocks should be provided, so that the calves lick and no changes for mineral deficiency.
13. Wean the calf from the mother and feed through pail feeding system.

Tagging for Identity

Individual Calf Pen

Care and Management of Heifer

Better Care and Management of heifer will give high quality replacement stock to the dairy farm. The following care and Management practices are recommended for a heifer.

1. Feed the heifer sufficiently to produce normal growth. During the early stage relatively more protein than energy is needed. Most heifers grow well if excellent hay is given as much they can eat. The amount of growth depends upon the quality of forage fed.

2. The heifers should be provided with a dry shelter free from drafts. A loose housing system with a shelter open to one side is sufficient.

3. The size rather than the age of a dairy heifer at breeding time is important. Breeding under sized animals is never profitable. They may be stunted or slow to reach maximum size. Small heifers are more likely to have difficulty in calving. Though the heifer that is bred to calve at an older age yields higher milk yield in the first lactation, the total milk produced by such a cow will be less when compared to the heifers that freshens at an

4. The heifer should be growing and in good flesh at calving time. This is necessary so that she can produce milk at the most profitable level.

5. Place the heifer in a separate shed about 6-8 weeks before she is due to calve.

6. Feed 2 - 3 kg of concentrate daily and all the forage she eats.

7. Before calving let the heifer becomes accustomed to handling and to the procedures used in the milking herd. Always handle her gently and with kindness.

8. Maintenance of health among heifers is very important for proper growth. The health among the heifers is maintained by hygienic housing, water balanced feeding and taking necessary preventive steps against common diseases.

9. Periodically the heifers in the herd should be checked for their proper growth and other progress. Animals lagging behind below the required standards should be removed from the herd.

10. For the heifer the calving is first time and it may have difficulty in calving. So take extra care during calving.

Care and Management of Milch Animal

To get high milk during any lactation, the milch animal should be properly fed and necessary care and manage mental practices should be followed.

1. Provide green succulent forage together with leguminous hay or straw to the extent of animal can consume, so that all its maintenance requirements are met with through forage only. Extra concentrate at the rate of 1 kg for every 2 to 2.5 liters of milk should be provided. Salt and mineral supplements should be given to maintain the lactation.

2. Never frighten or excite the animals. Always treat them gently and with kindness.

3. With proper feeding and care, a cow will come to heat within 16 days of calving. Do not withhold service unnecessarily after the signs of heat are noticed in a cow. The shorter the interval between calving, the more efficient the animal is as a milk producer. By maintaining proper records of breeding and calving of the animals will ensure a study flow of milk throughout the year.

4. Individual attention to feed each animal according to its production is a must. For this purpose maintain individual production records.

5. Keep up regularity of feeding. Concentrate mix is fed before or during milking, when as roughages after milking. This practice will avoid dust in the shed.

6. Water should be provided to drink at will or at frequent intervals. It is more beneficial, if the animal is maintained on paddy straw as sole rough age.

7. Regularity in milking is essential. Increase of milk in the udder will reduce further secretion of milk. Milking thrice is better than twice since 10 - 15 % more milk can be produced.

8. Rapid, continuous, dry hand milking should be practiced without undue jerking of teats. milking should be done with whole hand, but not with thumb and index finger.

9. Cows should be trained to let down milk without calf suckling. This will hold to wean the calves early.

10. Loose housing with shelter during hot part of the day should be provided. The animals will get maximum exercise in loose housing system.

11. Grooming of the cows and washing of the buffaloes before milking help in clean milk production. Daily brushing will remove loose hair a dirt from the coat. Grooming will also keep the animal hide pliable.

12. Wallowing of buffaloes or water spraying on their bodies will keeI6 the buffaloes comfortable especially in summer.

13. Common ailments should be properly detected and treated.

14. Common vices should be properly detected and care should be taken. Eg: Kicking, licking, suckling etc.

15. Provide at least 60 - 90 days dry period between calving. If the dry period is not sufficient, the milk yield is subsequent lactation will be reduced.

16. Vaccinate the cows- against important diseases and also guard against insects and pests.

17. Every animal should be numbered and particulars pertaining to milk, fat %, feed taken, breeding, drying and calving dates should be recorded.

18. Check for mastitis regularly.

Care & Management of Heifer

Care and Management of Dry and Pregnant Animal

The good care and manage mental practices given to pregnant animal will give good calf and also high milk yield during the successive lactation.

Care and Management of Bulls and Bullocks

1. Extra concentrate mix of 1.25 to 1.75 kg should be provided for pregnant animal as pregnancy allowance. Feed good quality of leguminous fodder. The animal should not be not - lean - not fat' condition.

2. Provide clean drinking water and protection from thermal stress.

3. Do not allow them to mix with other animals that have aborted or that are suffering from or carriers of diseases like brucellosis.

4. Allow moderate exercise, which helps in calving normally.

5. Do not tire them by making long distances especially on uneven surfaces.

6. Do not allow them to fight with other animals and take care that they are not chased by dogs and other animals.

7. Avoid slippery conditions, which causes the animal to fall receiving fractures, dislocation etc.

8. If accurate breeding records are available, calculate the expected date of calving. Separate it one or 2 weeks before and shifted to individual parturition pens.

9. These pens are thoroughly cleaned and fresh bedding may be provided.

10. Feed one kg extra concentrates during last 8 weeks of gestation.

11. Feed laxative about 3 - 5 days before and after calving (Wheat bran 3 kg + 0.5 gm of Groundnut cake + 100 gm of mineral mixture of salt).

12. Symptoms of delivery may be observed i.e. swelling of external genetalia, swelling of udder; usually majority of animals will deliver without any help. If there is any difficulty, provide veterinary help.

13. After parturition external genital, flank should be cleaned arid protect the animal from chill and give warm wafer.

14. Placenta will normally leave the cow within 2 - 4 hours after calving. It not take the help of a veterinarian. Take care of the animal before calving from milk fever.

15. Give calcium supplement. Sometimes the udder will be swollen just before calving. Remove the milk partially. Take care, of the animal, if at all any abortion. Provide always free access to drinking water.

Care and Management of Bull

1. The maintenance of breeding bulls in good condition and suitable for breeding is highly essential requirement for the success of breeding programme. A rising condition is better for reproduction than a falling one. Fat males may produce semen of inferior quality or they may be slow or fail at service. Breeding bull should receive plenty of exercise; will usually produce large ejaculation containing more sperms of higher activity. A breeding bull should house separately known as "Bull Shed" with sufficient area of floor and proper covering. It is sound practice to provide cool conditions and adequate drinking water. A balanced ration should be fed containing adequate energy, proteins, minerals, and vitamins. Green fodder must be available both before and during breeding season.

2. Most of the bulls are ferocious and so control them properly using nose rings etc. It is of great importance that males should be, fed regularly and not too much at one time, and too little at another. For bulls two mating a day has been found to be openings. Moderate exercise should be provided to keep the breeding bull in active and non-fatty conditions. Regular grooming of the breeding bull is practiced. In buffalo bulls regular shaving may be practiced.

Care and Management of Bullock

1. Bullocks are normally used for agricultural operations and or transport purpose. Some bullocks are ferocious and so control them properly with nose rope or nose rings. The hooves of the bullocks should be provided with metal shoes to protect the hooves from wear and tear. The working hours for bullocks are recommended as follows:

2. Normal Work - 6 hours of carting or 4 hours of ploughing. Heavy Work - 8 hours of carting or 6 hours of ploughing

3. Sufficient roughages and 1-2 kg of concentrates may be provided for feeding of bullocks during break period in works, the animal may be left for free grazing. The bullocks are housed in separate sheds with sufficient space and protection from hot and cool conditions. Free access to drinking water is essential. Regular grooming of animals should be practiced.

Types of Remote Sensing and its Advantages in Agriculture

Article ID: 40821

Pallavi Bharti[1], Pankaj Kumar Ray[2]
[1]Research Scholar, Birsa Agricultural University, Ranchi, Jharkhand.
[2]Subject Matter Specialist, Krishi Vigyan Kendra, Saharsa, Bihar.

What is Remote Sensing?

Remote sensing fundamentally involves the checking of land from advanced equipment from far distances. The checking includes the physical characteristics of a piece of land. The process works by estimating the produced and reflected radiation from the land, which helps structure a picture of the land and assists specialists with passing judgment on specific parts of the land.

What is Remote Sensing Used for?

To augment crop development and increase yield in a tough market, producers tend to exploit the most recent tech accessible. To guarantee the greatest yield, farmers need the harvests to remain in the most ideal health. Observing the strength of harvests over a huge region becomes significantly simpler with the utilization of remote sensing in agriculture. The data gathered from the process supports precision growing, empowering farmers to accomplish higher yields from their harvests.

How does Remote Sensing Work?

The process of remote sensing in agriculture works through information gathered by different devices over a period. The gathered data can then be used to analyse different aspects of the crop and yield. This analysis is used for making changes to the crops to ensure maximum output. The process can be used to conduct a variety of analyses and implement measures accordingly. Common threats faced by farmers are pest infestation and weeds in the crops. Remote sensing in agriculture can help detect those early on and warn the farmers to take the necessary countermeasures to ensure the health of crops. To carry out the process over different areas of land fluctuating in sizes and sorts of harvests, various kinds of devices and sensors are utilized.

Types of Sensors

Sensors of various sorts are utilized together to gather various kinds of information over fluctuating sizes of grounds. Sensors are fundamentally categorized into their logistical types. There are satellite sensors, Aerial sensors, and ground-based sensors.

These sensors can be further categorized such as the ground sensors and can come in varying configurations. There are handheld ground sensors, there are vehicle-mounted ground sensors, such as the ones mounted to tractors and there are freestanding ground sensors that are typically mounted to posts and bigger trees. Ground-based sensors are commonly used for checking the nutrient levels, the moisture content in the soil, and the weather. Using these many changes regarding the use of fertilizers and irrigation can be made to keep the yield high. The next category of sensors is Aerial sensors. Through the availability of drones, aerial sensors have become quite affordable and accessible. These aerial sensors can take high-resolution pictures of the land, as well as collect other sensor data cruising at low altitudes for longer periods of time over the crops. The data collected through these sensors can help with weed detection, estimating yield, and other detailed analyses such as measuring the soil salinity and the chlorophyll content. While they have become accessible and affordable, they are still rendered inoperable in strong winds and cloudy weather, which is a downside of their use.

The farthest of all the sensor platforms for imaging is the satellite sensor. The use of satellites for any kind of imaging was traditionally for governments and militaries. Using satellite imaging in agriculture helps cover a vast area of land and can help with checking crop status. After an event of a natural disaster, it can help calculate the loss and help estimate crop yield. While there are many upsides to using satellite sensor data, there are many caveats attached to it, for starters, it is expensive and even if you put the cost aside, the imaging must be requested for a specific time typically months in advance. Which could all be for nothing if there is cloud cover in the requested area at the requested time. Governments across the world have started to open satellite imaging for the public, which could make the process a lot easier in the future.

Working of the Sensors

By identifying the colours in a field of crops, sensors relay information that can be helpful in deducing the status of a plant's health. Looking at the colour of the plant through precise data provided by the sensors, the chlorophyll levels of a plant can be measured through which a farmer can determine any lack in nutrition or a problem with a plant's health. The simple data can be extracted through common colour sensors, but to get complex information, infrared and short-wave sensors are used. The reflection of light from leaves changes in the infrared spectrum if the leaf is damaged internally, this can also show if there isn't sufficient water content. One of the most reliable models in agricultural remote sensing is known as the normalized difference vegetation index or NDVI. Using infrared and Red-Edge sensors, the NDVI model can easily identify damaged crops, which gives farmers more reaction time to take effective countermeasures to save the crops. These sensors can likewise be utilized to check soil health and measure soil saltiness. Soil with unnecessary salt substances will in general be brighter in the infrared range, which can assist with identifying the soil which needs more water system and treatment.

The utilization of thermal sensors can assist in optimizing the irrigation framework. The heat emitted from any source is displayed as a lighter tone in the infrared range. After irrigation a farmer can send an aerial Long-frequency Infrared sensor or LWIR over his fields to check which regions are radiating heat due to poor water systems, so the issues with the irrigation framework can be fixed. Satellite sensors can cover a wide assortment of capacities. As they can bypass climate conditions, they are ideal for horticultural observing. Aside from the Radar and microwave sensors, the GPS from the satellites gives exact location information which is fundamental in new agricultural innovations like self-operated farming hardware and self-driving farm vehicles.

Advantages of Remote Sensing and GIS in Agriculture

Crop Sown Area Estimation: One of the critical uses of remote sensing in horticulture is the assessment of the Crop sown region. Data from aerial and satellite sensors give a precise analysis of planted regions and helps with risk evaluation if there ought to be an event of disaster or catastrophe.

Crop Disease Identification: GIS remote sensing in agriculture makes it simpler to recognize contaminations and pest attacks in crops over huge areas at starting stages. This gives producers an adequate opportunity to apply any counter means to safeguard the harvests from any tremendous losses. This becomes possible through satellite imaging and examination.

Soil Properties: Perhaps the primary element in ensuring a sound yield of harvests is the appropriate support of soil. It directly influences the harvest. Any progressions in farm management or farming system cause soil changes, which in turn influence soil capacity of production. Characteristics, for instance, Soil salinity, Soil pH, organic substance level, and soil texture can be recognized using remote detection and that data can be analysed to carry out any significant soil treatment. Soil moisture mapping gives a precise assessment of water content in the soil which can help with carrying out any upgrades in the irrigation system structure.

Flood Impact: Remote Sensing through satellite-based sensors and the data assembled through ground sensors can help with giving a ton of definite information to decide an accurate loss assessment. In case of flooding due to excess rainfall, the areas of land with poor drainage frameworks are at risk of waterlogging which causes basic loss of harvests and yield. The loss assessment can help with further planning for the damage control and countermeasures for keeping losses to a minimum.

NATCAT Modelling: Remote Sensing in agriculture can assist with assessing current and forecasting Natural Catastrophe hazards. Utilizing the information relayed by sensors and the behaviour of regular risks. This requires risk mapping and calculating hazards through estimating hazards which are finished by PC simulated disaster models. Remote sensing maps prepared with the assistance of historic information and present information gathered from various sensors help in assigning areas of high capability of flooding with high hazard ratings. This aids in farming as regions with higher risk ratings are not planted on and get treated for better flood protection for the subsequent season.

Drone Image Analysis for Crop Damage Assessment: Drone picture analysis is utilized in crop assessment for damages because of hailstorms, tree counting, and invasions. The drone imagery is as accurate as the input spatial resolution. Which can be increased as per the requirement.

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

Insect Ecology and its Behaviour

Article ID: 40822

B. Sampath Reddy[1], B. N. Chaudhari[2], Ch. Sowmya[3]
[1]M. sc. Entomology, PDKV, Akola,
[2]Assistant Professor of Entomology,
College of Agriculture, Nagpur, PDKV, Akola.
[3]M.sc.(Ag.) Entomology, College of Agriculture, Rajendranagar, PJTSAU.

Introduction

Insect ecology is defined as study of insects in a community when interacted with surrounding environment. Insect plays an important role in the ecosystem as they are vast in number with each insect having distinct functions for example honeybee, helps in pollinating flowers by dropping pollen grains. They support ecosystem by recycling compounds which are useful for plants as well as provide nutrients to the soil by decomposing decaying matter, leaf litter and dung.

These insects are also vital in food chain particularly for transferring energy for birds, animals and other predatory insects such as natural enemies. In nature there should be balance of biotic potential i.e., a condition of equilibrium between reproductive potential and environmental resistance. If population of insect increases by their reproductive capacity, then environmental factors such as physical, nutritional, host plant and biotic factors should act to control those pests reaching above ETL level.

Furthermore, insect behaviour covers a very wide range of activities, including locomotion, grooming, feeding, communication, dispersal, learning, fighting, migration, host or prey selection, diapause and various responses to environmental hazards such as temperature, humidity, parasites and toxins (Beck, 1980).

Summary

Insects are divided based on community such as decomposers (dung rollers, carrion beetles and manure flies), carnivores (predators, parasites and parasitoids) and herbivores (cut worms, stem borer and bollworms). Beyond this classification they prefer to live in interaction with other species by participating in mutualism (ants and aphids), amensalism (goats and insects), commensalism (ticks and mites) and parasitoid insects (predator and prey).

1. Ecosystem approach: It comprises of combination of physical factors, resources availability and interacting species that determine survival, reproductivity and defence. This approach is of hierarchical model and focuses mostly on lowest levels consisting of individual ecology, followed by population ecology and community level because at these levels it is easy to emphasize the adaptations to variable environmental conditions.

2. Insect Behaviour: Consequently, coming to behaviour of insects they respond to the external stimuli; however, they also behave spontaneously even without obvious stimulus. It is classified into INNATE and ACQUIRED behaviours.

a. Innate behaviour: Since innate behaviour is through DNA, but there can be few chances of genetic mutation, recombination and natural selection. If we make comparative studies of different behaviour of same species in a peer selective pressure, we can notice the evolutionary changes in their behaviours. It also explains unusual behaviour in some insects like dance fly where males give a ball of silk to the females as a ritual, unwinding it at the time of courtship, while other dance flies make nuptial flight long enough with females for decreasing aggression in females and get done insemination.

b. Learned behaviour: It is a type of behaviour which is acquired by environmental changes along with selection pressure in a peer group of same species, to exemplify this, honey bee is the best example as it locates its food through the help of sunshine hours.

Conclusion

By observing the ecology of insects which responds to the surrounding environment, we can be aware about the daily habits and habitats of insect. Besides, it might be helpful in controlling the harmful pests of crops, however, beneficial insects are also noticed, which add value to the human nutrition.

Insects has to accomplish tasks, one such work is, it should develop its own posture and unique qualities to survive (habitat) and to sustain in their community by supplying food as well as protection against damaging pests or parasitoids and other task is to maintain communication and be a functional role in their community.

Advances in understanding of factors controlling patterns of species diversity, community assembly and feedbacks between insects and ecosystem dynamics will improve prediction of species responses to various environmental changes and results in change in biotic control of ecosystem structure, function, and services.

References

1. Beck S. D., (1980). Insect Behaviour: An Evolutionary Approach. New York: Springer-Verlag.
2. CK-12 Foundation., (2015). Insect Behaviour. CK-12 Foundation; CK-12 Foundation.https://www.ck12.org/biology/insect-behavior/lesson/Insect-Behavior-Advanced-BIO-ADV.
3. Schowalter T. D., (2016). Insect Ecology (Fourth edition). Academic Press. 597-608.

Molecular Biology Techniques and Approaches of Insect

Article ID: 40823

B. Sampath Reddy[1], B. N. Chaudhari[2], Anvesh Sankuratri[3]
[1]M. sc. Entomology, PDKV, Akola
[2]Assistant Professor of Entomology,
College of Agriculture, Nagpur, PDKV, Akola.
[3]M. sc. Pathology, PDKV, Akola.

Introduction

In recent times, the study of molecular approaches has become significantly vital to study genetic diversity (DNA, proteins or enzymes), physiology (such as neural complexes which is helpful in secreting pheromones), gene function and for developing pest management strategies. These can be experimented by using different techniques such as Nucleic acid, DNA microarray, Gel electrophoresis, DNA sequencing, Cloning, Southern blot, RNA silencing (interference), Sanger sequencing, Northern blot, Polymerase Chain Reaction (PCR), Western blot, ELISA. All in all, it is beneficial in understanding the role of insects as well as controlling insects by establishing suitable measures.

Summary

These are following examples of molecular approaches:

Gene editing: It comprises of manipulating the genetic material such as DNA or RNA of insects to introduce a specific alteration. Its main purpose is to study the function of specific genes followed by developing strains of insect with desired characters and finally controlling insect population through genetic manipulation.

Proteomics: It helps in studying the full complement of proteins expressed by an insect and describe about interaction of insect with their surrounding environment. Moreover, it also depicts the response of insect to stressors and adaptation to different circumstances.

DNA sequencing: This process determines the sequence of insect DNA nucleotides which can be useful in studying genetic diversity and identifying specific genes that contribute to insect traits and behaviour along with tracking the evolution of insects over a period.

Transcriptomics: This technique is used to analyse gene expression particularly when RNA is extracted from DNA before transcripts are recorded. It is highly useful research tool but technically challenging.

Southern blot: This technique can be used to detect specific DNA sequences in insects, which can be useful for identifying genetic variations and for studying gene expression.

RNA silencing: This technique can be used to study gene function in insects by selectively suppressing the expression of specific genes or RNA formed from DNA (Tomoyasu et al., 2004).

Western blot: This technique can be used to detect specific proteins in insects, which can be useful for studying protein expression and for identifying differences between different insect populations (Fotadar et al., 2014).

Polymerase chain reaction (PCR): This technique can be used to amplify DNA fragments from insects, which can be useful for studying gene function and for identifying gene variations (Venkatesan et al., 2018).

Elisa: This technique can be used to detect specific antigens or antibodies in insects, which can be useful for studying insect-borne diseases and for developing insect control strategies.

Sanger sequencing: This technique can be used to sequence DNA fragments of interest, which can provide insights into the genetic makeup of insects (Peccoud 2017).

Conclusion

Finally, the amount of data being generated in the sequencing labs has resulted in new avenue called Bioinformatics. If the data is based on insects, it is known as “Entomo-informatics” deals with aspects such as data management, integration, functional genomics, proteomics, Computational entomology (protein structural biology, protein modelling and Engineering, discovery of new drugs), image analysis etc., and is intimately bound up with the internet. The use of these molecular approaches has greatly advanced our understanding of insect biology and has the potential to inform the development of novel insect control strategies. This advances in tools have made huge changes in understanding the DNA-RNA mechanisms, neural-hormonal complex, physiology, behaviour of insect through computer applications for analysing data. But these approaches remain somewhat challenging practically.

References

1. Fotadar, U., Bhattacharya, R., & Ojha, M. L. (2014). Comparative study of gut proteases from insect pests Helicoverpa armigera, Spodoptera litura and Bactrocera cucurbitae. Journal of insect science, 14(1), 93.
2. Peccoud, J., Loiseau, V., Cordaux, R., & Gilbert, C. (2017). Massive horizontal transfer of transposable elements in insects. Proceedings of the National Academy of Sciences, 114(18), 4721-4726.
3. Tomoyasu, Y., Denell, R. E., & Siegfried, B. D. (2004). RNA interference and insect metamorphosis. Developmental biology, 274(2), 607-611.
4. Venkatesan, T., & Rajesh Kumar, T. (2018). PCR techniques for detecting and genotyping insect pathogens. Insect molecular biology and biotechnology (pp. 95-108). Springer.

Post-harvest Technology of Fruits and Vegetables: An Overview

Article ID: 40824

Pankaj Kumar Ray[1], Pallavi Bharti[2]
[1]Subject Matter Specialist, Krishi Vigyan Kendra, Saharsa, Bihar.
[2]Research Scholar, Birsa Agricultural University, Ranchi, Jharkhand.

Introduction

Total vegetable and fruit production in the world has been estimated 486 million and 392 million tons, respectively and 30-40% of total production in developed country is spoiled due to lack of postharvest handling up to consumption. India is second largest producer of fruits and vegetables with first rank in production of ginger and okra, second in bananas, papayas, mangoes etc. (Anonymous, 2019). But in the case of developing country like India, the postharvest losses noticed close to 50% of the total fruits and vegetables production which badly affects the availability of fruits and vegetables to the consumers (Sudheer *et al*., 2017). Perishable fruits and vegetables (fruits and vegetables with more water content) facilitate the easy attack of the micro-organism due to high water activity and spoiled rapidly. Improper handling, storage, preservation techniques and microorganism spoilage increase the postharvest losses in fruits and vegetables up to 40%. The microbial effect plays a vital role in spoilage of fruits and vegetables due to some extensive heat or cold resistance micro-organism the processed or canned product also can be damage (Sharma *et al.,* 2019).

Postharvest Losses: World Scenario

Minimization of postharvest losses from harvest to consumption depends upon the several biological, environmental aspects, which can be controlled with the use of appropriate postharvest technology. Several quality factors like nutritional value, physical appearance, and sensory characteristics affect the quantitative as well as qualitative losses of fruits and vegetables. Some research stated that there were huge differences between postharvest losses of developing and developed countries, estimated range of losses 2-23% varies depends on different produces in united states (US), simultaneously overall average losses from production till consumption was estimated 12%. In the case of developed countries, the range of losses was observed 10-50%. Researchers have noticed that 20% fruits and vegetables wastage estimated as a consumer and food service losses. In Rwanda, Ghana, Benin and India, recent studies have generated similar findings, with losses ranging from 30% to 80%. Postharvest losses depend upon the various significant factors after harvesting till consumption that is why estimation of exact losses value is difficult which required statistical methods for found out the accurate figure of postharvest losses, first statistical survey based on successive sample technique was conducted in Uttar Pradesh, India with the help of Indian Agricultural Statistics Research Institute. The sampling design used in the survey was based on successive sampling technique. Total 1.30 billion tons of consumable food commodities spoiled per year caused the huge gap between total per capita production and per capita availability of the food commodities. Minimizing the losses directly influence the availability of food and improves the global food security. Economy of the farming-based regions of the world affected with the postharvest losses because the in this region selling of the fruits and vegetables have major source of income. Livelihood of nearly 70% of the Sub -Sahara African countries depends upon the fruits and vegetables.

Postharvest Losses: Indian Scenario

India is a major fruit and vegetable producer country of the world with 32 and 71 million metric tonnes respectively. Productivity of the fruit varies within 4-35 tonnes per hectare and productivity of vegetables varies within 6-15 tonnes per hectare. India produced 8% and 15% of the total world fruits and vegetables production respectively. After China, India is the world largest producer of total fruits and vegetables in the entire world but due to unavailability of appropriate cold storage, refrigerated transportation facilities, the fruits and vegetables of Rs. 13300 crores spoiled every year. Diversified climate of the India helps to produce most of all varieties of fruits and vegetables. In the different steps of postharvest handling nearly 20- 30% of the produced fruits of the total produced vegetables were spoiled and decreased the 100 g (Based on total produced fruits) to 80 g per capita per day (based on consumable produces after losses reduction). Production rate of the fruits increases with 3.9% annually and processing sector involves for the fruits strengthen 20% per year. In the case of vegetables 30-35% of the total produced vegetables were lost and only 2% of the total produced vegetables undergone for processing and able to marketed only 0.15 million tons of processed vegetables (Anonymous, 2006). Export market of vegetable also expanded and noticed 16% in volume and 25% in value of the total produced vegetables. Generally, India exported the vegetables to the Asian Region (Sri Lanka, Malaysia, Gulf countries and Singapore) and Europe (United Kingdom).

Postharvest Storage

Research concluded that 10-12 degree C temperature and 90-95% relative humidity required for storage of cucumber because low temperature less than100C enhances the chance of chilling injury and above 16-degree colour of cucumber turned to yellow and accelerate more rapidly in the case of multi fruits and vegetables was stored at same place. Storage facilities affect the physiochemical quality of fruits and proper care of maturity level of the fruits and vegetables in the storage minimized the decay, percentage and total sugar level. Some research revealed that maturity affects the many quality parameters of the fruits and vegetables like weight, shelf life and bioactive molecules contents. Botrel *et al*. (1993) studied the different ripening stages of the tomato also effect the pH value and concluded the maximum pH has been observed for matured green tomato. Total soluble solid content, total sugar content, weight and shelf life of the Mango fruits gradually increased with the increasing storage time. Uncontrolled temperature and humidity during storage increased the losses only can be controlled with the help of adequate refrigerated storage. Determination of postharvest characteristics of fruits and vegetables like colour, physical firmness, moisture content and sensory it is important to regulate the proper storage and transportation. Quantity of ascorbic acid decreases with increased duration of storage and temperature. Content of ascorbic acid decreased nearly half of the original amount within 6 months of cold storage in the case of apples. Chakraverty (2001) studied that spoilage of fruits and vegetables depends upon the several factors which defined as intrinsic factors like oxidation-reduction capacity, maturity level, cultivar, nutrient level and some exterior factors like temperature of storage, handling of produces and availability of oxygen. If at the time of harvesting the fruits and vegetables are not so dirty then can be stored without washing because of more moisture addition enhanced the chance of spoilage and some fruits and vegetables are very dirty just after harvesting, for such types of produces must be washed and properly dry up to optimum moisture level before storage. Generally, the shelf life of fresh cut fruits or vegetables is less than the same without cutting as a whole and for preventing the vitamins and minerals losses the several fruits and vegetables needs appropriate temperature and relative humidity during storage.

Shelf life and postharvest preservation temperature ranges were varying for different types of fruits and vegetables like some fruits and vegetables stored at temperature slightly more than freezing but some others fruits and vegetables store safely at 45-55°F. Some fruits and vegetables like pumpkin, okra, sweet potatoes and cucumber are highly sensitive to chilling injury but same time tomatoes, watermelon, muskmelon and peppers have moderate chilling injuries. Chilling injury was a physiological disorder subjected to the subtropical and tropical fruits below the temperature 12-14°C. Storage of fruits crops like banana, pineapple and sweet potatoes at low temperature hamper the quantity of ascorbic acid and accelerate the chilling injuries because of destruction in the ascorbic acid content caused the chilling. The temperature of fruits and vegetables during entire processing influenced the ascorbic acid content and caused chilling injury. Amount of ascorbic acid reduced at the lower temperature (5°C) but not affected at higher temperature (20°C) in the case of cucumber. During the storage and preserving process of fruits and vegetables the moisture and relative humidity also affect the shelf life, quality and other characteristics because mostly fruits and vegetables has shown better quality aspects at higher relative humidity (80-95%) (Bachmann *et al.,* 2000).

Conclusion

Implementation of efficient postharvest processing technologies were able to minimized the losses of the fruits and vegetables and enhance the food availability which can reduce the scarcity of the agriculture produces among the consumers. Effective elimination of postharvest losses has been required strong communication and ideas exchange among farmers, postharvest engineers, food technologist, and specialist of market of fruits and vegetables because reduction in postharvest losses and extension in the shelf life possible with advanced research and application of new scientific approach. Maintenance of the physical appearance, flavour, market value and other characteristics of consumable commodities, the proper and scientific processing are required. More and more emphasis are required for minimizing the fruits and vegetables losses throughout the world for overcoming the scarcity of fruits and vegetables in any corner of the world. This would help to enhance the per capita availability of fruits and vegetables by applying intensive and modern technologies because of reduction in losses automatically increased the availability of products without applying extra resources for enhancing the production and productivity.

References

1. Anonymous. (2006). Postharvest Management of Fruit and Vegetables in the Asia-Pacific Region. Asian Productivity Organization, Japan. ISBN: 92-833-7051-1.
2. Anonymous. (2019). Press Information Bureau Government of India, Ministry of Agriculture, MP: SS: CP: vegetables & fruits, 17th December, 17:20 IST.
3. Bachmann, J. and Earles, R. (2000). Postharvest handling of fruits and vegetables. Appropriate Technology Transfer for Rural Areas. NCAT Agriculture Specialists. pp. 1- 19.
4. Botrel, N., De-Carvalho, V.D., Capriade, V. D. (1993). Effect of fruit weight on internal browning and quality in pineapple smooth cayenne. *Pesquisa Agrropequaria Brasiliere*. 28(9): 1055-1064.
5. Chakraverty, A. (2001). Postharvest Technology. Enfield, NH: Scientific Publishers. ISBN: 0- 8247-0514-9.
6. Sharma, N., Garcha, S. and Singh, S. (2019). Potential of *Lactococcus lactis* subspecies lactis MTCC 3041 as a bio-preservative. *Journal of Microbiology, Biotechnology and Food Sciences*, 3(2): 168-171.
7. Sudheer, K.P. and Indira, V. 2017. Post-harvest technology of horticultural, pp. 01-05.

Solid and Liquid Waste Management

Article ID: 40825

Kirti Yadav[1]
[1]Department of Microbiology, Kurukshetra University, Kurukshetra, Haryana.

Bioremediation

A waste management strategy called bioremediation uses living things to remove or neutralize pollutants from polluted sites. Bio-remediators are the term for microorganisms that carry out the bioremediation process. They come in two varieties: in-situ (on site) bioremediation and ex-situ bioremediation. In essence, it promotes the usage of pollution-eating bacteria on the medium. One example is the usage of oil zappers to feed on oil spills.

Advantages of bioremediation	Disadvantages of bioremediation
• Cost effective	• Time consuming
• Natural process	• Heavy metal like Cd, Zn not removed
• Environment friendly	• Doesn't remove all type of contaminants
• Less energy and supervision	• Soil must have high permeability

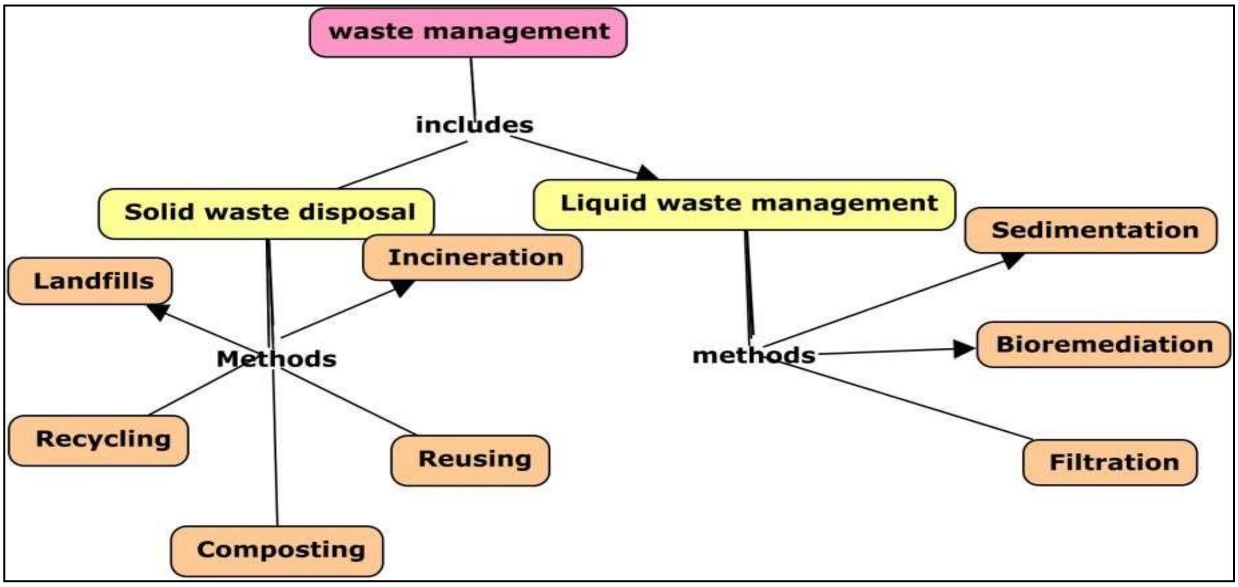
Waste Management

It is the generation, prevention, characterization, monitoring, treatment, handling, reuse and residual disposition of wastage. Waste can be characterized into solid, liquid and gaseous (in terms of the size of the waste). The biggest problem of waste is due to its improper disposal. It is here that awareness about waste management comes in handy. Waste management thus turns to the dealing of waste in terms of reduction in production of waste, reuses and recycles of waste. This constitutes to the 3R's (Reduce, Reuse, Recycle) in the "waste hierarchy". The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste.

Reduction of waste may also be termed as waste minimization, prevention of pollution, source reduction and cleaner technology. Waste minimization refers to the prevention of waste material being created. Reuse - In waste hierarchy reuse refers to the use of a commodity again and again to minimize waste production. The reuse of products, without reprocessing, without recycling, saves time, money, energy, and resources. This is the most important advantage of reuse. The process of extracting resources or value from waste is generally referred to as recycling, meaning to recover or reuse the material. It reduces the amount of waste that is thrown into the community dustbins thereby making the environment cleaner and the air fresher to breathe.

Energy Recovery from Waste

Waste energy is the energy or the heat, which is generated in the processing of waste by thermal treatment as combustion or any chemical reaction and could be utilized for some useful and economic purpose. The energy content of waste products can be harnessed directly by using them as a direct combustion fuel, or indirectly by processing them into another type of fuel.



Solid Waste Management

1. Dumps and Landfills: Dumps – Waste dumps are open areas in the ground where the waste is dumped in open. Open dumps pose the following-

Health, safety, and environmental threats:

a. Fire and explosion
b. Inhalation of toxic gases in nearby homes
c. Injury to children playing on or around the dump site
d. Disease carried by mosquitoes, flies, and rodents
e. Contamination of streams.

2. Landfill – Dumping of waste in open areas can create adverse environmental impact as litter, attraction of worms and flies, and generation of liquid leachate. Landfills are an improved method of open area dumps.

Environmental Impacts of Landfill:

a. Fatal accidents
b. Infrastructure damage
c. Pollution of the local environment
d. Soil contamination in the region during landfill usage, as well as after landfill closure
e. Gases, most commonly, methane and carbon dioxide are produced in landfills due to the anaerobic digestion by microbes on any organic matter. These gases create odor problems, kill surface vegetation, and contribute to greenhouse emission.

3. Incineration -is a disposal method that involves combustion of solid organic waste material with the release of heat energy gas, steam, and ash. Disposal of waste by incineration is based on the principle of waste-to-energy (WtE) or energy-from-waste (EfW), that implies burning of waste in a furnace or boiler to generate heat, steam or electricity.

4. Composting (Biological reprocessing) - Waste materials that are organic in nature, such as plant material, food scraps, and paper products, can be recycled using biological composting and digestion processes to decompose the organic matter and can be used as manure for agriculture purpose or landscaping purpose. The gas produced in the process of digestion can be utilized for generation of electricity. The intention of biological processing in waste management is to control and accelerate the natural process of decomposition of organic matter.

Conclusion - Solid Waste Management takes an overall approach to creating sustainable systems that are economically affordable, socially acceptable and environmentally effective. It is important to note that no one single treatment method can manage all the waste materials in an environmentally effective way. Thus all of the available treatment and disposal options must be evaluated equally and the best combination of the available options suited to the particular community chosen.

Liquid Waste Disposal

Liquid waste can be defined as such fluids as wastewater, fats, oils or grease, used oil, and hazardous household liquids, to name a few.

Following types of waste fall under the liquid waste category:

a. Oily Waste, Grease trap waste, Hazardous liquid spills.
b. Organic sludge, Bitumen, Phenol contaminated water acids.
c. Non-chlorinated solvents, Chemicals, Alkaline Paints Cyanide waste.
d. Dyes Resins, inks, Latex, Adhesives, Photographic processing effluent.
e. Paper pulp, Caustic & caustic sludge Chromium & chrome.
f. Laboratory materials, Wash waters, Detergents Acids.

The major steps of treatment are:

a. Preliminary treatment - Removes materials that could damage plant equipment or would occupy treatment capacity without being treated.
b. Primary treatment - Removes settle-able and floatable solids (may not be present in all treatment plants).
c. Secondary treatment - Removes BOD and dissolved and colloidal suspended organic matter by biological action. Organics are converted to stable solids, carbon dioxide and more organisms.
d. Tertiary treatment - Removes microorganisms to eliminate or reduce the possibility of disease when the flow is discharged.

Conclusion - Liquid waste management is an important component of various waste management activities. The treatment methodology should be such that it becomes pathogen free, does not promote insect breeding, and at the same time, this water could be recycled and reused. The choice of technology is a tricky issue. The high cost, high tech technologies will not be a solution for this problem under the prevailing conditions and situations in rural areas. They have to be environment friendly, low cost, hygienic, requiring intermediate or low-level construction and maintenance skills.

E-ISSN: 2581 - 8317

Flow-Sheet for Processing of Potato French Fries

Article ID: 40826

Dr. A. Nirmala[1], Dr. D. Rajani[2]
[1]Department of Horticulture, College of Agriculture, Hyderabad.
[2]Department of Horticulture, ACRIP, WIA, Hyderabad.
Professor Jayasankar Telangana State Agricultural University, Rajendranagar, Hyderabad.

POTATOES (Fully matured)
↓
WASHING
↓
SORTING (Removal of defective and small tubers)
↓
PEELING
↓
TRIMMING (Removal of residual skin, discoloured area, green portion)
↓
CUTTING (into strips-by-strips cutters)
↓
SORTING OF STRIPS (Removal of broken, discoloured and defective pieces
↓
BLANCHING
↓
REMOVAL OF EXCESS MOISTURE
↓
FRYING
↓
DEFATTING
↓
COOLING AND INSPECTION
↓
PACKAGING
↓
FREEZING[6]
↓
STORAGE (at 0^{o}F for at least 2-4 months)

Ref: Fruits and vegetable preservation principles and practices by R.P.Srivastatava and Sanjeev Kumar, 2006.

Leaf Colour Chart Based Nitrogen Management in Rice

Article ID: 40827

Firoj Saifi[1], Mohammad Hasanain[2]
[1]Student, Amar Singh Degree College, Lakhaoti Bulanadshahar U.P.
[2]SMS (Agronomy), KVK Chittora, Muzaffarnagar U.P.

Introduction

Being a simple and cost-effective gadget, it has already penetrated into South Asian farming and increasing numbers of farmers are finding it helpful in efficiently managing N fertilizer in rice and there is a need to establish technology for its use in maize, rice and wheat. Six-panel leaf colour chart used in this study was manufactured by N Parameters, Chennai, India as per specifications of International Rice Research Institute (IRRI, 1996). It consisted of high-quality plastic with strips of green colour shades of increasing green colour intensity from 1 to 6. The LCC were used to assess crop N need at 7–10-day interval starting from V6 to R1 stage (Peterson et al., 1993). Before the tasseling stage, measurements were made from the first leaf with fully exposed collar from top. After the tasseling stage, the ear leaf was used as index leaf (Peterson et al., 1993). The topmost fully expanded leaf was placed on top of the LCC and colour of the middle part of the leaf was graded according to the corresponding colour strip on the ruler. During measurement, the leaf being measured was kept under shade of the body to avoid colour variance caused by sun's angle and sunlight intensity.

Use of Leaf Colour Chart

1. Select fully opened disease-free new leaf i.e., third leaf from the top as index leaf in paddy plant for assessing the leaf colour and ten leaves to be selected from ten plants in the field.

2. Match the colour of the selected leaves by keeping the middle of the leaves on the colour strips of leaf colour chart and assess the colour intensity (LCC value) during morning hours (8-10 am).

3. Assess the intensity of leaf colour each time at a particular time by a particular individual.

4. Take average of two if the leaf colour matches between two colour strips of the chart.

5. Commence the assessment of the leaf colour with LCC at 14 DAT in transplanted rice or 21 DAS in direct seeded rice and continue up to flower initiation/heading at an interval of 7-10 days.

6. Critical LCC value varies with the type of paddy genotypes. LCC critical value is 3.0 in low N response cultures. In Tamilnadu LCC critical value is 3.0 in low N response cultures like White Ponni and 4.0 in other cultivars and hybrids.

7. Assess the average LCC values of 10 leaf samples. When the average LCC value of ten leaves or when the LCC values of five or more leaves found below the critical LCC limit fixed for that genotype, then top dress nitrogen depending on the crop growth and stage.

8. If six or more leaves read below the specified threshold value, N can be applied @ 35 kg N/ha in dry season and 30 kg N/ha in wet season per application per ha. If the value is above the threshold value, there is no need for top dressing during that week.

Guidelines for Using the Leaf Color Chart

1. Take LCC readings once every 7 to 10 d, starting after 14 DAT for transplanted rice (TPR) or 21 DAS for wet-seeded Rice (WSR). The last reading is taken when the crop starts flowering (first flowering). If farmers prefer to take fewer measurements, recommend the fixed-time approach (option N2) in which LCC readings are taken at critical crop growth stages such as active tillering and panicle initiation.

2. Choose the topmost fully expanded leaf (Y leaf) for leaf color measurement because it is a good indicator of the N status of rice plants. The color of a single leaf is measured by comparing the color of the middle part of the leaf with the colors on the chart. If the leaf color falls between two values, the mean of the two values is taken as the LCC reading. For example, if the leaf color lies between values 3 and 4, it is noted as 3.5.

3. During measurement, always shade the leaf being measured with your body because the leaf color reading is affected by the sun's angle and sunlight intensity. If possible, the same person should take LCC readings at the same time of day each time measurements are taken.

4. Take readings of 10 leaves from hills chosen randomly within a field. If six or more leaves show color values below the established critical values, immediately apply N fertilizer.

5. Recommended N application rates for semi dwarf indica varieties.

Fig 1. LCC in Rice

Leaf Colour Charts in Rice

The LCCs measure leaf greenness and the associated leaf N by visually comparing light reflection from the surface of leaves and the LCC (Yang et al., 2003). These are simple, easy-to-use and inexpensive alternatives to chlorophyll meters (IRRI, 1999) and are visual and subjective indicators of plant N deficiency. Developed from a Japanese prototype (Furuya, 1987), several types of LCCs are available now. The most common ones are those developed by the International Rice Research Institute (IRRI), Zhejiang Agricultural University, China and the University of California, Davis, California. There are two major approaches in the use of the LCC (Witt et al., 2007). Nitrogen at higher value of LCC proved to be better in terms of agronomic efficiency which was 32 g grain/g N applied at LCC 5. Budhar (2005) on direct seeded puddle rice recorded no significant increase in effective tillers under different LCC values in the first year, but in the second year LCC 5 recorded significantly higher number of effective tillers over LCC 3 only. A gradual increase in grain yield of direct wet seeded rice with N application at higher levels of LCC values from 3 to 5 had also been recorded by Nachimuthu et al (2007).

Table 1. Response leaf colour chart on yield and Nutrents use effeciency in cereals crop:

S.No.	Crop	Leaf colour reading	Increase in crop productivity and Nutrents use efficiency	References
1	Wet DSR	LCC values (3 to 5)	Agronomic efficiency with increasing	Nachimuthuss (2007)
	Rice	LCC values ≤ 5	Grain yield about 8.0 and 8.3(t ha-1) in both the year 2012-2013.	Tauseef et al. 2017

Conclusion

Based on research evident, it is concluded that application of N in rice based on LLC has significantly increases NUE as well as crop yield. LLC has also reduced N losses and reduce N_2O emission.

Impact of the Coronavirus-Imposed Quarantine Eating Lifestyle on Indian Population

Article ID: 40828

Seema Kanojia[1], Fauzia Bano[1], Minhaj A. Usmani[2]
[1]Research Scholar, Department of Food and Nutrition, Era University, Lucknow.
[2]Associate Professor, Department of Food and Nutrition, Era University, Lucknow.

Abstract
On March 24, 2020, the Indian government approved a 21-day statewide lockdown to restrict movement for the nation's 1. 3 billion residents in an effort to halt the COVID-19 epidemic. This led to boredom since they identify quarantine with the disruption of their normal workday. The individual consumed fresh fruits in India and followed a healthy dietary regimen while under quarantine. Antioxidants include vitamins E, C, and beta-carotene. Zinc is essential for maintaining immune system health. In addition to being particularly interested in COVID-19 prevention strategies, people were also aware that quarantine meant less time spent outside. Vegetable oils (soybean, sunflower, corn, wheat germ, and walnut), nuts, seeds, spinach, and broccoli are the main dietary sources of vitamin E. Food stores are open during quarantine. Keeping foods that are unquestionably good suppliers of nutrients for the immune system. Through social isolation, sanitation, and an immune-strengthening diet, government organizations, non-governmental organizationsn (NGOs), and individuals attempted to combat COVID-19. This study review studies the influence of the COVID-19 lockdown on feeding, diet and food behaviour habits in Indian countries.

Keywords: *Covid -19, Pandemic, Diet, Nutrition, Lockdown, Food behaviour.*

Introduction
Coronavirus Disease 2019, or COVID-19, is a severe acute respiratory illness brought on by SARS coronavirus 2. (SARS-CoV-2). On the Huanan Seafood Market in December 2019, it was presumable that SARS-CoV-2 spread quickly from Wuhan City in the Chinese province of Hubei to the rest of the world. Due to the increasing rate of case notification at Chinese and foreign locations, the WHO Emergency Committee declared a global health emergency on 30 January 2020[1]. As a precaution against the COVID-19 epidemic in India, the Indian government, led by Prime Minister Narendra Modi, issued a 21-day statewide lockdown on March 24, prohibiting movement for the full 1.3 billion people in India [2]. To ensure its long-term benefits, we must maintain the favourable behavioural changes in our food habits during the lockdown after the pandemic. One of the biggest global socioeconomic and health issues is the COVID-19 epidemic. There is rarely a field or person left unaffected by the outbreak and accompanying lockdown, whether financially or existentially. Despite the pandemic's apparent deluge of bad news, there has also been a bright spot: a discernible improvement in global dietary behaviours. This is especially true for urban populations, who typically (pre-COVID) eat more and consume more processed fast food than their rural counterparts. A surge in home-cooked meals was found in a study on food, eating habits, and lifestyle done by *Kumar et al.* in 2020. Study members also enjoyed spending time reading books, newspapers, and other materials. Participants now exercise at least more frequently (3 times per week) before lockdown, where they now descend as quickly as 22%. The main goal would be to prevent the virus from entering the food supply [3]. Updating hygiene and sanitation practises, disinfecting high-touch areas and surfaces, educating staff about the virus and how to protect themselves and others, improving protocols like physical separations, hand washing, and enhancing protection for people in their vehicles/sanitizing hands while dispensing documents and other materials are just a few of the key actions required. India has also experienced numerous changes in eating habits and nutrition, the most of which are positive. The pandemic and the corresponding lockdown seem to have had a greater than expected effect on eating patterns and food choices in different ways, as discussed below.

1. Preference for preparing own food: Since the beginning of the worldwide lockdowns due to the COVID-19 pandemic, nutritional changes have been noted. A number of trends have been noted and are expected to persist in the years following COVID 19. These include resurgence in home cooking and baking, an increase in demand for organic, plant-based, vegan, and vegetarian food, and a fall in demand for food that is perceived as being more exotic. Some consumers now favour vegan diets due to the COVID-19 epidemic, as well as rising health and environmental concerns. In particular, this has increased the manufacture of new goods by plant protein companies and raised public knowledge of the nutritional benefits of plants as part of a healthy diet and as a source of medicinal treatments.

2. Changing habits to improve the quality of food and nutrient intake: People around the world are concerned about the possibilities even though COVID-19 is only disseminated by airborne respiratory droplets and there is little chance that it might be consumed through food. After all, 40% of individuals are more diligent than they were before the pandemic about cleaning unpackaged fruit and vegetables. A change in behaviour and newly enacted laws could potentially result from the pandemic, including the formalization of small and micro-food enterprises, arrangements for producer-to-consumer sales, the employment of safety-improving technologies, and investments in a more reliable food system. The street food industry, which will undoubtedly be impacted by COVID-19, may also see an immediate impact from these advances. One of the newest trends, particularly in nations with distinct street food cultures, is the appearance of gourmet street food businesses that can deliver both excellent flavour and high standards of hygiene.

3. Eating Safe: Preventing adulteration, lowering pollutants and pathogens in food, controlling food hazards in packaging and manufacturing processes, and upholding personal and environmental cleanliness, hygiene, and sanitation throughout the food supply chain. the desire for a greater variety of foods and healthier diets, the elimination of unhealthy trans fats, or "poor fat," found in processed food products that have serious negative health effects, and the reduction of salt, sugar, and saturated fats—another type of "bad fat"—which may increase the risk of cardiovascular disease. And the encouragement of widespread nutritional fortification or dietary enrichment. In order to address micronutrient shortages and receive fortified food inserted into crucial nutrition programmes like the Mid-Day Meal Program, the ICDS (Integrated Child Development Services) Scheme, and the Public Distribution System, consumption of fortified staples such as rice, milk, and salt, among others, is rising (PDS).

4. Personalized diet: Almost everyone is interested in nutritionally fortified foods that can help fight COVID 19. They also produce unique products tailored to the dietary requirements of young children, the elderly, and athletes. Personalized nutrition hastens the integration of big data, technology, and health. Elite athletes are currently using wellness therapy technology that was developed by one of the organizations we work with to assist them make better dietary choices. Due to the fact that COVID-19 has afflicted individuals with pre-existing health issues including diabetes and obesity, the pandemic has an impact on tailored diet. The use of "Ayush Kwath" has been advocated by the Indian government as a way to boost immunity. This contemporary formulation needs to be put to the test through scientific research. The researcher made an effort to examine how COVID-19's immunological pathogenesis developed and how each herb interacted with it.

5. Self-Medication with Foods that Boost Immunity: A strong immune system, which guards the body against illness, aids in a greater defence against COVID 19. For the same reason, the government, academic institutions, and non-governmental organisations (NGOs) have developed self-sufficient immunity-boosting foods, such as almonds, walnuts, sesame seeds, black pepper, turmeric, cloves, citrus fruits like oranges, ginger, and garlic, as well as dry fruits, Dalchini/Cinnamon/Cinnamomum zeylanicum, Sunthi/Ginger/Zingiber officinale, Marich/Black Pepper/Piper Ayurveda, an ancient science with significant medical and cultural significance, influenced our kitchen and what people consumed during different seasons.

6. Consume more oil seasons and less sugar: The World Health Organization recommends consuming less than 5% of the daily diet as free sugar (sugar added or naturally found in food), less than 10% of the diet as saturated fats, less than 1% of the diet as trans fats, and less than 5 g/day as salt. However, during the lockdown, people tried preparing various recipes (one teaspoon). It also entails avoiding packaged foods and highly processed foods like salty chips and soft drinks that are typically rich in salt and sugar and contain preservatives, sweeteners, colouring agents, or flavours.

7. Increase intake of fluid: A person should consume at least 8 to 10 glasses of water daily and various beverages like lemonade, coconut water, buttermilk, and others, according to nutritionists.

Conclusion

Since the coronavirus disease (COVID-19) lockdown began, people have demonstrated a greater awareness of the disease's negative impacts and have adopted healthier lifestyles. In India, they were given preferences for nourishing foods. Nutritionists, doctors, and scientists advocated ingesting nutrient-enriched meals during the COVID-19 lockdown. The value of prevention over treatment has been stressed by social media. Numerous studies conducted by scientists and therapists worldwide have led them to the conclusion that every age group should practice preventive by eating well-balanced meals, fresh fruits, and herbs.

References

1. Vanishree R, Arjunraj KC, Vaseem A, Kumari SM. A RETROSPECTIVE STUDY OF BLOOD CULTURES IN COVID-19 POSITIVE PATIENTS IN A TERTIARY CARE HOSPITAL.
2. Abraham T. COVID-19 communication in India. Journal of communication in Healthcare. 2020 Jan 2;13(1):10-2.
3. Kumar M, Dwivedi S. Impact of coronavirus imposed lockdown on Indian population and their habits. International Journal of Science and Healthcare Research. 2020 Apr;5(2):88-97.
4. Kumar V. Adjusting to the new normal: Challenges of the food sector in the wake of COVID-19. Journal of Supply Chain Management, Logistics and Procurement. 2020 Jan 1;3(2):163-80.
5. Saxena S, Limbad MA. Consumption change of household food habits pre and post lockdown during Covid 19: A perspective study of Gujarat and Maharashtra. A Global Journal of Interdisciplinary Studies IV (II). 2021 Apr:16-36.
6. Soon JM, Vanany I, Wahab IR, Sani NA, Hamdan RH, Jamaludin MH. Protection Motivation Theory and consumers' food safety behaviour in response to COVID-19. Food Control. 2022 Aug 1;138:109029.
7. Ramya V. Food Safety in Selected Bakery Outlets during Covid 19-A Case Study. The Indian Journal of Nutrition and Dietetics. 2021 Sep 2:23-31.
8. Fahmi F, Yusrandi Y, Wibawa AP, Teng MF, Purnawansyah P. Asking a Chatbot for COVID-19 Food and Nutrition. Bulletin of Culinary Art and Hospitality. 2021 Aug 29;1(2):63-9.
9. Kim H, Rebholz CM, Hegde S, LaFiura C, Raghavan M, Lloyd JF, Cheng S, Seidelmann SB. Plant-based diets, pescatarian diets and COVID-19 severity: a population-based case–control study in six countries. BMJ Nutrition, Prevention & Health. 2021;4(1):257.

Arbuscular Mycorrhizal (AM) Fungi – Biocontrol Agent in Plant Disease Management

Article ID: 40829

Revati Ramesh Nalawade[1]
[1]Ph. D. Scholar, Department of Plant Pathology, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra – 415712.

Introduction

Biocontrol of plant pathogens is a very efficient method for increasing plant yield by controlling pathogens and improving plant resistance to pathogens. These biocontrol agents can be obtained from resident soil micro-organisms or may be of foreign origin. In general biocontrol agents provide different benefits like resistant to development of chemical pesticide resistance, safe and risk free and compatible with sustainable agriculture. One example of such biocontrol agent is Arbuscular Mycorrhizal (AM) fungi which act as bio-protector of plants.

What is AM-Fungi?

Arbuscular Mycorrhizal (AM) – fungi are antagonistic to plant pathogens and can be derived from resident microbial community. Mycorrhiza is the mutualistic association between soil-borne fungi and roots of higher plants. In this association, the mycelium of the soil-borne fungus remains in contact with the plant roots without causing any harm. These fungi form specialized structures called vesicles/arbuscules and utilize host photosynthesis for their growth. There interaction with rhizosphere flora and fauna influences the overall vigour and growth of associated host plant. Compatible AMF and host plant association leads to enhanced plant productivity with enhanced supply of plant nutrition and control of soil-borne plant diseases. In contrast incompatible association can result into serious yield losses.

Types of AM-Fungi

1. Ectomycorrhiza: produces extracellular fungal growth in the root cortex of plants. The extracellular fungal growth grows out of the nutrient depletion zone and provide inorganic nutrient mainly nitrate and phosphate to the host plant and in exchange the host plant provides photosynthesized material required for its growth.

2. Endomycorrhiza: produces inter- and intracellular fungal structures. This growth gives it the alternate name, Vascular Arbuscular Mycorrhiza and these structures are used for nutrient exchange between the partner hosts.

How AM Fungi Work as Biocontrol Agent?

1. VAM fungi compete with the pathogen for space and nutrition by producing antibiotics and inducing disease resistance in plants.
2. VAM fungi by compensating for the loss of root biomass increases host tolerance to the pathogen attack.
3. Some evidence showed that VAM fungi increases and changes soil micro-organisms population leading to stimulated production of some special components by soil microbiota that may be antagonistic to plant pathogens.
4. They also increase plant tolerance to attack by nematodes.

Biocontrol Mechanism of AM Fungi

1. Improved Plant Nutrition: AMF enhances host nutrition uptake which helps the mycorrhizal plant to tolerate the pathogen and compensate for the root damage and photosynthate drain by the pathogen. It was observed that mycorrhizal association between *G. proliferum* and a *Glomus sp*. Increases growth and shoot P content as well as reduces root damage caused by *Cylindrocladium spathiphylli* pathogen on Banana.

2. Plant Pathogen tolerance: AM fungi increases plants tolerance to pathogen attack without sever yield losses. Plant tolerance to the pathogen may vary according to AMF species and their potential to enhance host nutrition uptake. Some ineffective AMF species trigger a defence reaction in plants and therefore reduces pathogen entry.

3. Alterations in Pathogen Biomass: AMF colonization causes changes in root membrane permeability and leads to modification in root exudate composition which can induce changes in the rhizosphere microbial community. These changes benefit the host plant by creating favourable environmental condition for the antagonistic microflora to soil borne pathogens such as Pythium and Phytophthora. In some cases, AMF colonization have created unfavourable condition in mycorrhizosphere of plants which have prevented sporangial induction of *P. cinnamon*i in Tomato plants.

4. Competition: The AMF spores does not compete for nutrients or space. After host entry, competition may occur for infection site, host photosynthates and root space. This competition between AMF and pathogen can be used for pathogen exclusion by physical means by pre-inoculating the host.

5. Systemic induced resistance: tis resistance is induced in plants by previously inoculating the host with a pathogen or exposing it to an environmental condition or chemical treatment. The SIR phenomenon in mycorrhizal plants is demonstrated as localized and systemic resistance to the pathogen. In some mycorrhizal plants SIR induces host wall thickening by producing non-esterified pectins and PR proteins.

6. Phytoalexins and Phytoanticipins: Phytoalexins are produced in response to microbial infection, whereas Phytoanticipins are stored in plant cells prior to pathogen attack. AMF root colonization increases the level of total soluble plant phenolics for example isoflavonoids, flavonoids, lignin, syringin, ferulic or soumaric acids, etc. Tomato plants inoculated with *G. mosseae* AMF showed increased phenylalanine and β-glucosidase activity which increased resistance to *F. oxysporum* attack.

7. Hydrolases: The recent focus of AMF application as biocontrol agent has been shifted on differential expression of defense-related genes in mycorrhizal association. AMF when entered into host roots induces a local, weak and transient host defense mechanism against the pathogens such as Pythium. This mechanism involves induction of hydrolytic enzymes such as chitinase, chitosanase, β-glucanase and superoxide dismutase.

8. Antibiosis: Some AMF produces antimicrobial substances that prevents or inhibits conidial germination of many soil-borne plant pathogens. For example, AMF species *G. intraradices* reduced conidial germination of *F. oxysporum f. sp. Chrysanthemi*.

Challenges for Use of AMF as Biocontrol Agent

1. Production of large-scale AMF inoculum is not feasible because of its obligate biotrophicity.
2. There may be some negative interaction between the introduced AMF and resident microbial community and indigenous AMF after field introduction.
3. Host plant and AMF association compatibility is very important as it determine the AMF colonization as well as positive or negative effects by colonization on the host plant.
4. Maintaining the diversity of AMF in soil is very difficult because of various factors can indirectly alter AMF diversity in soils. For example, continuous cropping, host genotype, level of fertilizer and pesticide application, tillage, crop rotation and the effect of associated microorganisms.

Conclusion

The AMF offers for more than mere plant disease control with increased crop productivity, avoid resistance development in pathogen to chemicals, pollution control with risk-free disease control and follow sustainable agriculture practices. Mycorrhizal management has become one of the viable and ecosystem friendly solutions to manage plant diseases.

References

1. Dar M. H., Reshi Z. A. and Shah M. A., (2017). Vesicular Arbuscular Mycorrhizal (VAM) Fungi – as a Major Biocontrol agent in Modern Sustainable Agriculture system. Russian Agricultural Sciences. **43**(2):132-137.
2. Himaya S. M., Sivasubramaniam N. and Afreen S. M., (2021). A Review on Role of Mycorrhizal Fungi in Plant Disease Management. Sri Lanka Journal of Technology. Pp:41-50.

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

Image Processing Techniques for Plant Disease Detection

Article ID: 40830

Revati Ramesh Nalawade[1]
[1]Ph. D. Scholar, Department of Plant Pathology, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra – 415712.

Introduction

During these past few years, Agriculture has become an important source of economic development in India. To meet the increasing demands of Indian population, agricultural industries are continuously searching for new advanced techniques to increase the farm production with reduced input cost to aid the economic development of the country. This encourages researchers to develop new improved and efficient technologies to increase productivity. For successful farming system timely disease management is very important to minimize yield losses. If a farmer wants to check for any plant disease, he goes for naked eye observation of the plant or expert advice after surveying the field, which is very time consuming and expensive. This may lead to delay in control measure application which will ultimately result in increased yield losses. This problem can be solved using image processing techniques for plant disease detection.

Digital image processing detects plant disease at an earlier stage than the human eye could recognize them. This technique involves image acquisition, image pre-processing, image segmentation, feature extraction and classification of disease. It enables the farmers to take timely disease control measures to minimize the losses and improve the produce quality. In this paper, the steps of image processing techniques have been discussed along with different classifiers used for plant disease classification.

Steps Involved in Development of General Plant Disease Detection System Using Image Processing Techniques

Plant diseases are identified by observing different plant parts for disease symptoms. Image processing techniques can be used for detection of leaf flower, fruit, stem and root diseases also. Image processing techniques involve following steps (Fig.1):

Image acquisition: First step for developing any image processing system is image acquisition. The image acquisition is mostly carried out in real time in controlled condition or under field conditions. High quality images can be collected using drones, digital camera, smartphones or scanners. These images are used as input data for the image processing model, the input image data should be in .bmp., .jpg., .png., or .gif format. Minimum 1000 images in any mentioned format are required for analysis. To ensure accuracy of data image collection in controlled environment under even light conditions is mostly preferred.

Dataset Annotation: The collected image dataset is annotated for name, date, time, plant type, plant part type or disease type for knowledge-based dataset creation.

Image pre-processing: To improve the image data features different image pre-processing techniques are applied, also called as image restoration. This step involves image cropping, image resize, shape adjustment, image smoothing, contrast and brightness adjustment, colour conversion and noise removal to highlight the diseased area from an image. Before actual image processing unrequired data and objects are removed form the image.

Image segmentation: partitioning an image into different parts of same features is called as image segmentation. Image segmentation is done using different techniques like Otsu's, k-means clustering, thresholding, region and edge-based methods etc. it is one of the difficult tasks in image processing and first step in image analysis and pattern recognition. This step simplifies the image into more meaningful form for easier analysis. Specific segments of specific characters in an image which represents the particular symptom area can be segmented in more advanced steps.

Feature extraction: It is the most important part of disease classification system. In this step image features like colour, shape, texture and morphology are extracted using different feature extraction techniques. How the colour is distributed in the image the roughness, the hardness of the image is called as texture of the image. For detection of plant leaf diseases, morphology feature extraction is better than colour and texture feature extraction. Most commonly used feature extraction techniques involve Grey level Co-Occurrence Matrix (GLCM), Global Color Histogram (GCH), Blend vision and Machine intelligence etc.

Disease Classification: the extracted features are given different classes like diseases and healthy which are used to train the Machine learning or Artificial intelligence model to classify the remaining images into given classes using the features. It is the most challenging task in image processing.

Diagnosis: after all these steps are completed and the exact differentiating features set is created the model is trained using 1000-2000 images. Then is it field validated and upgraded with each field validation until it achieves 90-100% accuracy. Most of the models show 60-70% accuracy in first field validation.

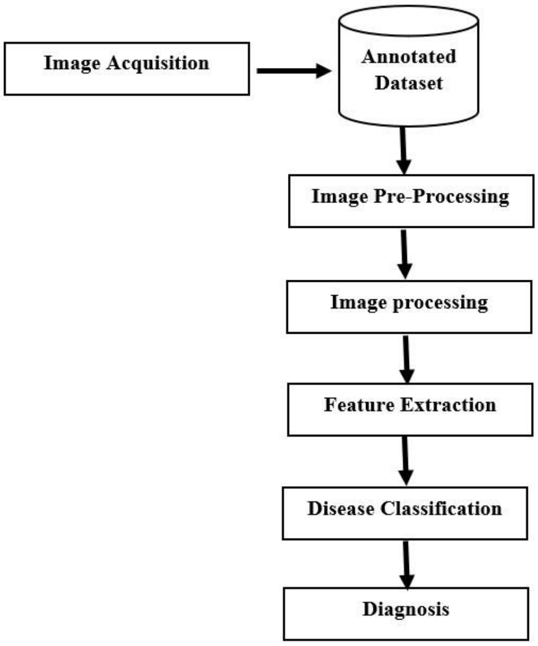


Fig. 1 Steps in Image Processing

Some Commonly Used Classifiers for Plant Disease Detection

1. Support Vector Machine: SVM is a supervised types of learning algorithm based on structural risk minimization. It is mostly used for classification and regression problems. This classifier is designed to maximize the classification boundaries between two classes as widely as possible.

2. Convolutional Neural Network (CNN): CNN is a class of deep forward neural network that processes multidimensional data. CNN reduces the image into an easier-to-process form essential for good prediction without reducing image features. CNN is available in different architectures such as ResNet, VGGNet, AlexNet, GoogLeNet etc. CNN model consists of an input layer, convolutional layer, max pooling layer, a fully connected layer and an output layer. The diseased plant images are provided as input then CNN extracts required features from the images with the help of convolutional and pooling layer to obtain more details. The output from these layers is transformed into a single vector by fully connected layer which is used as an input for next layer. Finally, the output layer classifies the plant disease.

3. K- Nearest Neighbor (K-NN): This is a statistical and non-parametric classification system where the weight is given corresponding to neighbors. The classification is done based on the computed Euclidean distance metric. It stores all the training tuples given to it as inputs in its learning phase without doing any calculations hence, called as lazy learner. This prevents its uses in areas where dynamic classification for large databases is needed. This technique is widely used for text mining, pattern recognition, forecasting the trends in stock market and plant disease classification in agriculture.

4. Artificial Neural Network (ANN): ANN is an information processing system which works like the biological system i.e., brain. It consists of interconnected artificial neurons of processing elements which form neural structure. They gather information by recognising data patterns and relationships and learn through experience and not by programming. Artificial neurons consist of several inputs that take any value between 0 and 1, but only a single output. Due to their capability of deriving meaning from complex database they are mostly used for pattern recognition. Feed forward ANNs and Feedback ANNs are the two types of ANNs. In Feed forward ANN, the behavior of any layer will not affect that same layer. In Feedback ANN, signals communicated in both directions by network loops.

Conclusion

Several plant diseases lead to annual yield losses in agriculture. Therefore, plant disease detection at an early stage is very crucial to minimize yield losses as well as reduce the input and control measures cost. In this paper, advanced image processing techniques have been discussed which are very efficient as compared to tradition plant disease control methods. It can be concluded that with further modifications and increased on field real time validation these image processing techniques can achieve accuracy up to 90-95% which will help for early detection and management of plant diseases ultimately reducing yield losses in agriculture.

References

1. Kartikeyan P. and Shrivastava Gyanesh, (2021). Review on Emerging Trends in Detection of Plant Diseases using Image processing with Machine Learning. *Int. Jr. Com. App.* **174**(11):39-48.
2. Sharma V., Verma S. and Goel N., (2020). Classification Techniques for Plant Disease Detection. *IJRTE*. **8**(6):5423-5430.
3. Shruthi U., Nagaveni V. and Raghavendra B. K., (2019). A Review on Machine Learning Classification techniques for Plant Disease Detection. Proceedings of 5th International Conference on Advanced Computing and Communication systems. Pg no. 281-284.

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

Millets Processing and Value Addition: A New Perspective on Staple Food

Article ID: 40831

Manjunath Madhukar Mopagar[1], Rani Kumar Sajane[2]
[1]Ph.D Scholar, Department of Agronomy, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shimoga, 577204.
[2]Ph.D Scholar, Department of Entomology, University of Agricultural Sciences, Bengaluru, 560065.

Introduction

Millets are small-seeded grasses that are commonly referred to as nutri-cereals. Sorghum, pearl millet, little millet, foxtail millet, proso millet, barnyard millet, kodo millet, and other millets are included. Seasonal cereals do provide food security; millets, on the other hand, can provide fodder, nutrition, health, livelihood, and environmental security. Millets have an alkaline effect on the digestive system, which helps to maintain the pH balance in the body, which is important for immunity. Millets are non-allergenic because they are gluten-free.

Millets, in addition to being nutritious, are also climate resilient. Millets are comparable to major staple cereals in nutrition due to richness in carbohydrate, protein, dietary fibre, micronutrients, vitamins, and phytochemical content (Table 1). They also contain a lot of phytochemicals like phytosterols, polyphenols, phytocyanin, lignin, and phyto-oestrogens. These phytochemicals function as antioxidants, immunomodulators, and detoxifiers. They have low glycemic index and contain very little gluten. All these quality factors provide numerous health benefits, including improved gastrointestinal health, blood lipid profile, and blood glucose clearance, and prevention of age-related degenerative diseases like cardiovascular disease, type 2 diabetes, and cancer (Kaushik *et al*., 2021).

Table1. The nutritional profile of millets per 100 g (Kaushik *et al*., 2021):

Millets	Protein (g)	Crude fat (g)	Dietary fiber(g)	Carbohydrate (g)	Minerals (mg)	Ca (mg)	Iron (mg)	Zn (mg)
Sorghum	10.00	1.70	10.20	67.70	1.40	27.60	3.95	1.96
Barnyard millet	6.20	4.40	13.70	65.50	4.40	20.00	5.00	3.00

Finger millet	7.20	1.90	11.20	66.80	2.70	364.00	4.62	2.30
Kodo millet	8.90	2.60	6.40	66.20	2.60	15.27	2.34	0.70
Foxtail millet	12.30	4.30	14.00	60.90	3.30	31.00	2.80	2.40
Little millet	10.40	3.90	7.70	65.60	1.50	16.06	1.26	3.70
Pearl millet	11.00	5.40	11.50	61.80	2.30	42.00	8.00	3.10
Proso millet	12.50	1.10	8.50	70.40	1.90	14.00	0.80	1.40

Several challenges exist in both production (farmer's end) and consumption (consumer's end). At the farmer level, there are well-developed processing techniques for wheat and rice, but farmers rely solely on traditional practices for millet. Offering farmers technical assistance so they can easily process millet should be the focus of research and development. Anti-nutritional factors present in the coarse seed coat, coloured pigments, astringent flavour, and poor keeping quality of millets-based processed products are reasons for consumer indifference towards millets. Despite the abundant nutrients in millet, the bioavailability of proteins, minerals, and other nutrients must be increased. It is necessary to design and develop high-demand, high-value, and popular processed foods using millet as the primary ingredient. This will encourage farmers to begin cultivating millets and make them more appealing to consumers as a food source. As a result, the growers would find a cash crop, which would improve things.

Processing Methods for Enhancement of Nutritional Quality

1. Decortication: Decortication is a technique for debranning grains by mechanically removing the grain's seed coat, as millets are coarse and generally unpalatable. Decortication reduces not only antinutrients but also fibre, lipids, minerals, and phenolic acids. Because most lipids and proteins are present in the millet germ and pericarp, removing the outer layers increases starch digestibility. The removal of the pericarp also removes anti-nutritional factors like phytates and tannins, which can improve the bioavailability of various nutrients (Taylor and Duodu, 2015). Decortication reduces astringency, improves digestibility, and produces lighter-coloured products that consumers prefer.

2. Parboiling: Parboiling or partial boiling is a common hydrothermal treatment technique that is frequently employed in the rice industry and can be used to process millets prior to decortication. Boiling causes starch gelatinization; cooling causes amylase molecules to re-associate and form a tightly packed structure, making kernels harder and glassier in appearance. The process of parboiling makes the endosperm harder and aids in the movement of water-soluble nutrients from the grain's outermost seed coat to its innermost layer. As a result, the decortication procedure does not remove the nutrients from the grain's outer layer. The extent and type of alterations in the granular structure of starch, complexes of amylose and lipid, and starch composition affecting changes in rapid digestible starch, residual starch, and glycemic index are all determined by parboiling.

3. Germination: Germination or malting is the soaking of grains in water until saturation and then allowing them to germinate under controlled conditions. Hydrolytic enzymes cause biochemical changes, structural modification, and the synthesis of new compounds during germination, some of which have high bioactivity and can increase the nutritional value and stability of the grains. An increase in the protein content of millets is attributed to the biochemical synthesis of new amino acids, as well as microbial enzyme activity favouring protein hydrolysis during germination, resulting in a significant increase in the total protein content of millets (Saleh *et al.*, 2013). Improvements in starch and protein digestibility during germination is due to reduction in anti-nutrients such as phytic acid, tannins, amylase, and protease inhibitors and also other phenolics. Germination increases the availability of nutrients and minerals (magnesium, iron, calcium, and sodium) by activating phytase, which hydrolyzes the anti-nutrient phytates. Total soluble sugars decrease due to amylolytic activity, while endosperm starch is consumed as an energy resource for millet germination. During the germination process, beneficial effects of an increase in GABA content and organic acids are observed due to microbial activity responsible for converting carbohydrates into lactic acid, citric acid, acetic acid, and so on.

4. Fermentation: It aids in the preservation of many foods, provides a wide range of flavours, and significantly improves the nutritional properties of the raw material. Fermentation alters the chemical composition of millet grains and their food products. Fermentation is the process that reduces antinutrient levels in grains while increasing protein availability, in vitro protein digestibility (IVPD), and nutritive value. The partial degradation of complex storage proteins to more simple and soluble products improves IVPD caused by fermentation (Saleh *et al*., 2013).

Value Addition of Millet-Based Products

Composite flours: Possible ways to enhance the utilization of millets is by making foods from blended flours made by mixing millets with wheat, rice, *etc.* Composite flours, rich in nutrients are prepared by integrating millets with skimmed milk powder and vegetable powder (carrot powder, cowpea powder, pumpkin seed powder) for children. Mixing the millets in different proportions with other flours, modifies the functional properties of composite flour. Addition of different levels of millet flour to wheat flour, the content of protein, crude fat, and fibres increases while the total carbohydrates, reducing sugar, and total sugar content of composite flours decreases.

Bread: Consumers prefer to have more sources of fibre and better values of nutrition in the same portion size of the meal. The preparation of gluten-free flour has an optimum composition of 7.75 g soy flour, 42.25 g of millet flour (sieved through 140 mesh IS Sieve), 40 ml of water, 1.5 g of sugar, 2.5 g of yeast, and 0.8 g of salt. Yeast increases the resilience and springiness of the bread while decreasing the hardness and cohesiveness because of the induced voids in the dough. Salt plays a vital role in textural properties. Millet enhances the water-binding ability of the dough. Thus, designing bread based on millet should be the target so that it not only finds a large-scale utility but it can also be the source of nutrients including fibre and minerals.

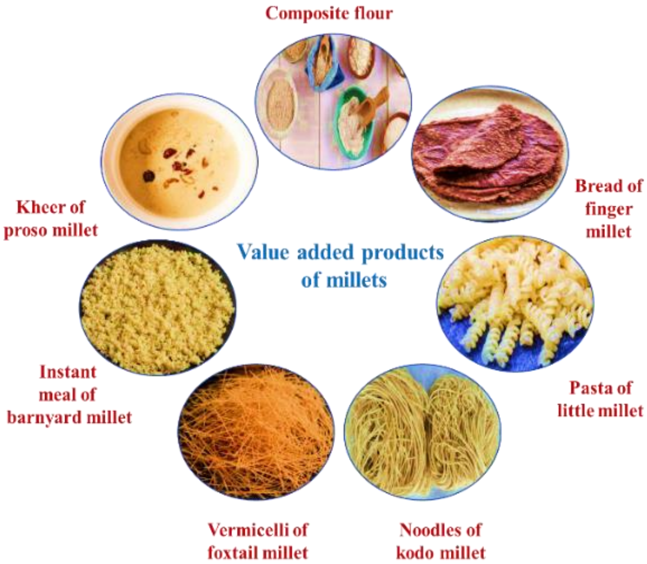


Figure 1. Value-added products of different millets

Pasta: The incorporation of millets in pasta increases its overall nutritional value while making them superior to conventional pasta based on whole wheat. Optimized pasta using flour of millets and paste of vegetables (carrot, spinach, tomato, and turnip) provides higher mineral content of calcium, iron, phosphorous, potassium, and sodium by a significant value for consumers. By the incorporation of vegetable paste increased firmness, reduced stickiness, minimum gruel losses and shelf-life of 3 months in a polyethylene bag without preservatives can be achieved.

Noodles: Incorporated various proportions (30–50%) of millets in refined wheat flour to develop noodles gives the best sensory attributes. Noodles based on millets show a significant reduction in glycaemic index, hardness, springiness, and cohesiveness of wet noodles on increasing the content of millets.

Vermicelli: Nutrient-rich vermicelli by wheat semolina (10–50%), malted finger millet (0–50%), and 2% salt gives best sensory parameter and shows higher protein, fibre, and minerals like calcium, iron, and phosphorous. Gluten-freesweet vermicelli can be prepared from pearl millet: sorghum: greengram: guar gum: sugar in the ratio of 48:15:23.5:1.5:12%, respectively, at commercial-scale.

Spread making and instant millet meal: The optimized peanut-millet spread meal is made with 38.5 g of sorghum, 8.9 g of chickpea flour, 33.7 g of peanut paste, 15 g of sugar, 10 g of vegetable oil, 8.9 g of milk powder, and 1 g of emulsifier. The instant-millet meal comprises 39.21 g of sorghum, 18.6 g of foxtail millet, 27.91 g of green gram, 1.4 g of curryleaves, 2.79 g of cumin, 1.21 g of pepper, 2.33 g of red chilli, 8.05 gof salt, and 2.05 g of sugar.

Ready to eat kheer mix: Composition of kheer-mix based on pearl millet: 15 g of sugar, 30 g of dairy whitener, and 20 g of pearl millet. The consistency increases with the addition of the millet solids, cohesiveness, viscosity index, and overall nutritional andtextural parameters.

Conclusion

Millets outperform all other cereals in terms of nutritional value and climate resilience. Growing millets will help to address issues such as climate change, global warming, and water scarcity. Millet grains contain numerous health-promoting components that may provide health benefits. However, novel processing and preparation methods are required to improve micronutrient bioavailability and the quality of millet diets. It is necessary to develop millet food products that provide convenience, taste, texture, colour, and shelf-stability at a low cost for the poor. Furthermore, it is necessary to promote millet grain utilisation in urban areas in order to open new markets for farmers and increase their income.

References

1. Kaushik N., Yadav P., Khandal R. K. and Aggarwal M. (2021). Review of ways to enhance the nutritional properties of millets for their value-addition. *Journal of Food Processing and Preservation*. 45(6):15550.
2. Saleh A. S., Zhang Q., Chen J. and Shen Q. (2013). Millet grains: nutritional quality, processing, and potential health benefits. *Comprehensive Reviews in Food Science and Food Safety*. 12(3):281-295.
3. Taylor J. R. and Duodu K. G. (2015). Effects of processing sorghum and millets on their phenolic phytochemicals and the implications of this to the health-enhancing properties of sorghum and millet food and beverage products. *Journal of the Science of Food and Agriculture*. 95(2):225-237.

E-ISSN: 2581 - 8317

Management of Buffalo in Summer

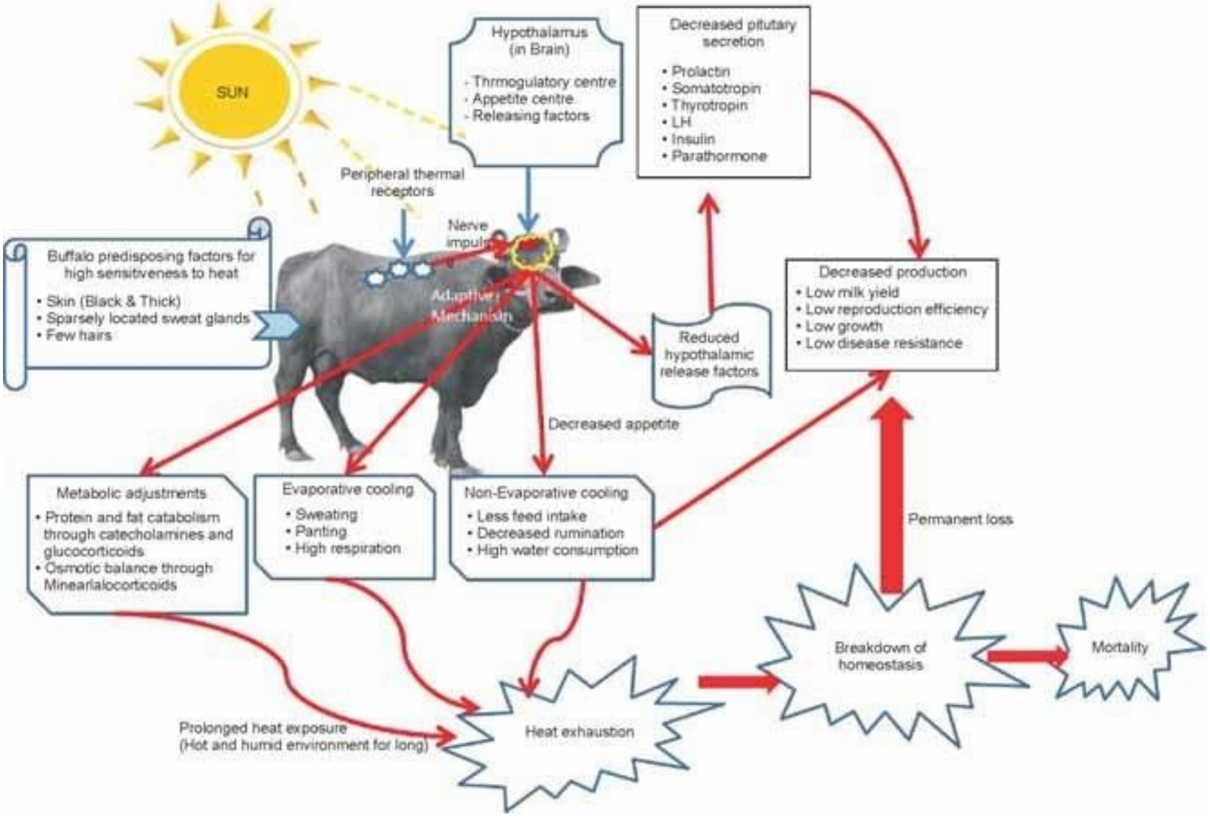
Article ID: 40832

Akshay P. Chawke[1], Pallavi Dattatray Mali[1], Abasaheb K. Parade[1]
[1]Ph.D. Scholar, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth Rahuri, Dist. Ahmednagar-413722.

What is Summer Management?

Proper feeding, housing and thermal ameliorative techniques are primarily necessary to overcome sub-reproductive problem in buffaloes linked with summer stress. Growth rate of buffalo heifers fall during severe hot months of the year due to inadequate intake, lack of excellent quality greens, diversion of better feeds to producing buffaloes at the cost of expanding stock, overcrowding and improper habitat. The research findings on summer management have suggested that adequate feeding and supply of thermal amelioration including proper housing are useful in attaining optimum growth in buffalo heifers. Growing buffalo calves kept in loose house grow better notably during extreme hot seasons than the calves housed inside the shed as loose housed animals spend maximum time in feeding and rumination. Buffaloes in loose housing system devoured more dry matter and water, generated more milk than those kept in the closed barn. Physiological reactions of buffaloes housed in shed were higher as compared to buffaloes in the open barns.

Amongst numerous climatic situations, it is the hot weather that ubiquitously impairs the productive and reproductive performance of cattle species. The plains, coast-line and foot-hill regions of the Indian subcontinent, home to over 90 percent of the world's buffaloes, face variable and extreme weather conditions, with temperatures reaching up to 48°C in summers and as low as minus 2°C.



How to Recognize Heat Stress?

1. Changes in consciousness: Rapid and weak pulse, rapid but shallow breathing;
2. Abnormal vital parameters: Elevated heart rate, respiration rate, rectal temperature;
3. Unusual salivation: Capillary refill is very fast

4. In case of heat stroke – Very high body temperature sometimes as high as 106–108°F. Heat stroke is life-threatening, so immediate veterinary attention is a must while moving the animal to a cooler place, giving a bath with cold water or wrapping in wet sheets and providing a fan.
5. Signs of heat exhaustion: Dizziness/unconsciousness; skin becomes dull and may be cold too.

Common Terms Associated with Heat Stress

1. Muscular pain and spasm due to heavy exertion in a hot climate.
2. Excessive loss of body fluids (usually through sweat) leading to fatigue.
3. Break-down in the thermoregulatory system of the body leading to increased internal temperature with no sweating and death, if not immediately treated.

Management of Heat Stress

Modification of the micro-environment / Use of cooling system. Good management procedures include alteration of the surrounding environment to lessen the effects of environment and at the same time increase heat loss from the animal. Combating heat stress in buffaloes can be by numerous management measures such as the provision of shade, promoting air movement and regularly soaking the animal with cold water for greater evaporative cooling.

1. Shade-Simple shade is the fundamental method of sheltering animals from direct sun radiation in day-time throughout summer. The most effective source of shade is the trees and plants. They provide not only protection from sunshine, but also generate a cooling effect by the evaporation of moisture from their leaves.

2. Air movement- Air movement becomes more crucial during hot-humid conditions for giving cooling and comfort to the animal. Apart from relocating animal to shaded airy spot, fans or dairy fans and different types of coolers can also be put for making the place airy. Air movement increases the rate of heat loss from animal's body surface, only as long as the air temperature is lower than the animal's skin temperature.

3. Evaporative Cooling-Numerous cooling solutions have been created such as holding-pen cooling, exit-lane cooling, and free-stall cooling. These solutions are suited for the animals maintained in covered pucca sheds. An evaporative system which employs water mist with fan is more effective and economises water use in contrast to repeatedly bathing the animals. Some farmers prefer sprinklers or mists, Water sprinklers generate a large volume of wastewater.

4. Feeding strategies in hot environment-There are numerous critical aspects of nutritional management which should be examined during hot weather. These include specific formulation to cater for lower dry matter intake with matching higher availability of critical nutrients and to compensate for dietary heat spike while avoiding nutrient excesses. The energy requirements of nursing buffaloes also increase during high-temperature condition but this increase is apparently caused primarily by the increase in metabolic energy.

5. Water intake-Water is the most important nutrient for buffalo during hot climate. Water intake is closely related to dry matter intake and milk yield, but regardless of the rate of increase, it is important that abundant water must be available at all times under hot conditions. Hot weather, declining dry matter intake and high lactation demand require increased dietary mineral concentration. The primary cation in bovine sweat is potassium. Sharp increases in the secretion of potassium through sweat occur during hot climatic conditions Alterations in mineral metabolism also affect the electrolyte status of buffalo during hot weather. So it important to supplement minerals during hot climate.

6. Night Grazing-Buffaloes kept in a shed maintain rapid heartbeat during the night. However, when the animals are allowed out into a pasture at night, these physiological responses decrease immediately. This is the result, both of a reduction in radiation heat from the surrounding buffaloes, as well as increased heat loss from the animal itself.

7. Feeding High-Energy Diets-Low-fibre, high fermentable carbohydrate diets lower dietary heat increment compared to high fiber diets. Although the metabolic energy of dairy buffaloes increases in a hot environment, heat stress depresses feed intake. For this reason, it is important to increase the energy content of the diet of dairy buffaloes, in order to maintain their energy intake under hot conditions. The heat increment, which is an internal heat stressor in hot environments, is lower in highly metabolizable diets. So it is imperative to use fatty feeds, or calcium salts of fatty acids, as the means of improving energy supply for buffaloes in summer. Buffaloes fed on such diets have higher milk yield, and a lower body temperature and respiration rate.

8. Feeding by-Pass Protein-Dietary protein degradability is also critical under heat stress conditions. It is well known that excessive protein intake increases heat production and decreases reproductive performance. However, the protein requirement of buffalo increases and dry matter intake decreases in a hot environment, consequently, the protein supplied to lactating buffaloes during summer is not always sufficient. By using fish meal, which is a by-pass protein, the milk yield and protein content of buffalo milk increases but the ruminal ammonia production decreases.

Conclusion

In hot-humid climates, although buffalo attempts to acclimatize through physiological changes including cutting down on feed intake and heat production, this does not come without sacrificing part of its productivity. In order to prevent this economic loss to the farmer, there is need to understand and effectively combat heat stress by minimizing its impact on the animal body and its productivity.

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

Edible Spineless Cactus (*Opuntia ficus-indica*): – An Emerging Fodder Alternative

Article ID: 40833

Abasaheb K. Parade[1], Pranjali B. Meshram[1], Sujit Balu Bhalerao[1]
[1]Ph.D Research Scholars, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth Rahuri-413722, Ahmednagar (MH).

Introduction

In India, around 53% of land is having dry and semi dry regions. Climate change impact is already observed in several places, particularly in dry and semi dry regions, destroying crops, animals and livelihoods. Farmers have been struggling in not only accessing food but also feed for the livestock.

Spineless cactus is a fast-growing xerophytic plant well adapted to arid conditions. It remains green even during summer and can be used as a feed during scarcity. Cactus belongs to the family Cactaceae assimilating about 130 genera. It is highly resilient and has high water use efficiency and capability to grow in poor and degraded soils where other plants fail to grow.

Cactus is vegetatively propagated and cladodes are used for this purpose. Cactus pear has the advantage of being a source of water for animals particularly during the dry season. It is tolerant to poor soil conditions and produces high biomass yield. Cactus is able to convert water 4-5 times more efficiently to dry matter (DM) than the most efficient grasses. These and other attributes such as ability to remain succulent during drought and produce forage, fruit and other useful products as well as its capacity in preventing long-term degradation of ecologically weak environments have increased the importance of cactus in arid and semi-arid regions. Ruminants adapted to these areas can make efficient use of non-conventional feed resources like Opuntia-indica. Different parts of edible cactus have been shown to have antioxidant, anti-inflammatory, anti-diabetic and anti-cholestrogenic activities.

Therefore, an attempt has been made to cover aspects like its production and potential as ruminant feed encompassing its effect of inclusion in the ration on feed intake, nutrient utilization and production performance.




Use of Cactus as Fodder for Livestock in India

The word "Cactus" derives, from the Ancient Greek word *kaktos*, a name originally used for a spiny plant whose identity is not certain. Cactus (plural: *cacti, cactuses,* or *cactus*) is a member of the plant family Cactaceae. Cactus *(Opuntia ficus indica)* is a long-domesticated cactus crop that has emerged as one of the most suitable crop species for arid and semi-arid climate for not only for its better Water Use Efficiency (WUE) and Rain Use Efficiency (RUE) but also a source to meet the requirements of food,forage and host of other benefits along with ecological advantages. This has made this crop as an integral part of agricultural economy especially in arid and semi-arid regions of the world.

Spineless Cactus can Survive in Degraded Soils

The arid and semiarid areas are characterized by limited resources. Production of green fodder is rare, particularly during the hot and dry season (summer) when the animal feed is strongly complemented by feeding concentrates. During summer period, farmers face green fodder scarcity and animals need green

E-ISSN: 2581 - 8317

fodder with more water content. In such a situation, spineless cactus cultivation is boon to the farmers. In India, however, cactus is not yet grown as a commercial crop.

Cactus Nursery

Preparation of cactus planting material for supply to Farmers

Dispatch of planting material for establishment of demonstrations at

To face these critical periods, the spineless cactus which is useful for ground conservation and reduction of streaming, has emerged as an alternative feed for livestock. Spineless cactus which is being widely cultivated to combat desertification and reclaim degradation could be used as green fodder in all seasons.

Spineless cactus is the best alternative to green fodder, especially in summer period as it consists of 80 - 85% water content. Cactus is an alternative source of green fodder during scarcity period. It can be grown in soils where no other crops can grow. Cactus is not only used as fodder. It is also used as a medicine. It is an excellent source of water too for livestock as it contains 85-90% of water, besides being rich in vitamins, carbohydrates proteins (5-9%), calcium, potassium and other minerals.

Feeding of Cactus

A livestock species like goat is already grazing the cactus in certain part of India particularly in dry land systems. Cactus can be fed to cattle and small ruminants like Goat by mixing it in Total Mixed Ration (TMR). Many farmers prefer and are encouraged to cut the cactus into smaller pieces and supplement with hay or straw. The cladodes, the fresh cactus pads or water storing segments of the plant, are rich in easily fermentable carbohydrates which aid digestion in the rumen. The assorted accessions of spineless cactus important substitute to farmers due to its considerable survival, propagation capacity and production potential under conditions of little rain and high temperatures. A Cactus should be cut into smaller pieces for ease of feeding. Use of cladodes as a feed can solve the problem of livestock watering, but attention should be paid to their high-water content. Ruminants should not consume large quantities of cladodes, which may lead to diarrhoea. It is therefore recommended to associate a fibrous feedstuff. Also, since cladodes are low in nitrogen and high in energy, it is vital to supplement them with sources rich in nitrogen. Inclusion of nitrogenous supplements (Atriplex nummularia foliage, oil seedmeals, urea) in cactus-containing diets is currently the most widely adopted option and good productivity responses have been observed in ruminants' animals.

Cactus feeding in milking cows

The Advantage of Using this Cactus as Fodder are Enumerated Below

As it can be grown in arid and semi-arid regions, it requires very little water for cultivation. It has high water-use efficiency (WUE), i.e. to produce 1 kg of dry matter, it needs 267 kg of water against 400 kg required for pearl millet. The plant is great during heavy monsoons as well. Due to high rain-use efficiency, it can produce 40 kg of dry matter/mm/year of rainfall against 25 kg in pearl millet. It has the potential to produce a large quantity of palatable and nutritious green fodder for the livestock for lesser labour. The entire plant can be used for green fodder, and there is nothing that goes to waste. The nutritional quality is off the charts. It is rich in vitamin A and water-soluble carbohydrates. Forage quality is comparable with several other cultivated fodder crops. It is an excellent source of water too as 90% of its composition is liquid. It is suitable for a range of soils. And not only that, it can help fight soil erosion, combat desertification and reclaim degraded land. And it has a high potential to capture carbon both in soil and in the air, thereby reducing carbon emissions in the region.

Nutrition of Cactus

The Opuntia ficus indica is the most widely used species as animal feed world over. The cladodes consist mainly of water (> 85 %) on fresh weight basis depending on growth conditions. Despite of fact that cactus plants are high in carbohydrates and vitamin A, protein content is ranging from 5% to 9%. It is characterized by a high palatability, digestibility, high content of water, soluble carbohydrates, ash, Ca and K and vitamin A.

Performance of Cactus as Fodder in Goat

Scarcity of fodder in India is the major challenge in raising animal production including small ruminants like goat. Availability of feed and fodder is drastically reducing during drought period. The small ruminants like Sheep and Goats are extensively grazed throughout the year. Arid and semi-arid areas are characterized by limited resources, herbaceous and rare green forage production particularly during hot summer season. Tree fodder form the major part of a diet for goats.

Cactus as Animal Feed

For sustainable food production systems including livestock production systems, cactus cultivation has a special place in drylands. Water scarcity and rangeland degradation are threatening livestock production in dry areas. Adapted perennial species such as cactus offer opportunities for improving fodder availability in such area. Cactus can produce a biomass from 20 tonnes dry matter (DM)/ha/year to 200 tonnes DM/ha/year. Being rich in water, it represents a cost-effective option for water provision to livestock in dry areas. With such high biomass yield (ca 60-fold increase over rangeland productivity), it is possible to produce sufficient forage to sustain 4–5 cows per year. A small intensively cropped cactus plantation can produce sufficient fodder, reducing the pressure on overstocked rangelands. The water footprint of cactus is also very low, approx. 250 litres/kg DM.


Cactus feeding to buffalo at farmer's field

Besides water, cactus (Opuntia spp.) cladodes are high in sugars, ash and vitamins A and C, but are low in crude protein (CP; 3–5%) and fibre. Most of the nitrogen is present as non-protein nitrogen. The older the cladode, the lower its CP content. The cladodes are highly palatable. They have a high Ca:P ratio. The nutritive value of cladodes varies with species and cultivars. It also varies according to season, agronomic condition, soil, rainfall, fertilization, among others. One- to three-year old cladodes are high in water during winter and spring (85–90%), low in summer (75–85%) and the younger the cladode, the higher is its water content. Provision of chemical fertilizers (ammonite and superphosphate) increased CP content of cladodes from 45 to 105 g/kg DM. Breeding has also been used to increase the CP content of cladodes to 10%. The carbohydrates content is approx. 60%, β-carotene level is approx. 0.65 mg/100 g DM and mucilage is high (6–13 g/kg fresh material). Mucilage concentration in summer is almost 2-fold higher than in winter. It reduces salivation in ruminants, which avoids a rapid decrease in rumen pH. Other soluble carbohydrate-rich feedstuffs, such as molasses, cause acidosis in the ruminant, because they are low in or free of mucilage. The neutral detergent fibre content varies from 18 to 30%. Acid detergent fibre and acid detergent lignin contents are from 12–20% and 1.5–4.0% respectively.

Conclusion

Edible spineless cactus can be grown easily in the lands with low water content due to its higher water conversion efficiency. Moreover, it has more tolerance to higher soil salinity. Therefore, growing cactus as a forage source for livestock can lead to a proper utilization of waste lands. Nutritional value of spineless cactus cladode is almost similar to some of the other conventional cereal fodders. Use of its cladodes as ruminant forage source reduces the water requirement as its cladodes are significantly high in moisture content which is of significance to the livestock farmers particularly in draught prone areas. Therefore, edible spineless cactus could be an alternate source of green fodder for livestock particularly small ruminants with due supplementation of nutrients especially protein, however, nutritional worth of different clones/varieties in different ruminant species need to be evaluated for formulation of balanced rations.

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

Standardization of Grafting Technology in Moringa (*Moringa Oleifera* Lam) and Compatibility in Different Perennial Rootstocks

Article ID: 40834

T. Sumathi[1], B. Muralidharan[1], J. E. Adline Vinila[1], M. Kumar[1]
[1]Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore – 641 004.

Moringa oleifera Lam. belonging to the family Moringaceae is a handsome softwood tree, native of India, occurring wild in the sub-Himalayan regions of Northern India and now grown worldwide in the tropics and sub-tropics. In India it is grown all over the subcontinent for its tender pods and also for its leaves and flowers. The pod of moringa is a very popular vegetable in South Indian cuisine and valued for their distinctly inviting flavour. It is grown best in dry sandy soil and also tolerates poor soil of Semi- arid tropical and sub-tropical areas. Optimum temperature for cultivation of moringa is 25- 35 ◦ C. Moringa paid its attention in export due to its nutritional value. It is called as 'Miracle tree' since all parts is exploited commercially.

Moringa seed possess antimicrobial activity whereas leaf is used to increase milk production in lactating mothers, useful in treating scurvy, respiratory ailments and as an emesis remedy. The juice from the leaf of Moringa serves as a treatment for piles, fever, sore throat, bronchitis, catarrh, eye and ear infections as well a healing sores and relieving headaches. *M. oleifera* flower is used for the treatment of inflammation, muscle diseases, tumors, and enlargement of the spleen. Tamil Nadu is the pioneering state as it has varied genotypes from diversified geographical areas. Important Perennial varieties of moringa are Moolanur moringa, Valayapatti moringa, Chavakacheri Moringa, chemmurungai, Jaffna type, Kattumurungai, Kodikkalmurungai, Palmurungai, Punamurungai, Palamedu moringa. Some annual types which are also suitable for ratooning are PKM 1, PKM 2, KM 1, and Dhanraj these are commercially utilized for leaf as well as pod production.

Moringa can be propagated from seeds and limb cuttings mostly, now a days Air Layering is commercializing propagation for enhancing nursery income. In Nurseries of Tamil Nadu, they also do single layered and double layered air layering. Grafting is a horticultural technology that combines two plants, the scion and the rootsock, to create a plant with desirable features from both parts. While the scion will produce economic part with the desired characteristics, the rootstock will provide desirable character viz., resistance against soil-borne diseases and/or nematodes / Extending duration /Wider adaptability etc.

Vegetable grafting has been successfully performed in crops, such as eggplants, tomatoes, peppers, watermelons, cucumbers, and melons. Vegetable grafting is nowadays extremely popular in some countries and is mainly used to improve plant tolerance to biotic stresses occurring particularly in intensive agro-systems. This technique has also been proposed as a way to enhance vegetable tolerance to abiotic stresses, since under such conditions plant show various disorders negatively affecting yield and quality of produce. Therefore, many genotypes have been screened for their resistance in order to individuate rootstocks tolerant to specific or multiple stressing conditions.

The study was undertaken at Horticultural College ad Research Institute, Coimbatore to identify the best performing perennial rootstocks for PKM 1 Moringa under drought condition. Survey and collection were done in an around Tamil Nadu and collected seven perennial rootstocks in Moringa from divers' conditions. The collection is,

Table 1. Perennial rootstock and their sources from different parts of Tamil Nadu

S. No	Treatment details	Source
1	Graft with moolanur moringa rootstock and PKM 1 scion	Moolanur, Erode
2	Graft with karumbu moringa rootstock and PKM 1 scion	Moolanur, Erode
3	Graft with ODC moringa rootstock and PKM 1 scion	Kanyakumari

4	Graft with kumbakonam 1ocal moringa rootstock and PKM 1 scion	Kumbakonam local
5	Graft with Padasolai Local moringa rootstock and PKM 1 scion	Kolli hills
6	Graft with perennial long moringa rootstock and PKM 1 scion	Dharapuram
7	Graft with perennial short moringa rootstock and PKM 1 scion	Dharapuram

Rootstock – Kumbakonam local

Root stock - Perennial long

Different root stocks ready for grafting

Graftable stage

Graft Union

Grafted plant ready for planting

Grafted plant

Among the seven rootstocks, moolanur moringa is identified as the best rootstock for PKM 1 Scion. The wedge method of grafting is standardized and confirmation studies were carried out with Histological method. Moolanur moringa has taken less number of days for germination, maximum germination percentage on 30 days after sowing, less number of days taken for graft union, less number of days for attaining graftable size and success percentage was higher on 15 days after grafting than other perennial rootstocks. The number of roots in grafted and non-grafted moringa plants was found to be significantly different ranging.

Among the rootstocks Moolanur moringa produced the highest number of roots followed by Kumbakonam local. Moolanur moringa produced the highest number of roots, root length, highest root weight and highest root volume. It is concluded that Moolanur moringa is the best rootstock for PKM 1 scion and also wedge method of grafting is standardized

Confirmation of Graft Union with Histological Studies

Necrotic layer which formed as a result of cutting was seen along the cut surfaces in all the grafts. But in the course of time, necrotic layer was broken into pieces and absorbed by the newly formed callus, especially in the cortex regions of the grafts and finally necrotic layer was seen as light dark strands. It was seen that the removal of necrotic layer depended on cell division where callus was profuse.

Quality Traits in Vegetable Pigeon Pea

Article ID: 40835

A. Thanga Hemavathy[1]
[1]Associate Professor (PBG), ADAC & RI, Trichy, Tamil Nadu.

Pigeon pea pods sold as vegetables are generally picked 25-30 days after flowering. The optimum growth stage for harvesting of commercial vegetable pigeon pea is fully grown bright green pod stage is mostly preferred, so the pods are harvested before they start losing their green color. Hand-picking or mechanical harvesting of green pods has become common practice for vegetable pigeon pea, and for large-scale processing for canning and freezing.

Vegetable pigeon pea is a good source of protein, vitamins (A, C, B complex), minerals (Ca, Fe, Zn, and Cu), carbohydrates and dietary fiber. In comparison to green peas (*Pisum sativum*), the vegetable pigeon pea has five times more beta carotene content, three times more thiamine, riboflvin and niacin content and double vitamin 'C' content. Besides it has higher shelling percent (72%) than that of green peas (53%). These all factors indicate that pigeon pea is nutritionally rich vegetable and it can be used in daily cuisine. Pulses are known to be rich in edible proteins. In India, the most commonly grown pulses, in order of their importance are chickpea, pigeon pea, green gram, black gram, peas, common beans, and cowpea. In spite of their high nutritive value and being important part of daily cuisine, most farmers give low priority to pulses in cultivation and are assigned to rainfed and relatively less productive portions of their fields. However, recent escalation in prices of pulses has brought about some changes in the mind set of some farmers and they are taking the cultivation of pulses more seriously than before.

Quality Traits

Green pigeon pea seeds are superior to dal in nutrition. The vegetable type pigeon pea had high polysaccharides and lower crude fiber content than dal, irrespective of its seed size. The crude fiber content in vegetable type pigeon pea and garden pea *Pisum sativum* (L.) were almost similar. Trypsin inhibitor activity was also higher in pigeon pea than in garden pea but its magnitude was less than soybean (Glycine max [L.] Merr).

The pigeon pea dal is superior to vegetable type with respect to starch and protein, while the vegetable pigeon pea grains had higher crude fiber, fat, and protein digestibility. As far as mineral and trace elements are concerned, green pigeon pea was better in phosphorus by 28.2%, potassium by 17%, zinc by 48.3%, copper by 20.9%, and iron by 14.7%. On the other hand, the dal had 19.2% more calcium, and 10.8% more manganese. Like other legumes, pigeon pea seeds also contain considerable amounts of some anti-nutritional factors. In dry pigeon pea seeds, certain amounts of poly–phenolic tannin compounds are also present, which inhibit the normal activity of digestive enzymes such as trypsin, chymotrypsin and amylase. Pigeon pea seeds have appreciable amounts of unavailable carbohydrates that adversely affect the bio-availability of certain vital nutrients. Some of the anti-nutritional factors such as phytolectins are heat sensitive and are generally destroyed during the cooking process.

Some of the flatulence-causing oligo-saccharides such as stachyose, raffinose and verbascose are also present in pigeon pea seeds. In the growing seeds, the starch content was negatively associated with their protein and sugar pigeon pea content. The amount of crude fiber content in the growing seeds increased slowly with maturation. Soluble sugars and proteins decreased but the starch content increased rapidly between 24 and 32 days after flowering. The variety ICP 7035 had high soluble sugars in each sample studied. Besides protein, vitamins such as B-complex and minerals are also important for human growth and development. The minerals and trace elements such as calcium, iron, zinc, magnesium and copper did not show significant changes during seed development.

Both vegetable pigeon pea and its dal are good sources of these mineral nutrients. Some of the minerals also play an important role in improving cooking quality of pigeon pea. In pigeon pea, seed and pod size are positively correlated and the varieties with large pods invariability have large immature and dry seeds. On the contrary, in some vegetable type lines, the immature seeds are large but their size reduces gradually with approaching maturity. The long-podded genotypes, all the ovules did not develop properly to their full size due to ovule abortion. The exact reason for the loss of ovules is not fully understood but there appears to be some sort of blockage in the supply of carbohydrates and other vital nutrients to the growing ovules resulting in their pre-mature cessation.

Nutrient Constituent in Vegetable Type Pigeonpea

Constituent(s)	Green seed	Mature seed
Protein (%)	21.0	18.8
Protein digestibility (%)	66.8	58.5
Starch content (%)	2.8	9.9
Starch digestibility (%)	53.0	36.2
Amylase inhibitor (units mg^{-1})	17.3	26.9
Soluble sugars (%)	5.1	3.1
Flatulence factors (g $100g^{-1}$ soluble sugars)	10.3	53.5
Crude fiber (%)	8.2	6.6
Fat (%)	2.3	1.9
Minerals and trace elements (mg $100g^{-1}$)		
Calcium	94.6	120.8
Magnesium	113.7	122.0
Copper	1.4	1.3
Iron	4.6	3.9
Zinc	2.5	2.3
Cooking time(min)	13	53

References

1. Vegetable pigeonpea – a review K.B. SAXENA, R.V. KUMAR and C.L.L. GOWD A International Crops Research Institute for the Semi-Arid tropics (ICRISAT), Patancheru-502 324,
2. Saxena KB, Faris DG and Kumar RV. 1984. Breeding for special traits Pigeonpea Breeding Annual Report, International Crops Research for the Semi-Arid Tropics, Patancheru, India. P 99.

E-ISSN: 2581 - 8317

Brooding Management in Poultry

Article ID: 40836

Abasaheb K. Parade[1], Pranjali B. Meshram[1], Pallavi D. Mali[1]
[1]Ph.D Research Scholar, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth Rahuri-413722, Ahmednagar (MH).

Brooding Management in Poultry is done in the first 14 days period of the broiler poultry life which is the most sensitive period because the bird is changing from an immature system to a mature system. For a better and profitable poultry production, we can't ignore Good Brooding Management practice. In many countries, some poultry producers think that by the second week the birds are adults already and stop giving them external help to maintain good conditions. This could lead to one of the worst situations in Brooding. While brooding management in poultry, poultry producer's one common mistake is to think only of maintaining the proper temperature.

Apart from temperature, we should also take care of other issues. Other issues like the 80-20 rule, which means that 80%of the consequences come from 20% of the causes. While brooding we should always think about the brooding temperature, air quality, water, and feed. Proper management of these areas will be the key factor in uniformity, which results in a good performance. We will assume that we receive good quality chicks from the hatchery, which suggests that the day-old chicks are active with bright eyes wide open, with strong and glossy shins, navels healed, without physical defects, no pathogens and with good maternal Immunity.

The first week of Brooding Management in Poultry corresponds to to23% of the life of the 1.75g broiler. This first week represented 1 1 % of the entire life in 1978 to achieve the same weight. So the proper commitment to a good start is very important for the broiler, and each good point achieved will be a 20 brooding period.

Temperature Management in Poultry

Two basic systems of temperature control are used for brooding management in poultry.

1. Spot brooding (canopy or radiant heaters). The heat source is local so chicks can move away to cooler areas and thus select for themselves a preferred temperature.

2. Whole-house brooding.

The heat source is larger and more widely spread so chicks are less ready to move to pick a preferred temperature.

In both **spot and whole-house brooding systems**, the target is to stimulate both appetite and activity as early as possible. Achieving optimum temperature is critical. Brooding temperatures for RH 60—70%.

Spot Brooding Management in Poultry Farming

Chick behaviour is the best indicator of correct brooder temperature. With spot brooding, the correct temperature is indicated by chicks being evenly spread throughout the brooding area. The layout for a spot brooding set up would be typical for 1,000 chicks on day one. Chicks are placed in a 5×5 meter square (25 m2) or a 16.5×16.5 foot square (272 ft2), which gives an initial stocking density of 40 chicks/m2 (4chicks/ft2) If stocking density is increased, the number of feeders and drinkers, and the heating capacity of the brooder, should also be increased accordingly.

Whole-House Brooding Management in Poultry Farming

Whole-house brooding refers to situations where the whole house are defined part of the house is heated by 'forced air heaters' only and the aim is to achieve one temperature in the house or air space. In whole-house brooding, there's no gradient within the house, although supplementary brooders may additionally be provided. The main whole-house heat sources are often direct or indirect (using hot air). Carefully monitor and cont rol house temperature and humidity when whole-house brooding is practiced. Chick behaviour is the best indicator of the correct temperature. With whole-house brooding, the correct temperature is indicated by chicks forming groups of 20—30, with movement occurring between groups. There should be continuous feeding and drinking within the flock.

Key Points to Remember About Brooding Temperature of Brooding Management in Poultry

1. Temperature is critical and should be maintained as recommended.

2. Temperatures should be checked manually at chick level. Chick behaviour should be observed closely and frequently.

The ratio of body surface to body mass is large in the one-day-old chick and decreases with age, so the chick will lose heat faster than an adult bird. The young chick's body is covered, which has a low insulation value, so if the temperature is not controlled, it will quickly lose heat through radiation and conduction.

We suggest preheating and stabilizing the garbage 24 hours before placing it, and sometimes preheating it for 48 hours, depending on the season, the region, and the outside temperature. A comfortable chick will breathe through its nostrils and lose 1-2 g of moisture in the first 24 hours. The yolk contains this amount of moisture: it will decrease but will not dehydrate. If birds are exposed to cold temperatures, they will try to save or generate heat by snuggling or burning food to keep warm, which affects the feed conversion ratio and this is the most expensive way. If the ambient temperature is 26^{0}C (78.8^{0}F), the same loss of moisture (1 -2g) in the yolk will last the chick for three days. That is why, in practical terms, once we see the large buds, we will say that the bird got cold in the first days.

In the opposite case, with too high a temperature, birds will try to remove heat or avoid producing heat, gasping to lose. Always watch and use the behaviour of the birds and the effective temperature because it is the definitive guide to determine the proper temperature for birds. Smaller egg chicks (younger brood flocks) require higher rearing temperatures because they produce less heat (about1oz.) during the first seven days. Depending on the seasonal climate, it is very important to have a tool to heat and cool the air, and options to provide correct airflow and distribution. Do not forget that broilers in a rearing phase do not need an air velocity greater than 0.3 m / s at ground level.

Air Management in Poultry Farming

Ventilation distributes heat throughout the house and maintains good air quality in the breeding area. Ideal air quality should be with 19.5% oxygen, less than 3000 ppm carbon dioxide, less than 10 ppm carbon monoxide and ammonia (NH3), and dust levels are less than 3.4 mg / m3. Inadequate minimum ventilation and the resulting poor air quality can cause an increase in NH3, CO2, and humidity levels and an increase in production-related syndromes, such as ascites. It is important to always assess NH3 levels at the height of birds. The negative effects of NH3 include burns on the footpads, burns to the eyes, blistering of the breasts/skin irritations, weight loss, unevenness, susceptibility to disease, and blindness.

Water and Feed Management in Poultry Farming

We can call the water an ‘invisible’ player in parenting; he can be an enemy and a friend too! Many times we see this component forgotten by the broiler industry and poultry farmers. Water is an essential nutrient that affects practically all physiological functions. We must give 24 ml of water per bird in the first 24 hours, mixed with Aquaculture.

Poultry farmers must also not forget the importance of cleaning and disinfecting water lines. Generally, the use of 40–50-micron water filters is suggested to take care of good water quality. The 650- 750mv oxy reduction potential (ORP) may be a good target; this will lead to equipment corrosion, but this may not adequately disinfect the water.

The best way to improve flock performance is not by increasing the seven-day weight of the fastest-starting chicks, but by decreasing the number of slower starters! A good coefficient of variation is 8-10%. A good tool to try is the Chick Check evaluation! It consists of evaluating 100 birds observing the consistency of the crop. The culture is palpated after six hours and again 24 hours after placement. A good goal is to obtain 95% of the birds with water and food in the crop. We must not forget that birds are the simplest sensor during a home. For better weight gain, lower mortality, development of immunity in birds, and protection against disease, it is highly recommended to use the best quality poultry medications, which are tested over time.


Cultivation Practices of Spine Gourd

Article ID: 40837

DurgaPrasad[1], Mamatha A[2]

[1]3rd year B.Sc. Horticulture, College of Horticulture, SKLTSHU RajendraNagar, Hyderabad,Telangana, IN.

[2]Assistant Professor, Department of Vegetable science, College of Horticulture, SKLTSHU RajendraNagar, Hyderabad, Telangana, IN.

Scientific name: *Momordica dioica* Roxb

Family: Cucurbitaceae

Chromosomes number: 2n=28

Other names: Kakrol, Teasle Gourd, Spiny Gourd, Kantola, Monsoon Vegetable and Bristly Balsam Pear and Kantíoli.

Uses

It is used as a vegetable in all regions of India and some parts in South Asia; it has commercial importance and is exported and used locally. The fruits are cooked with spices, or fried and sometimes eaten with meat or fish. It is a rich source of antioxidants and flavonoids. It has antilipid peroxidative properties,that prevent oxidation of fats, thus preventing fatty liver disease. It is rich in proteins and iron and low on calorie. It is high in fiber and antioxidant and therefore, very useful for easy digestion. It keeps your stomach in good shape during the monsoons by reducing the infections caused and controlling constipation.

Nutritional Composition

Moisture	84.1 g
Calcium	33 mg
Protein	3.1 g
Phosphorus	42 mg
Fat	1.0 g
Iron	4.6 mg
Minerals	1.1 g
Carotene	162 mg
Fibers	3.0 mg
Thiamine	0.05 mg
Carbohydrate	7.7 g
Riboflavin	0.18 mg
Energy	52 cal

Niacin	0.6 mg

Health Benefits

Prevents Hypertension and Supports Heart Health, Prevents Seasonal Infections, boosts Immune System, Cures Eczema and Skin Problems, Protects Liver, Skin and Pimple Care, Prevents and cures Respiratory Disorders, Brain Function, Good for a Diabetic Patient, Supports Digestive System, Prevents Cancer, Peptic Ulcer and Piles, Treats Cough, Give relief in breathing problem, Remove kidney stones, Useful for pregnant women, Work as anti-aging, Improve eyesight, Reduce excess sweating (Hyperhidrosis).

Botany

Spine gourd is propagated by underground tubers. It is a climbing creeper It has small leaves, small yellow flowers, it has small, dark green, round or oval fruits. It is **dioecious**, which means that it has distinct male and female individual organisms. Fruit is an inferior berry Or Pepo.

Origin & Distribution

The plant is native to tropical regions on Asia with extensive distribution in India, Pakistan, Bangladesh, China, Japan, South East Asia, Polynesia besides tropical Africa and South America.

Climate

Kantola is a warm and low humid season or monsoon vegetable crop. This vegetable can be cultivated in both tropical and sub-tropical regions. This crop requires good sunshine for better growth and yield. The optimum temperature of 27°C to 32°C is suitable for its cultivation. Crop can be grown even in places of slightly lower temperature and high rainfall areas.

Soil

Spine gourd/Kantola can be grown on sandy loam to clay soils with pH value of 5.5 to 7.0. Soils with well drainage and good organic matter are ideal for its cultivation.

Propagation

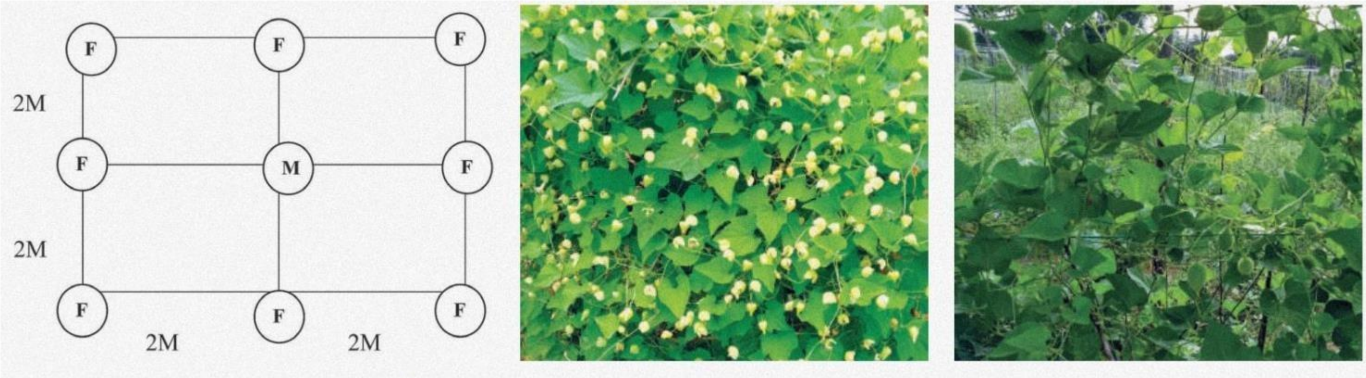
Spine gourd can be cultivated through seeds, but the population will segregate. However, the crop grown vegetatively through tubers and stem cutting will result in uniform, true to type plants. The seed requirement to cultivate a commercial crop in one hectare area will be 2.5-5.0 kg owing to difficulties in seed germination and Maintenance of male/female ratio for a healthy fruit set. However, if the vegetative mode of propagation through Tubers or plants generated from stem cuttings is used Where the male and female plants or tubers are already Known, a total of 2500–2650 tubers or plants having 2200–2300 female and 300–350 male plants will be required to cultivate in a 1 ha. area.

Land Preparation

Land should be levelled and well prepared by tractor or local plough. 3 ploughings are enough to get the soil to the fine tilth stage. In last plough, add 15 to 20 tonnes of farm yard manure (FYM) in the top soil to increase the soil fertility. Raised beds or ridges should be prepared in between the furrows.

Planting

Generally, spine gourd seeds and tubers are having dormancy period hence seeds & tubers are treated with sulphuric acid to break dormancy period before sowing or planting. Pit planting is commonly followed in garden system of cultivation. A pit size of 0.5 x 0.5 x 0.5 m with a spacing 2m × 2m is normally required. Small pits are dug in case of ridges and furrows. The pits are to be refilled with topsoil mixed with 10 kg of FYM (well decomposed), 250 gm of neem cake and 20 gm of carbofuran. Prepared pits are left open for 15-20 days for solar radiation to kill all the insects, soil borne diseases and for aeration before refilling. In saline alkali soil where pH is above 8, pit mixture is to be modified incorporating organic matter and gypsum.



Female(F) and Male(M) ratio= 8:1(F:M) Male Plant Female Plant

Field view of spine gourd

Varieties

Indira Kakoda 1: Spine gourd genotype RMF 37 identified as variety “Indira Kakoda 1” by Central Variety Release committee (CVRC) for Chhattisgarh, Uttar Pradesh, Jharkhand, Orissa and Maharashtra during Group Meet held at PAU, Ludhiana (Punjab) from May 5-6, 2006. It is resistant to all major pests; green fruit are attractive, dark Green and contain 12-14 % protein.

Arka Bharath: A high yielding teasel gourd variety released from CHES (ICAR-IIHR), Chettalli.

Arka Neelchal Gaurav: A Teasel gourd variety released from Central Horticultural Experiment Station, Bhubaneshwar for commercial cultivation in Odisha. This variety is moderately resistant to cucumber Moth infestation and tolerant to Anthracnose and Downy mildew disease. Average yield 180-200 q /ha.

Arka Neelchal Shanti: A Spine gourd variety developed through hybridization between spine gourd and teasel gourd, naturally pollinated, high yielding (15-16 kg/vine) with medium sized fruit (20 g), moderately tolerant to fruit borer, anthracnose and downy mildew. Average yield 80-90 q /ha. It was released by SVRC, Govt. of odisha in 2016.

Irrigation

Irrigation should be carried out immediately after sowing the seeds on the raised beds in the field. Thereafter, carry the irrigations on need basis. Irrigations are not needed in case of rainy season and soil has enough moisture. In dry spell weather conditions, 1 or 2 irrigations should be given in weekly interval. Make sure to have water well drained in rainy season or flooding stage.

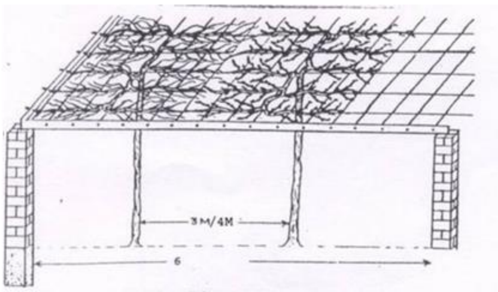
Manures & Fertilizers

Incorporate 15-20 t/ha of well rotten FYM at the time of soil /land preparation. NPK @100:60:40 kg/ha should be Applied. Full dose of Phosphorous and Potash should be applied before planting, however, ½ dose of Nitrogen Should be applied at the time of vine growth and Remaining ½ dose of N before flower initiation.

Intercultural Operations

Weeding: The weeding should be carried out regularly Depending on the appearance of weeds. Hand weeding and hand hoeing weeding methods are preferred as the crop has shallow root system.

Training / Staking: Since, spine gourd vine is climber in nature, it requires Proper support for vegetative growth. Hence, staking is advised for better vine growth and fruit yield. Wood, Bamboo or G.I. wire can be used for staking in single stake or Bower or knifing system as per the availability of resources and staking material. This operation can help to supply sunlight evenly and this will resist to attack of Fruit fly and leaf eating caterpillar.



Training of vines on Bower system.

Flowering, pollination and fruit set: Since spine gourd is a dioecious crop, the male/Female ratio needs to be essentially maintained in the field. This can be easily achieved by cultivating in the advised design mentioned above. The flowering, pollination and fruit set are largely affected by the weather conditions as the pollination is entomophilous. Under favourable Conditions, flowering starts 50-60 days after transplanting anthesis occurs in the evening. Hand pollination significantly increase the fruit Set. Lack of pollination often results in lower fruit set and consequently lower marketable yields. Hence, artificial Pollination may be done as far as possible to increase Fruit yield and profits.

Harvesting: The vegetable is ready for harvesting after 40 to 50 Days when we use tubers as planting material but when Stem cuttings are used as planting material, it takes up to 60-70 days for first picking. When we use seeds as planting Material it takes 65-75 days for getting seed to fruit.

Maturity indices: Fruits should be harvested at green mature stage. The fruit should be tender, Green in colour and seed should be soft for use as green Vegetable. The fully ripened fruits develop orange colour with red pulp and matured seeds

Yield: Under optimum crop management condition fruit yield is 2-3 kg/plant. Crop which raised through seeds & stem cuttings is 20-25 q/ha in first year and 30-35 q/ha from 2nd year. In case crop raised from tubers it yields about 40-50/55.q / ha.

Cultivation Practices of Spine Gourd

Article ID: 40838

DurgaPrasad[1], Mamatha A[2]
[1]3rd year B.Sc. Horticulture, College of Horticulture, SKLTSHU RajendraNagar, Hyderabad,Telangana, IN.
[2]Assistant Professor, Department of Vegetable science, College of Horticulture, SKLTSHU RajendraNagar, Hyderabad, Telangana, IN.


Scientific name: *Momordica dioica* Roxb

Family: Cucurbitaceae

Chromosomes number: 2n=28

Other names: Kakrol, Teasle Gourd, Spiny Gourd, Kantola, Monsoon Vegetable and Bristly Balsam Pear and Kantíoli.

Uses

It is used as a vegetable in all regions of India and some parts in South Asia; it has commercial importance and is exported and used locally. The fruits are cooked with spices, or fried and sometimes eaten with meat or fish. It is a rich source of antioxidants and flavonoids. It has antilipid peroxidative properties,that prevent oxidation of fats, thus preventing fatty liver disease. It is rich in proteins and iron and low on calorie. It is high in fiber and antioxidant and therefore, very useful for easy digestion. It keeps your stomach in good shape during the monsoons by reducing the infections caused and controlling constipation.

Nutritional Composition

Moisture	84.1 g
Calcium	33 mg
Protein	3.1 g
Phosphorus	42 mg
Fat	1.0 g
Iron	4.6 mg
Minerals	1.1 g
Carotene	162 mg
Fibers	3.0 mg
Thiamine	0.05 mg
Carbohydrate	7.7 g
Riboflavin	0.18 mg
Energy	52 cal

Niacin	0.6 mg

Health Benefits
Prevents Hypertension and Supports Heart Health, Prevents Seasonal Infections, boosts Immune System, Cures Eczema and Skin Problems, Protects Liver, Skin and Pimple Care, Prevents and cures Respiratory Disorders, Brain Function, Good for a Diabetic Patient, Supports Digestive System, Prevents Cancer, Peptic Ulcer and Piles, Treats Cough, Give relief in breathing problem, Remove kidney stones, Useful for pregnant women, Work as anti-aging, Improve eyesight, Reduce excess sweating (Hyperhidrosis).

Botany
Spine gourd is propagated by underground tubers. It is a climbing creeper It has small leaves, small yellow flowers, it has small, dark green, round or oval fruits. It is **dioecious**, which means that it has distinct male and female individual organisms. Fruit is an inferior berry Or Pepo.

Origin & Distribution
The plant is native to tropical regions on Asia with extensive distribution in India, Pakistan, Bangladesh, China, Japan, South East Asia, Polynesia besides tropical Africa and South America.

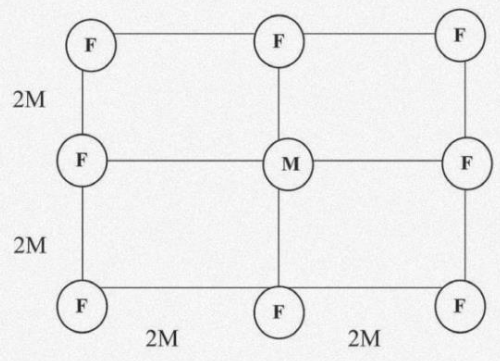
Climate
Kantola is a warm and low humid season or monsoon vegetable crop. This vegetable can be cultivated in both tropical and sub-tropical regions. This crop requires good sunshine for better growth and yield. The optimum temperature of 27°C to 32°C is suitable for its cultivation. Crop can be grown even in places of slightly lower temperature and high rainfall areas.

Soil
Spine gourd/Kantola can be grown on sandy loam to clay soils with pH value of 5.5 to 7.0. Soils with well drainage and good organic matter are ideal for its cultivation.

Propagation
Spine gourd can be cultivated through seeds, but the population will segregate. However, the crop grown vegetatively through tubers and stem cutting will result in uniform, true to type plants. The seed requirement to cultivate a commercial crop in one hectare area will be 2.5-5.0 kg owing to difficulties in seed germination and Maintenance of male/female ratio for a healthy fruit set. However, if the vegetative mode of propagation through Tubers or plants generated from stem cuttings is used Where the male and female plants or tubers are already Known, a total of 2500–2650 tubers or plants having 2200–2300 female and 300–350 male plants will be required to cultivate in a 1 ha. area.

Land Preparation
Land should be levelled and well prepared by tractor or local plough. 3 ploughings are enough to get the soil to the fine tilth stage. In last plough, add 15 to 20 tonnes of farm yard manure (FYM) in the top soil to increase the soil fertility. Raised beds or ridges should be prepared in between the furrows.

Planting
Generally, spine gourd seeds and tubers are having dormancy period hence seeds & tubers are treated with sulphuric acid to break dormancy period before sowing or planting. Pit planting is commonly followed in garden system of cultivation. A pit size of 0.5 x 0.5 x 0.5 m with a spacing 2m × 2m is normally required. Small pits are dug in case of ridges and furrows. The pits are to be refilled with topsoil mixed with 10 kg of FYM (well decomposed), 250 gm of neem cake and 20 gm of carbofuran. Prepared pits are left open for 15-20 days for solar radiation to kill all the insects, soil borne diseases and for aeration before refilling. In saline alkali soil where pH is above 8, pit mixture is to be modified incorporating organic matter and gypsum.



Female(F) and Male(M) ratio= 8:1(F:M)

Male Plant

Female Plant

Field view of spine gourd

Varieties

Indira Kakoda 1: Spine gourd genotype RMF 37 identified as variety "Indira Kakoda 1" by Central Variety Release committee (CVRC) for Chhattisgarh, Uttar Pradesh, Jharkhand, Orissa and Maharashtra during Group Meet held at PAU, Ludhiana (Punjab) from May 5-6, 2006. It is resistant to all major pests; green fruit are attractive, dark Green and contain 12-14 % protein.

Arka Bharath: A high yielding teasel gourd variety released from CHES (ICAR-IIHR), Chettalli.

Arka Neelchal Gaurav: A Teasel gourd variety released from Central Horticultural Experiment Station, Bhubaneshwar for commercial cultivation in Odisha. This variety is moderately resistant to cucumber Moth infestation and tolerant to Anthracnose and Downy mildew disease. Average yield 180-200 q /ha.

Arka Neelchal Shanti: A Spine gourd variety developed through hybridization between spine gourd and teasel gourd, naturally pollinated, high yielding (15-16 kg/vine) with medium sized fruit (20 g), moderately tolerant to fruit borer, anthracnose and downy mildew. Average yield 80-90 q /ha. It was released by SVRC, Govt. of odisha in 2016.

Irrigation

Irrigation should be carried out immediately after sowing the seeds on the raised beds in the field. Thereafter, carry the irrigations on need basis. Irrigations are not needed in case of rainy season and soil has enough moisture. In dry spell weather conditions, 1 or 2 irrigations should be given in weekly interval. Make sure to have water well drained in rainy season or flooding stage.

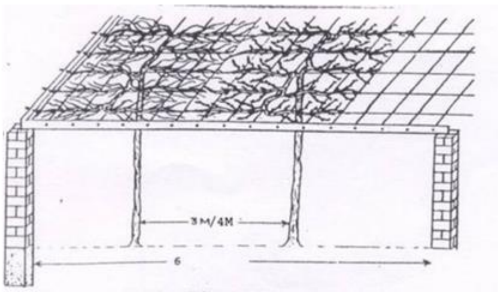
Manures & Fertilizers

Incorporate 15-20 t/ha of well rotten FYM at the time of soil /land preparation. NPK @100:60:40 kg/ha should be Applied. Full dose of Phosphorous and Potash should be applied before planting, however, ½ dose of Nitrogen Should be applied at the time of vine growth and Remaining ½ dose of N before flower initiation.

Intercultural Operations

Weeding: The weeding should be carried out regularly Depending on the appearance of weeds. Hand weeding and hand hoeing weeding methods are preferred as the crop has shallow root system.

Training / Staking: Since, spine gourd vine is climber in nature, it requires Proper support for vegetative growth. Hence, staking is advised for better vine growth and fruit yield. Wood, Bamboo or G.I. wire can be used for staking in single stake or Bower or knifing system as per the availability of resources and staking material. This operation can help to supply sunlight evenly and this will resist to attack of Fruit fly and leaf eating caterpillar.



Training of vines on Bower system.

Flowering, pollination and fruit set: Since spine gourd is a dioecious crop, the male/Female ratio needs to be essentially maintained in the field. This can be easily achieved by cultivating in the advised design mentioned above. The flowering, pollination and fruit set are largely affected by the weather conditions as the pollination is entomophilous. Under favourable Conditions, flowering starts 50-60 days after transplanting anthesis occurs in the evening. Hand pollination significantly increase the fruit Set. Lack of pollination often results in lower fruit set and consequently lower marketable yields. Hence, artificial Pollination may be done as far as possible to increase Fruit yield and profits.

Harvesting: The vegetable is ready for harvesting after 40 to 50 Days when we use tubers as planting material but when Stem cuttings are used as planting material, it takes up to 60-70 days for first picking. When we use seeds as planting Material it takes 65-75 days for getting seed to fruit.

Maturity indices: Fruits should be harvested at green mature stage. The fruit should be tender, Green in colour and seed should be soft for use as green Vegetable. The fully ripened fruits develop orange colour with red pulp and matured seeds

Yield: Under optimum crop management condition fruit yield is 2-3 kg/plant. Crop which raised through seeds & stem cuttings is 20-25 q/ha in first year and 30-35 q/ha from 2nd year. In case crop raised from tubers it yields about 40-50/55.q / ha.

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

Goat Ghee Benefits

Article ID: 40839

Chetan C. Chougale[1], Pranjali B. Meshram[1], Abasaheb K. Parade[1]
[1]Ph.D Research Scholar, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth Rahuri-413722, Ahmednagar (MH).

Goat Milk Ghee is rich in proteins and calcium that helps bone and muscular growth, boosts energy levels and promotes overall health and wellness. Goat milk ghee also contains a lot of probiotics and nutrients that improves digestion and bowel movement. Improves overall growth and development of young children by keeping them full of energy and activity. It also improves intelligence and helps kids develop critical thinking skills at a very young age.

Goat Milk ghee provides a fair and clear complexion since it is rich in healthy oils and nutrients. Goat Milk ghee is an immense source of skin friendly nutrients that add additional moisture and glow to your skin. Short-chain and medium-chain fatty acids in goat ghee indicating higher digestibility.

Good For the Heart Health

One of the most important organs in our body is the heart. By keeping it healthy we can avoid big risks. According to research, goat's ghee contains a good amount of magnesium, which is considered to be especially beneficial for the heart. Magnesium helps maintain heart rate. In addition, doctors believe that it also has a low amount of cholesterol, which is why it can be beneficial for the heart and arteries. Therefore, it can be said that the benefits of goat's ghee include a healthy heart.

To Reduce Inflammation

You may not be sure, but it is absolutely true that the use of goat's ghee can reduce the inflammation of the body. In fact, goat's ghee has anti-inflammatory properties, which can help reduce inflammation in your body.

Increase Bone Strength

The use of goat's ghee can benefit the bones. According to scientific research, consuming goat's ghee can help strengthen the bones. In fact, goat's ghee is considered a good source of calcium. It also contains some amount of magnesium and phosphorus. Phosphorus, magnesium, and calcium together can work to keep the bones healthy.

Increase Metabolism Power

Benefits from goat's ghee also include better metabolism. According to a study, goat's ghee is considered beneficial for people whose body is unable to absorb nutrients. Its intake can help in the metabolism of iron and copper in the body. Therefore, consuming goat's ghee may be much better than other ghee.

Easily Digestible

You may find it easier to digest goat's ghee and foods made from it. The protein found in goat's ghee is digested faster than the protein found in cow's ghee. It also contains less lactose than cow's ghee. In this case, it can be easy to digest and it can help keep the stomach healthy.

Helps to Improve Skin Health

Goat Milk ghee provides a fair and clear complexion since it is rich in healthy oils and nutrients. It is also well-known for treating various skin conditions such as skin rashes, uneven or discolored skin, skin infections and acne.

Good for Immune System

Selenium is one of the key components for the immune system functionality. Cow milk contains trace amounts of selenium, but there are significant amounts of it in goat milk. According to various studies, selenium is such as rare mineral that is extremely important to our immunity and found largely in goat milk. By having goat milk regularly, you are increasing the ability to protect yourself against illness and infections.

Good For Digestive & Metabolic Utilization

Goat milk is far more nutrient-dense than cow milk, which means that you don't need as much of it to receive the same (or better) nutrient intake. A single cup provides nearly 40% of our daily calcium requirements, 20% of vitamin B intake, as well as significant amount of potassium and phosphorus. Furthermore, studies have shown that goat milk can help increase the uptake of iron and copper in our digestive tract, which is essential for people who struggle with anemia and other deficiencies.

Controls Blood-Pressure

Goats' milk is a good source of K (Metal levels), an essential mineral for maintaining normal blood pressure and heart function. Since a cup of goat's milk contains 498.7 mg of K and 121.5 mg of Na, hence it helps to prevent high blood pressure and protect against atherosclerosis (hardening and narrowing of the arteries). It is also a good source of protein, phosphorus, riboflavin (vitamin B2) and potassium (http://goodoledays. weekly. com/benefits-of-goatsmilk.html) Goat milk has high amounts of potassium which can help to reduce the blood pressure because the potassium is a vasodilator which can relax our blood vessels and it can give a relief of tension on our cardiovascular system.

Helps Prevent Heart-Disease

There are nearly twice as many beneficial fatty acids in this milk as can be found in cow milk which can control our cholesterol balance. When we are balancing the essential fatty acid in our bodies, then we can prevent serious conditions such as heart attacks, strokes, atherosclerosis and other coronary complications. Milk products, including those that are higher in fat, are associated with a reduced risk of cardiovascular disease; High-fat milk products have a neutral or beneficial association with cardiovascular disease; Yogurt and cheese are associated with a reduced risk of cardiovascular disease including heart disease and stroke; Several nutrients and other components may explain the beneficial role of milk products on cardiovascular health. These include: calcium, vitamin D, protein, bioactive peptides, fatty acids.

A Good Source of Key Vitamins

Goat milk has a higher vitamin A content than cow milk because goats convert all B-carotene from foods into vitamin A in the milk (Conesa et al., 2008). For the same reason, goat milk is always whiter than cow milk. Both goat and cow milk have low concentrations of vitamin B6 and vitamin D, which are both important during infancy (Juarez et al., 2011) Goat milk contains a similar amount of vitamin A as human milk. Vitamin A is important for both innate and adaptive immune responses, including cell-mediated immunity and antibody responses Vitamin C is a well-known water-soluble antioxidant that is found in greater amounts in goat milk than in cow milk Goat milk is also a good source of vitamins such as D, E, thiamine, riboflavin and niacin:

1. Supplies more vitamin A, and does so in the vitamin form, rather than as beta-carotene,
2. Has substantially more niacin and B6
3. Is lower in folic acid and B12.

Nourishes Skin & Hair

For those who has skin problems especially dry skin problems can be helped with using milk. The content of lactic acid in the milk can make the skin more hydrated and also smoother and brighter. So no wonder many spas or scrubs products use pure milks because it is very good for skin beauty. In milk there is also antioxidants which can make skin healthier and more resistant to various kind of free radicals. Everyone would not want to have hair problems, such as hair loss. With routinely drinking milk can maintain healthy hair and avoid hair loss problems. This is because the vitamin content in milk that good for hair such as vitamin A and vitamin B6. Coupled with the presence of potassium in the milk content, so this will maintain your healthy. Goat milk is rich in silicon, a mineral that positively affects the skin, hair, nails and nervous system.

Conclusion

1. Goat milk ghee is good for immune system.
2. Good for digestive & metabolic utilization.
3. High in calcium and fatty acid but low in cholesterol. Helps prevent heart-disease and controls blood-pressure.
4. Good for growing children, improves intelligence.
5. Nourishes skin & hair.
6. Anti-inflammatory properties, anti-allergic properties.
7. Helps prevent anaemia.
8. Filled with a2 casein, which makes it comparable to breast milk in terms of protein.
9. An effective supplement for the patients of t.b., dengue, cough, asthma, cancer & diabetes -suggested by Ayurveda.

Millisecond Technology to Increase Shelf Life of Milk

Article ID: 40840

Chetan C. Chougale[1], Abasaheb K. Parade[1], Pranjali B. Meshram[1]
[1]Ph.D Research Scholar, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth Rahuri-413722, Ahmednagar (MH).

Introduction

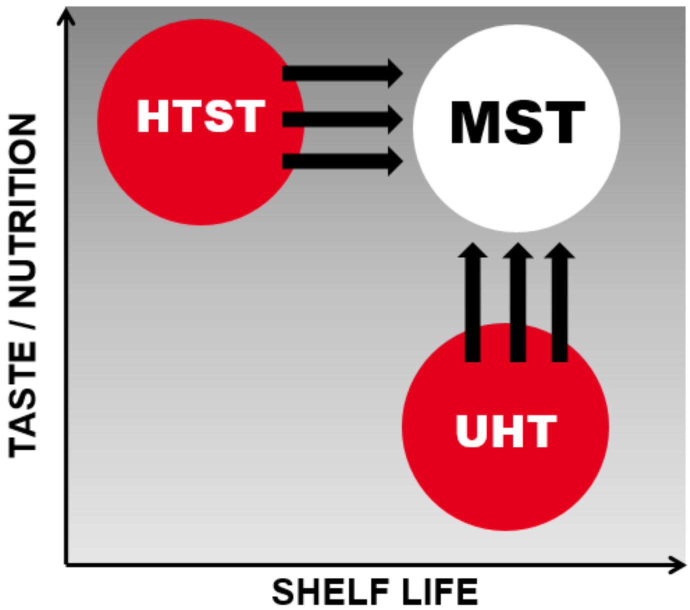
India is the world's top milk producer with annual production of about 210 million tons in year 2021. Liquid milk is an essential nutritional food for infants as well as the aged, as milk is generally considered complete food due to its health benefits. Milk is perishable commodity so work to extend shelf life is needful. Pasteurization or pasteurisation is the process in which milk is treated with mild heat, usually to less than 100˚C (212˚F), to eliminate pathogens and extend shelf life. The process is intended to destroy or deactivate organisms and enzymes that contributes to spoilage or risk of disease, including vegetative bacteria. There are many Pasteurization techniques are available with their advantages and disadvantages. Millisecond Technology (MST) a new cutting-edge pasteurization technology that significantly extends the shelf life of fresh milk without sacrificing nutrition or taste, helping dairy processors to differentiate its fresh milk products and create a new category in the dairy market. It is a novel low temperature, short time (LTST) method in which dispersed milk in the form of droplets was treated with low heat/pressure variation over a short treatment time, in conjunction with pasteurization.

History

Historically, the MST technology was first developed in Russia, by former nuclear scientists. The application for the F&B (Food and Beverages) was then tested at in a juice facility in Germany (due to the complexity of milk). Next, it was shipped to a leading milk processor in the U.K. Overall, results from these early ventures were good, but inconsistent. Eventually the unit was sent to the USA, where it was modified and installed into a fluid milk processing facility. The results were highly encouraging. They achieved a 6-log bacterial reduction and 35-day shelf life, as compared to ordinary pasteurisation levels of a 5-log reduction and an average 14-day shelf life.

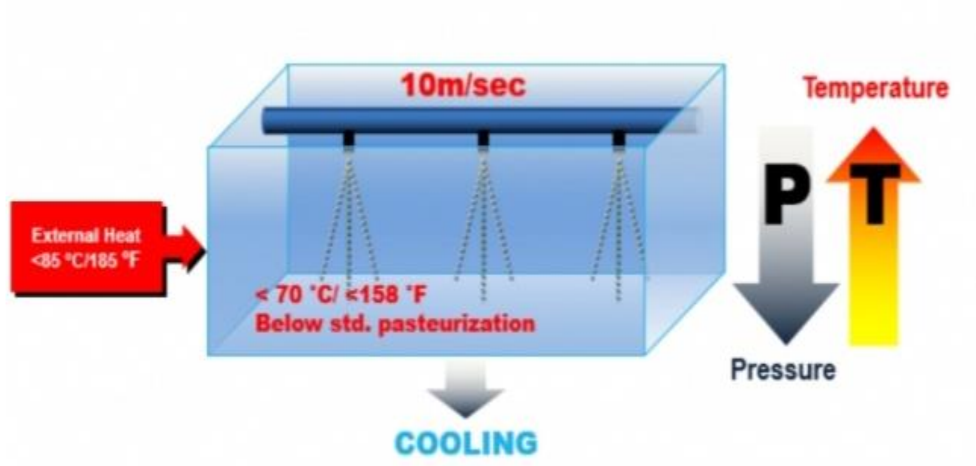
What is Millisecond Technology (MST)?

MST is a new patented pasteurisation technique. Employing a unique combination of low heat and low pressure it achieves a highly efficient reduction of microorganisms in liquid product and is applicable both to liquid and pharmaceutical products and substances.



How MST Work?

When raw milk arrives in unit, the milk undergoes laboratory testing to ensure it meets quality requirements and then moves through a series of filters. The filtered milk is pumped into the MST chamber, where it is subjected to a temperature of about 140F. As the liquid is pushed through a spray nozzle, it forms into small droplets at a speed of 10 meters per sec. The chamber increases in droplet temperature to about 158 °F, while the pressure drops to between 150 and 160 psi. Unlike a stream of liquid, the droplets don't have much cushioning to protect the microbes that may be in them, leaving the bacteria unable to survive the shock that comes when the temperature increase and the pressure decline suddenly in the droplet. The shock ruptures the microorganism's protective membrane and destroy the bacteria, achieving an efficient 8-log bacteria reduction that can extend the milk's shelf life without damaging its nutritional components and flavours. The milk undergoes HTST pasteurization in order to comply with the food safety regulations of third-party agencies, including FDA. "The thing that is unique about MST is that nobody thought to form droplets out of the milk to explode microbes."



PROCESSING TEMPERATURE PROFILE

PRE-HEATING	< 12°C/ 53.6°F → 57.2°C/ 135°F	80.0 sec
CHAMBER		
MST effect		0.002 sec
Hold time	< 70°C/ < 158°F	1.0 sec
Cooling	70°C/158°F → 60°C/140°F	4.0 sec
POST-CHAMBER COOLING	60°C /140°F → < 8°C/46.4°F	60.0 sec

Difference Between HTST, UHT, MST

	HTST	UHT	MST
Product Temperature	72-80°C	138°C	70°C
Process Time	15 sec	2-5 sec	<1 sec
Shelf Life (Days)	14-18	45-90+	45-90+
Taste	Fresh	Cooked	Fresh
Bacterial Kill	5-log	≥8-log	≥8-log
Remaining Bacteria	Usually <1-log	Not significant	Not significant

MST Benefits

1. Extending shelf life optimize distribution through the supply chain-
    a. Reduce returns and disposal

b. Allow shipping further distance

2. Increase capacity because of less spoilage at retailers
3. Fresh taste compared to ultra-pasteurization: The MST process is at a temperature close to HTST
4. Preserves Nutrition- MST maintains vitamin integrity, has significantly less denaturation of protein than Ultra-pasteurization.

Industry Advantage

1. Reduced processing costs compared to UHT or powdered milk products
2. Greater differentiation for the country of origin due to the nature of Fresh Milk
3. Potentially higher profitability overall for the processor and farmers
4. Differentiation product processors such as organic and A2 processors can achieve invest in-market infrastructure for Fresh Product, confident of sell through.

Application

1. Milk and milk-based products
2. Juice
3. Coffee
4. Coconut products
5. And many other types of beverages.

Conclusion

The MST addition demonstrated reduction in microbial load, prolonged shelf-life, and minimal-to-no loss of sensorial/ organoleptic properties tested. Current traditional methods of pasteurization have been effective at reducing microbial load by as much as 5.0 log10 cfu/mL (Guan *et al*. 2005). However, MST has been able to achieve 7.0–8.0 log10 reduction of microorganisms. Additionally, its in-line connection to a traditional pasteurization tube provides enough energy to run the MST unit, without addition of exogenous heat energy. Thus, the energy-saving characteristics and the previous results serve to demonstrate the effectiveness of the MST process. Lower cost per lit. Extended shelf life while preserving taste and nutrition.

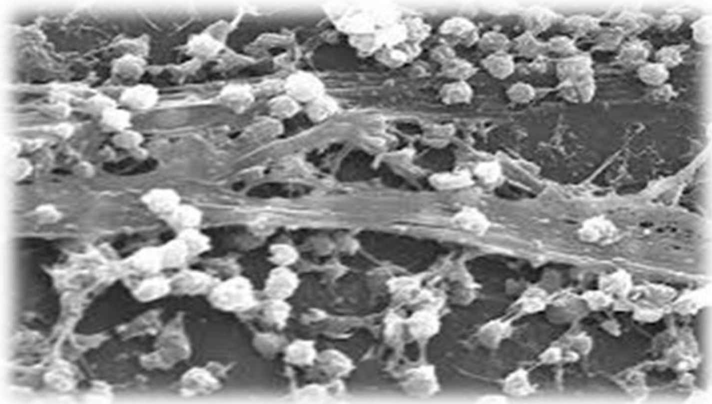
How Biofilm Affects Dairy Industry?

Article ID: 40841

Chetan C. Chougale[1], Pranjali B. Meshram[1], Abasaheb K. Parade[1]
[1]Ph.D Research Scholar, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth Rahuri-413722, Ahmednagar (MH).

Introduction

According to the changing scenario of global market, the dairy industry is considered to be one of the major food industries in world which manufactures a wide range of perishable (e.g., butter, yoghurt and cheese) and semi perishable (milk powder, casein) milk products. Insufficient sanitization and cleaning causes contaminants to accumulate in milk processing equipment which subsequently form biofilm that further become significant source of contamination of dairy products. Biofilm is aggregations of microbial cells interconnected by extracellular polymeric substances which accelerate growth on different material surfaces adversely affect the dairy industry. To maintain the quality, shelf life and safety of these products, microbiological guidelines are an essential requirement.



Biofilm Forming Microbes of Dairy Industry

There are some biofilm forming genera in Dairy Industry they are as fallow

1. *Bacillus:eg – B. subtilis:* It is present in raw and even pasteurized milk. It requires mainly carbon and energy to make the biofilm and use a number of sugars, organic acids and different organic compounds for this task. (Singh *et.al*.,2019)

2. *Pseudomonas:* eg –*P. fluorescens:* It is well-known for this cause because of its high heat resistance and short generation time and these characteristics make it a successful biofilm former.

3. *Listeria:* eg- *Listeria monocytogenes:* It is mainly affected by temperature, strain origin and nutrient level and also has the property of attachment to surfaces passively and its biofilms are primarily comprised of teichoic acids which can grow on polypropylene, steel, rubber and/or glass surfaces.

4. Staphylococcus: **eg- Staphylococcus epidermidis:** Accumulation and development of a mature stage depend mainly on the polysaccharide intercellular adhesions (PIA).

5. Streptococcus:eg- Streptococcus thermophilus: In the heating chamber of the section where temperature remains within 30 to 73°C lies, the maximum degree of biofilm formation occurs. Defects in milk and cheese quality like acidic flavour and undesirable texture are spotted.

6. Lactobacillus: eg-Lactobacillus like L. rhamnosus: It is relatively beneficial because of its property of colonization and longer mucosal permanence of the host as these help in avoiding pathogenic bacterial colonization.

7. E. coli: eg- E. coli: AI-2 signals regulate chemo taxis, flagellar synthesis and motility of genes &supplementary force for biofilm production The E. coli O157:H7 yields exopolysaccharides (EPS) which helps in cell attachment and formation of 3D structures of biofilms.

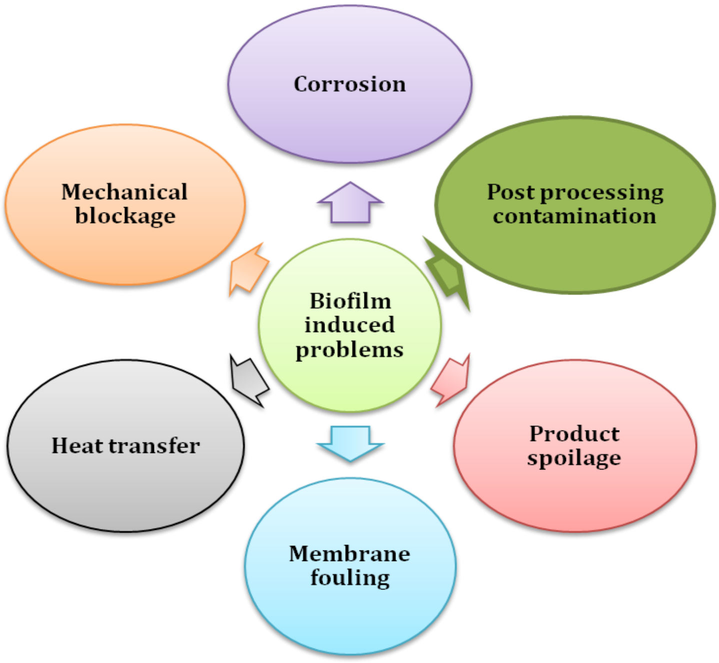
Food Borne Outbreaks Caused by Cross-Contamination Involving Work Surfaces

Pathogen	Involved food	Contamination pathway
E. coli O157:H7	Flavored yogurt	Pump used previously for unpasteurized milk
Salmonella berta	Soft cheese	Cheese ripening cubes previously used for chicken carcasses
Salmonella enterica	Ice cream	Ice cream transporting cistern previously used for raw egg
Listeria monocytogenes	Butter	Food plant environment
Yersinia enterocolitica	Pasteurized milk	Environmental contamination after processing

Microorganisms Involved in Biofilm Formation in Different Processes

Microorganism	Dairy Process surface
Bacillus species	Ultrafiltration and reverse osmosis, membranes, evaporators
E. coli	Ultrafiltration, membranes
Pseudomonas	Storage tank, Ultrafiltration
Acinetobacter	Milk transfer lines
Streptococcus thermophilus	Milk pasteurization & cheese manufacture

Biofilm Induced Problem



Conclusion

1. Biofilm led to financial crisis by impairment of raw material and its products. Therefore, choosing of a profound, prominent and efficient measure is in an urge in order to safeguard the whole sector from further deficiency and mitigating the present problem.

2. Cross-contamination has been shown to be a risk that causes 25% of food poisoning outbreaks, many of which originate in contaminated surfaces, implying a direct relation with poor surface hygiene.

3. It is emphasized that good manufacturing practices (GMPs), good hygienic practice (GHPs) and hazard analysis should be implemented in dairy industry to prevent the contamination of dairy products.

Use of Smart Phone in Smart Agriculture

Article ID: 40842

Vivek Pandey[1], Firoj Saifi[2], Mohammad Hasanain[3]
[1]Ph.D. Scholar, Department of Agronomy, SVPU&T, Meerut.
[2]Student, Amar Singh Degree College, Lakhaoti Bulanadshahar U.P.
[3]SMS (Agronomy), KVK Chittora, Muzaffarnagar U.P.

Introduction

At the present time to ensuring the food security Indian farmers need of adopt to new and modern methods to enhance the agriculture production. Now a days the traditional methods is no longer suitable, because farming outputs depend largely on surrounding environmental conditions and management practices. Among them technologies invented in the past few decades, new methods for farming have been invented like, precision agriculture. In this smart phone is currently most important electronic device in agriculture where farmers itself getting the solution their farming problems and boost the knowledge regarding farming practices with the help of mobile apps. Smart phone with its current trends and most applicable in field of agriculture to assess the weather and climate (cloud computing,) information for selection of cropping system and carryout the timely agricultural practices, soil description, agriculture market information related to price of crops, current demand of commodities and various useful government schemes, crop disease news sensor control, GPS, GIS, data mining, language processing and other technique have used to provide knowledge about smart farming. Meanwhile, farmers who already adopt assistance from other information technologies, they can utilize smartphone-based assistance apps to achieve better profit and farming productivity.

Major Role of Smart Phone in Agriculture

In this we describe the smartphone applications from ore survey. The applications were categorized into four major categories: farming, farm management, information systems and extension services.

1. Resource information- To identified and provide the information about fertilizers, pesticide insecticidal, herbicide, seed quality.

2. Agriculture input calculation- Smart phone use to getting the precise and calculate the amount of agriculture input in a very short time. Applying fertilizer is an important farming activity with the right amount for better response. Farmers may calculate proper amounts of fertilizers for crop fields upon analysing colour of crop leaves with some help from smartphone applications.

3. Diseases identification and control- Smartphone applications like; Plantix is dedicated to disease detection in farms when utilizing sensors on smart-phones.

These applications worked by capturing images of plant leaves being investigated for diseases and also suggest the control, ting the processed images to remote laboratories. The image

4. Current agriculture news- Provide the valuable news regarding agriculture in local and global market, such as agriculture produce market prices, subside in agriculture farm inputs, and warning related to use of high toxic residue chemicals.

5. Crop water needs estimation- For the obtaining higher production farmers also need to make the decisions on the time and amounts of water their crops need. Crop. The water requirement depends on the various conditions like: type crop, season, climate and critical stages of crops. Crops loss the water through the evapotranspiration. Crop water needs are analyzed to supplement water loss. A smartphone application called **PocketLAI** helped farmers in determining Leaf Area Index (LAI), which is a key factor to calculate crop water requirement.

6. Information System Applications- Now a days many applications provide information, which is a key factor for making effective decisions in all industrial sectors including agricultural sector. It is widely recognized that information can help farmers increase agricultural productivity. Up-to-date information about prices as well as market demands helps farmers in choosing the type and amount of crops to grow and where to sell their products, to maximize profits.

7. Maintain crop and livestock calendar
8. Weather information
9. Insect and Pest warning
10. Providing tips for organic cultivation of crops
11. Calculation of total field area and provide field map
12. Pollution and activity report submission
13. Government schemes.

Mobile Apps and their Use in Agriculture

Information area	Features of application	Mobile Apps name	Developers
Crops related	Selection of crop variety		
	Time of sowing	Agri app	
	Land mapping	Google earth, Smart tools	
	Precise irrigation management	KSNM Drip	
	Fertilizer calculates	Fertilizer calculator	Dr. Vishwanath Koti
	Disease identified and control	Plantix	
	Weeds identified	Plantix	
	Better and timely harvest		
	Processing		
	Storage		
	Pest warning	Agri smart	Punjab Agriculture Department
	Insect information	Kheti ki pathshala	
	Complete crop production information	Agri app, krish-e,	
Weather Forecasting	Amount and time of rainfall	MyRML	
	Temperature		
	Solar radiation		
	Humidity		
	Information on current weather. Next 5 days	Kisan suvidha	Launched by PM Narendra Modi
Water needs of cropps	Images of leaf canopy are acquired to estimate Leaf Area Index (LAI), which in turn gives crop water requirements	PocketLAI	
Market price	Indian agri. commodity market price list	Digital mandi	Appkiddo
Government schemes	Provide government schemes	Kisan yojana	ANN India

Conclusion

The smartphone can be very helpful in agriculture sector, without the needs for external sensors. There are many smartphone-based agricultural applications are found to be within our scope. Inexpensive smartphones equipped with various agriculture apps are opening new opportunities for rural farmers who previously had limited access to upto-date agricultural information (e.g., market, weather, and crop disease news) for smart agriculture practices.

References

1. Confalonieri, R., M. Foi, Casa, R.(2013). Development of an app for estimating leaf area index using a smartphone. Trueness and precision determination and comparison with other indirect methods. *Computers and Electronics in Agriculture* **96**:67–74.
2. Prasad, S., Peddoju, S. K. and Ghosh, D. (2014). "Energy efficient mobile vision system for plant leaf disease identification," in Proceedings of the *IEEE Wireless Communications and Networking Conference* (WCNC) **14**: 3314–3319.

Seed Priming: An Old Empirical Technique with New Comprehensive Approaches to Enhance Salt and Drought Stress Tolerance in Plants

Article ID: 40843

Rahul Kumar[1], Gagandeep Singh[1], Preeti Vashisht[1]
[1]Ph.D. Scholar, Chaudhary Charan Singh Haryana Agricultural University, Hisar.

Introduction

Seed priming being a value-added technique is performed on seed and this method is useful for quick germination and uniform emergence. Seed priming activates pre-germination metabolism, thus accelerating the seedling emergence and homogeneous plant stand in the field. It has been proved to improve the germination and seedling establishment of many field and horticultural crops. In recent times, seed priming has emerged as a beneficial strategy in abiotic stress management as it supports plants against various kinds of abiotic stresses *i.e.* drought, salinity, heat, chilling etc. Benefits of priming the seeds include rapid and synchronized germination, increase in nutrient uptake, ease of phytochrome induced photo and thermo-dormancy, improved germination temperature range, more efficient water use and uniform crop maturation. Literal meaning of 'Priming' is the trigger caused to tolerance of stress through moderate to intermittent stress. Seed priming for long has been known a potential way to boost crop performance by increasing tolerance of plant towards stresses. It improves seed vigour which itself is a complex agronomic trait under control of multiple genetic and environmental factors.

Brief History of Priming

Since right from the beginning of agriculture, man realized that most seeds do not germinate easily and uniformly. Seed priming was an age-old technique practiced by the Greek farmers. Theophrastus (372–287 BC) focused on seed physiology and suggested that germination process may be temporarily interrupted. He recommended the pre-soaking of cucumber seeds in milk or water to germinate earlier and vigorously []. Research reports also revealed that pre-hydration of legume seeds was done by Roman farmers in order to increase the germination rate and synchronize germination. In 1664, Evelyn mentioned that temperature prior to sowing may have an impact on further germination. During 1779, Ingenhousz studied the impact of light on seedling emergence. Amici during 1830 and Sachs during 1859 described the morphological process associated with seed germination [1,12]. The role of plant hormones in seed desiccation tolerance, reserve mobilization, cell division and cell elongation were discovered in 1920‟s [10]. The word seed priming was coined by Heydecker in 1973 and he successfully adopted seed priming to improve seed germination and emergence under stressful conditions [14].

Physiological Basis of Seed Priming

Germination of seeds commonly implies three distinct phases (Figure 1) consisting in:

Phase I: seed hydration process related to passive imbibition of dry tissues associated with water movement first occurring in the apoplastic spaces.

Phase II: activation phase associated with the re-establishment of metabolic activities and repairing processes at the cell level.

Phase III: initiation of growing processes associated to cell elongation and leading to radicle protrusion.

Phases I and III both involve an increase in the water content while hydration remains stable during Phase II. It is commonly considered that before the end of Phase II, germination remains a reversible process: the seeds may be dried again and remain alive during storage and able to subsequently re-initiate germination under favorable conditions.

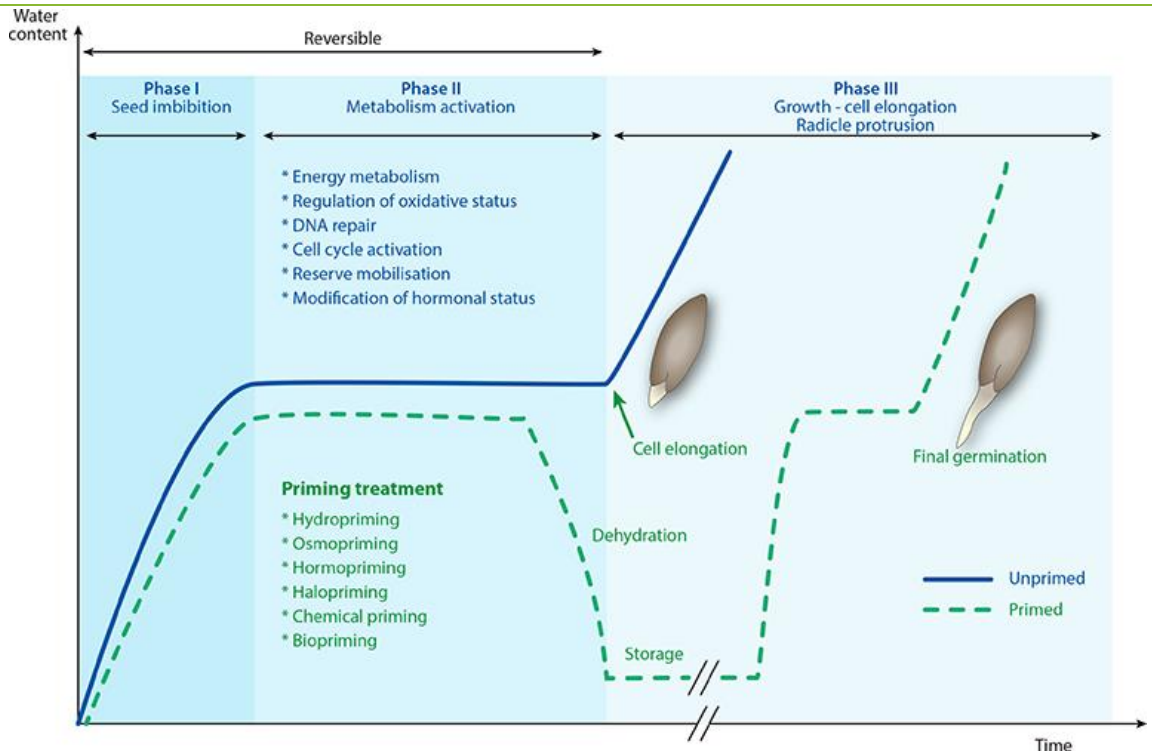
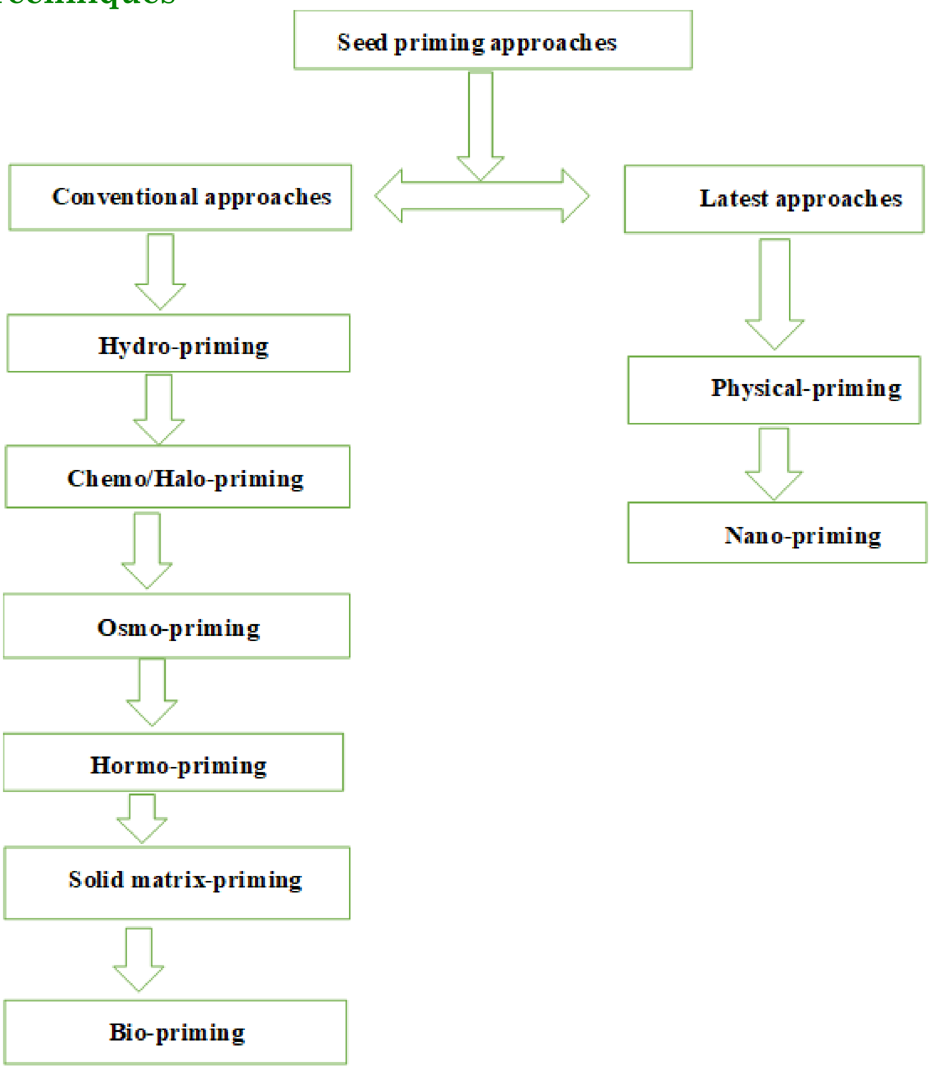


Fig. 1 Seed hydration curves and germinating phases in unprimed and primed seeds

Seed Priming Techniques



1.**Hydro-priming:** soaking the seeds in water before sowing and may or may not be followed by air drying of the seeds. Hydropriming is the simplest method of seed priming, which relies on seed soaking in pure water and re-drying to original moisture content prior to sowing. Hydro-priming may enhance seed germination and seedling emergence under saline and non- saline conditions and also have beneficial effect on enzyme activity required for rapid germination. It plays an important role in the seed germination, radical and plumule emergence in different crop species.

2. Halo-priming: refers to soaking of seeds in solution of inorganic salts i.e NaCl, KNO3, CaCl2 and CaSO4 etc. A number of studies have shown a significant improvement in seed germination, seedling emergence and establishment and final crop yield in salt affected soil in response to halo-priming. Priming with NaCl and KCl was helpful in removing the deleterious effects of salts.

3. Osmo-priming: Osmo-priming involves soaking seeds in osmotic solution with low water potential instead of pure water. Due to low water potential of osmotic solutions, water enters seed slowly which allows gradual seed imbibition and activation of early phases of germination but prevents radical protrusion. Different compounds are used in osmopriming procedure including polyethylene glycol (PEG), mannitol, sorbitol, glycerol, and inorganic salts such as NaCl, KCl, KNO3, K3PO4, KH2PO4, MgSO4, and CaCl2. Most common chemical employed in osmopriming treatment is PEG, mainly owing to its specific characteristic. Large molecular size of PEG prevents its penetration into the seed thus avoiding induction of potential cytotoxic effect and reduction of osmotic potential within seed. Nevertheless, PEG exhibits some undesirable features including high viscosity, which restrict diffusion of oxygen in the solution so in PEG priming aeration system is preferred. Seed priming with PEG has been shown as an effective method to improve seed germination, seedling emergence, and stress tolerance of several crop plants under unfavorable conditions.

4. Hormonal priming: is the pre - seed treatment with different hormones like GA3, kinetin, ascorbate etc., which promotes the growth and development of the seedlings. During hormonal-priming, seeds imbibitions occur in the presence of plant growth regulators, which can have direct impact on seed metabolism. The following regulators are commonly used for hormo-priming: absacsic acid, auxins, gibberellins, kinetin, ethylene, polyamines, and salicylic acid (SA). Gibberellic acid (GA3) .With the proper treatment of seeds they are able to germinate and emerge better as the inorganic salts improve germination and growth parameters of the treated seed; KNO3 increases yield, fruit size and improves quality in field and vegetables crops and seed priming with GA3 enhance emergence and germination rate of soybean. Cytokinins can also be used as priming agent as they are mainly involved in the breakdown of dormancy of some seeds.

5. Solid Matrix priming: Solid matrix priming (SMP, matri conditioning), in which water uptake by seeds is controlled, has been developed as an alternative method to osmopriming because of high cost of osmotic agents and technical problems with aeration . During solid matrix priming, seeds are mixed and incubated with wet solid water carrier for a certain period. Afterward, seeds are separated from matrix, rinsed, and back-dried. The use of solid medium allows seeds to hydrate slowly and simulates natural imbibitions process occurring in the soil To successfully accomplish SMP, materials utilized as matrices should possess specific physical and chemical features such as low matrix potential, minimal water solubility, high water holding capacity and surface area, no toxicity to seeds, and ability to adhere to seed surface. In fact, vermiculite, peat moss, charcoal, sand, clay, and some commercially offered substrate such as Celie or Micro Cell are exemplary solid carries applied in solid matrix priming.

6. Bio-priming: Bio-priming involves seed imbibition together with bacterial inoculation of seed, this treatment increases rate and uniformity of germination, but additionally protects seeds against the soil and seed-borne pathogens. Hydration of seeds infected with pathogens during priming can result in a stronger microbial growth and consequently impairment of plant health. However, applying antagonistic microorganisms during priming is an ecological approach to overcome this problem. Moreover, some bacteria used as biocontrol agents are able to colonize rhizosphere and support plant in both direct and indirect way after germination stage. It was found that biopriming is a much more effective approach to disease management than other techniques such as pelleting and film coating.

7. Nano – priming: Nano-priming is an innovative seed priming technology that helps to improve seed germination, seed growth, and yield by providing resistance to various stresses in plants. Nano-priming is a considerably more effective method compared to all other seed priming methods. Nano-priming induces the formation of nanopores in shoot and helps in the uptake of water absorption, activates reactive oxygen species (ROS)/antioxidant mechanisms in seeds, and forms hydroxyl radicals to loosen the walls of the cells and acts as an inducer for rapid hydrolysis of starch. It also induces the expression of aquaporin genes that are involved in the intake of water and also mediates H_2O_2, or ROS, dispersed over biological membranes. Nano-priming induces starch degradation via the stimulation of amylase, which results in the stimulation of seed germination. Nano-priming induces a mild ROS that acts as a primary signaling cue for various signaling cascade events that participate in secondary metabolite production and stress tolerance.

Stress Resistance to Salt and Drought

Most of the studies performed on the seedlings issued from primed seeds demonstrated a clear improvement of resistance to environmental constraints. Table 1 is providing a nonexhaustive list of recent publications dealing with stress resistance improvement on cultivated plant species. Frequently, such improvement is obvious just after emergence at the seedling level, but progressively disappears at the adult stage. For example, some young plants issued from priming treatments displayed improvement of resistance to salinity [4,15], high temperature [11], drought [5, 6, 7], and UV exposure [13]. Some interesting studies also demonstrated that priming may afford resistance to biotic stresses such as *Fusarium oxysporum* in tomato [9], viral disease in *Brassica rapa* [8], and downy mildew in pearl millet [2]. Such a large set of data suggests that seed priming may elicit numerous pathways contributing to stress resistance. The molecular basis involved in this stress resistance remains intact during the dehydration phase following priming and may contribute to stress resistance during the final germination step. Moreover, some data suggest that a single priming treatment may induce resistance to various stresses.

Environmental constraint	Plant species	Priming treatment
Salinity	*Brassica juncea*	hydro/osmopriming
	Brassica napus	PEG
		Halopriming
	Helianthus annuus	KNO_3
	Triticum durum	ascorbic acid
	Zea mays	Sand priming
	Triticum aestivum	ABA + SA
		Ascorbic acid
		Biopriming
		$KCl + CaCl_2$
High temperatures	*Lactuca sativa*	Hydropriming
	Daucus carota	PEG
Biotic stresses		
Phythium ultimum	*Zea mays*	Biopriming
Verticillium	*Brassica napus*	Biopriming
Downy mildew	*Pennisetim glaucum*	Biopriming
Fusarium oxysporum	*Solanum lycopersicum*	Methyl jasmonate

Table 1: Nonexhaustive list of recent studies devotes to priming-induced increase in the stress resistance of cultivated plant species.

Conclusion

Augmentation of stress tolerance potential through various seed priming techniques is a promising strategy to mitigate the detrimental effects of drought stress on plant growth and productivity. Just as priming enhancing the drought tolerance potential, it can also complement rapid and successful recovery from stress impacts. Maintenance of better plant water status, enhanced antioxidation machinery, improved photochemical efficiency, DNA and organelle damage repair, and denovo synthesis of nucleic acids and proteins attributed by seed priming reduces the severity of drought-induced damages on plant performances. These physiochemical modulations taking place during seed priming could favour most of the processes essential for a plant to recover quickly from drought stress. Hence, at the onset of a favourable environment through rain or irrigation, plants emerged from primed seeds recoup in a faster and improved manner. This eco-innovation augments the inherent stress tolerance potential of plants and thereby contributes towards better crop production. Environmental and ethical safeness offered by various seed priming techniques makes it a promising and sustainable strategy to ensure food security.

References

1. Amici, G. B. (1830). Note on pollen action mode on stigmata. Annales Sciences NaturellesBotanique. 21: 329-332.
2. Anup CP, Prasad M, Nataraj S, Mayuri NG, Manbali J, Hussain A, Kukkundoor RK. Proteomic analysis of elicitation of downy mildew disease resistance in pearl millet by seed priming with β-aminobutyric acid and Pseudomonas fluorescens. Journal of Proteomics. 2015;120:58-74.
3. Evenari, M. (1984). Seed physiology: Its history from antiquity to the beginning of the 20thcentury. Bot. Rev. 50:119-142.
4. Fallahi J, Rezvani-Moghaddam P, Nassiri Mahallati M, Behdani MA, Shajari MA, Amiri MB. 2013. Influence of seed nitrogen content and biofertilizer priming on wheat germination in salinity stress conditions. Archives of Agronomy and Soil Scence. 2013;59:791-891.
5. Goswami A, Banerjee R, Raha S. Drought resistance in rice seedlings conferred by seed priming: role of the anti-oxidant defense mechanisms. Protoplasma. 2013;250:1115-29. DOI: 10.1007/s00709-013-0487-x
6. Jisha KC, Puthur JT. Seed priming with BABA (β-amino butyric acid): a cost-effective method of abiotic stress tolerance in Vigna radiata (L.) Wilczek. Protoplasma. 2015. DOI: 10.1007/s00709-015-0804-7
7. Jisha KC. Vijayakumari K, Puthur JT. Seed priming for abiotic stress tolerance: an overview. Acta Physiologia Plantarum. 2013;35:1381-1396. DOI: 10.1007/s11738-012-1186-5
8. Kalischuk ML, Johnson D, Kawchuk LM. Priming with a double-stranded DNA virus alters Brassica rapa seed architecture and facilitates a defense response. Gene. 2015;557:130-137.
9. Krol P, Igielski R, Pollmann S, Kepczynska E. Priming of seeds mith methyljasmonate induced resistance to hemibiotroph Fusarium oxysporum f. sp. Lycopersici in tomato via 12-oxo-phytodienoic acid, salicylic acid, and flavonol accumulation. Journal of Plant Physiology. 2015;179:122-132.
10. Lutts, S., Benincasa, P., Wojtyla, L., Kubala, S. S., Pace, R., Lechowska, K., Quinet, M., and Garnczarska, M. (2016). Seed priming: New comprehensive approaches for an old empirical technique. In: New Challenges in Seed Biology - Basic and Translational Research Driving Seed Technology. Intech Open Limited, London, pp. 1-46
11. Nascimento WM, Huber DJ, Cantliffe DJ. Carrot seed germination and respiration at high temperature in response to seed maturity and priming. Seed Science and Technology. 2013;41:164-169.
12. Sachs, J. (1859). About treatments modifying germination strength in seeds. Bot. Zeitung. 17: 177-188.
13. Singh A, Gupta R, Pandey R. Rice seed priming with picomolar rutin enhances rhiospheric Bacillus subtilis CIM colonization and plant growth. PLoS One. 2016;11:e0146013.
14. Sivasubramaniam, K., Geetha, R., Sujatha, K., Raja, K., Sripunitha, A., and Selvarani, R. (2011). Seed priming: Triumphs and tribulations. Madras Agric. J. 98(7-9): 197-209.
15. Zhang CF, Hu J, Lou J, Zhang Y, Hu WM. Sand priming in relation to physiological changes in seed germination and seedling growth of waxy maize under high-salt stress. Seed Science and Technology. 2007;35:733-738.

Parthenium Weed and its Management

Article ID: 40844

Firoj Saifi[1]
[1]Student, Amar Singh Degree College, Lakhaoti Bulanadshahar U.P..

Introduction

Problematic weeds have certain specific characteristics viz prolific in seed production, competitive and aggressive in nature, troublesome, difficult to control by normal weed control measures.

Parthenium *hysterophorus (L.)*

An annual exotic alien weed, currently considered one of the seven most dreaded weeds of the world. Parthenium weed is native to the subtropics of North and South America. It is a fast-maturing annual. First introduced with milo grain seed in India and first noticed in Pune in 1955. It is known by several popular names such as gajar ghaas, congress grass, carrot weed, white cap or top etc. Some of the vernacular names by which Parthenium is called are chatak chandani, broom brush, asadi, gajari, phandriphuli, nakshatra gida, vayyari bhama and safed topi. Parthenium weed is toxic to stock and contact with parthenium weed, particularly its pollen, can cause allergic reactions such as dermatitis, hay fever and asthma in people.


Biology: Deep tap root system and an erect stem that becomes woody with age. It may eventually reach a height of 2 m. Leaves are pale green, branched and covered with soft fine hairs. The small white flowers (4 mm across) have five distinct corners and grow on the stem tips. Each flower produces four or five black wedge-shaped seeds that are 2 mm long with thin white scales. Its large and persistent soil seedbank, fast germination rate and ability to undergo dormancy make it well adapted to semi-arid environments. It also releases chemicals that inhibit the germination and growth of pasture grasses and other plants. Parthenium weed can germinate, grow, mature and set seed in four weeks. The weed has high reproductive capacity, with light weight seeds which disseminate fast by wind, rain and traffic activity. Lack of seed dormancy also enables the weed to complete 3-4 life cycles in a year.

Management:

a. Mechanical Control:

i. Ploughing the weed in before plants reach flowering stage and then establishing pasture may be effective. Before crops are planted, parthenium weed is normally ploughed in, or pre-emergent herbicides can be used.

ii. Uprooting the weed manually when the soil is wet and slashing with sword, collecting and burning the weed before flowering are some of the effective means of control.

iii. However, the manual removal is usually neither very effective nor economical, because of the rapid regrowth requiring repeated removals for season-long control.
iv. In gardens, tree plantation, ,open wasteland, etc., the weed should be ploughed under before flowering.
v. This has proved fatal to the people involved as it causes severe skin diseases and other infections on contact with the weed. Matured seeds fall on the ground and may increase infestation.
vi. Burning too has proved inadequate as it required large quantity of fuel. Moreover, burning destroys all plants in vicinity.

b. Cultural Control:

i. Growing competitive crops (fodder sorghum sunflower and maize).
ii. Self-perpetuating competitive plant species like Cassia sericea, C. tora, Tagetus erecta.
iii. *Abutilon indicum* in non-crop areas is recommended for effective management of Parthenium.

c. Biological control:

i. *Zygogramma bicolorata* , a Mexican beetle (50-100 beetles/plant) has been found promising.
ii. Several insect biocontrol agents and fungal pathogens are currently in use in Australia against Parthenium.
iii. leaf beetle ***Zygogramma bicolorata*** and the stem moth ***Epiblema strenuana*** The cause the most damage. The beetle emerges in late spring and is active until autumn. The moth is established in all *parthenium* weed areas. Its larvae (grubs) feed inside the stem, stunting the plant's growth and reducing its competitiveness and seed production.
iv. *Smicronyx lutulentus*, which lays eggs in the flower buds, leaving the newly hatched grubs to feed on the seed heads.
v. Leaf mining moth, ***Bucculatrix parthenica***, from Mexico, whose grubs feed on the leaves of parthenium weed.
vi. *Puccinia abrupta*, a winter rust from Mexico, infects and damages leaves and stems.
vii. Management of Parthenium through biocontrol is considered as natural and self-sustaining.
viii. Mycoplasma-like organisms (MLO) could be utilised as they cause seed sterility.
ix. These exotic insects are not effective some time because of the interference of weather. Long, dry day periods reduce the growth of the incest to very low levels.

d. Chemical Control:

i. For non-cropped area:

- Paraquat(0.5kg/ha)
- 2,4-D (Na,amine or ester)-0.5-1.0kg/ha
- Glyphosate (1.0-.2kg/ha)
- Metribuzin (1.0-1.5kg/ha

ii. For cropped area:

- Atrazine (1.0-1.5kg/ha)
- Terbutyryne (1.0-1.5kg/ha)
- Butachlor (1.0-1.5kg/ha)
- Pendimethalin (1.0-1.5kg/ha)
- Metribuzin (0.5-1.0kg/ha)
- 2,4-D (Na salt, dimethyl amine or diethyl ester)-(0.5-1.0kg/ha)

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

Nitrogen Management Based on *Green seeker* in Cereal Crop

Article ID: 40845

Firoj Saifi[1], Mohammad Hasanain[2]
[1]Student, Amar Singh Degree College, Lakhaoti Bulanadshahar U.P.
[2]SMS (Agronomy), KVK Chittora, Muzaffarnagar U.P.

Introduction

Green Seeker® optical sensor technology enables you to measure, in real time, a crop's variability, and variably apply the "prescribed" fertiliser or chemical requirements. Green Seeker® also predicts yield potential for the crop using the agronomic vegetative index (NDVI). Green Seeker® permits you to have better control of input use, allowing you to apply the right amount in the right place at the right time – improving your yields, decreasing your nitrogen cost and increasing your bottom line! Green Seeker® enables you to also collect data during existing farming operations such as spraying, cultivation and mowing.

Applications

1. In-season crop mapping for targeted agronomy
2. Biomass and plant canopy measurements
3. Variable Rate plant growth regulator (PGR)
4. Variable Rate nitrogen
5. Variable Rate insecticide (mapping grass grub and slug pressure)
6. Variable Rate fungicide
7. Variable Rate desiccant
8. Variable Rate herbicide
9. Weed mapping.

Key Benefits

1. Reduce in-crop fertilizer and input costs
2. Allows inputs to be adjusted during the growing season to meet plant requirements
3. Only apply inputs to areas that need it
4. Collect data during existing farming operations
5. Fast and precise optical sensing
6. Operational day of night
7. Simple to install and straight-forward to operate.

Handheld Green Seeker

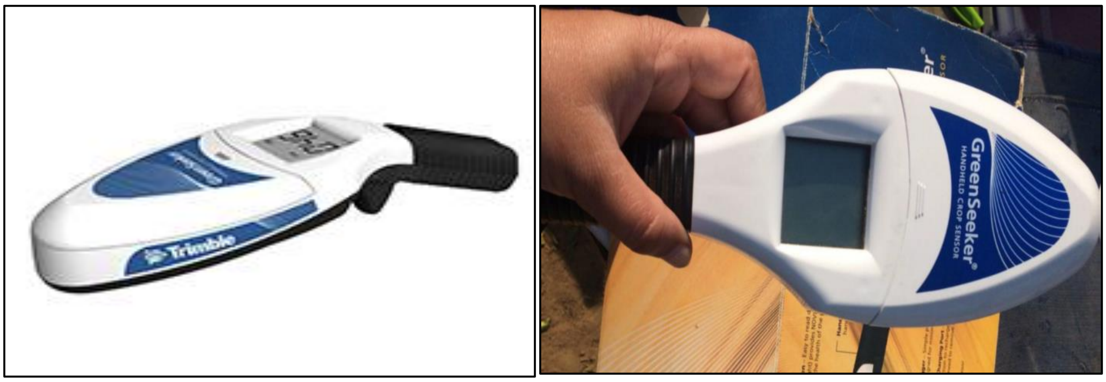


Fig. 1. Optical sensors (Green seeker)

The Trimble® Green Seeker handheld crop sensor is an affordable, easy-to-use measurement device that can be used to assess the health – or vigour – of a pasture or crop in order to make better nutrient management decisions on your farm. The Green Seeker handheld instantly takes a reading of your crop's health. Readings can be used to make non-subjective decisions regarding the amount of fertilizer to be applied to your crop, resulting in more efficient use of fertilizer a benefit to your bottom line and the environment.

NDVI-Normalized Difference Vegetation Index

$$NDVI = \frac{NIR - Red}{NIR + Red}$$

Factors Impacting NDVI

Measurements:

1. Crop factors:

a. Variety and/or plant maturity
b. Seeding rate
c. Growth rate (plant morphology)

2. Environmental factors:

a. Available soil moisture
b. Diurnal cycle

3. Soil background.

Calculation of Fertilizer N Requirement Using Green Seeker Instrument

Nitrogen fertilizer optimization algorithm i.e., procedure for calculating fertilizer N requirement by crop using NDVI readings has been thoroughly described by Raun *et al* (2002) and Singh *et al* (2011). The NFOA may be separated into following components:

1. NDVI: Normalized difference vegetation index is a measure of total biomass and greenness of leaves and is used for mid-season prediction of final grain yield. NDVI measurements by optical sensing of wheat with Green Seeker were made on different dates.

2. Mid-season prediction of grain yield (INSEY): In-season estimated yield (INSEY) as the measure of the daily accumulated biomass from the time of planting to the day of sensing.

$$INSEY = NDVI / DAS$$

3. Yield potential with no added inputs (YP0)

Yo= 6084.6 * INSEY /1.61

4. Response Index (RI_{NDVI}): The magnitude of response to N fertilization was predicted

RI_{NDVI} = NDVI enriched/NDVI of the test plot

5. Yield potential achievable with applied N Fertilizer (YPN): N rich strip was established and YPN was predicted based on RI and YP0.

YPn = Yo * RI

6. Generating Fertilizer N recommendation

Fertilizer N dose (kg ha^{-1}) = $\frac{10 \times (Yn–Y0) \times 1.85 \text{ (mean N content of grain)}}{0.5 \text{(Efficiency factor)}}$

Optical Sensors (Green Seeker) in Cereals Crop

Chlorophyll meter and LCC do not take into account the photosynthetic rates or biomass production and the expected yields for working out fertilizer N requirements. Optical sensors measure visible and near-infrared (NIR) spectral response from plant canopies to detect the N stress (Ma et al., 1996). Chlorophyll contained in the palisade layer of the leaf controls much of the visible light (400–720 nm) reflectance as it absorbs 60% of all the incident light in the red wavelength bands (Campbell, 2002). Optical sensor-assisted N management resulted in similar rice grain yields as the blanket recommendation for the region, but with reduced N rates leading to greater recovery efficiency (by 5.5–21.7%) and agronomic efficiency (4.7–11.7 kg grain/kg N applied). study has revealed that Green Seeker optical sensor can better predict N uptake and grain yield as it could explain 69 % and 61 % variability as compared to measurements at Leaf chlorophyll meter, which explained 55 % and 53 % variations in N uptake and grain yield, respectively.

Table 2. *Green seeker* on yield and Nutrients use efficiency in cereals crop:

Sl.No.	Crop	Increase in crop productivity and Nutrients use efficiency	References
1	Rice	Green Seeker optical sensor for top-dressing N at panicle initiation stage of rice	Xue et al. (2014)
2	Rice	To greater recovery efficiency (by 5.5–21.7%) and agronomic efficiency (4.7–11.7 kg grain/kg N applied).	Bijay-Singh et al. (2015)
3	Wheat	Green Seeker optical sensor can better predict N uptake and grain yield.	

Conclusion

This is concluded that prescription of N in cereal crop had significantly enhances NUE and productivity of crop. It also reduces L loss and N consumption rate in Agriculture.

References

1. Bijay, S., Yadvinder, S., Ladha, J. K., Bronson, K. F., Balasubramanian, V., Jagdeep, S. and S. Khind, C. 2002. "Chlorophyll Meter and Leaf Color Chart-Based Nitrogen Management for Rice and Wheat in Northwestern India," *Agronomy Journal*, **94**(4): 821-829.
2. Xue, L., Li, G., Qin, X., Yang, L. and Zhang, H. (2014), Topdressing nitrogen recommendation for early rice with an active sensor in South China, *Precision Agric*., 15, 95–110.

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

Effective Method for Controlling Wild Boar

Article ID: 40846

E. Siva Sundar[1], B. Imran Nazir[1], M. Siva Surya Prakash[1], P. Gugan Alais[1], Hari Hara Suthan[1], C. Thanga Tamil Selvan[1]
[1]B.Sc (Hons) Agriculture, S. Thangapazham Agricultural College, Vadudevanallur, Tenkasi.

Abstract
To develop an effective and biologically based wild boar management, detailed information about the biology of this species and the influencing factors is required. This need for knowledge is in particular true for family groups dominated by females, who are main subject of regulatory management measures. For understanding mechanisms of epidemics and damages it is essential to gain knowledge about space use and dispersal functions. To investigate management implications, improve hunting methods and thus help to reduce high population levels causing severe economic problems.

Capture Techniques
We captured wild boar in big cage traps of 5 x 2 x 2 m by video-observation and manual (electromagnetic) release from mid-November 2002 to end of March 2006. After separating them in small handling cages 152 wild boar were marked with ear-tags printed with address and phone number of our institute. Additionally, 68 females and 11 males of 30 different groups were fitted with ear tag radio transmitters with a weight of about 50 g. The transmitters had a beep-ratio of 20 beeps per minute with a lifespan of 3 years (mean lifespan 363 days), reaching up to 3 km.

Wild Boar Damage Status in Tamil Nadu

For the past 10 years, farmers in Usilampatti and Peraiyur taluks have been facing trouble in protecting their crops from wild boars.

The farmers, with the help of the district administration, are trying out a bio-repellent on a trial basis to prevent the entry of wild boars and bears into farmlands.

Usilampatti Revenue Divisional Officer K.V. Rajkumar said, a week back, they sprayed the bio-repellent diluted with water on half-an-acre of farmland at Vellamalaipatti. “There is no sign of animal intrusion ever since, though it can be seen in adjacent fields,” he said.

Buoyed by this, the bio-repellent was sprayed on five more acres of farmland in the village on Thursday using a drone. “We have expanded our trials to see its efficiency. The formulation is such that the smell of it is said to drive away the wild boars,” he said.

Farmers of Madurai district Wet and Dry Land Farmers’ Association had petitioned the RDO seeking solution regarding this issue which is prevalent in 13 villages of Usilampatti block and 19 villages of Peraiyur block.

Mr. Rajkumar said, based on the request of farmers, the district administration had contacted the Chief Executive Officer of Agri Business Consortium of Tamil Nadu Agricultural University in, Coimbatore. “He suggested trying out this bio-repellent. This formulation has also been approved by the forest departments in parts of Kerala and by the Krishi Vigyan Kendra of Ariyalur. We have to wait and see how it works out in the villages of Usilampatti," he added.

Recorded Observation

Based on the early and continuous monitoring of the On Farm Trials (OFT) for entry of wild animals like Wild boar, Monkey, Indian Gaur, Deer and Elephant, the following observations were recorded in the OFT.

1. Herbolive spray was effective against Wild boar only when the whole cropping area was drenched with 100 percent foliar spray.
2. Herbolive was not effective for banana against the entry of Elephants
3. The application of herbolive acts as an anti-feeding agent due to pungent smell and the crop was not damaged
4. Regarding the efficacy of Herbolive, foliar spraying is required once in fortnight to prevent the entry of Wild boar.
5. During the rainy time, Herbolive was not effective
6. The yield of the crops was not reduced due to spray of Herbolive.

Miscellaneous Management

1. A biological wild boar repellent has been discovered by the Agricultural Research Center of Tamil Nadu Agricultural University, Vellore District, Virinchipuram.
2. Farmers can use this natural repellent to protect their crops from wild boar attacks for up to three months. Natural Wild Boar Repellent is manufactured and supplied to farmers only by Virinchipuram KVK.

Methods of Using Wild Boar Repellants

1. 500 ml of wild boar repellent is required per acre. Plant two-foot tall sticks at ten-foot intervals around the cultivated land.

2. The back sticks should be tied at a height of 1.5 feet with tie wire. Both sides of the planted sticks should be kept free of weeds.

Conclusion

Wild pigs can be managed through small-scale exclusion, trapping, and/or shooting. While recreational hunting is often a preferred method, it is not effective at controlling wild pig population growth. Trapping, however, is highly effective at controlling and reducing wild pig population growth. Nonlethal methods include installing fencing to exclude pigs, using guard animals to protect livestock, and vaccinating animals to prevent disease spread. Lethal methods include trapping, shooting, and hunting with dogs.

References

1. Keuling O, Lauterbach K, Stier N, Roth M (2009) Hunter feedback of individually marked wild boar Sus scrofa L.: dispersal and efficiency of hunting in northeastern Germany. Eur J Wildl Res: online first: DOI 10.1007/s10344-009-0296-x
2. Larson G, et al. (2007) Ancient DNA, pig domestication, and the spread of the Neolithicinto Europe. Proc Natl Acad Sci USA 104:15276 –15281.
3. Peters J, von den Driesch A, Helmer D (2005) in The First Steps of Animal Domestication.New Archaeological Approaches, eds Vigne J-D, Peters J, Helmer D (Oxbow Books,Oxford), pp 96 –124.

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

Aeroponics in Vegetables

Article ID: 40847

Tejaswi K[1], Malica M. A[2], Mamatha A[3]
[1&2]MSc. 1st Year, Department of vegetable Science, College of Horticulture, SKLTSHU, Hyderabad.
[3]Asst. Professor, Department of vegetable Science, College of Horticulture, SKLTSHU, Hyderabad.

Introduction

Earth Population is expected to rise by 3 billion people. It is estimated that approximately 109 hectares of additional traditional land will be needed to feed them, among them only 80% of the Earth's arable land is suitable for farming now. A greater quantity of hectares with optimum inputs is needed every day to feed the rising population. To solve the problems mentioned, new farming methods have been searched, one of them being aeroponics.

An aeroponic system is medium-less in that the roots of the plant are free hanging inside an open root-zone atmosphere. Aeroponics structure supplies optimum levels of water, nutrients and air to the growing chamber. Aeroponics is the process of growing plants in an air or mist environment without use of soil or an aggregate media. This was widely used in horticultural species including potato, tomato, lettuce, cucumber etc.

Aeroponic system has been applied successfully in Korea for potato seed tuber production. Aeroponic systems are more water resource efficient than hydroponic system.

Importance of Aeroponics in Vegetable Crops

1. Water use efficiency - Almost 99% of the water is used by the plant. Since pesticides and soil compatible fertilizers are not used, vegetables obtained are pure and doesn't need to be washed before use.

2. Nutrient use efficiency - Delivers nutrients directly to the plant roots, which results in a faster growth of crops. Vegetables obtained from an aeroponics-based greenhouse are healthy, nutritious, pure, rich, fresh and tasteful. Aeroponics system uses nutrient solution recirculation. Aeroponics system also allows the measurement of nutrient uptake over time under varying conditions.

3. Uniform growth of crops was also observed. It comparatively offers lower water and energy inputs per unit growing area.

4. Optimizes root aeration - because the plant is totally suspended in air, giving the plant stem and root systems access to 100% of the available oxygen in the air which promotes root growth. Such environment also gives plants 100% access to the carbon dioxide concentrations ranging from 450 to 780 ppm for photosynthesis hence, plants in an aeroponics environment grow faster and absorb more nutrients than regular hydroponics plants.

5. Aeroponics method of propagation is one of the most rapid methods of seed multiplication. Another advantage of aeroponics system is that of easy monitoring of nutrients and pH. Aeroponics system also allows the measurement of nutrient uptake over time under varying conditions.

6. Aeroponics production system is very space efficient, with plants taking up minimal room.

Nutrients Used in Aeroponics System

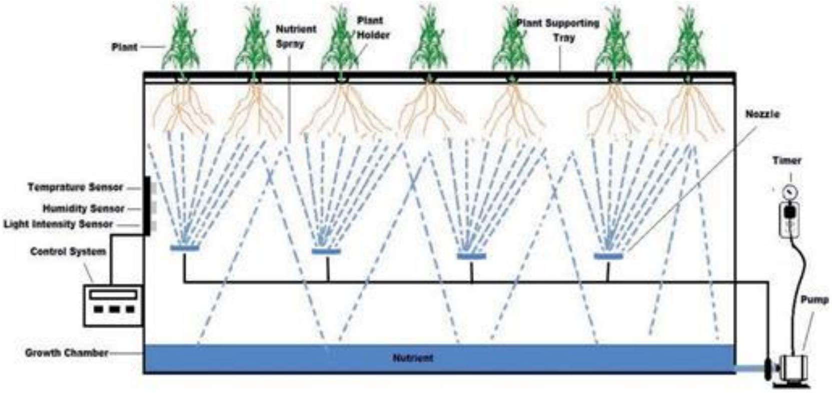
Carbon, oxygen and hydrogen are present in air and water. Water may contain a variety of elements with primary nutrients such as nitrogen, phosphorus, potassium and secondary nutrients *viz.*, calcium, magnesium, and sulphur, micro-nutrients are iron, zinc molybdenum, manganese, boron, copper, cobalt and chlorine.

The optimal pH for plant growth is between 5.8 and 6.3. In aeroponic system where water and nutrients are recycled, it is important to measure the acid/base or pH measurement to allow plants to absorb nutrients. Aeroponic using spray to nourish roots use much less liquid resulting in easier management of nutrient concentration with greater pH stability. The main nutrients used in aeroponics are:

Nutrient	Concentration (g/l)
Nitrate	0.54
P	0.40
K	0.35
Ca	0.17
Mg	0.08

Components of Aeroponics System

Spray misters: Automization is achieved by pumping water through nozzles at high pressure. Nozzels come in different spray patterns and orifices. Larger nozzles and orifices reduce the chance of clogging but need pressure to operate and have high flow rates. Droplet size in a given spray may vary from sub microns to thousands of microns.



Droplet size: The ideal droplet size range for most plant species is 20 - 100 microns. Within this range the smaller droplets saturate the air, maintaining humidity levels within the growth chamber. The larger droplets 30 - 100 microns make the most contact with the roots. Spray droplets less than 30 microns tend to remain in the air as a fog. While any droplets over 100 microns tend to fall out of the air before containing any roots. Too large of a water droplet means less oxygen is available to the root system.

High pressure water pump: High pressure aeroponics requires a pump that can produce enough to pressurize the water to produce the ideal droplet size of 20 to 50 microns. These pumps are generally diaphragm pumps or reverse osmosis booster pumps. The pump must produce a steady 80 PSI with required nutrient flow.

Light and Temperature: Replacement for Sun light is very essential. It can be replaced by fluorescent tubes of required Intensity. 15000-20000 lux – for vegetative growth, 35000-40000 lux –for flowering and fruiting. The optimum temperature for all plants is 15^0C – 25^0C. Misting Frequency and Nutrient Reservoir.

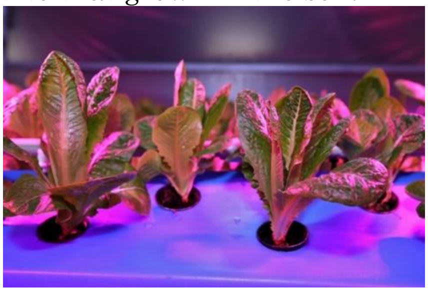
Crop Production

Potato: The International Potato Center (CIP) has recently developed and promoted mini-tuber production based on a novel, rustic and publically available aeroponics system. Results showed that the aeroponics system is a viable technological alternative for the potato minituber production component within a potato tuber seed system producing a greater number of tubers, high tuber yield tuber weight. Thus, aeroponic system, has potential to increase income and reduce cost of production of quality seed, thereby, making it more accessible to growers in developing countries where potato production is heavily constrained by the use of poor-quality seed tubers.

Yams: The aeroponics technology should be considered as an effective yam propagation method. Genotypes of both *D. rotundata* and *D. alata* were successfully propagated in it using both pre-rooted and fresh vine cuttings. Results of these studies revealed that vines cutting from five months old plants rooted successfully (95%) within 14 days in aeroponics. Other vegetables like lettuce, tomato and leafy greens are also cultivated through aeroponics.

Leafy vegetables: A comparison of the product yield, total phenolics, total flavonoids, and antioxidant properties was done in different leafy vegetables/herbs (basil, chard, parsley, and red kale) and fruit crops (bell pepper, cherry tomatoes, cucumber, and squash) grown in aeroponic growing systems and in the field. An average increase of about 19%, 8%, 65%, 21%, 53%, 35%, 7%, and 50% in the yield was recorded for basil, chard, red kale, parsley, bell pepper, cherry tomatoes, cucumber, and squash, respectively, when grown in aeroponic systems, compared to that grown in the soil.



Advantages

1. Reduction in fertilizer use - Since all the nutrients are contained, they don't end up in groundwater or sinking too deep into the soil to be of any help.
2. Reduction in water use - Very important for space travel and those in arid climates. Much of the water lost in traditional gardening is from water evaporating out of the soil. The rest of it just sinks past the roots and the plants never get a chance to drink it.
3. More Cost Effective - Since less nutrient solution is needed as compared to hydroponics the costs to operate an aeroponic garden are less than to operate a hydroponic garden. There are also fewer moving parts and complicated systems involved.
4. Reduced Disease Damage - Because the plants are separated from each other and not sharing the same soil, an infection in one plant has a much lower chance of spreading to the rest of your plants.
5. Faster and healthier growth since it has enough oxygen (in the root region) Increased harvest rate is 45–70% faster than conventional agricultural techniques.
6. Studies has shown that plants grown via the aeroponic system have an increase in flavonoids.

Disadvantages

1. More expensive for long scale production.
2. Ordinary farmers will struggle to manage all these sophisticated instruments
3. Mister spray heads may also have a tendency to clog and not produce mist when needed.
4. Many consumers believe that aeroponically grown plants are not as nutritious as other grown plants.
5. Maintenance of an aeroponics farm is very expensive.

Conclusion

Aeroponics growing allows plants and crops to grow without the use of pesticide and thus it will be disease free. The crops will grow in a natural healthy manner as the aeroponic system is very similar to nature environmental conditions. Aeroponics is conducted in air combined with micro-droplets of water, almost any plant can grow to maturity in air with a plentiful supply of carbon dioxide, water and nutrients. Aeroponics helps conserve water, land and nutrients, so the aeroponics system is the way of the future, making cultivation of crops easier. Aeroponics appeared to be a highly feasible method for the production of both aerial parts and roots as raw materials for the herbal dietary supplement and phyto pharmaceutical industries.

E-ISSN: 2581 - 8317

Effect of Abiotic (Seasonal) Factors on Incidence of Pests in Rice Crop

Article ID: 40848

B. Sampath Reddy[1], B. N Chaudhari[2], M. Nirmitha Vardhan Reddy[3]
[1]M. Sc. Entomology, PDKV, Akola
[2]Assistant Professor of Entomology,
College of Agriculture, Nagpur, PDKV, Akola.
[3]M. Sc. Soil Science and Agricultural Chemistry, PDKV, Akola.

Introduction

Paddy is one of the major cereal crops in India as most people prefer to consume rice and also it is exported to other countries crop. This crop is grown in *Kharif* season mainly by farmers where there is surplus water. It can be noticed that control of pest depends mainly on the weather factors such as rainfall, temperature and relative humidity apart from pesticides which are used to control. It is vital to know about weather parameters which would be helping in forecasting the pests and instantly apply management practices. The gall midge, for instance, is endemic in Sakoli (Maharashtra) and Warangal (Telangana). Likewise, there are many pests that can be affected by weather conditions such as rainfall, sunshine hours, relative humidity and temperature, leading to an increase or decrease in their population in certain areas.

Summary

Generally high temperature and low relative humidity are favourable factors for abundance of brown plant hopper and gall midge, whereas high rainfall and high relative humidity are favourable for stem borers and leaf folders. The increase in gall midge occurs mostly in the month of September with mean temperature (maximum and minimum temperature) in between 22 to 28 oC as well as rainfall and evening relative humidity also effect the peak in population (Sharma 2021). Even after spraying the insecticide, they develop resistance due to change in physiology of insect due to environmental factors.

But under certain circumstances different results can be observed, in particular for stem borer pest, rise in rainfall and relative humidity (both morning and evening) shows decrease in pest population, whereas temperature (maximum and minimum) does not affect and leaf damage due to leaf folder showed high fluctuation by mean temperature but rainfall, minimum and maximum relative humidity showed little or no effect at all (Seni and naik 2018). While brown plant hopper and white backed plant hopper would decrease in incidence with increase in relative humidity, whereas morning and evening relative humidity (91-95% and 75-80% respectively) is favourable for peak in population (Sarkar et al. 2018). Similarly, in ear head bug except relative humidity remaining factors does not show any effect, warm weather during reproductive stage of rice with humid state increases this population (Khare et al. 2020).

Conclusion

In amalgamation of above statements, we can conclude that without knowing weather parameters it would be difficult for the farmers to manage the pest. So, knowledge on Standard Meteorological Week (SMW) technique will help the farmers to identify the month when the pest attack is more and understand the stages in insect life cycle when it causes the excessive damage to crops.

Therefore, farmers should adopt the method of forecasting and understand it themselves which helps in controlling pests and implementing appropriate measures on their own farms without requiring the support of higher officials and spray the insecticides at a period of high population without spraying at low level of damage (below ETL) of crop for a particular pest, where integrated pest management practices are to be used which would not only support in enhancing the fertility of soil and but also suppress killing of natural enemies by overly use of insecticides.

References

1. Sarkar M. A. R., Mamun M. A. A., Rahman M. M., and Rashid M. H. (2018). Effect of abiotic factors on population dynamics of brown plant hopper (*Nilaparvata lugens*) in boro rice ecosystem. Bangladesh Journal of Entomology. 28(2): 59-68.
2. Seni A. and Naik. B., (2018). Influence of abiotic factors on incidence insect pests of rice. Journal of Agrometeorology. 20: 256-258.
3. V. K. Khare., Prakash R., Sneha., Kunal G., (2020). Effect of abiotic factors on the population dynamics of paddy earhead bug, *Leptocorisa oratorius* F. Journal of Entomology and Zoology Studies 8(6):157-160.
4. Sharma R., Sharma A., Rathour R., Singh B., and Sharma V., (2021). Climate-Based Modelling and Prediction of Rice Gall Midge Populations Using Count Time Series and Machine Learning Approaches. Frontiers in Sustainable Food Systems. 5: 627637.

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

Mycoremediation of Heavy Metals through Cultivated Mushroom

Article ID: 40849

Shrvan Kumar[1], Bhavya Singh[1], Astha[1]
[1]RGSC, Banaras Hindu University, Barkachha, Mirzapur (U.P.))- 231001.

Introduction

Mushrooms, macro-fungi, are among the nature's most important mycoremediators. *Pleurotus* species (*Pleurotus forida, P. ostreatus, P. sajor-caju, P. djamor, P. salmoneo-stramineus*) are considered to be the most popular and widely cultivated varieties worldwide and this might be attributed to their low production cost and higher yields. Apart from their nutritive and therapeutic properties, *Pleurotus* species have high biosorption potential due to their extensive biomass, i.e., mycelial production. Heavy metals are elements that exhibit metallic properties such as ductility, malleability, conductivity, cation stability and ligand specificity (Kapahi and Sachdeva, 2017, Mohamadhasani and Rahimi, 2022). They are characterized by atomic number greater than 20 and relatively high density. Heavy metals affect the number, diversity and activities of soil microorganisms. Its pollution cause change in size, composition and activity of the microbial community which in turn affects the soil enzymatic activities. The toxicity of these metals on microorganisms depends on a number of factors such as soil temperature, pH, clay minerals, organic matter, chemical forms of the metal, inorganic anions and cations. Reduction in number of beneficial soil microorganisms due to high metal concentration leads to decline in organic matter decomposition which leads to decrease in soil nutrients. Inhibition of cytoplasmic enzymes and damage to cell structures due to oxidative stress are some of the direct toxic effects caused by heavy metals (Chibuike and Obiora, 2014). Bioremediation is a type of remediation process which involves the use of biological organisms to remove contamination from polluted sites to provide a sustainable environment. Mycoremediation is the application of fungi in remediation of polluted soil and aqueous effluents. The great potential of fungi in bioremediation is due to their aggressive growth, great biomass production and extensive hyphae reach in the environment. Mushrooms are saprophyte which is a highly specialized group of macro-fungi and have unique capacity for degradation of certain types of organic pollutants like lignocellulotic wastes and biosorption of heavy metals (Adenipekun and Lawal, 2012).

Biosorption- The Key to Mycoremediation of Heavy Metals

Biosorption is a process of reversible binding of contaminants onto a biological surface. Biosorption of heavy metals is the ability of biologically active, living or non-living or dead organisms that can accumulate and concentrate heavy metals by means of adsorption, absorption, ion-exchange or by using metabolic processes. This process involves a solid phase (sorbent or biological material) and a liquid phase (solvent) containing a dissolved species to be sorbed (sorbate or metal ions). Due to higher affinity of sorbent for the sorbate species, the sorbate is attracted and removed by different mechanisms. The degree of sorbent affinity for the sorbate determines its distribution between the solid and liquid phases. The mechanisms like extracellular (chelation and cell wall binding) and intra-cellular (binding to compounds like proteins) separation of heavy metals have been proposed as mechanisms for heavy metals tolerance in fungi (Mohamadhasani and Rahimi, 2022). The metal biosorption process is a 2 step process: a) In first step, metal ions are adsorbed on the surface of cells by interactions between metals and functional groups present on the surface of cells which occurs passively by binding mechanisms, b) In the second step, due to active biosorption, metal ions penetrate the cell membrane and enter into the cells (Uddin *et al.,* 2020).

Biomaterials like mushrooms have been proved efficient and economical for the removal of toxic metals from dilute aqueous solutions by biosorption because fungal biomass offers the advantage of having a high percentage of cell wall material, which shows excellent metal-binding properties. The uptake of metals from the biosorption process by the mushrooms is unevenly distributed within the mushroom fruiting bodies. Heavy metals present in the soil are taken up by the fruiting bodies of mushrooms resulting in the accumulation of metals in the mycelia and sporocarps. Mushroom contains abundant hyphae in the mycelium that help the biosorption of nutritive elements and heavy metals in the substrates (Kulshreshtha *et al.,* 2014).

Mushrooms in Bioremediation

1. *Pleurotus* sp. specifically, ***P. sajor-caju, P. ostreatus*** and ***P. florida*** are reported to absorb Cd, Cu, Ni, Fe, Zn, Mn, Hg and Pb. The highest heavy metal recorded in *Pleurotus* sp. is Fe at 243.92 mg/kg of dry weight. *P. ostreatus* and *P. sapidus* have been reported to show affinity towards Cu and Zn as compared to Cd and Pb (Ita *et al.,* 2008). This is in consensus with reports by Zhu *et al.,* (2010). However, fruiting bodies of *P. ostreatus* immobilised in calcium alginate were shown to be effective in removing Pb and Co from solution (Xiangliang *et al.,* 2009). *P. ostreatus* displayed tremendous removal potential in the order of Ni > Cu > Cr > Zn ions from efuents of electroplating units (Javaid *et al.,* 2011). *P. foridianus* and *P. sajor-caju* have been reported to exhibit affinity in the order of Cd > Zn > Ni > Pb > Cu > Fe (Lamrood and Ralegankar, 2013).

2. *Agaricus bisporus*: Studies have shown that it is of great significance to use *Agaricus bisporus* as bioremediation agent in presence of heavy metal salts in substrate. The most accumulated metal found in mycelium of *Agaricus bisporus* was Mg followed by Cu, Zn and Mn respectively. The least accumulated metal was found to be Cd, Co and Cr followed by As and Pb (Sinha *et al.,* 2019). Detection of heavy metal concentration suchas Cu, Zn, Fe, Mn, Cd, Cr, Ni and Pb studied in 14 different wild growing edible mushrooms reported by (Singh *et al.,* 2011).

3. *Calocybe indica*: The bioaccumulation potential and yield of fruiting bodies of *C. indica* were found to be in the following order Zn>Mg>Cu>Mn>Al>Cr>Co>Cd>As. Heavy metal accumulation in mycelium varied significantly with the type of metal and total concentration of metals in the inoculated substrate. It was also observed that, as the concentration of heavy metals in substrate increased, the accumulation of heavy metals in fruiting bodies increased and vice versa. This suggested that *C. indica* is very effective in bioremediation of heavy metal-contaminated substrates (Gupta *et al.,* 2018).

4. *Lentinus squarrosulus*: It has been found to mineralize soil contaminated with various concentrations of crude oil resulting in increased nutrient contents in treated soil (Adenipekun and Lawal, 2012). Adenipekun and Isikhuemhen (2008) investigated the bioremediation of engine oil polluted soil by *L. squarrosulus*. Results indicated that contaminated soils had increased organic matter, carbon, available phosphorus while nitrogen and available potassium reduced. The concentrations of Fe, Cu, Zn and Ni recovered from the fungal biomass complex increased with increase of engine oil contamination.

5. Use of Spent mushroom substrate (SMS): SMS can bind heavy metals in soil and immobilize them, thereby reducing their toxic concentrations in plants. It was observed that the polluted soil contained greater concentrations of Fe, Hg, As, and Zn but lower concentrations of Cd, Cr, Co, Ni and Pb, which were all reduced in the experimented soil (Kapahi and Sachdeva, 2017). The SMS biosorbent of the species has been reported to exhibit higher selectivity for Ni than Cu in a bi-metal biosorption study conducted by Tay *et al.* (2016).

Conclusion

There are some limitations of using mushrooms for biosorption. Biosorption potential of different species is also being assessed in a comparative way. Looking at the amount of work done on *Pleurotus* spp., the species holds a promise to be used as a biosorbent for heavy metals. The biosorption potential of the species is yet to be tapped and used commercially. Mushrooms being a food crop and looking at the potential of mushroom mycelia, the SMS produced after harvesting the mushroom can be used for the mycoremediation of the degraded sites. The aged mycelia, SMS, are otherwise generated in huge amounts by the mushroom farms and pose a disposal problem.

References

1. Adenipekun CO, Isikhuemhen OS (2008). Bioremediation of engine oil polluted soil by the tropical white-rot fungus, Lentinus squarrosulus Mont. (Singer). Pakistan J. Biol. Sci. 11(12):1634-1637.
2. Adenipekun, C. O., and Lawal, R. (2012). Uses of mushrooms in bioremediation: A review. *Biotechnology and Molecular Biology Reviews*, *7*(3), 62-68.
3. Chibuike, G. U., & Obiora, S. C. (2014). Heavy metal polluted soils: effect on plants and bioremediation methods. *Applied and environmental soil science*, *2014*. Article ID 752708.

4. Gupta, R., Khokhar, M. K., & Roat, B. L. (2018). Uptake and bioremediation of heavy metals through Cultivated Mushroom (*Calocybe indica*). *Annals of Plant Protection Sciences*, *26*(1), 175-180.
5. Ita BN, Ebong GA, Essien JP, Eduok SI (2008) Bioaccumulation potential of heavy metals in edible fungal sporocarps from the Niger delta region of Nigeria. *Pak J Nutr* 7: 93–97.
6. Javaid A, Bajwa R, Shafique U, Anwar J (2011) Removal of heavy metals by adsorption on *Pleurotus ostreatus*. *Biomass Bioenergy* 35:1675–1682.
7. Kapahi, M., & Sachdeva, S. (2017). Mycoremediation potential of *Pleurotus* species for heavy metals: a review. *Bioresources and bioprocessing*, *4*(1), 32.
8. Kulshreshtha, S., Mathur, N., & Bhatnagar, P. (2014). Mushroom as a product and their role in mycoremediation. *AMB express*, *4*, 1-7.
9. Lamrood PY, Ralegankar SD (2013) Biosorption of Cu, Zn, Fe, Cd, Pb and Ni by non treated biomass of some edible mushrooms. *Asian J Exp Biol* 4(2):190–195
10. Mohamadhasani, F., & Rahimi, M. (2022). Growth response and mycoremediation of heavy metals by fungus *Pleurotus* sp. *Scientific Reports*, *12*(1), 19947.
11. Singh R, Gautam N, MishraA and Gupta R (2011) Heavy metals and living systems: An overview. *Indian J. Pharmacol.* 43(3), 246-253.
12. Sinha, S. K., Upadhyay, T. K., & Sharma, S. K. (2019). Heavy metals detection in white button mushroom (*Agaricus bisporus*) cultivated in state of Maharashtra, India. *Biochem Cell Arch*, *19*, 3501-3506.
13. Tay, C. C., Liew, H. H., Abdul-Talib, S., & Redzwan, G. (2016). Bi-metal biosorption using *Pleurotus ostreatus* spent mushroom substrate (PSMS) as a biosorbent: isotherm, kinetic, thermodynamic studies and mechanism. *Desalination and Water Treatment*, *57*(20), 9325-9331.
14. Uddin, M., Zhang, D., Proshad, R., & Haque, M. K. (2020). Role of mushrooms in soil mycoremediation: a review. *Chin J App Environ Biol*, *26*(2), 460-468.
15. Xiangliang P., Jianlong W., Daoyong Z. (2009) Biosorption of Co(II) by immobilised *Pleurotus ostreatus*. *Int J Environ Pollut* 37:289–298.
16. Zhu FK, Qu L, Fan WX, Qiao MY, Hao HL, Wang XJ (2010) Assessment of heavy metals in some wild edible mushrooms collected from Yunnan Province, China. *Environ Monit Assess* 30:61–62.

Urban Gardening: Future of Farming

Article ID: 40850

Rishabh Raj[1], B C Anu[2]
[1]Govind Ballabh Pant University of Agriculture and Technology, Uttarakhand- 263153.
[2]Krishi Vigyan Kendra, Turki, Muzaffarpur, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar-848125.

Introduction

Urban gardening refers to growing plants, fruits and vegetables in an urban environment such as a city or town. Small plots, containers, or other types of horticultural methods are used to grow plants in areas not normally used for agriculture. Urban gardening is growing in popularity as more and more people seek to grow their own food, connect with nature and improve the urban environment. Urban gardening also helps build communities by allowing individuals and groups to work together to create shared green spaces and encourage sustainable practices. In recent years, urban farming has become more popular as people have become more interested in locally grown and sustainable food sources.

Urban Farming Scenario in World

The global urban farming market is projected to grow at a CAGR (Compound Annual Growth Rate) of 6.8% from 2021 to 2028. The market is driven by growing demand for fresh, healthy, local produce. In the United States, the number of urban farms increased by 30 between 2008 and 2016, with an estimated 25,000 urban farms operating nationwide. According to a report by the National Sustainable Agriculture Coalition, urban agriculture can deliver a range of social, economic and environmental benefits, including job creation, community building and improved food security. The COVID-19 pandemic has increased interest in urban farming as people grow their own food and seek self-sufficiency.

Urban Farming Scenario in India

The Ministry of Agriculture and Agricultural Welfare reports that India's urban and suburban agricultural areas are estimated at around 38,000 hectares, producing more than 1.9 million tonnes of food annually. In recent years, urban agriculture has gained popularity in cities such as Mumbai, Delhi, Bangalore and Kolkata, with initiatives ranging from community gardens to rooftop farms. In Bangalore, the government has launched an urban farming promotion program with the goal of creating his 1,000 urban farming businesses across the city. In Mumbai, the government has launched a program called 'The Future of Agriculture in Mumbai' to encourage urban agriculture with a focus on rooftop farms and community gardens. Hydroponics and the use of aquaponics are becoming increasingly popular in India, especially in urban areas where space is limited. The National Institute of Urban Affairs reports that there are over 300 hydroponic and hydroponic farms in India. Urban agriculture in India also provides employment opportunities and income for urban residents.

Advantages of Urban Gardening

1. Access to Fresh, Healthy Produce: Urban gardening provides access to fresh, healthy produce. These products are often more nutritious than store-bought produce. Growing your own food can also save you money on your grocery bill, which can make it more affordable.

2. Environmental Benefits: Urban gardening can help alleviate some of the environmental problems facing cities, such as air pollution and the heat island effect. Plants absorb pollutants and help release oxygen into the atmosphere, which can improve air quality. In addition, green spaces help reduce the amount of heat absorbed by urban surfaces. , helps mitigate the urban heat island effect.

3. Community Building: Urban gardening can be a way to bring people together and build stronger communities. You can provide a space for your neighbors to work together, share knowledge, and socialize.

4. Educational Opportunities: Urban gardening offers people the opportunity to learn about plant biology, sustainable practices and conservation.

5. Mental Health Benefits: Gardening has been shown to have mental health benefits, such as reducing stress and anxiety and increasing feelings of well-being.

6. Food Security: It can help ensure food security by enabling access to fresh vegetables in locations where it is not commonly found.

7. Sustainable Practices: It may encourage resource conservation and waste reduction strategies like composting and rainwater gathering.

There are Many Crops that are Well-Suited for Urban Gardening, Including

Leafy Greens: Leafy greens like lettuce, kale, and spinach are ideal for urban gardening because they are fast-growing and can be grown in small spaces. They are also rich in nutrients and can be harvested continuously.

Tomatoes: Tomatoes are a popular crop for urban gardening because they can be grown in containers and have a high yield. They are also rich in vitamins and antioxidants.

Herbs: Herbs like basil, cilantro, and parsley are easy to grow and can be used in cooking. They can also be grown in small spaces like windowsills or on a balcony.

Peppers: Peppers are another crop that can be grown in containers and have a high yield. They are also rich in vitamins and antioxidants.

Radishes: Radishes are a fast-growing root vegetable that can be grown in small spaces like containers or raised beds. They are also a good source of vitamin C.

Strawberries: Strawberries are a fruit that can be grown in containers and have a high yield. They are also a good source of vitamin C and antioxidants.

Microgreens: Microgreens are small, edible plants that can be grown indoors and are often used in salads and sandwiches. They are easy to grow and can be harvested in as little as two weeks.

Economic and Environmental Benefits of Urban Gardening

Economic Benefits:

- **a. Reduced Food Costs:** By allowing access to fresh, healthy produce that would otherwise need to be acquired from grocery shops or farmers' markets, urban gardening can help individuals and families lower their food costs.
- **b. Income Generation:** It can also provide an opportunity for income generation, as excess produce can be sold to neighbours, at farmers' markets, or to local restaurants and cafes.
- **c. Employment Opportunities:** It can create employment opportunities, particularly in urban areas where unemployment rates are high.
- **d. Increased Property Values:** Green spaces, including urban gardens, can increase property values in urban areas, which can benefit property owners and the surrounding community.

Environmental Benefits:

- **a. Reduces Water Consumption:** It can be designed to use water efficiently, reducing the amount of water needed for irrigation.
- **b. Improves Air Quality:** It can improve air quality by capturing pollutants and carbon dioxide, and releasing oxygen into the atmosphere
- **c. Mitigated Heat Island Effect:** By lowering the amount of heat absorbed by urban surfaces, it can aid in lessening the urban heat island effect.
- **d. Biodiversity:** It can promote biodiversity by providing habitat for pollinators and other urban wildlife.

Conclusion

Overall, urban gardening can contribute to a more sustainable and resilient urban environment while delivering economic benefits to individuals and communities. It provides an opportunity to bring fresh, local produce to urban communities. However, urban agriculture can only be successfully integrated into urban areas if consumers perceive it positively and accept it in their communities.

Scope of Natural Rubber Production in North East India

Article ID: 40851

Sanjenbam Sher Singh[1], Kishalayee Gogoi[2]
[1]Ph.D. Scholar (Agril. Extn.), SSS, CPGS-AS, CAU (Imphal), Umiam, Meghalaya.
[2]Asstt. Prof. (Horticulture), Biswanath College of Agriculture, AAU, Biswanath, Assam.

Abstract
India's natural rubber production is becoming more significant as a result of having one of the fastest expanding rubber sectors worldwide. India is second in terms of consumption and one of the top producers of natural rubber. India's historic rubber-growing regions are Tamil Nadu's Kanyakumari district and Kerala. The remaining regions, such Karnataka, Goa, Maharashtra, Andhra Pradesh, Odisha, and the North Eastern state, are non-traditional. After Kerala, Tripura is regarded as India's second-largest producer of rubber. On the other hand, the other rubber-producing states in the region, Meghalaya, Mizoram, Assam, Nagaland, and Manipur, have also seen a discernible increase in rubber production. It has been demonstrated that natural rubber can be grown as an economically viable crop in the North East India with the right agro-management techniques. Rubber planting is an effective programme which helps in socio-economic development of the rural people.

Keywords: Natural rubber, North East India, Scope, Socio economic development.

Introduction
India ranks second and sixth in terms of Natural Rubber (NR) consumption and production worldwide. It has one of the world's fastest developing economies. Traditional and non-traditional zones make up the two zones that produce rubber in India. Tamil Nadu and Kerala are included in the traditional zone. The coastal parts of Karnataka, Goa, Andhra Pradesh, Odisha, some areas of Maharashtra, the North Easter states, and the Andaman and Nicobar Islands are included in the non-traditional zone. Kerala and Tamil Nadu make up more than 80% of all-natural rubber produced in India. Tripura produces the most natural rubber in NE India and comes in second place behind Kerala.

Why Rubber in NE?
All of the states in the North East have generally favourable agroclimatic conditions for the production of natural rubber, and the limiting elements can be controlled with sensible crop management techniques. It is also possible to effectively cultivate natural rubber on large tracts of land that are devoid of any tree cover and that are even exempt from the Forest Conservation Act. With the right agronomic inputs, rubber may even be cultivated as a rainfed crop in the less productive "Tillas" (hillocks).

A rapidly expanding domestic and international market for NR is natural rubber manufacturing, which aids in the socioeconomic advancement of rural residents. It is a labour-intensive crop with excellent potential for creating jobs in rural areas.

Favourable Factors in NE Region
1. Land availability - There are approximately 4,50,000 acres of suitable land in the area.
2. Locally available labour is available for plantation work.
3. Rubber Board provides technical support at all stages of planting, upkeep, harvesting, and initial processing.
4. Financial support provided by Rubber Board.
5. Rubber Board provides management staff and skilled workers with training help.
6. The region has a low incidence of disease.
7. Credit facilities from banks may be available.
8. Proximity to Kolkata, a significant rubber consumption hub.
9. A few well-kept small holdings in the area produce up to 1800–2000 kg per hectare annually.

Socio-Economic Benefits

Production of natural rubber aids in self-employment and offers young people a stable means of subsistence. Since it requires roughly 1000 man-days per ha during the early stages, it directly creates 1 permanent job per ha. Through the nursery, production and distribution of plantation inputs, intercropping, rubber dealers, processors, rubber wood cutting, sale, processing & furniture manufacture, it aids in the indirect employment generation. Additionally, it creates prospects for indirect employment through the establishment of manufacturing and industrial facilities, the sale of manufactured goods, etc. Aside from producing rubber, plantations also produce other products like seeds, seed oil, cover crop seeds, and rubber honey (250 kg/ha). The plantations guarantee a timber yield of 200 m^3 per year, have a successful programme for resolving tribal conflicts, and have export possibilities to nearby nations.

Ecological Benefits

North-East states are likewise becoming as India's rubber hub. Tripura is regarded as India's second rubber capital after Kerala and contributes around 9% of the nation's total rubber production. Table 1 displays the North East's natural rubber production from 2015 to 2019. It demonstrates that Tripura has the highest output levels across all years. Tripura is expected to produce over 53,000 tonnes in 2019. Assam is the second state after Tripura to produce natural rubber, with a production volume of over 24,000 tonnes in 2019. Arunachal Pradesh produced the least amount of natural rubber in 2019 with 450 tonnes.

Table 1. State-wise Potential and Planted Area of Rubber Plantation in North East:

State	Potential area (Ha)	Area planted (Ha)	Coverage (%)	Relative share in planted area (%)	Production (Tonne)	Productivity (kg/Ha)
Arunachal Pradesh	25000	4065	16.2	2.43	450	928
Assam	200000	51795	25.90	30.93	24300	1219
Manipur	10000	3955	39.55	2.36	1850	1040
Meghalaya	50000	14775	29.55	8.83	9100	1167
Mizoram	50000	3350	7.10	2.12	750	952
Nagaland	15000	14235	94.90	8.50	4930	1120
Tripura	100000	75070	75.07	44.83	53050	1226
Total	450000	167445	37.21	100	94430	1206

Source: Rubber Board, 2022.

NE-MITRA

The North East Mission of Tyre Industry for Rubber Augmentation (NE MITRA) is a collaborative initiative between the Indian government and the tire industry to promote rubber cultivation in the Northeastern region of the country. The program is being implemented for a period of five years (2021 -2026) to increase the production of natural rubber in the Northeast and to support the livelihoods of rubber farmers in the region. Under the NE MITRA program, tire companies have pledged to invest in the development of rubber cultivation in the region and to provide technical assistance to rubber farmers. The government, in turn, has provided financial assistance to rubber farmers to help them adopt new and innovative technologies for rubber cultivation. The NE MITRA program aims to create a sustainable rubber value chain in the Northeast, from rubber cultivation to processing and manufacturing. It also seeks to create employment opportunities for local people and to promote the development of small and medium-sized enterprises in the rubber sector. The program has already made significant progress in increasing the production of natural rubber in the Northeast, and it is expected to have a positive impact on the livelihoods of thousands of rubber farmers in the region.

Automotive Tyre Manufacturers Association (ATMA) has provided a fund of ₹ 1,100 crore for the natural rubber sector in the Northeast region of India. The fund is part of the "Rubber Skill Development Fund" (RSDF), which was set up by ATMA and the Rubber Board of India to improve the quality of rubber production and to provide skill development training to rubber farmers and workers in the country. The RSDF aims to promote sustainable rubber cultivation practices, increase productivity, and enhance the competitiveness of the rubber industry in India. The fund is being used to provide training and capacity building programs for rubber farmers and workers, to set up rubber processing facilities, and to promote the use of new and innovative technologies in the rubber sector. The ATMA and the Rubber Board are also working together to develop new varieties of rubber plants that are more resilient to disease and environmental stress.

The NE-MITRA scheme is an initiative of the Rubber Board of India that aims to promote the use of new and innovative technologies in the rubber cultivation sector in the Northeastern region of the country. The NE-MITRA scheme aims to help rubber farmers in the Northeastern region to improve their productivity and profitability by providing them with easy access to the latest information and technical expertise. It is part of the government's larger efforts to promote the use of technology in agriculture and to support the development of the rubber sector in the region.

Problems for Rubber Plantation in NE

1. Unavailability of quality planting materials
2. Lack of technical knowhow (Mainly in the outskirt areas)
3. Poor financial level of most of the growers
4. Unavailability of various equipment and amenities of rubber plantation mainly at time of tapping like acids, tray, knife etc
5. Lack of group approach.
6. Poor mobility/communication/ infrastructure/road etc.

Conclusion

One of the most significant commercial plantation crops in India is natural rubber, which is a raw ingredient for the quickly expanding rubber goods manufacturing sector. Consumption of NR rises as the nation's economy and industrial activities both expand. To meet rising domestic and international demand, India should increase its natural rubber production. In the WTO framework, constant participation in the export market is essential, and this again asks for increased output. By 2025, it's anticipated that production would increase to around 2 million tonnes. This would require a significant increase in the area where potential is present, primarily in North East India, and it can be accomplished by providing adequate inputs needed for rubber production, conducting training for manpower development in various locations as needed, giving special attention to new emerging and potential areas, starting joint ventures of rubber cultivation between state governments and Rubber Board specifically in ST areas under tribal development scheme, developing group communication skills, and more.

References

1. National Rubber Policy. (2019). Department of Commerce, Government of India. https://commerce.gov.in/hi/wp-content/uploads/sites/2/2020/02/NTESCL637038876015166279_National-Rubber-Policy-2019_Hindi.pdf
2. Rubber Board Statistics (2022) Rubber Board, Govt. of India, Kottayam. http://rubberboard.org.in/rbfilereader?fileid=730
3. Rubber Board. (2022). http://rubberboard.org.in/rbfilereader?fileid=297
4. Debbarma, R and Purkayastha, S. (2019). Expansion of area under rubber plantation and its distribution in Tripura, India. Space and Culture, India. 6:5,pp 56-70.
5. Sharma, R and Dey, S. (2008). Rubber cultivation in North East India- an agro meteorological perspective. Climate Change and Food Security. pp 149-162.

1. Training on Tapping at Kanhmun, Mizoram
2. Tapping training at Moreh, Manipur
3. Latex dripping in cup at Jiribam, Manipur

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

Supply Chain Management- An Overview

Article ID: 40852

Swarnima Paliwal[1], Sushmita Bhatt[2]
[1]Ph.D. Research Scholar, College of Agribusiness Management, G. B. Pant University of Agriculture & Technology, Pantnagar.
[2]Ph.D. Research Scholar, Department of Environmental Science, College of Basic Science and Humanities, G. B. Pant University of Agriculture & Technology, Pantnagar.

Introduction

Supply Chain Management consists of the end-to-end coordination of the flow of goods and services, including transportation and storage, from raw materials to customers, facilitated by information, planning, and integration activities. Supply Chain Management encompasses all activities, both direct and indirect, involved in meeting customer demands. The supply chain is a fluid process that entails the uninterrupted movement of information, goods, and finances among various stages, such as:

1. Suppliers of raw materials
2. Manufacturers
3. Wholesalers/distributors
4. Retailers
5. End-users/customers/consumers.

Adequate management of the movement of information, products, or funds is critical to the success of the supply chain. The most efficient configuration of the supply chain is dependent on both the demands of customers and the functions of the different stages involved. Additionally, Supply Chain Management is a category of software products that can aid in managing the supply chain. Supply Chain Management (abbreviated as SCM) considers all possible events and factors that could disrupt the supply chain, and with Supply Chain Event Management (SCEM), various scenarios can be simulated, and solutions can be planned accordingly.

Some Definitions of Supply Chain Managements are

1. Supply Chain Management is a "systems approach to managing the entire flow of information, materials, and services from raw materials suppliers through factories and warehouses to the end customers (Ganeshan and Harrison, 1995)."

2. "A supply chain is the alignment of firms that bring products or services to market (Douglas *et al*, 1998).

3. The integration of these activities through improved supply chain relationships, to achieve a sustainable competitive advantage (Handfield and Nichols, 2002).

4. Supply chain management is a set of approaches used to efficiently integrate supplier, manufacturer, warehouses, and stores so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time in order to minimize systemwide costs while satisfying service-level requirements (Simchi-Levi *et al*, 2003).

5. SCM is the " strategic and systematic coordination of the traditional business functions and the tactics across these business functions within a particular firm and across businesses within a supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole" (Mentzer *et al,* 2001).

6. A supply chain is the series of activities and organizations that materials – both tangible and intangible – move to their journeys from initial suppliers to final customers (Waters, 2007).

7. "The systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole (Mentzer *et al*, 2001).

8. The integration of business processes from end user through original suppliers that provides products, services and information that add value for customers (Cooper *et al*, 1997).

"Supply chain management is the overall journey of production, inventory, location, and transportation processes in a supply chain to achieve the best supply chain efficiency which add value for the end users"- my own words.

Objectives of Supply Chain Management

1. To enhance profitability.
2. Optimal utilization of resources to meet customer requirements.
3. To reduce overall operational and procurement expenses.
4. To raise the level of overall performance within the organization.
5. To aid in making better decisions.
6. To boost customer satisfaction levels.
7. To reduce the pre- and post-production inventory.
8. To increase the efficiency of operations through smart use of resources.

Importance of Supply Chain Management

1. To meet the global challenges and longer supply chain.
2. To gain efficiencies from procurement, distribution, and logistics.
3. To timely deliver the right quantity and quality of products.
4. Supply Chain Management is important to provide after-sales services/ support.
5. It helps in decreasing the purchasing cost.
6. It helps in reducing the production cost.
7. It helps in decreasing the total supply chain cost.
8. Helps in increasing the profit leverage.
9. Helps in managing and increasing the cash flow.

Problems of Supply Chain Management

1. It is not easy to adjust to cultural changes and differences, so it can be one of the major parts of SCM.
2. Ethics and compliance issues can be generated.
3. Consolidation of product development and supply chain is one of the key challenges.
4. Inability to forecast customer demand, which contributes to high inventory levels.
5. Robbery, leakage, and damage while unloading while transportation is some of the problems of the supply chain.

Goals of Supply Chain Management

Important goals of SCM are as follows:

1. As a supply chain manager has to focus on value addition for their customers, so cost efficient and cheap products are necessary part.
2. As to conserve capital in the economic uncertainties of a company, there is a need to minimize the supply chain expenses.
3. Collaborative efforts by supply chain partners result in increased resource productivity, standardized processes, reduced duplication, and lower inventory levels.
4. On the regular basis, exceeding the expectations of customers is the best way to satisfy them.
5. To satisfy clients' high expectations, supply chains must deliver a wide range of products, customizable goods, off-season inventory availability, and rapid fulfillment at prices that compare to in-store offerings.
6. Ensuring customer satisfaction requires that retailers treat inventory as a shared resource and leverage distributed order management technology to fulfill orders from the most appropriate location in the supply chain.
7. Supply chain management plays a significant role in the financial success of a company.

References

1. Douglas, L.M., Stock J. R. and Ellram, L.M. (1998). *Fundamentals of Logistics Management* Irwin/McGraw-Hill, Boston, MA

2. Ganeshan, R. and Harrison, T.P. (1995). *An Introduction to Supply Chain Management*, Department of Management Sciences and Information Systems, 303 Beam Business Building, Penn State University, University Park, PA
3. Waters, D. (ed.) (2007). *Global Logistics*. New Direction in Supply Chain Management, Kogan Page Limited, Philadelphia
4. Mentzer, J.T., DeWitt, W., Keebler, J.S., Min, S., Nix, N.W., Smith, C.D. and Zacharia, Z.G. (2001). Defining Supply Chain Management. *Journal of Business Logistics*, 22(2), 18.
5. Cooper, M.C., Lambert, D.M. and Pagh, J.D. (1997). Supply chain management: more than a new name for logistics. *The International Journal of Logistics Management*, 8(1), 1-13.
6. Simchi-Levi, D., Kaminsky, P. and Simchi-Levi, E. (2003) *Managing the supply chain*. McGraw-Hill, NY.

Insect Pest of *Phylanthus niruri* and its Management

Article ID: 40853

Dr. P. Indiragandhi[1], Dr. T. K. S. Latha[2]
[1]Associate Professor (Agrl Entomology),
[2]Associate Professor (Plant Pathology),
Tamil Nadu Agricultural University, Regional Research Station, Vriddhachalam-606 001.

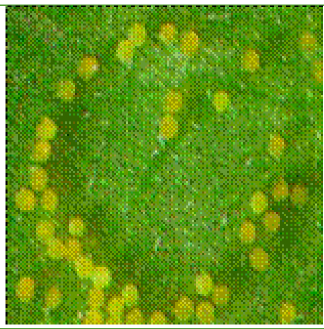
Keezhanelli- *Phyllanthus niruri* is one of the precious medicinal herbs growing in and around out home gardens. In spite of growing without any effort or support in terms of maintenance they tend to grow on their own, but having innumerous medicinal properties. It has other nemas such as Keezhkaai nelli, Keezhvai nelli, stone breaker, gale of wind and seed under leaf. It is a short shrub, growing along the water bodies, farm bunds and waste lands. The leaves are smaller, resembling tamarind leaves, arranged on either side of the leaf stem. Beneath the leaves present flowers and unripe fruits in perfect rows. The leaves of the plant contain 'Phyllanthin', an active ingredient that adds strong bitterness to the leaves. It is one of the plants that contain more amount of potassium. Its unripe fruits resemble neelikaai, amla or gooseberry, but smaller in size and grow beneath the leaves and hence the name, Keezhanelli. It has plenty of medicinal uses. It cures jaundice, facilitates urination, healthy hair growth protects eyes from infection and diseases, cures liver related diseases, protects skin from scabies and skin sores, heals the boils and inflammation due to heat, and prevents liver from degradation, cures anemia, infertility, renal diseases and controls diabetic condition.

None of the plants in the mother planet earth could not be escaped from insect pests' infestation. Keezhanelli is also prone to some of the sucking insect pests attack during its growth and development. Major sucking insect pests infesting *P. niruri* is listed below with management practices to protect the medicinal herb keezhanelli. Insect infestation leads to reduce the market value of the plants and produce and make it unfit for consumption and preparation of medicines. Hence, the knowledge about insect pests and its management pertaining to medicinal herbs like keezhanelli is paramount important.

Major Insect Pests of *P. niruri* and its Management

S.N	Insect pests	Symptom of Damage	Identification of the pest	Management
1.	Potato Aphids *Macrosiphum euphorbiae* Order: Hemiptera: Family: Aphidiae	• Nymphs and adults suck the sap from leaves • Weakening and early wilting of the plant • Infested leaves show leaf chlorois, withering and premature dropping of leaves • Finally death of the plant	• Elongated pear shaped body with large red eyes, black cornicles and pinkish in colour	• Collection and destruction of infested plant parts • Spray NSKE 5% (or) neem oil 3%
2.	Cotton Whitefly, *Bemisia tabaci* Order: *Hemiptera: Family: Alyrodidae*	• Nymphs and adults suck the sap from leaves • Weakening and early wilting of the plant	• Nymph- Greenish yellow, oval in outline Pupa- Oval in shape,	• Collection and destruction of infested plant parts

		• Leaf chlorosis, leaf withering, premature dropping of leaves • Death of the plants	present on the under surface of the leaves Adult- Minute insects with yellow body covered with a white waxy bloom	• Spraying of NSKE 5% or Neem Oil 3%
3.	Onion Thrips, *Thrips tabaci* Order:*Thysanoptera* *Family: Thripidae*	• Nymphs and adults lacerate the leaves • Leaf curling • Withering • Death of the plants	• Eggs: Are laid only in the tender leaf • Adult: The colour of the insect varies from pale yellow to grey	• Spray NSKE 5% (or) neem oil 3% • Place blue sticky traps at 12/ha
4.	Red spider mite, *Tetranychus urticae* Order: Acarina Family: Tectranychidae	• White spots developed on the feeding sites • In severe case, the whole leaf became white and further drying and wilting	• Nymphs and adults are red in colour. • Eggs are laid on the ventral surface of the leaves and are whitish, spherical in shape	• Spray dicofol 3 ml (or) wettable sulphur 2g/lit.

		
Unripe fruits under the leaf	**Whitefly nymph**	**Whitefly pupa**
		
Whitefly adult	**Thrips**	**Red spider mite**

Red spider mite (RSM) infested plant and RSM in leaves

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

Physiological Disorders of Mango

Article ID: 40854

Dr. D. Rajani[1], Dr. A. Nirmala[1]
[1]Scientist (Horticulture), AICRP – WIA, PG&RC, PJTSAU, Rajendranagar, Department of Horticulture, College of Agricultural, Rajendranagar, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad.

Spongy Tissue

It is a major problem in Alphonso, where a pulp patch fails to ripen. This malady is caused due to inactivity of ripening enzymes due to high temperature, convective heat and post-harvest exposure to sunlight.

Control: Use of mulching and post-harvest exposure to low temperatures between 10-15 C for 10-18 hours has been useful in reducing the malady.

Mango Malformation

Malformation is widely prevalent in northern India, particularly in the states of Punjab, Delhi and western U.P. where more than 50% of the trees suffer from this malady.

1. Three types of symptoms: bunchy top phase, floral malformation and vegetative malformation.
2. In bunchy top phase in nursery bunching of thickened small shoots, bearing small rudimentally leaves. Shoots remain short and stunted giving a bunchy top appearance.
3. In vegetative malformation, excessive vegetative branches of limited growth in seedlings. They are swollen with short internodes forming bunches of various size and the top of the seedlings shows bunchy top appearance.
4. The malformed panicles remain unproductive and are characterized by a compact mass of male flowers, greenish in colour and stunted in growth. The main and secondary rachis is thick and short and bears flowers with relatively larger bracts, sepals and petals as compared to normal flowers. The malformed panicles remain intact on the trees for a considerable long period. The complexity of the disorder is attributed to cultural, nutritional and factors like, mites, fungal, viral, hormonal imbalance etc. The exact cause and control of the malady is yet to be established.

	
Vegetative malformation	**Floral malformation**

Control:

a. Diseased plants should be destroyed
b. Use of disease-free planting material
c. Incidence reduced by spraying 100-200ppm NAA during October.
d. Pruning of diseased parts along the basal 15-20 cm apparently healthy portions.
e. This is followed by the spraying of Carbendazim (0.1%) or Captafol (0.2%).

Biennial Bearing

The term biennial, alternate or irregular bearing generally signifies the tendency of mango trees to bear a heavy crop in one year (On year) and very little or no crop in the succeeding year (Off year). Most of the commercial varieties of north India, namely, Dashehari, Langra and Chausa are biennial bearers, while south Indian varieties like Totapuri Red Small, Bangalora, and Neelum are known to be regular bearers. When a tree produces heavy crop in one season, it gets exhausted nutritionally and is unable to put forth new flush thereby failing to yield in the following season. The problem has been attributed to the causes like genetical, physiological, environmental and nutritional factors.

Control: For overcoming biennial bearing, deblossoming is recommended to reduce the crop load in the 'On' year so that it is balanced in the 'Off year. Proper maintenance of orchard by way of effective control of pests and diseases and regular cultural operations may also result in better performance of the tree every year. Soil application of Paclobutrazol (PP) or Cultar @ 4 g/tree in the month of September resulted in 333 early flowering with higher fruit set and yield. It may be applied every year for regular fruiting, particularly in young trees.

Ringing of branches is recommended as means of inducing flowering in the 'Off' year. However, Weak, stunted, unhealthy trees should not be ringed to force flowering. It involves removal of 1 cm wide ring of bark on a branch of about 15 cm thickness. Ringing stops vegetative growth and results in accumulation of carbohydrates and other metabolites in the portion of the branch above the ring, thereby creating physiological condition for flowering. Ringing should be done in August or early September, well before the time of fruit-bud differentiation.

Fruit Drop

The intensity of fruit drop varies from variety to variety. Among the commercially grown varieties, Langra is more susceptible to drop, while Dasheri is the least. The fruit drop is more or less a continuous process and can be classified into three phases, viz.

1. Pinhead drop.
2. Post-setting drop.
3. May-month drop.

The fruit drop in first two phases is insignificant compared to the third phase which affects the final yield significantly and needs more attention. Embryo abortion, climatic factors, disturbed water relation, lack of nutrition, attack of disease and pest and hormonal imbalances are the major factors that lead to fruit drop.

Control: The foliar application of Alar (B-nine) @ 100 ppm or NAA 20 ppm at pea stage of fruit was found effective in controlling fruit drop in mango.

Black Tip

Black tip is a serious disorder, particularly in the cultivar Dasheri. The affected fruits become unmarketable and reduce the yield to a considerable extent. The damage to the fruit gets initiated right at marble stage with a characteristic yellowing of tissues at distal end. Gradually, the colour intensifies into brown and finally black. At this stage, further growth and development of the fruit is retarded and black ring at the tip extends towards the upper part of the fruit.

Black tip disorder has generally been detected in orchards located in the vicinity of brick kilns. It has been reported that the gases like carbon monoxide, sulphur dioxide and ethylene constituting the fumes of brick kiln are known to damage growing tip of fruits and give rise to the symptoms of black tip. Apart from these factors, irrigation, condition of the tree and management practices also play important role in deciding the severity of the disorder.

Control: Planting of mango orchards in North-South direction and 5-6 km away from the brick kilns may reduce incidence of black tip to a greater extent. The incidence of black tip can also be minimized by spraying Borax (1%) or other alkaline solutions like caustic soda (0.8%) or washing soda (0.5%). The first spray of Borax should be done positively at pea stage followed by two more sprays at 15 days interval.

Clustering in Mango ('Jhumka')

A fruiting disorder, locally known as 'Jhumka', is characterised by the development of fruitlets in clusters at the tip of panicles. Such fruits cease to grow beyond pea or marble stage and drop down after a month of fruit set. Absence of sufficient population of pollinators in the orchards is the major reason. The other reasons causing the disorder are old and overcrowding of trees, indiscriminate spraying against pests and diseases, use of synthetic pyrethroids, monoculture of Dashehari and bad weather during flowering.

Control: Introduction of beehives in the orchards during flowering season for increasing the number of pollinators and restrict insecticidal sprays at full bloom to avoid killing of pollinators. Pests and diseases should be controlled in time by spraying the recommended pesticides and concentrations. Spraying of NAA (300 ppm) during October-November is recommended. The practice of monoculture of a particular variety may be avoided. Particularly in case of Dashehari, 5- 6% of other varieties should be planted in new plantations.

References

1. Bose, T.K., Mitra, S.K. and Sanyal, D. (Ed.) 2001. Fruits Tropical and Sub-Tropical 3rd Ed. Vols. 1: 69-74 Naya Udyog.
2. Bal, J.S. (Ed.) 2006. Fruit Growing. 98-101 Publ. Kalyani.

Integrated Farming System for Irrigated Upland and Dryland Eco-System

Article ID: 40855

G. Senthil Kumar[1]
[1]Associate Professor (Agronomy), Department of Rice, Tamil Nadu Agricultural University, Coimbatore – 641 003, Tamil Nadu, India.

The emergence of Integrated Farming Systems (IFS) has enabled us to develop a framework for an alternative development model to improve the feasibility of small sized farming operations in relation to larger ones. Integrated farming system (or integrated agriculture) is a commonly and broadly used word to explain a more integrated approach to farming as compared to monoculture approaches. It refers to agricultural systems that integrate livestock and crop production or integrate fish and livestock and may sometimes be known as integrated bio-systems. In this system an inter-related set of enterprises used so that the waste from one component becomes an input for another part of the system, which reduces cost and improves production and/or income. IFS works as a system of systems. IFS ensure that wastes from one form of agriculture become a resource for another form. Since it utilizes wastes as resources, it was not only eliminated.

The choice of components is many in irrigated upland compared to lowlands and rainfed lands. Components like dairy, poultry, goat, sheep, piggery, sericulture, mushroom, apiary, pigeon, rabbit, quill etc., can be easily integrated in an irrigated upland farm. In addition, perennial trees like coconut and other fodder, multipurpose farm forestry trees can be grown along the borders of the fields and boundary of the farm. The possibility of having a viable integrated farming system in irrigated uplands is possible. The control and management of available resources in more effective manner paves way to integrate two are more components with cropping.

Special Features of Upland

1. Wide range of crops and varieties can be grown
2. Effective resource utilization and management is possible due to controlled irrigation system.

The following are some of the examples of integrated farming system for irrigated uplands:

a. Crop + Dairy + Biogas unit
b. Crop + Poultry + Biogas unit
c. Crop + Sheep / Goat rearing +Biogas unit
d. Crop + Sericulture
e. Crop + Piggery
f. Crop + Sericulture + Biogas unit
g. Crop + Dairy + Biogas unit+ Homestead Garden
h. Crop + Dairy + Biogasunit + Vermi-composting.

Garden Land Farming System - Model

A model on integrated farming system to suit the small farmers under upland condition was developed. The following are the components of the model.

1. Cropping: 1:00 ha:

Ragi+Sunflower- Cotton+Maize+Green gram/Cowpea = 0.56 ha
Summer cotton- Maize+Green gram/Cowpea/
Sun flower/Radish/Beetroot/Bengal gram/ Bellary Onion = 0.19 ha
Perennial grass fodder (CO1) = 0.15 ha
Perennial legume fodder (Lucerne) = 0.05 ha
Farm shed = 0.05 ha.

2. Dairy: 3 number of graded jersey cross breed milch animals with two calves

3. Biogas plant: For effective recycling of farm and animal waste for fuel, light and enriched manure.

4. Farm silviculture: 200 Subabul trees along the boundary of field for fodder and timber.

Dry Land Farming System-Model

The dry land ecosystem is characterized by:
1. Inadequate and uneven distribution of rainfall
2. Poor and marginal soils
3. Low cropping intensity
4. Limited crop diversification
5. Low value crops
6. Poor resource mobilizing power of farmers.

The agriculture in dry lands is seasonal. The cropping season is restricted to 4-5 months and people remain without employment for rest of the year. Diversification of cropping by integrating with components like livestock (Sheep/Goat rearing), silviculture, horticulture tree crops and pasture would improve the standard of living and employment opportunities of the dry land farmers.

Possible combinations are:

Crop + Silvipasture + Goat / Sheep rearing
Crop + Silviculture + Hort. Fruits trees
Crop + agro-forestry + goat + farm pond
Crop + Silvipasture + Goat + Pigeon + farm pond
Crop + Silvipasture + Buffalo + farm pond.

Advantages of IFS Under Dry Land

1. Risk is minimized.
2. Optimum use of resources
3. Soil and moisture conservation will be improved
4. Improved is stabilized during period of drought.

Dry Land Farming System Model

Six goats (5 female and one male) were taken up for the study with the following cropping programme.

Cropping System

IFS:

a. Sorghum + Cowpea (grain): 0.20 ha
b. Sorghum + Cowpea (fodder): 0.20 ha
c. Subabul + *Cenchrus cilliaris*: 0.20 ha
d. *Acacia Senegal* (tree fodder): 0.20 ha
e. *Prosophiscineraris* (tree fodder): 0.20 ha

Control: Sorghum + Cowpea (grain): 0.20 ha

Feed for the Goat

The goats were allowed in the developed pasture *viz., Cenchrus cilliaris* grass + *Clitoriaternate* (leguminous plant) grown in the pasture land. Dry fodder was fed to the animal as stall feeding at 2 kg / day.

Crop Yield

The straw and green fodder yield from the crop was recorded and income calculated. The animal yield was recorded in terms of meat, the weight gained by the six animals for one year. The results reveals that the net income under integrated farming system may be increasing the herd size/ha that can be fed with the biomass produced from one hectare of land, besides increasing the employment opportunity throughout the year.

Tea Mosquito Bug and its Management in Moringa

Article ID: 40856

Dr. P. Indiragandhi[1], Dr. T. K. S. Latha[2]
[1]Associate Professor (Agrl Entomology),
[2]Associate Professor (Plant Pathology),
T.N.A.U., Regional Research Station, Vriddhachalam-606 001.

Moringa oleifera is one of the most important vegetable crops in many countries including India, Ethiopia, and Philippines etc. It is rich in proteins, vitamin A, B and C and some minerals. It is the most suitable annual or perennial crop for majority of the regions. Pests and diseases are major problems in crop production. Currently tea mosquito bug (TMB), *Helopeltis antonii* Signoret (Miridae: Hemiptera) is one of the important pests in *Moringa* ecosystem (Fig 1and 2). First incidence of TMB in *Moringa* was reported in Kerala during 1975. Besides, it also attacks economically important fruit crops like Guava, Mango, Grape vine, Pomegranate and other crops *viz*., Cashew, Singapore cherry, Pepper and Henna etc. However, incidence of TMB in moriga is gaining momentum since all the plant parts are used as medicines besides its culinary purpose. Hence studies on its nature of damage and life cycle may pave an avenue for managing this notorious insect pest in moringa.

Damage Symptom

The nymphs and adults suck the sap from young shoots of *Moringa*, forming lesions on shoots. Due to continuous feeding the lesions coalesce, resulting in drying of twigs (Fig a). Feeding also leads to exudation of gum (oozing) (Fig. b). The young instars mainly congregate on growing tips, which dry first. Later due to continuous feeding of bugs the whole twig used to dry and the leaves wither. Under severe infestation on the same tree, entire leaves fall-off and the plant resemble the snag.

Biology and Life Cycle

The life cycle of *H. antonii* has three stages namely egg, nymph and adult.

Egg: The gravid females oviposit individual eggs on the young shoots of *Moringa*. Presence of two chorionic hairs prominently on either side of egg and black colour will be visible externally. The egg period is 3-5 days.

Nymphs: The nymphs hatched undergo four moults and instars emerged differ in their size. Colour of nymphs varies from red to reddish brown. The young instar nymphs congregate over young shoots for feeding. The nymphal period lasts for 15-18 days.

Adult: The adult will be in black colour with red thorax and knobbed like sturucture in scutellar region and white abdomen. Adult lives for 2-4 days.

		
Damage in shoot portion	**Gummy exudates from pods**	**Damaged pod**

Figure. 1. Damage symptoms of Tea Mosquito Bug in Moringa Ecosystem Seasons

Incidence of TMB will be noticed from December II Fortnight to March II FN. Severe incidence starts during November month and the second peak incidence during June month. However, incidence of TMB is not occurring from March III week to May I FN. During June month incidence of TMB is coincides with the formation of tender pods. During early stage the incidence noticed upto 51.20% and during fruiting stage upto 30.38% incidence would be noticed.

Management: For effective control of tea mosquito bug, all possible management practices should be integrated. Since all the stages of the bug are destructive, management of all stages is important.

Cultural and Mechanical practices:

a. Since many weeds act as alternate hosts, field should be kept weed-free.
b. Pruning the infested shoots regularly will result in minimum damage.
c. Avoid trees such as neem, guava, cashew etc. around the field, which act as alternate hosts for tea mosquito bug.
d. Monitoring the field at regular intervals is the first and foremost step in managing tea mosquito bug.
e. Collection and destruction of damaged twigs, reduces the hatching of the next stage.

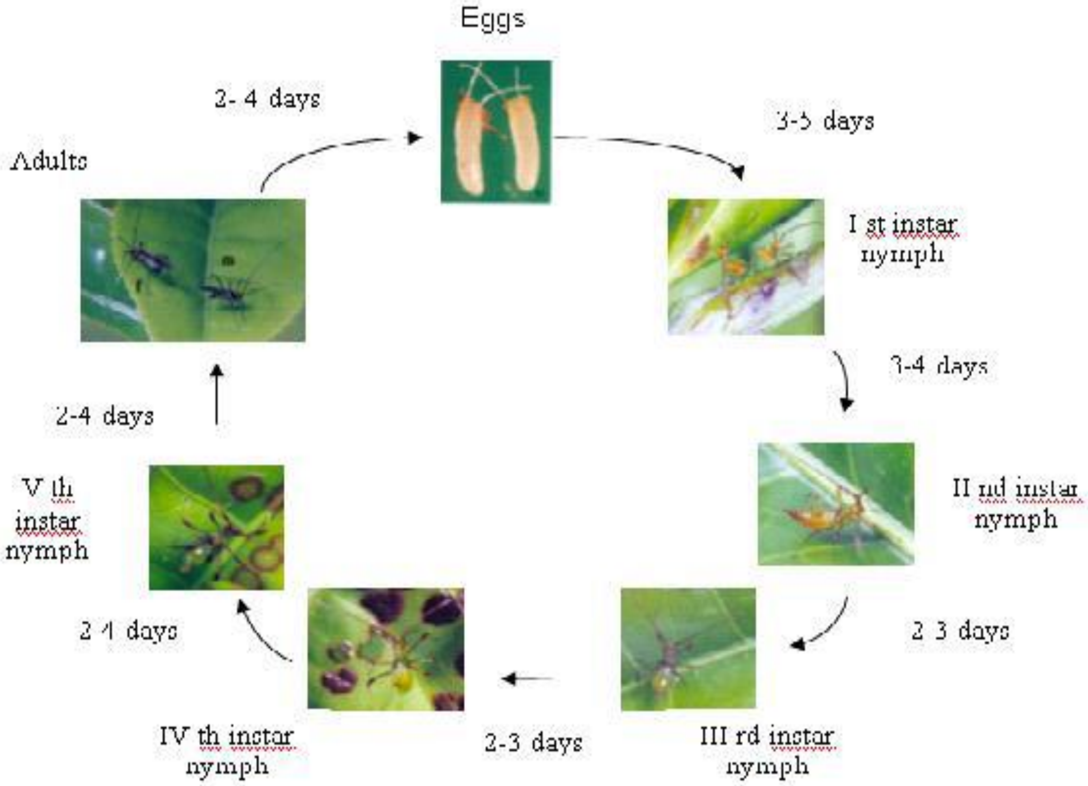


Figure 2. Life cycle of tea mosquito bug - *Helopeltis antonii*

Nymph

Adult TMB

Biological control:

a. There are many free-living natural enemies *viz.* predators, parasitoids that maintain tea mosquito bug population at lower level.

b. Predators like reduviids, black ant, red ant, some spiders, green lace wing, preying mantid etc. check the tea mosquito bug population.

c. The successful parasitoid that is reported for tea mosquito bug is *Telenomus* sp.

d. *Beauveria bassiana* at a concentration of 10^8 spores/ml has potential for managing tea mosquito bug. It is pathogenic to both nymphs and adults.

Chemical control: Spraying chemicals is the final solution for controlling any pest. For tea mosquito bug spraying chemicals on the whole plant will be effective. Spraying any one of the following chemicals will check the tea mosquito bug population.

a. Clothianidin 50% WDG 120 g/ha

b. Thiacloprid 21.7% SC 500 ml/ha

c. Thiamethoxam 25% WG 100 g/ha

d. For effective control the chemicals may be sprayed three times at regular intervals from new flush emergence to pod formation.

Laser Land Leveling and Water Conservation

Article ID: 40857

R. Suresh[1], S. K Nirala[1]
[1]Department of Soil & Water Engineering, CAE&T, RPCAU, Pusa (Samastipur), Bihar- 848 125.

Introduction

The soil surface in undulation form poses very serious impacts on seed germination, crop stand and yield as well because of so many in-conducive effects such as poor nutrient- water interaction and salt - soil moisture distribution pattern born in the soil concern. To accomplish a good agronomic, soil and crop management practices in field the land leveling is considered as a precursor. It is well proved that the resource conserving technologies comparatively perform better on the land segments having leveled topography. In undulating lands the application and distribution of irrigation water is completely non – uniform. In result the water use efficiency, water productivity and nutrient uptake are badly affected, leading to affect the crop yelled, significantly. On this ground the famers therefore devote considerable attention on land leveling to an optimum level. The studies have indicated that about 20 to 25% irrigation water gets lost during application in the crop field (Cook and Peikert, 1960). Normally, the irrigation water loss is heavily observed in rice cropped field. In nutshell, the unevenness of field involves inefficient use of irrigation water and rain water both, besides spatial variability in existing moisture contents in the soil media and nutrient conservation, too.

The land leveling can be done by adopting so many techniques such as manually, tractor mounted scrapers, buckets laser land levelers etc. All the methods have their own features in respect of perfuming their leveling work. However, the work capacities, accuracy, field size, energy consumptions are the overriding factors are considered for selecting leveling method. The methods/ techniques having better work performance and less expenditure cost are always preferred.

At present the laser guided land leveling techniques has been proved to be the best for leveling work at wide range. In smart farming context this is one of the most important farm implements/ machines for leveling the agricultural fields with fast speed. As per Rickman (2002) the laser land leveling is meant for optimizing the water-use efficiency, better distribution of water content (moisture) in soil media, improving crop establishment, reducing irrigation time and saving or conserving the irrigation water, essential to manage the crop for better productivity.

Land Leveling- General

Land leveling is the measure applied to the agricultural to accomplish better surface irrigation. In surface irrigation methods such as the border, basin and check basin the levelness of top soil surface is very important; otherwise the irrigation gets badly affected.

In general the land leveling is carried out in two aspects namely (i) Preparing the field in such a way that there is no highor low spots to disturb uniform distribution of irrigation water; and (ii) ensuring the optimal slope for water movement across a field when irrigated.Leveling results into efficient utilization ofirrigation, fertilizers and pesticides,as well.In an unlevelled field, the high spots are not covered by irrigation water. On the other hand, in low spots, the water and dissolved nutrients and chemicals get accumulate and create zones of water logging and nutrient or pesticide accumulation. All these effects disturb the soil aeration and water uptake for the crops. In nutshell, the land leveling accomplishes following points in respect of preparation of field conducive to better crop establishment,

1. Preparing the field in such a way that no high and/or low spots disturb the uniform distribution of irrigation water in the field, and
2. Ensuring the optimal slope for water movement across the field, when irrigated.

There are many land leveling methods; their suitability for use depends on several factors such as working capacity, suitable field size etc., mainly. Table- 1 provides a kind of guidelines in context to selection of most appropriate methods among them as per site condition and requirement of the concern.

Table-1. Suitability of different types of leveling methods:

Leveling method	Work capacity (ha/day)	Leveling accuracy (%)	Field size (ha)
Tractor	0.12	4 to 5	Less than 0.25
Blade	0.5 to 1.0	4 to 5	Less than 0.50
Bucket	0.5 to 1.0	4 to 5	Less than 0.10
Laser leveling	Up to 2.0	1.0	Less than 0.10

Laser Land Leveling

Laser leveling is the smoothening the land surface ± 2 cm in reference to its average elevation with the help of laser guided drag bucket to achieve the land levelnessin precise form. Sometimes the laser land leveling is also called as precision land leveling, which involves altering or modifying the field surface having a constant slope ranging from 0 to 0.2%. In other words, the laser land leveler is one of the most effective tools for precision leveling and smoothening the agricultural land for achieving the target of better crop yield via improving the water & nutrient efficiency, water productivity as well. The device comprises a laserguidance system to operate the soil cutting tool called blade. The system operation is totally sensor based.

The development of Laser land leveling equipment is marked to be one of the most significant advances for leveling the irrigated fields to perform the surface irrigation in better way with high level of water application efficiency and water productivity beside quality crop yield. Also, this technology plays significant role in minimizing the cost of cultivation by enhancing the crop yield and minimizing the magnitude of water application. The view of laser land leveling is presented in Figure-1.

Figure.1. The view of laser land leveling (Source-https://doi.org/10.1007/s12571-015-0460-y)

Few important features of laser land leveling technology are narrated as under,

1. Laser leveling accomplishes the accuracy in smoothening of land surface by ± 2 cm from average elevation.
2. Makes the field preparation, very fast and in easy manner
3. Ensures every drop of irrigation water, effective to crop
4. Enables to create a constant slope ranging from 0 to 0.2%.

Importance of Laser Land Leveling

The importance of laser land leveling is multi-fold in agriculture. As per research evidences there is reduction in irrigation ranging from 20 to25% along with adequate reduction in water use. In this context Bhatt and Sharma (2009) reported that through laser land leveling the irrigation water could be saved to the tune of 25 to 30% without having any adverse effect on the crop yield. In addition, the time and waterto be required for irrigating the crop are also reduced to a large extent. The other benefits to be realized due to laser land leveling are as: better uniformity in distribution of irrigation water in the field;development of a consistent moisture environment conducive to crop; and uniform and better germination of seeds, besides growth of the crops, as well. All these effects in combine form led to accelerate the level of crop yield. In nutshell, the laser land leveling which is the Precision Land Leveling (PLL) enhances the level of application efficiency of irrigation water by facilitating an even distribution of water. Kumar and

Maheshwari (2005) reported that on use of laser land leveling the reduction in field labour ranging from 21 to 5 labour-days/ha can be easily achieved. Overall, in agriculture sector the importance of laser land leveling is outlined as under,

Water Conservation - Laser land leveling reduces water waste by making irrigation more precise and efficient, because of smoothing the field to a desired gradient. In this context the derived data from research done by several individuals such as Bhatt and Sharma (2009) advocates that around 25-30% irrigation water could be saved through this technique without having any adverse effect on the crop yield.

Uniform Plant Growth - It is due to casting the land surface more uniform in slope/ gradient.

Time, Energy and Cost Savings - Laser leveling is a fast method of field leveling and also requires less labor hours besides producing high yield with less energy consumption. It minimizes in time and water required to irrigate the field, more uniform distribution of water in the field, consistent moisture environment for crops, more uniform germination and growth of crops, fertilizer, chemicals. It increases yield, improves uniformity of crop maturity and reduces weeds, enhance water use efficiency and the amount of water needed for land preparation.

Environmentally Friendly - It is because of following reasons,

a. Laser land leveling requires less use of emission-producing farm equipments than the conventional methods.
b. Less use of water-pumping equipments, besides harvesting the crop faster and easier.

Limitations

Besides so many advantages offered by the laser technique, there are few limitations in case of its adoption by the farmers, mentioned as under,

1. The cost of laser land leveler is very high.
2. For operating the machine skilled person is essential.
3. Repair and maintenance is not so easy by the farmer.

Benefits of Laser Land leveling

Laser land leveling optimizes water-use efficiency, better soil moisture distribution, improves crop establishment, reduces irrigation time; saves irrigation water and reduces spatial variability (Rickman, 2002). In nutshell, the salient benefits of L.L.L. are as follows,

1. It saves the irrigation water to a significant level as compared to the traditional practices of land leveling.
2. The cultivable area can be increased from 3 to 5% (approx.).
3. The effect on crop establishment is very appreciable.
4. The crop maturity attains uniformly in the entire crop field.
5. Laser land leveling enhances the water application efficiency up to 50%
6. There is an increase in cropping intensity by about 40%.
7. Appreciable increase in crop field (wheat 15%, sugarcane 42%, rice 61% and cotton 66%).
8. It also facilitates to manage the saline environments in the field.
9. It reduces the weed problem and also improves the efficiency of weed control.

References

1. Bhatt R, Sharma M. 2009. Laser leveller for precision land leveling for judicious use of water in Punjab, *Extension Bulletin*, KrishiVigyan Kendra, Kapurthala, Punjab Agricultural University, Ludhiana, India.
2. Cook RL, Peikert FW. 1960. A comparison of tillage implement. *J Am SocAgricEngg*31: 221–214.
3. Kumar T. and Maheshwari, 2005, Land preparation by Laser technology. Paper presented in the 39th annual convention of ISAE held at AcharyaN.G.Ranga Agricultural University, Hyderabad during, 9-11, March, 2005.
4. Rickman JF. 2002. *Manual for Laser Land Leveling, Rice-Wheat Consortium Technical Bulletin Series 5*. Rice-Wheat Consortium for the Indo-Gangetic Plains, New Delhi, India.

Micro-Irrigation Effects on Different Crops Under North Bihar Condition - An Overview

Article ID: 40858

R. Suresh[1], S. K Nirala[1]
[1]Department of Soil & Water Engineering, CAE&T, RPCAU, Pusa (Samastipur), Bihar- 848 125.

Introduction

Micro-irrigation systems include drip and sprinkler irrigation, used to improve irrigation efficiency in cropping system. These systems are known to enhance crop yield, save water and energy, and are particularly suitable for marginal lands. It was found that around 50%–80%, 31%, and 29% savings in water, energy, and fertilizer, respectively, can be gained by micro-irrigation methods with a consequent 42% enhancement in farmer income levels. Studies also reported that about 114% yield gain was obtained for cotton crop under drip irrigation compared to flood irrigation regimes. Similar results are also reported for crops such as banana, coconut, grape, turmeric, and apple, with productivity gains of 4%, 15%, 16%, 22%, and 35%, respectively, compared to traditional cultivation methods (Randev, 2015; Viswanathan et al., 2016). As such, micro-irrigation is reported to achieve a water-saving of 25%–80% across the cultivation practices and crops (Kumar et al., 2008) and a saving in electricity consumption of 25%–77%. Thus, it may be held that micro-irrigation measures enable farmers to contribute toward both climate change adaptation.

Similar studies were also carried out at Precision Farming Development Centre (PFDC), Department of Soil and Water Engineering, RPCAU, Pusa, Samastipur Bihar on several crops like banana, litchi, pointed gourd, capsicum, tomato, okra etc. for research trials.

Research Activities

Research studies were carried out under following research activities:
1. Drip irrigation with and without plastic mulch.
2. Fertigation.

The drip irrigation effect without plastic was evaluated on different crops namely bottle gourd, tomato, okra etc under four treatments, i.e. T_1 = application of V volume of water through drip; T_2 = application of 0.8 V volume of water through drip; T_3 = application of 0.6 V volume of water through drip, and T_4 = application of V volume of water through check basin (control). In case of drip with plastic mulch, it was performed under eight, i.e. T_1 = application of V volume of water through drip;T_2 = application of 0.8 V volume of water through drip ;T_3 = application of 0.6 V volume of water through drip , T_4 = application of V volume of water through traditional irrigation method (control);T_5 = application of V volume of water through drip + mulch;T_6 = application of 0.8V volume of water through drip + mulch;T_7 =application of0.6 V volume of water through drip + mulch, and T_8 = application of V vol. of water through traditional method + mulch . V is the crop water requirement. Mulching was performed by using 50 micro thickness black colour polythene sheets.

Fertigation study was carried out under four different treatments, e.g; F_1 = application of 100% N through drip; F2 = application of 80% N through drip; F_3 = application of 60% N through drip, and F_4 = application of 100% N through traditional method, for standardizing fertigation techniques in litchi, banana and pointed gourd to develop precision farming practices.

Research Findings

1. Drip Irrigation with and Without Plastic Mulch: The pointed gourd, bottle gourd, okra, tomato and brinjal as vegetable crops; litchi, banana, papaya, guava, citrus as the fruit crops were taken into consideration for study. The effect of drip irrigation with and without plastic mulch was evaluated in respect of water saving, labour saving, weed control and increase in yield over traditional method. Findings are presented below:

Water Saving: In vegetable crops, the saving of irrigation water through drip irrigation without plastic mulch conditions was found from 27 to 37%, while in fruit crops it was from 18 to 22 % as compared to traditional irrigation method. On the contrast, in comparison to without mulch condition the level of water saving was found more significant, e.g. in vegetable crops the water saving was found to the tune of 38 to 40%; and in fruit crops it was from 20 to 25%. Overall, 5 to 10 % more water saving was achieved by using black colour plastic mulch. The crop wise water saving due to drip irrigation method is shown in Table-1

Labour saving: In comparison to traditional irrigation method, an appreciable amount of labour saving was achieved by using drip irrigation technique in all the crops. However, in case of drip irrigation without plastic mulch, the level labour saving was relatively less as compared to drip irrigation with mulch. In vegetable crops, the labour saving was found from 45 to 55% under drip irrigation without mulch; whereas 53 – 65% in case of drip irrigation with mulch. In fruit crops the labour saving was realized to the tune of 60 to 65% in without mulch condition and 68 to 70% with plastic mulch condition over control practices (traditional irrigation method). Percentage of labour saving achieved under different crops are shown in Table-1.

Weed control: Weed control was very significant in all the crops due to use of drip irrigation as compared to traditional method; however, it was greater in case of mulching condition. In comparison to traditional method, 60 to 70% weed control was observed in vegetable crops and 68 to 75% in fruit crops due to application of drip method without plastic mulch. In case of drip irrigation with plastic mulch, the weed control was found to the tune of 81 to 83% in vegetables and 85 to 89% in fruit crops. Table-1 shows the percentage of weed control through drip irrigation in different horticultural crops.

Increase in Yield: As compared to traditional irrigation method, the yield was also increased to an appreciable level due to drip irrigation, in all the crops. However, on application of plastic mulch with drip irrigation the yield was further increased. In vegetable crops, the increase in yield was from 7 to 15 %; and in fruit crops it was 17 to 20 % by drip irrigation without mulch, while in case of drip with mulch 19 to 21% and 15 to 20% increase in yield of fruit and vegetable crops were noticed, respectively. Percentage increase in yield under drip irrigation with and without plastic mulch over traditional irrigation method is given in Table -1

2. Fertigation Effect: Fertigation effects were evaluated in pointed gourd, tomato, banana, papaya and litchi crops. In vegetables, the fertilizer saving was found to the tune of 20 to 25%; and in fruit crops it was from 25 to 30% over traditional method. Percentage of fertilizer savings in different crops are shown in Table-2. The effect of fertigation on increase in yield of different horticultural crops was also found significant over traditional method. In vegetable crops about 20% more yield was noticed, while in fruit crops it was up to 25%. Crop-wise increase in yield over traditional method is also shown in Table-2.

Conclusions

Saving of irrigation water through drip irrigation without plastic mulch conditions was found from 27 to 37% and with plastic mulch 38 to 40%. Using black color plastic mulch additional 5 to 10 % more water saving was achieved. Labour saving was found from 45 to 55% under drip irrigation without mulch; whereas 53 - 65% in case of drip irrigation with mulch. In case of drip irrigation with plastic mulch, the weed control was found to the tune of 81 to 83% in vegetables and 85 to 89% in fruit crops. the increase in yield was found in case of drip with mulch 19 to 21% vegetable crops and 15 to 20% increase in yield of fruit., the fertilizer saving was found to the tune of 20 to 25% in vegetables and 25 to 30% in fruit crops over traditional method.

Table-1: Water saving, labour saving, weed control and increase in yield through drip irrigation with and without mulch:

Crop	Water saving		Labour saving		Weed control		Increase in yield	
	Without mulch	With mulch	Without mulch	With mulch	Without mulch	With mulch	Without mulch	With mulch
Vegetable crops								
Okra	37.2	40.0	45 .0	53.0	67.0	75.0	7.4	18.00
Tomato	27.5	38.0	50.0	61.0	70.0	81.0	14.0	19.52

Bottle gourd	37.0	40.0	50.5	65.0	70.5	82.0	15.0	20.00
Pointed gourd	30.0	40.0	45.0	57.0	70.0	83.0	11.0	17.00
Brinjal	35.0	39.0	55.0	63.0	73.0	80.0	13.0	17.00
Fruit crops								
Papaya	20.0	25.0	65.0	70.0	75.0	85.0	20.0	23.00
Banana	18.0	25.0	65.0	70.0	75.0	87.0	17.5	21.00
Litchi	18.0	22.0	65.0	69.0	75.0	89.0	15.0	18.50
Citrus	18.0	20.0	60.0	68.0	68.0	85.0	15.8	19.00
Guava	22.0	25.0	65.0	68.0	69.0	86.5	15.0	20.00

Table-2. Fertilizer saving and increase in yield through fertigation:

Crop	Fertilizer saving (%)	Increase in yield (%)
Tomato	18.0	20.0
Pointed gourd	22.0	9.0
Papaya	30.0	25.4
Banana	27.0	11.0
Litchi	20.0	16.78

References

1. Ramdev, A.K.(2015)Analysis of crops productivity potential and drip irrigation system in india-Policy implications
2. Viswanathan, P.K. , Kumar, M. D, Narayanamoorthy A. (Eds.) (2016) Micro Irrigation Systems in India: Emergence, Status and Impacts in Select Major States, Springer-Verlag, Singapore , pp. 133-154.
3. Kumar,M.D., Turral, H., Sharma, B., Amarasinghe, U and Singh,O.P. (2008). Water saving and yield enhancing micro-irrigation technologies in India : when and where can they become best bet technologies? https://www.researchgate.net/publication/228894953

Artificial Intelligence in the Food Production

Article ID: 40859

Harmish Pokal[1]

Artificial intelligence (AI) has the potential to transform the food manufacturing industry by enhancing efficiency, lowering prices, and increasing output. AI is being utilised to alter every part of food production, from farming and harvesting to processing and distribution. In this essay, we will look at the function of artificial intelligence (AI) in the food manufacturing industry and its benefits.

Farming and Harvesting

Artificial intelligence is being utilised to optimise farming and harvesting operations. Drones and satellite photography can be used by farmers to monitor crops, analyse soil conditions, and identify pests and illnesses. This data can be utilised to make data-driven irrigation, fertilization, and pest control decisions. Precision agriculture can also benefit from AI-powered robots, which can conduct activities such as sowing, weeding, and harvesting.

Processing and Quality Assurance

AI may be used to improve food processing efficiency and quality control. It can monitor the quality of raw ingredients and completed products by analysing data from sensors, cameras, and other devices. Food goods may be sorted, graded, and packaged using AI-powered robots. To optimise processing parameters and reduce waste, machine learning methods can be applied.

Logistics and Distribution

Artificial intelligence can also be used to improve food distribution and logistics. It can use sensor, GPS, and weather forecast data to optimise delivery routes, reduce fuel usage, and enhance delivery times. Artificial intelligence can also be used to monitor food safety during transit, ensuring that products are stored and transported at the proper temperature and humidity levels.

AI's Role in Food Production

There are numerous advantages to employing AI in food production. For starters, it can boost efficiency and lower expenses. AI can reduce labour expenses and increase productivity by automating repetitive jobs and optimising processes. Second, it has the potential to increase quality and safety. AI can detect quality flaws and prevent food safety risks by monitoring raw materials and finished goods. Third, it has the potential to enhance output while decreasing waste. AI can boost output and decrease waste by optimising processing settings and decreasing product defects.

AI's Challenges in Food Production

Despite the numerous advantages of AI in food production, there are certain drawbacks. The expense of implementation is one issue. AI technology can be costly, and it may take some time for businesses to return their investment. Another issue is the shortage of competent employees to operate and maintain AI systems. To work with AI systems, businesses may need to invest in training and employing new staff.

Conclusion

Artificial intelligence is revolutionising the food production business by enhancing efficiency, lowering prices, and increasing output. AI is being utilised to optimise every element of food production, from cultivation and harvesting to processing and distribution. While integrating AI in food production presents certain problems, the rewards are substantial. As AI technology advances, we may anticipate even more advancements in the food production industry.

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

Climate Change Impact on Agriculture and Adaptation Strategies of Farmers

Article ID: 40860

Subash Chudali[1], Surbhi[1], Dr. Palak Mishra[1]
[1]School of Agricultural Sciences, Sharda University, Greater Noida (U.P.).

Introduction

Climate change is a huge issue that is having an impact on agricultural and food production in numerous countries worldwide. Fluctuations in temperature and precipitation are causing shifts in growing seasons, resulting in changes in the distribution and abundance of pests and diseases, as well as an increase in weather-related hazards, such as droughts, floods, and heatwaves, that are occurring more frequently and with higher intensity. These alterations are making a considerable impact on crop production and the lives of farmers and rural populations. It is very likely that the anthropogenic increase in greenhouse gas concentrations and other human activities, such as burning of fossil fuels (coal, oil, gas), deforestation, etc., together contributed to more than half of the observed increase in the global average surface temperature between 1951 and 2010 (Hegerl et al., 2019).

Impact of Climate Change on Agriculture

Climate change has significant impacts on agriculture, with both direct and indirect effects on crop production, livestock management, and food security. Here are some key impacts of climate change on agriculture:

1. Changing growing seasons: Climate change is altering growing seasons, leading to shifts in planting and harvesting dates. Rising temperatures and changing precipitation patterns can disrupt the timing of planting and harvesting, affecting crop yields and quality (IPCC, 2014).

2. Changes in precipitation patterns: Changes in precipitation patterns due to climate change can result in both droughts and floods, both of which can have detrimental impacts on agriculture. Droughts can reduce crop yields, increase water stress on livestock, and limit water availability for irrigation (FAO, 2020). Floods can cause soil erosion, damage crops, and disrupt the transportation and distribution of agricultural products.

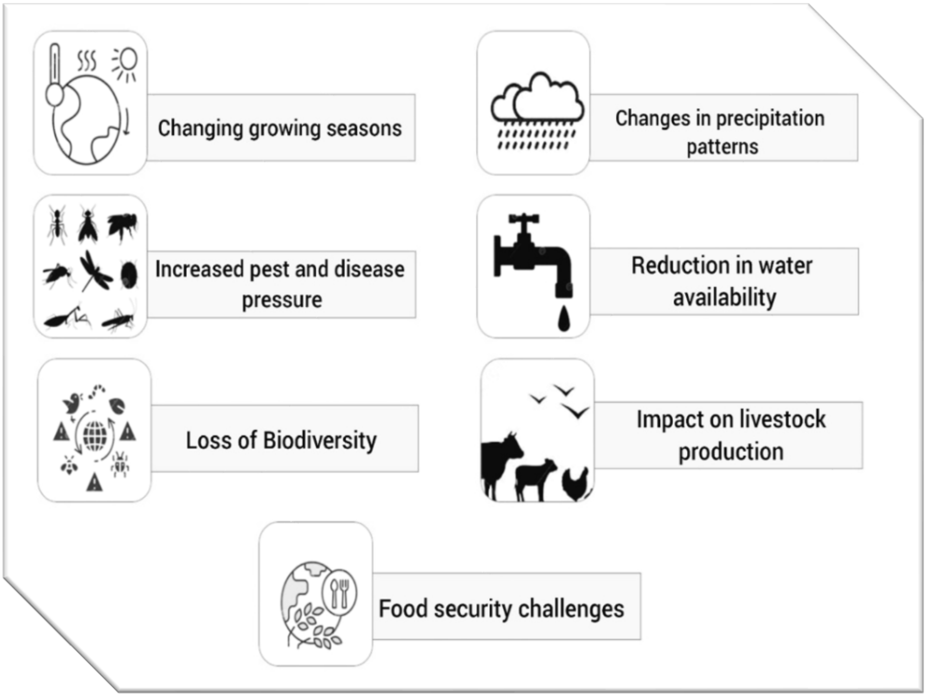
3. Increased pest and disease pressure: Climate change can affect the distribution and abundance of pests and diseases, increasing pressure on agricultural crops. Warmer temperatures, changing rainfall patterns, and altered growing seasons can create favorable conditions for pests and diseases, resulting in decreased crop yields and increased use of pesticides (Gregory et al., 2009).

4. Reduction in water availability: Climate change can impact water availability for agricultural irrigation, which is critical for crop production in many regions. Changes in precipitation patterns, melting of glaciers, and changes in river flows can reduce water availability for irrigation, affecting crop yields and food security (World Bank, 2020).

5. Loss of biodiversity: Climate change can disrupt ecosystems and result in loss of biodiversity, including pollinators, which are critical for crop production. Changes in temperature, precipitation, and habitat loss can affect the distribution and abundance of pollinators, leading to decreased pollination services for crops (Potts et al., 2016).

6. Impact on livestock production: Climate change can affect livestock production through changes in temperature, humidity, and forage availability. Heat stress on livestock can reduce reproductive rates, growth rates, and milk production, leading to reduced productivity and economic losses for farmers (Thornton et al., 2009).

7. Food security challenges: Climate change impacts on agriculture can have significant implications for food security, especially for vulnerable populations. Changes in crop yields, shifts in growing seasons, and disruptions in food supply chains due to extreme weather events can lead to food price volatility, reduced access to nutritious food, and increased food insecurity (Wheeler and von Braun, 2013).



Source: https://rb.gy/l3bt7

Mitigation Strategies

1. Sustainable agricultural practices: Implementing sustainable agricultural practices, such as conservation agriculture, agroforestry, and integrated pest management, can reduce greenhouse gas emissions, increase soil carbon sequestration, and enhance resilience to climate change (IPCC, 2019).

2. Improved irrigation and water management: Using efficient irrigation techniques, such as drip irrigation or sprinkler systems, and adopting water-saving practices, such as rainwater harvesting and mulching, can reduce water use and increase water-use efficiency in agriculture (FAO, 2020).

Source: https://www.fao.org/3/y4525e/y4525e09.htm

3. Agroecological approaches: Adopting agroecological approaches that promote biodiversity, crop diversification, and ecological intensification can enhance ecosystem services, such as natural pest control and pollination, and reduce the reliance on synthetic inputs (Altieri et al., 2015).

4. Improved livestock management: Implementing improved livestock management practices, such as better feeding and breeding practices, optimizing grazing systems, and improving manure management, can reduce methane emissions from livestock and improve overall livestock productivity (Thornton et al., 2014).

Adaptation Strategies of Farmers

1. Climate-smart crop selection: Farmers can adapt to changing climatic conditions by selecting crop varieties that are more resilient to drought, heat, or flooding, and by diversifying their crop portfolio to spread risks (Lobell et al., 2011).

2. Early warning systems and weather forecasting: Accessing timely and accurate weather forecasts and early warning systems can help farmers make informed decisions about planting, harvesting, and other farming activities, and reduce losses due to extreme weather events (FAO, 2017).

3. Soil and water conservation practices: Implementing soil and water conservation practices, such as terracing, contour plowing, and cover cropping, can reduce soil erosion, improve soil fertility, and enhance water availability for crops (Rockström et al., 2017).

4. Livestock adaptation measures: Providing shade, improving ventilation, and providing access to clean water for livestock can help them cope with heat stress and other climate-related challenges (FAO, 2020).

5. Diversification of income sources: Diversifying income sources, such as through non-farm activities or value-added processing of agricultural products, can provide alternative income streams and reduce risks associated with climate change impacts on agriculture (FAO, 2019).

6. Access to credit and insurance: Access to credit and insurance can provide financial support to farmers during times of crop losses or production risks associated with climate change impacts, enabling them to recover and adapt (World Bank, 2018).

7. Capacity building and extension services: Strengthening farmers' capacity through extension services, training, and education can improve their knowledge and skills in climate-smart agriculture and help them adopt and implement appropriate adaptation measures (FAO, 2020).

References

1. Hegerl, G.C., Brönnimann, S., Cowan, T., Friedman, A.R., Hawkins, E., Iles, C., Müller, W., Schurer, A. and Undorf, S., 2019. Causes of climate change over the historical record. *Environmental Research Letters*, *14*(12), p.123006.
2. IPCC (Intergovernmental Panel on Climate Change). (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.
3. FAO (Food and Agriculture Organization of the United Nations). (2020). The Impact of Disasters and Crises on Agriculture and Food Security 2020. Rome: FAO.
4. Wheeler, T., von Braun, J. (2013). Climate change impacts on global food security. Science, 341(6145), 508-513.
5. Gregory, P.J., Johnson, S.N., Newton, A.C., et al. (2009). Climate change and pests. Global Change Biology, 15(7), 1737-1751.
6. World Bank. (2020). Groundswell: Preparing for Internal Climate Migration. Washington, DC: World Bank Group.

Use of Hyperspectral Imagery for Crop Stress Detection

Article ID: 40861

Mastu Patel[1], Umesh Kumar Singh[1]
[1]Ph.D. Scholar, Department of Agronomy, School of Agriculture, Lovely Professional University, Phagwara Punjab 144411.

Abstract

Remote sensing information is used in a variety of agricultural applications to describe how crops and crop systems are distributed and are doing at different stages of the phenological cycle of the plants. One of the primary applications of hyperspectral data in agriculture is the identification of crop stress. The most effective narrow bands and brought bands hyperspectral indices must be identified in order to differentiate between different stressor levels. Imaging applications are investigated in relation to both field and glasshouse-based plants, with a focus on classification precision, early stress detection, and disease severity.

Keyword: Hyperspectral image, stress, plant disease and stress, identification, early detection of stress.

Introduction

Plant stress caused by biotic or abiotic factors that adversely influence plant growth significantly reduces productivity. When a plant is stressed, many different signs of stress are visible in the plant canopy. For instance, water stress causes the stomata to close and inhibit photosynthesis, which changes the temperature and hue of the leaves, [1]. Additional stress indications include morphological changes like curling or wilting in leaves. Early detection of plant stress is crucial in order to prevent terminal stress in plants and to reduce both acute and chronic productivity loss. The length of time between the damage's onset and identification has an impact on how serious.

It is the efficacy of any corrective measures at the orchard level depends on the quick discovery and identification of the source of stress. Human eyesight is distinct and complete due to individual differences in light perception, yet it is inconsistent when interpreting the colour and pattern of plant stress cues. Currently, a wide range of agricultural stand-scale applications (mapping, yield forecast, subsidies, etc.) use remote sensing data. In order to support applications in **precision crop management (PCM)**, new ultra-high spatial and spectral resolution sensors may even discern changes at the scale of the individual stand,[2]. The majority of the time, the spectrum data from such sensors is utilised using single linear regression (SLR) approaches and spectral ratios (vegetation indices) to estimate the intended target variable. In, overviews of frequently utilised spectral ratios are provided.

Only a small portion of the potential of hyperspectral remote sensing data is utilised by those analytic methods. Also, although they frequently neglect the causal relationship between spectral reflectance and crop condition factors, they are based on statistically significant associations.

Hyperspectral Imaging Technology

Hyperspectral imaging spectrometers use a variety of hardware strategies, therefore there are numerous ways to take the image. Push brooms, filter wheels, and liquid crystal tuneable filters are a few examples of operational devices. One application of push broom involves passing the incoming light through a convex grating (or a prism) that divides it into certain wavelength. A light-sensitive chip then records this separation (similar to a standard digital camera). Three parts make up a push broom device: a camera, a spectrometer, and a lens. This technology concurrently records the entire colour spectrum as well as a single spatial line in the image. The broom is "pushed" ahead, hence the name, and the next line is caught, effectively turning the camera into a line scanner. The final image is built up when the full scan is finished. Push-broom alternatives include the snapshot method, in which the complete image is taken in one shot. Push broom technology has so far been the most widely used, but recent developments in snapshot technology are expanding usage and opening up new opportunities for phenotyping and analysis.

Tools of Hyperspectral for Crop Stress Detection

1. Spectral plant: A free, open-source software programme called Spectral plant analyses hyperspectral data to determine the health of plants. It has tools for computing vegetation indicators, like the Normalized Difference Vegetation Index (NDVI), and for spotting signs of agricultural stress.

2. Crop sight: Crop sight is a web-based platform for hyperspectral crop monitoring and analysis. On the basis of vegetation indicators and other data, it comprises tools for locating and mapping agricultural stress as well as for estimating crop yields.

3. Spectral phone cam: A software programme called Spectral phonecam is used to examine hyperspectral images obtained by Phone cams, cameras made specifically for observing plant development and health. It has capabilities for assessing vegetation indices, other spectral properties, and for identifying signs of stress in crops.

4. Spectral geo: Crop stress detection tools are part of the software package Spectral geo, which is used for hyperspectral data analysis. It contains instruments for classifying, spectrum unmixing, and atmospheric correction, as well as instruments for detecting stress signs in plants.

5. Germinate: Tools for hyperspectral data processing are part of the crop data management and analysis software suite known as Germinate. It includes tools for analysing vegetation indices as well as tools for spotting spectral patterns that indicate stress symptoms in crops.

Early Detection of Stress Symptoms

Such detection systems' ultimate objective is to locate the disease with the least amount of physical alteration to the plant. The advantages of early disease or abiotic issue detection are evident. We might reasonably expect to recognise stress symptoms before a human observer by utilising hyperspectral technology in conjunction with suitable analysis techniques.

Drought can be a major issue for many crops, especially since some plant species or varieties may not immediately show signs of this stress. By the time this happens, the crop's potential yield or quality may have decreased due to the stress response's impact on normal plant developmental processes. The definition of 'drought' can also vary from a little water deprivation to complete deprivation.

Research included in this section have tracked the start of drought days before Vegetation Indices did, as well as before any outward symptoms could be seen. Simplex volume maximisation (SVM), a data clustering methodology, is one method in particular that has gained popularity for the early diagnosis of drought stress,[3].

Software for Capturing Hyperspectral Data

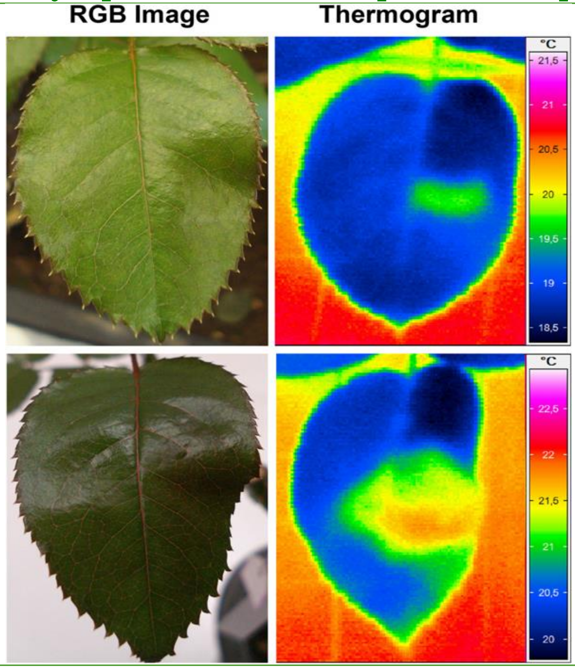
Large amounts of hyperspectral data are generated, particularly when several plants are photographed over a period of days. A single plant scan may easily take up one GB or more. The process will take much longer if the entire spectrum is analysed than if only a few wavelengths are chosen. The data does contain a lot of information, some of which may be important. The amount of spectral resolution to use and how much to reject must be decided by the researcher.

If your camera records data in 800 spectral bands, you must determine if you actually need all 800 bands or whether binning the data into 400, 200, or other bands will enough. This is comparable to compressing RGB photos with a JPEG-like format. compression reduces file sizes at the cost of permanently erasing image information (particularly colour information).

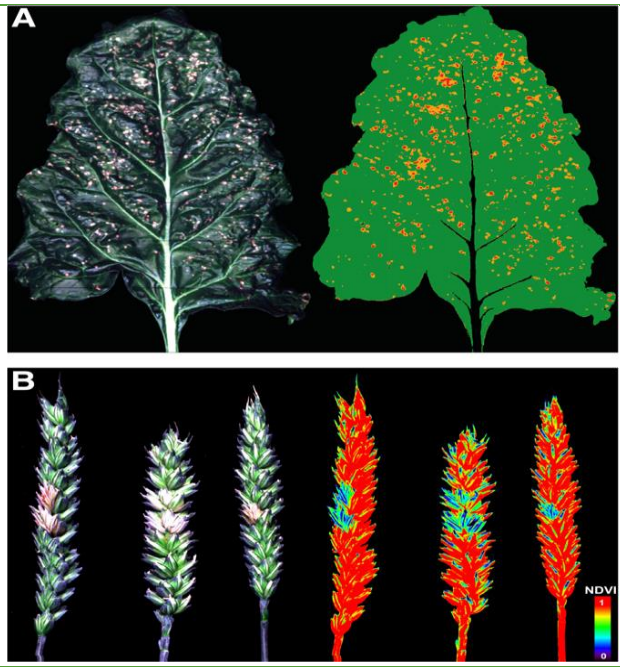
Fewer spectral bands are stored, resulting in smaller files and a simpler data analysis process at the expense of potentially significant colour characteristics. The calibration and characterization of spectrographs acquired using three different system setups are explored by Polder et al. in their study,[4]. The experiments examine the various noise kinds and the signal-to-noise ratio. By estimating the resolution, the spectral range, and the number of pixels, the studies also shown that, to some extent, binning can take place without information loss.

E-ISSN: 2581 - 8317

Some Symptoms Show in Specific Crop



Monitoring of rose leaf colonization by *pernospora sparsa* symptom's



Disease detection of fungal plant disease based on hyperspectral image

Disease Identification

In addition to identifying sickness, another study area is the capacity to differentiate between numerous diseases in order to identify specific infections. One such technique is the classification of spectral information divergence. Using this method, it is possible to examine the divergence between the observed spectra and a reference spectrum, a library of spectra, or the average spectra of interest derived from the data. The more similar the spectra are, the smaller the divergence value must be, and if it exceeds a certain threshold, the spectra are not considered reference spectra. Utilizing spectral information divergence, canker legions on citrus fruit (grapefruits) were found utilising data with a 450–930 nm spectrum, 92 bands, and 5.2 nm spectral resolution. Before analysis, the data undergoes pre-processing that drastically decreases its size by a factor of two. When cankerous grapefruits were compared to normal grapefruit and grapefruit that showed various illness or damage indications, such as oily patch, insect damage, melanosed, scab, and wind scar, the classification accuracy of this approach was 95.2% ,[5].

Table no.1: Some techniques use for detect drought and disease in plant:

Technique	Plant stress	Accuracies	Reference
Quadratic discriminant analysis (QDA)	Wheat (yellow rust) Avocado (laurel wilt)	92% 94%	[11] [12]
Partial least square regression (PLSR)	Wheat (yellow rust) Wheat (aphid)	92% 60%	[13] [14]
Erosion and dilation	Cucumber (downey mildew)	90%	[15]
Spectral angle mapper (SAM)	Sugarbeet (cerospora leaf spot) Sugarbeet (powdery mildew)	89.01–98.90% 90.18–97.23%	[16] [17]
LSSVM	Wheat(drought)	86.6%(H)/76.3%(S)	[18]
Simplex volume maximisation SiVM with DAR	Barley (drought)	4 days before Vegetation Indices	[19]

References

1. Nilsson, H. 1995. Remote sensing and image analysis in plant pathology. Annual Review of Phytopathology 15:489-527.
2. Fong AY, Wachman E. Hyperspectral imaging for the life sciences. Bio-photonics Int. 2008; 15:38.
3. Thurau C, Kersting K, Bauckhage C. Yes, we can: simplex volume maximization for descriptive web-scale matrix factorization. In: Proceedings of 19th ACM international conference *on* information *and* knowledge management [Internet]. New York, NY: ACM; 2010 [cited 2015 Nov 3]. p. 1785–8.
4. Polder G, van der Heijden GW, Keizer LP, Young IT. Calibration and characterisation of imaging spectrographs. J Infrared Spectrosc. 2003;11: 193–210.
5. Qin J, Burks TF, Ritenour MA, Bonn WG. Detection of citrus canker using hyperspectral reflectance imaging with spectral information divergence. J Food Eng. 2009;93: 183–191.

E-ISSN: 2581 - 8317

Nanoparticles in Waste Management

Article ID: 40862

Sushmita Bhatt[1], Swarnima Paliwal[2]
[1]Ph.D. Research Scholar, Department of Environmental Science, College of Basic Science and Humanities, G. B. Pant University of Agriculture & Technology, Pantnagar.
[2]Ph.D. Research Scholar, College of Agribusiness Management, G. B. Pant University of Agriculture & Technology, Pantnagar.

Introduction

Wastewater treatment, also known as sewage treatment, is the process by which wastewater is purified so that it does not contaminate groundwater or surface water sources such rivers, lakes, estuaries, and seas. Water is considered contaminated when it is inappropriate for human consumption or other uses (such as bathing, swimming, or fishing). Although natural factors may have an impact on water quality, the term "pollution" often refers to contamination caused by human activities. Chrome, cadmium, lead, mercury, nickel, copper, zinc, and arsenic are just a few examples of potentially fatal heavy metals. In high enough levels, sulphates, nitrates, fluorides, phosphates, selenides, chlorides, oxalates, and chromates are all harmful. Apart from inorganic pollutants like metals and chemicals, organic pollutants including hydrocarbons, pesticides, phenols, biphenyls, fertilisers, detergents, plasticizers, greases, and oils also contribute to water pollution. Nanoparticles will improve the efficiency of the process while decreasing the cost of waste management and the amount of energy needed to run it. As the technology required for nanoparticle-based water treatment is costly, the associated costs must be carefully handled in light of the competitive landscape (Crane and Scott 2012). Over 11.2 billion tonnes of solid garbage are produced annually, and more than 90% of this rubbish is publicly dumped or burnt in low-income countries (UNEP, 2020), making it a major cause of environmental degradation and poor health repercussions. In the remediation of water pollution, several nanoparticles, including iron, zinc, aluminium, and nickel, have attracted a great deal of study attention. Mechanisms for the use of nanoparticles in the treatment of wastewater are based on adsorption and photocatalysis, respectively. (R. Prasad., et al 2019).

Types of Sewage

Surface and underground water supplies have been severely depleted due to pollution by inorganic and organic toxins, fertilisers, detergents, pesticides, prescription medications, and heavy metals. This therefore resulted in a decrease in the availability of safe drinking water. A. Qian et al. (2013). The water used in hospitals, factories, and private homes are the primary contributors to the widespread presence of these noxious chemicals.

Wastewater, or sewage, may be divided into three categories. In addition to harming shellfish populations, domestic sewage, industrial sewage, storm sewage, and other wastewater pollutants (such as bacteria, viruses, and disease-causing pathogens) are fouling beaches. Human faeces often contain faecal coliform bacteria, which may spread diseases like typhoid and viruses like hepatitis B.

Nanoparticle for Waste Water Treatment

As an effective adsorbent, nanoparticles have found widespread usage in treating polluted water from factories. Both organic and inorganic contaminants may be cleaned up by using nano-adsorbents (Kumari et al., 2019). Nanoparticles are often classified as either carbon-based, metal-based, or metal oxide-based. Metal nanoparticles, polymer nanoparticles, zeolites, carbon-based nanomaterials, self-assembled monolayer on mesoporous substrates (SAMMS), biopolymers, iron nanoparticles, nanoscale semiconductor photocatalysts, etc. have all been documented in the literature as being employed in water remediation. There are a number of nanotechnology-based wastewater treatment routes now in use.

Silver Nanoparticles: Nanoparticles come in a broad variety of forms, but one of the most significant and useful is the silver nanoparticle. The excellent antibacterial activity and cost-effectiveness of Ag NPs that have been attached to filter materials have led to their consideration as a potentially useful therapy for the disinfection of water. Nanosilver, in the form of colloidal silver, has been used for over 150 years, and it has been registered in the United States as a biocidal substance since 1954. (Kim, et al., 2010). The silver loss from the Ag NPs sheets was lower than the requirements for the amount of silver that may be found in drinking water that have been proposed by the Environmental Protection Agency (EPA) and the World Health Organization (WHO). In the realm of wastewater treatment techniques, silver nanoparticles (also known as AgNPs) and their hybrids have garnered a significant amount of interest. In the treatment of wastewater, hybrids of silver nanoparticles (AgNPs) with other materials, such as cellulose, activated carbons, chitosan, alginate, grapheme oxides, titanium dioxides, and silicon dioxide, amongst others, have been employed extensively (Keya Ganguly et al.,2021).

Iron Nanoparticles: Due to iron's inexpensive cost, natural abundance, ease of synthesis, and super paramagnetic characteristics, it is possible to use these materials for the treatment of industrial wastewater without negatively impacting the environment (Z. Cai., et al 2017). When used as a nano-adsorbent, they have a remarkable ability to filter out a wide variety of pollutants during the treatment of wastewater (S. Parveen. et al 2018).

ZnO Nanoparticles: ZnO NPs, because to their distinct properties, have recently emerged as another promising candidate in wastewater treatment. As ZnO NPs are biocompatible, they are safe for the environment and may be used in wastewater treatment. In addition to its important roles in the rubber, pharmaceutical, and food sectors, zinc oxide is also a frequent ingredient in sunscreens, coatings, and paints because of its ability to absorb ultraviolet radiation. Textiles, surface coatings, cosmetics, and cellulose fibres have all integrated ZnO as an antibacterial agent (Varaprasad k, et al., 2006). ZnO, however, has flourished in nanoscale settings. TiO2 Nanoparticles

TiO_2 Nanoparticles: To yet, TiO2 has shown to be the most impressive photo catalyst. The lack of selectivity and general applicability to the destruction of pollutants of any sort (including, but not limited to, CFCs, PAHs, dyes, phenols, pesticides, arsenic, cyanide, and heavy metals) is a major problem. TiO2 NPs' photocatalytic characteristics allow them to destroy many different kinds of microorganisms, including bacteria (both Gram-negative and Gram-positive), fungus, algae, protozoa, and viruses. Additionally, it has been discovered that TiO2 NPs modified with nonmetal elements such as N, F, S, and C can significantly narrow the band gap, improve adsorption in the visible region, and accelerate the degradation of dyes when exposed to visible light irradiation, particularly when exposed to natural solar light. (H Lu et al. 2016).

Bioactive Nanoparticles: Bioactive nanoparticles are developing as a novel method for wastewater treatment since they are chlorine-free biocides. Nontoxic, physiologically friendly, and readily changed with functional groups, mesoporous silica nanoparticles might potentially be employed in wastewater treatment procedures (Gunduz et al. 2015). The identification and diagnosis of microbes and other infections will be aided by current and future nanotechnology methods.

Research have shown that nanotechnology may be used to provide answers to a variety of issues relating to medical science, food, agriculture, textiles, and the environment, among other topics. In recent years, the use of nanotechnology for the treatment of wastewater has shown successful results. Several different pollutants may be removed from wastewaters by using a range of metallic and non-metallic nanoparticles.

References

1. Ganguly, K., Dutta, S.D., Patel, D.K. and Lim, K.T., 2021. Silver nanoparticles for wastewater treatment. In Aquananotechnology (pp. 385-401). Elsevier. https://doi.org/10.1016/B978-0-12-821141-0.00016-1
2. Hussein, M.A.M., Guler, E., Rayaman, E., Cam, M.E., Sahin, A., Grinholc, M., Mansuroglu, D.S., Sahin, Y.M., Gunduz, O., Muhammed, M. and El-Sherbiny, I.M., 2021. Dual-drug delivery of Ag-chitosan nanoparticles and phenytoin via core-shell PVA/PCL electrospun nanofibers. Carbohydrate Polymers, 270, p.118373. https://doi.org/10.1016/j.carbpol.2021.118373
3. Parveen, S., Bhatti, I.A., Ashar, A., Javed, T., Mohsin, M., Hussain, M.T., Khan, M.I., Naz, S. and Iqbal, M., 2020. Synthesis, characterization and photocatalytic performance of iron molybdate (Fe2 (MoO4) 3) for the degradation of endosulfan pesticide. Materials Research Express, 7(3), p.035016. https://orcid.org/0000-0001-7393-8065
4. Singh, E., Osmani, R.A.M. and Banerjee, R., 2020. Nanobioremediation: an emerging approach for a cleaner environment. In Microbial Bioremediation & Biodegradation (pp. 309-363). Springer, Singapore. doi:10.1016/j.jhazmat.2011.11.073
5. Baruah, A., Chaudhary, V., Malik, R. and Tomer, V.K., 2019. Nanotechnology based solutions for wastewater treatment. In Nanotechnology in Water and wastewater treatment (pp. 337-368). Elsevier. https://doi.org/10.1016/B978-0-12-813902-8.00017-4

6. Kumari, P., Alam, M. and Siddiqi, W.A., 2019. Usage of nanoparticles as adsorbents for waste water treatment: An emerging trend. Sustainable Materials and Technologies, 22, p.e00128. https://doi.org/10.1016/j.susmat.2019.e00128
7. Sadiku, E.R., Agboola, O., Ibrahim, I.D., Olubambi, P.A., Avabaram, B., Bandla, M., Kupolati, W.K., Tippabattini, J., Varaprasad, K., Agwuncha, S.C. and Mochane, J., 2018. Nanotechnology in Paints and Coatings. Advanced Coating Materials, p.177.https://doi.org/10.1016/j.ceramint.2019.10.202
8. Lu, H., Wang, J., Stoller, M., Wang, T., Bao, Y. and Hao, H., 2016. An overview of nanomaterials for water and wastewater treatment. Advances in Materials Science and Engineering, 2016. https://doi.org/10.1155/2016/4964828
9. Yu, S.J., Yin, Y.G. and Liu, J.F., 2013. Silver nanoparticles in the environment. Environmental Science: Processes & Impacts, 15(1), pp.78-92. DOI: 10.1039/C2EM30595J
10. Crane, R.A. and Scott, T.B., 2012. Nanoscale zero-valent iron: future prospects for an emerging water treatment technology. Journal of hazardous materials, 211, pp.112-125. https://doi.org/10.1016/j.jhazmat.2011.11.073
11. Yunus, I.S., Harwin, Kurniawan, A., Adityawarman, D. and Indarto, A., 2012. Nanotechnologies in water and air pollution treatment. Environmental Technology Reviews, 1(1), pp.136-148. https://doi.org/10.1080/21622515.2012.733966.

E-ISSN: 2581 - 8317

Synthesis of Nanoparticles

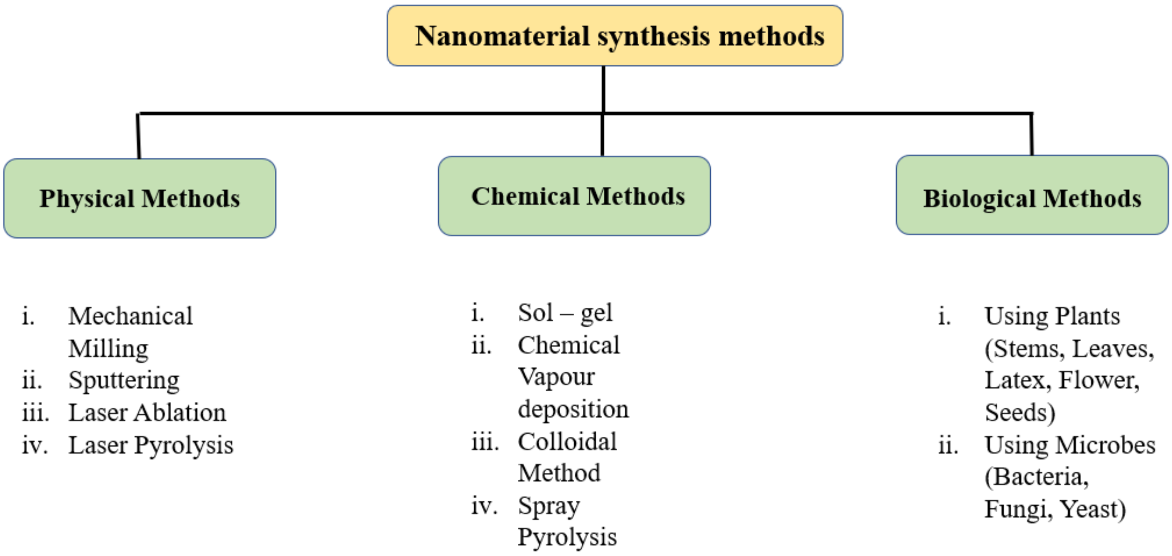
Article ID: 40863

Anuradha Beniwal[1], Sushila Singh[1], Jyoti Rani[1], Monika Moond[1], Pinki Matoria[1], Seema Sangwan[2], Vikas Dhanda[3]

[1]Department of Chemistry, CCS Haryana Agricultural University, Hisar, Haryana, India.
[2]Department of Microbiology, CCS Haryana Agricultural University, Hisar, Haryana, India.
[3]Department of LPT, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India.

Introduction

Nanotechnology is a new subject that has shown tremendous growth in a variety of applications. This method primarily makes use of 1-100 nm-sized particles. Unique characteristics of nanoparticles include various forms, sizes, and architectures. They feature crystalline or amorphous surface modifications, some of which are uniform or uneven. The creation of nanoparticles can be done in a number of ways, including environmentally friendly, physical, and chemical ones (Baig *et al.*, 2021).



Various Methods for the Synthesis of Nanoparticles

1. Top-down Approach: Synthesis is initialized with a bulk counterpart that leaches out systematically bit after bit leading to the generation of fine NPs (like a sculpture).

2. Bottom-up Approach: The bottom-up approach refers to the building of material from molecule by molecule, atom by atom, and cluster by cluster.

Physical Method

The physical method applies mechanical pressure, high-energy radiations, thermal energy or electrical energy to cause material abrasion, melting, evaporation or condensation to generate NPs.

1. Mechanical Milling: This method mainly operates on a top-down strategy. In mechanical milling, the moving balls transfer their kinetic energy to the milled material, this results in the breaking of their chemical bonds and rupturing of the milled materials into smaller particles with newly created surfaces.

2. Sputtering: In this method synthesis of NPs is done by a top-down approach. Sputtering works on the principle of momentum transfer in which the atoms from the target (which is made up of material to be deposited) are ejected by the ion bombardment. The deposition of material by sputtering can be achieved using DC, pulsed DC and radio frequency (RF) powers.

3. Laser ablation and Pulse laser deposition (PLD): In this method synthesis of NPs is done by a top-down approach. PLD is another vacuum-based PVD process that employs laser energy to remove the material from the target. The high-power laser pulses hit the surface of a target, leading to melting, evaporation and ionization of the material. Finally, the ablated materials deposit onto the substrate. PLD utilizes a pulsed laser beam, mainly coming from either an excimer laser or Nd: YAG laser, for the ablation of the material.

4. Laser Pyrolysis: In this method synthesis of NPs is done by a bottom-up approach. In this process, a mixture of reactant gases is decomposed using a powerful laser beam in presence of some inert gas like helium or argon. Atoms or molecules of decomposed reactant gases collide with inert gas atoms and interact with each other, grow and deposit on a cooled surface. Gas pressure plays an important role in deciding particle sizes and their distribution (Rajput, 2015).

Chemical Methods

1. Sol-Gel Method: In this method synthesis of NPs is done by a bottom-up approach. There are two types of components viz., 'sol' which is a colloidal suspension of solid particles in a liquid and 'gel' which are polymers containing liquid. Hydrolysis and condensation are the typical steps of the sol-gel process, in which the former uses water to disintegrate the bonds of the precursor which is also the first step in the formation of the gel phase. This process is then followed by condensation that leads to the formation of nanomaterials after which excess water is removed to determine the final structure of the material.

2. Chemical Vapour Method (CVD): In this method synthesis of NPs is done by a bottom-up approach. CVD is a process, which is often used for the deposition of solid films from the vapour phase via chemical reactions occurring at a very high-temperature conditions. In this technique, the precursors, gas or vapour, can react or decompose on the preselected substrate at high temperature and vacuum in a chamber.

3. Colloidal Method: The colloidal method is a traditional method of synthesizing inorganic nanocrystals, including semiconductors and metals. The chemical reaction is the sodium borohydride reduction of silver nitrate.

4. Spray Pyrolysis: In this method synthesis of NPs is done by a bottom-up approach. In spray pyrolysis, a solution of a precursor compound is sprayed as small droplets. This aerosol of droplets is heated and/or diluted, leading to solvent evaporation.

Zinc oxide (ZnO) NPs were synthesized by spray pyrolysis method using an aqueous solution of zinc acetate at various concentrations from 5 to 25 wt %. The decomposition precursor solutions were carried out at 800, 1000 and 1200 ^{C} under different pressure (Gudikandula & Maringanti, 2016).

Biological Methods

The biological synthesis of nanoparticles is a "Green method" (for reaction microbial enzymes or plant phytochemicals are used). These methods mainly operate on a bottom-up strategy.

1. Using Microbes (Bacteria, Yeast, Fungi): Microorganisms grab target ions from their environment and then turn the metal ions into the element metal through enzymes generated by cellular activities. This synthesis can be classified into intracellular and extracellular depending upon the location of NP synthesis.

> **a. Magnetotactic Bacteria:** Magnetotactic bacteria are a heterogeneous group of prokaryotes. They orient and migrate along geomagnetic field lines. Migration based on intracellular magnetic structure so-called magnetosomes. Magnetsomes: membrane-bound magnetic particles.
>
> **b. Fungi:** The use of fungi to synthesise silver NPs involves culturing on agar, followed by transfer to a liquid medium. The biomass produced is subsequently transferred to water to relieve the compounds that act in the synthesis. After filtration, the biomass is discarded and silver nitrate is added to the filtrate, reduction by fungal biomolecules and silver NPs are separated.
>
> **c. Yeast:** For the synthesis of nanoparticles using yeast biomass and yeast supernatant, the strains are grown in a YNBG liquid medium at 22°C under shaking at 160 rpm for 96 h. The yeast biomass is separated from the culture broth by centrifugation (5000 rpm, at 10°C for 10 min) and washed thrice with sterile distilled water.

2. Using Plant Extract: Due to the presence of phytochemicals, plant-assisted reduction is a key mechanism for plant-mediated AgNP synthesis. The phytochemicals such as amides, ketones, flavonoids, terpenoids, aldehydes, carboxylic acids, organic acids, flavonoids and quinones, are responsible for the immediate reduction of silver ions in the reaction mixture. It is well known that the type of plant extract, pH, temperature, concentration of metal salt and contact time will affect the formation rate, quality and other characteristics of nanoparticles (Narayanan & Sakthivel, 2010).

Conclusion

The biological method is superior to the physical and chemical methods because it is an eco-friendly method which reduces toxic chemicals concentration, is economically viable, easier to tailor size, shape and nature just by modifying culture pH, temperature and nutrient media. The common challenges related to commercializing nanotechnology, are high processing costs, problems in the scalability of R & D for prototype and industrial production and concerns about public perception of environment, health and safety issues. The Governments across the world should form common and strict norms and monitoring, before commercialization and bulk use of these nanomaterials.

References

1. Baig, N., Kammakakam, I., & Falath, W. (2021). Nanomaterials: A review of synthesis methods, properties, recent progress, and challenges. *Materials Advances*, *2*(6), 1821-1871.
2. Rajput, N. (2015). Methods of preparation of nanoparticles-a review. *International Journal of Advances in Engineering & Technology*, *7*(6), 1806.
3. Gudikandula, K., & Charya Maringanti, S. (2016). Synthesis of silver nanoparticles by chemical and biological methods and their antimicrobial properties. *Journal of experimental nanoscience*, *11*(9), 714-721.
4. Narayanan, K. B., & Sakthivel, N. (2010). Biological synthesis of metal nanoparticles by microbes. *Advances in colloid and interface science*, *156*(1-2), 1-13.

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

Production Technology of Apricot

Article ID: 40864

V. Sivakumar[1], K. A. Shanmugasundaram[1], G. Thiyagarajan[2], B. Suthakar[2], M. Manikandan[3], M. Nagarajan[2]

[1]Horticultural College & Research Institute, TNAU, Coimbatore, Tamil Nadu (641 003), India.
[2]Agricultural Engineering College & Research Institute, TNAU, Kumulur, Tamil Nadu (621 712), India.
[3]Agricultural Research Station, TNAU, Kovilpatti, Tamil Nadu (628 501), India.

Introduction

Apricot tree belongs to genus *Prunus* in the Rosaceae (rose) family. It is one among the highly nutritious fruits of the family. Apricot is categorized under 'stone fruits', along with peaches, plums, almonds, and some cherries, due to its seed being enclosed in a hard, 'stone' like endocarp. Throughout its history, apricot has been noted for delicious flavor, delicate velvety fruit surface, and early flowering and fruiting. The fruits are mainly consumed fresh but are also cooked and often stuffed. The high sugar content makes them suitable for drying. Apricot is found to be rich source of carbohydrates (both mono- and poly-saccharides), polyphenols, carotenoids, vitamins and volatile compounds viz. benzaldehyde, esters, norisoprenoidsand terpenoids (Turans*et. al.*, 2007). The fruit is major source of isoflavones and lignans (Kuhnle*et. al.*, 2007).

Origin and Distribution

This fruit is native to temperate Asia, first discovered growing wild on the mountain slopes of China, and long cultivated in Armenia later. Apricot is a deciduous plant of continental region with cold winters which can tolerate temperature as low as -30°C. It is mostly grown in the Mediterranean countries, Central Asia, Russia, USA, Iran, Iraq, Afghanistan, Pakistan, Syria and Turkey. United States produces almost 90% of the world's apricot crop. In India it is mainly cultivated in North West Hilly regions of Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and in North Eastern Hills comprising the state of Arunachal Pradesh, Nagaland, Meghalaya, Sikkim and Manipur.

Soil

Apricot trees grow best in deep, fertile, well-drained soil, but they grow well in light, sandy soil when adequately fertilized and watered. In clay and clay-loam soils it is more difficult to manage the soil moisture. Apricots do not tolerate high levels of salts or boron. They prefer soils with pH of 6.0 to 7.0.

Varieties

The popular varieties of Apricot are Kaisha, New Castle, Harcot, Turkey, Halman, KokcheyKarpo, Tokpopa, Rogan, Safaida, Shakar Para and Charmagz.

Propagation and Rootstock

The most important method of propagation of stone fruits is to bud or graft cultivars to rootstocks in the nursery and transplant trees to the orchard. Commercially important ones are T-budding and Chip budding.

Apricot seedling: Apricot seedling rootstocks are widely used internationally. It is hardy and productive, although apricots are somewhat slow to come into bearing.

Land Preparation and Planting

Generally, apricot trees require less space than peaches and most plums. Planting distances range from 6.6 to 7.2 m. Dormant nursery stock is usually planted in the spring. This can be done as late as March. Common spacing in conventional orchards is 20 x 20 feet. Standard sized apricot trees should be planted at least 25 feet from other trees. Dwarf varieties can be spaced between 8 and 12 feet apart.

Irrigation

Stone fruit are not tolerant to high salt levels or toxic elements such as boron and sodium in the irrigation water. All stone fruit orchards require a substantial amount of high-quality water for top production and fruit size. Supplemental irrigations may be required during long dry periods. Excessive water may have adverse effects on fruit quality, as it increases vegetative growth, promoting a nutritional imbalance and decreasing fruit dry mass.

Weed Control

Weed competition can significantly reduce the growth rate of young apricot trees and delay time to first cropping year. Prior to planting, weeds that can adversely affect apricot trees should be identified and targeted for control. Perennial weeds are problematic because many reproduce vegetatively and spread beneath the undisturbed soils.

Mulching and In-Situ Moisture Conservation

Organic mulches, such as straw, sawdust and composted animal waste, can be applied beneath fruit trees to suppress weeds. Composted poultry litter applied to a depth of 10 cm beneath the trees suppressed soil-germinating weeds but additional control was necessary for weeds germinating in the mulch.

Intercropping

Fruit tree intercropping system is suitable for orchards in which the fruit trees are still young, before the canopy closes. It can make fuller use of land, water, fertilizer and sunlight and covers the fields so preventing soil erosion and decreasing weeding. A good intercrop should have a short growth period, short stem, high economic value, ability to increase soil fertility, few pests and no pests in common with the main tree crop. To ensure adequate spacing for both fruit trees and crops, a suitable distance between fruit trees and intercropping belts must be established. Usually, the crops suitable as intercrop with apricot are *Allium cepa, Allium sativum, Brassicaapekinensis, Lactuca sativa, Raphanus sativus.*

Harvesting

Changes in the skin ground color from green to yellow are used to determine maturity. The yellowish-green color is cultivar dependent. Since apricots are susceptible to high bruising when fully ripe and soft, picking is recommended when the fruit is still firm. Important quality criteria include fruit size, shape, freedom from defects (including gel breakdown and pit burn), and decay.

Yield

Yield of apricot show vast variation depending upon soil conditions, cultivar, orchard management practices and altitude of orchard. Trees start bearing in the 3 year with an average production of 1.5 tons per acre. Fruit yield varies from 20-100 kg/tree/year. Yields range from 5 to 9 tons per acre.

Storage

Apricots can be kept well for 1-2 weeks (or even 3-4 weeks for some cultivars) at 0°C to 1°C with RII of 90-95% Susceptibility to freezing injury depends on soluble solid contents, which vary from 10% to 14%. Cultivars that are sensitive to chilling develop and express chilling injury symptoms (gel breakdown, flesh browning), and loss of flavor, more rapidly at 5°C than at 0°C. In order to minimize chilling injury on susceptible cultivars, storage at 0°C is recommended.

Conclusion

Apricot fruit, due to its high respiration rate and rapid ripening process, must be processed to maintain quality because they are seasonal, and their shelf life is limited. To extend the shelf life of this fruit, several conservation methods have been improved, such as drying, canning, packing in a controlled/modified atmosphere and processing to produce fruit juice, fruit puree, jam, marmalade.

References

1. Turans, S. Topcu, A., Karabulut, I.: Vural, H.; and Hayaloglu, A.A. 2007. Fatty acid triacylglycerol phytosterol and tocopherol variation in kernel oil of Malayta apricot from turkey. Journal of Agricultural and Food chemistry,55: 10787-10794.
2. Kuhnle, G; Dell'Aquila, C.; Low, Y.L.; Kussmaul, M. and Bingham, S.A. 2007, Extraction and quantification of phytoestrogens in foods using automated solid-phase extraction and LC/ MS/MS. Analytical Chemistry, 79: 9234-9239.
3. Bassi, C.; Besset, J. and Girard, T. 2003. Effects of fertilizer rates and dates of application on apricot (cv. Bergeron) cropping and pitburn. Sci Hort., 98: 139-47.

Black Soldier Fly: A Promising Feed for Poultry

Article ID: 40865

B C Anu[1], Rishabh Raj[2]
[1]Krishi Vigyan Kendra, Turki, Muzaffarpur, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar-848125.
[2]Govind Ballabh Pant University of Agriculture and Technology, Uttarakhand- 263153.

Introduction

Variety of goods and services can be obtained from insects for human benefit. Medicinal purposes, such as wound therapy, or engineering antibodies and vaccines, may be the reasons for rearing them. These plants have alternate uses like producing honey, fabric or coloring agents, and also can be utilized to manage populations of harmful insects. According to certain sources, insects tend to have a less efficient feed-to-protein conversion ratio compared to cattle or pigs, and even some poultry. However, they emit fewer greenhouse gases and ammonia emissions in comparison to conventional livestock. Among all the livestock groups, poultry is significantly the most extensive one. Nonetheless, the need for animal-based nutrients is predicted to rise soon due to the consistent rise of the global population, which might hit 9 billion come 2050 (Roberts, 2011). This demand will most likely focus on poultry items, which have a lesser detrimental effect on the environment than other animal protein types concerning water usage and carbon dioxide emissions.

Due to an increased population worldwide, there has been a rise in food consumption habits and shifts in lifestyle choices, leading to a greater desire for animal-based protein. The demand for livestock feeds will be impacted, which will create additional strain on limited resources. As a result, the demand for substitute protein sources for animals is growing more pressing.

The *Hermetia illucens*, commonly known as the **Black Soldier Fly**, belongs to the **Stratiomyidae family** of the **order Diptera**. Despite being originally from the Americas, this fly can now be found in various tropical and temperate regions globally (Cicková, 2015), but its inability to withstand cold temperatures prevents it from invading non-native places like Northern Europe. Adult flies only drink water, avoid contact with people, refrain from biting or stinging, and do not spread any particular illnesses. Black Soldier Fly Larvae (BSFL) have the ability to consume a wide array of organic matter and have previously been employed for limited-scale waste management initiatives through the utilization of materials such as food waste, rice straw, distillers' grains along with manure, faecal sludge, animal offal, kitchen waste, and so on.

Importance of Black Soldier Fly Larvae (BSFL)

When BSFL are at the pre-pupa stage, they will instinctively leave the substrate and move to a high, clean place, a behavior called “self-harvesting” that removes an otherwise labor-intensive step from their farming. According to a recent study by Chia et al. (2020), the adult BSF can survive without food for up to two weeks due to the development of fatty reserves during its larval stages. Additionally, if provided with water during the mating process, the adult BSF can even survive for a longer period of time. The black soldier fly does not spread diseases and can help reduce E. coli and Salmonella enterica in cow dung and poultry faeces through the use of chemicals that repel these harmful pathogens.

Nutritional value of Black Soldier Fly Larvae (BSFL)

S.No.	Parameter	Composition of BSFL	Reference
1.	Crude Protein	41-42%	(Fauzi 2018)
2.	Crude Fats	4.6-38.6%	
3.	Ether Extract	31-35%	
4.	Ash	14-15%	
5.	Calcium	4.8-5.1%	
6.	Phosphorus (in dry form)	0.6-0.63%	

7.	Amino acids (Methionine, Lysine, Valine, arginine)	2-3mg/100 g DM*	

(DM*- Dry Matter)

Mass Production of Black Soldier Fly

For reproductive purposes, the *Hermetia* pupal stage is used. Adults give priority to mating and oviposition after emergence from pupae. Mating and egg-laying occur all year round. 69% of mating occurs 2 days after eclosion and 70% of egg laying occurs 2 days after mating. Mating is related to time of day and light, and oviposition is correlated to time of day, temperature and humidity. Adults begin mating on the wings. Females typically lay about 500 eggs and prefer to lay them in dry crevices near the selected larval medium in a temperature range of 27.5-37.5°C and humidity >65%.

BSF eggs take 102-105 hours (4.3 days) to hatch at 24°C. After preparation of the rearing substrate, the larvae colonize the substrate. The nutritional composition of the organic waste used for larval rearing determines the number of larvae introduced. The final stage of larval development is the prepupa, the migratory stage. At this point, the BSF prepupae are ready to store large amounts of fat to provide energy for adult migration and pupation. This stage, when fat reserves are greatest, is the desired harvest stage for feedstuff. Black soldier fly's larva develops through five instars. Upon reaching the final instar (prepupal stage), the larvae seek out a dry pupation site and leave the rearing substrate to complete pupation into adults. This dispersal stage facilitates the separation of the larvae from the manure. At this scattering stage, prepupae can be easily harvested by simply directing the search for pupation sites to the collection bin. A portion of the colony must be left to generate a new stock of pupae to sustain the production chain.

Effects on Poultry Performance

1. Hens fed partially defatted BSF larval diets (12% and 24%) do not develop metabolic or health disorders. In addition, the lack of mortality and morbidity in laying hens fed BSF-supplemented diets indicates that BSF larvae do not adversely affect the health status of laying hens.
2. Egg quality parameters affected by the addition of BSF meal, including yolk color change, increased yolk percentage, decreased egg protein percentage, and decreased eggshell thickness.
3. Elevated globulin levels and decreased albumin-to-globulin ratios indicate higher resistance and improved immune responses in layer hens fed partially-defatted or defatted BSF diets
4. Addition of BSF larvae to diets improves the performance, product quality, health and welfare of laying hens depending on the level of addition.

Conclusion

Sustainable mass rearing of BSFL for feed requires efficient and reliable process performance. The poultry sector is one of the most important suppliers of animal protein for humans. To meet future demand, the industry is moving towards more sustainable production. A major issue facing the industry is the need for sustainable feed protein sources and higher animal welfare while maintaining economic viability. Both goals are the use of insects in poultry diets. It may be possible to achieve this by using insects in poultry diets.

References

1. Roberts, L. (2011). 9 billion? *Science*, 333; 540–543.
2. Chia, S.Y., Tanga, C.M., Osuga, I.M., Cheseto, X., Ekesi, S., Dicke, M., and van Loon, J.J. (2020). Nutritional composition of black soldier fly larvae feeding on agro-industrial by-products. *Entomologia Experimentalis et Applicata*, 168; 472-481. DOI: http://www.doi.org/10.1111/eea.12940
3. Cicková, H., Newton, G.L., Lacy, R.C., Kozánek, M. (2015). The use of fly larvae for organic waste treatment. *Waste Management*, 35; 68–80.
4. Fauzi, R.U.A., and Sari, E.R.N. (2018). Analisis usaha budidaya maggot sebagai alternatif pakan lele. *Industria: Jurnal Teknologi dan Manajemen Agroindustri,* 7; 39–46.

Physiological Disorders in Tomato

Article ID: 40866

J. Sheela[1], Thilak Baskher L B.[2], V. Sudhan[2], V. Sudharsan[2]
[1]Professor, Department of Plant Pathology, Agricultural College and Research Institute, Killikulam.
[2]UG Scholars, Agricultural College and Research Institute, Killikulam.

Introduction

Physiological disorders are non-infectious disorders that affect the growth and development of plants. These disorders are caused by environmental factors, nutrient imbalances or genetic abnormalities (abiotic factors). It can be reversible or irreversible depending on its severity and duration. In most cases, they cannot be reversed after they have occurred. Tomato crop has been observed to exhibit a wide range of physiological disorders. This chapter deals with various physiological disorders of tomato and the remedial measures.

Blossom End Rot

Blossom-end rot is a common physiological disorder that affects tomatoes and is characterized by the appearance of a brown water-soaked spot formed at the blossom end while the fruit is still green. Blossom-end rot is caused by calcium deficiency in the developing fruit, which results in the death of cells and the breakdown of the tissue. Several environmental factors can contribute to blossom-end rot, including fluctuations in soil moisture levels, high salt levels in the soil and high temperatures. Inadequate water uptake by the plant can also result in calcium deficiency, as the nutrient is not able to reach the fruit in sufficient amounts. Balanced irrigation, staking and foliar spray of 0.5% calcium chloride ($CaCl_2$) at the time of fruit development can be recommended.

Fruit Cracking

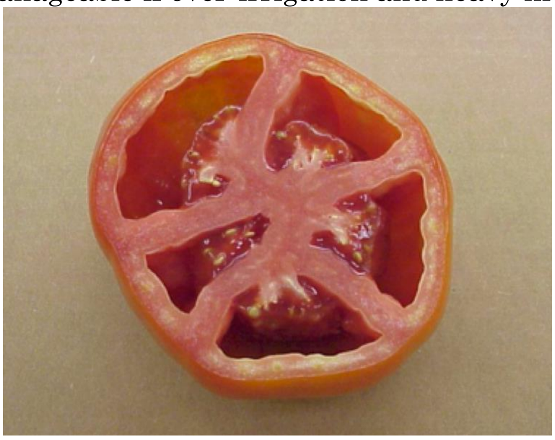
Radial and concentric cracks are formed on the tomato fruit due to boron deficiency, fluctuations in soil temperature and irrigation or rainfall. Radial cracking is more common than concentric cracking. It can be managed by spraying 0.3 - 0.4 per cent borax solution on seedlings before transplanting.

Blotchy Ripening

Irregular ripening and green blotches over the red skin due to severe water stress, poor potassium uptake, and distribution in plants. To control this, regulated water supply during fruit development and foliar sprays of 0.5 per cent potassium chloride is practised.

Puffiness

A fruit that is only partially filled, light in weight, and lacks a solid texture. A cross-section of diseased fruit reveals voids or pockets. Low or high temperatures, as well as insufficient pollination, can cause tomatoes to be puffed up. It is manageable if over-irrigation and heavy nitrogen applications is avoided.



Sun Scald

Scorching sunshine leads to desiccation in the blistered portion turns the sunken areas white or grey in green fruits and yellow in pink or red fruits. Sun scald can be managed by protecting plants from defoliation due to pest and diseases. If any defoliation occur shade should be provided.

Catface

Catface is a physiological disorder that affects the appearance and shape of tomato fruit. High or low temperature at fruit set or flowering cause distortion of the blossom end, resulting in various ridges, furrows and indentations in a localised area of the fruit resembling a 'catface'. Maintaining adequate moisture level and mulching will helps to reduce catface.

Golden Fleck

Tiny yellow spots appear on the fruit surface around the fruit shoulder due to the high supply of calcium and phosphatic fertilizers. Adequate amounts of calcium and phosphatic fertilizers helps to overcome the problem.

Unfruitfulness

Night temperature, has a significant impact on fruit set in tomatoes. Both high (> 32°C) and low temperatures (at or below 13°C) have a negative impact on fruit set by decreasing pollen viability and pollen germination on the stigma. This problem can be solved by applying parachlorophenoxy acetic acid (PCPA) 50 ppm at full bloom stage or 2,4 D, 1-2 ppm prior to anthesis.

Conclusion

Preventing and managing physiological disorders in tomatoes requires proper cultural practices, including optimal sowing timing, adequate water and nutrient management, avoiding extreme temperatures and maintaining appropriate growing conditions. Proper identification and management of physiological disorders in tomatoes can help to ensure healthy plant growth, higher yield and improved fruit quality.

Future Perspective for Non-Conventional Sources of Energy in India

Article ID: 40867

Dr. E. Shirin Hima Bindu[1]

[1]Assistant Professor, Department of RMCS, College of Community Science, PJTSAU, Saifabad, Hyderabad-04, Telangana.

Sun is the source of all energy on the planet earth. It is a large nuclear reactor where hydrogen gas is continuously burning at high temperature and pressure. Solar energy originates from the thermonuclear fusion reactions occurring in sun. The energy generated by sun into the space is received on the earth as electromagnetic radiant energy. Out of the solar radiations reaching the earth, 92% consist of radiations in the range 315 nm to 1400 nm, 45% of this radiation is in the visible region, 400 nm to 700 nm. The earth absorbs radiation mainly in the visible region and emits radiation in the infra-red region.

Production of Electricity Using Solar Energy

Solar energy can be used either by absorbing radiations to produce heat or by converting it directly into electricity by the following methods:

1. Photovoltaic Cells (Solar Cells): Solar panels or a large number of solar cells are connected in series parallel combination to obtain the required amount of power. These cells when exposed to solar radiation give direct current (DC) which can be converted into alternating current (AC) using inverters. The silicon solar cell, developed for the space programme consists of a sandwich of n-type and p-type silicon semiconductors, the charge separation is developed across the junction between them and electricity is produced.

2. Solar Trough Collectors (Invented by Charles Abbott): Sunlight hitting the solar trough collector is reflected onto a pipe and heat the fluid circulating through it. The heated fluid is used to boil water, thereby generating steam to run turbo generator.

3. Power Tower: In this method, an array of sun tracking mirrors is used to focus sunlight on a large area of land onto a boiler mounted on a tower. The intense heat produces steam in the boiler which drives a turbo generator to generate electricity.

4. Solar Furnace: Here thousands of small plane mirrors are arranged in concave reflectors which collect the solar heat and produces high temperature up to ‘3000°C.

Applications of Solar Energy

The best application of solar energy is in heating buildings and providing hot water which in developed countries like USA, consumes about 25% of the fuel supply. The figure below illustrates the detailed heating system in a solar heated house. Sunlight is collected on plates on the roof and heat transferred to a circulating water system.

1. The use of solar energy is a completely benign operation. Solar energy can be used as solar heat by several gadgets such as solar cooker, solar dryer, solar water heater, solar distillation, space conditioning, green house technology, solar air crafts.

2. Solar energy can also be used as solar electricity by PVC or solar cells. Solar photovoltaic cells could be installed in remote areas in forests and deserts where installation of electric cables is cost-prohibitive.

3. Solar energy being non-polluting and non-depletable is considered as renewable energy and fits into the principle of sustainability.

4. Solar cells are widely used in electronic watches, calculators, traffic signals and artificial satellites. Because of their nonpolluting nature, solar cells are known as clean and green cells.

Limitations of Solar Energy

1. The major constraint is that sunlight is diffuse and intermittent.
2. Density of solar energy is low as compared to oil, gas or coal etc.
3. CO_2 produced while forming silicon from silica increases atmospheric temperature. Silicon dust is also an occupational hazard.
4. Cadmium is used in fabricating thin film solar cells which is carcinogenic. However, only traces of Cd are released from discarded PV panels.

Wind Energy

Principle: In India, wind power can be usefully exploited for the generation of electricity as there are large coastal, hill and desert areas. The concept of air plane type propeller blades turning a generator geared to shaft is applied. Wind turbines, comprising of two blades, convert kinetic energy of the wind into electrical energy.

Operation: The flow of air against the windward side of the blades creates suction on the reverse side, which turns the rotor shaft on which the blades are mounted. This rotor turns the generator which is linked directly to the electricity grid. When the wind speed is greater than 25 m/s, a disc brake stops the turbine from operation.

The operation of the wind turbine is monitored and controlled by a computer in the bottom of the tower. The computer receives information regarding wind speed and wind direction via an anemometer and a wind wave mounted on the top of turbine housing. Currently, wind turbines have horizontal axis with high hub height (328 ft) and large rotors (180 ft).

Advantages of Wind Energy:

a. Wind energy is a renewable and economically competitive energy source.
b. Wind machines can be built on shore or off shore.
c. Cost effective and reliable wind power generators are now being produced.
d. Wind machines are useful in supplying electric power to remote and rural areas.
e. Dispersed wind energy systems are more environmentally benign than any other alternate source of energy.

Limitations of Wind Energy:

a. Low energy density.
b. Wind is variable, irregular and intermittent.
c. Design, manufacture and installation of wind turbines is complex due to varying atmospheric conditions where they have to operate.
d. Small units are more reliable but have higher capital cost per KWh. Large units require high technology.
e. Requires energy storage batteries which indirectly contribute to environmental pollution.
f. Requires vast open area which is generally far away from load centres.
g. Wind generators may interfere with habitats, causing noise pollution and aesthetic degradation.

Geothermal Energy

Geothermal energy is the exploitation of heat energy from the molten core of the earth. In volcanic regions, holes can be drilled into the hot-rocks and make the rising steam from ground water to drive turbo generators to produce electric power. The high temperature (>150°C) geothermal resources are exclusively used for power generation.

Advantages of Geothermal Energy:

a. Geothermal resources in the moderate temperature range (90°C to 150°C) can be used for space heating, for generating industrial process steam, green houses and aquaculture.
b. Coupled with heat pumps, the low temperature (< 90°C) geothermal resources are used for heating and cooling the houses.

Limitations of Geothermal Energy:

a. Natural steam vents occur only in few regions whereas hot dry rocks are available in almost all places.

b. Hot steam coming to the surface is usually contaminated with the salts and sulphur compounds. Some of these contaminants are highly corrosive to turbines.
c. SO_2 pollution from a geothermal plant may be as much as that of a high sulphur coal based thermal power plant.
d. Hot brine released into surface waters may be ecologically hazardous.

Tidal Power

A lot of energy is inherent in the rise and fall of the tides and ocean waves. One of the simple schemes to utilize tidal energy is to construct a dam across the mouth of a bay and mount turbines in the structure. The incoming tide forming through the turbines generates power. As the tide shifts, the blades may be reversed so that outflow of water continues to generate power.

Tidal power plants are accompanied by the adverse environmental effects because of the dams which may trap sediments, impede the migration of marine organisms, change water circulation and cause mixing of fresh water with salt water.

Control of Stored Grain Pests Using Sailor's Tobacco Isosecotanapartholide

Article ID: 40868

Nameirakpam Bunindro Singh[1], Wahengbam Elizabeth Devi[2]
[1]Ph.D Scholar, Department of Zoology, Rajiv Gandhi University, Itanagar, Arunachal Pradesh, India-78101.
[2]ICAR Research Complex for North Eastern Region, Imphal, Manipur, India-795004.

Summary
The Green revolution in India was a blessing, liberating the nation from frequent and severe famines of the past. Despite the huge increase in food yield, food security remains a major concern due to huge loss of grains to pests and pathogens during storage. To combat such huge loss in food grains, use of synthetic chemical insecticides like Methyl Bromide, Sulfuryl fluoride have started, which are hazardous to health as well as the ecosystem. Even modern-day storehouses such as Food cooperation of India storage units continue to depend exclusively on such harmful artificial chemicals to control pests. Therefore, we have investigated the use of environment-friendly plants source with pest resistant properties to combat the loss of stored grains.

Introduction
Stored grain pests not only eat up our stored food grains but also make the remaining uneaten food grains unfit for consumption. In a single year, ₹7,000 crores worth of food grains are lost during storage due to insects, pests, mites, rats, moisture content, relative humidity, temperature, etc. Among which ₹1,300 crores worth food grains are lost due to stored grain infestation by pests alone. [**Source: Indian Grain Storage Management and Research Institute (IGMRI)].** This wasted food grains could have fed 1/3rd of India's poor population.

To combat such huge loss in food grains, store-houses resort to the use of powerful synthetic chemical insecticides which are hazardous to health as well as the ecosystem. The chemical insecticide Methyl Bromide which had been used previously is now phased out as it was found to be a main contributor to ozone layer depletion, and also affects the central nervous system as well as reproductive system in humans. Sulfuryl fluoride which replaced Methyl bromide is now known to be a neurotoxin too, and a potent greenhouse gas. Some pests have even developed resistance against the use of another such pest control agents, e.g., phosphine tablets. For lack of a better solution, however, modern day storehouses such as Food cooperation of India storage units continue to depend exclusively on such harmful artificial chemicals to control pests. Given the adverse side-effects of synthetic chemical pesticides, there is an urgent need for an alternate way to protect our stored grains effectively, without affecting our health. We need to find a solution that is also environment-friendly, equally effective as chemical insecticides currently in use, readily available, chemical residue free, biodegradable, with no ill effects in seed germination.

Traditionally, in the Northeast India, subsistence-farming households have been using leaves and fruits of certain plants with pest resistant properties to preserve and protect the stored grains in their domestic granaries from pests. One such plant is ***Artemisia vulgaris*** called as Sailor's tobacco, the dried leaves of which are often used in and around the granary storage to control the insect pests as well as rodents. But traditional knowledge alone is not enough. One must find out what is the substance that makes this plant so effective, and once that substance is identified, one needs to also figure out whether it is possible to produce this substance on a large scale that is enough for commercial storehouses. Therefore, we have started to focus research on understanding this plant and its pest-control potential.

Working Process
Artemisia vulgaris grows wildly in the hills and plains regions of the Northeast region of India. Samples were collected from the Phayeng village of Manipur. The collected samples were shade dried to fine powder. Using various techniques in the laboratory at the Institute of Bioresources and Sustainable Development,

Imphal, extracted the chemical substances using various purification techniques. Further, purified chemical compounds were tested. We confirmed from the study that the purified compounds have pest-control activity on stored-grain-pests.

Conclusion

Using the Bio-assay-guided fractionation of the crude extracts of *Artemisia vulgaris* followed by the toxicity assay, the biofumigant is identified as isosecotanapartholide. It is found to be effective against the most detrimental insect pests like rice weevil, rice moth, and red flour bettle. In the fight against insect pests, green pesticides are safer and increasing research is supported from government agencies and privately funded programs. Our finding will provide an effective natural solution to the problem of stored-grain-pests.

This enormously useful botanical substance, whose potency was so far only restricted to traditional storage practice, has never been scientifically investigated. It has the potential to be developed as an eco-friendly solution to control the most detrimental of stored-grain-pests, food loss and food-borne diseases.

Photo Courtesy 1: Nameirakpam Bunindro Singh (*Artemisia vulgaris* / Sailor's tobacco bushes and Traditional storage granary in Manipur.

References

1. Sinha, B. (2010). An appraisal of the traditional post-harvest pest management methods in Northeast Indian uplands. *Indian journal of traditional knowledge*. 9, 536-543.
2. Sharifian, I., Hashemi, S. M., and Darvishzadeh, A. (2013). Fumigant toxicity of essential oil of Mugwort (Artemisia vulgaris L.) against three major stored product beetles. *Archives of Phytopathology and Plant Protection*, 46(4), 445-450.

Pruning in Grapes for Quality Improvement

Article ID: 40869

Wahengbam Elizabeth Devi[1], Chingbiana G. Momin[2], Yumnam Somi Singh[3]
[1]ICAR Research Complex for North Eastern Region, Imphal, Manipur.
[2]Department of Horticulture, N.E.H.U., Tura Campus, Meghalaya.
[3]Department of Horticulture, N.E.H.U., Tura Campus, Meghalaya.

Introduction

Pruning is the proper and judicious removal of plant parts such as shoots, spurs, leaves, roots or nipping away of terminal parts etc. to correct or maintain tree structure and increase its usefulness. It is done to – make the plant more productive and bear quality fruits, – increase longevity of the tree, – make it into manageable shape and – to get maximum returns from the orchard.

When to Prune?

Dormant period: leaf fall - bud break – Fall-pruned vines are more susceptible to winter injury than unpruned vines – Delayed pruning allows for compensation in case of winter injury

Best time: Late winter – early spring – Prune hardy varieties before tender ones – Finish initial pruning and wood removal before bud swell to avoid bud breakage – Double pruning helps avoid damage from late frost.

Fig1. Pruned grapevine

Principle of Pruning Grapevine

When a vine has reached the stage of full bearing, pruning consists in the removal of all the growth except
1. Bearing units – spurs and fruit canes for the production of fruit and new wood or fruit only.
2. Renewal spurs, for renewal or the production of wood for the next year.
3. Replacement spurs, in the case of the older vines, for the replacing or shortening of arms.

Pruning Techniques in Grapes

Cane Pruning (Head):

a. The pruner selects two or four shoots (canes) from the previous season and cut back each to leave 15 buds per cane and trains them along the trellis wire.
b. The other canes are removed, and new shoots sprouts from the buds on selected canes in spring.
c. Cane pruning involves cutting back about 90 percent of the last year's growth.
d. To cane prune removes the dead two-year-old canes. then select two well-formed canes growing out of the head of the vine.
e. The canes select should be one-year-old wood, containing tightly spaced, healthy buds. They should be at least pencil width.
f. Tie those two canes to the trellis wire
g. Leave a replacement spur which you cut back to two or three buds. It will provide the next year's growth.

h. In some varieties the basal (lower) buds that normally produce fruit on spur-pruned varieties often are not fruitful, so cane pruning is the preferred method.
i. Cane-pruned varieties start bearing fruit further out on the cane, on buds numbered 4 to 12.
j. In winter, on head-trained vines, 4 to 6 canes that grew and fruited in the past season are selected for next seasons fruit.
k. Each fruiting cane should have about 10 to 14 regularly spaced buds, cutting off excess length if necessary. After selecting the fruiting canes, an additional strong cane arising near the base of each fruiting cane is selected to become a renewal spur. This second set of canes is cut down to spur size and used next winter for the fruiting canes. The more vigorous the vine the more spurs or canes you can leave.
l. Examples of cane pruned varieties are Thompson Seedless and Concord.

Spur pruning:

a. Spur pruning is done on vines that retain one or two pairs of long canes (permanent cordon) trained along the trellis system.
b. Each winter new canes grow along the cordon are cutback to a small shoot containing two buds known as spur.
c. In spring new growth develops from buds on the spur,
d. Some common spur-pruned varieties are Flame Seedless, Ribier , and Tokay.
e. To prevent "over-cropping" vigorous fruitful varieties are 'spur pruned'.
f. In winter, grapevine canes that grew and fruited in the past season are pruned out or selected to remain on the vine's main permanent arms.
g. The selected canes are pruned down to spur size and spaced along the cordon at 6 to 8–inch intervals.
h. The result is a series of spurs (each with 2-4 buds) along two cordons. Each cordon would have 6 or 7 spur positions.
i. Buds on the spurs will grow new canes and produce fruit in the summer or early fall.

Conclusion

Cane pruning is one of the most common pruning techniques. Here all the canes grow vertically. It doesn't allow light and air circulation as much as spur pruning does. However, as long as you take appropriate care of the soil and ensure proper watering, you shouldn't have any low-quality clusters. Spur pruning requires you to choose two canes to grow horizontally in opposite directions. It is an excellent technique for beginners. Some advantages of this process are that air and light can circulate better through the grapevine. For this technique, you need to install a trellis so that your grapevine can rely on it.

E-ISSN: 2581 - 8317

Neutraceutical Potential of Edible Insects of North Eastern Region of India

Article ID: 40870

Wahengbam Elizabeth Devi[1], Arati Ningombam[2], Yumnam Somi Singh[3]
[1,2]ICAR Research Complex for North Eastern Hill Region, Imphal, Manipur, India-795001, [3]North-Eastern Hill University, Tura Campus, Chasingre, Meghalaya-794002.

Summary

A large number of unexplored and yet to be documented edible insects species are available in the North Eastern Region (NER), India. People consider this eating habit as a primitive behaviour. However, it is currently considered as a novel and promising food source because of its high nutraceutical value. Functional properties of insect-derived protein can be utilised as a novel food applications. Enzymatic modification of edible insect protein leads to production of various principal bioactive components which contribute to anti-inflammatory and anti-oxidant effects. However, studies on the above properties and toxicity of edible insects are minimal and still awaiting scientific study and discovery. Therefore, it is necessary to explore the edible insects from NER, India, using modern scientific tools and techniques for the welfare of humankind.

Introduction

Consumption of insects as food by humans (entomophagy) is an age-old, well-known practice in different parts of the world. Such practice is widespread among various ethnic groups of Northeast regions (NER) India. A large number of edible insects' species are available in this biological hotspot region. In most countries, people view entomophagy with disgust and associate eating insects with primitive behaviour. However, insects are rich in protein, amino acids, fats, carbohydrates, vitamins, and trace elements and possess nutraceutical and therapeutic properties (Chakravorty *et. al.,* 2011).

Insects is the most diverse group of organisms on earth (80–90% of the world's biodiversity), with nearly 1 million species described and millions more estimated to remain undiscovered. To increase the utilisation, accessibility, and availability of foods with high nutrient content throughout the year, the use of traditional underexploited foods from local sources should be promoted, along with education/awareness on nutritive value to motivate people into eating a healthy and nutritious diet.

Depending on the insect's availability, medicinal value, and social belief as well as on local traditional and customs, the purpose of insect's consumption differs from community to community (Chakravorty *et. al.,* 2011). Consumption of insects as a food in North- East India such as Nagaland, Manipur, Arunachal Pradesh etc. has been well-known from the beginning of as early as the 20th century (Shantibala *et. al.,* 2014). Edible insect protein has been utilised in food applications. Enzymatic modification of edible insect protein increased its functional properties. However, studies on the functional properties and toxicity of edible insects are minimal. Therefore, it is necessary to explore the edible insects from NER, India, using modern scientific tools for the welfare of humankind.

Some therapeutic edible insects of North East India

Sl.no	Scientific name	Order: Family	Disease alignment	State
1.	*Acheta domestica*	Orthoptera: Gryllidae	Pain, for better eyesight, improve pancreas	Assam
2.	*Aeolesthes holosericea*	Coleoptera: Cerambycidae	relief pain:	Nagaland
3.	*Batocera rubus*	Coleoptera: Cerambycidae	Anaemia, analgesic, diarrhoea:	Manipur; Nagaland
4.	*Batocera rufomaculata*	Coleoptera: Cerambycidae	Aphrodisiac, malaria, joint pain, stomach ache, typhoid:	Nagaland
5.	*Cybister limbatus*	Coleoptera: Dytiscidae	Diarrhoea:	Nagaland

6.	*Cybister tripunctatus lateralis*	Coleoptera: Dytiscidae	Diarrhoea:	Nagaland
7.	*Elimaea securigera*	Orthoptera: Tettigonidae	Nutrient supplement	Nagaland
8.	*Gryllopalpa orientalis*	Orthoptera: Gryllotalpidae	Used for sprains, dropsy & anemia: Control of unwanted moles or warts	Manipur
9.	*Hydroplilous olivaceous*	Coleoptera: Hydrophillidae	Dietary supplements, recovery of lost of appetite	Manipur
10.	*Hydrous olivaceus*	Coleoptera: Hydrophilidae	Dog bite and tumor	Manipur
11.	*Mecopoda elongata*	Orthoptera: Tettigoniidae	Prevent malnutrition	Manipur
12.	*Orthosoma brunneum*	Coleoptera: Cerambycidae	Analgaesic; diarrhoea; malaria, stomach ache, typhoid	Nagaland
13.	*Oryctes rhinoceros*	Coleoptera: Dynastidae	Applied on clot and bruises	Manipur
14.	*Rhynchophorus phoenicis*	Coleoptera: Curculionidae	Larva: Diet supplement	Assam
15.	*Zonocerus variegatas*	Orthoptera: Pyrgomorphidae	Diet supplement: ashes used in dog bit	Assam

Nutritional Properties

Edible insects have an excellent nutritive value. They are rich in protein, essential amino acids, unsaturated fatty acids, minerals, vitamins, and carbohydrates, which are necessary for the human body. Based on the variation in species and region, the energy contents of edible insects vary and significantly higher than those of livestock and vegetables (Bernard & *Womeni*, 2017).

Functional Properties

Enzymatic modification of edible insect proteins is a useful mechanism to improve their functionality compared with the native unhydrolysed proteins. The successful use of protein hydrolysates in ingredients depends upon their abilities to fulfil one or more of the functionality requirements, e.g. good solubility, emulsion/foam stabilisation and/or gel formation (Hall *et. al.,* 2018).

Therapeutic Properties

The usage of insects in traditional medicine was recorded in many parts on the countries (Brazil, Africa, China, South Korea, etc.) including India since time immemorial. These ethno-medicinal insects are used for various aspects of health ailment of metabolic disorder, alimentary tract, relief of gastric trouble, mental relief, common cold and cough etc. The commonly consume insects which also have medicinal values are mostly bees, wasp, beetle, termites, dragonflies etc.

Nutraceutical Properties

Extraction and isolation of proteins are obtained through hydrolysis, proteolysis using different enzymes (such as proteases, alcalase etc.) to obtain bioactive peptides The production and success of a specific insect peptide with bioactive properties (e.g., antioxidant, antimicrobial, antihypertensive) can motivate investments and research into insect protein extraction and food supplementation through the hydrolysis process. The bioactivity of peptides might be influenced by source of protein, degree of hydrolysis (DH), peptide structure, amino acid composition and type of protease used (Zielińska *et. al*., 2017).

Conclusion

There is enormous potential for discovery of new natural products with nutraceutical and functional value from among the class Insecta. Insects are a significant biological resource which is still not fully exploited, especially in North Eastern Region of India. Many insect species on this region has to be analysed chemically or explored for the potential presence of functionally relevant substances that could be a valuable and safe food ingredient. European Union has already allowed the consumption of insects as novel superfood. Considering that Western society has no traditional culture of eating insects, this is a step in the right direction to combat climate change and nutritional food security challenges in the near future.

References

1. Bernard T. and Womeni, H.M., 2017. Entomophagy: insects as food. Insect physiology and ecology. IntechOpen, London, UK, 233-253.
2. Chakravorty J., Ghosh S. and Meyer-Rochow V.B., 2011. Practices of entomophagy and entomotherapy by members of the Nyishi and Galo tribes, two ethnic groups of the state of Arunachal Pradesh (North-East India). *Journal of Ethnobiology and Ethnomedicine*, 7: 5-20.
3. Hall F., Johnson P.E. and Liceaga A., (2018). Effect of enzymatic hydrolysis on bioactive properties and allergenicity of cricket (Gryllodes sigillatus) protein. *Food Chemistry*, 262: 39-47.
4. Shantibala T., Lokeshwari, R.K. and Debaraj H., (2014). Nutritional and antinutritional composition of the five species of aquatic edible insects consumed in Manipur, India. *Journal of Insect Science*,4,14-22.
5. Zielińska E., Baraniak B. and Karaś M., (2017). Antioxidant and anti-inflammatory activities of hydrolysates and peptide fractions obtained by enzymatic hydrolysis of selected heat-treated edible insects. *Nutrients*, 9: 970-978.

Role of Drone Technology for Crop Health Analysis

Article ID: 40871

Ramandeep Singh[1]
[1]Ph. D R Scholar Department of Agronomy, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India, 144411.

Abstract

With the rapid increase in the population and higher incidence of diseases have led to the increased food demand worldwide which should have high nutritious value and lower level of toxins. With continuous cultivation of few crops have led to soil degradation and higher insect pest and diseases attack for which more amount of herbicide has to be used. But the drone technology has provided the best solution as with this timely identification of the problem is done which help to control the harmful insects and disease well in advance before they could hamper the quality of produce. The application of chemicals is also carried out by drone which requires lesser amount to be applied with greater efficiency and results in better crop health which gives a high-quality food to people.

Keywords: Agriculture, Crop health, Drone, Remote sensing.

Introduction

Drone technology is becoming popular in the agriculture due to its diversity and potential to improve the agriculture. The environmental factors play a key role in the agriculture production like weather, temperature and condition of soil. The drone help to assess these conditions from aerial view which otherwise can be missed in case of normal observation. The health is of prime concern now a days which makes it especially important to produce the superior quality crop which can have least infections and deficiencies of various minerals and salts. The drone can be used to analysis the insect pest incidences, disease infections, nutrient deficiencies, unwanted plants etc. which can hamper the crop yield as well as quality of produce. The management and treatment of the problems can be done with the help of drones like applications of insecticides, herbicides, and as well as nutrient application for correcting the deficiencies. Drones contain special equipment like Normalized Difference Vegetation Index or regular cameras for assessment of the plant canopy from that data or information, conclusions can be made about the health of the plant either by checking the differences in the color of leaves or imaging which shows direct image of the incidence of any insect pest. The use of drone technology is highly beneficial in the precision agriculture.

Utilization of Drones in Crop Health Monitoring

1. Crop scouting is one of the methods in which estimation of the plant height is done and it is cheaper method of imaging.

2. Crop health monitoring which includes the plant count along with the plant health monitoring. It helps in early observation of problems and precision is high (Devi *et. al.,* 2020).

3. The field surveying is done before planting of the crop for the measurement of the nutrients present in the soil which improves the fertilizer recommendations based on the initial capacity of a soil.

4. Drones are also utilized for the monitoring of plant stress which can be due to abiotic or biotic reasons. The drones estimate the relative biomass of different plants or compare biomass of particular patch with other patch to derive the results which helps in the site-specific management of the stress (Dileep *et al.,* 2020).

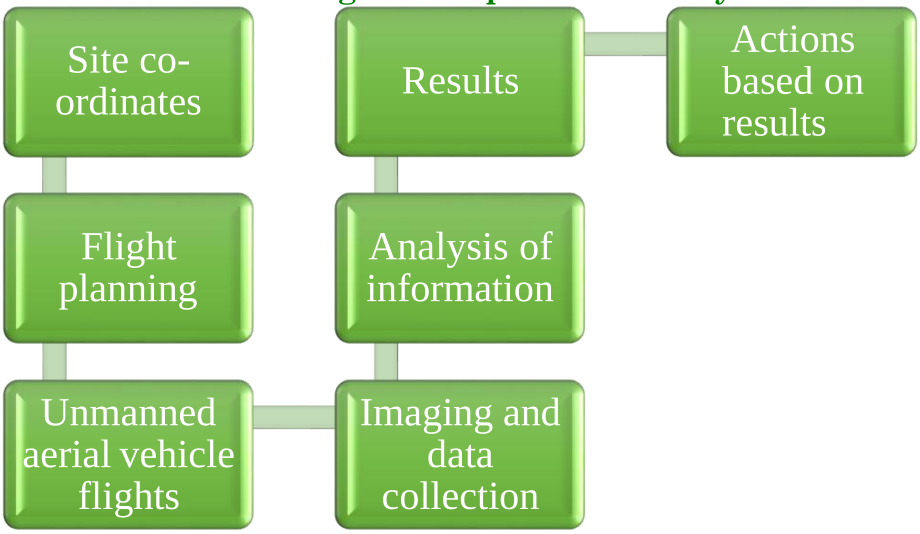
5. The drones use volumetric data for the assessment of drought and extent of the drought in the particular area.

6. For recording of the leaf area index of crop, the drones are utilized for collecting the information which is further utilized for the comparisons and conclusions to be made on the optimum leaf area for the crop.

7. The drone is used to first assess the crop field through sensors and based on that information and its comparison with the earlier data, conclusions are made and drones are utilized for the treatment of deficiencies by application of fertilizers with variable rate technology based on site specific nutrient management.

8. With the daily crop monitoring by drone technology, problem can be found out and based on the data, application of pesticides is done on the crop field where it is required and, in the amount, required at a particular place.

Flowchart of Drone Working for Crop Health Analysis



Advantage of Using Drones in Crop Health Analysis

1. The crop health analysis with the drone is more efficient than the manual observation of the farmers as the number of plants are extremely high.

2. The drones have specific sensors and cameras which take images and also collect information through thermal imaging, multispectral bands etc.

3. The diseases and insect attack does not occur in the whole field at once. With drones, the detection can be done at very earlier stage that reduces the damage to the crop.

4. Daily assessment by drones is beneficial in early and correct estimation of the amount of nutrient deficient that need to be applied.

5. The drones also applied the nutrients in correct amount based on the information collected during monitoring.

6. The observation of type and density of weeds taken with drones helps to select the appropriate amount and type of herbicide that need to be applied for the control of the weeds.

7. The use of drone technology not only reduce the time consumed in various agricultural operations but cost of production is also reduced (Daponte *et al.,* 2022).

Drawbacks of Drone Technology

1. Generally, the flight time of the drone is less, so for larger field there would be need to change the drone batteries for a greater number of times.
2. The drones are highly effect by weather, so there need to be clear weather for using the drones and take the observations of the field which in case of India is always not possible.
3. With drones the observations are taken from the top of the crop canopy which can lead to missing of some problems and would require
4. Advanced sensors are costly and cannot be afforded by all the farmers during their initial period.
5. The drones require proper training for efficient working which can be little difficult for the normal uneducated farmers.

Conclusion

The drone technology is greatly beneficial for the modern agriculture in the crop health analysis. But with the help of drones, the greater amount of the information is collected from the plants like information about the problems whose symptoms are hidden for certain period. So, the drone technology is really helpful for precision agriculture in monitoring and maintaining the crop health during the growth stages to produce a high-quality crop with higher productivity.

References

1. Daponte, P., Vito, L., Glielmo, L., Iannelli, L., Liuzza, D., Picariello, F., Silano, G. 2022. A review on the use of drones for precision agriculture. *IOP Conf. Series: Earth and Environmental Science,* **275**; 1-10.
2. Devi, K. G., Sowmiya, N., Yasoda, K., Muthulakshmi, K., Kishore, B. 2020. Review on application of drones for crop health monitoring and spraying pesticides and fertilizer. *Journal of Critical Review,* **7** (6); 667-672.
3. Dileep, M. R., Navaneeth, A. V., Ullagaddi, S., Danti, A. 2020. A study and analysis on various types of agricultural drones and its applications. *Fifth International Conference on Research in Computational Intelligence and Communication Networks,* **2020**; 181-185.

E-ISSN: 2581 - 8317

Satellite Monitoring for Water Availability

Article ID: 40872

Amit Raj[1]

[1]Ph.D Scholar Department of Agronomy, School of Agriculture, Lovely Professional University, Punjab, India, 144411.

Abstract

A through assessment of the state of satellite monitoring for water availability is given in this article. The management of water resources is a pressing concern on a global scale, and proper monitoring of water availability is crucial for sustainable development. Satellite and remote sensing technology advancements have drastically changed how water resources are monitored and managed. This page describes the many satellite-based methods used to monitor water availability, their benefits and drawbacks, and the current state of this area of study. It is also investigated how satellite data might be combined with additional data sources like ground-based measurements and hydrological models.

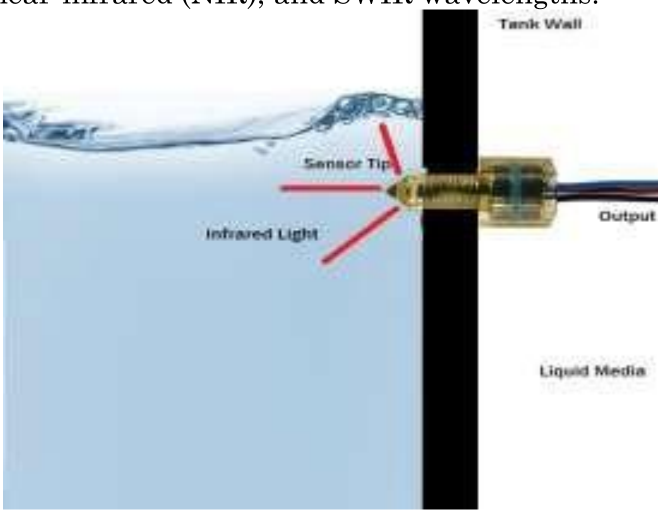
Introduction

Across the world, freshwater makes up around 2.5% of all the water on Earth. Around 30% of this freshwater is kept in underground reservoirs, with the remainder being kept in ice caps and glacier waters (69%), snow and ice (1 %), surface water bodies (0.30%), soil (0.05%), and the atmosphere (0.03%). There are roughly 23 million km^3 of ground water in the upper two kilometers of the Earth's surface, of which 5 million km^3 are modern (Gleeson et al., 2016). Satellite, data and hydrological models can improve water availability monitoring. This technique allows space-based data collection on lakes, rivers, groundwater, snow cover, and glaciers. Satellite data calibration and validation can improve these models (Ogilvie et al., 2018). Satellite data combined with ground observations and hydrological models will improve water availability monitoring. When climate change affects water supplies, more advanced and detailed monitoring systems will be needed to preserve these resources.

Satellite Based Remote Sensing Techniques for Water Availability Monitoring

water availability statistics across large distances. Remote sensing requires ground data to calibrate and confirm its spatial and temporal resolution. Water availability monitoring has utilized a number of sensors, such as:

1. Optical sensors: These sensors measure visible and near-infrared radiation from Earth's surface. Sentinel-2, MODIS, and Landsat are examples. Optical sensors are used to measure surface water, snow cover, and evapotranspiration indices. These methods assess the reflectance of water bodies and their surroundings using visible, near-infrared (NIR), and SWIR wavelengths.

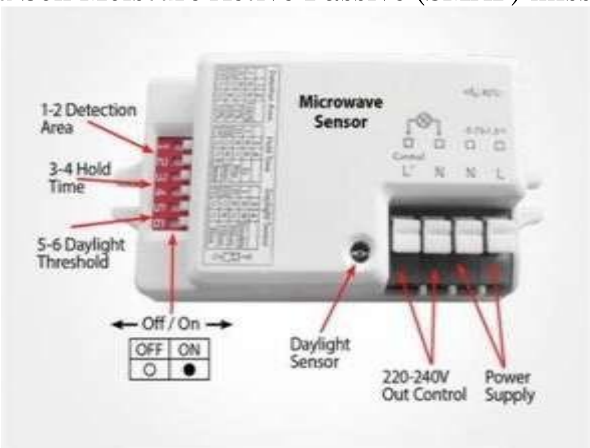


Optical Sensors (www. Fluid switch.com)

2. Thermal infrared sensors: Thermal infrared sensors can detect subsurface water sources or water flow changes by measuring plant or water body temperatures. The Thermal Infrared Sensor (TIRS) on Landsat and MODIS are examples.

Thermal infrared sensors (www.renhotecic.com)

3. Microwave sensors: Beneficial microwave sensors monitor reservoir levels, soil moisture for irrigation, floods warning, and more using Earth's natural microwave radiation. Examples include the Soil Moisture and Ocean Salinity (SMOS) and Soil Moisture Active Passive (SMAP) missions.



Microwave sensors (www.directtradesupplies.co.uk)

Pros and Cons of Satellite Monitoring for Water Availability

Pros:

a. Satellite monitoring can detect water availability in large, distant, and inaccessible places.
b. Satellite monitoring provides real-time water availability data, which is crucial for water resource management, especially during droughts.
c. Satellite monitoring of water availability is cost-effective since it doesn't require ground-based equipment or employees.
d. Satellite monitoring offers trustworthy data for water management choices.

Cons:

a. When evaluating water quality, satellite monitoring may not provide as much detail as ground-based methods.
b. Clouds and fog can reduce satellite signal accuracy.
c. Satellite data interpretation expertise may be hard to get.
d. Satellite sensors may not detect groundwater replenishment or subsurface stream flow.

Using Hydrological Models and Other Data Sources to Combine Satellite Data

Satellite data is often used alongside hydrological models and ground-based observations to determine water availability. Data assimilation, model calibration, and multi-sensor fusion integrate data. Hydrological models simulate water behavior and movement (Zhang et al., 2022). These models can integrate satellite data with ground observations to get a more accurate picture of water availability.

Satellite data can be used with hydrological models. Ground-based soil moisture, groundwater levels, and streamflow observations can confirm satellite data and improve water availability estimates. Satellite data can help water managers and academics understand water availability and distribution (Brocca et al., 2020).

Table 1: Remote sensing is used to design hydrological models on the Indian subcontinent:

S. No	Hydrological Parameters	Study Area	Satellite Data Used
1.	Level of water and stored underground water	North India, Ganga, Kosi, Sutlaj and Beas basin	MODIS, GRACE, TRMM
2.	Water Quality	Beas Basin, Ganga Basin, Chilika Lake	Landsat, MODIS
3.	Soil Moisture	Indian Subcontinent, North Region	SMOS,MODIS, SMAP
4.	Snow Cover	Himalayan Region	GRACE, MODIS, Landsat
5.	Precipitation	North Monsoon Region, Indian Subcontinent	IMR, TRMM, INSAT

MODIS- Moderate Resolution Imaging Spectroradiometer, GRACE- Gravity Recovery and Climate Experiment, TRMM- Tropical Rainfall Measurements Mission, SMOS- Soil Moisture and Ocean Salinity, SMAP- Soil Moisture Active Passive, IMR- INSAT Multi-spectral Rainfall.

Current Research and Future Directions

Climate change, population growth, and urbanization make satellite water monitoring more important than ever. This field's study focuses on improving satellite data processing and water resource monitoring technologies. New sensors and algorithms are being developed to improve satellite data. Combining ground and satellite measurements improves accuracy in other investigations. Another study area is using satellite data and hydrological models to predict water availability. The European Space Agency's Water Cycle Multi-Mission Observation Strategy (WACMOS) assesses regional water availability using satellite data and hydrological models. Satellite water availability monitoring will become increasingly important as water resources become scarcer. Global collaboration is needed to effectively manage water resources using satellite data.

Conclusion

Satellites can accurately track world water resources. Present and future satellite sensors, data processing, and water monitoring technologies will be needed to manage water resources in a changing environment. Scientists and water managers require satellites to monitor precipitation, soil moisture, surface and groundwater, and evapotranspiration to secure future water supplies.

References

1. Brocca, L., Massari, C., Pellarin, T., Filippucci, P., Ciabatta, L., Camici, S., ... & Fernández- Prieto, D. (2020). River flow prediction in data scarce regions: soil moisture integrated satellite rainfall products outperform rain gauge observations in West Africa. *Scientific Reports*, *10*(1), 12517.
2. Gleeson, T., Befus, K. M., Jasechko, S., Luijendijk, E., & Cardenas, M. B. (2016). The global volume and distribution of modern groundwater. *Nature Geoscience*, *9*(2), 161-167.
3. Ogilvie, A., Belaud, G., Massuel, S., Mulligan, M., Le Goulven, P., Malaterre, P. O., & Calvez, R. (2018). Combining Landsat observations with hydrological modelling for improved surface water monitoring of small lakes. *Journal of Hydrology*, *566*, 109-121.
4. Zhang, Y., Hou, J., & Huang, C. (2022). Integration of Satellite-Derived and Ground-Based Soil Moisture Observations for a Precipitation Product over the Upper Heihe River Basin, China. *Remote Sensing*, *14*(21), 5355.

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

Musli Plant an Ancient Herb: A Review

Article ID: 40873

Khushi Tehri[1]
[1]Department of Biotechnology, School of Applied and Life Sciences, Uttaranchal University, Dehradun.

Musli plant is commonly known as safed musli it is an ancient indigenous plant. It has a great medicinal property which is useful for treating several diseases which could even be fatal for some people. Its chemical name is chlorophytum borivillianum and belongs to Liliaceae family. It is a found in peninsular India in the form of herbs, it has ova shaped leaves which are becoming pointed at each end like a knife (lanceolate), it is a kind of fibrous plant which have tuberous roots. There are about 256 species of CHLOROPHYTUM all over the world but around 17 of them all together are present in India. It has a good market value in India as well as all over the world. It is naturally bee grown in hilly regions of Madhya Pradesh, Rajasthan and Gujarat by farmers a is being sold for Rs. 1050 per kg in the form of powder all over India. The reason for its high price that it is rare and have great medicinal as well as nutritional value. Components of safed or whit musli includes fibers, calcium, potassium, steroids, alkaloids, magnesium, copper, glucose etc. it has been chosen as the 6th most valuable plant to be conserved by the plant board.

Uses and Benefits of Musli (Chlorophytum Brivillianum) Plant

1. It is an important ancient herb which is being used from along tie in ayurvedic, unani as well as homeopathic.
2. According to Ayurveda it is used to treat diabetes, prevents bleeding, rejuvenates the body, improves muscle strength, helps in relieving burning sensation, treats skin disorder, sexual issues in men and women, helps in digestion etc.
3. It exhibits an important property that is anti- inflammatory property which means it provides relief in pain.
4. It is also responsible for providing immunity to humans.
5. Safed musli can help in weight gain and help to overcome malnutrition.
6. It plays an important role I preventing anxiety and depression.
7. Also plays a role as pain killer in pain due to arthritis.
8. It helps in reducing mental strength.
9. It boosts our immunity.
10. It enhances digestion.
11. It plays an important role in preventing heart ailments.
12. It is used as a remedy for women's who are at their lactating period, so that they can lactate properly and provide nourishment to their baby.
13. It also has antibacterial property so that it can help in killing bacteria present n our body and prevent several diseases.
14. It also provides us with beauty benefits such as prevents skin ageing and many more benefits.
15. It helps in reducing urinary disorders.

Side Effects of Safed Museli

1. If it has been taken for long time it might lea to excessive weight gain.
2. It should be taken on consultation of doctor I taking it during pregnancy or during lactation period.
3. If consumed for a long period it can lead to loss of appetite.

Conclusion

Safed musli is a plant with antibacterial, anti- inflammatory and many other properties which are useful for humans and prevents several diseases.

References

1. https://www.healthkart.com/connect/understanding-the-uses-of-safed-musli/
2. https://www.netmeds.com/health-library/post/safed-musli-benefits-formulation-uses-dosage-and-side-effects
3. https://www.webmd.com/vitamins/ai/ingredientmono-1268/safed-musli#:~:text=Reviews%20(0)-,Overview,ED)%2C%20and%20other%20conditions.
4. https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.ayurtimes.com%2Fsafed-musli-chlorophytum-borivilianum%2F&psig=AOvVaw200U-qQ91o7lDehFvHqrTU&ust=1680181973846000&source=images&cd=vfe&ved=2ahUKEwjf0vjem4H-AhVcxnMBHZpQCvIQr4kDegUIARDXAQ
5. https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.myupchar.com%2Fen%2Ftips%2Fsafed-musli-benefits-and-side-effects-in-hindi&psig=AOvVaw200U-qQ91o7lDehFvHqrTU&ust=1680181973846000&source=images&cd=vfe&ved=2ahUKEwjf0vjem4H-AhVcxnMBHZpQCvIQr4kDegUIARC7AQ

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

The Role of Machine Learning in Improving Food Quality Control

Article ID: 40874

Harshith N[1], Prakasha R[2]

[1]M. Sc Scholar, Department of Agricultural Statistics, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat, 388110.

[2]M. Tech Scholar, Department of Food Processing Technology, College of Food Processing Technology and Bio Energy, Anand Agricultural University, Anand, Gujarat, 388110.

Introduction

Are you concerned about the safety and quality of the food you eat? If so, you're not alone. The food industry recognizes the critical need to ensure the safety and quality of food products. With the increasing demand for safe and high-quality food products, there is a growing need for innovative approaches to address various challenges in food quality control. Machine learning (ML) has emerged as a powerful tool for improving food quality control (Caswell, 1998). This article explores the application of ML methodologies, such as classification, clustering, regression, and outlier detection to address various challenges in food quality control. These methodologies have been applied to sort food products based on their quality, detect food fraud, rapidly detect contaminants in food products, and optimize food processing parameters. The article also discusses the benefits and challenges of using ML in food quality control and highlights the importance of ensuring accuracy and minimizing bias in the algorithms used.

Working Mechanism of Machine Learning in Food Quality Control

The working mechanism of machine learning in food quality control involves various methods such as classification, clustering, regression, and outlier detection.

1. Classification: It is a supervised learning method, that involves training an algorithm to classify data into different categories based on their characteristics. For instance, an algorithm can be trained to classify images of fruits and vegetables into different categories based on their quality, such as high quality, medium quality, and low quality. The algorithm is provided with a labelled dataset of images, where each image is labelled based on its quality. Once the algorithm is trained, it can be used to classify new images of fruits and vegetables into different categories based on their quality (Jana, 2022).

2. Clustering: It is an unsupervised learning method, that involves grouping data into clusters based on similarities in their characteristics. This method can be used to group similar food products together based on their quality or composition.

3. Regression: It is another supervised learning method, that involves predicting a continuous output variable based on input variables. This method can be used to predict the quality of food products based on various parameters such as temperature, humidity, and processing time.

4. Outlier detection: A method for identifying outliers in data, can be used to detect unusual patterns or contamination in food products. For example, it can be used to detect the presence of foreign materials or chemical contaminants in food products.

For example, in the context of food quality control, an algorithm can be trained to classify images of fruits and vegetables into different categories based on their quality, such as high quality, medium quality, and low quality (Mendoza and Aguilera, 2004). This can be achieved by providing the algorithm with a labelled dataset of images, where each image is labelled based on its quality as shown in Fig 2. Once the algorithm has been trained, it can be used to classify new images of fruits and vegetables into different categories based on their quality as shown in Fig 3. By inputting the new image into the algorithm, the category that the image belongs to can be determined based on the characteristics it has learned (Bhole and Kumar, 2020).

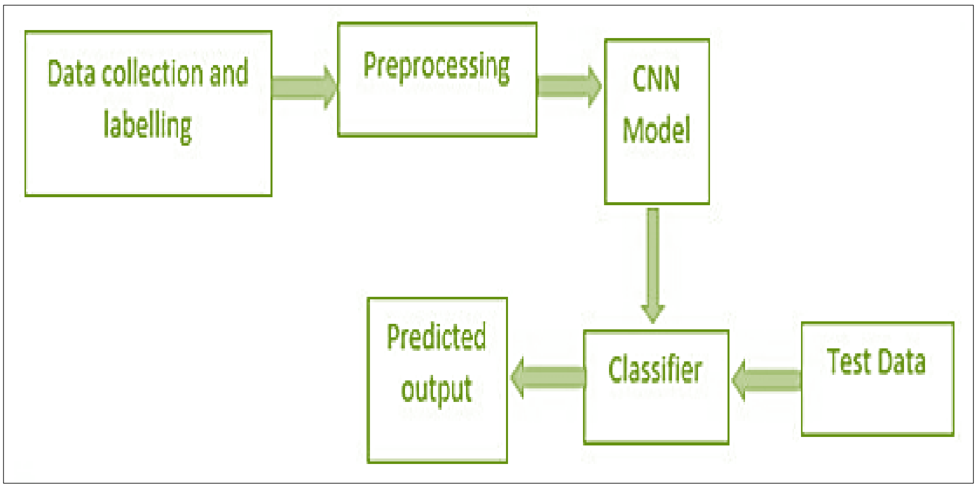


Figure 1: Block Diagram of ML classifying algorithm

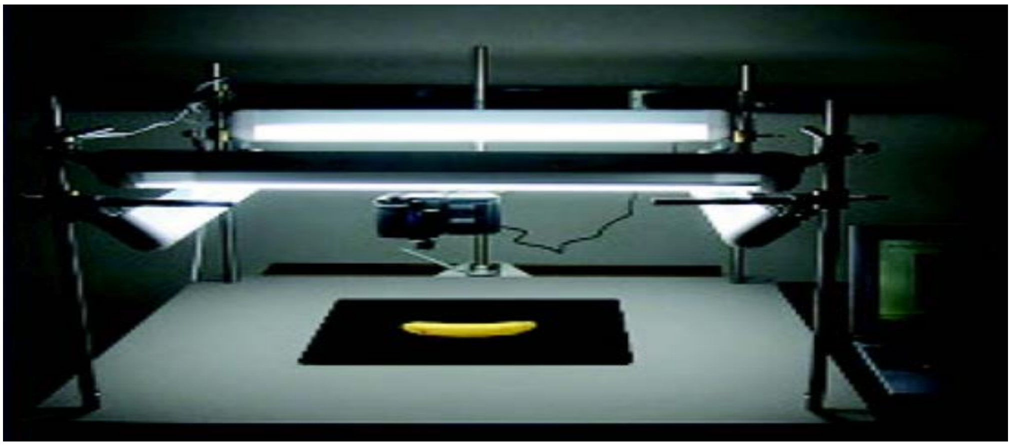


Figure 2: Fruit image data training with suitable label

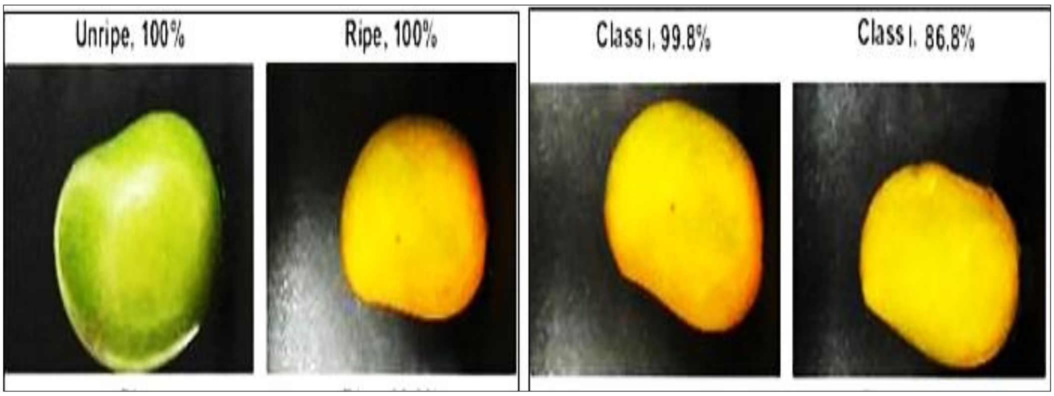


Figure 3: Classification output based on maturity parameter of Mango

Application of Machine learning in Food Quality Control

1. Detection of food fraud: Food fraud involves intentionally misrepresenting food products for financial gains, such as labelling a lower quality product as a higher quality product. To detect food fraud, an algorithm can be trained to classify different food products based on their authenticity. This can be achieved by providing the algorithm with a labelled dataset of food products, where each product is labelled based on whether it is authentic or fraudulent. Once the algorithm has been trained, it can be used to classify new food products into different categories based on their authenticity. This can be done by inputting information about the food product into the algorithm, such as the supplier's records and ingredient lists, which the algorithm will then use to classify the product as either authentic or fraudulent (Hong *et. al.*, 2017).

2. Rapid detection of contaminants: The challenge in food quality control is the need for rapid detection of contaminants in food products. Contaminants such as bacteria, viruses, and toxins can cause foodborne illnesses and have serious public health implications. Traditional methods of detecting contaminants involve time-consuming and labour-intensive laboratory testing, which can delay the detection of contaminated food products. Machine learning can help overcome this challenge by enabling the development of rapid and accurate detection methods. For example, an algorithm can be trained to detect the presence of specific contaminants in food products by analysing the characteristics of the contaminants and their interactions with the food matrix. This can be achieved by providing the algorithm with a labelled dataset of contaminated and uncontaminated food products, where each product is labelled based on its contamination status. Once the algorithm has been trained, it can be used to detect contaminants in new food products by analysing the data generated by sensors and other detection devices. This can be done in real-time, enabling rapid and accurate detection of contaminated food products before they reach consumers **(Shah and Bhavsar, 2021).**

3. Optimization of food processing parameters: Food processing parameters such as temperature, pressure, and time can affect the quality and safety of food products. However, finding the optimal processing parameters can be challenging, as it requires balancing multiple factors such as microbial safety, nutritional quality, and sensory attributes. Machine learning can help overcome this challenge by enabling the development of predictive models that can optimize food processing parameters. For example, an algorithm can be trained to predict the quality and safety of food. The potential impact of ML on food quality control is significant. ML can help to ensure that consumers have access to safe and high-quality food products, build trust between consumers and the food industry, and result in significant cost savings for food manufacturers. Additionally, the potential impact on food safety regulations makes it an attractive option for the food industry.

Challenges of Machine learning in Food Quality Control

Machine learning has the potential to revolutionize food quality control by improving accuracy, reducing costs, and increasing efficiency. However, there are several challenges that must be overcome to achieve these benefits. These challenges include:

1. Limited availability of high-quality food data
2. Complex nature of food composition
3. Difficulty in identifying quality indicators
4. Human biases and errors

It is important to ensure that the algorithms used are accurate and reliable, and that bias is minimized by using representative datasets. By addressing these challenges, the use of machine learning in food quality control can revolutionize the food industry and ensure that consumers have access to safe and high-quality food products (Khan *et. al.,* 2022).

Conclusion

Machine learning holds significant potential in improving food quality control through accurate detection and prediction of food quality, reducing costs, and increasing efficiency. Its application can also aid in the detection of food fraud and contaminants, ensuring the safety and quality of the food supply chain. The methodology involves collecting high-quality data, identifying quality indicators, and training algorithms to recognize patterns and make predictions. However, challenges such as the complex nature of food composition, limited availability of high-quality data, variability in raw materials, and adapting to new production methods and technologies must be overcome. Despite these challenges, machine learning's benefits in improving food quality control outweigh the costs, and it will continue to play an increasingly crucial role in the food industry's safety, quality, and authenticity.

References

1. Caswell, J. A. (1998). Valuing the benefits and costs of improved food safety and nutrition. *Australian Journal of Agricultural and Resource Economics*, *42*(4), 409-424.
2. Mendoza, F., & Aguilera, J. M. (2004). Application of image analysis for classification of ripening bananas. *Journal of food science*, *69*(9), E471-E477.

3. Bhole, V., & Kumar, A. (2020, October). Mango quality grading using deep learning technique: Perspectives from agriculture and food industry. In *Proceedings of the 21st annual conference on information technology education* (pp. 180-186).
4. Hong, E., Lee, S. Y., Jeong, J. Y., Park, J. M., Kim, B. H., Kwon, K., & Chun, H. S. (2017). Modern analytical methods for the detection of food fraud and adulteration by food category. *Journal of the Science of Food and Agriculture*, *97*(12), 3877-3896.
5. Shah, B., & Bhavsar, H. (2021). Overview of deep learning in food image classification for dietary assessment system. In *Intelligent Systems, Technologies and Applications: Proceedings of Sixth ISTA 2020, India* (pp. 265-285). Springer Singapore.
6. Khan, M. I. H., Sablani, S. S., Joardder, M. U. H., & Karim, M. A. (2022). Application of machine learning-based approach in food drying: Opportunities and challenges. *Drying Technology*, *40*(6), 1051-1067.
7. Jana, S., Thangam, S., Kishore, A., Sai Kumar, V., & Vandana, S. (2022). Transfer learning based deep convolutional neural network model for pavement crack detection from images. *International Journal of Nonlinear Analysis and Applications*, *13*(1), 1209-1223.

User-Centered Design: A Way Forward for Design of Agricultural Machinery

Article ID: 40875

Wahengbam Elizabeth Devi[1], Hijam Jiten Singh[2], H. Dayananda Singh[2], Nivetina Laitonjam[2]
[1]ICAR Research Complex for North Eastern Hill Region, Imphal, Manipur, India-795004.
[2]ICAR Research Complex for NEH Region Umiam – 793103, Meghalaya.

Introduction

User-centered design (UCD) is one of design processes that prioritizes the needs and preferences of users in every stage involved in design process. The primary goal of UCD is to fully comprehend the end users who will utilize the good or service. Design teams collaborate with users using various research and design techniques to ensure the products or services created are highly usable and accessible. It is important to note that UCD is not a one-size-fits-all approach, as there are various principles that guide the process. These include designing based on a clear understanding of the users, tasks, and environments, refining the design through user-centered evaluations, and creating a holistic user experience.

UCD is an Iterative Process

In the UCD process, designers utilize various investigative methods and tools, such as focus group discussions, interviews, surveys, usability testing, card sorting, and participatory design, along with generative methods like brainstorming, to gain knowledge of user needs. Don Norman, a usability-engineering expert who specializes in improving user experience, popularized the word after it first emerged in the 1970s. The UCD process typically consists of general four phases which are given below.

1. Specify the context of use: The people who will use the product, their intended usage scenarios, and the circumstances in which they would use it must all be identified in this process.

2. Specify requirements: The designers define the user objectives and business requirements that must be satisfied for the product to succeed during this phase.

3. Create design solutions: This step of the procedure may be carried out in stages, progressing from a basic idea to a finished design.

4. Evaluate designs: Evaluation of the final product through user feedback-gathering methods, such as usability testing. This procedure is repeated until the ideal design is obtained.

The user-centered design process can vary depending on specific project needs and is composed of various methods and tasks. The tasks and their order are influenced by factors such as the project requirements, team composition, timeline, and development environment. It is important to tailor the UCD process to the specific needs of each project.

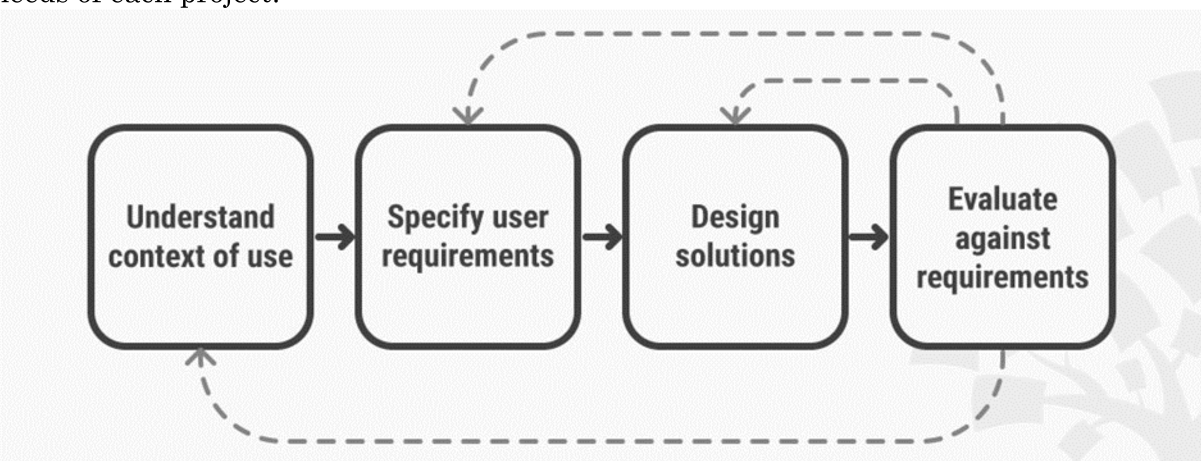


Figure 1: Basic stages of the UCD process

UCD Considers the Whole User Experience

With the aim of capturing and addressing the entire user experience, the UCD approach places a strong emphasis on the value of developing an explicit understanding of users, tasks, and environments. The design team should consist of specialists from diverse fields, subject matter experts, stakeholders, and users themselves to accomplish this. It is important to include users in the review process to have a thorough understanding of the user experience. Experts may evaluate design solutions using established design rules and criteria, but it is also important to include people in the evaluation process. Long-term use monitoring is also necessary to guarantee continuous performance and user satisfaction.

Investment in UCD Pays Off

Engaging users at every stage of the design process can be an effective way to determine what functions well, what doesn't and why in a user-centered design approach. This investment of effort and resources can serve as an early-warning system to help the design team course-correct and fine-tune their design. Users can provide valuable feedback that can help to expose positive and negative aspects of the design, particularly in areas such as usability and accessibility that the design team may have overlooked. Designers may build products that are incredibly useable, accessible, and well-suited to the demands of their end customers by recognizing the value and advantages of a user-centered design approach.

Conclusions

UCD benefits come in a variety of ways:

1. Increased sales and decreased customer service expenses result from involving customers in the design process, which raises the possibility that the product will fulfil their expectations and requirements.
2. Products are safer when they are made specifically for particular situations and work to decrease the possibility of human error.
3. Close interaction with users develops a greater capacity for empathy and produces moral designs that value people's privacy and quality of life.
4. Design professionals may acknowledge and address the diversity of cultures and human values by putting the needs of all users first, resulting in more sustainably run enterprises.
5. UCD is an iterative process that takes the user and their context into account at all points in the design and development process, leading to better products that are more likely to satisfy user needs.

References

1. https://www.usability.gov/what-and-why/user-centered-design.html#:~:text=User%2DCentered%20Design%20Process&text=Design%20is%20based%20upon%20an,process%20and%20it%20is%20iterative. Accessed on 13.04.2023
2. https://www.interaction-design.org/literature/topics/user-centered-design. Accessed on 13.04.2023.
3. https://usabilitygeek.com/user-centered-design-introduction/. Accessed on 13.04.2023.
4. https://opensenselabs.com/blog/articles/user-centered-design-approach-core-principles-methods. Accessed on 10.04.2023.

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

Rearing of Silkworm on Artificial Diets

Article ID: 40876

Chaitanya[1]
[1]PhD Scholar, Division of Entomology, ICAR – Indian Agricultural Research Institute, New Delhi.

Abstract
Artificial diet is the one which is not the natural food of an insect which can be classified as holidic, meridic and oligidic diet. Since, silkworm is the productive insect it also required to be reared on artificial diets. Which consists of mulberry flour as primary component and their constituents such as sitosterol, corn starch, citric acid, ascorbic acid, ascorbic acid, citric acid, citric acid, citric acid, citric acid, citric acid, ascorbic acid, soybean meal, and preservatives The following information throughs light on diet composition, diet preparation and rearing procedure on artificial diets.

Keywords: Silkworm, Diet composition and Rearing.

Introduction
For more than 100 years, artificial diets have been used to grow insects. Its chemical makeup can be totally defined (holidic), partially defined (meridic), or undefined (oligidic).In Japan, the concept of a "artificial diet" was initially created and then extended globally. In the making of the artificial food, mulberry flour is the primary component. Other constituents in it include sitosterol, corn starch, citric acid, ascorbic acid, ascorbic acid, citric acid, citric acid, citric acid, citric acid, citric acid, ascorbic acid, soybean meal, and preservatives.

Table:1. An example of practical artificial diet for younger larvae (Ito, 1980):

Substance	Dry diet (%)
Dried mulberry leaf powder	25
Corn starch	7.5
Sucrose	8
Defatted soybean meal	36
Refined soybean oil	1.5
Soybean sterol	0.2
Salt mixture	3
Cellulose powder	15
Agar	7.5
Ascorbic acid	1
Citric acid	4
(Total)	(108.7)
Vitamin B mixture	added
Antiseptic (sorbic acid, propionic acid)	added
Antibiotic	added
Water	2.57 ml/g diet

Table:2. Composition of artificial diet for silkworm enriched with 2% ascorbic acid:

Ingredients	Quantities/100 g dry weight[a]
Dried mulberry leaf powder	25.0 g
Defatted soybean meal	36.0 g
Wheat meal	15.0 g
Corn starch	4.0 g
Soybean fiber	5.0 g
Citric acid	4.0 g
Ascorbic acid	2.0 g
Salt mixture	3.0 g

Agar	4.2 g
Vitamin mixture	399.0 mg
Sorbic acid	200.0 mg
Propionic acid	691.0 mg
Chloramphenicol	10.0 mg
b-sitosterol	500.0 mg

[a]The powder was hydrated in the ratio of 1 g dry powder: 2.6 g of water.

Diet Preparation

The powder was hydrated (1 dry powder: 2.6 water), combined, and cooked in an autoclave for around 40 minutes at 105°C. The powder contained 25% dried and pulverised mulberry leaf out of the diet's dry weight. The diet was brought to room temperature, then stored until use in a refrigerator (5°C). Diets containing vitamin C were supplemented with 2% pure grade L-ascorbic acid (Sigma, Italy, 99% purity) (Cappellozza *et al*, 2005).

Silkworm Rearing

Rearing was done in a climate-controlled environment where the temperature, relative humidity, and photoperiod were all regulated. The temperature was set at 25.1°C, with relative humidity (R.H.) levels of 85.5% for the first instar, 80.5% for the second, 75.5% for the third, 705% for the fourth, and 65.5% for the fifth. To enable diet desiccation during the moulting stage, R.H. was decreased to 60.5%. The photoperiod was 16 h of darkness and 8 h of light. After the moulting period, bed cleaning was done once during the first, second, and third instar stages, twice during the fourth instar stage, and every day during the fifth instar stage. Feeding took place according to the same schedule: for the first four hours, nutrition was provided "ad libitum." (Cappellozza *et al*,2005).

Advantages and Disadvantages

Although the risk of illness occurrence is considerably more than with fresh mulberry leaf feeding, it is important to prepare and clean the premises and inventory. It is mostly utilised for research purposes when doing various tests with mulberry silkworm larvae. The use of artificial food also offers a number of benefits, including lowering the price of the finished product—silk. Reducing the maintenance and cost of huge mulberry trees. It also increases the space and opportunity for cultivating *Bombyx mori* year-round.

Conclusion

As cultivation of food for mulberry silkworms are laborious and affected by climatic hazardous. Artificial meeting of nutrient requirements of larvae through artificial diet is easy and economical for successful rearing of silkworms.

References

1. Cappellozza,L., Cappellozza, S., Saviane, A. and, G. 2005. Artificial diet rearing system for the silkworm *Bombyx mori* (Lepidoptera: Bombycidae): Effect of vitamin C deprivation on larval growth and cocoon production. *Applied Entomology and Zoology*, Vol: 40: 405-412. 10.1303/aez.2005.405.
2. Ito, T. 1980. Application of Artificial Diets in Sericulture. *Japan Agricultural Research Quaterly*. Vol:14 (3): 163 - 168.

Site-specific Nutrient Management (SSNM)

Article ID: 40877

Plabani Roy[1], Soura Shuvra Gupta[1]
[1]Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi, India, PIN-110012.

Summary
Site Specific Nutrient Management (SSNM) is an approach to feeding crops with nutrients as and when needed. The application and management of nutrients are dynamically adjusted to crop needs of the location and season. The SSNM strategy does not have a clear goal of either increasing or decreasing fertiliser use. Instead, it seeks to apply nutrients at the best possible rates and times to generate high rice yields and high nutrient usage efficiency in the rice, resulting in high monetary value of the harvest per unit of fertiliser injected.

Introduction
Site Specific Nutrient Management (SSNM) is a strategy for providing plants with nutrients that best matches their inherent spatial and temporal requirements for supplemental nutrients. SSNM techniques include remote sensing, GPS, GIS systems, VRT, and yield monitoring.

The SSNM practices developed and evaluated in farmers' fields before 2001 increased yield and profit as compared to farmers' fertilizer practices (Dawe *et al.*, 2004). A simplified framework for dynamic plant-need based management of N, P, and K for rice has been developed since 2001 by methodically evolving the original SSNM concept in partnership with national agriculture research and extension institutions in Asia. In-field studies involving thousands of farmers in the key rice-growing regions of Bangladesh, China, India, Indonesia, Myanmar, the Philippines, Thailand, and Vietnam resulted in the development and evaluation of refined SSNM recommendations.

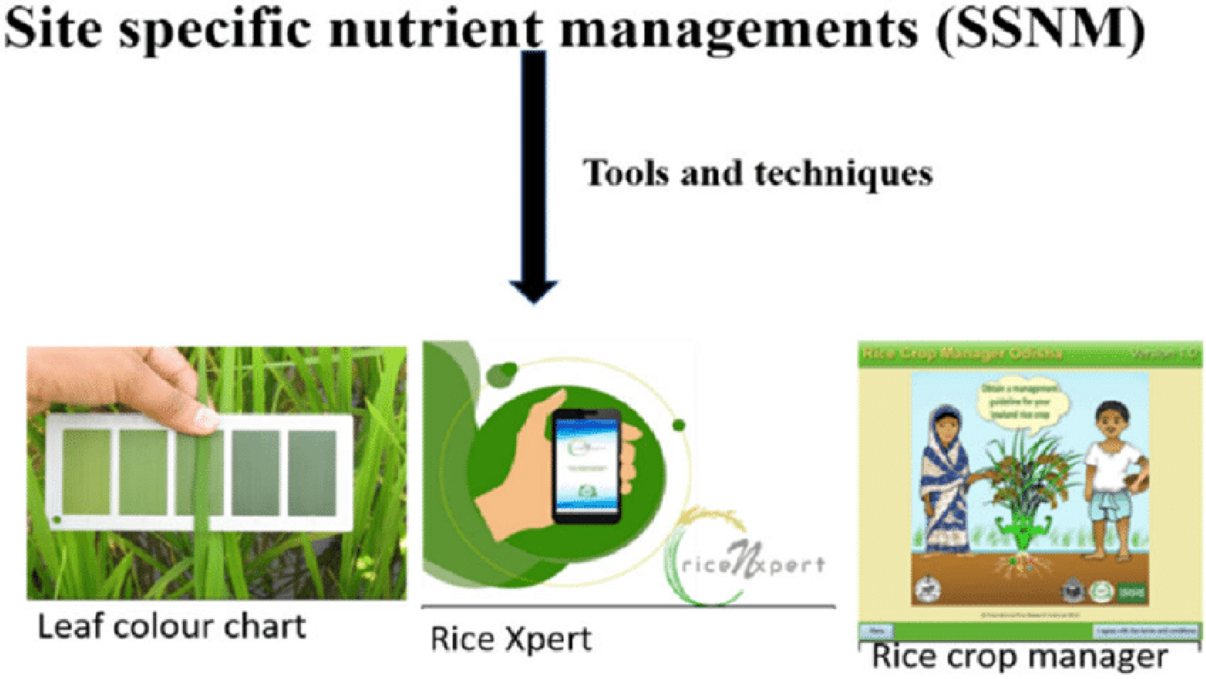
Principle
The goal of SSNM is to provide farmers with the tools they need to dynamically alter fertiliser use in order to best close the gap between the nutrient requirements of a high-yield crop and the nutrient supply from locally available, naturally occurring sources, such as soil, crop residues, manures, and irrigation water.

Features
The key features of the SSNM approach include (1) dynamic adjustments in fertilizer N, P, and K management to accommodate field- and season-specific conditions; (2) effective use of indigenous nutrients; (3) efficient fertilizer N management through the use of the leaf colour chart (LCC), which helps ensure N is applied at the time and in the amount needed by the rice crop; (4) use of the omission plot technique to determine the requirements for P and K fertilizer, and (5) managing fertilizer P and K to both overcome P and K deficiencies and avoid the mining of these nutrients from the soil (Witt *et al.*, 2002; IRRI, 2006).

Site-specific nutrient management (SSNM) as developed in Asian rice producing countries provides an approach for 'feeding' rice with nutrients as and when needed (IRRI, 2006).

The growth stage has a significant impact on the need for N in rice. Rice plants need enough N at the early and mid-tillering stages (branching) to produce enough panicles (grain bunches), at the panicle initiation stage to increase the number of spikelets (flowers) per panicle, and during the ripening stage to improve grain filling in order to produce a high yield. Supplemental N is often required for higher yields in rice fields since the availability of N from soil and organic sources is rarely sufficient. To guarantee that the supply of sufficient N is synchronised with the crop's need for N, farmers can use the SSNM technique, which allows them to administer fertiliser N in numerous doses.

The LCC-improved N management methods provided by SSNM are complementary and equally efficient. When using the "real-time" N management option, farmers periodically check the colour of the rice leaves (for example, once per week), and they fertilise with N whenever the leaves turn more yellowish-green than the crucial threshold value shown on the LCC. In the "fixed-time/adjustable dose" option, the timing of N fertilisation is pre-set during crucial growth phases, and farmers modify the dose of N in accordance with the colour of the leaves.



Source: Shahid *et al.*, 2021

The lower N_2O emissions with SSNM are reportedly the consequence of less inorganic N building up in the soil during periods of alternate drying and wetness. At the end of the rice-growing season, when the soil dries out and N_2O can be released through nitrification-denitrification, the SSNM practises used by farmers for N management should therefore ensure that there is no or very little organic soil nitrogen.

When carried out in accordance with the recommendations of SSSM, grain yield and profit from the real-time and fixed-time/adjustable-dose choices for N management are often equivalent. Farmer preferences and site-specific elements may be taken into consideration while choosing an LCC option. Farmers who engage in lucrative non-rice enterprises or who lack the time to make weekly visits to their rice fields prefer the fixed-time/adjustable-dose option, for instance, because it requires less time. When farmers are unsure of the crucial phases for applying fertiliser N at the right moment, the real-time solution is typically selected. However, in order to overcome the limits of other nutrients, sufficient P, K, and micronutrient treatment is necessary for both techniques to effectively regulate N.

Tools of SSNM

1. Remote sensing
2. GPS
3. GIS systems
4. Variable Rate Technology (VRT)
5. Yield monitoring.

Managing nutrients is referred to as the 4Rs: Right rate, Right timing, Right source, and Right placement. Consistent use of the 4Rs will help prevent excess nutrient loss from agricultural fields into surface and ground water resources.

Conclusion

A promising method for enhancing cropping systems' economic and environmental performance is site specific management, an emerging technology. There are numerous facets of SSNM, some of which are intriguing and others questionable. SSNM will undoubtedly need some work before becoming fully viable. We are enthusiastic about SSNM, but not so much because we have achieved its ultimate objectives as because of the creativity and valuable information we have learned in the process.

References

1. Dawe D., Dobermann A., Witt C., Abdulrachman S., Gines H.C., Nagarajan R., Satawathananont S., Son T.T., Tan P.S. and Wang, G.H., (2004). Nutrient management in the rice soils of Asia and the potential of site-specific nutrient management. In: Dobermann, A., Witt, C., Dawe, D. (Eds.), Increasing Productivity of Intensive Rice Systems through Site-Specific Nutrient Management. Science Publishers, Enfield, NH (USA) and International Rice Research Institute, Los Ban˜ os, Philippines. 337-358.
2. International Rice Research Institute Research findings Optimizing Crop Nutrition (IRRI). (2006). Site-specific nutrient management. http://www.irri.org/irrc/ssnm/. Accessed 23 Oct 2006.
3. Shahid M., Munda S., Khanam R., Chatterjee D., Kumar U., Satapathy B. S. and Nayak A. K., (2021). Climate resilient rice production system: Natural resources management approach. *Oryza*. 58 :143-167.
4. Witt C., Balasubramanian V., Dobermann A. and Buresh R.J., (2002). Nutrient management. In: Fairhurst,T., Witt, C. (Eds.), Rice - A Practical Guide to Nutrient Management. Potash and Phosphate Institute (PPI) and Potash and Phosphate Institute of Canada (PPIC) (Singapore) and International Rice Research Institute, Los Ban˜ os, Philippines, 1-45.

Lac Culture: An Overview

Article ID: 40878

B. C. Anu[1]

[1]Krishi Vigyan Kendra, Turki, Muzaffarpur, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar-848125.

Introduction

The term lac seems to have been derived from the Sanskrit word "Laksha" meaning a hundred thousand (Ogle, 2006) and is suggestive of the large number of insects involved in its production. The description of the lac insect and its host plant– *Butea monosperma* (Lakshataru) is recorded in the Atharva Veda. It is also mentioned in the Mahabharata that Kauravas built the highly inflammable lakhshagriha or Jadugriha (Lac house) with a motive of physically eliminating Pandavas by setting the Lac palace on fire (Chattopadhyay, 2011).

Status of Lac Production

Lac, a natural resin, produced by tiny lac insects mainly *Kerria lacca* (Kerr) belonging to family Kerriidae (Homoptera). Estimated national production of stick lac during 2013-14 was 21008 tons. About 70 percent of the national lac production is exported. In India, lac production is mainly restricted to the Chhota Nagpur region of Jharkhand, Chhattisgarh, Madhya Pradesh, West Bengal, Orissa, Uttar Pradesh and Maharashtra. Among the lac growing states, Jharkhand ranks 1st followed by Chhattisgarh, Madhya Pradesh, Maharashtra and Odisha and the contribution of these five states in national lac production is about 53%, 17%, 12%, 8% and 3%, respectively. These major lacs producing five states contribute around 93% of the national lac production (Yogi, 2015).

Biology of Insect in Lac Cultivation

Two generals are found in India, out of which genus *Kerria* is the most important and widely exploited insect for lac cultivation in India. Lac insect is a soft-bodied, round tiny creature, which completes its life cycle in four stages viz., egg, larva, pupa and adult on host plants within six months. The adult male lac insect lives for a very short duration, such as 3-4 days, while the female lac insects live longer. During the life cycle, these insects suck the sap juices of tree branches through its mouth, and the female lac insect secretes lac around the branches of host plants by which stick lac obtained; thus, it plays a major role in the production of lac.

Types of Raw Lac

It is represented by two strains, i) Rangeeni strain and ii) Kusumi strain. Rangeeni strain based on their life cycle and preference of the insect for specific host plants. In the case of Rangeeni, two crops are such as- **Katki** (June/July to October/November) and **Baishakhi** (October/November to June/July), and in case of Kusumi strain, two crops are- **Jethwi** (January/Feburary to June/July) and **Aghani** (June/July to January/Feburary) are harvested. Of the two strains i.e., Kusumi and Rangeeni of lac insect, Aghani (winter) crop of Kusumi contributes the most in total lac production.

Scientific Method of Lac Cultivation

To start lac cultivation, two things are mainly to be taken into consideration, such as the suitable host plant on which the lac insect thrives and the availability of healthy brood lac in time. Major lac cultivation operations/practices consist of six stages such as:

1. Selection of suitable host plants,
2. Inoculation of brood lac,
3. Removal of brood lac sticks,
4. Natural enemies of lac insect,
5. Harvesting of lac sticks and
6. Scraping of raw lac from twigs.

Selection of Suitable Host Site for Lac Cultivation

The sites for lac host plantation should be in such a place where open area, do not have fire susceptibility, free circulation of air around, the host is assured. When starting cultivation in new areas having a lac host pruned the selected host tree before infection to ensure good lac production. Selected lac hosts should have the following salient features:
1. Fairly fast-growing,
2. Lower sap density and
3. Well adapted to pollarding.

Lac insects thrive on the tender twigs of specific host trees viz., palas (*Butea monosperma* Lam), ber (*Ziziphus mauritiana* Lamk), kusum (*Schleichera oleosa* Oken), semialata (*Flemingia semialata* Roxb), bhalia (*F. macrophylla*) and others.

Harvesting of Lac Crop

Harvesting is the process in which lac is collected from the host trees. Two types of harvesting process are used in most of the regions. It may be of two types: i) Ari lac harvesting and ii) Mature harvesting. Immature harvesting and collection of lacs before swarming is known as 'Ari lac'. In India, in the case of range lac, it is found that ari lac gives better production. Hence, ari lac harvesting is recommended in case of Rangeeni only and in mature harvesting lac is collected after swarming, obtained lac is known as mature Lac. The different crops have different harvesting periods. The summer (Baisakhi) and rain carpet (Katki) crop of Rangini lac, matures after 8 and 4 months of transmission respectively. Similarly, summer (Jethvi) and winter (Aghani) crops of Kusumi are ready in June-July and January-February, respectively. Estimated yields obtained from per tree in India are about 6-10 kg for Kusum, 1.5-6 kg for ber, and 1-4 kg for dhak. The insect life cycles can produce two stic klac yields per year, though it may be better to rest for six months to let the host tree recover.

Scrapping of Raw Lac from Twigs

Scraping is a process in which incrusted lac resin is removed from lac host stick. After harvesting of matured lac and sometimes immature lac is needed to be scraped as primary processing for long time storage. This practice is done with the help of a scraping knife or crusher for different applications in the processing area.

Lac Composition

resin	68-90%
dye	2-10%
wax	5-6%
mineral substances	3-7%
albuminous substances	5-10%
water	2-3%

Lac called as multipurpose resin due to possess so many desirable properties. The important properties of lac are such as i) it is soluble in alcohol. ii) It has adhesive nature. iii) Resistance to water. iv) Possess high scratches hardness. v) It consists of capacity of forming a uniform durable film. vi) it allows quick rubbing with sandpaper without gumming or slicking.

Natural Enemies of Lac Insect

S.No.	Family	Order	Insect
Parasitoids			
1.	Aphelinidae	Hymenoptera	*Coccophagus tschirchii* Mahd.
2.	Braconidae	Hymenoptera	*Bracon greeni* Ashmead
3.	Encyrtidae	Hymenoptera	*Tachardiaephagus tachardiae*
4.	Eulophidae	Hymenoptera	*Tetrastichus purpureus*
Predators			
1.	Blastobasidae	Lepidoptera	*Pseudohypatopa pulvera* (Black enemy of lac)

2	Chrysopidae	Neuroptera	*Chrysoperla zastrowii sillemi* (Green lacewing)
3.	Noctuidae	Lepidoptera	*Eublemma amabilis* (White enemy of lac)
4.	Pyralidae	Lepidoptera	*Ephestia* sp.

Lac and its Forms

Lac can be obtained in different form such as Stick lac, Seed lac, Shellac, Button lac, Garnet lac and Bleached lac which is present below with their name and photographs.

Uses of Lac

It has long been in use both for decorative and insulating varnishes, usually used as a first coating on wood to fill the pores. Bleached lac widely used in the coating of confectioneries and medicinal tablets. Lac dye widely used in India as a dye for woof and silk and skin cosmetic. Lac wax has widely used in the manufacturing of lipstick and shoe polishes. Lac due to unique combination of properties, in pharmaceutical industry used in coating of tablets, micro-encapsulation of vitamins and coating of medicines; also used in automobile paint cosmetic and leather industry.

Conclusion

Lac cultivation is the need of the day in order to preserve environmental biodiversity. Fast depleting forests are a serious threat to the biodiversity of lac insects. Many lac insects and associated fauna have become endangered where lac cultivation has been abandoned or its habitat destroyed. Promoting and encouraging lac culture will not only check environmental degradation, but also conserve associated fauna and flora for posterity.

References

1. Yogi, R.K., Bhattacharya, A., Jaiswal, A.K., and Kumar, A. (2015). Lac, Plant Resins and Gums Statistics 2014: At a Glance. ICAR-Indian Institute of Natural Resins and Gums, Ranchi (Jharkhand), India. Bulletin (Technical), 07:01-68.
2. Chattopadhyay, S. (2011). Introduction to lac and lac culture. Tech. Bull. FBTI: 01/2011, Department of forest Biology and Tree improvement, Faculty of forestry, Birsa Agricultural university, Kanke, Ranchi, India, May 2011.

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

Uses of Spent Mushroom Substrate (SMS/SMC) for Nature Benevolence

Article ID: 40879

Shrvan Kumar[1], Puja Sinha[1], Astha[1]
[1]RGSC, Banaras Hindu University, Barkachha, Mirzapur (U.P.))- 231001.

Introduction

Mushroom substrate prepared common ingredients are wheat straw bedding containing horse manure, hay, corn cobs, cottonseed hulls, poultry manure, brewer's grain, cottonseed meal, cocoa bean hulls, livestock manure, sawdust, straw, woodchips and gypsum. Growers may add ground soybeans or seed meal supplements later in the production cycle (Ahlawat and Tewari, 2007, Leong *et al.,* 2022). Which are used to grow certain species i.e., *Lentinula edodes, Pleurotus* spp., *Volvariella volvacea*, *Flammulina velutipes*, and others (Ahlawat and Sagar, 2007). On top of the substrate, farmers apply a "casing" layer, which is a mixture of peat moss and ground limestone. Every kilogram of mushrooms produced results in 5–6 kg of by-product (Ma *et al.,* 2014). Spent mushroom substrate (SMS) still has some nutrients available for the mushroom; however, it is more economical to replace the substrate and start a new crop. Before removing the spent substrate from the mushroom house, the grower "pasteurizes" it with steam to kill any pests or pathogens that may be present in the substrate and casing. This final pasteurization kills weed seeds, insects, and organisms that may cause mushroom diseases. Users may consider spent substrate clean of weed seeds and insects. Nevertheless, following the rapidly expanding mushroom industry, a large amount of spent mushroom substrate (SMS, fresh) or spent mushroom compost (SMC, composted) was generated after mushroom harvesting, with more than 60 million tons of by-products generated annually (Atallah *et al.,* 2021). Without proper waste management, the improper disposal of these by-products might cause environmental pollution, such as air and water pollution and soil contamination. In addition, SMS is an emerging and promising feedstock for a wide range of renewable and sustainable biofuels, including biogas/biomethane, biohydrogen, bioethanol, bio-oil, solid biofuel and others (Leong *et al.,* 2022). Mushroom growers sometimes apply a registered pesticide during the crop cycle. The local garden center sells most of the same pesticides a mushroom farmer uses. Even if pesticides have been applied, they are generally hard to find for two reasons. Organic matter in the substrate effectively binds pesticides. Also, these compounds decompose rapidly at the high temperatures used for pasteurizing the completed crop. It is safe to assume that the pesticide residue on spent substrate is low. Some farms are strictly "organic" and will not use chemical pesticides (Beyer, 2015).

Characteristics of Spent Mushroom Substrate

The typical composition of spent mushroom substrate fresh from a mushroom house will vary slightly. Since raw materials and other cultural practices change, each load of fresh spent substrate has a slightly different element and mineral analysis. Sometimes, fresh substrate is placed in fields for at least one winter season and then marketed as "weathered" mushroom soil. This aged material has slightly different characteristics because the microbial activity in the field will change the composition and texture. The salt content may change during the aging period. Spring and summer are the best time to use weathered material as a mulch. As a soil amendment, spent substrate adds organic matter and structure to the soil. Spent substrate primarily improves soil structure and it does provide a few nutrients (Becher and Pakuła, 2014; Beyer, 2015).

What is Spent Mushroom Substrate (SMS)?

1. It is the remain compost waste released after the harvest of one full crop of mushroom produced abundantly by mushroom industries.
2. It is made up of agricultural materials such as wheat straw, horse manure, hay, poultry manure, cottonseed meal, cocoa shells and gypsum.

3. Different SMS have different impacts as they are made from different substrate ingredients. For example, the Straw mushroom (*Volvariella*) mainly degrades cellulose and leaves the lignin almost intact (Wong *et al.,* 1990).

Uses of Spent Mushroom Substrate

Biogas Production: SMS is used as feedstock for biogas generation and it has following benefits:
1. Possibility to utilize feed stocks of high moisture content
2. Ability to be scaled to suit community needs
3. Sludge with properties of good manure can replace chemical fertilizers.

The composition of SMS as feedstock for biogas production is important as different types of SMS may give variable results due to different pre-treatment and anaerobic digestion period. *Mamimin et al.* (2022) have demonstrated the application of SMS of Empty Fruit Bunches from *Volvariella volvacea* cultivation that yielded about 281 L CH_4 per kg volatile solids. *Nuchdang et al.* (2015) report a promising result of use of paragrass treated with *Coprinopsis cinerea* and *Polyporus tricholoma* (BCC2285) that produced 311 L CH_4 per Kg volatile solids.

Biohydrogen, Bioethanol or Biobutanol Production

The productivity of Biohydrogen and Bioethanol by using SMS can be improved by acid pre-treatment, microbes and steam explosion for the delignification of cellulose materials. With a production capacity of approximately 27.3 billion gallons in 2021, bioethanol is the biofuel with the highest demand currently and the most widely accepted in terms of blending with gasoline due to government policies (Leong *et al.,* 2022). Although most commercial bioethanol is currently produced from starch or sugar crops, however, there are issues of 'food versus fuel' debate and low sugar yield per cultivation area (Umor *et al.,* 2021). *Clostridium* sp. is a versatile species that can degrade lignocellulosic materials to produce acetate, hydrogen, lactate and ethanol. Non-edible biomass such as lignocellulosic materials is better option for Bioethanol production (Lin *et al.,* 2016). Ryden *et al.* (2017) suggest the SMS of sorghum chaff is suitable for second generation Bioethanol.

Reclamation of Soil

Fresh as well as 15-20 days old rotten SMS from paddy straw mushroom is most acceptable for the worms to multiply and convert it into manure for field crops (Singh *et al.,* 2020).

Biofertilizer and Compost

Excessive use of chemical fertilizers has resulted in degradation of soil fertility, water hardness and contributed to environmental problems. SMC is one of the options for conversion to biofertilizer. Amendment processes such as additional of organic nutrient or starter culture are required for SMC to be used as fertilizer. SMS can be used as biofertilizer (Umor *et al.,* 2021). Addition of organic nutrients or starter culture is required for SMS to be used as fertilizer. SMS is nutrient rich and contains about 80% of the total nitrogen in bound form with high molecular weight fractions of lignin and humic substances but nitrogen release from the compost is very slow, that's why addition of some available form of nitrogen is required. *Uzun* (2014) determined that weathered SMS is suited to be used as fertilizer and soil conditioner better than fresh SMS. Use of SMS as biofertilizer seems to be an alternative way of using SMS for soil amelioration and plant nutrition.

Bioremediation

SMS has the ability to chemically adsorb the organic and inorganic pollutants and also it contains various microbes that can break down the organic compounds present in soil or water. The pentachlorophenol (PCP) contaminated soil can be treated with aliquots of spent sawdust cultures of shiitake mushroom, supplemented with nutrient solution of glucose, thiamine and mineral salt, resulted in disappearance of about 44.4-60.5% of PCP within 21 days of incubation (Chiu *et al.,* 1998).

Agaricus *bisporus* Spent Substrate is Used for

Purification of air: When mixed with other materials used for removal of H_2S or volatile organic compounds.

Purification of water: Used in treatment of metal-contaminated water from coal mines and treatment of acid mine drainage in wetland environments.

Purification of soil: effective against zinc, cadmium and lead (Shuman, 1998 &1999,) distributions among soil fractions.

SMS for Disease Management

SMS also exerts some antagonism to the pathogens surviving and multiplying in soil. The soil treatment with SMS helps in restricting the root knot infestation of tomato plant by *Meloidogyne incognita.* The extract from SMS inhibits the conidial germination of *Venturia inaequalis* which is a causal agent of apple scab. *Agaricus bisporus* spent substrate has been evaluated against Colorado potato beetles (Gent *et al.,* 1998) and as an organic alternative to methyl bromide in strawberries (Sances and Ingham, 1997).

Animal Feed

SMS of wheat straw from *Agaricus bisporus* mushroom is used as ruminant feed that improve the nutrient intake, digestibility and nitrogen balance (Fazaeli and Masoodi, 2006). Paddy straw mushroom (*V. volvacea*) is considered a primary decomposer. It prefers high cellulose-, low lignin-containing substrate and produces a range of cellulolytic enzymes. However, common methods for cultivation use composted substrates based on cotton waste and/or paddy straw (Ahlawat and Tewari, 2007). SMS from *Volvariella volvacea* where mushroom has been grown on rice straw and banana leaves has been used as feed for sheep. Spent substrate from *Pleurotus* spp. (Oyster mushroom) cultivation act as energy source for animals.

Horticulture

Suitable treatments like rapid salt leaching and weathering in open for 2 to 3 years make SMS more suitable for either complete or partial substitution of growing media for growing flowers, vegetables, fruit, saplings, ornamental shrubs and other horticulture plants of economic importance. SMS being rich in N, P and K acts as a good growing medium for vegetables like cucumber, tomato, broccoli, tulip, cauliflower, peppers, spinach etc. but every plant has different response to different levels of SMS incorporation (Ahlawat and Tewari, 2007). Some recent findings are given below are the outcome of the AP-Cess funded scheme concluded at National Centre for Mushroom, Solan (HP):

Tomato (*Lycopersicon esculentum*):

SMS Dose: 18.5 ton/ha.
Superior Yield: 6-24 months old naturally weathered SMS and 12 months old anaerobically recomposted SMS.
Superior Quality: Superior fruit weight, ascorbic acid content, dry matter, total soluble solids (TSS) and acidity in anaerobically recomposted SMS.
Diseases management: Lower incidence of Blossom end rot, Buck eye rot, Leaf curl in anaerobically recomposted SMS.

Shimla Mirch (*Capsicum annum*):

SMS Dose: 25 ton/ha.
Superior Yield: 6-18 months old naturally weathered and 12 months old aerobically recomposted SMS.
Superior Quality: Superior fruit length, fruit width, dry matter, total soluble solid and ascorbic acid content in 12 months old naturally weathered and aerobically recomposted SMS.

Pea (*Pisum sativum*):

SMS Dose: 20 ton/ha.
Superior Yield: 12 months old anaerobically recomposted SMS.
Superior Quality: Higher contents of protein, ascorbic acid, dry matter and total soluble solids in 18 months aerobically/anaerobically recomposted SMS.

Diseases management: Lower incidence of *Fusarium* wilt and Powdery mildew score in SMS (Ahlawat and Sagar, 2007).

Conclusion

Commercial mushroom production produces a coproduct of great value. Researchers have addressed the possible usages for many decades, exploring its resource potential. Integration of mushroom cultivation and biofuel production has multiple benefits of satisfying global food/fuel demands, facilitating waste management, and minimizing GHG emissions and environmental pollution. Biogas production from SMS/SMC is close to the commercial-scale application due to the high availability of related knowledge and the flexibility of AD process itself.

Future research directions should focus on the development of efficient pretreatment technologies, biofuel production. SMS has the potential of solving several agriculture related problems. However, it requires some early treatments like desalting/prolonged leaching and recomposting for added advantages. The conductivity of SMS, which is taken as a criteria of high salt concentration can be tested before using SMS for raising crops.

However, the ions which contribute to high conductivity in recomposted SMS are highly water soluble and their leaching is possible. The exploitation of spent mushroom substrate for the management of environment, agriculture and production of recyclable energy requires strict watch on its physical, chemical and microbiological properties.

References

1. Ahlawat, O. P. and Tewari, R. P. (2007). Recycling of spent mushroom substrate to use as organic manure. *Folder,* National Research Centre for Mushroom (ICAR): Chambaghat, Solan; 1-5 pp.
2. Ahlawat, O. P., & Sagar, M. P. (2007). *Management of spent mushroom substrate*. National Research Centre for Mushroom, Indian Council of Agricultural Research. Chambaghat, Solan – 173 213 (HP), INDIA
3. Ahlawat, O.P. and Tewari, R.P. 2007. Cultivation Technology of Paddy Straw Mushroom (*Volvariella volvacea*); National Research Centre for Mushroom (ICAR): Chambaghat, Solan; 36p
4. Atallah, E., Zeaiter, J., Ahmad, M. N., Leahy, J. J., & Kwapinski, W. (2021). Hydrothermal carbonization of spent mushroom compost waste compared against torrefaction and pyrolysis. *Fuel Processing Technology*, *216*, 106795.
5. Becher M, Pakuła K. (2014). Nitrogen fractions in spent mushroom substrate. *Journal of Elementology* 19(4):947–958.
6. Beyer D. (2015). Spent mushroom substrate. http://extension.psu.edu/plants/vegetable-fruit/ mushrooms/mushroom-substrate/spent-mushroom-substrate. (Accessed on January 3, 2016.)
7. Chiu, S. W., Ching, M. L., Fong, K. L., & Moore, D. (1998). Spent oyster mushroom substrate performs better than many mushroom mycelia in removing the biocide pentachlorophenol. *Mycological Research*, *102*(12), 1553-1562.
8. Cunha Zied, D., Sánchez, J. E., Noble, R., & Pardo-Giménez, A. (2020). Use of spent mushroom substrate in new mushroom crops to promote the transition towards a circular economy. *Agronomy*, *10*(9), 1239.
9. Fazaeli, H., & Masoodi, A. R. (2006). Spent wheat straw compost of Agaricus bisporus mushroom as ruminant feed. *Asian-australasian journal of animal sciences*, *19*(6), 845-851.
10. Gent MPN, Elmer WH, Elmer WH, Fernando FJ, LaMondia JA. (1998). Growth, yield and mushroom nutrition of potato in fumigated or non-fumigated soil amended with spent mushroom compost and straw mulch. Compost Science & Utilization 6(4):45–56.
11. Leong, Y. K., Varjani, S., Lee, D. J., & Chang, J. S. (2022). Valorization of spent mushroom substrate for low-carbon biofuel production: Recent advances and developments. *Bioresource Technology*, 363: 128012.
12. Lin HN, Hu BB, Zhu MJ (2016) Enhanced hydrogen production and sugar accumulation from spent mushroom compost by Clostridium thermocellum supplemented with PEG8000 and JFCE. Int J Hydrogen Energy 41(4):2383–2390
13. Ma Y, Wang Q, Sun X, Wang X, Su W, Song N. (2014). A study on recycling of spent mushroom substrate to prepare chars and activated carbon. Bioresources 9(3):3939–3954.
14. Mamimin C, Chanthong S, Leamdum C, Thong SO, Prasertsan P (2021) Improvement of empty palm fruit bunches biodegradability and biogas production by integrating the straw mushroom cultivation as a pretreatment in the solid-state anaerobic digestion. Bioresour Technol 319:124227.
15. Nuchdang S, Vatanyoopaisarn S, Phalakornkule C (2015) Effectiveness of fungal treatment by *Coprinopsis cinerea* and *Polyporus tricholoma* on degradation and methane yields of lignocellulosic grass. Int Biodeterior Biodegrad 104:38–45.
16. Ryden P, Efthymiou MN, Tindyebwa TAM, Elliston A, Wilson DR, Waldron KW, Malakar PK (2017) Bioethanol production from spent mushroom compost derived from chaf of millet and sorghum. Biotechnol Biofuels 10(1):1–11.
17. Sances FV, Ingham ER. (1997). Conventional and organic alternatives to methyl bromide on California strawberries. Compost Science & Utilization 5(2):23–27
18. Shuman LM. (1998). Effect of organic waste amendments on cadmium and lead in soil fractions of two soils. Communications in Soil Science and Plant Analysis 29(19–20):2939–2952.
19. Shuman LM. (1999). Organic waste amendments effects on zinc fractions of two soils. Journal of Environmental Quality 28(5):1442–1447.

20. Singh S., Avasthe R., Raj Chandramani, Kapoor C. and Lepcha S.C. (2020) Spent mushroom substrate- A multifaceted utility for organic agriculture. *Farm Magazine* 10(1): 2-5.
21. Umor, N. A., Ismail, S., Abdullah, S., Huzaifah, M. H. R., Huzir, N. M., Mahmood, N. A. N., & Zahrim, A. Y. (2021). Zero waste management of spent mushroom compost. *Journal of Material Cycles and Waste Management*, *23*(5), 1726-1736.
22. Uzun I (2004) Use of SMC in sustainable fruit production. J Fruit Ornam Plant Res 12(Special edition):157–165
23. Wong PK, Au KS, Fong WK, Chan KY. (1990). Bacterial flora isolated from spent composts with special reference to cellulolytic bacteria. Microbios 61:153–167.

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

Black Soldier Fly: An Economic Important Dipteran

Article ID: 40880

Neelakanta Rajarushi Chava[1], Kalyanam Sai Ishwarya Lakshmi[1], Rajesh V[1]
[1]Division of Entomology, ICAR-Indian Agricultural Research Institute, New Delhi-12.

Summary

The black soldier fly, *Hermetia illucens* (L.) (Diptera: Stratiomyidae) is considered as beneficial arthropod which undergoes holometamorphsis in approximately 45 days. The larval stage is used to reduce manure accumulations in confined animal feeding operations and its prepupae is rich in protein and can be used as feed for a variety of animals, including swine, chickens, and fish. In addition, it has been used as food by many indigenous peoples and local communities and other important features of this economic important insect is reviewed below.

Introduction

Hermetia illucens, the black soldier fly (BSF), is a true fly (Diptera) of the family Stratiomyidae that originated from the Americas, now occurring worldwide in tropical and temperate regions. Regarding the range of substrates, they can digest, they may be the most effective of all the flies. It is well known that their feed conversion ratios are higher than those of both mealworms and crickets. BSF provides a remedy for the issues of inadequate global waste management, urban unemployment, and rising need for sustainable animal feed in contemporary society. (Siddiqui *et al*., 2022).

Life Cycle

The life span of *H. illucens* have four different stages including eggs, larvae, prepupae and pupa or adult fly with 45 days of lifecycle (Cannella *et al*., 2016). During its adult stage, *H. illucens* does not feed and relies solely on its body fat reserve. Females mate two days after emerging and oviposit into dry cracks and crevices adjacent to a feed source. Due to the relatively long period between oviposition and eclosion (3–4 days), eggs are never laid directly onto the moist rotting material. The larvae hatch and start feeding on different decaying organic material, such as rotting fruits and vegetables, animal manure and human excreta etc. Under ideal conditions with abundant food sources (i.e. waste deposits), larvae can mature in two weeks. However, food shortage and low temperatures can extend the larval period up to four months (Furman *et al*., 1959). Due to high larval densities and the voracious appetite of the larvae, fresh material is processed extremely fast and bacterial growth suppressed or restrained, thereby reducing production of bad odour to a minimum. The prepupae, the final immature stage, exhibit a clear migration pattern away from the feed source in search of a dry, safe place to lay their eggs. After around 14 days, the adult emerges from under the skin of the larva.

Benefits that make BSFL more Special to Rear

1. Adults ingest just water, avoid humans, and do not bite or sting due to redundant mouthparts. To date, no studies indicate BSF as a disease vector. This is because the larvae's huge fat storage minimises or eliminates the need for adults to feed and transfer any potential disease (Siddiqui *et al*., 2022). *H. illucens* has the capacity to repel oviposition of female house flies and *Fannia sp* by chemical communication (allomone) (Bradley and Sheppard, 1984).

2. Black soldier fly larvae (BSFL) are reported as a polyphagous insect as they feed on all types of organic materials of animals and plants (Bava *et al*., 2019) and their larval development time of over three weeks is longer than that of flies such as house and carrion flies (<5days) meaning a single larva will consume a larger amount of substrate and produce larger pupae. Under optimum conditions (temperatures 27–30 ◦C; 70–85% humidity; shaded environment; and optimal food supply) BSFL appears to be more effective in waste reduction in a shorter amount of time and resulted in high-quality products for agricultural uses. Beskin *et al.* (2018) reported its ability to reduce the odorous compounds from poultry, swine and dairy manures up to 87% or more and in a case study conducted by Indonesia shows that the BSF waste treatment facility has lower hazardous gas emissions (CO_2, CH_4, and N_2O) (Mertenat *et al*., 2019)

3. Additionally, when BSFL are at the pre-pupa stage, they will instinctively leave the substrate and move to a high, clean place, a behaviour called "self-harvesting" that removes an otherwise labour-intensive step from their farming.

4. BSF larval meal serves as the best source of protein because the protein extracted from the larvae and pupae was found to be just as good as soybean or meat meal in the composition of common feed. Whole or processed BSF larvae or pupae can be included in the diets of poultry, fish, pets, and pigs, serving as potential substitutes for ingredients found in common feed, such as soybean and fish-based meal. The nutritional profile was described in (table 1) (Siddiqui *et al.,* 2022). The nutritional makeup of the larvae varies substantially depending on the organic elements consumed.

Table: 1. Nutritional profiles of black soldier fly larvae (Siddiqui *et al.*, 2022):

Body composition	It comprises of 50%-60% of crude protein, 30-35% of lipids and amino acids.
Protein/amino acid content	The five-day-old (BSFL) larvae had the highest percentage of crude protein content (61%) with a continuous reduction in protein content with increasing age which is made of numerous amino acids such as alanine, arginine, aspartic acid, cystine, glutamic acid, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, proline, serine, threonine, tryptophan and tyrosine.
Fatty acids content	BSF larvae consists of 58%-72% saturated fatty acids and 19%-40% mono and polyunsaturated fatty acids (PUFAs) content. The fatty acids such as lauric, palmitic, α-linolenic acid or eicosapentaenoic acid and oleic acid have been reported from the BSFL. BSFL lipid content ranges from 8% to 60% of its dry weight and the major constituents present in the BSFL are triglycerides.
Mineral content:	The mineral content of BSF larvae may widely vary and depends on the manure utilized for culture. BSF larvae contains best source of minerals and calcium predominantly and other essential minerals including iron, zinc, calcium, phosphorous, copper and magnesium.
Chitin content:	The chitin concentration of BSF varied greatly from 3.6% in the larva to 14.1% in the puparium to 2.9% in the adult.

5. BSFL-based lipids were shown to be viable non-food raw materials for generating biodiesel, as the qualities of the BSFL-based fuel were found to be comparable to those of regular biodiesel derived from rapeseed oil (Li *et al.,* 2011).

References

1. Siddiqui, S. A., Ristow, B., Rahayu, T., Putra, N. S., Yuwono, N. W., Mategeko, B., ... & Nagdalian, A. (2022). Black soldier fly larvae (BSFL) and their affinity for organic waste processing. *Waste Management*, *140*, 1-13.
2. Cannella, L., Nassef, A. R. A., Bailey, D., & Ferrarezi, R. S. (2016). Alternative Sources of Food for Aquaponics in the US Virgin Islands: A Case Study with Black Soldier Flies. *Agricult. Exp. Station*, *34*.
3. Furman, D. P., Young, R. D., & Catts, P. E. (1959). Hermetia illucens (Linnaeus) as a factor in the natural control of Musca domestica Linnaeus. *Journal of Economic Entomology*, *52*(5), 917-921.
4. Bradley, S. W., & Sheppard, D. C. (1984). House fly oviposition inhibition by larvae of Hermetia illucens, the black soldier fly. *Journal of chemical ecology*, *10*, 853-859.
5. Bava, L., Jucker, C., Gislon, G., Lupi, D., Savoldelli, S., Zucali, M., & Colombini, S. (2019). Rearing of Hermetia illucens on different organic by-products: Influence on growth, waste reduction, and environmental impact. *Animals*, *9*(6), 289.

6. Beskin, K. V., Holcomb, C. D., Cammack, J. A., Crippen, T. L., Knap, A. H., Sweet, S. T., & Tomberlin, J. K. (2018). Larval digestion of different manure types by the black soldier fly (Diptera: Stratiomyidae) impacts associated volatile emissions. *Waste Management*, *74*, 213-220.
7. Mertenat, A., Diener, S., & Zurbrügg, C. (2019). Black Soldier Fly biowaste treatment–Assessment of global warming potential. *Waste management*, *84*, 173-181.
8. Li, Q., Zheng, L., Cai, H., Garza, E., Yu, Z., & Zhou, S. (2011). From organic waste to biodiesel: Black soldier fly, Hermetia illucens, makes it feasible. *Fuel*, *90*(4), 1545-1548.

E-ISSN: 2581 - 8317

Potential of Millets in the UT of Ladakh

Article ID: 40881

Rigzen Tsewang[1]
[1]University of Horticultural Sciences, Bagalkot, Karnataka, India (587103).

Introduction

Millets are a group of small-seeded grasses that have been cultivated as a source of food for thousands of years. They are often referred as 'Nutri-Cereals' due to their high nutritional properties. They are quite beneficial in the areas having water scarcity and are cultivated as drought-resistant crops. They can grow in a range of soil types and weather conditions, making them a staple crop in many parts of the world. Millets are often used in traditional dishes, particularly in Asia and Africa. They are rich in nutrients such as protein, fiber, vitamins and minerals, and have a low glycemic index, which means they can help regulate blood sugar levels.

Millets can be used to make a variety of dishes, including porridge, brad and pancakes. They are also used to make alcoholic beverages such as beer and traditional spirits. In recent years, there has been renewed interest in millets as nutritious and sustainable alternative to more common grains like wheat and rice. In the regard, UN has declared year 2023 as the 'International Year of Millets' in response to a proposal by India. India is one of the largest producers of millets in the world, which constitutes to 80 per cent of world's millet output. It is cultivated in the states of Karnataka, Rajasthan, Andhra Pradesh and Maharashtra. According to the Ministry of Agriculture and Farmers' Welfare, millet production in India in 2020-21 was 11.88 million tons, with an area of 14.04 million hectares.

Millets in Ladakh

Millets are grown in Ladakh, but the cultivation is limited due to harsh climatic conditions and lack of irrigation facilities. However, there have been efforts to promote millet cultivation in Ladakh to enhance food security and promote sustainable agriculture. The Ladakh Agriculture Department has been promoting millets like buckwheat, foxtail millet and proso millet, which are better suited to the region's climate and require less water than other crops. Millets in Ladakh are grown as the second crop in a season and usually followed after the cultivation of barley in the lower areas of Ladakh at an altitude ranging from 2,500 meters to 4,000 meters above sea level. In Ladakh, millet is grown in several regions, including Leh, Kargil and Zanskar. Overall, millet is an important crop in Ladakh, providing a source of food and income for local farmers and contributing to the region's agricultural economy.

Area and Production

There is no latest data on the area and production of millets grown in Ladakh. But the data released by the administration of UT of Ladakh, LAHDC Leh, statistical handbook 2018-19. The area under millets is **318 hectares** and production of millets is **21465 quintals**. Whereas, for Kargil data given by the administration of UT of Ladakh, LAHDC Kargil, statistical handbook 2019-20, area under millets is **20 hectares** and production is **80 quintals**. Millets such as foxtail and porso millets are grown as the second crop in the areas of Skilikstey, Poyen, Minjee, Gongma Kargil in Kargil district and in Aryan valley, small area of Domkar village in Leh district. Whereas, buckwheat is grown extensively in Nubra valley, Skurbuchan, Domkar and other parts of Leh and Kargil districts.

Some Millet Grown in Ladakh Includes

1. Foxtail millet (Cha; Ladakhi)
2. Proso millet (tsey-tsey; Ladakhi)
3. Buckwheat (bro, dro, fafar; Ladakhi)

Foxtail millet: There are two types of foxtail millets in Ladakh called as Cha mar (Red foxtail millet) and Cha kar (White foxtail millet). They were one of the earliest cultivated crops in Ladakh. Traditionally people used make chathuk (soup dish), chakur (roti), paba (kneaded flour). Figure 1 & 2 showing picture of different foxtail millets.

Fig. 1: Foxtail millet (Cha mar)

Fig. 2: Foxtail millet (Cha kar)

2. Proso millet: It is known as tsey-tsey in local Ladakhi language. They are made into various dishes and also used as a fodder crop in some parts of Ladakh now. Picture of proso millet is as shown in the figure 3.

Fig.3: Proso millet

3. Buckwheat: Buckwheat is gaining much importance in Ladakh due to awareness among the people and they fetch good price in the market for both whole grain and flour. It is grown in both Kargil and Leh district but mainly grown extensively in Leh district. It is known as bro, dro, fafar in Ladakh and grown in parts of Skurbuchan, Domkhar, Nubra and other parts. There are two variants of buckwheat. The yellow-colored, small-sized, buckwheat called 'brosuk' and black-colored, larger-sized buckwheat called 'gyamrus'. It is used to make in several traditional dishes like tenh-tenh (dosa type), Tapu/prapu (buckwheat small pieces eaten along with walnut curry). Figure 4&5 showing buckwheat seeds and flowers with seeds on plant respectively.

Fig. 4: Buckwheat seeds

Fig.5: Buckwheat flower with seeds

Conclusion

Although, millets were grown traditionally in Ladakh and were part of their food habits but in recent time millets have lost its importance and are now only grown for fodder purpose. Therefore, there is a need to do a lot of work for uplifting millets in the Ladakh region and to realize its importance not only as a healthy nutritious choice of food but also as economically viable crop. Although, millets like buckwheat have gained much of importance due to its health benefits and awareness among the people. Similar, change in the perception among the people can be done for other millets as well. Every agricultural crop such as millets in Ladakh is grown organically and is perceived to be more nutritious and healthier. They can fetch good return in domestic as well as international markets.

Organizing field demonstrations and trainings regarding the high yielding potential varieties that can be introduced from ICAR institutes such as Indian Institute of Millet Research (IIMR) at agriculture institutes of the districts. Low yielding traditional varieties need to be replaced with high yielding varieties in order to realize good returns. Another way is to promote cultivation of millets in drought affected areas and where water is a scare commodity to address water scarcity and promote agricultural practices. Promotion of millets can also be done under Rashtriya Krishi Vikas Yojana (RKVY). Param - paragat Krishi Vikas Yojana (PKVY).

References

1. Dolker R., (2022). Millet: A solution for nutritional security, climate change in Ladakh. Kargilnama, 20-22, October edition.
2. Joshi, B. D. and Paroda, R. S., *Sci. Monogr.*, 1991, **2**, l17.
3. The Administration of Union Territory of Ladakh, Ladakh Autonomous Hill Development Council, LAHDC Kargil, Statistical Handbook 2019-20.
4. The Administration of Union Territory of Ladakh, Ladakh Autonomous Hill Development Council, LAHDC Leh, Statistical Handbook 2018-19.

Gaps and Safe Sites in Seed Ecology

Article ID: 40882

Nivethitha. M[1]
[1]Ph.D Scholar, Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu - 641 003.

Introduction

In most plant communities with a closed canopy, the establishment of seedlings usually requires at least some degree of disturbance to provide areas free of existing vegetation. Established plants have a clear advantage over seedlings in their ability to intercept light and monopolize other resources such as water and nutrients. Gaps that are created by any agency in vegetation can be considered 'competitor-free spaces' that provide opportunities for seedling establishment (Bullock, 2000). The study of gaps and their role in promoting recruitment has been an important focus of investigations into regeneration and species diversity in plant communities over the past few decades.

Gaps, Patches and Safe Sites

Gaps: A gap is an area that is at least partially free of vegetation, where there are sufficient resources available to permit the recruitment of new individuals. Gaps are not always necessary for regeneration, especially in cases where vegetation itself can ameliorate conditions in a harsh environment.

Patches: The term 'patch' is often used in this context to mean much the same as a gap, but it is a less satisfactory term because it suggests something that is stuck on rather than removed. It is perhaps best reserved as a term to refer to the successional vegetation that comes to occupy a former gap.

Safe site: A useful term coined by Harper (1977) is 'safe site'. This is defined as a place (on the scale of the individual seed) where the requirements for dormancy-breaking, germination and establishment are fulfilled and where the effects of predators, competitors and pathogens are reduced. Successful recruitment implies that the microsites available in a gap provided these conditions.

All plant communities are subjected to disturbance, usually of many different types simultaneously. The cause may be abiotic (storms, floods, fires, landslides, frost heave) or biotic (burrowing, wallowing, trampling, scraping and dung deposition by animals). Some animals, such as beavers, can cause major ecosystem disturbance that is both spatially extensive and long-term in its effects (Naiman *et al*., 1994). Even insects can have a surprisingly large influence as gap-creators, especially in mangrove communities (Feller & McKee, 1999). Gaps may occur simply through vegetation processes, for example by the fall of dying trees or even of branches. Turnover in both tropical and temperate forests under natural conditions is in the range 0.5--3.1% per annum (Arriaga, 1988; Ricklefs & Miller,

1999). Disturbance of all kinds is thought to have a major role in the maintenance of species diversity in natural communities (Sousa, 1984; Wooton, 1998).

a. Moderate disturbance may promote species diversity by reducing the dominance of the most vigorous species, so preventing competitive exclusion.
b. Too much disturbance can reduce diversity by preventing the regeneration of longer-lived species.
c. The idea that there is an optimum level of disturbance that results in maximum diversity was put forward by Grime (1973) and later by Connell (1978) as the well-known 'intermediate disturbance hypothesis', and it is supported well by examples in the literature (Sousa, 1979; Collins & Barber, 1985; Hiura, 1995).

Gaps may be of **any size**, depending on the **agent of disturbance**.

a. However, their frequency distribution is usually such that small gaps predominate, with progressively fewer larger gaps (Lawton & Putz, 1988; Cho & Boerner, 1991; Yamamoto, 1995).
b. Since small gaps disappear quickly through growth of the surrounding vegetation.

c. The gap dynamics of most communities consist of a mixture of frequently formed, short-lived, mostly shaded, small gaps combined with infrequently formed, longer-lived, mostly unshaded, large gaps.

Gaps' Difficult to Define and Detect

Sometimes, a gap may be invisible until its existence is revealed by the seedling equipped to fill it. There have been few experimental investigations of the regeneration requirements of individual species. An example is the North American woodland orchid, *Tipularia discolor. An extensive search of deciduous woodlands in* Maryland, USA, revealed that all *Tipularia seedlings were located on decomposing* wood (both logs and stumps) of a wide variety of tree species (Rasmussen and Whigham 1998). Despite much searching, no seedlings were found growing on soil. Experimental sowing of seeds on to soil, decomposing wood and a wood/soil mixture showed clearly that the requirement for wood acts at the germination stage, although the basis of the requirement remains unknown. Moreover, although a safe site for *Lobelia seedlings never contained litter alone or combined only with* higher-plant cover, litter in various combinations with bryophytes generally was favourable. Seedlings of *Betula alleghaniensis establish preferentially on litter-free surfaces,* e.g., soil mounds and pits, irrespective of the presence or absence of a tree canopy (Houle, 1992).

Limitations to Recruitment in Gaps

Recruitment may be limited either by the number of seeds or by the availability of suitable microsites for establishment, or both. The limiting factor depends on the relative numbers of seeds and safe sites per unit area. Seed limitation can be investigated readily by sowing seeds into vegetation to see whether recruitment increases.

Limiting factors for recruitment can operate at any stage in the process. Seed limitation may be due not to low seed numbers but to a failure to arrive in the appropriate microsites because of poor dispersal.

The limiting factor can differ between sites for the same species. In successional vegetation, yew (*Taxus baccata) regeneration was found to be* Herbivore - limited on younger sites but microsite - limited on older sites because seed predation was greater beneath shrubs compared with in the open (Hulme, 1996).

Ehrl'en & Eriksson (2000) found that patch occupancy (number of patches naturally occupied by seedlings of a species as a percentage of suitable sites) ranged from 17.2 to 94.6% among seven species of temperate forest herbs. Percent patch occupancy was correlated negatively with seed mass, suggesting that in many cases recruitment success may be linked quite closely with dispersibility. The sites where seeds actually accumulate (either due to deposition by:

Microtopography of soil surface: The germination of a seed depends on the conditions that obtain in its immediate environment. For many seeds, the relevant scale is measured in millimetres. The microtopography of the soil surface in a gap is of crucial importance in determining how suitable the site will be for regeneration.

The microsite requirements of each species for recruitment are probably somewhat inconsistent and difficult to define precisely because they depend on so many interacting factors. The 'required' microsite varied according to the time of year the cohort emerged (Eldridge et al., 1991). Fowler (1988) obtained similar results for two grass species in Texas, USA, showing that microsite requirements varied from year to year. A safe site today may not be safe tomorrow.

Role of leaf litter in regeneration: Because of the sensitivity of seeds to the microenvironment of the soil surface, the presence of litter can have a crucial influence on whether a gap is able to provide safe sites for seedling establishment. The deposition and decomposition of the dead remains of leaves and other deciduous organs modify conditions on the soil surface considerably, intercepting light, reducing thermal amplitude, releasing nutrients and toxins and reducing evaporation.

Litter in negative effect: Many studies have investigated specific aspects of the role of litter in inhibiting regeneration. In a tropical forest, seeds of certain species have been found to be inhibited strongly by the light filtered through dead leaves in both laboratory and field experiments (V´asquez-Yanes et al., 1990). In other cases, the effect may be due to reduction in water availability (Caccia & Ballare, 1998). Allelopathic toxins also may play a part in the suppression of germination in some species. This was suspected in one experiment on the effects of *Poa pratensis litter on the establishment* of grassland forbs (Bosy & Reader, 1995). An indirect role of litter in regeneration can be as an attractant to invertebrate herbivores. Facelli (1994) found that invertebrate damage to cotyledons (and seedling mortality) in *Ailanthus altissima increased when litter was present.*

Litter can, however, have Positive Effects in Certain Cases

Everham *et al.* (1996) found that seedling establishment of four out of five species in a tropical montane forest was actually facilitated by litter; And in a range of Mexican highland tree species, it was again found to favour germination and establishment (Camacho-Cruz *et al., 2000). In some cases,* litter *may* have the beneficial effect of hiding the seeds from potential seed predators (Cintra, 1997b; Myster & Pickett, 1993). There is no doubt that the response to litter is highly species-specific. In comparisons between species, those with smaller seeds are generally much more inhibited by litter than species with larger seeds, either at the germination or seedling stages (Molofsky & Augspurger, 1992; Peterson & Facelli, 1992) Even within the same species, litter can have different effects at different stages in the regeneration process. Litter had simultaneously a positive effect on individual growth by reducing competition from herbs and a negative effect on numbers by increasing predation and seedling mortality.

References

1. Ari jumpponen. 1999. Characterization of safe sites for pioneers in primary succession on recently deglaciated terrain. Journal of Ecology
2. Fenner, M. and Thompson, K. 2005. The Ecology of Seeds, Cambridge University Press, New York. Heydecker, W. 1973. Seed Ecology, London. Norma l. Fowler *et al*., 1988.

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

Double Stranded RNA (dsRNA) Vaccines – A Novel Strategy for Control of Plant Viruses

Article ID: 40883

Gowtham kumar Routhu[1], Lopamudra Giri[2]
[1]Department of Plant Pathology, Assam Agricultural University, Assam, India.
[2]Department of Plant Pathology, PJTSAU, Hyderabad, India.

Introduction

Biotic and abiotic stress factors pose a significant threat to food security, agricultural sustainability, and biodiversity. According to estimates, the global crop yield experiences a reduction of 20-40% every year due to plant pests and diseases. Plant viral diseases are responsible for causing a yield reduction of approximately 10-15%, resulting in an estimated global economic loss of US$60 billion annually. The safeguarding of plants is predominantly dependent on the utilization of chemical pesticides and fungicides. However, the extensive application of these agents is causing environmental contamination, which is a growing concern for society. Consequently, there is a heightened impetus to explore alternative approaches to pest management. The utilization of sprayable RNA biopesticide, also known as RNA-based vaccines (RBVs), which operates through the RNA interference (RNAi) mechanism, presents a viable substitute for chemical pesticides/fungicides in the management of pathogens and pests. The current era of genomics is anticipated to facilitate the creation of innovative control measures against plant viruses through the utilization of the abundant sequence information available. The present review focuses on the potential of RNA-based vaccination, also known as exogenous RNAi (exoRNAi), as a game-changing method that is safe, selective, low-cost, and rapidly deployable.

Methods of Controlling Plant Viruses

The fundamental tenets of virus control encompass the avoidance or elimination of the infection source, mitigation or reduction of virus dissemination, and fortification of the plant's immunity against viral infection. The control and management of viral diseases can be classified into two main categories: Traditional methods and biotechnological methods.

1. Traditional methods: Effective management of viral diseases in crop plants involves implementing key agronomic and cultural practices such as the removal of virus-infected plants, alternating crops, selecting optimal planting dates, eliminating weed and reservoir plants within and around farms, and utilizing pesticides to control insect vectors responsible for virus transmission. The aforementioned tactics encompass biological management, genetic and induced immunity, proficient cultural methodologies, utilization of natural biopesticides and sanctioned chemicals, and deployment of planting material that is free from and resilient to diseases.

2. Biotechnological methods: The traditional approaches for virus management that have been previously discussed have not yielded complete success in mitigating viral illnesses. The utilization of genetic engineering techniques has facilitated the development of virus resistance, which can be categorized into two main types: pathogen-derived resistance (PDR) and host genetic resistance. RNA silencing (RNAi) mechanism is conserved among all eukaryotes and is an extremely effective natural antiviral defense system in plants is a means to achieve PDR and has proven successful against to defense against several plant viruses.

RNAi-Mediated Plant Virus Resistance

RNA interference (RNAi) or RNA silencing is an endogenous biological process, present in nearly all eukaryotes, that operates through sequence-specific degradation of the RNA (transcriptional) or by translation repression of gene expression, via the action of a multitude of enzymes implicated in the silencing pathway. The RNA interference (RNAi) process is mediated by an endogenous RNAi pathway containing foreign DNA or viral dsRNA. When there is a ds-RNA molecule of viral origin, the enzyme RNase III Dicer (a member of RISC) initiates the pathway to cleave the ds-RNA into brief fragments (21-23 nucleotides in length with 3'overhang) to Si-RNA. ATP will be used as a precursor to transfer the fragments produced by cleavage into the RISC. The RISC will unravel the ds-RNA short fragments (si-RNA, mi-RNA) to generate two strands: the guide strand and the passenger strand. RISC degrades the passenger RNA strand and the guide RNA strand as they proceed to the translation machinery complex, thereby inhibiting gene expression.

Ds RNA (Double Stranded RNA)-Mediated Plant Virus Resistance

Various inducers of the RNA interference (RNAi) pathway, such as hpRNAs, dsRNAs, artificial miRNAs (amiRNAs), and sRNAs, have been utilized to apply the potent antiviral RNAi technology to plants. This has resulted in the induction of viral resistance in diverse pathosystems. Nontransgenic exoRNAi has potential applications in areas where transgenic cultivation is prohibited, in cases where transgenesis is difficult to achieve, and in responding quickly to emerging virus epidemics. The inclusion of a novel protection method in the toolbox could enhance plant resistance against viruses, pathogens, and other pests. DsRNA-mediated protection has proven to be the most reliable and efficient approach for defending plants against several plant viruses. Some of the plant viruses that were successfully controlled by employing a non-transgenic approach via dsRNA application were listed below in Table 1:

Table 1: List of plant viruses that were controlled using exogenous dsRNA on host plants:

Sl. No.	Target virus	Gene targeted	Host plant	Level of protection (%)
1	Pepper mild mottle virus	Replicase	*Nicotiana benthamiana*	82%
2	Potato virus Y	NIb	Tobacco	72 %
3	Tobacco mosaic virus	CP, p126	Tobacco	50% , 65%
4	Papaya ring spot virus	HC-Pro, CP	Papaya	81%, 94%
5	Zucchini yellow mosaic virus	HC-Pro	Cucumber	82%
6	Cucumber mosaic virus	CP	Bhut jolokia	70%-85%
7	Potato virus Y	CP	Potato	80%
8	Tobacco etch virus	HC-Pro	Tobacco	100%
9	Bean common mosaic virus	NIb	Cow pea	53%
10	Tomato spotted wilt virus	N	Tobacco	54%

DsRNA Application Methods

Several application strategies have been employed to deliver dsRNAs onto plants. These include the use of leaf abrasive, medium- and high-pressure sprays, drenching, agroinfiltration, virus vectors, and lately bacteria. recent years, the spray-induced gene silencing (SIGS) method has acquired increased popularity as themost amenable method for dsRNA delivery for crop protection in field applications. Because insects, nematodes, and fungi are able to transmit plant viruses, RNAi-mediated control via SIGS (or host-induced gene silencing) of these organisms is important.

Adjuvants for RNA Delivery onto Plants

The internalization of dsRNA within plant cells and the duration of RNAi triggered by the administered RNA molecules are two crucial elements for the development of an effective dsRNA application strategy. The successful delivery of a dsRNA formulation to the plant cell cytoplasm is impeded by various challenges, including the traversal of the stomata on the plant epidermis and the cell wall that encases the plant cells. Achieving adequate cellular uptake of dsRNA is crucial for the induction of resistance. Various nanocarriers have been synthesized, which possess inherent characteristics to surmount the structural hindrances of plant tissues, as mentioned earlier. The internalization of bioactive molecules such as siRNA and dsRNA into plant cells can be enhanced by binding them to specific carriers. Carbon dots are a class of nanomolecules that are cost-effective and facile to synthesize. They have demonstrated efficacy in delivering drugs in animal models. The utilization of LDH clay nanosheets as a carriers for dsRNA molecules is considered a highly successful example of delivering methods. The utilization of this formulation results in the entrapment of dsRNA within the nanosheets, thereby providing protection against nucleolytic degradation for an extended duration. This protection facilitates the continuous uptake of dsRNA molecules by the cells.

Conclusions and Future Prospects

RNAi technology allows trait-specific engineering of crop plants, however numerous countries' rejection of transgenic plants has stalled crop improvement. However, misuse of chemical pesticides to control insect pests that spread viruses and fungicides against fungal diseases has polluted water and soil resources, causing an ecological imbalance. Uncontrolled usage of these carcinogenic compounds to boost crop production has also harmed human and animal health. RNA-based vaccinations have emerged as a panacea to boost crop yields without harming the environment or valuable lives. In contrast to controlled studies with few plants, open field tests with many plants are affected by extremely changeable environmental influences. RNA sprays must be applied at the right time and frequency to control the target pathogen. Finally, public outreach and stakeholder understanding of this technology would require a massive, transparent, and educational science-based effort.

References

1. Kaldis, A., Berbati, M., Melita, O., Reppa, C., Holeva, M., Otten, P., & Voloudakis, A. (2018). Exogenously applied dsRNA molecules deriving from the Zucchini yellow mosaic virus (ZYMV) genome move systemically and protect cucurbits against ZYMV. *Molecular plant pathology*, *19*(4), 883-895.
2. Routhu, G. K., Borah, M., Siddappa, S., & Nath, P. D. (2022). Exogenous application of coat protein-specific dsRNA inhibits cognate cucumber mosaic virus (CMV) of ghost pepper. *Journal of Plant Diseases and Protection*, 1-8.
3. Routhu, G. K., Borah, M., Siddappa, S., & Nath, P. D. (2023). Topical application of coat protein specific dsRNA molecules confers resistance against cognate Potato virus Y (PVY) infecting potato of North-East India. *Gene Reports*, 101776.
4. Tenllado, F., and Diaz-Ruiz J.R., (2001). Double-stranded RNA-mediated interference with plant virus infection. *J. Virol.* 75(24):12288–97.
5. Voloudakis, A. E., Kaldis, A., & Patil, B. L. (2022). RNA-Based Vaccination of Plants for Control of Viruses. *Annual Review of Virology*, *9*, 521-548.
6. Worrall, E. A., Bravo-Cazar, A., Nilon, A. T., Fletcher, S. J., Robinson, K. E., Carr, J. P., & Mitter, N. (2019). Exogenous application of RNAi-inducing double-stranded RNA inhibits aphid-mediated transmission of a plant virus. *Frontiers in Plant Science*, *10*, 265.

Role of Molecular Genetics in Agriculture

Article ID: 40884

Sherlin Jebisha W [1], Mohamed Yaseen S. K[2], Katta Sravan Naga Parimala Kumar[2]

Introduction

Agricultural production throughout the world is limited by abiotic and biotic stresses. Every year agricultural production is reduced by nearly 33 percent by biotic stresses alone which include insect-pests, pathogens, nematodes and weeds. Crop plants grown under stress environments result in poor yield since they, usually lack the inherent mechanism to grow well under stress. To address the situation of low yield, the science of plant molecular genetics is possibly the only means. Recent advances in plant molecular genetics have elucidated the genetic mechanisms conferring resistance to plants against various biotic and abiotic stresses. Its improved techniques have enabled plants through artificial transfer of genes to suit the changing environment under stress and to produce high yield.

Molecular Genetics in the Improvement of Agricultural Production

Innovative or novel genetic approaches may provide solutions to some of the problems of genetic analysis and the developments of additional genetic variability in plants. Genetic engineering can now be used to transfer the chemical defense mechanism between species by transferring the genes involved in the defence. But the transfer of single gene resistance mechanism is much easier than multigene resistance mechanism using the current gene transfer technology.

Techniques Used in Molecular Genetics

Gene cloning, Genetic engineering, Proteomics, DNA Sequencing, Site-directed mutagenesis, cell culture, DNA feeding and Somatic cell hybridization may enable us to expand the gene pools for disease and pest resistance, greater tolerance to environmental stress increased quality or possibly to develop new plant types.

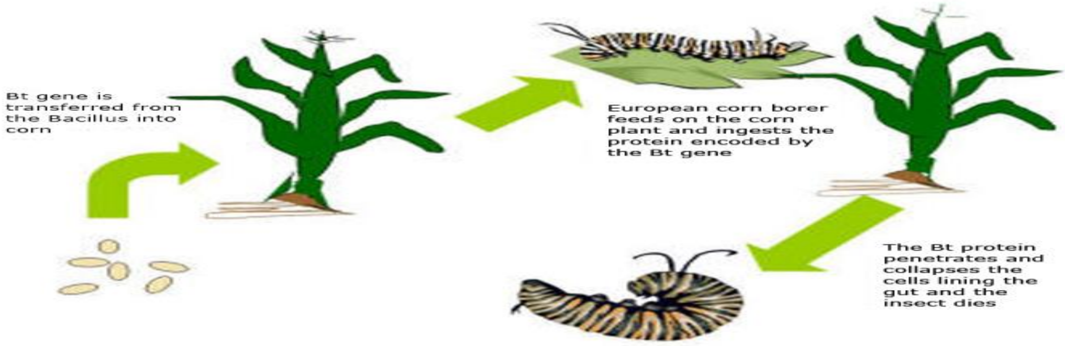
More recently, tools have become available to elucidate the genetics that underlies complex quantitative traits through the identification of chromosomal regions that harbor Quantitative Trait Loci (QTL) and in rare cases, their fundamental mutations. This has opened the door for the use of molecular genetics to enhance breeding programmes.

Molecular Markers: Molecular markers are DNA sequence fragments connected with a genome that are used to identify a certain DNA sequence. With the development of genetic research, molecular markers have become a significant tool for plant breeding. The broad term that describes the use of markers to enhance breeding strategies in Marker-Assisted Selection (MAS). Selection programmes in which MAS has been used include genotype building, which aims to establish lines that combine favorable genes from different lines, and recurrent selection programmes, which aim to enhance the genetic performance of a breeding population for a quantitative trait.

Innovations in Agriculture Using Molecular Genetics

Gene Cloning for Insect Resistance: Transgenic plant is produced by transferring a foreign gene from other source using the techniques of molecular biology Insect-resistant transgenic plant of a crop is developed by the transfer of insect resistance gene from other crop species or microorganism. The foreign genes for insect resistance express itself in the new host and protects the transgenic plant against insect attack.

Bacillus thuringiensis (Bt) crystal protein genes encode insecticidal δ-endotoxins that are widely used for the development of insect resistance crops. This strategy involves engineering plants with a fusion protein combining the *δ-endotoxins Cry1Ac* with the galactose-binding domain of the non-toxic ricin B-chain (RB). This fusion, designated BtRB, provides the toxin with additional, binding domains of, thus increasing the potential number of interactions at the molecular level in target insects. Transgenic rice and Maize plants engineered to express the fusion protein were significantly more toxic in insect bio-assays than those containing Bt gene alone. They were also resistant to wider range of insects, including important pests that are not normally susceptible to Bt toxins.



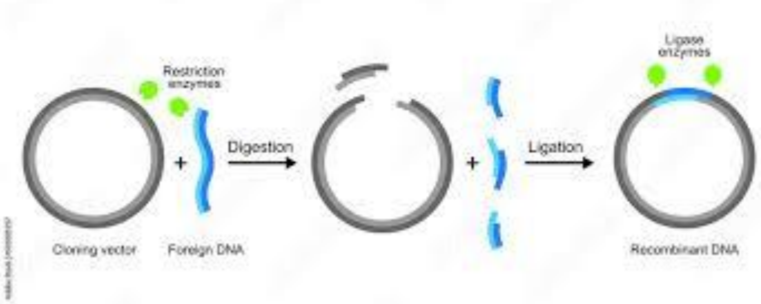
Genetic Engineering for Fungal Pathogen Resistance in Crops

The introduction of natural resistance by traditional breeding approaches includes non-transgenic breeding programs, such as DNA-based marker-assisted selection that may require several cycles of breeding to combine the disease resistant trait and desirable ornamental characteristics into a single plant genotype, in ornamental pants recently. In contrast, the transgenes to introduce specific or broad-spectrum disease resistance to genotypes with elite ornamental qualities. Tolerance to several fungal diseases has been achieved by transferring various genes such as glucanase, chitinase, defensin, osmotin and pathogenesis-related (PR) genes into ornamental plants. *RNA interference (RNAi)* strategies have demonstrated the potential to protect plants against pathogens, and one of the strategies is host-induced gene silencing (HIGS).

In addition to HIGS, a novel strategy designated as 'Spray-induced gene silencing' (SIGS) has been demonstrated to protect plants from fungal pathogens through the direct spraying of ds RNA-targeting pathogen genes in plant tissues thus displaying the potential to be used as an alternative to conventional fungicides. Furthermore, advances in genome editing technology and its applications have offered greater possibilities with regard to precise manipulation of the genome sequences at genes of interest, and these techniques are currently being used to improve disease resistance in plants. Research advances, such as biotechnological advancements are used for improving resistance against fungal disease in some economically important ornamentals such as the rose, Chrysanthemum, Gerbera, Lily, Carnation and Petunia.

Gene Cloning for Bacterial Resistance

Many different genetic strategies have been proposed to engineer plant resistance to bacterial diseases, including producing anti-bacterial proteins of non-plant origin, inhibiting bacterial pathogenicity or virulence factors, enhancing natural plant defenses and artificially including programmed cell death at the site of infection.



Crop pathologists and breeders are pursuing not only mechanistic understanding of plant pathogen interactions but also engineered durable and broad-spectrum disease resistance cultivars by genes like *Xa1, Xa2, Xa3, Xa26, Xa8* and *Xa9*. Both goals are achieved in three recent studies by editing of regulatory elements within promoters of susceptibility genes for bacterial bright disease in Rice.

Gene Cloning for Virus Resistance in Crops

Virus resistant crops can be developed by either of the two methods namely,
1. By exploiting the naturally occurring virus resistance genes.
2. By constructing artificial virus resistance genes in transgenic plants.

Transposon tagging has been widely employed in extracting numerous pant genes from naturally occurring virus resistance genes. The Maize transposon Ac could potentially be used for this purpose.

Virus resistance in plants can be developed by expressing the *virus coat protein (CP) genes* in plant cell. Transgenic tobacco and tomato plants that express the CP genes of the common Strain (UI) of TMV were constructed and found to be partly resistant to TMV infection (Powell et al., 1986; Nelson et al., 1988). The CP genes were expressed under the control of a 35s promoter. The transgenic plants either did not show symptoms of TMV or delayed the symptom development indicating the development of resistance.

Breeding for Herbicide Resistant Varieties

Genetic engineering techniques for the transfer of herbicide resistance gene have mostly employed the Ti-plasmid vector of the soil bacteria *Agrobacterium tumefaciens*. The transformants showing herbicide resistance property have been selected by using Kanamycin resistance property conferred by the *NPT II gene*. This marker gene is carried on the Ti-plasmid vector in tandem with the herbicide resistant gene. High level expression of herbicide resistance gene in transformants has been obtained by using the constitutive *cauliflower mosaic virus 35s* promoter gene. This promoter has been widely used in both dicot and monocot plant species for the expression of alien genes.

Conclusion

The spectacular growth of plant genetics over the last few decades has in turn made possible transfer of genes across plant species even with sexual barriers. Plant molecular genetics has now come-up with several sophisticated methods of tailoring plant genome. Using these methods, plants have been developed having resistance to various biotic (insects, diseases, nematodes etc.) and abiotic stresses (Heat, cold, drought, flood). Plants resistant to herbicide have been produced by using the tools of plants molecular genetics to combat weed menace in commercial cultivation. Genes for seed storage proteins from both cereals and legumes have been successfully transferred and expressed in tobacco endosperm. The plant molecular genetics plays vital contributions to humanity. Further study in molecular genetics, could render tremendous benefits in the field of agricultural sciences.

References

1. Bryan C. Gibbon., Brian A. Larkins., 2005. Molecular genetic approaches to developing quality protein Maize. Trends in Genetics. Volume 21, Issue 4, Pages 227-233.
2. Jack C. M. Dekkers. 2002. The use of molecular genetics in the improvement of agricultural populations. Nature Reviews Genetics 3, 22-32.
3. Holl, F. B., 1975. Innovative approaches to genetics in agriculture. Canadian Journal of Genetics and Cytology 17(4), 577-524.
4. John A. Gatehouse., Paul Christou.,Teresa Capell. 2005. An alternative strategy for sustainable pest resistance in genetically enhanced crops. Proceedings of the National Academy of Sciences 102(22), 7812-7816.
5. Sharma, H. C., 2001. Transgenics, Pest management and the environment. Current Science, 421-437.

Functional Uses of Lipids and Proteins in Food Industry

Article ID: 40885

Sukomaljot Kour[1], Anju Bhat[1], Anjali Langeh[1]
[1]Division of Post Harvest Management, Sher-e-Kashmir University of Agricultural Sciences and Technology-Jammu, Chatha- 180009, Jammu and Kashmir, India.

What are Lipids?

Lipids are fatty, waxy, or oily compounds that are soluble in organic solvents and insoluble in polar solvents such as water. Lipids include: Fats and oils (triglycerides).

Functional Role of Lipids in Food Industry

The presence of fat significantly enhances the organoleptic perception of foods, which partly explains the strong preference and market advantage of fat-rich foods. As a class, lipids contribute many desirable qualities to foods, including attributes of texture, structure, mouthfeel, flavor and color.

Lipids are defined on the basis of their solubility characteristics, not primarily their chemical composition. The term “lipids” is defined as those organic molecules that are insoluble in water, soluble in organic solvents (e.g., chloroform, methanol, ether), contain hydrocarbon groups as primary parts of the molecule, and are exist in or derived from living organisms.

Compound classes covered in this definition or classification include fatty acids (FAs), acylglycerols, fatty acids esters, and isoprenoid hydrocarbons. Further compounds also included are regularly considered as belonging to different classes, such as carotenoids, sterols, and the vitamins A, D, E, and K. Lipids tend to be categorized as “simple” or “complex,” referring to the size or structural detail of the molecule. The group of simple lipids includes fatty acids, hydrocarbons, and alcohols, all of which are comparatively “neutral” in terms of charge.

While complex lipids, for instance glycolipids and phospholipids, are relatively more charged and are also referred to as “polar.” Fats and oils are fractions of lipids, mainly composed of triglycerides with great importance in food systems, and they are formed through the esterification of fatty acids molecules with one molecule of glycerol.

Lipid oxidation is one of the major reasons of quality retrogradation in natural and processed food products. Oxidative retrogradation is a large economic issue in the food industry because it affects many quality parameters such as flavor (rancidity), texture, color, and the nutritive value of foods. Furthermore, it results in the production of potentially poisonous compounds.

Lipid oxidation is one of the major factors that limit the shelf life of foods. In addition, the oxidative instability of the polyunsaturated fatty acids frequently limits their applications as nutritionally beneficial lipids in functional foods production.

Types and Functions of Lipids

Functional lipids for instance, omega-3 and omega-6 fatty acids, conjugated linoleic acids, medium chain triglycerides, and phytosterols have numerous positive influences on human health such as in obesity, blood pressure, cardiovascular diseases, bone health, and in treating and managing depression. There is some misunderstanding between lipids and fats, since not all lipids are fats, but all fats are lipids. There are numerous types of lipids to discover before completely understanding their functions, these types include the following:

Triglycerides: Triglyceride molecules are composed of three of fatty acids and one molecule of glycerol. The fatty acids may be either saturated or unsaturated. Triglycerides have the ability to float in a cell’s cytoplasm since they have a lower density compared to water and are non-soluble, as is the case with all lipids. A triglyceride can be categorized as a fat if it converts to a solid at a temperature of 20°C, otherwise that are classified as oils. They are fundamental in the body for energy storage.

Steroids: Steroids are these organic compounds mainly composed of four rings arranged in a specific configuration. A few categories of common steroids are cholesterol, vitamin D2, estrogen and testosterone. These fractions of lipids have two main biological roles: certain steroids (such as cholesterol) are substantial constituents of cell membranes which change the fluidity of membranes, and many steroids are signaling molecules which stimulate steroid hormone receptors.

Phospholipids: Phospholipids can be defined as lipids containing phosphorus. They received their name as their constitution is primarily phosphate groups. They contain molecules that both attract and repel water, playing a key role in the organization of cell membranes structure. There are two major groups of phospholipids; glycerophospholipids and sphingolipids.

Glycolipids: Glycolipids are lipids with a carbohydrate attached by a glycosidic bond. Short sugar chains form glycolipids, which can be found in a cellular membrane's exoplasmic surface. They play an important role in enhancing the body's immune system, as well as helping to maintain the stability of the membrane and attaching cells to one another to form tissues.

Applications of Lipids in Food Industry

1. Role and Changes of Plant Lipids in Processed Foods: Plant lipids have the ability to increase the nutritional values of foods. They also contain tocopherols and tocotrienols, which are the major essential sources of vitamin E. Lipids affect the functional properties of foods; for example, they help to retain carbon dioxide in dough, thus increasing the final volume of bakery products. The main importance of lipids is their influence on the sensory properties. They affect the texture and increase the viscosity of the morsel after mixing with saliva; high viscosity is appreciated by many consumers. The most desirable influence of lipids is their effects on the odor and flavor of food products. Plant lipids, being more unsaturated than animal lipids, produce different flavor notes as a result of culinary operations. Flavors originating at roasting or frying temperatures are particularly appreciated.

2. Frying Oils and Fats: The using of oils and fats as a frying medium in both shallow and in deep frying mode is an important component in the overall picture of food applications. Recently, it has been reported that 20 million tons of oils and fats is used in this way. This represents a major share of the 90 million tonnes used for dietary purposes. Of course, it should be taken in mind that while some of the frying oil is consumed along with the fried foods, much is thrown away (shallow pan frying) or ultimately finds other uses as spent frying oil.

3. Spreads: Butter, Ghee Butter. For many centuries, butter from cow's milk fat has been mainly used as a spread, but also for baking and frying purposes. Butter has become less widespread with the continuous development of good-quality margarine and other spreads. The are some disadvantages associated with butter such as, its comparatively high price, its poor spread-ability (especially from the refrigerator), and its poor health profile resulting from its high fat content, its high content of saturated fatty acids and cholesterol, and the presence of trans unsaturated fatty acids. Butter has the advantages of its completely natural profile and its splendid flavor.

4. Ghee: Milk fat can be consumed partly as butter but also as ghee, however the latter is declining and is now probably below one-quarter of the combined total. Ghee is a concentrate of butterfat with more than 99% of milk fat and less than 0.2% moisture. It has a shelf life of 6- 8 months even at ambient tropical temperatures. Butter or cream is converted to ghee by controlled heating to reduce the content of water to below 0.2%. In other procedures the aqueous fraction is allowed to separate and some of it is run off before residual moisture is removed by heating. Ghee is distinguished by a cooked caramelized flavor varying slightly with the method of preparation

5. Baking Fats, Dough and Shortening: The application of oils and fats in baking processes ranks with frying and spreads as a major food use of these materials. The products range from breads and layered dough to cakes, biscuits (cookies) and biscuit fillings, pie crusts, short pastry, and puff pastry. The fats used to produce this wide range of baked goods vary in their properties and particularly in their melting behavior and plasticity. It is possible to achieve these properties with different blends of oils, and preferred mixtures vary in different areas of the world.

6. Lipids Oxidation: The mechanism of lipids oxidation is shown in Fig. Lipid oxidation or rancidity is clearly the major challenge for stabilizing specialty oils, particularly since oils with special nutraceutical properties have predominantly polyunsaturated fatty acids. While there is relatively little data yet available regarding oxidation of specialty oils per se, all oils follow the same fundamental processes, modified by endogenous pro- and antioxidants and innate variances in fatty acid composition.

What are Proteins?

Functional role of Proteins in Food Industry: The techno-functional properties of proteins such as their **water- and oil-binding capacities, solubility and emulsification and foaming properties** influence food processing, preparation and storage, in addition to contributing to the quality and organoleptic properties of foods. In addition to their biological role in sustaining the functions of living organisms, proteins also play important roles in foods providing taste, texture and flavor, which are essential criteria for food selection. Due to their versatile functionality and complex molecular structure, proteins have also been explored in many industrial applications. Some recent examples include adhesives, protein plastics, gels, coating, additives and biomaterials. Protein scaf-folds and cross-linked networks also hold much promise for use in the pharmaceutical industry.

Protein Separation Processes in Food and Bioproduct Manufacturing

Protein separation process in food and by-product manufacturing: Proteins can be processed to obtain enriched flours, concentrates or isolates for various food and bioproduct applications. In this chapter, the term bioproduct is used to indicate functional foods, nutraceutical products, cosmetic products and other industrial (non-food) products. In general, protein flours may contain up to 65% w/w protein on a dry basis (db), whereas concentrates and isolates contain >65% (w/w, db) and >80–90% (w/w, db) protein, respectively. Microbiological and quality standards will vary for different applications. Proteins used in the food and bioproduct sectors are derived from either animal or plant sources, which vary significantly in their lipid, carbohydrate and protein content. Proteins of interest may be separated using dry or wet processing techniques. Dry processing primarily involves air classification and is frequently applied to plant materials such as cereals (e.g., wheat) and grain legumes (e.g., peas, chickpeas, lentils) containing high amounts of starch and protein. Wet processing has several processing steps. Some of the major unit applications of proteins in food industry.

Applications of Protein in Food Industry

1. Slab gel electrophoresis: Electrophoresis is widely applied for protein separation and characterization. The technique involves the separation of proteins on the basis of their mobility in an electric field. Proteins move with different speeds depending on their charge, shape and size. Polyacrylamide gels (PAG), which are formed by the copolymerization of acrylamide monomers with a cross-linking agent such as bisacrylamide, are generally used as the matrix for electrophoresis. Different types of gels containing a linear or non-linear concentration gradient of polyacrylamide can be used to optimize protein separation.

2. Native Polyacrylamide Gel Electrophoresis (PAGE): PAGE under native conditions has been used to separate soluble proteins which retain their biological and enzymatic properties. Factors affecting the migration of proteins in native PAGE are: size, shape, and native charge A derivative method from native PAGE developed by Schägger and Von Jagow (1991), known as Blue Native PAGE, was originally used for the qualitative and quantitative analysis of mitochondrial protein complexes and proteins ranging in molecular weights from 10 to 10 000 kDa

3. SDS-PAGE Sodium dodecyl sulfate: (SDS) is an anionic detergent that denatures proteins through specific binding to the hydrophobic tail around the polypeptide backbone, giving a net uniform negative charge per molecule. The binding of SDS unfolds the protein as a consequence of hydrogen bond cleavage, and blockage of hydrophobic interactions. Consequently, electrophoretic separation is only dependent on the molecular weight and proteins migrate in the anodal direction. Moreover, proteins can be denatured by the addition of strong reducing agents, such as dithiothreitol (DTT) or ß-mercaptoethanol, which disrupt disulfide bonds between cysteine residues, allowing a more detailed characterization of proteins.

4. Immunoelectrophoresis: Immunoelectrophoresis is a specific method characterized by the presence of polyclonal monospecific antibodies against a specific protein in the agarose gel. The running buffer used in this method should have a pH corresponding to the isoelectric point of the antibody. The fixation of the latter in the gel leads to the formation of a precipitate comprised of the antigen and the specific antibody, which may be visualized by using a Coomassie blue stain or some other suitable technique Immunoelectrophoresis has been used for the qualitative and quantitative analysis of individual proteins in complex mixture.

5. Isoelectric focusing: (IEF) is an electrophoretic method that separates proteins based on their isoelectric points (pI, neutral charge state). The migration is performed in the presence of a continuous pH gradient generated using carrier ampholytes or immobilized pH gradients gels. After migration according to their charge, proteins attain a steady sate when they reach the pH value corresponding to their pI. The technique is commonly used in combination with SDS-PAGE in 2D electrophoresis. IEF can also be performed under native conditions

6. Capillary electrophoresis: New developments in the field of capillary electrophoresis (CE) offer a powerful tool for the rapid separation of proteins Separation of proteins by CE is based on electrophoretic migration driven by an electroosmotic flow (EOF) and occurs in capillary tubes, filled with background electrolytes (BGE)) following similar principles as for standard electrophoresis. CE is characterized by high efficiency, short time of analysis, low consumption of samples and running buffers, and possible connectivity to detectors originally designated for liquid chromatography, including mass spectrometry. Examples of CE use in protein analysis include successful quantification of 7 S and 11 S fractions in several soybean varieties characterization of cereal proteins), and the analysis of casein/caseinate addition in processed cheeses.

Conclusion

Lipids have a functional and significant role in foods because of their contribution to palatability, satiety, and nutrition. Consequently, lipid quality is a very important issue to consumers and may show a relation to numerous health problems. Lipid oxidation is a major problem in many areas of the food industry. Delaying lipid oxidation not only prolongs the shelf-life of the products but also decreases raw material waste, nutritional loss, and widens the range of lipids that can be used in specific product. Therefore, by controlling lipid oxidation, food processors can use more available, less costly and/ more nutritionally favorable oils for product preparations wherein, proteins play a key role in food, feed, and in many health and industrial applications. Due to their versatility, the market for semi-purified and highly purified proteins is likely to grow. There has been significant effort to identify novel sources of healthy and functional proteins. Additionally, optimization of the processing conditions for the current techniques and the development of new processes that could enhance protein and lipids functionality while increasing its health benefits and nutritional properties would be extremely useful.

References

1. Kates M, Kates M. Techniques of lipidologyisolation, analysis and identification of lipids1986.
2. Rios RV, Pessanha MDF, Almeida PFd, Viana CL, Lannes SC ds. Application of fats in some food products. Food Science and Technology (Campinas) 2014; 34:3-15.
3. Rao M. Phase transitions, food texture and structure. Texture in food 2003; 1:36-62. [4] Kołakowska A, Sikorski ZE.
4. Lipids and Food Quality. Chemical, Biological, and Functional Aspects of Food Lipids 2010:71.
5. Damodaran S, Parkin KL, Fennema or. Química de alimentos de Fennema: Artmed Editora; 2009.
6. Halliwell B, Aeschbach R, Löliger J, Aruoma O. The characterization of antioxidants. Food and Chemical Toxicology 1995; 33:601-17.
7. Alabdulkarim B, Bakeet ZAN, Arzoo S. Role of some functional lipids in preventing diseases and promoting health. Journal of King Saud University-Science 2012; 24:319-29.
8. Voet D, Voet JG, Pratt CW. Fundamentals of biochemistry: Life at the molecular level. 2016.
9. Eymard S, Baron CP, Jacobsen C. Oxidation of lipid and protein in horse mackerel (Trachurus trachurus) mince and washed minces during processing and storage. Food Chemistry 2009; 114:57-65.
10. Horwitz W. Peroxide value of oils and fats. Official methods of analysis of AOAC international 2002; 41:16.

Millets for Healthier Life and Sustainable Agriculture

Article ID: 40886

S. A. Shendekar[1], M. R. Meshram[1], D. P. Gadpayale[2]
[1]PhD Scholar, Department of Agril. Botany, Post Graduate Institute, MPKV, Rahuri. MS-413722
[2]PhD Scholar, Division of Biochemistry, ICAR-IARI, New Delhi-110012.

United nation declared 2023 as “International year of millets”. Therefore, millets became in limelight now a day. Because of potential health benefits of millets, it’s getting popularity in the scientific world, to improve the millets in all way. Millets is a group of species under cereals. Generally, it’s says that, all millets are cereals but all cereals are not millets. Millets having small grain size and having high nutritional values than broad cereals such as maize. Millets are small-seeded with different varieties such as pearl millet (*Pennisetum glaucum*), finger millet (*Eleusine coracana*), kodo millet (*Paspalum setaceum*), proso millet (*Penicum miliaceum*), foxtail millet (*Setaria italic*), little millet (*Panicum sumatrense*), and barnyard millet (*Echinochloa utilis*).

At world level, India is highest millet producing country. Millets are good source of proteins, vitamins, minerals and fibers. Millets, such as pearl millets having highest content of Zn and Fe which can be used to cure such nutrient deficiency. Finger millets having three times more calcium than milk, so that it can be use as substitute for milk. Generally, all the millets having low glycemic index. Glycemic index (GI) is nothing but, when we take any food, how much time it will release in blood. It takes longer time to digest than other foods. Low-GI foods can help keep your blood sugar from spiking after eating, which allows people with diabetes to manage their blood sugar levels more easily. Millets having low glycemic index used to prevent diabetes in certain extent. Another important health benefit is; it contains high amount of antioxidant’s. So, it can be used to prevent heart diseases. Some millets are rich in niacin which are used to increase the enzymatic rate of reactions in body.

Some millets are rich in dietary fibers which are soluble and insoluble both. These insoluble fibers are nothing but prebiotic. These stimulate the growth of good bacteria in digestive canal. This also help to reduce the colon cancer level. The increased consumption of millets and millets products has been associated with reduced risk of developing chronic diseases such as cardiovascular disease, type 2 diabetes, some cancers, and all-cause mortality. It also contains phytochemicals in considerable amount which can help to tackle problems associated with various diseases. Phytochemicals are generally available in fruits, but some peoples are unable to purchase the fruits, they can take millets.

The calorie content of millets is low. It can be used for weight loss. Millets keep our body sustain longer than other type of food. It’s also used to build immunity. Millets provide a great source of protein and can help develop and strengthen our immunity. Stronger immunity means fewer chances of you catching diseases.

Millets remain planet friendly crop and hence receive attention of climate change initiatives and sustainable environment practices. These crops having low water footprint. For eg. For production of 1 kg of rice, 5000 liters of water required. But millets like, pearl millet can withstand extreme drought. All millets are short duration crops which can fit any cropping systems. These are photosensitive, so it can be grown in any environment’s. Millets grown on marginal and low fertility soil conditions. All millets are C_4 plants and kranz anatomy is present. Kranz anatomy that is presence of mesophyll and bundle sheath cells. Due to this structure, it can’t fix oxygen and utilize Co_2 in better way. All millets are having low carbon footprint. These help to stabilize the greenhouse emission, which help to tackle the problem of climate change.

In this way, millets are ray of hope to combat nutrition issues and help to tackle the problem of climate change.

E-ISSN: 2581 - 8317

Consumer Preference Traits of Vegetable Pigeon Pea

Article ID: 40887

A. Thanga Hemavathy[1]
[1]Associate Professor (PBG), ADAC & RI, Trichy, Tamil Nadu.

Vegetable Pigeonpea has a wide range of uses and its use as fresh or canned green peas is common in parts of India, Africa, Central America and the Caribbeans. Vegetable pigeonpea is characterized by large pods and seeds because of easy shelling. Some parts of India prefer green pod colour but the literatures revealed that pod colour does not play an important role in determining the organo-leptic qualities of vegetable pigeonpea. The anti-nutritional factors like phyto-lectins are also present in pigeonpea, but it is heat sensitive and destroyed during cooking. Vegetable pigeonpea can be grown in backyards, field bunds and also as a commercial crop. The fresh seeds can also be frozen and canned for commercialization and export. The Dominican Republic stands first in exporting commercialized vegetable pigeonpea to United States and other countries. Vegetable pigeonpea is a good source of protein, vitamins (A,C, B complex), minerals (Ca, Fe, Zn, Cu), carbohydrates and dietary fibre. In comparison to green peas (*Pisum sativum*), the vegetable pigeonpea has five times more beta carotene content, three times more thiamine, riboflavin and niacin content and double vitamin 'C' content. Besides it has higher shelling percent (72%) than that of green peas (53%). These all factors indicate that pigeonpea is nutritionally rich vegetable and it can be used in daily cuisine. Also in some parts of India including Karnataka and Gujarat, the use of immature shelled seeds is very common as fresh vegetable. Besides this, in the tribal areas of various states, the use of pigeonpea as green vegetable is very common. The recipes prepared with green pigeonpea seeds are nutritive and tasty and are consumed with rice as well as chapati. Green peas in the form of frozen or canned products are also available for use as vegetable in the markets of USA and Europe.

One of the important attribute of vegetable pigeonpea is fresh pod colour: There is a large variation for fresh pod colour in pigeonpea and for vegetable market, green podded pods fetch better price in the market however, fresh seeds harvested from purple pods had poor texture, flavour,and taste as compared to those of green seeds; but after cooking operation such differences disappeared, suggesting that the pod colour does not play any important role in determining the organo-leptic qualities of vegetable pigeonpea. In a survey conducted in Gujarat state of India, where vegetable pigeonpea is consumed on a large scale, it was found that the rural consumers preferred pods with green base colour with minor or dense streaks on its surface. In contrast, the urban consumers preferred green colour pods. The pods produced on cultivar 'ICP 7979' were the most preferred because of their good taste, attractive green colour, less stickiness, and easy shelling. For vegetable purposes, generally large pods are preferred for they are attractive and relatively shelled easily. Cultivars with white seedcoat are preferred because the cooking water remains clear when such seeds are cooked. Sweetness of fully grown immature seed is also a preferred trait. Sweetness of fully grown immature bean is also a preferred trait.Marketing of green peas in frozen form and as canned products are exported to other countries since the shelling percentage of vegetable pigeon pea is 72% compared to 53% of green peas. This practice is more prevalent around cities where green pods can readily be marketed at attractive prices. After harvesting green pods, the crop is left for producing dry seeds. Such dual purpose varieties are very profitable for peri–urban farmers. Cultivars with white seed coat are preferred because the cooking water remains clear when such seeds are cooked.

But In India, the marketing of vegetable pigeon pea is not well organized. It is due to low production, lack of Commercialization of Vegetable Pigeon Pea, Lack of awareness about the nutritive value, and lack of government Conventions in promoting vegetable pigeon pea. In India, small local markets in some states like Gujarat, sell fresh vegetable pigeon pea. Currently, the supply of vegetable pigeon pea is mostly seasonal, and is affected by demand, traits and growing conditions in various environments. Consumer Preferences directly influence the marketing status of Vegetable pigeon pea

Fresh Pod Color: In different states of India preferences of Vegetable pigeon pea vary from market to market. Green pods fetch better price in the market

Pod and bean size: For vegetable purposes, generally large pods are preferred for they are attractive and relatively shelled easily.

Other Marketing preferences are organo-leptic properties, sweetness, cultivars which have a maximum of 2-3 pickings to ensure good profit and run processing factories for longer periods.

Functional Role of Lipids in Food Industry

The presence of fat significantly enhances the organoleptic perception of foods, which partly explains the strong preference and market advantage of fat-rich foods. As a class, lipids contribute many desirable qualities to foods, including attributes of texture, structure, mouthfeel, flavor and color.

Lipids are defined on the basis of their solubility characteristics, not primarily their chemical composition. The term "lipids" is defined as those organic molecules that are insoluble in water, soluble in organic solvents (e.g., chloroform, methanol, ether), contain hydrocarbon groups as primary parts of the molecule, and are exist in or derived from living organisms.

Compound classes covered in this definition or classification include fatty acids (FAs), acylglycerols, fatty acids esters, and isoprenoid hydrocarbons. Further compounds also included are regularly considered as belonging to different classes, such as carotenoids, sterols, and the vitamins A, D, E, and K. Lipids tend to be categorized as "simple" or "complex," referring to the size or structural detail of the molecule. The group of simple lipids includes fatty acids, hydrocarbons, and alcohols, all of which are comparatively "neutral" in terms of charge.

While complex lipids, for instance glycolipids and phospholipids, are relatively more charged and are also referred to as "polar." Fats and oils are fractions of lipids, mainly composed of triglycerides with great importance in food systems, and they are formed through the esterification of fatty acids molecules with one molecule of glycerol.

Lipid oxidation is one of the major reasons of quality retrogradation in natural and processed food products. Oxidative retrogradation is a large economic issue in the food industry because it affects many quality parameters such as flavor (rancidity), texture, color, and the nutritive value of foods. Furthermore, it results in the production of potentially poisonous compounds.

Lipid oxidation is one of the major factors that limit the shelf life of foods. In addition, the oxidative instability of the polyunsaturated fatty acids frequently limits their applications as nutritionally beneficial lipids in functional foods production.

Types and Functions of Lipids

Functional lipids for instance, omega-3 and omega-6 fatty acids, conjugated linoleic acids, medium chain triglycerides, and phytosterols have numerous positive influences on human health such as in obesity, blood pressure, cardiovascular diseases, bone health, and in treating and managing depression. There is some misunderstanding between lipids and fats, since not all lipids are fats, but all fats are lipids. There are numerous types of lipids to discover before completely understanding their functions, these types include the following:

Triglycerides: Triglyceride molecules are composed of three of fatty acids and one molecule of glycerol. The fatty acids may be either saturated or unsaturated. Triglycerides have the ability to float in a cell's cytoplasm since they have a lower density compared to water and are non-soluble, as is the case with all lipids. A triglyceride can be categorized as a fat if it converts to a solid at a temperature of 20°C, otherwise that are classified as oils. They are fundamental in the body for energy storage.

Steroids: Steroids are these organic compounds mainly composed of four rings arranged in a specific configuration. A few categories of common steroids are cholesterol, vitamin D2, estrogen and testosterone. These fractions of lipids have two main biological roles: certain steroids (such as cholesterol) are substantial constituents of cell membranes which change the fluidity of membranes, and many steroids are signaling molecules which stimulate steroid hormone receptors.

Phospholipids: Phospholipids can be defined as lipids containing phosphorus. They received their name as their constitution is primarily phosphate groups. They contain molecules that both attract and repel water, playing a key role in the organization of cell membranes structure. There are two major groups of phospholipids; glycerophospholipids and sphingolipids.

Glycolipids: Glycolipids are lipids with a carbohydrate attached by a glycosidic bond. Short sugar chains form glycolipids, which can be found in a cellular membrane's exoplasmic surface. They play an important role in enhancing the body's immune system, as well as helping to maintain the stability of the membrane and attaching cells to one another to form tissues.

References

1. Vegetable pigeonpea – a review K.B. SAXENA, R.V. KUMAR and C.L.L. GOWD A International Crops Research Institute for the Semi-Arid tropics (ICRISAT), Patancheru-502 324,
2. Saxena KB, Faris DG and Kumar RV. 1984. Breeding for special traits Pigeonpea Breeding Annual Report, International Crops Research for the Semi-Arid Tropics, Patancheru, India. P 99.

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

Current Scenario of Ground Water Development in India and its Implications

Article ID: 40888

Geetha M. L[1], Nandini Saha[1]
[1]ICAR-Indian Agricultural Research Institute, New Delhi.

Introduction

Ground water is defined as all water that occurs in the soil and geological formations below the land surface and an aquifer is a geologic formation capable of yielding usable quantities of ground water to wells or springs (Central Ground Water Board, CGWB). In recent decades ground water has steadily emerged as the backbone of India's agriculture as it accounted for around 62.7 percent of the net irrigated area in India which highlights the critical role that ground water plays in meeting India's irrigation needs, particularly in areas with limited surface water resources in increasing crop yields and ensuring food security for the country (Ministry of Agriculture and Farmers Welfare, 2019-20). Ground water is also used by industries for various purposes such as cooling, processing, and washing, and in rural areas, it is the primary source of drinking water where it accounts for over 85 percent of the drinking water supply. Even in urban areas, it is a significant source of drinking water, particularly in cities that face water shortages.

Economic Implications

Overexploitation of ground water has led to declining water levels and poor water quality in many parts of the country. This has led to adverse impacts on agriculture, livelihoods, and the environment, including land subsidence, waterlogging, and salinization. As a result, ground water irrigation is heading for a crisis and needs urgent attention and understanding in India. Since the growth in ground water irrigation has not been largely government or policy driven and has happened mainly through highly decentralized private activity, the ground water revolution has gone largely unnoticed. However, despite its huge significance and importance, the number of irrigation blocks labelled as overexploited is increasing at an alarming rate. The sinking of new wells continued rapidly at enormous private, public, and environmental costs. Therefore, managing ground water resources will clearly have serious implications for the future growth and development of the water resources, agriculture, and food sectors in India.

Hence, India faces a significant challenge in balancing the demand for ground water for agriculture, drinking water, and industrial use with the need to conserve this finite resource. The report notes that the overexploitation of ground water has led to declining water levels and poor water quality in many areas of the country. This, in turn, has led to adverse impacts on agriculture, livelihoods, and the environment (India Infrastructure Report, 2021). In recent years, there has been growing recognition of the need to conserve and manage India's ground water resources effectively. Several government initiatives, such as the National Aquifer Mapping and Management Program, have been launched to better understand and manage India's ground water resources. There is also a need for greater public awareness and participation in ground water management to ensure sustainable and equitable water use for future generations.

Ground Water Development

There are two main components to be understood to know the Ground Water Development in India, they are

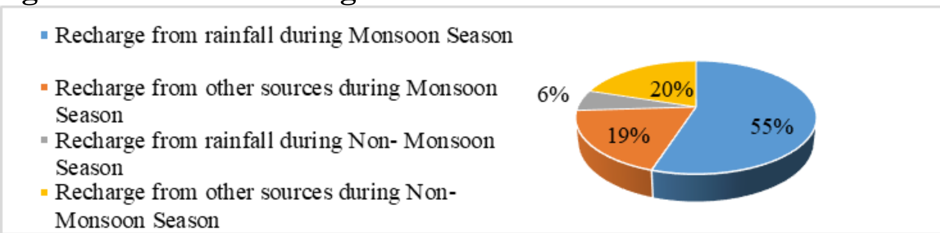
1. Ground water resources/recharge
2. Ground water draft.

Ground Water Resources

The dynamic ground water resources are also known as annual replenishable ground water resources because ground water gets recharged every year. The current annual replenishable ground water resource for the entire country has been assessed as 437.6 billion cubic meter (bcm) out of which, the net annual ground water availability for the country is 398 bcm i.e., after deducting natural discharge (36.85 bcm) from annual replenishable ground water resource.

Major sources of ground water recharge in India: The monsoon rainfall is the primary contributor to the recharge of ground water in India, accounting for 55 percent (245.85 bcm) of the annual replenishable resource. Rainfall, which includes both monsoon and non-monsoon periods, accounts for 61 percent of the country's annual replenishable ground water resources. The remaining 39 percent of the annual replenishable ground water resources come from other sources such as canal seepage, return flow from irrigation, recharge from tanks, ponds, and water conservation structures.

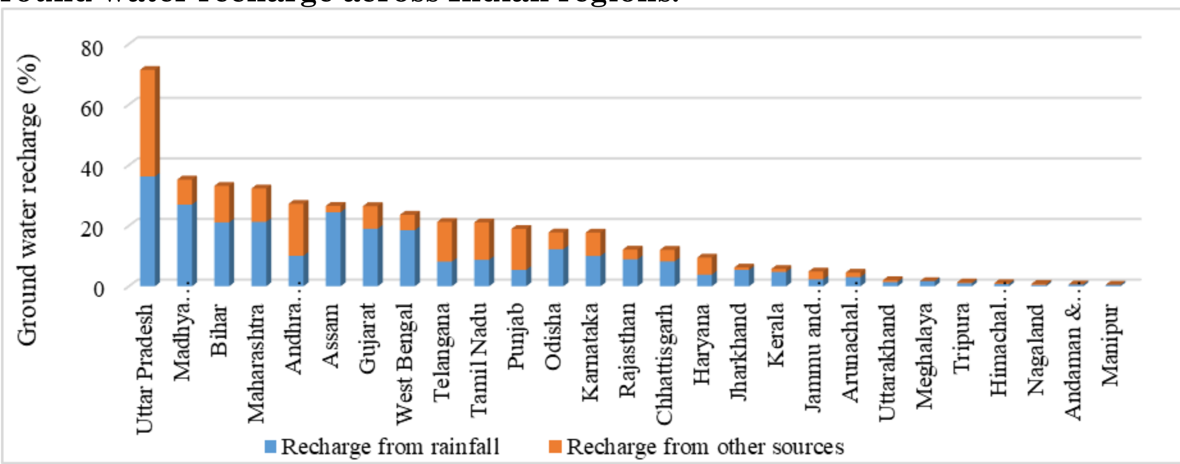
Fig. 1: Sources of ground water recharge in India:



Source: National Compilation on DYNAMIC GROUND WATER RESOURCES OF INDIA, 2022

State of Ground water recharge across Indian regions: Ground water recharge varies across Indian regions depending on several factors such as rainfall, topography, geology, land use, and water management practices. The northern and eastern region of India receives moderate to high rainfall, Ground water recharge in these regions is primarily dependent on monsoon rainfall, whereas the southern and western region of India receives moderate to low rainfall, and Ground water recharge is mainly dependent on monsoon rainfall and the recharge from the Western Ghats. The Fig.2 displays the total recharge of water, combining both rainfall and other sources, across various regions in India. Uttar Pradesh has the highest total recharge at 71.45 percent, followed by Madhya Pradesh, Bihar, and Maharashtra, which have the next higher recharge rates respectively wherein other regions with ground water annual recharge less than 0.5 bcm are excluded in the.

Fig. 2: Ground water recharge across Indian regions:

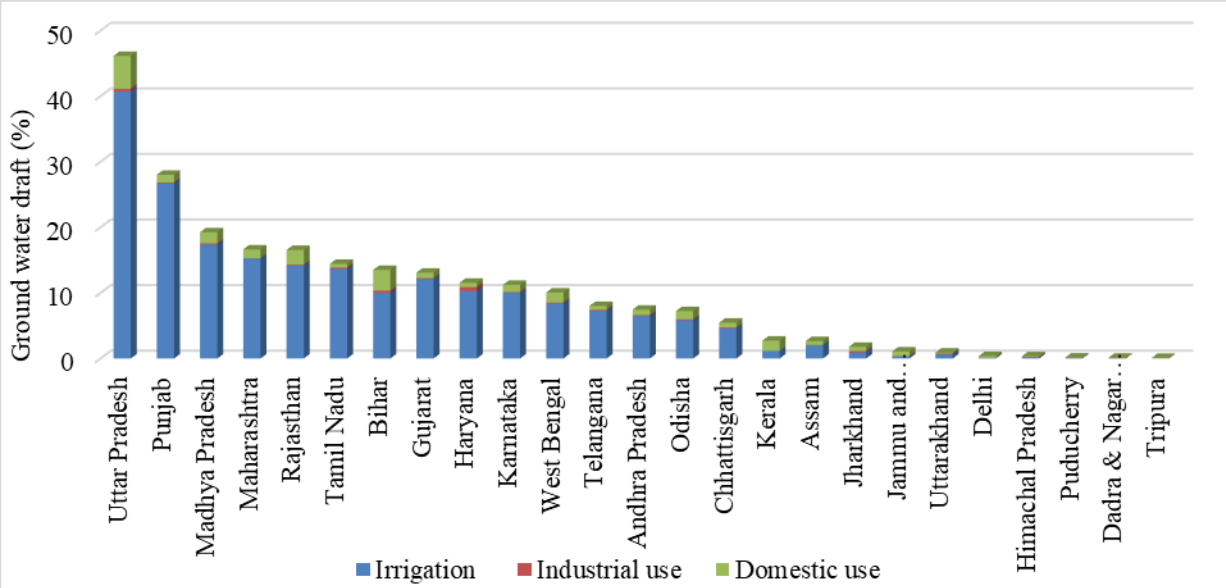


Source: National Compilation on DYNAMIC GROUND WATER RESOURCES OF INDIA, 2022

Ground Water Draft

Ground water draft refers to the amount of ground water extracted from aquifers, either naturally or through human intervention, within a particular geographical area during a specific time frame. The primary mode of ground water draft is through pumping from multiple borewells. As per estimates, the total annual ground water draft for India is approximately 239.16 bcm. The agricultural sector is the major consumer of ground water resources, accounting for about 87 percent of the total annual ground water draft. In contrast, domestic and industrial sectors only use around 13 percent of the total draft, which amounts to approximately 25 bcm. The states with significant utilization of ground water resources are Uttar Pradesh, followed by Punjab, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Bihar, Gujarat, Haryana, Karnataka, and West Bengal. These states have an annual ground water draft of over 10 bcm, and the figure (Fig.3) excludes regions with an annual ground water draft of less than 0.1 bcm.

Fig. 3: Ground water draft across Indian regions:



Source: National Compilation on DYNAMIC GROUND WATER RESOURCES OF INDIA, 2022

Ground Water Development: Ground water development refers to the extent of usage of underground water resources. It is a crucial aspect of water management, especially in regions where surface water is scarce or inadequate for agricultural, domestic, and industrial purposes. It is closely associated with the intensity of irrigated agriculture that drives ground water development. In areas where the demand for water exceeds the supply of surface water, farmers often turn to ground water resources to meet their irrigation needs.

Stage of Ground Water Development is expressed as a percentage and indicates the extent to which ground water resources are being used in a particular region. It is calculated by dividing the existing gross draft for all uses by the net annual ground water availability and multiplying it by 100. (CGWB);

$$\text{Stage of Development} = \frac{\text{Existing gross draft for all uses}}{\text{Net annual ground water recharge}} \times 100$$

Table.1: State-wise Stage of Ground Water Development:

States	Existing Gross Draft for All Uses (bcm)	Net Annual Ground water recharge (bcm)	Stage Of ground water Development (%)	Remarks
Punjab	28.02	17.07	164.15	Over-exploitation
Daman & Diu	0.06	0.04	158.33	Over-exploitation
Rajasthan	16.56	10.96	151.09	Over-exploitation
Dadra & Nagar Haveli	0.11	0.08	137.50	Over-exploitation
Haryana	11.54	8.61	134.03	Over-exploitation
Delhi	0.36	0.37	98.16	
Chandigarh	0.04	0.05	80.00	
Tamil Nadu	14.43	19.09	75.59	
Uttar Pradesh	46.14	65.30	70.66	
Karnataka	11.22	16.04	69.95	
Puducherry	0.13	0.19	68.42	
Madhya Pradesh	19.25	32.58	59.09	
Maharashtra	16.65	30.45	54.68	
Gujarat	13.09	24.58	53.25	

Kerala	2.73	5.19	52.60	
Other regions			<50	
India	239.16	398.08	60.08	

Source: National Compilation on DYNAMIC GROUND WATER RESOURCES OF INDIA, 2022

The table.1 provides information about the existing gross draft for all uses refers to the total amount of ground water withdrawn for various purposes, including domestic, industrial, and agricultural. The net annual ground water availability refers to the total amount of ground water that is naturally replenished in a year. The table shows that some states and union territories, such as Punjab, Daman & Diu, Rajasthan, Dadra & Nagar Haveli, and Haryana, have a stage of ground water development of over 100 percent, indicating that they are over-exploiting their ground water resources. This means that the rate of ground water withdrawal is higher than the rate of replenishment, which can lead to a decline in groundwater levels and other environmental problems. In contrast, the remaining states and union territories have a stage of ground water development below 100 percent, indicating that there is scope for them to increase their utilization of ground water resources beyond the current levels.

Conclusion

In conclusion, the use of ground water for irrigation has seen a significant increase in India, while surface irrigation has declined. To ensure sustainable use of water resources, it is essential to improve both canal and tank irrigation systems for augmenting surface water and encourage the balanced consumption of ground water. Overexploitation of ground water in some regions has led to declining water levels and poor water quality, impacting agriculture, livelihoods, and the environment, highlighting the need to create awareness. Moreover, efficient ground water governance and revamped policies are crucial for curbing over-exploitation of ground water and achieving sustainability. It is imperative to adopt a collaborative approach among stakeholders to ensure proper management of ground water resources in India.

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

Straw Management Device - Baler

Article ID: 40889

Dr. Sreedevi M. S.[1]

[1]Zonal Agricultural Research Station, V.C. Farm, Mandya University of Agricultural Sciences, Bangalore.

Introduction

Crop residues are materials left in an agricultural field or orchard after the crop has been harvested. These residues include stalks and stubble (stems), leaves and seed pods. Rice straw is produced as a byproduct of rice production at harvest. Rice straw is removed with the rice grains during harvest and it ends up being piled or spread out in the field depending if it was harvested manually or using machines. Ratio of straw to paddy ranges from 0.70-1.40 depending on the variety and growth. Globally, roughly 800 to 1,000 million tons per year of rice straw is produced, with about 600 to 800 million tons per year produced in Asia. There are several options which can be practiced such as composting, generation of energy, production of biofuel, mulching, baling, biochar production and recycling in soil to manage the residues in a productive manner. The implements developed by various institutions which are commercially available are not reaching the farmers in an effective way. The awareness about commercially available baler has to be created among the farmers through transfer of technology. Demonstrations are effective method for popularization of baler than any other means. The paddy straw baler was demonstrated to the farmers and stakeholders of Mandya district for the adoptability and to reduce drudgery, cost of operation and for better straw management.

Treatment Details

T1: Baling by manual method.
T2: Baling by straw baler.

Fig.1: Paddy straw baling by manual method

Fig.2: Paddy straw baling by Redlands round straw baler

Results and Discussion

The performance of the straw baler at research station is as below:

Table 1. Performance of Straw Baler at Research Farm:

Sl. No.	Parameters	Baling by Straw baler
1	Crop	Paddy
2	Harvesting method	Combined harvester
3	Size of field, ha	5
4	Labour requirement, man-days/ha	1
5	Stubble height in the field, cm	10
6	Loose straw length, cm	50-60
7	Loose straw MC, %	15-25
8	Pick width, mm	800
9	Bale dimension (diameter x width), mm	500 x 700
10	Bale weight, kg	15-20
11	Bale capacity	50-55 bales/h
12	Straw recovery, %	90-95
13	Field capacity, ha/h	0.26
14	Field efficiency, %	80-85
15	Time required, h/ha	3.75
16	Fuel consumption, l/h	12

Table 2. Comparative Performance of tractor drawn Straw Baler:

Sl. No.	Parameters	Baling by Straw baler	Baling by Manual method
1	Crop	Paddy	Paddy
2	Harvesting method	Combined harvester	Combined harvester
3	Size of field, ha	1	1
4	Labour requirement, man-days/ha	2	20
5	Stubble height in the field, mm	100	100
6	Loose straw length, mm	600	600
7	Loose straw MC, %	20	20
8	Pick width, mm	800	-
9	Bale dimension (diameter x width), mm	500 x 700	-
10	Bale weight, kg	15-20	-
11	Bale capacity, bales/h	50-55	20
12	Straw recovery, %	90-95	95
13	Field capacity, ha/h	0.26	-
14	Field efficiency, %	80-85	-
15	Time required, h/ha	3.75	8
16	Fuel consumption, l/h	12	-
17	Cost of operation, Rs/h	770	875
18	Cost of operation, Rs/ha	2887	7000

Inference

Preliminary tests were conducted to study the feasibility and performance of the straw baler at sub campus of University of Agricultural Sciences, Bangalore at Zonal Agricultural Research Station, V.C. Farm Mandya and demonstrated the baler in 18 ha of selected farmer's fields of Mandya district, Karnataka. The straw baler can bale 50-55 bales/h and saves 58% of cost of operation compared to baling by manual method. This device can be effectively used as crop residue/ straw management device, by which we can also reduce labour and transportation cost.

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

Agrochemicals: A Major Cause of Declining Sparrow Population

Article ID: 40890

Adarsh Dangwal[1], Nazneen Qureshi[2]
[1]PLANTICA- Indian Academy of Rural Development, Dehradun.

Introduction

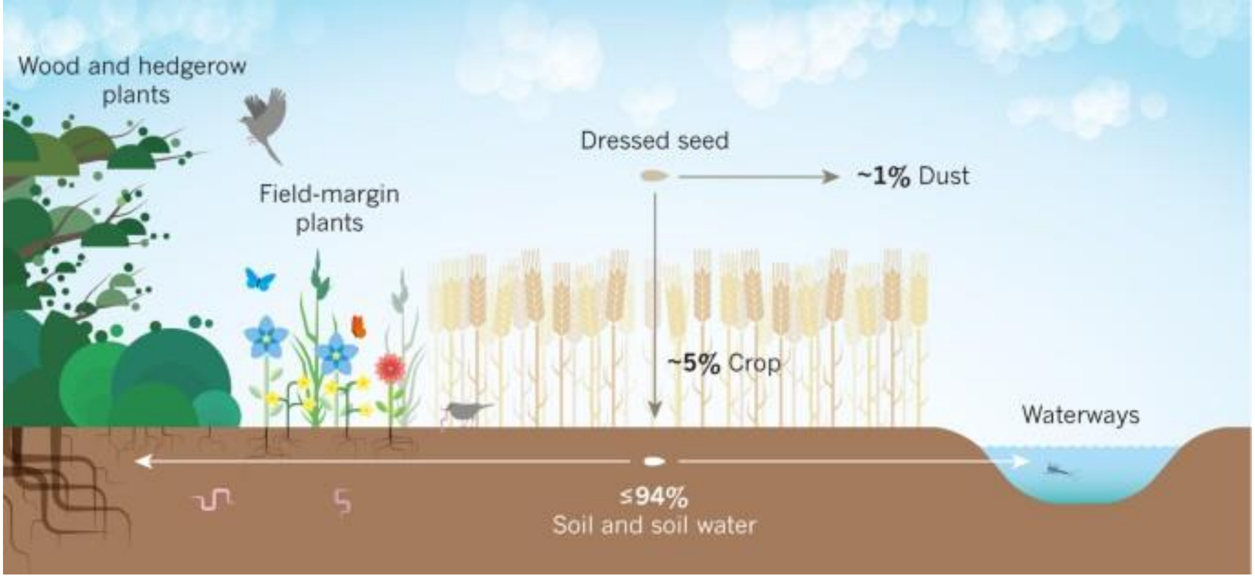
Agriculture is the necessary activity which man does to get his food or fulfill his needs. Agriculture is done all over the world. But India is considered to be the backbone of the country. To increase the agricultural product and to increase the income, today the farmer is using more chemical fertilizers, chemical weedicides, chemical pesticides in his fields. Due to which some herbs which were commonly found in the fields, such as- Brahmi, Bhumi Amla etc., some insects devoured the insects, which acted as pollination in the crops, and the pests that caused diseases in the crops. And some such birds that used to eat these insects. There is a decline in the population of all these, one of which is a sparrow. Sparrow bird is on the verge of extinction in today's time. This bird prefers to live among the community of humans, and makes its living in agriculture done by man. This sparrow bird has a great contribution in our agriculture. which we have been ignoring, and only we are trying to preserve it as a bird species.

Various schemes are being made for its conservation. But it can be conserved only when we can know the real reason for the decline in its population. Because it is a matter of thinking that how suddenly there was a decline in the population of this bird. Recently, many experts believe that the main reason for this is radiation (1). But how can this radiation hazard be only for sparrows? While there are many types of birds in our environment, whose population has not seen such a decline. As much as the sparrow has come. We will get to know its habitat, its routine, and its dependence on food to understand its cause. Radiation alone is not the reason for the decline in their population. The reason for this is also the chemicals used in today's modern farming system and our farming methods which have become modern now.

Causes

1. Pesticides Application: Pesticides are used to control pests that damage crops, but they can also harm non-target organisms such as birds. Studies have shown that pesticides can cause a decline in sparrow populations by reducing their food supply or directly poisoning them. Pesticides can also disrupt the reproductive system of birds, leading to a decrease in egg production and hatching success.

2. Herbicides Application: Herbicides are used to control weeds that compete with crops for nutrients and water. However, the use of herbicides can reduce the availability of seeds and insects that sparrows rely on for food. In addition, the destruction of weeds can also remove the nesting sites and shelter that sparrows need to survive.



Source- https://www.nature.com/articles/nature13642

3. Fertilizers Application: Fertilizers are used to increase crop yields by providing nutrients to plants. However, the excessive use of fertilizers can lead to the accumulation of nitrates and phosphates in soil and water, which can have negative impacts on the environment. These nutrients can stimulate the growth of algae in water bodies, leading to a decrease in the availability of insects that sparrows feed on.

Several studies have examined the impact of Agrochemicals on Sparrow populations, and the results are concerning.

a. A study conducted in India by Pratap Singh and colleagues (2020) found that exposure to agrochemicals reduced the abundance and diversity of sparrow populations. The researchers measured the concentration of pesticides and heavy metals in soil and water samples from agricultural fields and found that these chemicals were present in levels that were toxic to sparrows. The researchers concluded that the use of agrochemicals was a significant threat to sparrow populations in agricultural areas.

b. Similarly, a study by Németh and colleagues (2020) in Hungary found that exposure to pesticides had a negative impact on sparrow populations. The researchers studied the breeding success of sparrows in different agricultural landscapes and found that those in areas with high pesticide use had lower breeding success rates. The study suggested that the effects of pesticide exposure on sparrow populations were likely due to changes in their habitat quality and food availability.

c. In addition to pesticides, fertilizers can also have negative effects on sparrow populations. A study by Purushotham and colleagues (2021) in India found that exposure to high levels of nitrogen and phosphorus from fertilizers reduced the diversity and abundance of sparrow populations. The researchers suggested that this was due to changes in the availability of food sources and nesting habitats.

Solution

To mitigate the impact of Agrochemicals on Sparrow populations, there are several measures that can be taken.

1. Reducing the use of Pesticides – Minimum use of Pesticides in Agriculture field helps to mitigate the impact of Agrochemicals on sparrow Population.

2. Reducing the use of Herbicides- Minimum use of Herbicides in Agriculture field helps to mitigate the impact of Agrochemicals on sparrow Population.

3. Reducing the use of Fertilizers- Minimum use of Fertilizers in Agriculture field helps to mitigate the Impact of Agrochemicals on Sparrow Population.

4. Using Alternative Pest control methods such as Crop Rotation and Integrated Pest Management

5. Promoting the use of **Organic Farming practices.**

6. Creating and maintaining habitats that provide food and shelter for sparrows can help to support their populations.

Conclusion

Overall, the use of agrochemicals can have a negative impact on sparrow populations. To mitigate this impact, it is important to use these chemicals responsibly and to consider alternative methods of pest and weed control. Additionally, creating and maintaining habitats for sparrows can help to support their populations in areas where agrochemicals are used.

References

1. Lakhera Pradha (2015), Impact of Electromagnetic Radiations on House Sparrows (Passer Domesticus), International Journal of Engineering Research & Technology (IJERT), 4(07), 2278-0181.
2. Németh, A., Lang, Z., Demeter, I., & Barta, Z. (2020). Pesticide exposure and reproductive success of house sparrows (Passer domesticus) in agricultural landscapes. Science of The Total Environment, 737, 140188.
3. Pratap Singh, A., Singh, A., & Singh, V. (2020). Heavy metal and pesticide contamination in soil and water and their impacts on house sparrow (Passer domesticus) population in agricultural fields of eastern Uttar Pradesh, India. Environmental Science and Pollution Research, 27(27), 34020-34029.
4. Purushotham, K. R., Rao, B. M., Rao, R. N., & Reddy, N. P. (2021). Effect of nitrogen and phosphorus fertilization on bird diversity in agricultural fields of Anantapuramu district, Andhra Pradesh. Journal of Environmental Biology, 42(1), 123-128.

E-ISSN: 2581 - 8317

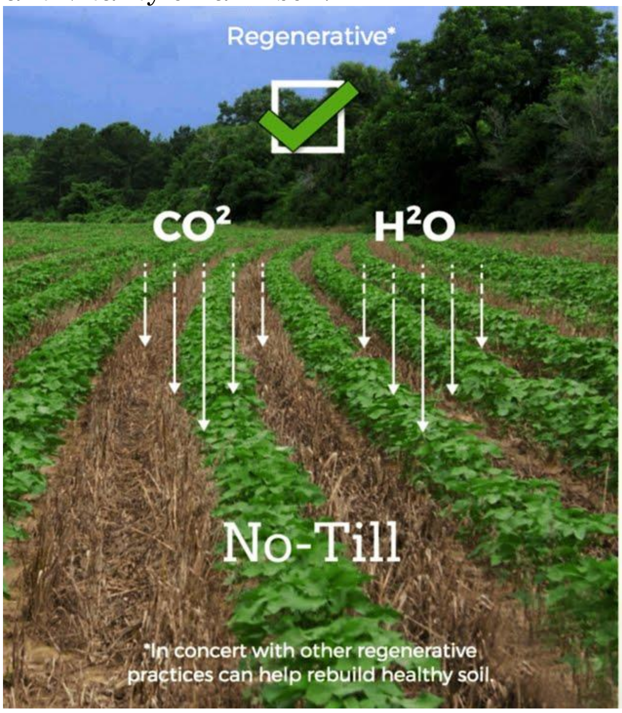
Regenerative Agriculture

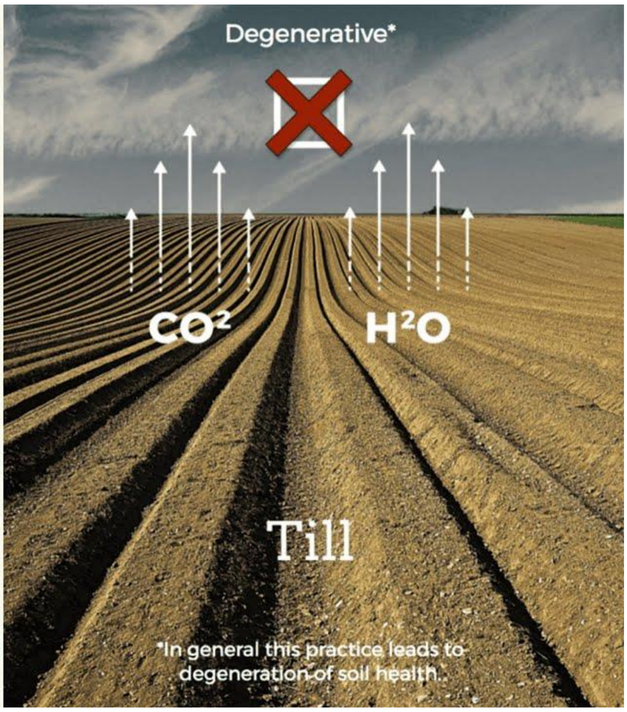
Article ID: 40891

Mo Naushad[1], Nivedita Prasad[2]
[1]M.Sc. Scholar, Department of Agronomy, United University, Jhalwa, Prayagraj (U.P.)
[2]Assistant Professor, Department of Agriculture & Allied Sciences, United University, Jhalwa, Prayagraj (U.P.)

Introduction

Regenerative agriculture is a conservation and rehabilitation approach to food and farming systems. It focuses on topsoil regeneration, increasing biodiversity, improving the water cycle, enhancing ecosystem services, supporting bio sequestration, increasing resilience to climate change, and strengthening the health and vitality of farm soil.





Principles

There are several individuals, groups, and organizations that have attempted to define what the principles of regenerative agriculture are. In their review of the existing literature on regenerative agriculture, researchers at Wageningen University created a database of 279 published research articles on regenerative agriculture. Their analysis of this database found that people using the term regenerative agriculture were using different principles to guide regenerative agriculture efforts. The 4 most consistent principles were found to be:

1. Enhancing and improving soil health.
2. Optimization of resource management.
3. Alleviation of climate change.
4. Improvement of water quality and availability.

Why Regenerative Agriculture?

The loss of the world's fertile soil and biodiversity, along with the loss of indigenous seeds and knowledge, pose a mortal threat to our future survival. According to soil scientists, at current rates of soil destruction (*i.e.* decarbonization, erosion, desertification, chemical pollution), within 50 years we will not only suffer serious damage to public health due to a qualitatively degraded food supply characterized by diminished nutrition and loss of important trace minerals, but we will literally no longer have enough arable topsoil to feed ourselves. Without protecting and regenerating the soil on our 4 billion acres of cultivated farmland, 8 billion acres of pastureland, and 10 billion acres of forest land, it will be impossible to feed the world, keep global warming below 2 degrees Celsius, or halt the loss of biodiversity.

Its Work

The key to regenerative agriculture is that it not only "does no harm" to the land but actually improves it, using technologies that regenerate and revitalize the soil and the environment. Regenerative agriculture leads to healthy soil, capable of producing high quality, nutrient dense food while simultaneously improving, rather than degrading land, and ultimately leading to productive farms and healthy communities and economies. It is a dynamic and holistic, incorporating permaculture and organic farming practices, including conservation tillage, cover crops, crop rotation, composting, mobile animal shelters and pasture cropping, to increase food production, farmers' income and especially, topsoil.

Ecological Benefits

1. Improvements in soil health and fertility—the foundation of healthy water, nutrients, and carbon cycling—as evidenced by healthier crops, increased yields, improved soil test results, and vibrant microbial communities.
2. Biodiversity on land, in the air, and in the water (following improved biodiversity in the soil), including richer plant, bird, and insect populations.
3. Reduced soil erosion.
4. Reductions in water pollution—including contributions to harmful algal blooms—due to fewer chemical inputs.
5. Improvements to water-holding capacity in the soil.

Personal and Regional Economic Benefits

1. Cost savings from reduced use of antibiotics and chemical fertilizers, herbicides, and pesticides.
2. Greater financial security from diversified revenue streams.
3. The promotion of rural economic development with local employment and healthier food choices.

Community Benefits

1. Networks of growers who exchange information, learn from one another, and build community.
2. On-farm/on-ranch visits and networks of farmers markets that help farmers and ranchers build stronger relationships between consumers and their food.

Environmental and Nutritional Advantages

The case for regenerative agriculture effect on the environment is simple. By focusing on the soil, regenerative agriculture techniques pull carbon dioxide, one of the most prevalent greenhouse gases, out of the atmosphere. This is a positive impact on the prevalence of climate change. While many operations may boast decreased greenhouse gas production, regenerative agriculture takes it a step further with greenhouse gas elimination by the farmland itself.

Regenerative agriculture has the potential to feed the world an increased number of nutrient-rich foods—an important benefit, as the population is expected to grow up to 9 billion by the year 2050. By investing in the soil, regenerative agriculture farmers are helping to make more food on less land to feed more people.

Regenerative Agriculture Practices

Regenerative agriculture practices vary by region, context, and history. The following methods are aspects farmers and ranchers can adopt best suited to their land's story.

No-Till

Let's return to carbon. If we're practicing conventional farming, we are typically tilling a lot, which means turning the soil over. Tilling breaks up the soil aggregates and disturbs the organic matter while exposing it to oxygen. Once it oxidizes, the carbon and the oxygen form CO_2, which then atmosphere. Tilling can be a problem.

Context is key when it comes to tilling. You'll hear plenty of enthusiasts touting "no till" agriculture, and while this may be the ideal for low disturbance agriculture, it's often not the reality when you're facing land that's been mistreated for centuries.

For starting off, minimal tillage or "low-till" is best, and there are reasons other than the obvious to till. For example, a farmer could do a one-time tillage event that will create the yield she's looking for years to come. Or, a rancher may plow just once to break up a resistant hardpan so their cover crop will germinate. When it comes to tilling (or not tilling) your soil, context is the most important factor and there is no hard and fast rule.

Compost

Compost is a more commonly known practice associated with regenerative living. Rightfully so — in the U.S. alone, over 60 billion pounds of mineral-rich food materials go to landfills each year, when they could be composted.

If a farmer for example is thinking about using compost, the first thing they have to deal with is cost, because well-made compost is not cheap. How can farmers use compost it in a cost-effective manner and reap the same benefits? We need to look at the microbes.

Most farmers or growers that want to use compost have damaged the microbes in their soil. A good start is with a small dose of compost through an extract, meaning you add compost to water, and dilute it plenty. Farmers can also inoculate their seeds – coat them or put in a little dilution drip around them, which is similar to putting a probiotic around tee seed. Once that seed sprouts, it does a few things. Compost speeds up the germination process. Seeds are amazing in their own way. Somehow, they know when to germinate, which then produces exudates, feeding the soil microbes. It has its own internal micro biome inside the seed itself, and those start multiplying. With a little bit of compost extract, a farmer can make the micro biome more diverse, which will then help with nutrient acquisition and protect the plant from other diseases. The list goes on.

Conclusion

Although you might not know that your food was produced with regenerative agriculture techniques simply by looking at it in a store that may change soon. Farmers and ranchers are hoping to have regenerative organic certification approved by the United States Department of Agriculture. Although regenerative agriculture isn't a completely new way of farming more of these practices must be put into play and we look forward to seeing what the future brings.

References

1. Giller, K. E., Hijbeek, R., Andersson, J. A., and Sumberg, J. (2021). Regenerative agriculture: an agronomic perspective. *Outlook on agriculture*, 50(1), 13-25.
2. White, C. (2020). Why regenerative agriculture? *American Journal of Economics and Sociology*, 79(3), 799-812.

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

Precision Agricultural Practices for Enhancing Crop Productivity and Sustainability

Article ID: 40892

Thakur Indu[1], Amit Kumar [2], R. Nagasai Vardhan Naik[3], Prateek Kumar[4]

[1]Ph.D Scholar, Department of Agronomy, (Naini Agricultural Institute), Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, U.P, India.

[2]M.Sc. Agronomy, Department of Agronomy, (Naini Agricultural Institute), Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, U.P, India.

[3]Ph.D Scholar, Department of Agronomy, (Naini Agricultural Institute), Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, U.P, India.

[3]Ph.D Scholar, Department of Agronomy, (Naini Agricultural Institute), Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, U.P, India.

Introduction

Precision Farming or Precision Agriculture is generally defined as information and technology-based farm management system to identify, analyse and manage spatial and temporal variability within fields for optimum productivity and profitability, sustainability and protection of the land resource by minimizing the production costs. Precision farming is an approach where inputs are utilised in precise amounts to get increased average yields compared to traditional cultivation techniques. Hence it is a comprehensive system designed to optimize production by using a key element of information, technology, and management, to increase production efficiency, improve product quality, improve the efficiency of crop chemical use, conserve energy and protect environment. Precision farming becomes more and more an accepted way of crop production and helps to achieve a sustainable environment friendly agriculture. Furthermore, growing interest in automated data acquisition and information processing is going to form another milestone towards improved farm management and an overall trace ability in agricultural food production. The benefit and effectiveness of using precision farming techniques is highly dependent on the capabilities of the utilized technology.

Need of Precision Farming

The decline in the total productivity, diminishing and degrading natural resources, stagnating farm incomes, lack of eco- regional approach, declining and fragmented land holdings, trade liberalization on agriculture, limited employment opportunities in non-farm sector, and global climatic variation have become major concerns in agricultural growth and development. Therefore, the use of newly emerged technology adoption is seen as one key to increase agriculture productivity in the future. Therefore, the use of newly emerged technology adoption is seen as one key to increase agriculture productivity in the future. Instead of managing an entire field based upon some hypothetical average condition, which may not exist anywhere in the field, a precision farming approach recognizes site-specific differences within fields and adjusts management actions accordingly. Farmers usually are aware that their fields have variable yields across the landscape. Precision agriculture offers the potential to automate and simplify the collection and analysis of information. It allows management decisions to be made and quickly implemented on small areas within larger fields.

Scope of Precision Farming in India

Remote sensing applications to agriculture have grown to a stage where such inputs are being used for number of policy level decisions related to food security, poverty alleviation and sustainable development in the country. Nation-wide wasteland, land use, land cover and soil mapping has helped in expanding and intensification of agricultural activities and also in identifying the land capability classes and crop suitability indices. Indian Agriculture is known for its multi-functionalities of providing food, employment, livelihood, nutritional and ecological securities. However, the rate of increase in population demands much higher rate of increase in food production while maintaining harmony with the environment-the core concept of sustainable agriculture. The agriculture in the WTO era has to be more competitive and cost effective. The farming technologies followed in India need to be constantly updated to meet these challenges. In this context, comprehensive and reliable information on land use/cover, soils (extent of wastelands and degraded lands), agricultural crops, water resources (both surface and underground), natural hazards/ calamities like drought and floods and agrometeorology is essential. Season-wise information on crops, their acreage, vigor and production enable the country to adopt suitable measures to meet shortages if any, and implement proper support and procurement policies.

Precision Farming

Precision farming is an emerging concept in modern agriculture. It is a micro-management system to arrive at improved agricultural and land management decisions that result from using information delivered by geospatial technologies. In other word's it is "Digital Agriculture" involving very large-scale farm level mapping, comprehensive data base creation on required resources generated through space-based inputs and field observations and making a detailed plan of work for maximizing the yield and reducing the cost on inputs using the decision support system. The precision farming data base generally includes:
1. Crop characteristics like, stage of the crop, crop health, nutrient requirement, *etc.,*
2. Detailed soil layer with physical and chemical properties, depth, texture, nutrient status, salinity and toxicity, soil temperature, productivity potential, *etc.,*
3. Microclimate data (seasonal and daily) about the canopy temperature, wind direction and speed, humidity etc.,
4. Surface and sub surface drainage conditions.
5. Irrigation facilities, water availability, and other planning inputs of interest.

Classification of Precision Agriculture

Data Collection Technologies	Data Process & Decision-Making Technologies	Application Technologies
• Soil sampling and mapping • Yield monitoring and mapping • Remote sensing • Global satellite positioning • Geospatial Technology • Field/crop scouting	• GPS-GIS based farm management • Agricultural mapping software • Geoinformatics • Geostatistics • Crop modelling • Artificial Intelligence primarily based Controlling systems	• Variable-rate technology • Yield monitors • Agricultural robots • Wireless data logger and Sensor catalogue • Global Navigation Satellite system (GNSS) based guidance • Hyperspectral sensor-based applications • Automated control system through Greenhouse and Polyhouse cultivation • Precision Lazer Land leveller • Mulching • Low Tunnel Technology/Walking Tunnels • Microirrigation • Site-specific Nutrient Management (SSNM) • Drone Technology

Basic Steps in Precision Farming

1. Assessing Variation
2. Managing variation
3. Evaluation

Assessing variability: Assessing variability is the critical first step in precision farming. Since one cannot manage what one does not know. Factors and the processes that regulate or control the crop performance in terms of yield vary in space and time. Quantifying the variability of these factors and processes and determining when and where different combinations are responsible for the spatial and temporal variation in crop yield is the challenge for precision agriculture.

Techniques for assessing spatial variability are readily available and have been applied extensively in precision agriculture. The major part of precision agriculture lies in assessing to spatial variability. Techniques for assessing temporal variability also exist but the simultaneous reporting a spatial and temporal variation is rare. We need both the spatial and temporal statistics. Hence, we need both the space and time statistics to apply the precision farming techniques.

Managing variability: Once variation is adequately assessed, farmers must match agronomic inputs to known conditions employing management recommendations. Those are site specific and use accurate applications control equipment. We can use the technology most effectively. In site-specific variability management.

We can use GPS instrument, so that the site specificity is pronounced and management will be easy and economical. While taking the soil/plant samples, we have to note the sample site coordinates and further we can use the same for management. This results in effective use of inputs and avoids any wastage, and this is what we are looking for.

The potential for improved precision in soil fertility management combined with increased precision in application control make precise soil fertility management as attractive, but largely unproven alternative to uniform field management. For successful implementation, the concept of precision soil fertility management requires that within-field variability exists and is accurately identified and reliably interpreted, that variability influences crop yield, crop quality and for the environment. Therefore, inputs can be applied accurately. The higher the spatial dependence of a manageable soil property, the higher the potential for precision management and the greater its potential value. The degree of difficulty, however, increases as the temporal component of spatial variability increases.

Evaluation: The most important fact regarding the analysis of profitability of precision agriculture is that the value comes from the application of the data and not from the use of the technology Potential improvements in environmental quality is often cited as a reason for using precision agriculture. Reduced agrochemical use, higher nutrient use efficiencies, increased efficiency of managed inputs and increased production of soils from degradation are frequently cited as potential benefits to the environment. Enabling technologies can make precision agriculture feasible, agronomic principles and decision rules can make it applicable and enhanced production efficiency or other forms of value can make it profitable.

The term technology transfer could imply that precision agriculture occurs when individuals or firms simply acquire and use the enabling technologies. While precision agriculture does involve the application of enabling technologies and agronomic principles to manage spatial and temporal variability, the key term is managed. Much of the attention in what is called technology transfer has focused on how to communicate with the farmer.

Precision Farming Key Technologies

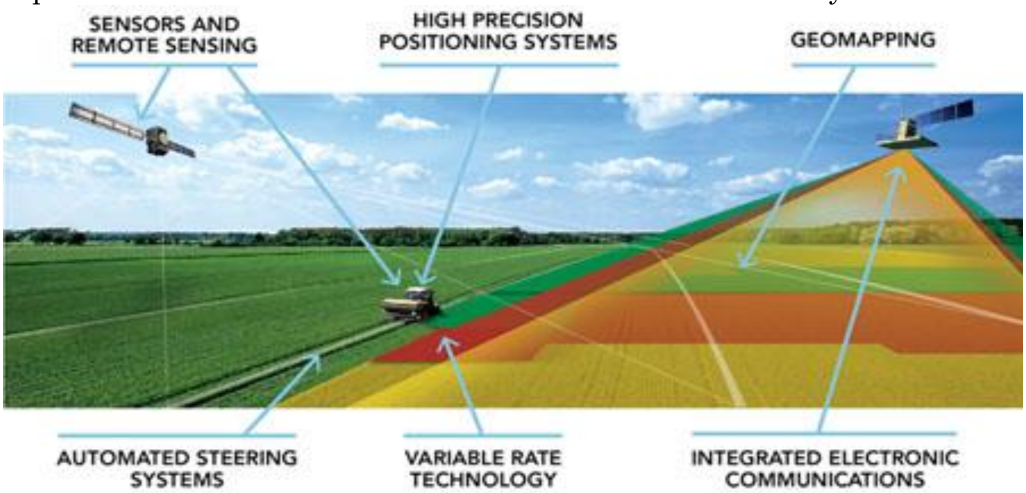
High Precision Positioning systems (GPS) are the key technology to achieve accuracy when driving in the field, providing navigation and positioning capability anywhere on earth, anytime under any all conditions. The systems record the position of the field using geographic coordinates (latitude and longitude) and locate and navigate agricultural vehicles within a field with 2 cm accuracy.

Automated steering systems: enable to take over specific driving tasks like auto-steering, overhead turning, following field edges and overlapping of rows. These technologies reduce human error and are the key to effective site management:

a. Assisted steering systems show drivers the way to follow in the field with the help of satellite navigation systems such as GPS. This allows more accurate driving but the farmer still needs to steer the wheel.

b. Automated steering systems, take full control of the steering wheel allowing the driver to take the hands off the wheel during trips down the row and the ability to keep an eye on the planter, sprayer or other equipment.

c. Intelligent guidance systems provide different steering patterns (guidance patterns) depending on the shape of the field and can be used in combination with above systems.

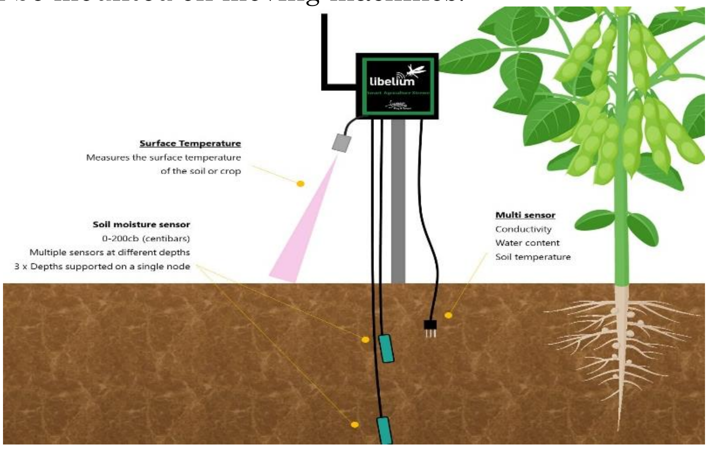


Geomapping: Geomapping is the analysis of tabular data that is geographic in nature. Software is used to create an intuitive and revealing map visualization. Geo-maps communicate information about space and location in a very efficient way. They reduce volumes of data to single, clear visual presentation. In Agriculture it is used to produce maps including soil type, texture, structure, temperature, vegetation, nutrients levels etc in layers and assign that information to the particular field location.

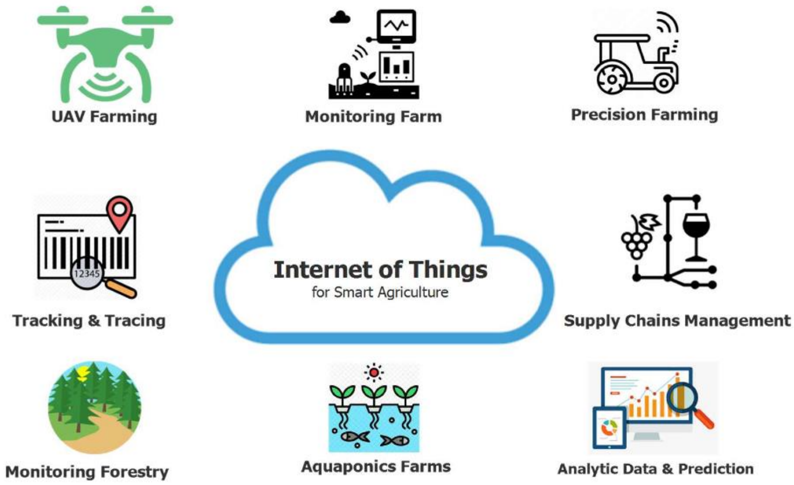
Variable Rate Technology (VRT): ability to adapt parameters on a machine to apply, for instance, seed or fertiliser according to the exact variations in plant growth, or soil nutrients and type.

VRT uses data and automation to apply fertilizer, crop protection products, seeds and even irrigation water at different rates in different locations without a grower having to change application rates or make multiple passes manually.

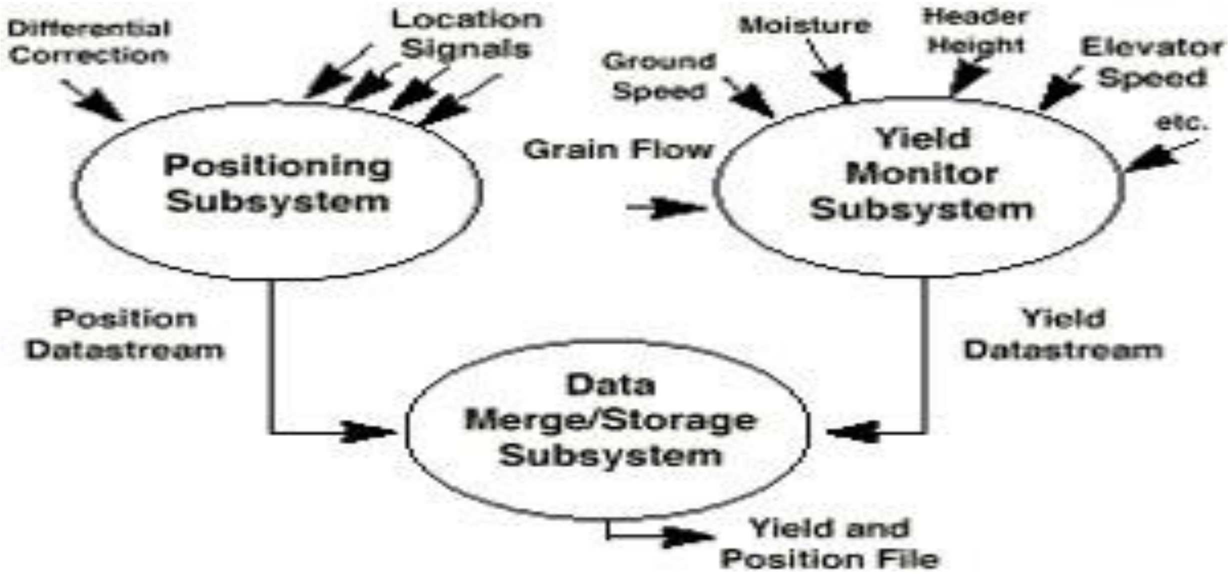
Sensors: Agriculture sensors such as air temperature and humidity, soil moisture, soil pH, light intensity, and carbon dioxide are often used to collect data in all aspects of crop growth such as nursery, growth, and harvest. Agricultural conductivity and agricultural pH sensors are used to monitor water and fertilizer. collect data from a distance to evaluate soil and crop health (moisture, nutrients, compaction, and crop diseases). Data sensors can be mounted on moving machines.



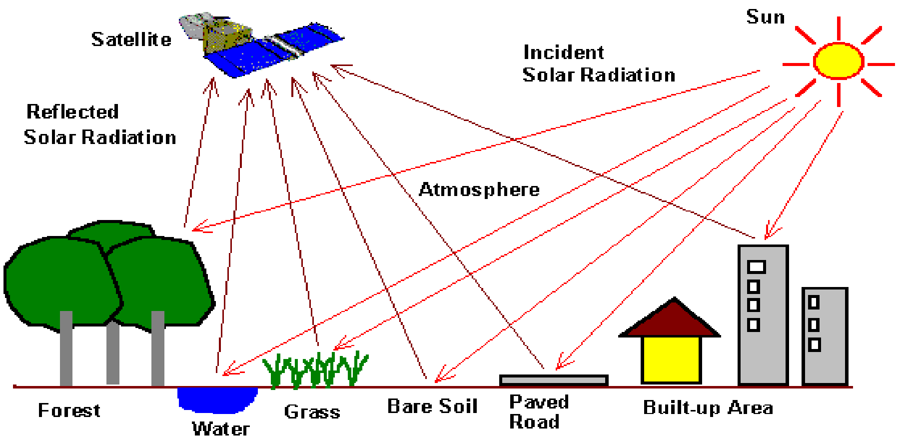
Integrated electronic communication between components in a system for example, between tractor and farm office, tractor and dealer or spray can and sprayer. Global electronic communication has grown dramatically in recent years, and it makes heavy use of public domain software, produced on a voluntary basis and obtainable for most standard computer uses, this mode of cooperative software development could be successfully applied in agriculture, especially if cooperation between the software producers is increased and there is extensive use of electronic communication.



Yield Monitors: Yield monitors are a combination of several components. They typically include several different sensors and other components, including a data storage device, user interface (display and key pad) and a task computer located in the combine cab, which controls the integration and interaction of these components. The sensors measure the mass or the volume of grain flow (grain flow sensors), separator speed, ground speed, grain. In the case of grains, yield is continuously recorded by measuring the force of the grain flow as it impacts a sensible plate in the clean grain elevator of the combine. A recent development of a mass flow sensor works on the principle of transmitting beams of microwave energy and measuring the portion of that energy that bounces back after hitting the stream of seeds flowing through the chutes. In all yield monitors, GPS receivers are used to record the location of yield data and create yield maps. Other yield monitoring systems include devices used in forage crops to keep track of weight, moisture, and other information on a per-bale basis.



Remote Sensing: Remote sensing techniques play an important role in crop identification, acreage and production estimation, disease and stress detection, soil and water resources characterisation and also by providing required inputs for the following: generation of land and water resources developmental plans, bringing additional land into cultivation through mapping and reclaiming wastelands, increasing the irrigation potential through ground-water prospects mapping; crop-yield and crop-weather models, integrated pest management, command area management, watershed management, agrometeorological services, precision farming, etc Remote sensing applications to agriculture have grown to a stage where such inputs are being used for number of policy level decisions related to food security, poverty alleviation and sustainable development in the country.



Opportunities

1. Forecasting of outbreak of pests and diseases based on soil water status and plant stress indicators in crops such as paddy, wheat, sugarcane, cotton, chilli, & pigeonpea, etc.
2. Development of decision support system for precise management of resources at farm level at least in commercial / fruit / flower crops to begin with.
3. Soil mapping at cadastral scale using high resolution spatial, spectral and radiometric resolutions.
4. Soil moisture estimation and mapping using microwave/optical/thermal remote sensing techniques in surface and root zone depth.
5. Hyper spectral studies on soils to establish quantitative relationship between spectral reflectance and soil properties.
6. Development of digital techniques for a variety of applications using GIS techniques. For *e.g.,* soil suitability to crops, land capability classification and land irrigability assessment etc.
7. Preparatory activities towards hyper spectral data utilization for understanding the plant processes and development of spectral response models for stress detection.

Conclusion

Agriculture, the dynamic system governed by several biotic and abiotic factors, needs to be sustained, as it is the major player in Indian economy. Though we are self-sufficient in food grain production, there are several Gray areas which need to be improved for achieving ever-green revolution. Successful adoption, however, comprises at least three phases including exploration, analysis and execution. Precision agriculture can address both economic and environmental issues that surround production agriculture today. There is a need to transform low-yielding food production systems in to high yielding ones through the convergences of agrotech (mainly production related), biotech (productivity related) with space technology (RS and GIS). Precision farming provides a new solution using a systems approach for today's agricultural issues such as the need to balance productivity with environmental concerns. It is based on advanced information technology. It includes describing and modelling variation in soils and plant species and integrating agricultural practices to meet site-specific requirements. It aims at increased economic returns, as well as at reducing the energy input and the environmental impact of Agriculture.

Protein Rich, Super Food - Lotus

Article ID: 40893

T. Navya Swetha[1], A. Deepika[1], B. Pragna[1]
[1]Assistant Professor, Dep FLA.

Introduction

Protein-energy deficiency has been recognized as the most common form of malnutrition in regions where people mainly depend on starch-based diets and cereal porridges. Scarcity of protein rich food and food supplements has been responsible for the recurring problems associated with malnutrition in children and women in developing countries. Lotus seeds *(Nelumbo nucifera)* can play a significant role due to their edibility and medicinal properties. Nutritionally, lotus seeds are rich in proteins (10.6- 14.8%) and essential minerals. Lotus seeds are in high demand in Ayurvedic medicinal preparations and widely used in medicines to treat tissue inflammation, cancer, diuretics, skin diseases.

The Lotus

Lotus is a perennial, large and rhizomatous aquatic herb with slender, elongated, branched stem consisting of nodal roots; leaves are membranous, peltate (60-90 cm and above) and concave to cup shaped; flowers are white to rosy, sweet-scented, solitary, hermaphrodite, 10-25 cm diameter; fruits are ovoid having nut like achenes; seeds are black, hard and ovoid. *Nelumbo nucifera* belongs to the family Nelumbonaceae, which has several common names (e.g. Indian lotus, sacred lotus and Chinese water lilly). Lotus plants propagate vegetatively through rhizomes. Its seeds sold in the Indian markets (kamal gatta) as vegetable or raw material for Ayurvedic drug preparation.

	
Flower	**Seed**

Nutritional Value

Serial no.	Parts of plant	Nutritional value
1.	Rhizome	1.7% protein, 0.1% fat, 9.7% carbohydrate and 1.1% ash
2	Stem	6, 2.4, 0.2 mg/100 g calcium, iron and zinc respectively
3.	Seed	10.5% moisture, 10.6-15.9% protein, 1.93-2.8% crude fat, 70-72.17% carbohydrate, 2.7% crude fibre, 3.9-4.5% ash and energy 348.45 cal./100 g
4.	Minerals of lotus seeds	chromium (0.0042%), sodium (1%), potassium (28.5%), calcium (22.1%), magnesium (9.2%), copper (0.0463%), zinc (0.084%), manganese (0.356%) and iron (0.199%).

Pharmaceutical Value

Traditional knowledge:

a. The whole plant serves as astringent, diuretic and sudorific and possesses antifungal, antipyretic and cardiotonic.

b. Different parts of the lotus plant are useful in treatment of diarrhea, tissue inflammation and haemostasis.

c. The rhizome extract has anti-diabetic and anti-inflammatory properties.

d. The stem is used in indigenous Ayurvedic medicines as diuretic, anthelmintic and to treat strangury, vomiting, leprosy, skin disease and nervous exhaustion.

e. Young leaves with sugar are useful to treat rectal prolapse and the leaves boiled with Mimosa pudica in goat's milk can be used to treat diarrhea.

f. Leaf paste can be applied to the body during fever and inflammatory skin conditions.

g. Flowers are useful to treat diarrehoea, cholera, fever, hepatopathy and hyperdipsia.

h. The fruits and seeds of lotus are astringent and used to treat hyperdipsia, dermatopathy, halitosis, menorrhagia, leprocy and fever.

Alkaloids and flavonoids:

a. Lotus alkaloids dilate the blood vessels and reduce the blood pressure.

b. Leaves are bitter, sweet and consist of several flavonoids and alkaloids.

c. The embryos possess small amount of alkaloids, which are anti-spasmodic for the intestines and alleviates diarrhea.

d. The embryos within lotus seeds possess an alkaloid iso-quinoline, which is sedative, antispasmodic and beneficial to heart.

e. The major phytochemicals present in lotus seeds are alkaloids (e.g dauricine, lotusine, nuciferine, pronuciferine, liensinine, isoliensinine, roemerine, nelumbine, neferine).

f. Thirteen flavonoids and seven of its glycosides were isolated from lotus plants along with four non-flavonoid compounds.

Antioxidants: Lotus seed extract possess hepatoprotective, free radical scavenging properties and antifertility properties. The antioxidant activity of hydro-alcoholic extract of lotus seeds using in-vitro and in-vivo models.

Anticancerous: The ethanolic extracts of lotus inhibit the cell proliferation and cytokines in primary human peripheral blood mononuclear cells activated by phytohemagglutinin.

Antiviral: Anti-HIV benzylisoquinoline alkaloids and flavonoids from lotus leaves [-(+)-1(R)- Coclaurine, (-)-1(S)-norcoclaurine and quercet in 3-O-b-D-glucuronide]. The first two compounds possess potent anti-HIV activity [EC50, 0.8 and <0.8l μg/ml; therapeutic index (TI), >125 and 152 >25 respectively], while the third was less potent (EC50 2l μg/ml).

Anti-obesity: The pharmacological mechanism of the anti-obesity effect of lotus *N. nucifera* leaf extract in mice and rats. The extracts prevented the increase of body weight, parametrial adipose tissue weight and liver triacylglycerol levels in mice with obesity induced by high fat diet and the UCP3 mRNA expression in skeletal muscle tended to be high.

Conclusion

Lotus seeds hold promising future as an alternate protein supplement and potential pharmaceutical source. As lotus seeds have potential nutraceutical advantage, mixing its flour with other nutritionally rich legumes (e.g. soybean) or millets (e.g. finger millet) will be of immense value to develop low cost proteinaceous and healthy food supplements to combat malnutrition as well as specific ailment.

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

Roles and Responsibilities of Individuals in Environmental Protection

Article ID: 40894

Dr. V. Vijaya Lakshmi[1]
[1]Professor & Head, Dept of RMCS, College of Community Science, PJTSAU, Hyderabad.

Many environmental problems are caused by human actions on the environment. Each one of us need to be individually responsible for the quality of the environment we live in. Our personal actions can either worsen or improve our environment quality. This necessitates that individuals should feel responsible to protect the environment by developing environmentally friendly life styles.

Individual Responsibilities Towards Conservation of Resources and Protection of Environment

1. Plant more trees of local or indigenous species around your home and your workplace and encourage your friends to do so. Plants are vital to our survival in many ways.

2. If your urban garden is too small for trees, plant local shrubs and creepers instead. These support bird and insect life that form a vital component of the food chains in nature. Urban biodiversity conservation is feasible and can support a limited but valuable diversity of life.

3. If you live in an apartment, grow a terrace or balcony garden using potted plants. Window-boxes can be used to grow small flowering plants, which also add to the beauty of your house.

4. Whenever and wherever possible prevent trees from being cut, or if it is not possible for you to prevent this, report it immediately to the concerned authorities. Old trees are especially important.

5. Insist on keeping our hills free of settlements or similar encroachments. The degradation of hill slopes leads to severe environmental problems.

6. When shopping, choose products in limited packaging. It will not only help cut down on the amount of waste in landfills, but also helps reduce our need to cut trees for paper and packaging.

7. Look for ways to reduce the use of paper. Use both sides of every sheet of paper and send your waste paper for recycling.

8. Buy recycled paper products for your home; e.g., sheets of paper, envelopes, etc.

9. Reuse cartons and gift-wrapping paper. Recycle newspaper and waste paper instead of throwing it away as garbage.

10. Donate used books and magazines to schools, hospitals, or libraries. The donations will not only help these organizations, but also will reduce the exploitation of natural resources used to produce paper.

11. Participate in the events that highlight the need for creating sanctuaries and national parks, nature trails, open spaces, and saving forests.

12. Support Project Tiger, Project Elephant, etc., and join NGOs that deal with environmental protection and nature conservation.

13. Involve yourself and friends in activities carried out during Wildlife Week and other public functions such as tree plantation drives and protests against destruction of the environment.

14. Visit forests responsibly. Remember to bring out everything you take in, and clean up any litter left by others. Stay on marked trails, and respect the fact that wildlife need peace and quiet. Study the ecosystem; it gives one a **greater sense** of responsibility to conserve it.

15. Be kind to animals. Stop friends from disturbing or being cruel to wild creatures such as birds, frogs, snakes, lizards and insects.

16. Learn about birds and identify the birds that are common in your area. Understand their food requirements and feeding habits. Construct artificial nesting boxes for birds. This will encourage birds to

stay in your neighborhood, even if their nesting habitat is scarce. You can learn more about birds by making a birdbath. Birds need water to drink and to keep their feathers clean. You can make a birdbath out of a big ceramic or plastic saucer. Having birds around your home, school or college can even help increase species diversity in the area.

17. Attract wildlife such as small mammals, such as squirrels, to your garden by providing running or dripping water. Make a hole in the bottom of a bucket and poke a string through to serve as a wick. Hang a bucket on a tree branch above your birdbath to fill it gradually with water throughout the day.

18. Protect wildlife, especially birds and insects that are insectivorous and live in your neighborhood by eliminating the use of chemicals in your garden. Instead, use vermicompost and introduce natural pest predators. Do your gardening and landscaping using local plants to control the pests in your garden.

19. If you have pets, feed them well and give them a proper home and in an emergency proper medical care.

20. When you visit a zoo, learn about the animals that are found there but do not tease or hurt them through the bars of their cage. They have a right to a peaceful existence. The zoo is, in any case, not an ideal home for them.

21. Cover the soil in your farm or garden with a layer of mulch to prevent soil erosion in the rains and to conserve soil moisture. Mulch can be made from grass-clippings or leaf-litter.

22. If you plan to plant on a steep slope in your farm or garden, prevent soil erosion by first terracing the area. Terraces help in slowing the rain water running downhill so it can soak into the soil rather than carry the soil away.

23. Help prevent soil erosion in your community by planting trees and ground-covering plants that help hold the soil in place. You might organize a group of citizens to identify places that need planting, raise funds, work with the local government to plant trees, shrubs and grasses, and maintain them over the long term.

24. If your college is surrounded by open space, evaluate how well the soil is being conserved. Look for places where soil can run off, like on an unplanted steep slope or stream bank, or where the soil is exposed rather than covered with mulch. These areas need special care and must be carefully replanted.

25. Add organic matter to enrich your garden soil; e.g., compost from kitchen scraps and manure from poultry and cows are good sources of nutrients. Make sure the manure is not too fresh and that you do not use too much. Healthy soil grows healthy plants, and it reduces the need for insecticides and herbicides.

26. In your vegetable garden, rotate crops to prevent the depletion of nutrients. Legumes like peas and beans put nitrogen back into the soil.

27. Set up a compost pit in your college or garden, so that you can enrich your soil with the organic waste from the kitchen and cut down on the amount of waste it sends to a landfill. Set up buckets in your college or lunchroom where fruit and left-over food can be put. Empty the buckets daily into a compost pit, and use the rich compost formed in a few weeks to enrich the soil around the college.

28. Encourage your local zoo, farms, and other organizations or people that house a large number of animals to provide your community with bio fertilizer made from animal manure. This can be composted to make a rich fertilizer, and it forms an additional source of income for the animal owners.

29. Buy organically-grown produce to help reduce the amount of toxic pesticides used in farms that harm soil organisms. Look for organically-grown produce in your grocery shop, or try growing some yourself if you have the space.

30. Support environmental campaigns in your state and community. Cutting down on irresponsible development can protect soil, biodiversity, and enhance our quality of life.

31. Reduce the amount of water used for daily activities; e. g., turn off the tap while brushing your teeth to save water.

32. Reuse the rinsing water for house-plants. Reuse the water that vegetables are washed in to water the plants in your garden or your potted plants.

33. Always water the plants early in the morning to minimize evaporation.

34. Soak the dishes before washing them to reduce water and detergent usage.

35. Look for leaks in the toilet and bathroom, to save several liters of water a day.

36. While watering plants, water only as rapidly as the soil can absorb the water.

37. Use a drip irrigation system to water more efficiently.

38. When you need to drink water, take only as much as you need to avoid wastage. So many people in our country don't even have access to clean drinking water!

39. Saving precious rainwater is very important. Harvest rainwater from rooftops and use it sustainably to recharge wells to reduce the burden on rivers and lakes.

40. Monitor and control wastes going into drains for preventing water pollution.

41. Replace chemicals like phenyl, strong detergents, shampoo, chemical pesticides and fertilizers used in your home, with environment friendly alternatives, such as neem and biofertilizers. Groundwater contamination by household chemicals is a growing concern.

42. For *Ganesh Chaturthi,* bring home a clay idol instead of a plaster of paris idol and donate it instead of immersing it in the river to reduce river pollution.

43. Turn off the lights fans and air-conditioning when not necessary.

44. Use low voltage lights.

45. Use tube lights and energy-saver bulbs as they consume less electricity

46. Switch off the radio and television when not required.

47. Use alternative sources of energy like solar power for heating water and for cooking food.

48. Cut down on the use of electrical appliances.

49. In summer, shut the windows, curtains and doors early in the morning to keep the house cool.

50. Use a pressure cooker as much as possible to save energy.

51. Turn off the stove immediately after use.

52. Plan and keep things ready before you start cooking.

53. Keep the vessels closed while cooking and always use small, narrow-mouthed vessels to conserve energy.

54. When the food is almost cooked, switch off the gas stove and keep the vessel closed. It will get completely cooked with the steam already present inside.

55. Soak rice, pulses etc., before cooking to reduce cooking time and save fuel.

56. Get your family to eat together, it will save re-heating fuel.

57. Select a light shade of paint for walls and ceilings, as it will reflect more light and reduce electrical consumption.

58. Position your reading tables near the window and cut down on your electricity bill by reading in natural light.

59. Use a bicycle-it occupies less space releases no pollutant and provides healthy exercise.

60. Try using public transport systems like trains- and buses as far as possible.

61. Plan your trips and routes before setting out.

62. Walk rather than drive wherever possible. Walking is one of the best exercises for your health.

63. Get your vehicles serviced regularly to reduce fuel consumption and reduce pollution levels.

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

Weed Management in Organic Farming

Article ID: 40895

Thounaojam Babycha[1], Ngangom Sonaly Devi[1], Yumnam Sanatombi Devi[1]
[1]Department of Agronomy, South Asian Institute of Rural and Agriculture Management, (SAIRAM) Langjing Achouba, Imphal, Manipur.

Introduction

In organic crops weeds management is more challenging and competitive for nutrient, Space, water, light between the crops and weeds. And in organic farming, weeds are generally appeared as a main barrier. As the organic farmer rise their experience most of the farmer reveal less care about weeds. Organic weeds management is proceeded to weed removal and prevention that are not require to use chemical and weed killer. To control the weed management mechanical, cultural and biological method is done in organic farming. However, farmer use different kind of tools to control the weeds. For successful weed management it may analyst crop rotation, soil management, time and labor etc.

Reason for Using Organic Weed Management

From the time of agriculture farmer have suffer weeds which are being there in the field. Weed can be considered a significant problem because they tend to reduce crop yield production by increasing competition for nutrient, space, water, light while performing as host plants for pests and diseases. To removed weeds from their field farmers, apply chemicals from the time of herbicides invented. By using herbicide to removed weed it increase the crop yield not only that but also reduce the require amount of labor. Nowadays some farmers have newly interest in organic methods of weed managing because by using agro-chemicals it become environmental and health problem. In some cases, it has found that herbicide used can cause some weed species to conquer the field because the weeds developed resistance to herbicide.

What is Organic Weed Management?

Organic weed management is a holistic system including an entirely different approach to manage a farming system. Not interested in removing all the weed by the organic farmer but desire to retain the weed at a threshold that is both economical and manageable. Chemical herbicide can't be used in organic weed management. A farmer who manages weed organic must be intimately familiar with the type of weed and to determine which type of control method must be use in their growth habit.

Method Use in Organic Weed Management

1. Cultural method.

a. Soil solarization: During the summer or in the sun, sometime organic farmer kept their soil through sunlight to make free from bacteria. Throughout the time of this process, after the field has been tilled the area will cover with a clear plastic film. Under the plastic film when the soil caused heat, which is hardly sealed at the edge, become great enough to kill weed and the embryos inside the dormant seeds.

b. Mulch: Mulching or covering the soil can prevent weed seed germination. By absence of sunlight/ light transmission exist photosynthesis of the germinating weed that can cause them to die. In the mulch allelopathic chemical can also cause physically suppressing seeding emergence. There are many different ways for mulching. Mulching which are normally use are:

i. Living mulch: A living mulch is commonly a plant species that grows closely and low to the ground, like clover. Before or after the crop is established living mulch can be planted. It much be till in, kill or living mulch much manage so that it does not complete with certain crop.

ii. Organic mulch: Organic mulch is natural material that can supply productive weed control, materials like straw, crop residues, leaves, bark, wood chips etc. Material of farm production is suggested that since the cost of purchase can be so high that many people cannot effort, based on the amount needed to protect weed emergence. Material that are place in soil surface to avoid from weed management, erosion and decrease the evaporation.

iii. Inorganic mulch: Inorganic mulch is usually non nature material like black plastic, rubber, etc. are used for weed control in a range of crop.

d. Crop rotation: Crop rotation is the practice of cultivated different crop in sequence on the same land by the year. Weeds try to challenge with crops of similar growth requirements as their own and cultural practices designed to contribute to the crop may also benefit the growth and development of weeds. When the same crop growing in the same field by year, result in a development of weed species which are changed in a crop growing condition. When diverse crop practice in rotation, weed germination and growth cycles are disrupted by variations in cultural practices associated with each crop.

e. Inter cropping: It is associated with planting a smother crop between row of the main crop. Seed should be controlled approach carefully by using intercropping as strategy. The intercrops can greatly reduce the yields of the main crop if competition for water or nutrients occurs.

f. Water management: In crop production effective water management is the main source of controlling weeds. By applying drip water irrigation in crop zones, it reduced weed growth. In field time and method of irrigation control weed growth. There are many methods which can help in reducing weed pressure on crop by careful irrigation management.

2. Mechanical method: Specially in organic farming this mechanical method is the most effective method for managing weeds. Both time consume and labour intensive is involved in mechanical removal of weeds. In mechanical weeder, it contained cultivating tools like hoes, harrows, tines and brush weeder and cutting tools like mowers and stemmers. Tools like fixed harrows are suitable for arable crops, whereas inter-row brush weeder are considered to be more effective for horticultural use. The brushed weeder is commonly used in vegetable like carrot, beetroot, onion, garlic, etc. The optimum of timing, implementation and frequency are based on the structure and form of the crop and growth stage and number of weeds. Cultivation involved killing emerging weeds under the depth from which they germinate.

a. Hand hoeing: Hand hoeing is a post-planting interculture operation, which stirs the soil and make it more loosened. It is effective against annual weeds but not for perennial weeds, since it cannot control the under-ground vegetative structure of perennial weeds.

b. Hand weeding/Hand pulling: In weed control hand weeding/ hand pulling is the oldest method. It effectively controls annual weeds but can’t control perennial weeds.

c. Burning, flaming and heating: Burning is practiced mainly under non crop situation towards non-selective control of weeds or unwanted vegetation. Flaming, on the contrary, could be used both selectively and non-selectively. Flame is directed towards the ground and injury to crops is avoided. Crop plants can withstand heat of the burner, whereas small succulent weeds cannot. Crop plants should be taller than weeds. It has been used successfully for selective weed control in alfalfa, cotton, sugarcane and soybean. Heating soil through solarization or residue burning is another aspect for weed control in crops in recent years.

d. Tillage: The aim of tillage is to produce good root growth, healthy seed bed, smooth germination of root bed and to reduce weed by process of continuous unchanged of drainage weed seed bank. Sufficient tillage check and delay emergence of weeds and in early crop establishment it produced better favorable environment. By doing this, tillage break cut or tears of weeds and exposes them in sun to desiccation. It decreased the weed resistance by exhausting the food reserved of the vegetative structure.

3. Biological Control: The biological control of weeds involves the use of living organisms, such as insect, herbivorous fish, other animals, disease organisms, and competitive plants to limit their infestations. An important aspect of biological weed control is that at a time, it is applicable to the control of only one major weed species that has spread widely. With perennial weeds the main objective of bio-control is the destruction of the existing vegetation, in the case of annual weeds prevention of their seed production is generally more important.

Conclusion

Effective weed management on organic farming needs cultural, mechanical and methods. Mulching, crop rotation is the fundamental for weed control and successful organic farming. We foreword a number of concept and tools which can analysis in organic weed management. Some weeds can also serve as host plant for pests. An organic farmer will benefit from knowing which weeds are in their fields, whether they should be considered detrimental to crop growth.

References

1. PATEL, D. D.*, PATEL, T.U., THANKI, J. D. AND ARAVADIA, M. K, Weed management strategy in organic farming.
2. Ravisankar, N., A.S. Panwar, Kamta Prasad, Vipin Kumar and S. Bhaskar. 2017.Organic Farming Crop Production Guide, Network Project on Organic Farming.
3. Melissa VanTine, Graduate Assistant in Horticulture and Sven Verlinden, Assistant Professor of Horticulture Work supported by: WVU Extension Service Tom McConnell, Extension Farm Management Specialist and Program Leader Sept. 2003, Organic Weed Management.

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

Plant Growth Promoting Bacteria – A Boost to Plant Immune System

Article ID: 40896

Lopamudra Giri[1], Gowtham Kumar Routhu[2]
[1]Department of Plant Pathology, PJTSAU, Hyderabad, India, Department of Plant Pathology, Assam Agricultural University, Jorhat, India.

Introduction

In nature, the growth of a plant is not considered as an individual entity, but rather as a complex community that involves intricate and relatively stable partner relationships. Plant growth-promoting rhizobacteria (PGPR) are a type of bacteria that inhabit plant roots and facilitate plant growth, thereby conferring significant advantages to their host. Various secondary metabolites, including siderophores, cyclic lipopeptides, and Quorum sensing molecules, are synthesized by bacteria to stimulate Induced Systemic Resistant (ISR) responses through the activation of multiple defense-related signaling pathways. In recent times, there has been a thorough investigation of the mechanisms behind microbial signals, plant receptors, and hormone signaling pathways that play a role in the process of PGPR-induced ISR in plants. This paper presents a comprehensive analysis of plant recognition, microbial elicitors, and the associated pathways involved in plant-microbe interactions. The study particularly emphasizes the significance of small RNAs in regulating the ISR induced by PGPR in plants.

How Host Plant Recognizes Plant Growth Promoting Rhizobacteria?

Plant Growth Promoting Rhizobacteria (PGPR) are microorganisms that form either symbiotic or non-symbiotic relationships with their host plants, resulting in enhanced plant growth. As these microorganisms are regarded as extra-terrestrial entities, their active intervention in the plant's defence mechanisms serves as the foundation for developing a symbiotic and advantageous association with the host organisms. The identification of molecules that are not self-signalling is a crucial stage in the attainment of efficient defence responses. This identification process is facilitated by pattern recognition receptors (PRRs) present in plants. Pathogen-associated molecular patterns (PAMPs), also known as microbial-associated molecular patterns (MAMPs), are capable of being detected by pattern recognition receptors (PRRs). Pattern recognition receptors (PRRs) identify microbe-associated molecular patterns (MAMPs) or pathogen-associated molecular patterns (PAMPs), subsequently initiating the activation of PAMP-triggered immunity (PTI), which constitutes the primary mechanism of plant defence against pathogens. The receptor-like proteins (RLPs) or the receptor-like kinases (RLKs) are considered the most distinctive pattern recognition receptors (PRRs) in the plant kingdom. Plant growth-promoting rhizobacteria (PGPR) have the ability to generate significant amounts of microbe-associated molecular patterns (MAMPs) such as flagellin, lipopolysaccharides (LPS), exopolysaccharides, and chitin oligosaccharides. These MAMPs act as ligands that activate the plant defence response. Plant defence systems can identify various strains of PGPR and elicit defence responses akin to PTI during the initial stage.

Microbial Elicitation of Induced Systemic Resistance in Plants

Various active molecules, such as Quorum Sensing (QS) molecules, Volatile Organic Compounds (VOCs), siderophores, and cyclic peptides, are released by PGPR strains and serve as significant ISR elicitors.

Quorum Sensing (QS) Molecules

Quorum sensing is a prevalent biological phenomenon in which bacteria are capable of producing and detecting QS molecules to regulate their cell density and group behaviors. They facilitate the modulation of gene expression pertaining to various biological processes such as chemotaxis and biofilm formation. The release of N-acyl-homoserine lactones (AHLs) by Gram-negative bacteria is a thoroughly researched form of quorum sensing (QS) molecules that possess a homoserine lactone ring with an attached acyl side chain.

The presence of a lactone ring is crucial for the proper identification of acyl-homoserine lactones (AHLs) by their corresponding receptors, and for ensuring the accuracy of intercellular recognition. The augmented immune response facilitated by Acyl-homoserine lactones (AHLs) is intricately linked to the stimulation of numerous signaling elements. Compounds such as N-hexanoyl-homoserine lactone (HHL) have been observed to stimulate the biosynthesis of Salicylic acid (SA) in plants, while oxo-C14-HSL has been found to induce the production of oxylipins. These processes have been shown to promote the deposition of callose and phenolic compounds, as well as stomatal closure, increased levels of reactive oxygen species (ROS), and enhanced defense-related enzymatic activities. As a result, the resistance of plants is increased.

Volatile Organic Compounds (VOCs)

Volatile organic compounds (VOCs) produced by bacteria play a crucial role in triggering the induced systemic resistance (ISR) mechanisms in plants, which help to defend against pathogenic infections. Various strains of PGPR have the ability to release a range of volatile organic compounds (VOCs), which trigger systemic plant defense against pathogenic assaults in a manner that is specific to the strain. Volatile organic compounds (VOCs) elicit the induction of plant immune responses by activating the Jasmonic acid (JA), Salicylic acid (SA), and Ethylene (ET) signalling pathways, thereby enhancing the host's defense against pathogenic assaults through the modulation of multiple signalling cascades. Nitric oxide synthases (NOS) are significant volatile organic compounds (VOCs) produced by bacteria. The translocation of the SA signalling component, NPR1, is influenced by NO. NPR1 is involved in the activation of PR genes. It has been observed that SAR can be triggered by NO, which collaborates with ROS and SA signals.

Siderophores

Iron (Fe) is an essential element for all living organisms due to its redox catalytic properties. However, an excess of iron can lead to the overproduction of hydroxyl radicals, which can be detrimental to cellular metabolism and structures. The crucial role of microbial siderophore release in rhizospheric warfare has been demonstrated. Pathogenic plants have the ability to secrete siderophores, which are utilized to obtain iron, an essential element for their virulence and successful invasion. Prior to any pathogen infection, soil-borne pathogens must compete with other microorganisms for limited iron resources in the rhizosphere in order to support their growth. The utilization of PGPR has been observed to mitigate the incidence of plant diseases through the reduction of bioavailable iron in the rhizosphere. Additionally, PGPR has been found to directly stimulate the ISR in plants by activating signalling pathways associated with iron uptake.

Cyclic Lipopeptides

Cyclic lipopeptides (CLPs) such as iturin, surfactin, and fengycin have been found to possess antibacterial properties, which are produced by plant growth-promoting rhizobacteria (PGPR) such as Bacillus spp. The secretion of protein molecules has been identified as a crucial factor in the activation of plant ISR. This process sensitizes the resistance activity in plants, resulting in heightened sensitivity to fungal pathogen penetration. Consequently, this triggers a robust stimulation of H2O2-mediated plant defense. Oxylipins are a group of lipid metabolites that arise from the oxidation of polyunsaturated fatty acids. They serve as signaling molecules and antimicrobial agents in plants, inducing defense responses and regulating cell death. The catabolism of these oxylipins may be facilitated by plant growth-promoting rhizobacteria (PGPR), thereby augmenting the modulation of defense mechanisms.

Regulation of Induced Systemic Resistance in Plants by Small RNAs

MicroRNAs (miRNAs) are a significant type of non-coding RNA molecules in plants that can regulate the expression of target mRNAs through translational repression or cleavage. Research suggests that miRNAs play a role in facilitating plant-microbe interactions. The positive correlation between the expression of miR172c and the efficiency of rhizobia infection and nodulation formation suggests that miR172c plays a crucial role in regulating the symbiotic relationship between plants and rhizobia. A number of microRNAs (miRNAs) have been recently documented to regulate the phenomenon of induced systemic resistance (ISR) in plants triggered by plant growth-promoting rhizobacteria (PGPR). The enhancement of plant defense against pathogenic attacks can be attributed to the suppression of plant miRNAs by PGPR. Plant growth-promoting rhizobacteria (PGPR) have the ability to produce specific signals that can inhibit negative regulators of plant defense mechanisms, including miRNA825/miRNA825, miR472, and miR1918. This results in the upregulation of genes associated with defense mechanisms, such as jacalin lectin, Ring-H2 finger gene, and NBS-LRRs. Consequently, plants become more resistant to pathogenic attacks.

Conclusion and Future Prospects

The activation of the plant defense system can occur in response to a range of pathogenic attacks, facilitated by PGPR, which modulates the JA and SA signalling pathways. Various plant pattern recognition receptors (PRRs) can identify them as microbe-associated molecular patterns (MAMPs), subsequently inducing defense responses in the host. PGPR have devised tactics to mitigate the activation of host defense mechanisms in order to establish mutually advantageous relationships with their hosts. Thorough investigation into the mechanism by which plant roots discern signals from both pathogens and beneficial microbes and subsequently elicit an appropriate response is warranted. A comprehensive examination is necessary to explore the genome-wide profiling of miRNA, followed by functional validation. Additionally, RNA interference technology has been identified as a viable approach to manage plant diseases and pests.

References

1. Backer, R., Rokem, J. S., Ilangumaran, G., Lamont, J., Praslickova, D., Ricci, E., ... & Smith, D. L. (2018). Plant growth-promoting rhizobacteria: context, mechanisms of action, and roadmap to commercialization of biostimulants for sustainable agriculture. *Frontiers in plant science*, *9*, 1473.
2. Van Loon, L. C. (2000). Systemic induced resistance. *Mechanisms of resistance to plant diseases*, 521-574.
3. Van Loon, L. C., Bakker, P. A. H. M., & Pieterse, C. M. J. (1998). Systemic resistance induced by rhizosphere bacteria. *Annual review of phytopathology*, *36*(1), 453-483.
4. Yu, Y., Gui, Y., Li, Z., Jiang, C., Guo, J., &Niu, D. (2022). Induced systemic resistance for improving plant immunity by beneficial microbes. *Plants*, *11*(3), 386.
5. Zhou, C., Zhu, L., Huang, J., & Lu, X. (2022). Development of plant systemic resistance by beneficial rhizobacteria: Recognition, initiation, elicitation and regulation. *Frontiers in Plant Science*, 2853.

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

Studies on Chemical Tests for DUS Characterization

Article ID: 40897

S. A. Shendekar[1], M. R. Meshram[1], D. P. Gadpayale[2]
[1]PhD Scholar, Department of Agril. Botany, Post Graduate Institute, MPKV, Rahuri. MS-413722
[2]PhD Scholar, Division of Biochemistry, ICAR-IARI, New Delhi-110012.

The PPV&FR Act passed by Govt. of India in 2001, provides registration of new plant varieties if it confirms to the criteria of distinctness, uniformity and stability (DUS). The examination of a variety for DUS generates a description of the variety using its relevant characteristics (Eg: plant height, time flowering etc.,) by which it can be described as a variety in terms of the act. The ability to identify and differentiate between the varieties of agricultural crops is fundamental to the breeders for registration and notification, to seed industry for certification and seed testing and to the farmers, processors and traders at some stage or the other in their activities.

Need for Detailed Examination of Diagnostic Characteristics of Crop Varieties

In early days, all over the world, a small list of descriptors was sufficient to distinguish between crop varieties in use. However, in the recent decades, the world witnessed the emergence of large and highly competitive variety development programmes, particularly in the developed programmes, particularly in the developed countries and in some of the developing countries. At the global level, a large number of new candidate varieties are being generated for testing every year, thus underlining the need for establishing their clear-cut diagnostic features. The technology-rich developed countries had obviously realized this requirement much earlier and had, accordingly, tuned their systems to meet the requirement. In most of the developing countries now considering implementing a PVP-system, while certain diagnostic features for released crop varieties are generally known and followed in seed certification procedures, accurate identification keys, giving detailed description on a comparative basis with clear-cut features of distinctness are, in general, lacking; and thus cases of confusion in seed certification and quality control, if such systems are existing, are also not uncommon.

Seed Response to Added Chemicals

1. NaoH test: Verification of red wheat seed in adversely damaged white wheat due to unfavorable environmental conditions is difficult by visual observation. These seeds can be differentiated by Sodium hydroxide test (Payne, 1988). Four replications of 50 seeds each soaked in 3 % NaOH solution for 3 hours and thereafter, the change in color of the solution was observed. Based on intensity of color reaction, the genotypes were classified into three groups' *viz.,* no color change, light yellow and wine red.

2. Alkaloid test for lupinous Spp: Take 400 seeds for distinctness, soak the seeds in water for 24 hrs, cut the seeds in to thin slices. Place the cut pieces in the glass plate over white surface. Add one or two drops of lugol's solution. This test can distinguish seeds with low alkaloid content called sweet lupine from seeds with high alkaloid content called bitter lupine.

3. Phenol colour reaction:

a. Standard phenol test: Soak fifty seeds of each cultivar with eight replicates in distilled water for 16h. Then transfer these seeds to petri plates with two layer of Whatman No. 1 filter paper saturated with 1% phenol solution. Cover the petri plates and keep it in an incubator at $30^{o}C\pm1^{o}C$. Observe the colour reaction after 24h. Based on the colour reaction cultivars can be grouped into **no visible colour change; light brown; dark brown and black**.

b. Modified phenol test: Modified phenol test can be carried out with the presence of Fe+ and Cu+. This can be conducted similar to the standard phenol test, except that the seeds are to be soaked in 0.6 % Na2CO3 and 0.4% CuSO4, separately. The grouping of cultivars can be done based on the colour reaction **no visible colour change; light brown; dark brown and black**.

4. Ferrous sulphate test: Soak 100 seeds of four replicates in 1% ferrous sulphate solution and keep it in an incubator for 2h after the stipulated time record the distinct colour groups.

5. Potassium hydroxide response test: Soak each variety in 5% potassium hydroxide solution with four replications of 100 seeds and keep it in room temperature for 6h. Then, observe the colour development of the solution.

Four replications of 100 seeds in each cultivar are to be soaked in 0.5% guaiacol solution in the test tubes. After 10 minutes, add 10 drops of 0.1% hydrogen peroxide. The grouping can be made as *high, moderate, low and no response* by identifying the solution colour as dark reddish brown, reddish brown, light reddish brown and colourless, respectively.

Seedling Response to Added Chemicals

1. GA_3 soak test: Germinate four replications of 100 seeds in roll towel and keep it in a plastic bucket containing GA_3 (Gibberellic acid) 100-ppm concentration and allow the seeds to germinate in a germinator at 25 ^{0}C After 10 days, evaluate 10 seedlings at random for seedling characteristics.

2. 2, 4-D soak test: Moisten the germination paper with 50-ppm concentration solution of 2, 4-D sodium salt. Then, place four replication of 100 seeds of each cultivar on 2, 4-D moistened germination paper and allow it to germinate in between paper method. The study can be conducted in step-in germinator or Room type germinator or germination cabinets at 25^{0}C. After 10 days, seedlings are to be observed for their root length inhibition.

References

1. Seed technology - Dhirendra Khare and Mohan S. Bhale
2. Seed technology – R. L. Agrawal
3. DUS test manual by PPV and FRA

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

Recent Advances in Weed Management in Crops and Cropping Systems

Article ID: 40898

Eslavath Priyankabai[1]
[1]Ph. D. Scholar, Department of Agronomy, S.V. Agricultural College, Tirupati, ANGRAU-517502.

Weeds are one of the most important biological constraints in agricultural production systems. They negatively affect crop growth and yield by competing with crops for nutrient, sunlight, space, and water. These compete with the crops for all the inputs which are given for the crop growth and play a significant role in reducing the productivity of the crops.

Emerging Issues in Weed Management

1. Herbicide Resistance
2. Weed Plasticity
3. Herbicide-Resistant crops
4. Misconceptions about Integrated Weed management
5. Lack of improved mode of action of herbicides
6. Herbicide Related Contamination
7. Lack of Trained Weed Scientists in Developing Countries
8. Neglected Areas of Research in Weed science
9. Climate Change
10. Use of traditional herbicides.

Recent Advances in Weed Management

Allelopathy/allelochemicals: Allelopathy is a biological phenomenon by which an organism produces one or more bio-chemicals that influence the growth, survival, and reproduction of other organisms. These bio-chemicals are known as allelochemicals and can have beneficial (positive allelopathy) or detrimental (negative allelopathy) effects on the target organisms. Allelochemicals are a subset of secondary metabolites, which are not required for metabolism (*i.e.,* growth, development and reproduction) of the allelopathic organism.

Efficient use of herbicides/ Herbigation: Compatible herbicide combinations control the weeds in a single pass. Besides that, it also reduces the occurrence of herbicide resistant biotypes in weeds by using single herbicide. In ready mix formulations, the different herbicides are mixed in desired concentration to avoid any phytotoxicity to crop. Adding surfactants and adjuvants facilitates to improve spreading, wetting, dispersing and other surface modifying properties which enhance the action of active ingredient. Herbigation is the effective method of applying herbicides through irrigation systems. Success of good herbigation programmes depends upon good management, uniform water applications and knowledge of the movement of herbicides in the soil.

Herbicide tolerance crops: Farmers because of the attributes of glyphosate and because of outstanding crop safety have rapidly adopted herbicide tolerant (HT) crops, particularly glyphosate tolerant (GT) crops.

HT technology has provided farmers with flexible, convenient, economical weed control programs in many parts of the world.

GT crops made it unnecessary to apply separate herbicides to control grasses, broadleaves and perennials.

Bioherbicides: A bioherbicide is a biologically based control agent for weeds. Bioherbicides are made up of microorganisms (e.g. bacteria, viruses, fungi) and certain insects (e.g. parasitic wasps, painted lady butterfly) that can target very specific weeds. The microbes possess invasive genes that can attack the defense genes of the weeds, thereby killing it. A bioherbicide based on a fungus is called a mycoherbicide. In the industry, bioherbicides and other biopesticides are often referred to as "naturals".

Soil solarization: Solarization is a simple nonchemical technique that captures the radiant heat and energy from the sun and causes physical, chemical, and biological changes in the soil. Solarization consists of covering the soil with a clear plastic tarp for 4 to 6 weeks. When properly done, the top 6 inches (15 cm) soil will heat up to as high as 125^0F (52 ^{0}C).

Remote sensing in weed management: Art and science of obtaining useful information about an object without being in physical contact with it (or) without physically contact between the object and sensor. Remote sensing uses the electromagnetic spectrum to image the land, ocean and atmosphere.

Precision weed management or site-specific weed management: Real-time weed detection/recognition and control in agronomic field crops requires seamless integration and high performance of sensors, data processing, and actuation systems. Continuing technological advances in computer vision, robotics, machine learning, etc. are advancing for the improved site-specific weed management.

Drone or Unmanned Aerial Vehicles (UAV): DRONE (Dynamic Remotely Operated Navigation Equipment), also known as **UAV** (Unmanned Aerial Vehicle), is a device which can fly either with the help of autopilot and GPS coordinates on the pre-set course or can be operated manually with radio signals using the remote control or smartphone app. Unmanned Air Vehicle can stay in the air for up to 30 hours, doing the repetitive tasks, performing the precise, repetitive faster scan of the region even in the complete darkness or in the fog.

Weed identification: Using Normalized Difference Vegetation Index (NDVI) sensor data and post flight image processing to create a weed map, farmers and their agronomists can easily differentiate areas of high intensity weed proliferation from healthy cropped areas.

Red, Green and Blue (RGB) bands, Near Infra-Red (NIR) band, Red Edge band (RE) and Thermal Infra-Red band: These bands are used for counting the number of plants, for modeling elevation, water management, erosion analysis, plant counting, soil moisture analysis, assessment of crop health and visual inspection of the crop field.

Crop spraying: Drones can scan the ground and spray the correct amount of liquid, modulating distance from the ground and spraying in real time for even coverage.

Robotics in weed management: Agricultural robots have great potential to deliver weed control technologies that are much more adaptable even down to the plant scale. Agricultural robots can have these characteristics because they bring recent advances in artificial intelligence (AI) to bear on the control of weeds in crop fields. Blue river technology, Ecorobotix, Zasso technology etc., are the companies working on agricultural robotic weed management.

Artificial intelligence: Artificial intelligence ("AI"), is a branch of computer science that aims to create intelligent machines that work and react like humans. Al is the simulation of human intelligence processes by machines, especially computers systems. These processes include learning, reasoning and self-correction. Particular applications of Al include expert systems, speech recognition and machine vision.

Robovator: Robovator is a vision based robotic hoeing machine for controlling weeds in row crops. Detection of weeds by discriminating between plant sizes High capacity, depending on soil and plant conditions – up to 1.5 – 2 ha/hour. Low power requirement of only 5 KW. Suitable for transplanted or direct seeded crops until closing of the rows. Weed seeker, see and spray technique, autonomous robot working in a same manner.

Nanoherbicides: None of the herbicides inhibits activity of viable belowground plant parts like rhizomes or tubers, which act as a source for new weeds in the ensuing season. A target specific herbicide molecule encapsulated with nanoparticles is aimed for specific receptor in the roots of target weeds, which enter into roots system and translocated to parts that inhibit glycolysis of food reserve in the root system.

Combination of past solutions and new technologies: Spot and spray technique, variable rate application (chemicals and irrigation), targeted tillage, autonomous tractors, unmanned aerial vehicles and robots. Should be combined with more unique options which are still in use like laser weeding, stamping, microwaves and radiations, electrical discharge, flaming, pressurized air or solar irradiation.

Future Advancements

1. RNAi Technology.
2. Clustered regularly interspaced short palindromic repeats (CRISPR)/CRISPR-associated protein 9 (CRISPR/Cas9) Technology.
3. Altering Sex Ratios.

Conclusion

The conventional methods like intercrops, cover crops, conservation tillage, flaming, herbicides cannot be replaced suddenly. To have better weed management and to overcome herbicide resistance, these technologies and improved tools should be used. The robotic weed management, soil seed bank management, nanotechnology, biotechnology improvement may be future options for weed control other than the conventional method of weed control.

Out of these methods, the most adaptable method is efficient use of herbicides. This can be easily practiced by the farmers in the field when compared to other methods. Biological methods and non-chemical weed management are useful for maintaining good soil health and also environmental quality. Other approaches are need based or demand driven in nature.

Double Stranded RNA (dsRNA) Vaccines – A Novel Strategy for Control of Plant Viruses

Article ID: 40899

Gowtham kumar Routhu[1], Lopamudra Giri[2]
[1]Department of Plant Pathology, Assam Agricultural University, Assam, India.
[2]Department of Plant Pathology, PJTSAU, Hyderabad, India.

Introduction

Biotic and abiotic stress factors pose a significant threat to food security, agricultural sustainability, and biodiversity. According to estimates, the global crop yield experiences a reduction of 20-40% every year due to plant pests and diseases. Plant viral diseases are responsible for causing a yield reduction of approximately 10-15%, resulting in an estimated global economic loss of US$60 billion annually. The safeguarding of plants is predominantly dependent on the utilization of chemical pesticides and fungicides. However, the extensive application of these agents is causing environmental contamination, which is a growing concern for society. Consequently, there is a heightened impetus to explore alternative approaches to pest management. The utilization of sprayable RNA biopesticide, also known as RNA-based vaccines (RBVs), which operates through the RNA interference (RNAi) mechanism, presents a viable substitute for chemical pesticides/fungicides in the management of pathogens and pests. The current era of genomics is anticipated to facilitate the creation of innovative control measures against plant viruses through the utilization of the abundant sequence information available. The present review focuses on the potential of RNA-based vaccination, also known as exogenous RNAi (exoRNAi), as a game-changing method that is safe, selective, low-cost, and rapidly deployable.

Methods of Controlling Plant Viruses

The fundamental tenets of virus control encompass the avoidance or elimination of the infection source, mitigation or reduction of virus dissemination, and fortification of the plant's immunity against viral infection. The control and management of viral diseases can be classified into two main categories: Traditional methods and biotechnological methods.

1. Traditional methods: Effective management of viral diseases in crop plants involves implementing key agronomic and cultural practices such as the removal of virus-infected plants, alternating crops, selecting optimal planting dates, eliminating weed and reservoir plants within and around farms, and utilizing pesticides to control insect vectors responsible for virus transmission. The aforementioned tactics encompass biological management, genetic and induced immunity, proficient cultural methodologies, utilization of natural biopesticides and sanctioned chemicals, and deployment of planting material that is free from and resilient to diseases.

2. Biotechnological methods: The traditional approaches for virus management that have been previously discussed have not yielded complete success in mitigating viral illnesses. The utilization of genetic engineering techniques has facilitated the development of virus resistance, which can be categorized into two main types: pathogen-derived resistance (PDR) and host genetic resistance. RNA silencing (RNAi) mechanism is conserved among all eukaryotes and is an extremely effective natural antiviral defense system in plants is a means to achieve PDR and has proven successful against to defense against several plant viruses.

RNAi -Mediated Plant Virus Resistance

RNA interference (RNAi) or RNA silencing is an endogenous biological process, present in nearly all eukaryotes, that operates through sequence-specific degradation of the RNA (transcriptional) or by translation repression of gene expression, via the action of a multitude of enzymes implicated in the silencing pathway. The RNA interference (RNAi) process is mediated by an endogenous RNAi pathway containing foreign DNA or viral dsRNA. When there is a ds-RNA molecule of viral origin, the enzyme RNase III Dicer (a member of RISC) initiates the pathway to cleave the ds-RNA into brief fragments (21-23 nucleotides in length with 3'overhang) to Si-RNA. ATP will be used as a precursor to transfer the fragments produced by cleavage into the RISC. The RISC will unravel the ds-RNA short fragments (si-RNA, mi-RNA) to generate two strands: the guide strand and the passenger strand. RISC degrades the passenger RNA strand and the guide RNA strand as they proceed to the translation machinery complex, thereby inhibiting gene expression.

Ds RNA (Double Stranded RNA)-Mediated Plant Virus Resistance

Various inducers of the RNA interference (RNAi) pathway, such as hpRNAs, dsRNAs, artificial miRNAs (amiRNAs), and sRNAs, have been utilized to apply the potent antiviral RNAi technology to plants. This has resulted in the induction of viral resistance in diverse pathosystems. Nontransgenic exoRNAi has potential applications in areas where transgenic cultivation is prohibited, in cases where transgenesis is difficult to achieve, and in responding quickly to emerging virus epidemics. The inclusion of a novel protection method in the toolbox could enhance plant resistance against viruses, pathogens, and other pests. DsRNA-mediated protection has proven to be the most reliable and efficient approach for defending plants against several plant viruses. Some of the plant viruses that were successfully controlled by employing a non-transgenic approach via dsRNA application were listed below in Table 1:

Table 1: List of plant viruses that were controlled using exogenous dsRNA on host plants.

Sl. No.	Target virus	Gene targeted	Host plant	Level of protection (%)
1	Pepper mild mottle virus	Replicase	*Nicotiana benthamiana*	82%
2	Potato virus Y	NIb	Tobacco	72 %
3	Tobacco mosaic virus	CP, p126	Tobacco	50% , 65%
4	Papaya ring spot virus	HC-Pro, CP	Papaya	81%, 94%
5	Zucchini yellow mosaic virus	HC-Pro	Cucumber	82%
6	Cucumber mosaic virus	CP	Bhut jolokia	70%-85%
7	Potato virus Y	CP	Potato	80%
8	Tobacco etch virus	HC-Pro	Tobacco	100%
9	Bean common mosaic virus	NIb	Cow pea	53%
10	Tomato spotted wilt virus	N	Tobacco	54%

DsRNA Application Methods

Several application strategies have been employed to deliver dsRNAs onto plants. These include the use of leaf abrasive, medium- and high-pressure sprays, drenching, agroinfiltration, virus vectors, and lately bacteria. recent years, the spray-induced gene silencing (SIGS) method has acquired increased popularity as the most amenable method for dsRNA delivery for crop protection in field applications. Because insects, nematodes, and fungi are able to transmit plant viruses, RNAi-mediated control via SIGS (or host-induced gene silencing) of these organisms is important.

Adjuvants for RNA Delivery onto Plants

The internalization of dsRNA within plant cells and the duration of RNAi triggered by the administered RNA molecules are two crucial elements for the development of an effective dsRNA application strategy. The successful delivery of a dsRNA formulation to the plant cell cytoplasm is impeded by various challenges, including the traversal of the stomata on the plant epidermis and the cell wall that encases the plant cells. Achieving adequate cellular uptake of dsRNA is crucial for the induction of resistance. Various nanocarriers have been synthesized, which possess inherent characteristics to surmount the structural hindrances of plant tissues, as mentioned earlier. The internalization of bioactive molecules such as siRNA and dsRNA into plant cells can be enhanced by binding them to specific carriers. Carbon dots are a class of nanomolecules that are cost-effective and facile to synthesize. They have demonstrated efficacy in delivering drugs in animal models. The utilization of LDH clay nanosheets as a carriers for dsRNA molecules is considered a highly successful example of delivering methods. The utilization of this formulation results in the entrapment of dsRNA within the nanosheets, thereby providing protection against nucleolytic degradation for an extended duration. This protection facilitates the continuous uptake of dsRNA molecules by the cells.

Conclusions and Future Prospects

RNAi technology allows trait-specific engineering of crop plants, however numerous countries' rejection of transgenic plants has stalled crop improvement. However, misuse of chemical pesticides to control insect pests that spread viruses and fungicides against fungal diseases has polluted water and soil resources, causing an ecological imbalance. Uncontrolled usage of these carcinogenic compounds to boost crop production has also harmed human and animal health. RNA-based vaccinations has emerged as a panacea to boost crop yields without harming the environment or valuable lives. In contrast to controlled studies with few plants, open field tests with many plants are affected by extremely changeable environmental influences. RNA sprays must be applied at the right time and frequency to control the target pathogen. Finally, public outreach and stakeholder understanding of this technology would require a massive, transparent, and educational science-based effort.

References

1. Kaldis, A., Berbati, M., Melita, O., Reppa, C., Holeva, M., Otten, P., & Voloudakis, A. (2018). Exogenously applied dsRNA molecules deriving from the Zucchini yellow mosaic virus (ZYMV) genome move systemically and protect cucurbits against ZYMV. *Molecular plant pathology*, *19*(4), 883-895.
2. Routhu, G. K., Borah, M., Siddappa, S., & Nath, P. D. (2022). Exogenous application of coat protein-specific dsRNA inhibits cognate cucumber mosaic virus (CMV) of ghost pepper. *Journal of Plant Diseases and Protection*, 1-8.
3. Routhu, G. K., Borah, M., Siddappa, S., & Nath, P. D. (2023). Topical application of coat protein specific dsRNA molecules confers resistance against cognate Potato virus Y (PVY) infecting potato of North-East India. *Gene Reports*, 101776.
4. Tenllado, F., and Diaz-Ruiz J.R., (2001). Double-stranded RNA-mediated interference with plant virus infection. *J. Virol.* 75(24):12288–97.
5. Voloudakis, A. E., Kaldis, A., & Patil, B. L. (2022). RNA-Based Vaccination of Plants for Control of Viruses. *Annual Review of Virology*, *9*, 521-548.
6. Worrall, E. A., Bravo-Cazar, A., Nilon, A. T., Fletcher, S. J., Robinson, K. E., Carr, J. P., & Mitter, N. (2019). Exogenous application of RNAi-inducing double-stranded RNA inhibits aphid-mediated transmission of a plant virus. *Frontiers in Plant Science*, *10*, 265.

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

Ecosystem Services of Insects

Article ID: 40900

Dileep Kumar N. T[1], Rakshitha T. N[1]
[1]University of Agricultural Sciences, Dharwad- 580005, Karnataka, India.

Introduction

All the plants and animals in a particular area together with their surroundings constitute an ecosystem. Ecosystem services are defined as the gains acquired by mankind from surroundings ecosystem. Ecosystem services are "the benefits people obtain from ecosystems". Four different types of ecosystem services have been distinguished by the scientific body *viz.*, regulating services, provisioning services, cultural services and supporting services. An ecosystem does not necessarily offer all four types of services simultaneously but given the intricate nature of any ecosystem, it is usually assumed that humans benefit from a combination of these services.

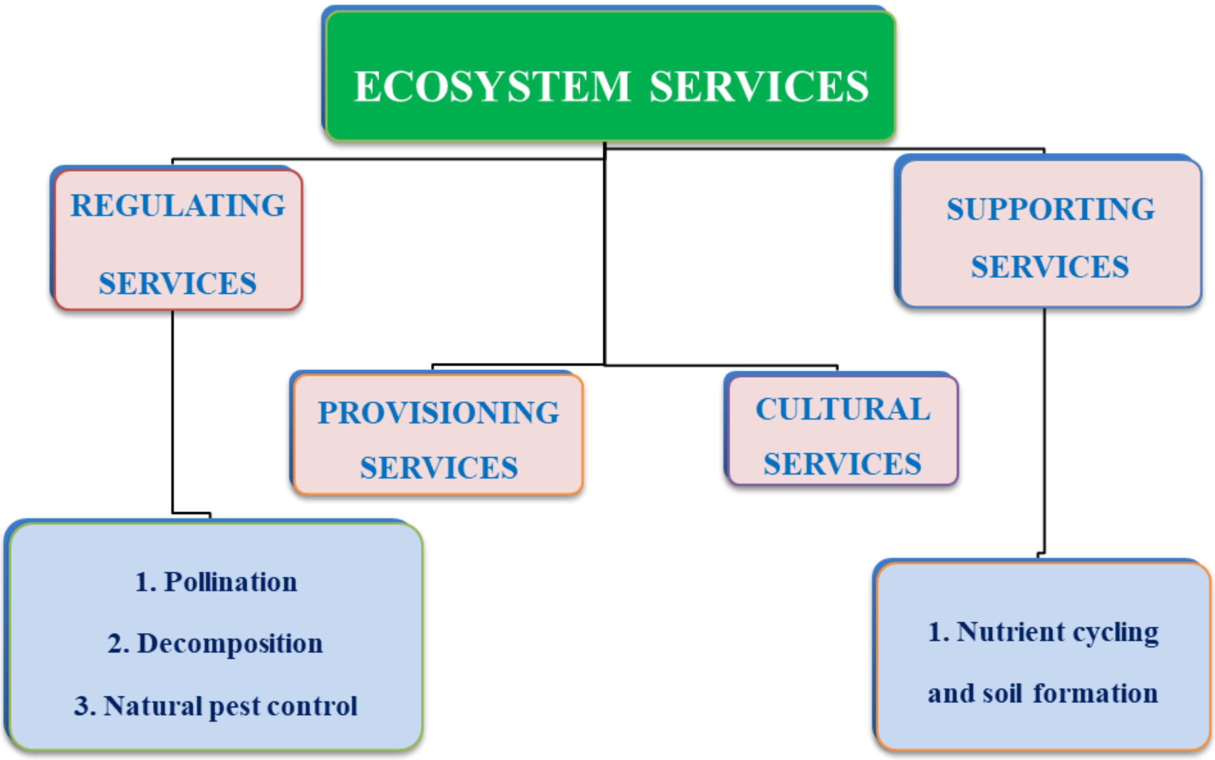


Fig1. Classification of ecosystem services

Important Ecosystem Services Provided by Insects

1. Crop pollination
2. Decomposition (Dung burial)
3. Natural pest control

Crop pollination: A pollinator is an animal that moves pollen from the male anther of a flower to the female stigma of a flower. This helps to bring about fertilization of the ovules in the flower by the male gametes from the pollen grains. Approximately, 80 percent of all flowering plants species are pollinated by animals, including vertebrates and mammals but the main pollinators are insects. Pollinators are responsible for providing with a wide variety of orchard, agricultural crops, horticultural crops and forage production. More than three quarters of the world's food crops rely at least on some parts on pollination by insects and other animals. Nevertheless, insects provide ecosystem services worth at least $57 billion per year in the United States alone (Losey & Vaughan 2006), and insect pollination may have an economic value of $235 to 577 billion per year worldwide.

Entomophily is the phenomenon of pollination service offered by insects. It is by far the most common mean of pollen transfer and it played a vital role in the evolution of angiosperms. There are about 250000 species of flowering plants globally which are pollinated by 200000 species of animals. Out of 95 percent of the flower which are cross pollinated, more than 85 percent depend on insects for pollination. Insect pollinators include honey bees, bumble bees, pollen wasps, ants, flies including bee flies, hoverflies and mosquitoes, butterflies and moths and flower beetles. 50 percent of the plant species propagated by seeds are dependent on insect pollination whereas one third of the food supply is either directly or indirectly depend on these insects' pollinated plants. Insect pollinators are essential for food production, improving the yield and quality of crops.

Table1. The percent contribution of different pollinating agents in crops pollination:

Pollinator	Contribution to pollination (%)
Bees	73%
Flies	19%
Bats	6.5%
Wasps	5%
Beetles	5%
Birds	4%
Butterflies and moths	4%

(Source: Gautham, 2020)

Honey bee

Bumblebees

Butterflies

Fig wasp

Moth

Syrphid fly

Important insect pollinators

2. Decomposition: The process of waste biodegradation is regulated and controlled by the insect community. Beetle larvae, flies, ants and termites clean up dead plant matter and break them into finer particles for further decomposition by microbial community. Dung beetles also play a significant role in decomposing manure. If the dung remains on the soil surface, about 80% of the nitrogen is lost to the atmosphere which is one of the prime causes of global warming. Insects and their arthropod relatives are responsible for much of the nutrient cycling, conditioning and aeration of the soil. The value of nutrient cycling in terrestrial ecosystems is estimated to be over $3 trillion per year.

Dung beetles - ecological engineers: Beetles in the family scarabaeidae are especially efficient at providing dung burial services. They decompose wastes generated by large animals there by recycling nitrogen, enhancing forage palatability, and reducing pest habitat, resulting in significant economic value for the cattle industry. The dung is buried in the ground where it decomposes, aerating and fertilizing the soil. The removal of dung also minimizes the number of flies, so these beetles are extremely useful in maintaining a healthy environment.

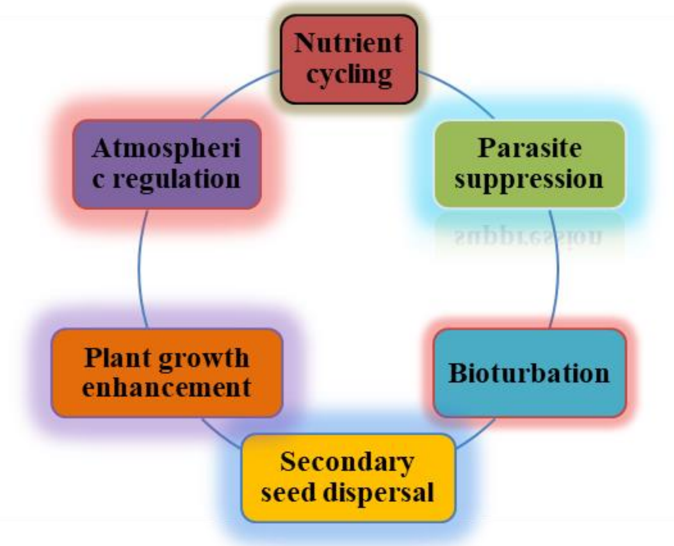


Fig 2. Ecological significance of Dung beetles

4. Natural pest control: Natural control refers to the control of insects provided by natural processes, without human involvement. Although insects can seem very abundant at times, their populations are actually much lower than they would be if it weren't for this natural control. Natural control of plant pests is provided by generalist and specialist predators and parasitoids, including birds, spiders, dragonfly, ladybird beetles, preying mantids, flies, lacewing and wasps, as well as entomopathogenic fungi. This ecosystem service in the short term suppresses pest damage and improves yield, while in the long-term maintains an ecological equilibrium that prevents herbivore insects from reaching pest status.

			
Coccinellid grub	**Green lacewing adult**	***Trichogramma* sp.**	**Robber fly**

General predators and parasitoids aids in natural control of insect pests

Conclusion

Knowledge on the ecological services provided by insects is relatively scarce and biased. This occurs despite their numerical abundance, the ecological functions they perform for the maintenance of ecosystem functioning and their links to human well-being. However, given the sheer diversity of insects and their key ecological role in all terrestrial and freshwater ecosystems, it is extremely likely that the economic and non-economic benefits provided many ecological services may exceed those harmful effects and disservices they cause, even when considering some specific areas such as crop production.

References

1. Gautham A. (2020). Role of insect pollinators in crop pollination.
2. Losey JE and Vaughan M. (2006). The economic value of ecological services provided by insects. *Bioscience* **56** (4): 331–323.
3. Nichols E, Spector S, Louzada J, Larsenc T, Amezquita S and Favilad ME. (2008). Ecological functions and ecosystem services provided by Scarabaeinae dung beetles. *Biological Conservation* 141:1461–1474.

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

Salt Tolerance Transgenic: Types, Mechanisms and Approaches

Article ID: 40901

Rakesh S. Ganvit[1], Rajesh J. Panchal[1], Hardik R. Patel[1]
[1]Dept. of Genetics and Plant Breeding, N. M. College of Agriculture, Navsari Agricultural University, Navsari - 396450, Gujarat, India.

Introduction

Salinity is a critical abiotic stress which not only restricts the plant growth and its survival but also decreases worldwide distribution of plants. According to a recent estimation, around 20% of arable land is affected by salt, which is responsible for 50% substantial yield loss of important crops. In India, 6.73 Mha of land is affected by salinity, in which Gujarat constitutes 2.23 Mha, followed by UP 1.37 Mha, while Maharashtra has 0.61 Mha. Salinity stress involves ionic and osmotic stress which causes changes in various morphological, physiological, biochemical and molecular responses, depending on severity and duration of the stress, and ultimately inhibits crop production. So, major challenge towards world agriculture involves production of 70% more food crop for an additional 2.3 billion people by 2050 worldwide. Plants may be categorized as halophytes or glycophytes, as far as their responses to salinity are concerned.

What are Transgenic Plants?

Transgenic plants simply mean plants carrying foreign genes. The transgenic plants are the plants whose DNA is modified using genetic engineering techniques. Transgenic plants can be developed by inserting transgenes into any of the three genomes *i.e.*, nuclear, plastid or mitochondrial. This process provides many advantages like improving shelf life, higher yield, improved quality, pest resistance, tolerant to heat, cold and drought resistance against a variety of biotic and abiotic stresses. Transgenic plants can also be produced in such a way that they express foreign proteins with industrial and pharmaceutical value.

How to Develop Transgenic Crops?

Genetically engineered plants are generated in a laboratory by altering the genetic make-up by adding one or more desired genes in a plant's genome. The nucleus of the plant cell is the target for the new transgenic DNA. Most genetically modified plants are generated by the biolistic method (gene gun method) or by *Agrobacterium tumefaciens* mediated transformation method.

Type of Salinity Stress

Stress caused due to saline condition is mainly of two types depending upon mechanism *i.e.*, ionic stress and osmotic stress. An ionic stress is the stress which is caused due to imbalance in ions, mainly of Na^+, K^+ and Ca^{2+}, whereas osmotic stress is the stress which is caused due to imbalance in various osmolytes e.g., Mannitol, Sorbitol, Proline, Glycine betaine. The effect caused due to ionic and osmotic stress is as following:

1. Morphological responses:

- a. Reduced plant growth
- b. Chlorosis
- c. Leaf burning
- d. Low tillering
- e. Leaf rolling

2. Physiological responses:

- a. Stomata closure
- b. Photosynthesis inhibition
- c. Reduced water content
- d. High osmolytes

3. Biochemical responses:
   a. Disturbed metabolism
   b. High Na+ transport
   c. Low K+ uptake
   d. Oxidative Stress

4. Molecular responses: Alters the expression of:
   a. Signalling genes
   b. Regulatory genes
   c. Functional genes
   d. Modulate protein profile.

Cellular Mechanisms of Salinity Tolerance

1. Cell membrane stability
2. Osmotic adjustment (Glycine betaine, Mannitol, Proline, Osmoprotectant etc.)
3. Phytohormones (GA_3, IAA, ABA, Brassinosteroides etc.)
4. Enzymes (Amylases, Protease, Peroxidase)
5. Vitamins (Vitamins B_6 and PP)
6. Ion accumulation and ion balance
7. Ion exclusion
8. Leaf characters (Xerophytic feature and Epicuticular wax)
9. Crop stage (Germination and seedling stage).

Approaches to Enhancing Salt Tolerance

1. Develop halophytes as alternative crops
2. Use of interspecific hybridization to raise the tolerance of current crops
3. Use of variation already present in existing crops
4. Generate variation within existing crops by using conventional and non-conventional methods
5. Tolerance breeding must be accompanied by transformation metabolic engineering.

Strategies for Achieving Salt Tolerance

1. Conventional approaches (Selection, Hybridization, Back crossing, Heterosis breeding)
2. Marker assisted selection (MAS)
3. Use of phytohormones
4. Transgenic approach
5. Genome editing.

Achievements

Transgene	Gene isolated from	Promoters used	Transgenic crop	Reported transgenic plant performance during salt stress
Ion exclusion (transporters) Na^+/H^+ antiporter (*SOS1*)	*Arabidopsis*	Constitutive	Tobacco	Altered shoot and root accumulation of Na^+ and K^+
Na^+/H^+ antiporter (*SOD2*)	*Salicornia brachiata*	Stress inducible	Rice	Improved biomass production
Trehalose-6-phosphate phosphatase (*TPP*)	Rice	Stress inducible	Tomato	Improved plant survival
Tissue tolerance (transporters/proton pumps) Na^+/H^+ antiporter (*NHX*)	*Arabidopsis*	Constitutive	Buckwheat	Improved shoot and root biomass production

Tissue tolerance (Compatible solutes) Trehalose-6-phosphate	Yeast	Constitutive	Alfalfa	Increased compatible solute accumulation
Na+ /H+ antiporter (*nhaA*)	*Atriplex gmelini*	-	Cotton	Altered Na^+ and K^+ accumulation
Betaine aldehyde dehydrogenase (*BADH*)	Spinach	-	Sweet potato	Maintenance of photosynthetic efficiency
Na^+ transporter (*HKT subfamily 1*)	Yeast	ABA responsive	Barley	Improved germination
Na^+/K^+ transporter (*HKT subfamily 2*)	Barley			
Na^+ ATPase (*ENA*)	*Physcomitrella patens*			

The Role of Epigenetics in Plant Breeding: Opportunities and Challenges

Article ID: 40902

Purnima Ray[1], Jatin Tanwar[2], M. R. Prajapati[1]
[1]Department of Genetics and Plant Breeding, NMCA, NAU, Navsari, Gujarat.
[2]Division of Genetics, ICAR-Indian Agricultural Research Institute, New Delhi.

Summary
Epigenetics is a rapidly growing field that explores heritable changes in gene expression that are not due to changes in the underlying DNA sequence. Recent advances in our understanding of epigenetic mechanisms have opened up new opportunities for plant breeding. By modifying the epigenetic marks that control gene expression, it is possible to develop crops with improved traits such as disease resistance, improved yield, and enhanced nutritional content. However, there are also challenges associated with the use of epigenetics in plant breeding, including potential environmental impacts and ethical concerns. In this article, we explore the opportunities and challenges of using epigenetics in plant breeding.

Introduction
Plant breeding has long been an essential tool for improving crop yields and quality. However, traditional breeding methods often rely on a limited set of genetic variation, and it can be challenging to develop crops with complex traits such as drought tolerance or disease resistance. Epigenetics offers a new approach to plant breeding by modifying the expression of genes without changing the underlying DNA sequence. The term "epigenetics" was coined by Waddington by combining "epigenesis" and "genetics". In essence, it refers to the study of the interaction between genes and their products that leads to the observable characteristics, or phenotype, of an organism. Epigenetic changes occur as a result of modifications to DNA methylation, histone proteins, or RNA interference, rather than alterations to the underlying DNA sequence. Certain epigenetic variations have been identified in various crops, including rice (dwarf phenotype), apple (anthocyanin production), oilseed rape (reduced oil content), pigeon pea (high heterosis), pineapple (increased somatic embryogenesis), soybean (enhanced yield and stability), melon (sex determination), and tomato (fruit ripening).

Epigenetic Mechanisms in Plants
Epigenetic marks control gene expression by altering the accessibility of DNA to the transcription machinery. The most well-known epigenetic marks are DNA methylation and histone modification. DNA methylation is a heritable process that involves the addition of a methyl group (CH_3) to the 5th carbon of a cytosine base. This process plays a crucial role in various functions, including gene expression, genomic stability, gene imprinting, and inactivation of transposable elements. It is typically passed on in a Mendelian fashion, but in cases of paramutation, variations in methylation can result in non-Mendelian inheritance, generating phenotypic diversity. Given its heredity and potential to influence plant phenotypes, DNA methylation is a crucial factor in crop productivity. Methylation of DNA has been shown to impact traits of agronomic importance, such as time of flowering, seed dormancy, yield, and more. Histone modifications, on the other hand, occur when chemical groups are added to histone proteins that wrap around DNA. These modifications can either promote or inhibit gene expression, depending on their location in the genome. MicroRNAs (miRNAs) are small, non-coding RNAs that are encoded by miRNA genes and typically consist of 20-24 nucleotides. In plants, they play a crucial role in regulating gene expression and can impact complex biological processes. Most miRNAs act as negative regulators of their target transcripts, using significant sequence complementarity to target coding sequences (ORFs). In cases where there is low sequence complementarity, translational repression occurs in the targets.

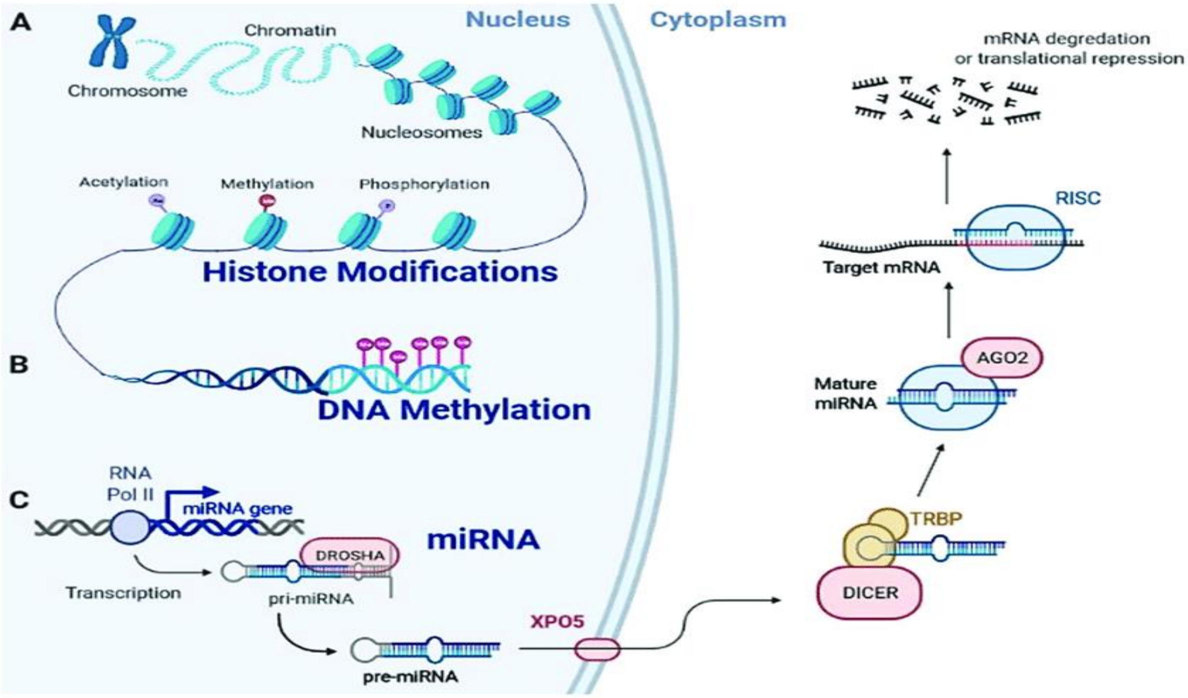


Fig. 1 Epigenetic mechanisms

Table 1 Epigenetic changes in crops associated with agronomic traits:

Crops	Trait/changes induced	Epigenetic modification
Cotton	Methylation at H3K9me2 controls fibre differentiation by targeting synthesis of lipid and spatio-temporal modulation of reactive oxygen species	DNA methylation
	Demethylation of DNA activates expression of COL2 gene which is responsible for photoperiodic flowering	DNA methylation
	Hypomethylation of DNA in non-embryonic calli stimulates plant regeneration	DNA methylation
Pigeon pea	Methylation in DNA is associated with heterosis	DNA methylation
Wheat	miR408 targets Timing of CAB Expression 1 TF and associated with heading time	mi RNA
	miR159 targets MYB TF and is associated with development of anther	mi RNA
	cuticular wax biosynthesis by TaGCN5 and attenuation of a fungal pathogen	Histone modification
Barley	miR172 targets APETALA2 (AP2)-like TF and is associated with grain density as well as cleistogamous flowering	mi RNA

Epigenetics in Plant Breeding

Epigenetics has become an increasingly important tool in plant breeding due to its ability to modify gene expression without introducing foreign DNA into the genome. This is achieved through the addition or removal of chemical groups, such as DNA methylation or histone modifications, which can affect the accessibility of certain genes to the transcription machinery. These epigenetic modifications can be heritable, meaning that they can be passed down to future generations without changing the DNA sequence. This makes them a valuable tool for crop improvement, as they can be used to modify the expression of specific genes or genomic regions that are associated with desirable traits such as yield, disease resistance, or stress tolerance.

Another advantage of using epigenetics in plant breeding is that it allows for more precise control over gene expression. Traditional breeding methods involve crossing plants with desired traits, but this process can be time-consuming and often leads to unwanted traits being passed on. Epigenetic modifications, on the other hand, can be targeted to specific genes or genomic regions, allowing breeders to modify the expression of specific genes without affecting other areas of the genome. This can lead to more precise and efficient crop improvement, as breeders can focus on improving specific traits rather than having to deal with unwanted side effects.

Overall, the use of epigenetics in plant breeding has the potential to revolutionize crop improvement. By allowing for targeted modifications to gene expression, epigenetics can help breeders to create crops that are better adapted to changing environmental conditions, have increased yields, and are more resistant to pests and diseases. Furthermore, because epigenetic modifications are heritable, they can provide a long-term solution to improving crop productivity, as the modified traits can be passed down to future generations. While there are still challenges to be overcome, such as understanding the complex interactions between genes and epigenetic modifications, the potential benefits of using epigenetics in plant breeding are clear.

Challenges Associated with Epigenetics in Plant Breeding

Despite the many opportunities offered by epigenetics in plant breeding, there are also challenges that need to be addressed. One of the most significant challenges is potential environmental impacts. For example, if epigenetic modifications are passed down to wild relatives of crops, they could alter their growth or reproductive patterns, leading to unintended ecological consequences. Another challenge is ethical concerns surrounding the ownership and control of epigenetically modified crops. Finally, there is still much we do not understand about epigenetic mechanisms in plants, and more research is needed to fully realize the potential of epigenetics in plant breeding.

Conclusion

Epigenetics offers exciting new opportunities for plant breeding, allowing for the development of crops with improved traits without introducing foreign DNA into the genome. However, there are also challenges associated with the use of epigenetics, including potential environmental impacts and ethical concerns. Future research in this area will be essential to fully realize the potential of epigenetics in plant breeding.

References

1. Gupta, C., & Salgotra, R. K. (2022). Epigenetics and its role in effecting agronomical traits. Frontiers in plant science, 13, 925688.
2. Kakoulidou, I., Avramidou, E. V., Baránek, M., Brunel-Muguet, S., Farrona, S., Johannes, F., Kaiserli, E., Lieberman-Lazarovich, M., Martinelli, F., Mladenov, V., Testillano, P. S., Vassileva, V., & Maury, S. (2021). Epigenetics for Crop Improvement in Times of Global Change. Biology, 10(8), 766.
3. Rotondo, J. C., Mazziotta, C., Lanzillotti, C., Tognon, M., & Martini, F. (2021). Epigenetic Dysregulations in Merkel Cell Polyomavirus-Driven Merkel Cell Carcinoma. International journal of molecular sciences, 22(21), 11464.
4. Tonosaki, K., Fujimoto, R., Dennis, E. S., Raboy, V., & Osabe, K. (2022). Will epigenetics be a key player in crop breeding? Frontiers in plant science, 13, 958350.

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

Different Systems of Sheep and Goat Rearing/ Feeding

Article ID: 40903

Sujit B. Bhalerao[1], Pallavi D. Mali[2], Akshay P. Chawke[3]
[1]Ph. D in Animal Husbandry and Dairy Science, Assistant professor, Agriculture College, Sonai- 414105.
[2&3]Ph. D in Animal Husbandry and Dairy Science, MPKV, Rahuri- 413722.

Introduction

Rearing- The process of keeping feeding, breeding and medical care of useful animal is called rearing, there are four system of rearing they are extensive, semi-intensive, intensive and Tethering.

Extensive System

1. Grazing the sheep and goat in the entire pasture and leaving them there for the whole season is the extensive system of rearing.
2. In this method feed cost is very much reduced.
3. It is not conducive to make the best use of the whole grasses. So, we can preferably practice the **rotational grazing method.**

Rotational grazing method:

a. Rotational grazing should be practiced under which the pasture land should be divided by temporary fences into several sections.
b. The animals are then moved from one section to another section. By the time the entire pasture is grazed, the first section will have sufficient grass cover to provide second grazing.
c. Parasitic infestations can be controlled to a great extent.
d. Further, it helps to provide quality fodder for most part of the year.
e. Under this system, it is advisable to graze the lambs first on a section and then bring in ewes to finish up the feed left by the lambs.

Semi-Intensive System

1. Semi-intensive system of sheep / goat production is an intermediate compromise between extensive and intensive system followed in some flocks having limited grazing.
2. It involves extensive management but usually with controlled grazing of fenced pasture.
3. It consists of provision of stall feeding, shelter at night under shed and 3-to-5-hour daily grazing and browsing on pasture and range.
4. In this method, the feed cost is somewhat increased.

This system has the advantage of:

a. Meeting the nutrient requirement both from grazing and stall feeding.
b. Managing medium to large flock of 50 to 350 heads and above.
c. Utilizing cultivated forage during lean period.
d. Harvesting good crop of kids both for meat and milk.
e. Making a profitable gain due to less labour input.

Intensive System - (Zero Grazing-System)

1. It is a system in which sheep goats are continuously kept under housing in confinement with limited access in which they are stall fed.
2. It implies a system where goats are not left to fend for themselves with only minimum care.
Intensive operation of medium sized herd of 50 to 250 heads or more oriented towards commercial milk production goes well with this system particularly of dairy goats.
3. It merits exploitation of the system of feeding agro-industrial by products as on fodder grass with carrying capacity of 37 to 45 goats per hectare.
4. This system of management requires more labour and high cash input.
5. However, this has the advantage of close supervision and control over the animals.

6. In this method, the dung is collected in one place and used as a good fertilizer.
7. Less space is sufficient for a greater number of animals.

Rearing in mud floor:

a. In this method, once in a year 1-2 inches of mud surface should be removed.
b. Application of lime powder once in a month will reduce the disease occurrence in the shed.
c. The shed should be constructed in elevated area to prevent water stagnation.

Deep litter shed:

a. In this method, the litter materials like ground nut husk, sugarcane tops etc. are spread on the floor for a depth of ½ feet and animals are reared in it.
b. The urine and dung mixed with the litter materials are used as fertilizer.
c. The litter materials should be removed once in six months.
d. In heavy rain seasons, the litter materials should not be over wet to prevent which would cause ammonia gas production.

Elevated floor shed:

a. Its initial investment is high.
b. In the wooden floor sheds, in a distance of 3m from the floor, the animals are reared.
c. This requires less labour and more irrigation land for the fodder production.
d. The elevated sheds will be clean and urine and dung will be collected in the floor and periodical removing is required once in six months.

Tethering

1. In this method is specially used for goats when raised in a single or numbers.
2. In this method animals are tied with a long rope to pivot or long wire fixed to facilitate the animal to graze in a limited area.
3. The location should be changed on every alternate day.

Advantages:

a. Animal can be grazed in field while the laborers work field.
b. Less expensive method.
c. Rotational or open range grazing can be provided.

Disadvantages:

a. This method useful for only single or few animals.
b. Loss of manure during grazing.
c. Animals are exposed to adverse climatic condition.

Identification of Animal

Article ID: 40904

Akshay P. Chawke[1], Pranjali B. Meshram[1], Pallavi Dattatray Mali[1]
[1]Ph.D. Scholar, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth Rahuri, Dist. Ahmednagar-413722 Maharashtra, India.

A lot of ignores animal identification which is very important. Giving names to farm animals may serve the purpose to an extent for a small herd, but may not be feasible for a large herd. So it is important to put some important identification mark on each farm animal soon after its birth.

Identification of Animals

Importance:
1. To identify the animal if lost or stolen.
2. To record the details of animal in respect of breeding, feeding, management and health cover.
3. To know pedigree of animal.
4. To record growth, reproduction, and production of animal.
5. To make easy for treatment or culling of sick or unproductive animals from the herd.

Methods of Identification

1. Ear tattooing
2. Ear notching
3. Tagging
4. Branding
5. Electronic Identification System

Ear tattooing: It is the process of puncturing desired number or letter on inside skin of ear with the help of tattoo forcep and then rubbing tattooing ink (blsck carbon pigment) over the punctures.

Technique:

a. The surface of the ear is cleaned inside with the help of soap water and then wiped with spirit swab to remove grease before tattooing.
b. The desired number is then fixed in the tattooing forceps and pressed on the inner side of ear in between two veins.
c. The tattoo puncture is then rubbed with tattooing ink with the help of thumb.
d. Tattooing is done on undersurface of tail in case of animals having dark or pigmented ear skin.

Ear notching: It is the method of making 'V' or 'U' shape cuts / notches along borders of ear with the help of scissor or pincers.

Techniques:

a. Animal mis firmly secured, ear is cleaned and disinfected with the help of spirit.
b. Then 'V' or 'U' shape cut notches made at the border of ear by using sterilized ear punch/ scissor/ pincers.
c. A single notch at lower side of right ear indicates the number '1' while of left year indicates the number '3'.
d. A single notch at the upper side of right ear indicates the number '10' while on left year indicates the number '30'.
e. Notches should neither be made to small nor to large.

Tagging: It is method of fixing of numbered tag at ear/neck of animals.

Type of tagging:

a. Ear tagging.
b. Neck tagging

Ear tagging: It is the most popular method of identification of farm animals.

Techniques:

a. In this method, tags made up of light metal or strong coloured plastic having number engraved on it are used.
b. Tags are of two types i.e. self-piercing and non-piercing.
3. Prior to tagging ear is cleaned with spirit.
c. Self-piercing tag is directly pierced and locked with the help of pincers.
d. In case of non-piercing tag. Whole is made on the upper edge of ear with the help of ear notcher or ear punch and then tag is placed in the hole and fixed.
e. While tagging, number should be visible outside the upper edge of ear.
f. Tag should not be too tight or too loose.
g. Antiseptics solution like tincture iodine or benzoin should be applied at the side of tagging.

Neck tagging:

a. In this method metallic or plastic tag is tied in the neck chain by the use of thread or wire.
b. It is temporary method of marking animals as there is chance that they may be lost.

Branding: It is the method of imprinting number or any identification mark on the thigh of animal by hot iron, chemical or coolant. Branding is mostly used for marking of cattle, buffaloes' horse and camels.

Electronic identifications: The electronic identification system is started in the year 1970s. Radio frequency identification (RFID) is one of the most advanced methods used in organised farm to identify and record the day-to-day data of animal.

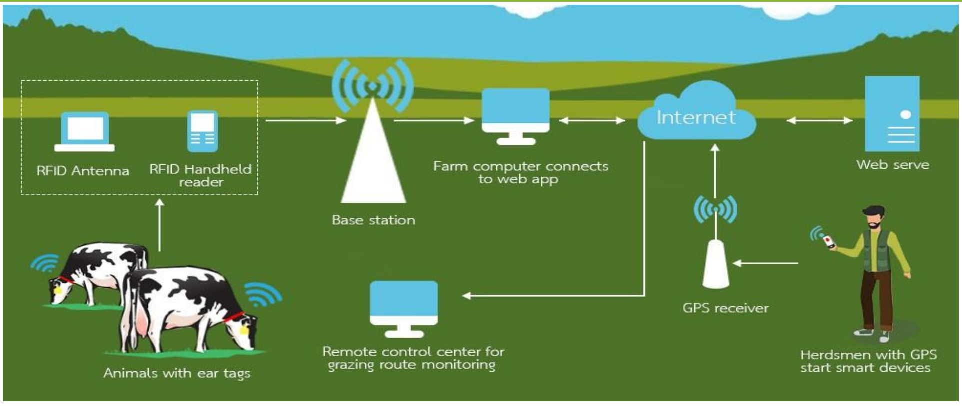
Radio frequency identification (RFID) technology for cattle: Radio frequency identification (RFID) describes the system that wirelessly transmits the identity of an animal. These devices have an electronic number that is unique for an individual animal and link that animal to be database. Electronic ear tags, injectable transponder and boluses with the transponders, inside in the reticulum are the latest technologies for animal identification.

Types of RFID Tags

1. Active RFID tags: Active RFID tags have a local power source like a battery and can operate hundreds of meters away from the RFID reader. They constantly transmit data.

2. Passive RFID tags: Passive tags don't have a local power source. It takes energy from the interrogating radio waves of a nearby RFID reader. A passive RFID tag needs to be "powered up" by a nearby reader before it can transmit data.

		
Ear Tattooing	**Ear Notching (1)**	**Ear Notching (2)**
		
Ear Tagging	**Neck Tagging**	**Branding**



Radio frequency identification (RFID) technology for cattle

Methods of Milking

Article ID: 40905

Akshay P. Chawke[1], Pranjali B. Meshram[1], Pallavi Dattatray Mali[1]
[1]Ph.D. Scholar, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth Rahuri, Dist. Ahmednagar-413722 Maharashtra, India.

Milking

Milking is a skilful act of drawing milk from udder of lactating animal. Principles of milking:

1. Milking is a key operation on the dairy farm.
2. Milking is hormone related act. Oxytocin secreted by pituitary gland is responsible for letting down of milk.
3. Milking should be gentle, quick and complete.
4. Letting down of milk can be stimulated by gentle massage.
5. Milking should be completed within 7 minutes.
6. Before milking, hind quarters should be groomed and washed.
7. Tail should be tied with hind legs.
8. Udder should be washed with a weak antiseptic solution prior to milking.
9. Milking should be done by an experienced milker who is free from bad habits like spitting or smoking and communicable disease. He himself realizes cleanliness.
10. Milking is usually done from left side of the animal.
11. Full hand method of milking should be followed particularly for large animals.
12. First drawn milk strips are collected in strip cup to check any abnormality and should not be added in milk.
13. The last stripping of milk is rich in fat.
14. Milking time and interval between milking should be kept constant.
15. A concentrate mixture should be offered to animal during milking for calm convenient milking.
16. Silage, leaves of onion, cabbage, cauliflower, parthenium etc. should not be fed just before milking.
17. Hind legs should be well secured before milking.
18. Animal should not be disturbed or excited during milking as it may cause inhibition of milk ejection due to action of adrenaline hormone.
19. Avoid excess noise/sound during milking.
20. At the end of milking teats should be dipped in antiseptic solution.

Methods of Milking

There are two methods of milking:
1. Hand milking – done manually.
2. Machine milking – done by milking machine.

Hand milking:

a. It is most common method of milking.
b. There are three methods of hand milking.

Stripping or strip milking:

a. In this method, teat is firmly held at the base between thumb and index finger.
b. It is then pulled downward along the length of teat with equal pressure thereby milk flows down in a strip.
c. The procedure is repeated in quick successions till that quarter of udder is evacuated.

Full hand method:

a. In this method, teat is held completely in the first with thumb raised hence method is also called as fisting.
b. Base of the teat is firmly held in ring formed by thumb and forefinger.
c. It is then pulled downward to tip of teat which causes milk ejection.

Knuckling:

a. It is the modification of full hand method.
b. The thumb is folded inside and teat is pressed in between the bend of thumb and remaining fingers.
c. It gives more irritation to teats and if continuously used, teat become smaller at the centre with depression.
d. It is more troublesome and uncomfortable to the animal.

Machine Milking

In this method, machine is used for milking instead of hands.

Method:

a. Udder and teats are wiped with warm antiseptic solution half a minute prior to milking.
b. Two to three strips of foremilk are drawn from each teat.
c. Teat cups are then placed on teats.
d. Then the machine is operated at 10- 15" vacuum with a pulsation rate of 50/ minute.
e. The negative pressure created by machine evacuates the milk from udder.
f. Teat cups are removed as soon as milk ceases to flow.

Precautions to be Taken

1. Teat cups should not be kept for long time.
2. Machine should be operated with optimum vacuum.

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

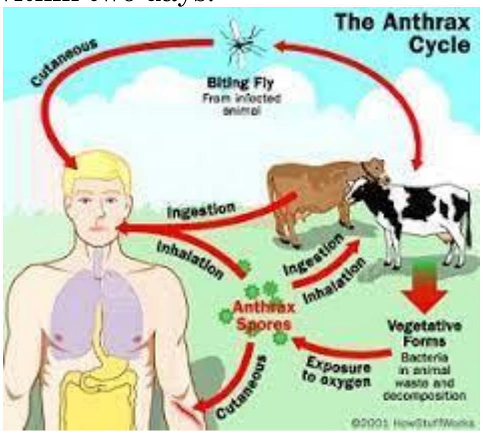
Common Animal Diseases and their Management

Article ID: 40906

Akshay P. Chawke[1], Pranjali B. Meshram[1], Pallavi Dattatray Mali[1]
[1]Ph.D. Scholar, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth Rahuri, Dist. Ahmednagar-413722 Maharashtra, India.

Anthrax

Anthrax, a highly infectious and fatal disease of cattle, is caused by a relatively large spore-forming rectangular shaped bacterium called *Bacillus anthracis*. Anthrax causes acute mortality in ruminants. The bacteria produce extremely potent toxins which are responsible for the ill effects, causing a high mortality rate. Signs of the illness usually appear 3 to 7 days after the spores are swallowed or inhaled. Once signs begin in animals, they usually die within two days.



Symptoms:

a. Sudden death (often within 2 or 3 hours of being apparently normal) is by far the most common sign;
b. Very occasionally some animals may show trembling, a high temperature
c. Difficulty breathing, collapse and convulsions before death. This usually occurs over a period of 24 hours;
d. After death blood, may not clot, resulting in a small amount of bloody discharge from the nose, mouth and other openings.

Treatment and control:

a. Due to the acute nature of the disease resulting in sudden death, treatment is usually not possible in animals even though Anthrax bacilli are clines. Treatment is of use in cases showing sub-acute form of the disease.
b. In most cases, early treatment can cure anthrax. The cutaneous (skin) form of anthrax can be treated with common antibiotics.

Preventive measures:

a. Regular annual vaccination of animals in endemic areas will prevent the disease from occurring.
b. Vaccination may be carried out at least a month prior to expected disease occurrence in endemic areas.

Black Quarter (Black-Leg)

It is an acute infectious and highly fatal, bacterial disease of cattle. Buffaloes, sheep and goats are also affected. Young cattle between 6-24 months of age, in good body condition are mostly affected. It is soil-borne infection which generally occurs during rainy season. In India, the disease is sporadic (1-2 animal) in nature.

Causal organism: it is a bacterial disease caused by *Clostridium chauvoei*

Symptoms:

a. Fever (106-108°F), Loss of appetite, Depression and dullness
b. Suspended rumination
c. Rapid pulse and heart rates
d. Difficult breathing (dyspnoea)
e. Lameness in affected leg
f. Crepitation swelling over hip, back & shoulder
g. Swelling is hot & painful in early stages whereas cold and painless inter.
h. Recumbency (prostration) followed by death within 12-48 hrs.

Treatment:

a. Early treatment can be possible to complete cure of the animal.
b. Consult with veterinarian immediately.

Foot and Mouth Disease

The foot-and-mouth disease is a highly communicable disease affecting cloven-footed animals. It is characterized by fever, formation of vesicles and blisters in the mouth, udder, teats and on the skin between the toes and above the hoofs. Animals recovered from the disease present a characteristically rough coat and deformation of the hoof.

Symptoms:

a. Fever with 104-105^{o} F
b. Profuse salivation - ropes of stringy saliva hangs from mouth
c. Vesicles appear in mouth and in the inter digital space
d. Lameness observed
e. Cross bred cattle are highly susceptible to it.

Treatment:

a. The external application of antiseptics contributes to the healing of the ulcers and wards off attacks by flies.
b. A common and inexpensive dressing for the lesions in the feet is a mixture of coal-tar and copper sulphate in the proportion of 5:1.

Blue Tongue

Bluetongue, a disease which is transmitted by midges, infects domestic and wild ruminants and also camelids, however sheep are particularly badly affected. Cattle, although infected more frequently than sheep, do not always show signs of disease. Virus spreads between animals occurs via the midges of Cullicoides species.

The likelihood of mechanical transmission between herds and flocks, or indeed within a herd or flock, by unhygienic practices (the use of contaminated surgical equipment or hypodermic needles) may be a possibility.

Clinical signs include:

Sheep: Eye and nasal discharges, drooling, high body temperature, swelling in mouth, head and neck, lameness and wasting of muscles in hind legs, haemorrages into or under skin, inflammation of the coronary band, respiratory problems, fever, lethargy.

In cattle: Nasal discharge, swelling of head and neck, conjunctivitis, swelling inside and ulceration of the mouth, swollen teats, tiredness, saliva drooling, fever.

Note: a blue tongue is rarely a clinical sign of infection

Control: Inspect stock closely, particularly focusing on the lining of the mouth and nose and the coronary band (where the hoof stops and the skin starts). If an animal is suspected as having bluetongue, it must be reported as quickly as possible. Telephone your local animal health office immediately.

Bonsai

Article ID: 40907
C N R Santhoshini[1]
[1]Assistant Professor, Department of Floriculture and Landscaping, SKLTSHU, Rajendranagar, Telangana, India.

Summary
The art of training and growing trees in short container. In history it started in china and spread to world by Japan. Based on size they are miniature, small, medium and large bonsai. Based on style they are uniform upright, wind swept, bunjin, root on rock, broom etc types. Steps followed for making bonsai- set container, pruning, planting, training, moulding and maintenance. Trees and shrub species are suitable for bonsai.

Penjing form

Introduction
Bonsai means growing plants in shallow pots, here the growth is checked or dwarfed but not starved. It adds beautification in little space.
1. Bonsai was first developed in China and popularized by Japan.
2. In China it was started as penjai and penjing forms.
3. PENJAI- tree planted in container without any landscape
4. PENJING-tree planted in container with a landscape.
5. Japanese expert on bonsai, KYOZO MORATA said “like a pet animal, it needs water, sunshine and nourishment.”
6. Buddhist believed bonsai is stairway leading to heaven.

Criteria of Plants for Bonsai

Penjia form

1. Hardiness of the plant was for most.
2. Trunks of woody appearance are selected.
3. The trunk must be strong and thick at base level.
4. The trunk should look natural.
5. It should withstand the rigours of growing in shallow containers.
6. It should withstand operations like pruning of roots and shoots.
7. It should withstand hard training practices.
8. Plants of seasonal variations in growth pattern and flowering.

Plants Suitable for Bonsai

Adansonia digitata	*Adenanthera pavonina*	*Bambusa nigra*
Bombax malabaricum	*Brassaia actinophylla*	*Berberis thunbergii*
Butea monosperma	*Callistemon lanceolatus*	*Chorisia speciosa*
Erythrina crista galli	*Erythrina parcelli*	*Ficus religiosa*
Ficus benghalensis	*Ficus infectiria*	*Ficus mysorensis*
Ficus retusa	*Jacandra mimosifolia*	*Kigellia pinnata*
Mangifera indica	*Milletia ovalifolia*	*Punica granatum*
Putranjiva roxburghii	*Thespesia populnea*	*Adenium obesum*

Classification of Bonsai Based on Size

1. Miniature bonsai: Height is 15 cm. Also called mame bonsai.
2. Small bonsai: Height is 15-30 cm. Both trees and shrubs are used.
3. Medium bonsai: Height is 30-60 cm. Convenient to handle.
4. Large bonsai: Height is above 60 cm. Trained in to vast art forms.

Mame bonsai

Classification of Bonsai Based on Style / Shape

1. Formal upright: straight trunk, alternate branch, pyramid shape
2. Informal upright: Asymmetrical trunk upward growth
3. Slanting/oblique: trunk diagonally grown
4. Semi cascade: Trunk slight bending to one edge
5. Cascade: Trunk complete bending to one edge

Cascade style

6. Multiple trunk: Give dense appearance as like forest
7. Clump style: Series of shoots around a base
8. Raft style: Horizontal trunk produce vertical branches
9. Root over rock: Appearance of roots holding rock
10. Tree growing on rock: Mimics natural mountain trees

E-ISSN: 2581 - 8317

11. Broom style: appears as reverse broom.

Clump style

12. Bunjin: bent and straight form tree
13. Wind swept: appearance of bending tree to wind
14. Twisted trunk: trunk twisted 1 or 2 times
15. Split trunk: trunk split to 2 parts
16. Gnarled: trunk twisted near ground to form loop or knob.

Root on rock

Creating Bonsai

Material needed:

1. Plant
2. Container
3. Pot mix
4. Training copper wire
5. Pruning knives and cutters.

Media

1. No water logging, free drainage, neutral P$^{H, rich}$ in fertilizers
2. Composed of 2 parts loam: 1.5 parts sand: 1 part leaf mould.

Procedure

	
Training	**Pruning**

1. Take a bonsai container (check for drainage)

2. Add drainage material at bottom
3. Before planting plant is pruned
4. Based on style place the plant in container
5. Fix the plant with remaining media.
6. Train the plant with wires to different forms
7. Repotting, pinching, pruning, rewinding is practiced
8. Finally gives desired style to the plant after 3-5 years.

Precaution

1. Containers of shallow depth are chosen with round, oval or rectangle shape and black green or white colour.
2. Irrigation and nutrient timely supply and maintenance.

Conclusion

Protocol must be followed to get a correct stature of bonsai. It adds beautification to place, as we cannot accommodate tree in small living or working space, we add bonsai.

References

1. G. S. Randhawa and A. Mukhopadhyay., (1968) FLORICULTURE IN INDIA Allied Publishers aparivate Limited, New Delhi.
2. T. K. Bose *etal*., (2002) Floriculture and Landscaping, Naya Udyog Publication, Kolkata.

Value Added Products in Floriculture

Article ID: 40908

C N R Santhoshini[1]
[1]Assistant Professor, Department of Floriculture and Landscaping, SKLTSHU, Rajendranagar, Telangana, India.

Summary
Value addition in floriculture is a smart way to double your income. To boost women's empowerment and the country's export trade worth. Some value-added flower products include gulkand, resins, potpourri, dried, flower frames, flower petal jam, flower petal tea, cosmetic use, essential oils, rose water, rose cream, and rose hip juice. flowery dyes, floral scents, and so on.

Introduction
Value addition in floriculture also covers novel innovative products and technologies such as floral genes, novelty for molecular breeding, flower form, flower colour, floral fragrance and modern gardening. Sunrise sector refers to floriculture. The development of various value-added goods in floriculture, in my opinion, is a wise business approach that can benefit both the floriculture industry and customers. Floriculture enterprises that offer a broader choice of goods might tap into more market segments and create more revenue. At the same time, consumers have more options to match their individual requirements and tastes.

Flowers are utilised in a variety of ways, including fresh flower products, dried flower products, and processed dried flower products. Dry flower trading is becoming increasingly common these days. India's dry flower trade rate is 70%. Potpourri, dried flower frames, resins, rose water, gulkand, and essential oils are some dried flower items. Fresh flower items include venis, garlands, flower bouquets, rangoli, wreath, corasage, and button hole.

Fresh Flower Products
Floral Rangoli: Pookolam is another name for Floral Rangoli. Kolam is an Indian word that means "colourful Rangoli." Rangoli is done with colours around the entryway. Floral rangoli is formed with flower petals. This sort of rangoli is environmentally friendly.

Garlands: Garlands are commonly used for many events and prayers. Garlands are formed of a single type of flower or a combination of two or three different types of flowers. They are not only attractive but also fragrant.In general, chrysanthemum, tuberose, carnation, rose, jasmine, and other flowers are used to make garland.

Veni: A sort of flower product that is commonly utilised by South Indians during special occasions or when performing traditional dances such as barathanatyam.Women wear this to embellish their plaits of hair.

Floral bouquets: A flower bouquet is a grouping of flowers. They are usually used to greet people. Flower bouquets are arranged for house or public building decor, or they can be carried. Handheld bouquets are divided by numerous common shapes and styles, such as nosegay, crescent, and cascade bouquets.

Floral crown: The floral crown is largely formed of perfumed tuberoses. It is worn by the women at weddings. However, it gained popularity following Queen Victoria's wedding.

				
Floral Rangoli	**Veni**	**Floral bouquets**	**Garland**	**Floral crown**

Dried Flower Products

Candle making: Candle making is becoming increasingly popular, and many people are turning to it as a small-scale business. The dried petals are applied to the outside of the plain candle in this step. It enhances the appearance of the candle.

Resins: This can be done on a small scale as a business or as a hobby. Dried flower petals are added to the resin solution in this step. First, we need to make a mould, then fill it with resin solution and dried petals. The finished product takes 3 to 5 days to arrive. This strategy can be used by those who desire to retain their good moments through flowers.

Gulal: Preparation of floral colours from flower petals. It is eco-friendly. People who believe in the concept of sustainable living and environmentally friendly practises are showing an interest in purchasing organic hues such as gulal.

Candle

Resins

Gulal

Processed Dried Flower Products

Processed products include essential oils, absolutes, concrete, petal jam (rose, rhododendron), jelly, ready to serve beverages, wine, floral tea, rose hip juice, poultry feed, insect repellent, floral dyes, petal embedded handmade paper, cosmetics like calendula cream, rose water, rose cream etc.

S.No	Type of Products	Type of Flowers
1	Floral Rangoli	Rose, marigold,chrysanthemum,daisy,
2	Garlands	Marigold, chrysanthemum, crosandra , rose, tuberose,gomepherna
3	Veni	Crosandra , tuberose, marigold
4	Floral bouquets	Gerbera , rose, gladiolus, tuberose,bird of paradise , orchids, heliconia
5	Floral crown	Tuberose ,gypsphylla,chrysanthemum blooms
6	Candle making	All the dried flowers
7	Resins	All the dried flowers
8	Gulal	Rose,hibiscus
9	Floral teas	Rose ,kavender,butterfly pea,
10	Floral perfumes	Jasmine, rose,lavender,lilytuberose

Personal Opinion

Floriculture value-added goods include fresh-cut flowers, potted plants, dried flowers, wreaths, and floral arrangements, among others. These goods not only enhance the environment's aesthetic value, but they also serve utilitarian purposes such as air purification, aromatherapy, and even food and medication. Overall, I feel that the growth of various value-added products in floriculture is a favourable trend that will benefit both the sector and customers. It benefits all parties involved by encouraging economic progress, environmental sustainability, and customer satisfaction.

Conclusion

Many people have realised the importance of value-added goods from flower crops and have begun to practise them. Even illiterates can practise this by acquiring skills. Women's empowerment is growing.

References

1. Chavan, V.B., S.P. Khedkar, B.R. Salvi, Y.R. Parulekar and Dalvi, N.V. 2019. Novel Innovations in Floriculture Industry. Int. J. Curr. Microbiol. App. Sci. 8(06): 1855-1863.
2. L. C. De., (2020). Value Addition in Flowers and Orchids, published by New India Publishing Agency, Pitampura, New Delhi-110088, Pp.294 (ISBN: 9789381450123).

Non-Insect Pests Management

Article ID: 40909

Dr. Allwin Loveson[1], Dr. S. Susikaran[1]
[1]Tamil Nadu Agricultural University, Coimbatore, India.

Birds

1. Cause damage to many of our standing crops.
2. Cause damage to sprouting seeds, seedlings, vegetables and fruits.
3. Carry disease producing germs.
4. Some cause nuisance by their noisy and persistent behaviour, and
5. Are a constant source of danger to air traffic. They often strike against flying aircraft or get sucked into their engines.

However, they deserve to be repelled rather than killed.

Crow: *Corvus splendens*

a. Omnivorous, crow feeds on kitchen waste to dead animals. It feeds on grain mixed up in refuse sweepings spillage around warehouses.

b. It causes damage to earheads of maize, wheat, sorghum in the field, fruits, vegetables and flowers of silk cotton trees.

c. It breeds during April-August with 4-5 eggs per brood. The eggs are light blue to greenish with dark speckles

Parrot: *Psittacula krameri*, *P. cyanocephalus*

a. It cuts and feeds upon maize, sorghum, bajra, wheat, and barley grains and fruits of guava, fig, mango and pomegranate.

b. It is green with typical short, stout, deeply hooked red bill. It has a black and rose-pink ring around the collar. The female parrot has no collar ring. It has a fine pointed tail, short legs and climbing feet. It lays 4-6 whiteish oval eggs in one brood.

House sparrow: *Passer domesticus*

a. It damages wheat, sorghum, maize, bajra ear heads, and fleshy fruits of mulberry. It also damages grains in open storage, contaminating them with excreta and feathers.

b. The female sparrow is brown with blackish and rufous streaks and whitish under parts. It lays 3-5 pale white greyish eggs in one brood. There are 5 broods per year.

Pigeon: *Columba livia*

a. It eats food grains in stores and godown and contaminates them with excreta and feathers. It is found in goods sheds, railway stations, shops, houses and threshing yards, rice mills, flour mills, etc.

b. It is grey in colour with glistening metallic green. It lays 2 elongated white eggs in one brood. It breeds rounds the year especially from January to May with 3-5 broods in a year.

Common mynah: *Acridotheres tristis*

a. It damages the food grains in fields. It feeds on insect, earthworm, fruit, vegetables, kitchen wastes and grain in refuse.

b. It breeds from April to September. It lays glossy, spot free blue-coloured eggs.

Management:

Cultural methods:

i. Sow the seeds deeply into the soil.

ii. Cover the seeds with soil after sowing.

iii. Grow trap crops near the main crop.

iv. Use plant varieties that are physically and gustatorily unattractive to birds.

v. Plant morphological features such as shed layer of anthers or awns (hybrid *bajra),* tight spathe (maize), compact or loose earheads (pearl millet), large glumes (bracts), loose panicles

and gooseneck-shaped (pendant) heads (sorghum) make the crop unacceptable (resistant) to birds.
vi. Gustatory feature such as an extra quantity of tannins in the grains (sorghum) also make the crop unacceptable (resistant) to birds.

Scaring methods:

i. A conventional deterrent commonly used by the farmers is 'scare crow', a human figure erected in the fields, may scare some birds like crows.
ii. Use throw balls made out of old cloth, jute twine or cotton waste to scare the birds.
iii. Use acetylene gun to create loud noise at regular intervals.
iv. Use tape recorder to record and to play alarm signals of different birds at high pitch in infested areas.

Physical methods:

i. Cover the window ventilators and other entries of godown with bird proof meshes to prevent even rat entry.
ii. Use strips of cloth, polythene or bamboo or cloth or nylon curtains in godown to prevent the birds effectively.
iii. Spreads nylon net over the crops and orchards to protect against birds.

Mechanical methods:

i. Destroy the bird habitat, nests and eggs to reduce the population drastically.
ii. A preferred bird-habitat can be made unpreferred by removing food, water and shelter.
iii. Bird-perches could be electrified to disperse the birds or kill them by regulating the voltage.
iv. Use bird traps, nets, cages to trap birds.
v. Destroy the birds by shooting using air gun and poison (Strychnine) baiting.

Biological methods: Utilize the predators, i.e. hawks and owls for bird control.

Chemical methods

i. Fumigate the nests on trees or in wall holes (mynas, parrots) using aluminium phosphide tablets.
ii. Mix alpha chloralose compounds with food grains or other eatables to make the birds unconscious after they consume.
iii. Use bird sterilant to prepare poison baits, which affect the reproduction.
iv. Use repellents like some insecticides (malathion) or avion feeding deterrent (Tetra methyl thiuram disulphite, TMTD) to repel birds.

The Giant African Snail: *Achatina fulica* (Gastropoda: Mollusca)

1. It is a native of East from where it has spread or deliberately taken to other parts of the world. It has now become established in many countries including India, where it is seen mainly in west Bengal, Assam, Bihar, Orissa, Kerala and Tamil Nadu and in Andaman.
2. The snail is active in the rainy season. During night it comes out of its hiding places and destroys many vegetables, ornamental plants and fruit crops. It also feeds upon dry yellow leaves and bodies of dead snails of its own species
3. The snail is large in size, bisexual weighing about 250 g. The shell is about 7 to 15 cm long, chestnut brown in colour.
4. Two to four weeks after mating the snail lays egg in the soil surface or just below it in batches up to 200 at a time. They hatch after about a week in the rainy season. The young ones take about nine months to mature. The adults live for three to nine years and each can lay about 100 eggs during its life time.

Management:

a. The snail is kept in check by the hermit crabs, which kill and eat the snail and occupy its shell.
b. A predatory millipede *Orthomorpha* sp. inactivates the snail and eats it. Two exotic predatory snails *Englandina rose* and Gonaxis *quadrilateralis* can be introduced for biological control of this snail.

c. During off season the hiding places of the snail can be searched and the snails collected and destroyed.

d. During the rainy season moist gunny sacks or leaves can be heaped near the cropped areas and the snails that collect under these can be gathered next morning and killed.

e. Among the chemical's metaldehyde is the most effective molluscicide and 5% pellets of this compound are spread over the field. It acts as a specific attractant toxicant. It is toxic by ingestion and absorption by the food of the snail. It increases in the secretion of slime resulting in immobilization and ultimate death by desiccation.

The snails *Helix* spp. attack seedlings of various plants during nights and *Limax* spp. feed on leaves and young stems of various crop plants.

The Rice Field Crab: *Paratelphusa hydrodromus* (Decapoda: Crustacea)

1. Young seedlings in nurseries and newly transplanted ones in the main field, mostly within a fortnight after planting are damaged. The seedlings are cut at ground level into small bits which are taken to the holes for feeding. In the older plants outer sheaths are cut open and the tender inner portions are consumed. In an attacked field bits of leaves and stems can be seen floating in water. In badly damaged fields patches of areas, where from the plants have been cut, can be noticed. The crabs are active mostly after dusk and at height. In Tamil Nadu severe damage is observed in samba crop in September – October and in fields with poor drainage.

2. In addition to damage to plants the crab holes made in bunds lead to breaches and water loss.

Life cycle: It has an oval body with the abdomen tucked beneath the thoracic region. It lives in holes made in the fields, bunds, irrigation channels and in such parts of the fields as the corners, where water does not stand. The holes are protected by heaping soil around their openings. The crab multiplies mainly in the dry period, April to June. A single female lays about 200 eggs which are carried by her in a pouch–like abdominal flap on her ventral side. The young ones, on hatching, separate out to make holes and start independent life.

Management:

a. The crabs are naturally kept in check by rats and pond heron.

b. They can be trapped in wide mouthed pots buried with their rim at about the water level moistened rice bran kneaded and made into large lumps are kept as bait inside the pots. About ten pots / ha is sufficient for a good collection of crabs.

c. Poison baits with warfarin 0.025% in popped rice mixed with fried onions and fish bits can be kept for about three weeks.

d. Spraying a contact insecticide over a thin sheet of water in the field and draining for three days after application may be effective.

Mites

The Rice Mite, *Oligonychus oryzae* (Acari: Tetranychidae)

a. It has now become a serious problem in Tamil Nadu.

b. The greenish mites occur on the undersurface of leaves in nurseries and transplanted crops.

c. Plants show characteristic whitish patches on the leaf surface with different stages of mites and webbings.

d. The infested leaves may start drying. In severe moisture stress conditions, the entire crop may be affected/destroyed.

e. It may cause loss in yield is about 25%.

Life cycle:

a. Adults lay spherical straw-coloured eggs singly in rows along leaf midribs and veins. Eggs hatch in 4-9 days. This is followed by the three immature stages: larva, protonymph and deutonymph.

b. Life cycle is very short during hot weather.

Management:

a. Follow crop rotation.

b. Though there are a good number of mite-predators and insect-predators in nature to balance these mites, these predators are destroyed by the pesticides that are being used. Hence overuse of pesticides may be avoided

c. The chemicals that are recommended for the control of mites are:

i. Wettable sulphur @ 2.0g/litre
ii. Dicofol @ 2.5 ml/litre
iii. Profenophos @ 0.5 ml/litre.

The Jowar Mite, *Oligonychus indicus* (Acari: Tetranychidae)

1. It is a major and serious pest of jowar in Tamil Nadu causing considerable damage.
2. The greyish green mite is found in large number on the under surface of leaves.

Symptoms of damage:

a. Formation of characteristic red blotches on the leaves
b. Devitalisation of plants.
c. The nymphs and the female adults suck the sap.
d. Injured leaf shows characteristic red spots or patches which enlarge and coalesce making the whole leaf reddish and distinguishable even from a distance.
e. In case of a heavy attack the leaves and stem dry up resulting in considerable crop losses.
f. The mites attack sugarcane and banana also.

Life cycle:

a. The life cycle of a tetranychid mite consists of an egg, three nymphal and an adult stage. The nymphal stages are called the protonymph, deutonymph and tritonymph. The protonymph, also called larva, has only three pairs of legs and for the absence of genital openings, they resemble the adults.
b. The mite spins delicate webs on the lower surface of the leaf and lives inside the web. Though all stages are capable of spinning the web, it is usually the females which do the job. The mite is able to complete about 30 generations in a year.
c. A female lays about 80 spherical, white eggs during her life-time. Egg stage lasts 3 or 4 days.
d. The emerging larva is six-legged and light amber coloured but later becomes elongate and greenish. The larval and nymphal stage lasts three to eight days.
e. The life cycle is completed 19 days.

Management:

a. Avoid monoculture. Include non-host intercrops.
b. Dispose of the first attacked leaves.

c. Some of the predatory mites provide an effective control over the phytophagous mites by voraciously feeding on them. The example is *Amblyseius longispinosus*.

d. The insects which are voracious feeders on mites are coccinellid beetles *Brumus suturali*, *Scymnus gracilis and Stethourus pauperculus, Scolothrips indicus* (Thripidae), *Chrysopa* sp., anthocorid bug *Orius tantilus* and Lygaeid bug *Geocoris* sp. Of these *Scymnus gracilis* has been found to be very effective against the jowar mite *Oligonychus indicus* in South India, feeding upon eggs, larva, and nymphs of this mite.

e. ETL is 5 mites/cm^2 of the leaf area.

f. Spray dicofol (Kelthane) 18.5 EC 600 ml / acre. It is a long lasting acaricide, non-phyto-toxic, and active against all stages of mites.

Red Spider Mite, *Tetranychus neocaledonicus, T. cinnabarinus, T. urticae* (Acari: Tetranychidae)

1. Alternate hosts: Cotton, castor, bhendi, tomato, pumpkin, etc.
2. It is generally found on the under surface of the leaves but in heavy infestations it may be found all over the leaf surface. The mites feed on the plant sap with chlorophyll and other plant pigments. This results in characteristic whitish speckles that coalesce to give a bleached appearance to the leaves.
3. The life cycle consists of an egg, three nymphal and an adult stage. The nymphal stages are called the protonymph, deutonymph and tritonymph. The protonymph also called larvae, has only three pairs of legs.
4. They are preyed upon by coccinellid beetles (*Brumus suturalis*, *Scymnus gracilipes)* and *thrips* S*colothrips indicus*.
5. Sulphur can be used as dust (10 D) at the rate of 25 kg/ha or spray (50 WP) at 1 kg in 500 litres of water. Lime could be mixed with both these formulations.
6. Dicofol 18 EC at the rate of 400 ml per acre is more effective than sulphur.

The Red Gram Eriophyid Mite, *Aceria cajani* (Acari : Eriophyidae)

1. This mite is the vector of the sterility mosaic disease of red gram in India, one of the most series diseases of red gram.
2. The mite infestation on the underside of the tender leaves causes yellowing of leaves and suppression of flowering and fruiting in redgram.
3. The disease and mite incidence in South start from the month of October and the mite populations increase (20/leaf) in February-March on ratoon crop. In northern India mite population is very high during the month of May and June.
4. The eriophyid mite is about 0.2 mm long and microscopic.
5. The mite can complete a generation in less than 2 weeks under optimum condition.
6. The mite incidence in red gram is severe at 135 days after sowing.
7. The virus is persistent and circulative.

Symptoms of damage:

a. The common symptoms are reduction in leaf size, bushy growth of plants. The leaves develop yellowing in mosaic pattern and the under surface of the leaf becomes velvety to touch.

b. Flower formation does not take place and, even if formed, they wither and fall off.

c. Incidence of the mite and disease appear 45 days after sowing.

d. The mite population is more on the young leaves and buds compared to that on the middle leaves. A large number of mites occur on top canopy compared to the middle and bottom canopy.

Management:

a. Rogue out the infected plants or plant parts to minimize the attack in the early stages of growth.

b. Grow lines resistant or less susceptible to the pest and the disease.

c. Avoid staggered sowing.

d. Adjust the sowing dates. In Tamil Nadu crops sown in August and later had more incidence as compared to crop sown in June.

e. Remove the self-sown crop, diseased plants and ratoon crop.

f. Avoid monoculture. Raise non-host intercrops.

e. The following plants serve as alternative hosts. Therefore, they may be removed or destroyed: *Albizia odoratissim* (Mimosaceae), *Coculum hirsutum* (Menispermaceae), *Bauhinia recemosa* (Caesalpiniaceae), *Casesalpinia* sp. (Caesalpiniaceae), *Tephorosia* sp. (Fabaceae), and *Desmodium* sp. (Fabaceae).

f. Spray monocrotophos 200 ml/acre on noticing initial symptom. Repeat after 15 days with dicofol 600 ml/acre.

Conclusion

Though non insect pests are not posing serious threats to the farming community, due to global warming and other meteorological changes in the ecosystem the minor and non-insect pests turn into major pests. Knowing the knowhow about non insect pests and their management is vital.

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

Biofortification: A Sustainable Way to Reduce Malnutrition

Article ID: 40910

Shruti[1&2], Ch. Raveendra[2], Anil Jadhav[1], Channabasava[1]
[1]University of Agricultural Sciences (UAS), Raichur.
[2]ICAR – Indian Institute of Rice Research (IIRR), Hyderabad.

Introduction

According to the global nutrition report 2022, the global nutrition crisis displays worrying trends across each form of malnutrition, from hunger to obesity. Around 768 million people were affected by hunger in 2021, and 3.1 billion in 2020 were unable to meet the expense of a healthy diet. Almost a third of the world's population (29.3%), were moderately insecure in 2021, up from 25.4% before the covid-19 pandemic. At the same time, obesity and diet-related non-communicable diseases (NCDs) are on the rise and at epidemic levels – around 40% of all adults and 20% of all children are now overweight or obese. Micronutrient deficiency causes blindness, stunting diseases and even death. Reaching of fortified foods and nutritional supplements to rural families is a main strategy of biofortification. Once it reached, it reduces the number of micronutrient deficient peoples.

Bio-Fortification is a process of increasing bio available concentration of essential element/ nutrients in edible portion of crop plants through agronomic or genetic/molecular approaches. One of the main reasons for Biofortification in rice is due to being a staple food crop for more than one billion people in the world. The aleurone layer of rice grain is rich in micronutrients, but it gets lost automatically during milling and polishing and the unprocessed rice become rancid. Nutritional breeding provides a comparatively cost effective, sustainable and long term means of delivering more micronutrients. This strategy not only reduces the number of malnourished peoples and also helps in improving the nutritional status.

Types of Nutrients

Macronutrients: Nutrients which require relatively in large quantities.

Micronutrients: Nutrients which require relatively in small quantities. Macronutrients can be further split into energy macronutrients (that provide energy), and macronutrients that do not provide energy. Lack of nutrients in diet causes malnutrition.

Malnutrition: The condition results from taking an unbalanced diet in which certain nutrients are lacking, excess or in wrong proportion.

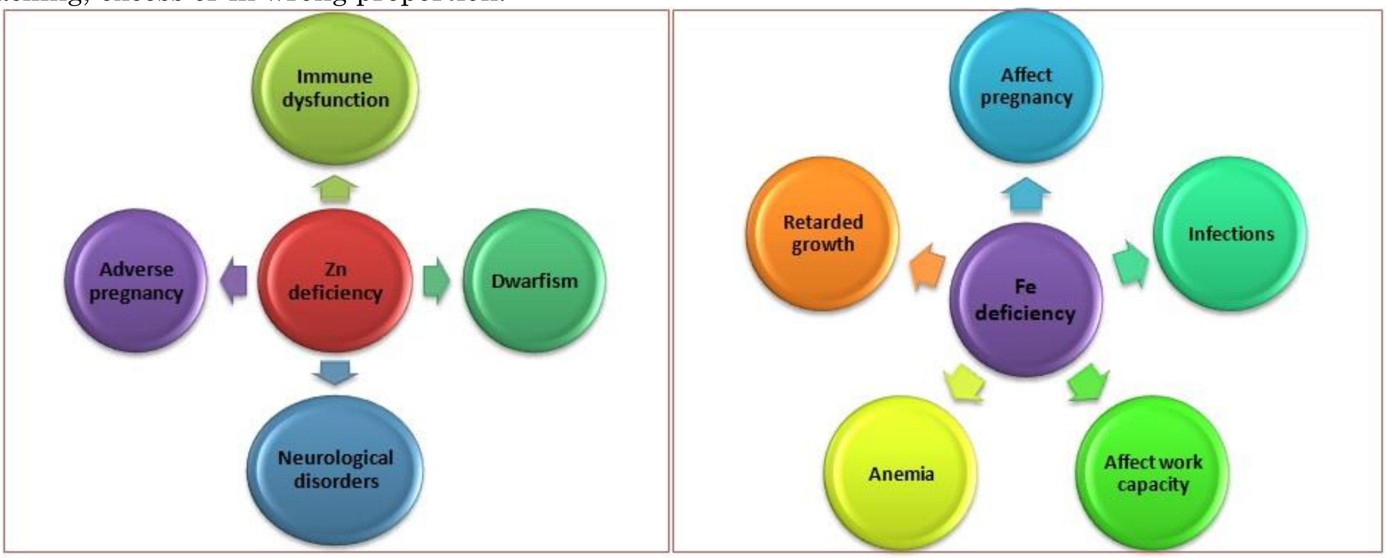


Fig. 1 Micronutrient deficiency symptoms in humans

Strategies for Alleviating Micronutrient Malnutrition

Mineral supplementation: Providing capsules, syrups for immediate relief. Eg: Vit-A capsules
Dietary diversification: Eat diversified food for long term solution
Food fortification: Add micronutrients to food. Eg: Iodized salt, Fluoride to toothpaste etc.
Biofortification: Sustainable - one time solution. Eg: QPM, Golden rice.

Pathways for Biofortification

Discovery: Identify target population, set nutrient target level, screen germplasm & gene discovery.
Development: Breed bio-fortified crops, test the performance of new crop varieties, measure nutrient retention in crops, and evaluate nutrient absorption & impact.
Dissemination: Develop strategies to disseminate the seed, promote marketing & consumption of Bio-fortified crops, and improve nutritional status of target population.

Biofortification Strategies

1. Agronomic strategy
2. Conventional Breeding
3. Genetic modification

Agronomic strategy: This method uses fertilisers to improve the number of micronutrients in plants through agronomic practices. It is used in soil conditions that are deficient in micronutrients and minerals.

There are three methods of Agronomic biofortification namely soil treatment, foliar application, seed treatment, microbial biofortification.

In soil treatment, nutrients are required in larger amounts and it is most effective method. In foliar application, applications of soluble inorganic fertilizers are made. In seed treatment, seeds are treated by the nutrients to increase nutrients content in harvested grains through seed priming and seed coating. In Microbial Biofortification, Plant growth-promoting bacteria (PGPB) and Plant growth-promoting fungi (PGPF) are applied to the agricultural soil. This is a popular method because these microbes restore the quality of the agricultural soil, helps in the assimilation of the nutrients, improve the water uptake, increases mobility and ultimately the plant growth is improved by the release of various hormones and antibiotics.

Conventional Breeding: This method is more expensive and time consuming. This technique uses the breeding methods in a traditional way. The genetic variations are sufficiently produced for a particular trait that is desired. Crossing various breeds of plants over many generations is done, and then it finally yields a progeny plant with high nutrients.

Genetic modification: This technique involves transfer of desired genes. This technique uses a DNA genome of an organism to insert the desired characteristic. This method takes less time and more expensive. Golden rice is an example of genetically modified crop. Golden rice produces rice with high beta-carotene content.

Examples of Bio-Fortified Varieties

S. No.	Crop	Varieties
1	Rice	CR Dhan 310 (protein rich variety)
		DRR Dhan 45 (zinc rich variety)
		DRR Dhan 63 (Zinc rich variety)
2	Wheat	WB 02 (zinc & iron rich variety)
		HPBW 01 (iron & zinc rich variety)
3	Maize	Pusa Vivek QPM9 Improved (provitamin-A, lysine & tryptophan rich hybrid)
		Pusa HM4 Improved (lysine & tryptophan rich hybrid)
		Pusa HM8 Improved (lysine & tryptophan rich hybrid)
		Pusa HM9 Improved (lysine & tryptophan rich hybrid)

4	Pearl millet	HHB 299 (iron & zinc rich hybrid)
5	Lentil	Pusa Ageti Masoor (iron rich variety)
6	Mustard	Pusa Mustard 30 (low erucic acid variety)
		Pusa Double Zero Mustard 31 (low erucic acid & low glucosinolate variety)
7	Cauliflower	Pusa Beta Kesari 1 (β-carotene rich variety)
8	Cabbage	Kinner red (high anthocyanin)
9	Sweet Potato	Bhu Sona (β-carotene rich variety)
		Bhu Krishna (anthocyanin rich variety)
10	Pomegranate	Solapur Lal (iron, zinc & vitamin-C rich variety)
11	Beans	BIO-101 and BIO-107 (Rich in iron and zinc)

References

1. Yadav, D. K., Choudhury, P. R., Firoz Hossain and Dinesh kumar. 2017. Biofortified Varieties Sustainable way to alleviate Malnutrition. Indian Council of Agricultural Research, New Delhi. Pp1-33.
2. Garg M, Sharma N, Sharma S, Kapoor P, Kumar A, Chunduri V and Arora P (2018) Biofortified Crops Generated by Breeding, Agronomy, and Transgenic Approaches Are Improving Lives of Millions of People around the World. *Front. Nutr.* 5:12. doi: 10.3389/fnut.2018.00012.

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

Genomic Approaches in Improving Nitrogen Use Efficiency in Crop Plants

Article ID: 40911

Shruti[1&2], Ch. Raveendra[2], Anil Jadhav[1], Channabasava[1]
[1]University of Agricultural Sciences (UAS), Raichur.
[2]ICAR – Indian Institute of Rice Research (IIRR), Hyderabad.

Introduction

Nitrogen is the most common pure element in the earth, making up 78.1% of the entire volume of the atmosphere. It is an important nutrient for plant growth, development and reproduction. Healthy plants contain 3 to 4% nitrogen in their above-ground tissues. Only 0.0025% of the earth's N is biologically available. It is the major component of chlorophyll, amino acids and nucleic acids (DNA and RNA). Nitrogen is also a component of energy-transfer complexes, like ATP (Adenosine Tri phosphate) which provides essential energy to the cells. There is slogan called "Without Nitrogen, there would be no life".

In nitrogen cycle, nitrification, a process carried out by nitrifying bacteria, transforms the soil ammonia into nitrate (NO_3^-) form, which plants can incorporate into their own tissues. Nitrates are also metabolized by denitrifying bacteria, which are particularly dynamic in anaerobic water-logged soils. The action of these bacteria depletes soil nitrates, which led to release of free atmospheric nitrogen.

Nitrogen in Plants

Healthy plants contain 3 to 4% Nitrogen in their above ground tissues. This is much higher concentration compared to other nutrients. Nitrogen plays an important role, as it is a major component of chlorophyll (photosynthesis). It is also a major component in amino acids, which are building block of proteins and without these proteins, plants would not produce the trait specific features. It is a component of energy transfer compounds, such as ATP. Finally nitrogen is a significant component in genetic material, which allows cells to grow, multiply and reproduce.

Soil Nitrogen

Soil nitrogen exists in three different forms i.e. Organic Nitrogen compounds, Ammonium (NH_4^+) and Nitrate (NO_3^-) ions. Soil organic matter (plant and animal residues) forms about 95 to 99% of the potentially available nitrogen in the soil. Most of the available nitrogen is in inorganic forms like NH_4^+ and NO_3^- ions. A very small amount of organic nitrogen may exist in soluble organic compounds, such as urea.

Components of NUE

Nitrogen Use Efficiency (NUE) can be divided into two parts i.e. assimilation efficiency and utilization efficiency. Assimilation efficiency involves nitrogen (N) uptake and assimilation and Utilization efficiency involves N remobilization. Understanding the mechanisms regulating these processes is crucial for improvement of NUE in crop plants. One important approach is to develop an understanding of the plant response to different N regimes, especially to N limitation, using various methods like transcription profiling, analysing mutants defective in their normal response to N limitation, and studying plants that show better growth under N-limiting conditions.

Need for Improvement of NUE

The cost of mineral nitrogen fertilizer accounts for a major portion of the total cost of production. N recovery by crops only 30 to 35% of that applied and remaining 65 to 70% is lost into environment through combination of ammonia, volatilization, denitrification, leaching, immobilization and runoff. Therefore, physiologist and plant breeder need to develop cultivars that can exploit N more efficiently in order to minimize losses of N, reduce environmental pollution, decrease input cost and make more economic use of the absorbed N.

Plant Responses to Nitrogen Limitation

There are two types of responses to N limitation.

Adaptive responses:

a. Increase in N Uptake
b. Remobilization of N from leaves towards developing seeds
c. Increased Anthocyanin accumulation

Non adaptive responses:

a. Having sudden senescence
b. Fail to accumulate anthocyanin
c. Unable to remobilize N metabolites from rosette leaves towards developing seeds.

Approaches for improving NUE

a. Agronomical Approaches
b. Physiological Approaches
c. Genetic approaches
    i. Conventional approach
    ii. Genomic approach.

QTL Mapping

QTL is a region of chromosome which is associated with particular phenotypic expression. QTLs are mapped by polymorphic molecular markers (SNPs and SSRs) correlate with an observed trait.

Association Mapping

Association studies or linkage disequilibrium mapping are useful to resolve complex trait variation down to sequence level by exploiting historical and evolutionary recombination events at the population level.

Marker Assisted Selection

A method of selecting desirable individual in a breeding scheme based on DNA molecular marker pattern. It is useful to the Plant Breeders to select more efficiently to develop desirable crop traits.

Marker Assisted Backcrossing

The main objective of the MABC is to integrate a targeted gene from agronomical substand sources (donor parent) into an exclusive breeding line (recipient parent). Use of molecular markers to accelerate the backcrossing process by reducing the number of backcrosses required to recover the recipient parent.

Pyramiding

It is defined as a method aimed at assembling multiple desirable genes from multiple parents into a single genotype. It is mainly used to improve the existing cultivars for a few unsatisfactory traits, for which genes with large positive effects are identified.

Transgenic Efforts to Improve NUE

Need to concentrate on diverse targets that include genes belonging to uptake, translocation and remobilization. Manipulation and over expression of candidate genes also helps to improve the NUE. Nitrogen assimilatory pathway is one of the most widely choosen target for improvement of NUE.

Conclusion

Understanding Nitrogen requirement & Nitrogen Use Efficiency could improve crop grain yield and it is not an equidistant process between the N uptake and yield. Nitrogen uptake and metabolic pathways are under the control of a complex regulatory network involving many genes. The identification of large-effect QTLs/genes and their enrichment with N metabolism genes is very important for improving the NUE of crops. There is need to explore stacking or pyramiding candidate genes to obtain an NUE phenotype in crop plants that remains stable in field conditions.

References

1. Glass, A. D., Britto, D. T., Kaiser, B. N., Kinghorn, J. R., Kronzucker, H. J., Kumar, A., Okamoto, M., Rawat, S., Siddiqi, M. Y., Unkles, S. E. and Vidmar, J. J., 2002, The regulation of nitrate and ammonium transport systems in plants,*J. Exp. Bot*, 53(370): 855-864.
2. Hirel, B., Le Gouis, J., Ney, B. and Gallais, A., 2007, The challenge of improving nitrogen use efficiency in crop plants: towards a more central role for genetic variability and quantitative genetics within integrated approaches, *J. Exp. Bot*, 58(9): 2369-2387.
3. Kant, S., Bi, Y. M. and Rothstein, S. J., 2010, Understanding plant response to nitrogen limitation for the improvement of crop nitrogen use efficiency, *J. Exp. Bot*, 62(4): 1499-1509.

Phosphorus Cycle

Article ID: 40912

Shruti[1&2], Ch. Raveendra[2], Anil Jadhav[1], Channabasava[1]
[1]University of Agricultural Sciences (UAS), Raichur.
[2]ICAR – Indian Institute of Rice Research (IIRR), Hyderabad.

Introduction

Phosphorus (P) is an essential macro nutrient that is required for all major developmental processes and reproduction in plants. P is considered as the second most limiting nutrient in agricultural production and it is also a major constituent of the phosphatic fertilizers. Cultivated plants use approximately 20-30% of the applied phosphorus. Inorganic phosphate (Orthophosphate; Pi) is the only form of P that can be assimilated by plants. P is an essential macronutrient for all living organisms. In plants, P plays a basic biological function such as a structural element in nucleic acids and phospholipids, in energy metabolism, in the activation of metabolic intermediates, as a component in signal transduction cascades, and in the regulation of enzymes.

P deficiency in soil is considered as a major limiting factor for crop growth and development. The process of P cycle is a very slow, as the different weather processes helps in washout the phosphorus present in the rocks into the soil. Phosphorus is absorbed by the organic matter in the soil which is used for various biological processes. Since phosphorus and phosphorus-containing compounds are present only on land, atmosphere does not play any significant role in the phosphorus cycle. The phosphorus cycle is defined as the bio-geochemical cycle that involves the movement of phosphorus through the lithosphere, hydrosphere, and biosphere.

Phosphorus Pools in Aquatic Systems

There are four major pools of phosphorus:
1. Inorganic phosphorus
2. Dissolved organic phosphorus (DOP)
3. Particulate organic phosphorus (POP)
4. Particulate inorganic phosphorus (PIP).

The dissolved inorganic P mainly consists of orthophosphate ions (PO_4^{3-}) and polyphosphate, while DOP consists of DNA and phosphoproteins. POP consists of both living and dead organisms, while PIP consists of hydroxyapatite ($Ca_5(PO_4)_3OH$). Inorganic phosphorus comes in the form of readily soluble orthophosphate. Particulate organic phosphorus occurs in suspension in living and dead protoplasm and is insoluble.

Steps in Phosphorus Cycle

1. Weathering
2. Plant absorption
3. Animal Absorption
4. Decomposition

Weathering: Phosphorus found abundantly in the rocks and that is why the phosphorus cycle starts in the earth's crust. The phosphate salts are broken down from the rocks. These salts are washed away into the ground where they mix in the soil.

Plant absorption: The phosphate salts dissolved in water are absorbed by the plants. However, the amount of phosphorus present in the soil is very less. That is why the farmers apply more phosphate fertilizers on agricultural land. The aquatic plants absorb inorganic phosphorus from lower layers of water bodies. Since phosphate salts do not dissolve in water properly, they affect plant growth in aquatic ecosystems.

Animal absorption: The animals do absorb the phosphorus from the plants or by consuming plant-eating animals. Plant and animals have faster P cycle when compared to rocks.

Decomposition: When the plants and animals die, they are decomposed by microorganisms. During this process, the organic form of phosphorus is converted into the inorganic form, which is recycled to soil and water. Soil and water will end up in sediments and rocks, which will again release phosphorus by weathering. Thus, the phosphorus cycle starts over.

Components of Phosphorus Cycle

1. Uplift of tectonic plates and exposure of phosphorus containing rocks such as apatite to surface weathering.
2. Biological weathering, physical and chemical erosion of phosphorus containing rocks dissolves the phosphorus particulates into the soils, lakes and rivers.
3. Sub-surface transportation and riverine of phosphorus to various lakes, rivers and run-off to the oceans.
4. Sedimentation of particulate phosphorus (eg., phosphorus associated with organic matter and oxide/carbonate minerals) and eventually burial in marine sediments (this process can also occur in lakes and rivers).

In terrestrial systems, bio-available P mainly comes from weathering of phosphorus-containing rocks. The most abundant primary phosphorus-mineral in the earth crust is apatite, which can be dissolved by natural acids generated by soil microbes and fungi, or by other chemical weathering reactions and physical erosion. The dissolved phosphorus is bio-available to terrestrial organisms and plants and is returned to the soil after their decay. Phosphorus retention by soil minerals (e.g., adsorption of iron and aluminum hydroxides in acidic soils and precipitation of calcite in neutral-to-calcareous soils) is usually viewed as the most important process in controlling terrestrial P-bioavailability in the mineral soils.

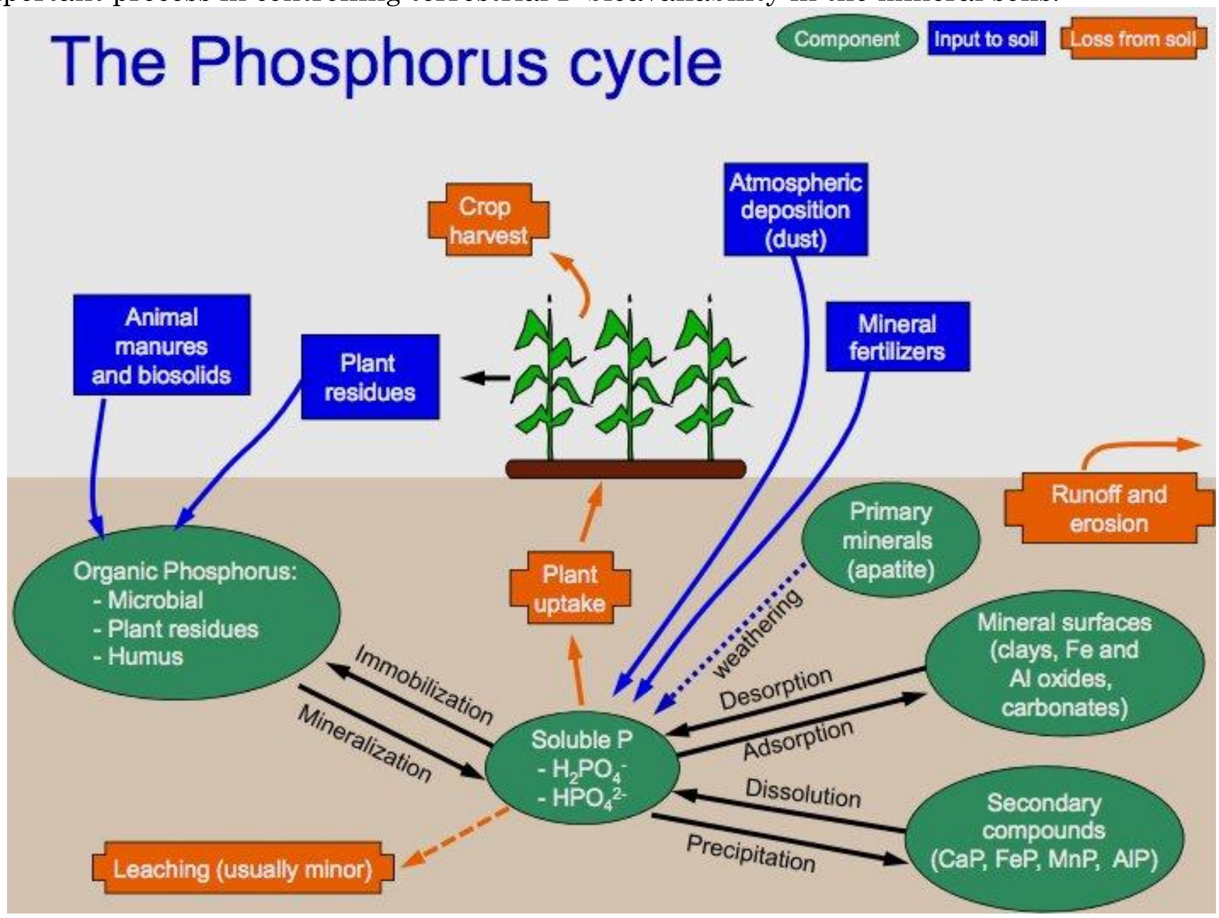


Fig. 1 Inputs and cycling of the phosphorus form the soil to atmosphere

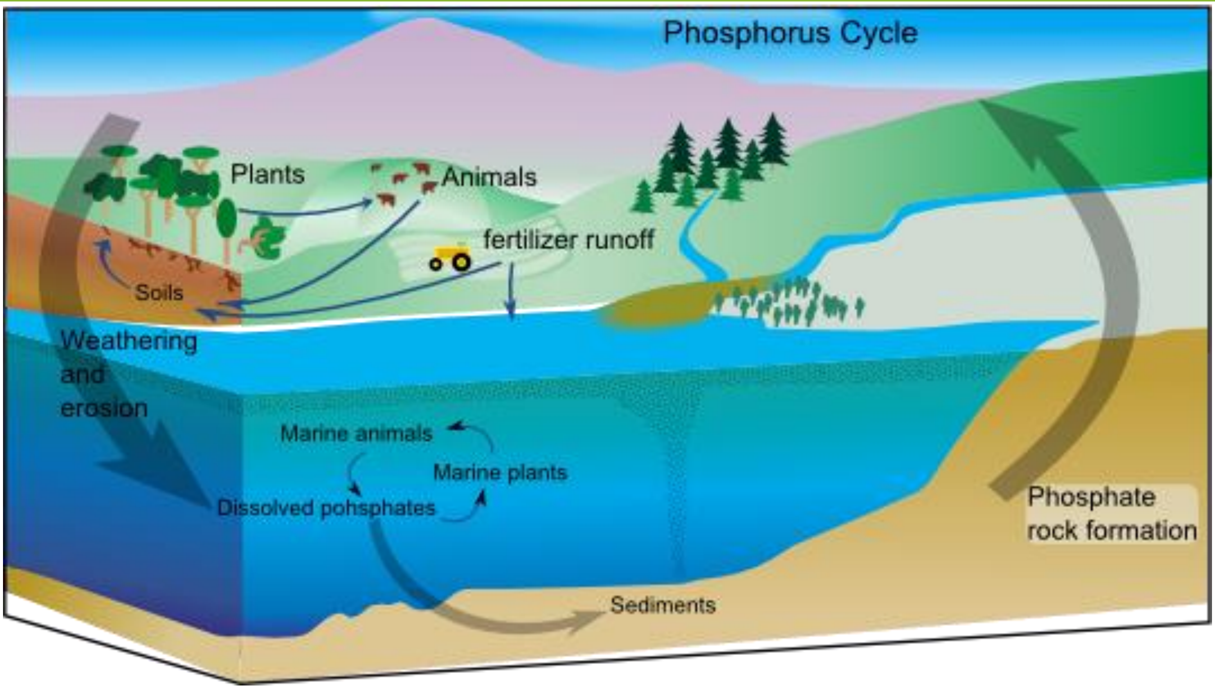


Fig. 2 Process of phosphorus cycle in the terrestrial and aquatic systems

References

1. Slocombe SP, Zúñiga-Burgos T, Chu L, Wood NJ, Camargo-Valero MA and Baker A (2020) Fixing the Broken Phosphorus Cycle: Wastewater Remediation by Microalgal Polyphosphates. *Front. Plant Sci.* 11:982. doi: 10.3389/fpls.2020.00982
2. McBeath, T. M., Lombi, E., McLaughlin, M. J., Bünemann, E. K. (2007). Polyphosphate-fertilizer solution stability with time, temperature, and pH. *J. Plant Nutr. Soil Sci.* 170, 387–391. doi: 10.1002/jpln.200625166
3. Rao, N. N., Gómez-García, M. R., Kornberg, A. (2009). Inorganic Polyphosphate: Essential for Growth and Survival. *Annu. Rev. Biochem.* 78, 605–647. doi: 10.1146/annurev.biochem.77.083007.093039.

Wild Rice: A Promising Source for Yield Enhancement

Article ID: 40913

Shruti[1&2], Ch. Raveendra[2], Anil Jadhav[1], Channabasava[1]
[1]University of Agricultural Sciences (UAS), Raichur.
[2]ICAR – Indian Institute of Rice Research (IIRR), Hyderabad.

Introduction

Rice (*Oryza sativa* L.) is an important staple food of half of the world's population. Rice is growing under a wide range of agro climatic conditions. To meet the growing needs of the ever-increasing human population, rice production and productivity must be increased continuously. Wild species of crop plants are continuously being used in breeding programmes to improve different agronomically important traits including yield of cultivated varieties. QTLs for yield related traits have been identified from wild relatives of several crop plants. Advanced backcross QTL analysis is one of the methods used to identify the naturally occurring favourable alleles for yield and as well as to minimize the effect of unwanted alleles from wild species.

Wild Relatives of Rice

The genus *Oryza* has two cultivated and 22 wild species. The two cultivated rice species namely, *Oryza sativa* (2n = 24; AA), the Asian rice, is grown worldwide, but *Oryza glaberrima* (2n = 24; AA), the African rice, is cultivated on a limited scale in West Africa. The wild rice species possessing either 2n = 24 or 48 chromosomes, representing AA, BB, CC, BBCC, CCDD, EE, FF, GG, and HHJJ genomes. Wild rice species possesses agronomically important genes and offer great potential to incorporate such genes into the background of commercial rice cultivars for resistance or tolerance to major biotic and abiotic stresses. Many AA genome wild rice species that are closely related to the cultivated rice species possess genes for resistance. Some of the yield enhancing genes from the wild rice species possessing AA genome have been identified and mapped for their introgression into *O. sativa* genome.

The genus *Oryza* has been divided into four species complexes:
1. *Sativa complex*;
2. *Officinalis* complex;
3. *Meyeriana* complex
4. *Ridleyi* complex.

Two species, namely *Oryza brachyantha* (FF*)* and *Oryza schlechteri* (HHKK), does not included in any of these groups.

Table. 1 Classification of *Oryza species* with the chromosome number and genomic composition

***O. sativa* complex:**

Species	2n	Genome	Traits
O. sativa	24	AA	cultigen
O. nivara	24	AA	Resistances to grassy stunt virus, sheath blight, stem borer and whorl maggot; drought avoidance, CMS.
O. rufipogon	24	AA	Resistance to diseases, tolerance to aluminum, salinity and soil acidity, source of CMS, improved yield.
O. barthi	24	AA	Resistance to diseases, drought avoidance, source of CMS.
O. glumaepatula	24	AA	Elongation ability, source of CMS
O. longistaminata	24	AA	Resistance to diseases, drought avoidance
O. meridionalis	24	AA	Elongation ability, drought avoidance, sheath blight tolerance.

***O. officinalis* complex:**

Species	2n	Genome	Traits
O. punctata	24,48	BB, BBCC	Resistance to BPH, leafhopper.
O. minuta	48	BBCC	Resistance to BB, blast, BPH, GLH
O. rhizomatis	24	CC	Drought avoidance.
O. eichingeri	24	CC	Resistance to BPH, WBPH, GLH
O. latifolia	48	CCDD	Resistance to BPH, high biomass production.
O. alta	48	CCDD	High biomass production
O. grandiglumis	48	CCDD	High biomass production
O. australensis	24	EE	Drought avoidance.

***O. meyeriana* complex:**

Species	2n	Genome	Traits
O. granulata	24	GG	Shade tolerance, adaptation to aerobic soil
O. meyeriana	24	GG	Shade tolerance, adaptation to aerobic soil

***O. ridleyi* complex:**

Species	2n	Genome	Traits
O. longiglumis.	48	HHJJ	Resistance to blast, BB
O. ridleyi	48	HHJJ	Resistance to blast, BB, stem borer

Challenges of Transferring Genes from Unadapted Germplasm or Wild Species

Several incompatibility barriers, such as lower cross compatibility several recombination barriers between the chromosomes of wild and cultivated species are major limitations in introgression of useful alleles from wild species. A major challenge is the difficulty in identifying genes from wild or unadapted materials that are likely to enhance the performance of elite cultivars without disrupting favorable gene complexes.

Recent Advances to Overcome the Challenges

In tissue culture, some of the techniques such as embryo rescue, *in vitro* pollination and protoplast fusion, and another culture have enabled the production of wide hybrids between distantly related species. In addition, molecular marker technology and *in situ* hybridization techniques have made it possible to precisely detect the introgression of chromosome segments from wild into cultivated species.

Steps for Transferring Genes from Wild Species into Cultivated Species

1. Identification of useful genetic variability
2. Production of hybrids
3. Continuous back-crossing
4. Evaluation of advanced fertile backcross progenies
5. Characterization of alien introgression lines
6. Chromosomal location of introgressed gene(s)
7. Tagging of introgressed alien genes.

Wild Rice as a Source for Yield Enhancement

Traditional approach: Traditional approach usually considers the phenotype of the plants in selection for high yield and other agronomically important alleles form wild species. Wild species generally possesses smaller fruits, produce fewer seeds, shattering and other undesirable traits compared to cultivars, thus appear to be relatively poor as donors for enhancing the yield. Simultaneous effect of each chromosomal region on other traits (epistasis, pleiotropy or linkage) and the genetic basis of such yield related traits (dominance or over-dominance) create problems in transfer of useful alleles from wild rice.

Molecular approach: Molecular markers such as RFLP, RAPD, AFLP, SSR, STS, and SNPs are using for genotyping the mapping populations. Molecular map shows the location of various genetic markers on chromosomes. The phenotypic variance associated with a trait can be attributed to a few chromosomal segments defined by flanking markers. Thus a superior QTL allele in the wild species can be introgressed and studied for its effect in an elite genetic background.

Advanced backcross-QTL method (AB-QTL): Advanced backcross method integrates the process of QTL identification with transfer of chromosomal regions from wild species and thus reduces the time needed to release a new variety and also reduces the linkage drag.

Recent advances in genome-editing technology: Recent advances in genome-editing technology allow precise, targeted genomic changes, including whole-gene insertion or deletion, stacking or pyramiding of genes, and precise modification of genetic elements. Several classes of editing technologies are developed, including zinc finger nucleases, TAL effector nucleases (TALENs) and most recently clustered regularly interspaced short palindromic repeats (CRISPR)/CRISPR-associated proteins (CRISPR/Cas), for the introgression of valuable genes/traits into cultivated varieties in a timely and economically sound manner.

Increasing the yield of plants is a major thrust area of crop improvement research. There is concern about the limited diversity of current high yielding varieties and hybrids. The wild species of the genus *Oryza* are a wealth of genetic resource for rice improvement. One strategy should aim at identifying gene(s) controlling homologous chromosome pairing in *Oryza.* The future outlook for broadening the gene pool of rice through the precise transfer of useful genes from wild species into rice cultivars seems more promising than ever before.

References

1. Haritha, G., Vishnukiran, T., Yugandhar, P., Sarla, N. and Subrahmanyam, D. 2017. Introgressions from Oryza rufipogon increase photosynthetic efficiency of KMR3 rice lines. *Rice Science*, 24(2): 85-96.
2. Gaikwad, K. B., Singh, N., Bhatia, D., Kaur, R., Bains, N. S., Bharaj, T. S. and Singh, K. 2014. Yield enhancing heterotic QTL transferred from wild species to cultivated rice (*Oryza sativa* L.) *PLoS ONE*, 9(6): 36-69.
3. Kang, M. S. 2022. Quantitative genetics, genomics and plant breeding. *CAB Int*. 1-365.
4. Swamy, M. B. P., Sarla, N. 2007. Yield enhancing quantitative trait loci (QTLs) from wild species. *Bio. Adv*, 26: 106-120.

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

Millets – Good for People, the Environment, and Farmers

Article ID: 40914

Prachi Patel[1], Amit Tomar[1], A.K. Mishra[1], S.P. Singh[1], H.H. Khan[1], R.P. Singh[1]
[1]ICAR-Krishi Vigyan Kendra, Gajraula, Amroha, (Directorate of Extension), Sardar Vallabhbhai Patel University of Agriculture Science & Technology, Meerut.

Introduction

Millets are resilient cereals that can provide an affordable and nutritious option and help guarantee food security. They are also deeply rooted in Indigenous Peoples' culture and traditions. The United Nations General Assembly at its 75th session in March 2021 declared 2023 the International Year of Millets (IYM 2023) with the Food and Agriculture Organization of the United Nations (FAO) as the lead agency.

Why are Millets a Smart Food?

Millets encompass a diverse group of **cereals** including pearl millet, proso millet, foxtail millet, barnyard, kodo, browntop, finger and Guinea millets, as well as fonio, sorghum (or great millet) and teff. Millets can grow in both low and high altitudes and across a wide latitudinal range, on arid lands, under non-irrigated conditions, in very low rainfall regimes, and have a low water footprint. Millets require less water than rice and wheat. They are very tolerant of heat (up to 64 degrees Celsius), drought and flood and it makes the crop an obvious choice for farmers in an era of climate change and depleting natural resources. Millets are an ideal solution for countries to increase self-sufficiency and reduce reliance on imported cereal grains. They need minimal inputs, are resistant to diseases and pests and offer a reduced dependence on synthetic fertilisers and pesticides. They are also more resilient to changes in climate than any other cereals. On top of diversifying the food system, millets can help enhance livelihoods for small farmers, including women, nationally and regionally.

Nutritional and health benefits of millet consumption: Millets are among the first plants to be domesticated and are considered **"nutri-cereals"** due to their high nutritional content. They are rich in vitamins and minerals, including iron and calcium; are high in protein, antioxidants, resistant starch, and have a low glycaemic index, which can help prevent or manage diabetes. Millets are also gluten-free. As whole grains, millets provide different amounts of fibre. Dietary fibre has a role in regulating bowel function, blood sugar and lipids, and satiation.

Millet production in the world: Millets have served as a **traditional staple** for hundreds of millions of people in Sub-Saharan Africa and Asia (particularly in India, China, and Nigeria) for 7000 years and are now cultivated across the world. Estimates show that more than 90 million people in Africa and Asia depend on millets in their diets. Africa accounts for more than 55 percent of global millet production, followed by Asia with nearly 40 percent, while Europe represents around three percent of the world market. In recent years, their production has gradually declined due to market distortions, a lack of appreciation of the benefits of millets and policies that have favoured the production of the so-called Big Three cereals – rice, wheat and maize. Farmers have switched to cultivate more remunerative crops grown to sell for profit. They moved away from subsistence agriculture responding to changing consumer preferences and markets inputs.

Millets in Europe: Millet cultivation began in Europe around 3,500 years ago. The oldest cereals come from the eastern part of Europe, including Ukraine, which is consistent with the concept of the arrival of domesticated grain from Asia. Thanks to millets' wide range of growing conditions and a lifecycle shorter than three summer months, they offer an additional harvest and therefore surplus food and fodder. It was likely a transformative innovation in European prehistoric agriculture previously based mainly on (winter) cropping of wheat and barley.

Revitalisation of millets: As the cultivation of millets is declining in many countries, their potential to address climate change and food security is not being realised in full. With a deepening climate crisis and multiple environmental stresses, this recently forgotten and underutilised crop could be the crucial link in the sustainable food supply chain as well as one of the climate resilient solutions. Contributions of millets to nutrition, livelihoods and incomes of family farmers, especially small-scale family farmers, can play an important role in contributing to food security and eradicating poverty. The popularisation of millets is also an effort to achieve the **Sustainable Development Goals (SDGs)**, and in particular: SDG 2 (zero hunger), SDG 3 (good health and well-being), SDG 12 (sustainable consumption and production), and SDG 13 (climate action).

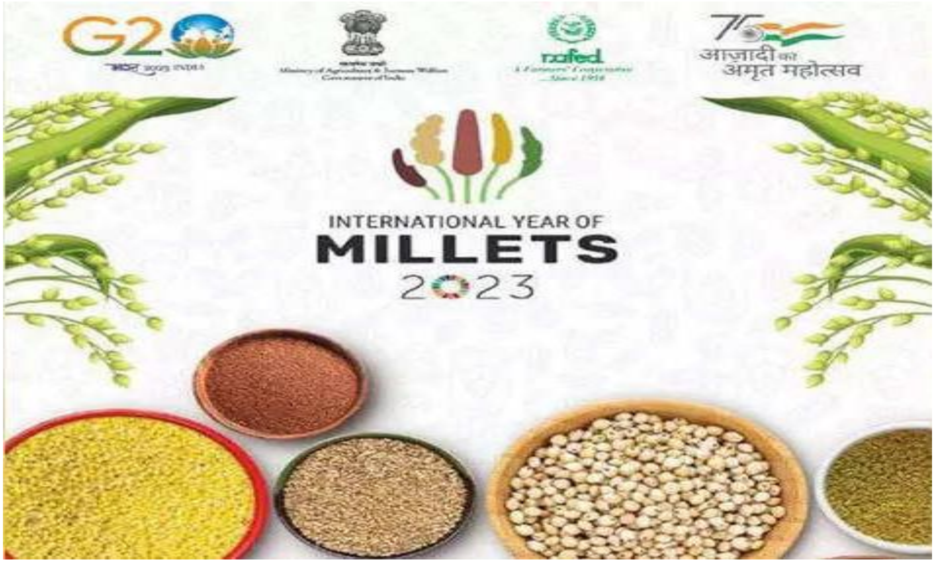
The International Year of Millets 2023 will Focus on

1. Raising awareness of the nutritional and health benefits of millets and promoting millets as a key component of the food basket.
2. Raising awareness of the contribution of millets to food security and their important role in keeping a check on food wastage. Some of the millets are good for consumption even after 10-12 years of growing!
3. Promoting the sustainable cultivation of millets, also under adverse and changing climatic conditions and improving their quality.
4. Highlighting their potential to provide new sustainable market opportunities for producers and consumers. Greater millet production can support the livelihoods of smallholder farmers and can provide decent jobs for women and youth.
5. Promoting a better utilization of crop rotations.
6. Enhancing investment in research and development.

Millets in India - Background, Types, Scheme & Advantages

Article ID: 40915

H. H. Khan[1], Amit Tomar[1], A. K. Mishra[1], S. P. Singh[1], Prachi Patel[1], R. P. Singh[1]
[1]ICAR-Krishi Vigyan Kendra, Gajraula, Amroha, (Directorate of Extension), Sardar Vallabhbhai Patel University of Agriculture Science & Technology, Meerut.



Introduction

2023 will be observed as the International Year of Millets after India's proposal to the Food and Agricultural Organization (FAO) was approved. In the last six decades, millets have seen a drop in area despite green evolution in the 1960s; however, the productivity seems to go up with the help of high-yield varieties and better technologies. Read about millets in India for better knowledge that will be useful for all government exams.

About the National Year of Millets – 2018

The Government of India has approved 2018 as the National Year of Millets to boost production of the nutrient-rich millets and the agro-industries involved in its production. The observation of the year of millet will help in the promotion of millet production and consumption in the country. The increased production of Millets will help fight against hunger and mitigate climate change effects in the long run. As per Prime Minister Narendra Modi, India needs to work on the Millets revolution in order to ensure a nutritious diet and good health. Hence, the aim of this article is to provide detailed information on Millets in India. Candidates will learn about the background of millets, types of millets in India, advantages and government schemes supporting millet production in India.

Millets in India is an important topic from the point of view of various competitive exams. Candidates appearing for exams such as SSC, RRB, Bank, etc., might face questions related to millets in India under general awareness section. Candidates can check SSC General Awareness for details. Even the aspirants of the most coveted UPSC exam might encounter questions related to Millets in India under GS I. Candidates preparing for UPSC exams or any other competitive examination can check the following link for their preparation:
1. Static GK
2. Current Affairs.

Background of Millets

Millets are one of the oldest foods, these are the small-seeded hardy crops which can grow well in dry zones or rain-fed areas under marginal conditions of soil fertility and moisture. Millets are cultivated in low-fertile land, tribal and rain-fed and mountainous areas. These areas include Haryana, Uttar Pradesh, Chhattisgarh, Gujarat, Rajasthan, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu and Telangana. Due to their short growing season, millets can develop from seeds to ready to harvest crops in just about 65 days. This highly beneficial characteristic of the millets is of vital importance in thickly populated regions of the world. If stored properly, millets can keep well for two years or beyond. Millets can not only grow in poor climatic or soil conditions and provide nutritious grain as well as fodder, but these can also very well fit into multiple cropping systems under irrigation as well as dryland farming due to their short growing season.

The prolonged and easy storability of millets under ordinary conditions has given them the status of **Famine Reserves** and this feature is of great importance for India, as the agriculture of our country suffers from unexpected changes in monsoon.

Types of Millets in India

The millets commonly grown in India include Jowar (sorghum), Bajra (pearl millet), ragi (finger millet), Jhangora (barnyard millet), Barri (Proso or common millet), Kangni (foxtail/ Italian millet), Kodra (Kodo millet) etc. Let us read about them in detail and also learn their regional names.

1. Barnyard Millet is a high source of iron and fibre. It is known as Kuthiravali in Tamil, Oodhalu in Kannada, Odalu in Telugu, Kavadapullu in Malayalam and Sanwa in Hindi.

2. Finger Millet is a staple that is a very good substitute for oats and cereals. It is known as Ragi in Kannada, Ragulu in Telugu, Kelvaragu in Tamil, Koovarugu in Malayalam and Mundua in Hindi.

3. Foxtail Millet is rich in minerals and vitamins. It is known as Thinai in Tamil, Kirra in Telugu, Thinna in Malayalam, Navane in Kannada and Kangni in Hindi.

4. Little Millet is also loaded with iron and fibre, the regional names are Chama in Malayalam, Same in Kannada, Samai in Tamil, Sama in Telugu and Kutki in Hindi.

5. Proso Millet is known as Barri in Hindi, Panivaragu in Tamil & Malayalam, in Kannada it is called Baragu and Varigalu in Telugu

6. Pearl Millet is a high source of proteins, it is known as Bajra in Hindi, Sajje in Kannada, Sajjalu in Telugu, Kambu in Tamil and Kambam in Malayalam.

Importance of Millets

According to the Ministry of Agriculture & Farmers Welfare, in 2016 – 2017, the area under the cultivation of millet declined with 60% less coverage area (to 14.72 million hectares) due to change in consumption pattern, conversion of irrigated area for wheat and rice cultivation, unavailability of millets, low yield, dietary habits, less demand. This resulted in fall in the level of nutrients like vitamin-A, protein, iron and iodine in women and children leading to malnutrition. With regard to the Global Hunger Index – GHI, India ranks 64 among the 81 nations. It occupies second place in child malnutrition highlighting the poor plight of our country. This scenario persists when the Public Distribution System and Targeted PDS are working for nearly five decades. The reason is that the focus has been only on wheat and rice distribution while the millets have long been disregarded. Among the food crops, millets occupy a relatively lower position in Indian agriculture, though they are really important from the point of food security at the regional and household level. Bearing this in mind, below given are points that highlight the importance of millets.

1. Most of the millets are non-acid forming, non-glutinous, highly nutritious, and easily digestible foods. Due to low glycaemic index (GI) being gluten-free, it helps in a slower release of glucose over a longer period of time thus reducing the risk of diabetes mellitus. Individuals suffering from celiac disease can easily incorporate various millets in their diets.

2. Millets are rich sources of minerals like calcium, iron, zinc, phosphorus, magnesium, and potassium. It also contains appreciable amounts of dietary fibre and vitamins such as folic acid, vitamin B6, ß- Carotene, and niacin. The availability of high amounts of lecithin is useful for strengthening the nervous system. Therefore, regular consumption of millets can help to overcome malnutrition.

3. Although Millets are rich in phytochemicals like tannins, phytosterols, polyphenols and antioxidants, they do contain some anti-nutritional factors which can be reduced by certain processing treatments.

4. Millets have a wide capacity for adaptation because they can grow from coastal regions of Andhra Pradesh to moderately high altitudes of North-eastern states and hilly regions of Uttarakhand. Millets can withstand variations in moisture, temperature and the type of soils ranging from heavy to sandy infertile lands.

Therefore, to ensure food and nutrition security for our country, it is important to increase the production of these crops and simultaneously revert the control of production, distribution and consumption back to the people.

Government Measures to Increase Millet Production

Despite numerous qualities, utilization of millets as food is confined to the traditional consumers i.e. tribal populations. This is mainly because of the non-availability of consumer-friendly ready-to-eat millet-based products. Recently, millets have gained attention and efforts are underway to obtain their convenient and value-added processed products. Since many households in dry land and hilly regions depend on millets to meet their food needs, it has now been proposed to enlarge the food basket and include millets like jowar, bajra, ragi etc in the Public Distribution System. Government has recognized the role of millets in the food chain.

Under the National Food Security Mission – NFSM of the preliminary targets for enhancing food grain production by an additional 25 Million Tonnes, the share allocated for millets is 2 Million Tonnes i.e. 8% of the enhanced food grain production. The Indian policymakers refocused their attention towards millet farming systems and enacted policies to create an enabling environment for the farmers.

With respect to millets production, some of the existing schemes by the Government of India include:

1. Integrated Cereals Development Programmes in Coarse Cereals ICDP-CC based Cropping Systems Areas under Macro Management of Agriculture -MMA.

2. Initiative for Nutritional Security through Intensive Millet Promotion – INSIMP a part of Rashtriya Krishi Vikas Yojana" – RKVY which is the only comprehensive initiative to support millet production.

3. Rainfed Area Development Programme–RADP: a component of the Rashtriya Krishi Vikas Yojana – RKVY.

4. For further information on the Rashtriya Krishi Vikas Yojana check the linked page.

Candidates can also check for various other Government Schemes launched for the welfare of the nation.

Advantages of Millet Production

Millets have often been called the coarse grains, however, because of their nutritional contributions they are now being referred to as 'nutria-millets or nutria-cereals'. Given below are some of the advantages of Production of Millets in India.

1. Millets are termed as the 'miracle grains' or 'crops of the future' as they can not only grow under harsh circumstances but are drought-resistant crops that require fewer external inputs.

2. Millets are dual-purpose crops. It is cultivated both as food & fodder, thus providing food/livelihood security to millions of households and contributing to the economic efficiency of farming.

3. Millets contribute to mitigating climate change as it helps reduce the atmospheric carbon pressure CO2. On the contrary, Wheat being a thermally sensitive crop and Paddy is a major contributor to climate change through methane emission.

4. Production of millets does not depend on the use of chemical fertilizers. The millet crops do not attract pests and are not affected by storage.

5. Millets are remarkable in their nutritive value be it vitamins, minerals, dietary fibre or other nutrients. It is nearly 3 to 5 times nutritionally superior to wheat and rice. Sorghum (Jowar) is an important source of polyphenols, antioxidants, and cholesterol-lowering waxes.

6. Millets help in curbing obesity, lowers the risk of hypertension, CVDs, T2DM, cancers as well as helps in preventing constipation due to their high dietary fibre content coupled with low glycaemic index.

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

Significance of Millet Farming in India: International Year of Millets-2023

Article ID: 40916

S. P. Singh[1], Amit Tomar[1], A. K. Mishra[1], H. H. Khan[1], Prachi Patel[1], R.P. Singh[1]
[1]ICAR-Krishi Vigyan Kendra, Gajraula, Amroha, (Directorate of Extension), Sardar Vallabhbhai Patel University of Agriculture Science & Technology, Meerut.

About Millets

1. Millets are **coarse grains** and a repository of protein, fibre, vitamins and minerals.

2. They include jowar (sorghum), ragi (finger millet), korra (foxtail millet), arke (kodo millet), sama (little millet), bajra (pearl millet), chena/barr (proso millet) and sanwa (barnyard millet).

3. Millets were one of the oldest foods known to humans. But they were discarded in favour of wheat and rice with urbanization and industrialization.

4. India is their largest global producer, with a 41% market share, and a compound annual growth rate of 4.5% is projected for the global millet market in the coming decade.

What are the Advantages with Millets?

1. Climate Resilience:

a. Being hardy crops, they can withstand extreme temperatures, floods and droughts.
b. They also help mitigate the effects of climate change through their low carbon footprint of 3,218-kg CO_2 equivalent per hectare, as compared to wheat and rice, with 3,968kg and 3,401kg, respectively, on the same measure.

2. Restoration of ecosystems and sustainability:

a. Land degradation has been a major problem in India, causing massive economic losses year after year. Drought-tolerant crops, like millets, with low dependence on chemical inputs would put far less pressure on ecosystems.
b. The inter-cropping of millets with other crops is especially beneficial because the fibrous roots of millet plants help in improving soil quality, keep water run-off in check and aid soil conservation in erosion-prone areas, thereby restoring natural ecosystems.

3. Biofuel and Ethanol Blending:

a. In June 2021, government set a target of achieving 20% ethanol blending with petrol by 2025.
b. Most bio-ethanol in India is produced using sugar molasses and maize.

c. However, a study conducted among farmers in Madhya Pradesh showed that bio-ethanol can be created using **sorghum (jowar) and pearl millet (bajra)**, and that this fuel could bring down carbon emissions by about half.

d. Estimates also suggest that millets can deliver greater returns than maize, while using 40% less energy in processing. Millets also offer a significant cost advantage over maize as a feedstock for bio-ethanol production.

4. A cultural connection:

a. The cultivation of millets is deep-rooted in Indian culture.

b. Organizations like Deccan Development Society have formed women's collectives in Telangana and are promoting millets through a culture-centric approach.

c. Such **crop sensitization** has filtered into urban settings too. In 2018, the #Lets Millet Campaign in Bengaluru saw the use of millets in dishes such as risotto and pizza by restaurateurs.

5. Helps address Sustainable DGs:

a. Millets can play a role in India's sustainability policy interventions. Contemporary research developments have shed light on the influence of millets on energy optimization, climate resilience and ecosystem restoration.

b. Millet farming has led to women's empowerment, too. The Odisha Millet Mission, for example, saw 7.2 million women emerge as 'agri-preneurs'.

What are the Concerns with Millets Growth?

1. A rise in incomes and urbanization has reduced the demand for millets
2. Inadequate government policies.
3. Unjust pricing for farmers due to intermediaries.
4. Lack of input subsidies and price incentives.
5. Procurement and subsidised supply of rice & wheat through the PDS has made farmers shift from millets to these crops.
6. Millets being used for various purposes other than for consumption.

Way Forward

1. Incentivizing the adoption of inter-cropping with millets (two or more crops planted side by side) and providing crop insurance and support for storage facilities will foster income and food security.

2. Brimming with potential, millets can act as a vital cog in the country's sustainable development wheel if backed by policies that promote their production, incentivize farmers and strengthen market linkages.

E-ISSN: 2581 - 8317

International Year of Millets-2023: Millets Comeback

Article ID: 40917

A. K. Mishra[1], Amit Tomar[1], S. P. Singh[1], H. H. Khan[1], Prachi Patel[1], R.P. Singh[1]
[1]ICAR-Krishi Vigyan Kendra, Gajraula, Amroha, (Directorate of Extension), Sardar Vallabhbhai Patel University of Agriculture Science & Technology, Meerut.

Introduction

A renewed focus on boosting the production of millets and highlighting their benefits, is critical to reducing over-reliance on more commonly grown crops, boosting diverse diets, and food security. That's especially true during periods of natural disaster when food becomes scarce, according to ***"Dr Nancy Aburto, an agriculture expert at the Food and Agriculture Organization (FAO)".*** She spoke to UN News earlier this year, saying that following the UN General Assembly's recent adoption of a resolution proclaiming 2023 as the International Year of Millets in March 2021, efforts are afoot to promote cultivation as a solution to climate and global food security challenges. ***Millets – often called "Nutri-Cereals"*** due to their high nutritional value – are a group of small-seeded grasses grown mainly in dry zones of Asia and Africa. These include sorghum (or great millet), pearl millet, finger millet, fonio, proso millet, foxtail millet, teff and other smaller varietals. Estimates show that more than 90 million people in Africa and Asia depend on millets in their diets. Africa accounts for more than 55 percent of global production, followed by Asia with nearly 40 percent, while Europe represents around three percent of the world market.

Fig.-1: A woman farmer using a sickle to harvest pearl millet

Population Challenge

The world needs to produce more food to feed a rapidly growing global population, which is projected to reach 8.5 billion by 2030, and a staggering 9.7 billion by 2050. With a deepening climate crisis and aggravating environmental stresses, there is a heightened need for crop diversification by promoting crops suitable for cultivation in the toughest of environments. Acknowledging the role of millets in responding to nutritional, agrarian and climate challenges, the UN resolution considers the ***"urgent need to raise awareness of the climate-resilient and nutritional benefits of millets and to advocate for***

diversified, balanced and healthy diets through the increased sustainable production and consumption of millets." They are rich in vitamins and minerals, including iron and calcium; are high in protein, fiber, resistant starch, and have a low glycemic index, which can help prevent or manage diabetes.

Good to Grow

"Compared to the more commonly known cereals such as wheat, rice or corn, millets are capable of growing under drought conditions, under non-irrigated conditions even in very low rainfall regimes, having a low water footprint", explained Dr. Aburto, deputy director in the nutrition and food systems division of the UN Food and Agriculture Organization. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) based in Hyderabad, India, is a non-profit organization that conducts agricultural research for development. ICRISAT works closely with farmer communities and its partners, including the International Fund for Agriculture Development (IFAD), focusing on millets, among other crops. ICRISAT Assistant Director General for External Relations, Joanna Kane-Potaka, described millets as a smart food – good for people, the planet, and farmers. "Millets can help contribute to some of the biggest global challenges in unison - nutrition and health needs, mitigation and adaptation to climate change, poverty of smallholder and marginalized farmers in the dry zones - some of the toughest areas that will take longer to reach the sustainable development goals."

Fig.-2: High-iron biofortified pearl millet variety Dhanshakti released in India's western state of Maharashtra

Boosting Sustainability

Through offering a reduced dependence on synthetic fertilizers and pesticides, millets cultivation may also help promote a shift towards sustainable agriculture, diversifying crop rotations and avoiding the promotion of mono-cropping systems. "The high carbon content of the crop residues makes them particularly important for maintaining and increasing soil carbon levels, important for sustainable cropping systems, and, where applicable, for providing forage, at the same time, for livestock," noted Dr. Aburto.

'Food System Divide'

Millets are believed to be among the earliest domesticated plants, which have long served as traditional staple crops for millions of farmers, particularly in India, China, and Nigeria. Notwithstanding the wide range of benefits that millets provide, they have largely been missing from the global food security agenda. In fact, in recent years, their production has gradually declined. Experts point towards market distortions, a lack of appreciation of the benefits of millets and policies that have favored the production of the so-called Big Three cereals - rice, wheat and maize, resulting in a "Food System Divide". Joanna Kane-Potaka of ICRISAT, gave the example of India where "during the green revolution, high yielding varieties of rice and wheat were introduced and supported to scale out on a massive scale, to improve food security, while arguably, inadequate attention was paid to nutrition or environmental factors." The problem is further compounded by changing dietary habits, high transaction costs and the challenges involved in accessing better markets; especially true for Africa. "Farmers have therefore shifted to more remunerative crops grown to sell for profit and moved away from subsistence agriculture responding to changing consumer preferences and markets inputs," said Dr. Aburto.

Fig.-3: Foxtail millets

Millet Comeback

According to Ms. Potaka, helping millets make a comeback is not just popularization of a neglected and underutilized crop but also an effort to achieve the sustainable development goals (SDGs) – mainly SDG 2 (zero hunger), SDG3 (good health and well-being), SDG 12 (sustainable consumption and production), and SDG 13 (climate action). "It is essential to work on increasing the production and changing of perceptions about them to drive demand with new and modern products," she emphasized. The current trend can be reversed with government-led policies to support production and consumption of millets, coupled with enhanced consumer awareness of their nutritional and health benefits, said Dr. Aburto. In parallel, raising investments for research and development and generating opportunities for farmers to secure better connectivity with efficient value chains and markets, would also be crucial. Dr. Aburto also stressed the vital role of farmers in the conservation and maintenance of genetic diversity of millet through initiatives such as community seedbanks, seed fairs, and farmer networks, with a focus on promoting local millets.

Fig.-4: Women winnowing millet

2023: The International Year of Millets

In declaring ***2023 the International Year of Millets***, the resolution calls on all stakeholders to provide support to "activities aimed at raising awareness of and directing policy attention to the nutritional and health benefits of millet consumption, and their suitability for cultivation under adverse and changing climatic conditions, while also directing policy attention to improving value chain efficiencies." Building on the experiences gained from past initiatives such as ***the 2016 International Year of Pulses and the 2021 International Year of Fruits and Vegetables,*** the UN agriculture agency is working to develop an action plan in partnership with external stakeholders, including farmers and research institutions. "Actions taken will be aligned and supported via existing initiatives, such as the UN decade of action on Nutrition, 2016-2025 that provides an umbrella for a wide group of actors to work together to address malnutrition and other pressing nutrition issues," Dr. Aburto added. In line with FAO's vision of a sustainable and food secure world for all, producing more and nutritious food for a growing population without overburdening land resources is a massive global challenge. In the search for climate resilient solutions, millets could be the crucial link in the sustainable food supply chain.

Millets: The Future Food

Article ID: 40918

Amit Tomar[1], Mahak Singh[2]

[1]Subject Matter Specialist (Plant Breeding), ICAR-Krishi Vigyan Kendra, Gajraula, Amroha, (Directorate of Extension), Sardar Vallabhbhai Patel University of Agricultural & Technology, Meerut, U.P., India.

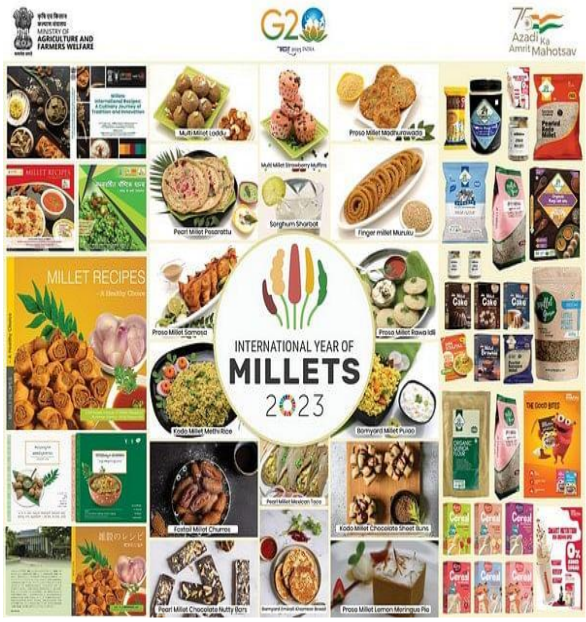
[2]Professor/Project Leader AICRP&M, Linseed Cum Oil Seeds, (Section of Oilseeds), Department of Genetics & Plant Breeding, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur-208002, U.P, India.

Introduction

Millets are a group of small-seeded grains cultivated for thousands of years in many parts of the world. They are a great source of nutrition, high in fibre and rich in vitamins, minerals and proteins. They have gluten-free properties, which makes them ideal for those with celiac disease or other gluten sensitivities. Millets can be cooked whole as porridge or ground into flour to make bread, cakes and pasta. Millets, being grown in more than 130 countries, have been considered an integral part of the diet of over half a billion people across Asia and Africa for centuries. In India, Millets were among the first crops to be domesticated. In addition to many health benefits, millets are also good for the environment with low water & input requirement. Recognising the enormous potential of Millets to generate livelihoods, increase farmers' income and ensure food & nutritional security worldwide, the Government of India (GoI) has prioritised Millets. In April 2018, Millets were rebranded as **"Nutri Cereals"**, followed by the year 2018 being declared as the National Year of Millets, aiming at more extensive promotion and demand generation.

International Year of Millets-2023

United Nations declared the Year-2023 as the International Year of Millets on 5th March 2021, on the proposal moved by India and supported by 72 countries. It is essential to give such honour to the traditional wisdom of humanity. These are the first plants to be domesticated for food. On 6th December 2022, the Food and Agriculture Organization (FAO) of the United Nations organised an opening ceremony for the International Year of Millets (IYM) 2023 in Rome, Italy. The Department of Agriculture & Farmers Welfare has taken a proactive multi-stakeholder engagement approach (engaging all the central government ministries, states/UTs, farmers, start-ups, exporters, retail businesses, hotels, Indian Embassies etc.) to achieve the aim of IYM 2023 and taking Indian millets globally. Ministries, states and Indian embassies have been allocated focused months in 2023 to carry out various activities to promote IYM and increase awareness about the benefits of millet for the Consumer, Cultivator and Climate.



Sustainable Agriculture Development Goals

There is evidence of the cultivation of millets in the Korean peninsula around 3500 B.C. In India, millets have been mentioned in Yajurveda Texts. Millet was extensively cultivated till around 50 years back. But due to the Western development model, India has neglected its traditional wisdom. Millets are cited as too primitive and coarse grains. It was looked at only as the food of rural people or ancestors. Besides that, the Green revolution had a negative impact on the production of millet. Before Green Revolution, the millets are 40 percent of total grain production. India produces 170 lakh tons of millet (20 % of the global output). The global average yield is 1,229 kg per hectare, while the average yield of millets in India is 1,239 kg per hectare. Sustainable Development Goal 2 aims to achieve **"zero hunger"**. It is one of the 17 Sustainable Development Goals established by the UN in 2015. The official wording is: "End hunger, achieve food security and improved nutrition and promote sustainable agriculture. A profound change in the global food and agricultural system is needed to nourish today's 800 million people. It can be possible by focusing on millet production. Nearly 40 percent of the global land surface is dryland. Millets are the most suitable crop for dryland agriculture.

Nutritional Structures & Benefits

These Nutri cereals are annual, short-duration (75 to 120 days) rainfed crops that grow well on shallow and low fertile soils with a pH range from acidic to alkaline soil. It has a low water requirement and can be grown even under extremely high temperatures and less rainfall. These are resistant to drought, resistant to most diseases and pests, and need minimum care. These are C4 plants that can convert CO_2 into carbohydrates with higher photosynthetic efficiency than C3 plants. Millets are Nutri cereals and climate-resilient crops. It ensures food security, nutritional security, and economic security for people. Millets are superfoods that are rich in macro and micronutrients. They contain non-starchy polysaccharides, gluten-free proteins, high soluble fibre content, high antioxidants, low glycemic index, and are rich in bioactive compounds. It is a good source of beta-carotene and B vitamins.

Types of Millets

The term 'Millet' originated from the Latin word 'Milum' means grain. Millet is a group of cereals that belong to the Poaceae family commonly known as the grass family. There are various types of millet, which differ in their colour, texture, appearance, grain size, and species. On the basis of the size of the grain, these are classified into two types – Large or major millets and Small or minor millets.

Large (Major) Millets: Jowar (Sorghum), Bajra (Pearl Millet), Finger Millet (Ragi). Foxtail Millet (Kagni), and Proso (Cheena)Millet

Small (Minor) Millet: Kodo Millet (Kodra), Barnyard Millet (Sama), Browntop Millet (Hari Kagni), Little Millet (Kutki).

Table-1: Classification of Millets:

Common Name	Scientific Name	Colour
Jowar	*Sorghum vulgare*	Brown, deep red
Bajra	*Pennisetum typhoids*	White, yellow
Finger millet	*Eleusine coracana*	Red to purple
Foxtail millet	*Setaria italica*	White, yellow, red, brown, black
Proso millet	*Panicum miliaceum*	White, cream, yellow, orange, red, brown and black
Kodo millet	*Paspalum scorbiculatum*	pinkish
Barnyard millet	*Echinochloa esculenta*	White-creamish
Little millet	*Panicum miliare*	Off-white, creamish
Browntop millet	*Urochloa ramosa*	Greenish with brown colour at the top

Geographical Distribution of Millets

In India, Jowar and Bajra are grown in most states like Maharashtra, Karnataka, Andhra Pradesh, Madhya Pradesh, Gujarat, Rajasthan, Uttar Pradesh, and Tamil Nadu, except North East states, Himachal Pradesh and Jammu and Kashmir. Both can be grown as Kharif (July -November) and Rabi (October – February) crops. Traditional varieties of these crops are available in India. They exhibit a wide range of variations concerning duration and quality. They can be grown as sole crops, intercrop, and mixed crops. The crop duration varies from 90 -120 days. The mixed cropping of Jowar-Arhar and Jowar with other pulses and even Bajra and other cereals could be done. The crop rotation of mung followed by Jowar improves soil fertility. Bajra can also be grown as a mixed crop. Finger millet (Ragi) is an important cereal of Karnataka. It grows as summer and Rabi crops in Southern India but mainly as a Kharif crop in Northern India. It can grow in alkaline soil with a pH as high as 11. The duration of the Ragi crop is 135 days. It grows as the sole crop in Southern India and Orissa, as a mixed crop with Jowar, Bajra, Oilseed, and Pulses, and as an off-season crop in rice fallow. Foxtail (Italian) millet can grow under tropical and temperate conditions. It grows throughout the year in Southern India. The duration of the crop is 80-100 days. The Little millet and Barnyard millet are also produced under rainfed conditions. Both can withstand drought and waterlogging conditions. Proso, Kodo, and Brown top millets are highly drought resistant. Brown top has the shortest duration of 70-75 days among all millets.

Millets are also grown in irrigated conditions. One to two ploughing is enough for the cultivation of millets. The seed rate for sowing varies from millet to millet. 3 to 4 rain is sufficient to grow these crops. The sowing is done through seed drill or dribbling. Nitrogenous fertilisers or phosphatic fertilisers are required in small quantities. There is a minimum or no requirement for pesticides. The panicles contain grains, and the stalk and leaves are utilised as fodder for animals.

Millets and Health

Millets are rich in non-starchy polysaccharides, fibre, and low glycemic index, which controls blood sugar levels, and are the ideal grain for diabetic patients. The soluble fibre and millet protein help to improve gut health and reduce cholesterol levels. Millets are gluten-free grains, a viable choice for people with celiac disease. Ragi is an excellent source of calcium and is suitable for bone health, blood vessels, muscular contraction, and nerve function. Kodo millet is rich in iron. It purifies the blood, reduces hypertension, and regulates the body's immune system. Foxtail millet keeps neurons (brain cells) healthy. Little millet is good for the thyroid. Because of the goodness of nutrients, these are termed Nutri cereals. These should be part of the daily diet, and each millet should be consumed in a week on a rotational basis. Bajra is best to eat in winter and Jowar in summer. Barnyard millet is usually eaten during religious fasts and is suitable for liver health. Brown top millet has anti-cancerous properties. Kutki, Sama, and Kagni can be substituted for rice.

Millets Recipes/Products

These are coarse grains, so prior soaking of 6 to 8 hours before cooking is required. Traditional millet recipes like millet roti and millet khichdi already exist on the regional level. Besides that, many innovative recipes like millet dosa, millet idli, pancakes, millet bread, waffles, crispy crumbs in the salad, and cookies are developing professionally in hotels, bakeries, and also at home. New ideas to improve its palatability and acceptability by all age groups will end the hidden hunger and can fulfill the goal of zero hunger. Millet farming can play a crucial role in sustainable agriculture and make farmers prosperous.

Conclusion

Millets are also an integral part of the G-20 meetings, and delegates will be given an actual millet experience through tasting, meeting farmers and interactive sessions with start-ups and FPOs. The spirit of the whole government approach is indeed seen in the celebration of the International Year of Millets 2023.

Weed Management in Organic Farming

Article ID: 40919

Thounaojam Babycha[1], Ngangom Sonaly Devi[1], Yumnam Sanatombi Devi[1]
[1]Department of Agronomy, South Asian Institute of Rural and Agriculture Management, (SAIRAM) Langjing Achouba, Imphal, Manipur.

Introduction

In organic crops weeds management is more challenging and competitive for nutrient, Space, water, light between the crops and weeds. And in organic farming, weeds are generally appeared as a main barrier. As the organic farmer rise their experience most of the farmer reveal less care about weeds. Organic weeds management is proceeded to weed removal and prevention that are not require to use chemical and weed killer. To control the weed management mechanical, cultural and biological method is done in organic farming. However, farmer use different kind of tools to control the weeds. For successful weed management it may analyst crop rotation, soil management, time and labor etc.

Reason for Using Organic Weed Management

From the time of agriculture farmer have suffer weeds which are being there in the field. Weed can be considered a significant problem because they tend to reduce crop yield production by increasing competition for nutrient, space, water, light while performing as host plants for pests and diseases. To removed weeds from their field farmers, apply chemicals from the time of herbicides invented. By using herbicide to removed weed it increase the crop yield not only that but also reduce the require amount of labor.

Nowadays some farmers have newly interest in organic methods of weed managing because by using agro-chemicals it become environmental and health problem. In some cases, it has found that herbicide used can cause some weed species to conquer the field because the weeds developed resistance to herbicide.

What is Organic Weed Management?

Organic weed management is a holistic system including an entirely different approach to manage a farming system. Not interested in removing all the weed by the organic farmer but desire to retain the weed at a threshold that is both economical and manageable. Chemical herbicide can't be used in organic weed management. A farmer who manages weed organic must be intimately familiar with the type of weed and to determine which type of control method must be use in their growth habit.

Method Use in Organic Weed Management

1. Cultural method.

a. Soil solarization: During the summer or in the sun, sometime organic farmer kept their soil through sunlight to make free from bacteria. Throughout the time of this process, after the field has been tilled the area will cover with a clear plastic film. Under the plastic film when the soil caused heat, which is hardly sealed at the edge, become great enough to kill weed and the embryos inside the dormant seeds.

b. Mulch: Mulching or covering the soil can prevent weed seed germination. By absence of sunlight/ light transmission exist photosynthesis of the germinating weed that can cause them to die. In the mulch allelopathic chemical can also cause physically suppressing seeding emergence. There are many different ways for mulching. Mulching which are normally use are:

i. Living mulch: A living mulch is commonly a plant species that grows closely and low to the ground, like clover. Before or after the crop is established living mulch can be planted. It much be till in, kill or living mulch much manage so that it does not complete with certain crop.

ii. Organic mulch: Organic mulch is natural material that can supply productive weed control, materials like straw, crop residues, leaves, bark, wood chips etc. Material of farm production is suggested that since the cost of purchase can be so high that many people cannot effort, based on the amount needed to protect weed emergence. Material that are place in soil surface to avoid from weed management, erosion and decrease the evaporation.

iii. Inorganic mulch: Inorganic mulch is usually non nature material like black plastic, rubber, etc. are used for weed control in a range of crop.

c. Crop rotation: Crop rotation is the practice of cultivated different crop in sequence on the same land by the year. Weeds try to challenge with crops of similar growth requirements as their own and cultural practices designed to contribute to the crop may also benefit the growth and development of weeds. When the same crop growing in the same field by year, result in a development of weed species which are changed in a crop growing condition. When diverse crop practice in rotation, weed germination and growth cycles are disrupted by variations in cultural practices associated with each crop.

d. Inter cropping: It is associated with planting a smother crop between row of the main crop. Seed should be controlled approach carefully by using intercropping as strategy. The intercrops can greatly reduce the yields of the main crop if competition for water or nutrients occurs.

e. Water management: In crop production effective water management is the main source of controlling weeds. By applying drip water irrigation in crop zones, it reduced weed growth. In field time and method of irrigation control weed growth. There are many methods which can help in reducing weed pressure on crop by careful irrigation management.

2. Mechanical method: Specially in organic farming this mechanical method is the most effective method for managing weeds. Both time consume and labour intensive is involved in mechanical removal of weeds. In mechanical weeder, it contained cultivating tools like hoes, harrows, tines and brush weeder and cutting tools like mowers and stemmers. Tools like fixed harrows are suitable for arable crops, whereas inter-row brush weeder are considered to be more effective for horticultural use. The brushed weeder is commonly used in vegetable like carrot, beetroot, onion, garlic, etc. The optimum of timing, implementation and frequency are based on the structure and form of the crop and growth stage and number of weeds. Cultivation involved killing emerging weeds under the depth from which they germinate.

a. Hand hoeing: Hand hoeing is a post-planting interculture operation, which stirs the soil and make it more loosened. It is effective against annual weeds but not for perennial weeds, since it cannot control the under-ground vegetative structure of perennial weeds.

b. Hand weeding/Hand pulling: In weed control hand weeding/ hand pulling is the oldest method. It effectively controls annual weeds but can't control perennial weeds.

c. Burning, flaming and heating: Burning is practiced mainly under non crop situation towards non-selective control of weeds or unwanted vegetation. Flaming, on the contrary, could be used both selectively and non-selectively. Flame is directed towards the ground and injury to crops is avoided. Crop plants can withstand heat of the burner, whereas small succulent weeds cannot. Crop plants should be taller than weeds. It has been used successfully for selective weed control in alfalfa, cotton, sugarcane and soybean. Heating soil through solarization or residue burning is another aspect for weed control in crops in recent years.

d. Tillage: The aim of tillage is to produce good root growth, healthy seed bed, smooth germination of root bed and to reduce weed by process of continuous unchanged of drainage weed seed bank. Sufficient tillage check and delay emergence of weeds and in early crop establishment it produced better favorable environment. By doing this, tillage break cut or tears of weeds and exposes them in sun to desiccation. It decreased the weed resistance by exhausting the food reserved of the vegetative structure.

3. Biological Control: The biological control of weeds involves the use of living organisms, such as insect, herbivorous fish, other animals, disease organisms, and competitive plants to limit their infestations. An important aspect of biological weed control is that at a time, it is applicable to the control of only one major weed species that has spread widely. With perennial weeds the main objective of bio-control is the destruction of the existing vegetation, in the case of annual weeds prevention of their seed production is generally more important.

Conclusion

Effective weed management on organic farming needs cultural, mechanical and methods. Mulching, crop rotation is the fundamental for weed control and successful organic farming. We foreword a number of concept and tools which can analysis in organic weed management. Some weeds can also serve as host plant for pests. An organic farmer will benefit from knowing which weeds are in their fields, whether they should be considered detrimental to crop growth.

References

1. PATEL, D. D.*, PATEL, T.U., THANKI, J. D. AND ARAVADIA, M. K, Weed management strategy in organic farming.
2. Ravisankar, N., A.S. Panwar, Kamta Prasad, Vipin Kumar and S. Bhaskar. 2017.Organic Farming Crop Production Guide, Network Project on Organic Farming
3. Melissa VanTine, Graduate Assistant in Horticulture and Sven Verlinden, Assistant Professor of Horticulture Work supported by: WVU Extension Service Tom McConnell, Extension Farm Management Specialist and Program Leader Sept. 2003, Organic Weed Management.

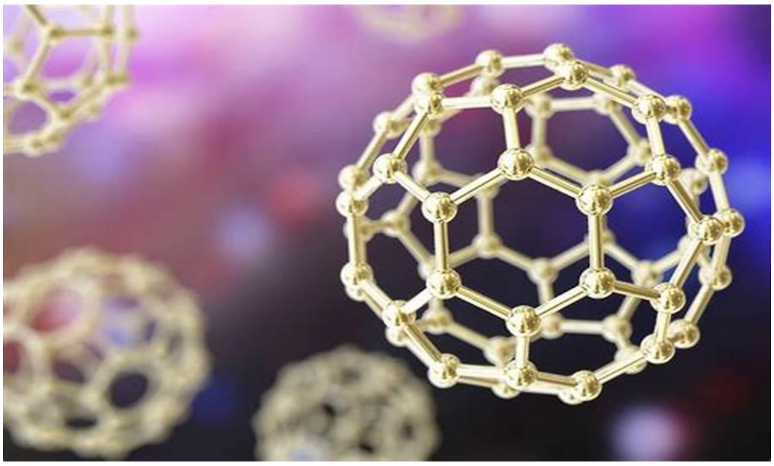
AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Nanotechnology in Horticulture

Article ID: 40920

Kulkarni Sumith Kumar[1], K Nirosha[2]
[1]B.Sc. Student & [2]Assistant Professor, College of Horticulture, SKLTSHU, Rajendranagar, Hyderabad, Telangana State.

The ideas and concepts that paved way for the science of nanoparticles began long before the very term nanotechnology has been coined. Renowned physicist, Dr Richard Feynman, in his talk entitled "There is plenty of room at the bottom" at an American Physical Society meeting at the California Institute of Technology on December 29, 1959, described a process in which scientists would be able to manipulate and control individual atoms and molecules.



Introduction

The word 'nanotechnology' is coined from the Greek word "nano", meaning dwarf. A nanoparticle or ultrafine particle is usually defined as a particle of matter that is between 1 and 100 nanometres (nm) in diameter. Nanotechnology is the art and science of manipulating matter at the nanoscale (at scales of 1 to 100 nanometres) which includes the design, characterization, manufacture, and application of structures, devices, and systems at the nanoscale by managing shape and size. The physical, chemical, and biological properties of materials can differ fundamentally and usefully at the nanoscale from those of bulk matter, allowing for new applications for existing materials.

Nanotechnology in Agriculture

Agricultural farm management is the efficient and effective usage of agricultural resources in a sustainable manner without wastage. This is only possible when every farm activity is done with absolute precision and of course, it cannot be achieved through the traditional methods of farming which is why the concepts of modern agriculture, precision farming, remote sensing in agriculture and agriculture robots have been put forward and are being implemented in real fields which are working wonders for farmers.

A new addition to this is the application of nanotechnology in agriculture. Especially, Plant nutrition is critical for agricultural production and crop quality, and fertilizer application accounts for roughly 40% to 60% of global food production. Nanotechnology works with the tiniest particles possible, increasing the chances of enhancing agricultural productivity by solving problems that have previously been unsolved.

Nanotechnology applications have the potential to change agricultural production by allowing better management and conservation of plant and animal inputs. In relation with extension of horticultural products shelf life, nanotechnology has proven to be helpful. It provides a great scope of novel applications in the plant nutrition fields to achieve the future request of the rising population because nanoparticles have exclusive physicochemical characters i.e., high surface area, high reactivity and tuneable pore size.

Some Unique Features of Nanoparticles

There are various advantages that nanotechnologies offer due to the unique functional properties of nanoparticles and materials like:

1. Higher charge density and higher reactivity of nanoparticles due to small size.

2. As the surface area increases in comparison to volume, the activity of the atoms on the surface of the particles becomes more than the inside the particles.

3. The nanoparticles possessed higher strength, increased heat resistance, decreased melting point, and varied magnetic characteristics as a result of the huge surface to volume ratio.

4. Variations in atomic distribution across nanoparticles are caused by differences in the exposed surfaces of various nanoparticles, which affect the electron transfer rate kinetics between metal nanoparticles and corresponding adsorbed species.

5. Nanoparticles with a tetrahedral structure exhibit stronger catalytic activity than those with a cubic or spherical structure, which is recognized for improving chemical reactivity at the sharp edges and corners of the former.

Impact of nanotechnology on growth and development of horticultural crops and the scope of application of specifically designed nanoparticles in agriculture especially in horticultural crop production is presented below:

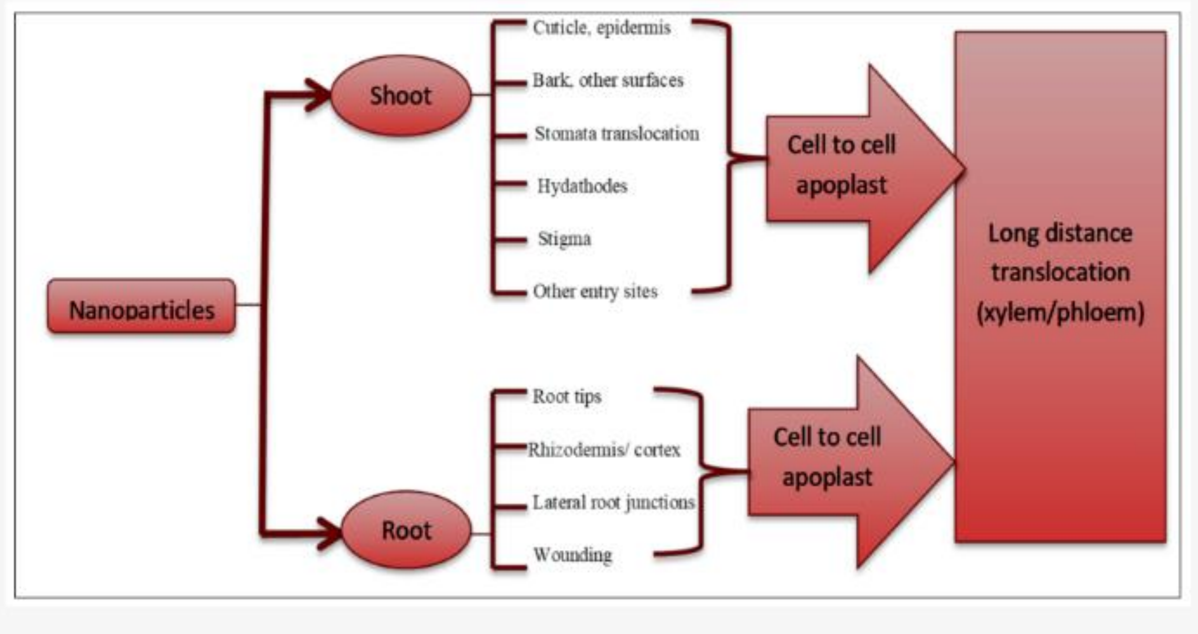
Nanofertilizers: Nanofertilizers are being formulated by incorporating with plant nutrients into nanomaterials, applying a fine layer of nanomaterials on nutrient molecules, and producing nanosized emulsions. Nanofertilizers and nanobiofertilizers encompass both natural and synthetic materials, respectively, thus judiciously improve the bioavailability and soil fertility compared to the traditional fertilizers.

Nanofertilizers show promising results in increased efficiency and productivity of the crop plants. The N source nano-fertilizers such as zeolites, mesoporous silica nanomaterials and hydroxyapatite are known as slow or controlled release nanofertilizers. A biosafe nanofertilizer is one where phosphorus (P) is a component. It is a nanoscaled (60–120 nm) suspension of water-phosphorite particles. The usefulness of zinc-based nanofertilizers in many horticultural crop plants such as garden pea, cucumber, spinach, tomato, eggplants, chilli, coriander and onion is known well.

Similarly, the application of Zn nanoparticles in a non-horticultural field crop, pearl millet (*Pennisetum americanum* L.), increased grain yield by about 38%. The enhancement of grain yield was associated with an enhancement of shoot height (15%), root length (4%), root area (24%), chlorophyll accumulation (24%), total soluble protein (39%) in leaf and plant biomass (12%) in comparison to control. Using Zn nanoparticles, a significant yield increase was noticed in rice, wheat, maize, sugarcane, potato, sunflower and *Brassica*.

Application of iron (Fe) source nanofertilizers improve yields in various horticultural crops such as cucumber, lettuce and garden pea. Application of appropriate concentration of Cu nanoparticles remarkably enhances the physiological development of many horticultural crop plants such as lettuce and tomato. Nano-Mn fertilizer improves the growth and yield of crop plants if the soil is deficient in this micronutrient.

Nanoparticles are easily absorbed to plant surfaces and uptaken by plants via nano- to micrometre-scale natural openings of plants. Nanoparticles uptake into the plant body can use different pathways. Uptake rates depend on the surface properties and size of the nanoparticles. Very small-sized nanoparticles can be penetrated via the cuticle. Large size nanoparticles can enter via non-cuticle areas e.g., hydathodes, stomata, and the stigma of flowers.



Nanopesticides: Most nanopesticides are eco-friendly, and the majority of nano-pesticide formulations are highly target-specific and controlled release. Nanopesticide formulations improve the adhesion of droplets on plant surfaces, which improves the dispersion and bioactivity of the active ingredient of pesticide formulations. Therefore, nanopesticides have a higher efficacy compared to conventional pesticide formulations. Insecticidal value can also be developed by using nanoencapsulation. In this method, the nanosized active pesticide ingredient is sealed off by a thin protective coating. This approach greatly improves the effectiveness and reduces the amount of pesticide required and related environmental pollution.

Nanosensors: A nanosensor can be defined as any device that is capable of conveying data and evidence about the behavior and characteristics of nanoparticles at the nanoscale level to the macroscopic level. Nanosensors are necessary for facilitating real-time tracking of field crop, crop growth, and pest and disease incidence. Smart agricultural practices in horticultural crop production involve: (i) nanoformulation-based fertilizers or pesticide delivery systems, which increase the dispersion and wettability of nutrients (ii) nanodetectors for pesticide or fertilizer residues; and (iii) remote-sensing-based monitoring systems for disease incidence and crop growth.

Conclusion

Not only as nanofertilizers, nanopesticides and nanosensors, nanoparticles can also be used for enhancing the shelf life of horticultural produce and reduce post-harvest spoilage of fruit and vegetables. Finally, it is demonstrated that substantial practice of nanotechnology would significantly promote growth, increase yields and reduce production costs and post-harvest losses through maintaining the superior quality and storage duration of fresh and processed fruits and vegetables.

The availability of useful nanoparticles and safety assessments of their field application are needed for ensuring food and nutritional security of the ever-increasing world population in a changing climate scenario. Larger application of nanotechnology will lead to a climate-smart horticulture, reduce post-harvest losses and improve the overall quality of the produce.

References

1. *Horticulturae* 2021, *7*(10), 332; https://doi.org/10.3390/horticulturae7100332
2. Nanotechnology in Horticulture Vibhu Pandey, Shalini Singh, Khursheed Alam and Deepesh Keshari Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U. P.), 250 110, India
3. Education and Outreach | National Nanotechnology Initiative.

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

Importance of Creativity and Imagination to Children

Article ID: 40921

Y. D. Haritha[1]
[1]Ph.D Research Scholar, College of Community Science, Human Development and Family Studies, Acharya N.G. Ranga Agricultural University, Guntur, Andhra Pradesh.

Introduction

Creativity is defined as the tendency to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, entertaining self and others. Whereas, imagination is the act or power of forming a mental image of something not present to the senses or never before wholly perceived in reality.

Importance of Creativity and Imagination to Children

Creativity is children's unique response to all that they see, hear, feel and experience. A child's individual responses to materials, experiences and ideas inspire their creativity and imagination.

Children's responses can be physical, emotional, social, cultural or a combination. Younger children might respond in verbal and nonverbal ways, for example, a toddler swaying to music.

For young children to have an individual response it's important that do not have a set goal. Children need their contributions to be noticed and valued so they build confidence and resilience. Give children enough space and time to experience and explore. Help and encourage them to develop their own curiosity and creativity. A child's imagination and creativity are enriched through their awareness of art and other children around them. All of these creative experiences build powerful connections within the brain, Creativity is associated with focus, independence, a willingness to explore and ingenuity.

As children develop in imagination and creativity, they are able to tell a story, relate to other people, keep themselves emotionally grounded and enter their imaginary worlds.

Creativity and imagination can help child's motor skills, social interactions and even his problem-solving skills. When children imagine, they visualize a world without its physical limits. This helps them see things in a new light and look for solutions using a different approach. It also helps them express themselves and urges them to question the working of things around them. And this is just the tip of the iceberg of learning! Wondering how child's creative world will shape his future.

Conclusion

1. Imagination and creativity are children's unique response to what they see, hear and experience around them.

E-ISSN: 2581 - 8317

2. Children have a natural curiosity to explore experiences. Non-verbal and verbal creative expression must be valued and noticed.
3. Repetition allows children to explore and make sense of their experiences and to respond in their own unique way.

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

Digital Agriculture: Technology at Service

Article ID: 40922

Manjunatha P. B.[1], Sagar S. P.[2]
[1]Ph. D. Scholar, Division of Genetics and Plant Breeding, ICAR-Indian Agricultural Research Institute, New Delhi - 110 012.
[2]Ph. D. Scholar, Division of Microbiology, ICAR-Indian Agricultural Research Institute, New Delhi – 110 012.

Introduction

Agriculture encompasses the art of cultivation, which starts with sowing till reaping the harvest. Art, as an essential component of agriculture the word STEM got an extended version of STEAM, which stands for science, technology, engineering, art, and mathematics. Despite STEAM being the pillar anchoring core arenas (Defense, space, and manufacturing), also address the upcoming global challenges in agriculture and allied sectors. It has gained acceleration in agriculture through the driving programs under Digital India Mission. Digital agriculture is steaming progress in the agriculture sector at a global level.

It takes into consideration linking farmers to real-time information on cultivation aspects and connecting them to broader markets at a national level (A foundation for the future). That enables limiting the middlemen and addresses the need for domestic demand and merchandised export in fulfilling the aim of Atmanirbhar Bharat. STEAM strengthens inclusive growth and empowers farmers through the delivery of social services up to the grassroots level and covers the loopholes present in regulatory regimes.

Objectives

1. Dissemination of varied information through ICT-based platforms: Information and communication technology has revolutionized the software sector and overall lives at a global level. Utilizing such technologies to smoothen farming operations is looked forward to.

2. Conservation of the farming ecosystem: Nature has set an appreciable platform to utilize and sustain for the generations to come. The lack of knowledge on the application of agrochemicals in an agro-ecosystem may imbalance the natural diversity of living species and alters the natural processes. This could be overcome through a digital platform answering queries and information on the same.

3. Demonstration of solidarity with all farming folks and concerned stakeholders: It enables the formation of the farmer-producer organization or through the creation of integrated business modules like B2B, B2C, and others. It also attempts to bridge the marketing gaps that exist within the farming community and in the formation of farmer's cooperatives and associations.

4. Eco-friendly sustainable agriculture: A sustainable ecosystem is what mankind is behind. Rise in the temperature, greenhouse gases, climate change, and global warming is warning the man race regards to the ecological imbalance. Information on a farm pond, rainwater harvest, agro-forestry system, and integrated farming system will cope with balancing the ecosystem to have eco-friendly sustainable agriculture.

Contemporary Challenges

1. Private innovation and investment in keeping distance from this sector: Private sector participation along with public sector policies and innovations will pave way for a success of a project. Digital payment systems with UPI, and NCPI will set an example here.

2. Low participation of youth: India is leading the world in its large population under the working age group or its youth category. So there needs to be an effort from the youth to take up entrepreneurship activities in solving the issues of the farmers like cultivation aspects and marketing.

3. Dependence on imports for food security: Despite the Indian green revolution and achieving food security, India is still dependent on agricultural inputs like fertilizers and farm machinery.

4. Low yield and productivity: Climate change and global warming have posed farmers with uncertainty in the yield they obtain. Drought, pest, and disease incidents with other distress are affecting agricultural productivity.

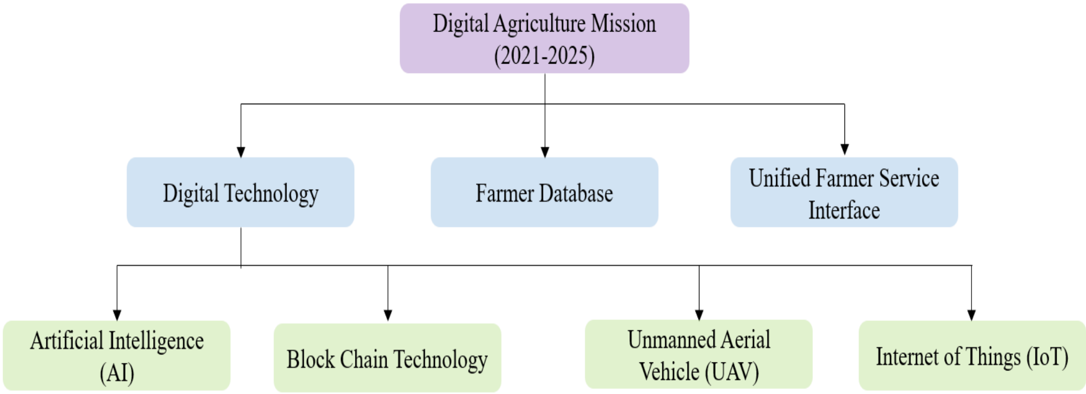


Fig. 1. Representation of the Digital India Mission (2021-2025)

Initiatives for a Better Agriculture

1. Digital Agriculture Mission (2021-2025): The Government of India have taken up measure to build up an agristack in the country, that takes forward the foundation to build an innovative solution-based digital agroecosystem by the incorporation of artificial intelligence (AI), the Internet of things (IoT), machine learning (ML), and other such programs. Indian Digital Ecosystem of Agriculture (IDEA) report prepared by the high-level task force constituted by the Ministry of Agriculture and Farmers Welfare is driving the mindset of digital agro-ecosystem to a farmer's level that which works towards educating and mobilizing farmers to look beyond the present conventional way of collecting information required for the better productivity via the usage of the following:

Artificial Intelligence:

a. Provide an accurate advisory on challenges

b. AI-enabled remote sensing technology for the identification and management of weeds, pests, and diseases

c. Notifications via smartphones on minimum support price, weather forecast, and others

d. Reduce post-harvest wastage, inadequate usage of agrochemicals

e. Quality improvement through post-harvest processing, cold storage, and proper warehousing facility

f. Quick access to the market made possible through startups like BigBasket, Ninjacart, and others.

Unmanned aerial vehicle:

a. Access real-time information on the field through digital forecasting and geographic information system

b. Selective application of weedicide, fertilizers, and micronutrients based on the forecast details

c. Precision farming could be achieved

d. Drone-based imaging (Garuda aerospace startup got DGCA approval).

Block Chain Technology:

a. Track information on seed quality, plant growth

b. Consolidated information on multiple aspects (Ex: Tracking crop journey from farm to market)

c. Tracking of transactions.

2. Kisan Suvidha App: Integration of all agricultural schemes/ services under one umbrella initiated by the Department of Agriculture of Cooperation as a farmer's smart app providing information and answering the needs of the farming community. It serves farmers with the following schemes and services:

Schemes:

a. Crop insurance (PMFBY): The Pradhan Mantri Fasal Bima Yojana was launched in 2016 to provide moral and financial support to farmers.

b. e-market (e-NAM): As a pan-India electronic trading portal, the National Agriculture Market links mandis and other trading platforms to create an online marketing environment.

c. Land record (PM-SWAMITVA): Launched in 2020, it is an approach to bring financial stability to rural households. It enables land records to use as an asset to get credits from financial institutes.

Services:

a. Weather forecast and real-time information
b. Information on prevailing market price and minimum support price
c. Information on authentic input dealers and appropriate agrochemicals in solving the pest and disease incidence
d. Agro-advisories on all aspects related to cultivation and marketing.

2. IDEA (Indian Digital Ecosystem of Agriculture): The innovative solution by the creation of an agristack (A digital repository). It covers National e-Governance Plan in Agriculture (NeGP-A), Sub Mission on Agricultural Mechanization (SMAM), National Agriculture Market (e-NAM), PM-KISAN Mobile App, Integrated Scheme for Agricultural Marketing schemes (AGMARKNET), Agriculture Infrastructure Fund (AIF), National Mission on Horticulture, National Project on Soil Health and Fertility and others.

3. KISAAN 2.0 (By ICAR): The Indian Council of Agriculture Research (ICAR) has assembled and posted on its website all the mobile applications created by ICAR, State Agricultural Universities, and Krishi Vigyan Kendras. These mobile apps, which were created in the fields of crops, horticulture, veterinary medicine, dairy, poultry, fisheries, and integrated subjects, provide farmers with useful information such as a set of best practices, market prices for different commodities, weather-related data, advisory services, and others through this application. KISAAN 2.0 is among those an umbrella of all.

4. Kisan.gov.in: A unified farmer service platform by the Ministry of Agriculture and Farmers Welfare. Farmers can obtain a farmer ID and avail of the services available on the platform. It encompasses farmers availed scheme benefits and also provides an extension system through information via SMS.

5. Promotion of Natural Farming:

a. PM-PRANAM (Promotion of Alternate Nutrients for Agriculture Management) Yojana: For a balanced usage of fertilizers in conjunction with biofertilizers and naturally available organic fertilizers.

b. GOBARdhan Yojana: It was brought up to improve the lives of villagers by transforming bio-waste, such as cow dung, kitchen leftovers, crop residue, and market garbage. Farmers and households will profit economically and in terms of resources from this. A unified portal has been launched for the same program.

c. Mission Amritsarovar: As a part of Azadi Ka Amrut Mahotsav, it was launched in 2022 with a vision of water conservation by the creation of 75 water bodies in each district across the country.

Conclusion

STEAM-based platforms help farmers and scientists to transform the situation by making the nation self-reliant. It is capable of improving the export of agricultural produce and achieving nutritional and food security, thereby, improvise the living standard and lifestyle of the farming community. With the efforts of scientists, farmers, and the farmer-friendly policies of the government unprecedented progress could be achieved in the agriculture sector. Still STEAM isn't a pawer for all challenges. Traditional knowledge alongside technology in agriculture can address concerns in agriculture. Therefore, technology and traditional skills are the temperaments for remunerative and sustainable agriculture.

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

Shinrin-yoku or Forest Bathing: The Simple and Intuitive form of Preventative Care

Article ID: 40923

Takhellambam Henny Chanu[1], Lhingneivah Chongloi[2]
[1]Ph.D. scholar, KRC College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot-591 218, Karnataka.
[2]Ph.D. scholar, College of Horticulture Bagalkot, University of Horticultural Sciences, Bagalkot-591 218, Karnataka.

Introduction

Stress has wide-ranging effects on people's mental and physical health, which has made it a top public health concern. One commonly acknowledged aspect underlying psychological stress amongst children and adults nowadays is a declining amount of contact with nature. Youth who lack contact with nature have the tendency to remain disconnected from nature as adults (Bowler *et al.*, 2010). Therefore, there is a desire and necessity for alternate interventions that aid in introducing youth to nature. In order to improve wellbeing, many educators, health care providers, and social scientists from a variety of disciplines look for alternatives to conventional interventions or therapies. One such option is forest therapy, often known as *shinrin-yoku*.

Shinrin-yoku or Forest Bathing

In 1982, Tomohide Akiyama, Director of the Japanese Forestry Agency, coined the term *shinrin-yoku*, or "forest bathing" interprets to "forest baths" and can also be translated as "taking in the forest atmosphere" or "care by the forest." (Miyazaki, 2018). *Shinrin-yoku* is more than a kind thought, it is a rapidly developing field of research and increasingly recommended form of preventative care.

Shinrin-Yoku is a traditional Japanese nature practice which consists in walking by the woodland in silence and by paying attention to the one's senses in connection with nature (Miyazaki, 2018). Its practice has been spread around the world during the last decade, and it is considered both a recreational and a therapeutic activity, guided and structured, aimed at improving well-being and strength (Farkic *et al.*, 2021).

Fig. 1: Walking in nature

In theory, the concept of *shinrin-yoku* is simple: a person basically visits a natural location and strolls leisurely (Fig. 1). In order to be completely present in the event, practitioners put away their phones, cameras, and other distractions. They occasionally stop to take a closer look at a leaf or take in the feel of ground underneath their feet. A person can awaken their senses, develop their intuition, and have an entirely new experience of the woodland by combining these unhurried walks beneath a forest canopy with guided activities. *Shinrin-yoku* sessions are mainly created by merging deep nature connection mentorship methods and mindfulness meditation techniques.

There is no singular way to practice forest bathing, nor is there an exact amount of time prescribed. Some practitioners suggest that a single session last from two to four hours, but some research has shown that even 15 minutes can have beneficial short-term effects on mental health (Antonelli *et al*., 2021). There are a variety of activities within forest bathing including walking, standing, sitting, and deep breathing all while being mindful of one's senses.

Benefits of *shinrin-yoku* or Forest Bathing

The comforting, revitalizing and healing benefits of *shinrin-yoku* have perhaps always been acknowledged instinctively, but in recent years, scientific research has helped to shed some light on how merely being in wild places has healing effects. A numerous study from Japan and South Korea have demonstrated health benefits of spending time under canopy of the living forest (Han *et al.*, 2016). It activates human senses, allowing multisensory, affective and kinaesthetic experiences that induce relaxation and vitality. Some authors propose that the inhalation of terpenes, as main volatile oils contained in forest aerosols, is the mechanism that mediates the association between forest bathing and health improvements (Cho *et al*., 2017). Forest bathing has been found to:

1. Help in the regulation of blood pressure

2. Be beneficial to a person's parasympathetic nervous system (sometimes called the rest and digest system), the toolkit our body uses to balance out the sympathetic nervous system that revs our adrenaline and heartbeat in times of stress. *Shinrin-yoku* in a forested area like Washington Park presses play on the rest and digest system, allowing the body to enter a state of relaxation (Farkic *et al*., 2021).

3. Improve the number of natural killer cells, which defend against disease by killing virally infected cells.

4. Research indicates forest bathing also provides a defense against the pangs of anxiety, stress, depression, and other inflictions on one's mind. In recognition of its potential to help, Japan has included it in its national health service as an intervention for mental health (Clarke *et al*., 2021). *Shinrin-yoku* seems to have a positive impact on post-traumatic stress disorder, has been observed to have benefits for those dealing with insomnia, and has improved the mood of people with unhealthy alcohol use (Antonelli *et al*., 2021). One study even did something as simple as studying facial expressions and found that people became happier by spending a few hours in the embrace of green (Wei *et al*., 2020).

5. Forest bathing has been regarded as a sustainable touristic activity that enable visitors discover forest landscapes and that promotes pro-environmental attitudes and well-being (Farkic *et al*., 2021).

Conclusion

An increasing corpus of studies indicates that *shinrin-yoku* may have positive effects on a person's well-being and health in many different ways. To ease the symptoms of depression, anxiety and stress and to increase happiness, relaxation, a general sense of well-being, and a sense of balance in life, health care practitioners and educators can use the *shinrin-yoku*. It is a simple, inexpensive, and pleasurable supplemental intervention. Additionally, *shinrin-yoku* as a restorative and healing therapy may enhance the overall well-being of the clinician and patient while fostering a sense of serenity, respect, and comfort.

References

1. Antonelli M., Barbieri G., Donelli D., (2019). Effects of forest bathing (*Shinrin-yoku*) on levels of cortisol as a stress biomarker: a systematic review and meta-analysis. *Int J Biometeorol*. 63(8): 1117–1134.
2. Bowler D.E., Buyung-Ali L.M., Knight T.M. and Pullin A.S., (2010). A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health*. 10(1): 456.
3. Cho K.S., Lim Y., Lee J., Lee J.H., Lee I., (2017). Terpenes from forests and human health. *Toxicol Res*. 33(2): 97–106.
4. Clarke F.J., Kotera Y. and McEwan K., (2021). A qualitative study comparing mindfulness and *shinrin-yoku* (forest bathing): Practitioners' perspectives. *Sustainability*. 13*(*12): 6761.
5. Farkic J., Isailovic G. and Taylor S., (2021). Forest bathing as a mindful tourism practice. *Annals of Tourism Research Empirical Insights*. *2*(2): 100028. https://doi.org/10.1016/-j.annale.2021.100028

6. Han J.W., Choi H., Jeon Y.H., Yoon C.H., Woo J.M. and Kim W., (2016). The effects of Forest therapy on coping with chronic widespread pain: Physiological and psychological differences between participants in a Forest therapy program and a control group. *International Journal of Environmental Research and Public Health*. 13(3): 255.
7. Miyazaki Y., (2018). *Shinrin-yoku*: the Japanese way of forest bathing for health and relaxation. Octopus books, London.
8. Wei H., Ma B., Hauer R.J., Liu C., Chen X. and He X., (2020). Relationship between environmental factors and facial expressions of visitors during the urban forest experience. *Urban Forestry & Urban Greening*. 53*:* 126699. https://doi.org/10.1016/j.ufug.2020.126699.

Daisugi: The Ancient Japanese Art of Growing Trees on Top of Other Trees

Article ID: 40924

Takhellambam Henny Chanu[1]
[1]Ph.D. scholar, KRC College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot-591 218, Karnataka.

Introduction

Covering over 30% of the earth's land surface, the forests of the world are a significant natural resource for the planet and humanity. Their role in our wellbeing is endless. They help to store massive amounts of carbon, ensure the balance of nature, purify water and air as well as provide a livelihood for people across the world. Unfortunately, due to the ever-growing global forestry and logging industry, forests the equivalent of 30 soccer fields are disappearing every minute. According to estimates, the global forestry and logging industry was worth US$509.8 billion in 2019 and is expected to grow at a CAGR of 4% from 2021 eventually reaching US$544.2 billion in 2023. But this comes at a cost.

Since 1990, the area of primary forest globally has decreased by over 80 million hectares meaning that the net loss of forest area decreased from 7.8 million hectares per year in the 1990s to 4.7 million hectares per year during 2010–2020. To put it simply, between 1990 and 2020, the global forest area decreased by 178 million hectares, which is about the same area size as Libya. If this continues, not only people depending on the forests for livelihood will be out of jobs but the biodiversity that forests help to maintain will also vanish. Several solutions have been proposed to protect our forests, one of which is a Japanese technique dubbed Daisugi that aims to provide an efficient and sustainable approach to forestry.

Daisugi

Around the 15th century, Japan experienced a shortage of seedlings as well as land to cultivate trees at a time when demand for Kitayama cedar, a type of straight and knot-free lumber, was high. As there was little flat land in the area, planting and maintaining trees on the steep slopes became extremely difficult. This problem led to development of an indigenous horticulture technique called Daisugi, giving way for arborists to reduce the number of plantations making the harvest cycle faster, and producing comparatively denser wood. While it is well known in Japan, this technique, which originated in Kyoto, also has roots in ancient Rome, where it was known as pollarding, as well as across Europe, especially in Britain, where it was called coppicing.

The Daisugi technique literally means platform cedar, a technique that uses existing trees to grow additional trees. The result of such a technique looks like an open palm with multiple perfectly vertical trees growing out of it thus creating a sustainable harvest of timber from a single tree. Ideally, one prunes the branches of Kitayama cedar ensuring the remaining shoots grow straight upwards from a platform and this results in round and straight timber known as taruki, mainly used in the roofs of Japanese teahouse.

Fig: Daisugi

According to a tweet by Wrath of Gnon, a Daisugi enthusiast, "The shoots are carefully and gently pruned by hand every two years leaving only top boughs, allowing them to grow straight. Harvesting takes around 20 years and 'old tress stock' can grow up to 100 shoots at a time.

The final result is slender cedar that is not only flexible but dense, making it an ideal choice for traditional wood roofs and beams. Daisugi cedar can be harvested every 20 years and with the base tree lasting hundreds of years, there's quite a lot of wood to be harvested from just one tree. This makes it a faster method when compared to others to help save the global forestry industry as well as the planet - we need trees to absorb our emissions, provide oxygen and help foster wildlife biodiversity. Timber is the least of their fruits.

With Daisugi, instead of harvesting the entire tree for lumber, loggers can use the upper portions while still leaving the base and structure in one shape. Supposedly, the lumber produced as a result of this method is 140% as flexible as standard cedar and 200% as dense/strong, thus making it an ideal choice making to be used in building rafters and roof timber. Daisugi's straight, slender, and typhoon-resistant end product is favoured even 600 years later.

Fig: A traditional Japanese tea room in the sukiya-zukuri architectural style.

In the same Twitter thread, Wrath of Gnon shared that in the forests around Kyoto, you can find abandoned giant Daisugi. "They only produce lumber for 200-300 years before they are worn out still alive with trunk diameters of over 15 metres. This has to be done with a Japanese cedar of a kind called white cedar and from a tree that has a genetic defect which makes it sterile and straight growing. There is only one such tree in the world from which all these trees are cut saplings."

To keep the trees knot-free, foresters climb the long trunks every three to four years, carefully pruning any new branches. After around 30 years, only then one single tree is finally cut down. This type of cedar, which is slightly thicker than the daisugi cedar, has several different uses. Previously, this wood was a central part of Japanese architecture. These days, the wood is used for everything from chopsticks to furniture. This technique enables foresters to harvest wood much more quickly and the shoots can either be planted helping to quickly populate a forest or harvested and if done the right way, it can help prevent deforestation.

Conclusion

Japan's Daisugi technique is an ingenious way to grow more wood using less land and given that the world's forests represent a natural asset of almost incomparable value, it is important and the need of the hour, to preserve the forests' ability to capture and store carbon thus reducing the overall effects of global warming.

Noni – A Multi-Beneficial Gift from Nature

Article ID: 40925

B. Pawan Kumar[1], D. Naga Harshitha[1]
[1]College of horticulture, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Hyderabad-500030.

Noni is the Hawaiian name for the fruit of *Morinda citrifolia* L. (Rubiaceae). Its various vernacular names are: "Indian mulberry", "nuna", or "ach" on the Indian subcontinent, "mengkudu" in Malaysia, "nhau" in South-east Asia, "painkiller bush" in the Caribbean, or "cheese fruit" in Australia (Morton, 1992; Nelson, 2001; Ross, 2001; Wang et al., 2002).

It is an evergreen plant indigenous to Southeast Asia. This plant, which grows in tropical and subtropical regions, is identified by its large leaves, straight stem, and grenade-like yellow fruit (Sang *et al*., 2001). In traditional Polynesian medicine, Noni has been used to treat variety of diseases for more than 2000 years (Dixon *et al*., 1999; Mc Clatchey, 2002). In traditional pharmacopoeia, the fruit is claimed to prevent and cure several diseases. It is primarily used to stimulate the immune system and thus to fight bacterial, viral, parasitic and fungal infections; it is also used to prevent the formation and proliferation of tumors, including malignant ones (Dixon *et al*., 1999). Noni juice is also claimed to relieve inflammation. Most noni is consumed as juice, although leaves, flowers, bark and roots can also be used. In various *in vivo* and *in vitro* Noni and products derived from it have shown anticlastogenic, antimutagenic, anticarcinoma, and anti-inflammatory activities, and the abilities to scavenge free radicals, to inhibit oxidation of low-density lipoprotein, to regulate cholesterol, to stimulate the immune system, to regulate cell function, and to purify the blood (Furusawa *et al*., 2003; Hirazumi and Furusawa, 1999; Hornick *et al*., 2003).

Plant Description

The genus *Morinda* contains approximately 80 species, including citrifolia. It is 3-10m tall, with wide elliptical leaves, flowers are tubular and groped together on peduncle. The fruit is oval fleshy with embosed appearance. It is slightly wrinkly, semi translucent and ranges from green to yellow in color. It is covered with small reddish brown buds containing the seeds.The pulp is juicy and bitter, light dull yellow or whitish, gelatinous when the fruit is ripe, numerous hard triangular reddish brown pits are found, each containing four seeds(3.5mm)(Dittmar,1993).

Nutritional and Phytochemical Composition of Noni Fruit

Analyses of the nutritional composition of Noni have shown that the fruit contains 90% water and 10% dry matter. The dry matter consists of soluble solids (8–10 Brix), of which 5% are reducing sugars (glucose and fructose) and 1.3% is sucrose, with the remainder made up of dietary fiber and protein (Chunhieng, 2003). There is a high protein content in the dry matter, approximately 11.3%.

Noni fruit also have a high ascorbic acid (vitamin C) content; as much as 250 mg ascorbic acid per 100 g fresh matter (Thomson & Yang 2006). The fruit also contain provitamin A (Dixon *et al*., 1999), caprylic acids, and caproic acids, mainly malic acid (Pino *et al*., 2008). During maturation of Noni fruits, there are decreases in the amounts of volatile substances such as octanoic acid, decanoic acid, and 2E-nonenal, and increases in the concentrations of some esters (methyl octanoate, methyl hexanoate, methyl 4E-decenoate, and ethyl octanoate). Also, the total phenols content, antioxidant capacity, and ascorbic acid content of Noni fruit increase from the green to the white hard stage, but decrease from the white hard to the ripe/soft stage (Yang *et al*., 2011). Compared with ripe fruits, white hard Noni fruits showed 1.2–2.2 times higher antioxidant activity, 1.5 times higher total phenols content, and 7.0 times higher ascorbic acid content, while immature green fruits showed 1.1-1.5 times higher antioxidant activity, 1.3 times higher total phenols content, and 1.3 times higher ascorbic acid content (Yang *et al*., 2011).

Among all of the fruits analyzed to date, the Noni fruit contains one of the widest ranges of chemical substances by possessing at least 200 phytochemicals including phenolic compounds, carbohydrates, organic acids, alcohols, alkaloids, vitamins, precursors, lignans, proteins, anthraquinones, minerals, esters, carotenoids, plant sterols, fatty acids, and glycosides. Its unique heteropolysaccharides are mainly composed of glucuronic acid, rhamnose, arabinose, and galactose. The main water-soluble polysaccharides in Noni fruit are fucose, xylose, mannose, galactose, and fructose (Liu *et al.*, 2008), Approximately 100 volatile compounds have been identified in Noni fruit, including fatty acid esters, monoterpenes, and short chain fatty acids (Potterat and Hamburger, 2007).

Biological Activities of Noni

Noni has been consumed as a traditional medicine in Polynesia, South East Asia, and the Caribbean for many centuries. The fruit can be applied externally to treat sores, cuts, wounds, and stings from toxic fish. In traditional medicine, different parts of the Noni plant such as the fruit, leaves, and roots, are consumed to treat bowel irregularities, menstrual cramps, and urinary tract infections (Smith, 2010). Many studies have reported on the insulinotropic (Hamid *et al.*, 2008), wound healing (Negori and Solanki, 2011), antioxidant (Krishnaiah *et al.*, 2007; Chanda *et al.*, 2011), anti-diabetic and anti-osteoporosis properties of Noni. It has also been used in America and Bulgaria to treat colds and influenza (Solomon, 1999a).

Anti-microbial effect: The anti-microbial effect of noni may have been the first observed property: indeed, the fruit contains relatively large amounts of sugars that are not fermented when fruits are stored in closed containers at ambient temperature. It has been reported that noni inhibits the growth of certain bacteria, such as Staphylococcus aureus, Pseudomonas aeruginosa, Proteus morgaii, Bacillus subtilis, Escherichia coli, Helicobacter pylori, Salmonella and Shigella (Atkinson, 1956). It has also been found that ethanol and hexane extracts of noni have an antitubercular effect since they inhibit by 89–95% the growth of Mycobacterium tuberculosis (Saludes *et al.,* 2002). The anti-microbial effect is highly dependent on the stage of ripeness and on processing, being greater when the fruit is ripe, without drying.

Anti-cancer activity: The ethanol precipitable fraction (ppt) of noni juice, corresponding to a poly-saccharide-rich substance composed of glucuronic acid, galactose, arabinose, and rhamnose, has been found to have immunomodulatory and anti-tumor effects against Lewis lung carcinoma (LLC). On cell models, noni-ppt seems to stimulate the production of T-cells, thymocytes and macrophages that produce cytokines, which are important mediators of tumor cytostasis and cytotoxicity. Noni-ppt also appears to stimulate the release of several mediators from murine effector cells such as cytokines, which slow down the cell cycle in tumors, increase the response of cells to other immunized cells that fight tumor growth, and have a potent macrophage activator activity, suspected of playing a role in the death of tumors (Hirazumi *et al.*, 1996; Hirazumi and Furusawa, 1999).

Anti-oxidant properties: The anti-oxidant properties of ethanol and ethyl acetate extracts of noni fruit have been assessed using the ferric thiocyanate method (FTC) and thiobarbituric acid test (TBA). The authors found that ethyl acetate extract exhibited strong inhibition of lipid oxidation comparable to the same weight of pure a-tocopherol and butylated hydroxy toluene (BHT) (Mohd *et al.*, 2001). Radical scavenging activity was also measured in vitro by the tetrazolium nitroblue (TNB) assay on a commercial juice, by assessing the potential capacity of the juice to protect cells or lipids from oxidative alteration promoted by superoxide anion radicals (SAR). The SAR scavenging activity of noni juice was shown to be 2.8 times higher than that of vitamin C, 1.4 times that of pycnogenol (PYC) and almost of the same order as that of grape seed powder. (Wang and Su, 2001).

Anti-inflammatory activity: Commercial noni juice has a selective inhibition effect on some cyclo-oxygenase enzymes (COX-1 and COX-2) involved in breast, colon and lung cancer, and also in anti-inflammatory activity. The inhibition of the activity of these enzymes by noni juice was compared with that of commercial traditional non-steroidal inflammatory drugs such as aspirin, Indomethacins and Celebrexs. Noni juice showed selective inhibition of COX enzyme activity in vitro and a strong anti-inflammatory effect comparable to that of Celebrexs and presumably without side effects.

Analgesic activity: Recent research examined the analgesic properties of a commercial juice in rats. The results showed that rats fed with 10% and 20% noni juice had greater pain tolerance (162% and 212%, respectively) compared with the placebo group (Wang *et al.*, 2002). A French research team has also studied the analgesic and sedative effects of noni on mice through the writhing and hotplate tests. Noni root extract (1600 mg/kg) showed significant analgesic activity in the animals, similar to the effect of morphine (75% and 81% protection using noni extract and morphine, respectively), and it also proved to be non-toxic.

Cardiovascular activity: Recent research has demonstrated the effects of noni fruit on preventing arteriosclerosis, a disease related to the oxidation of low-density lipoproteins (LDL). Methanol and ethyl acetate extracts showed with the thiobarbituric acid reactive substance method 88 and 96% inhibition, respectively, of copper-induced LDL oxidation. This beneficial effect could be due to the presence of lignans, phenylpropanoid dimers (Kamiya *et al.,* 2004).

Noni Juice

Noni juice, obtained from the Pacific Basin *Morinda citrifolia* tree's fruit, is promoted in the popular press as a complementary treatment for a variety of medical conditions, including cancer (Solomon, 2003). Noni juice can be created through either homemade or commercial methods. The homemade method provides 100% noni juice and was speculated to have been introduced by Chinese immigrants to Hawaii. Based on personal observations, fully ripened fruits are placed into a glass or earthen jar, and then it is tightly sealed so the contents naturally decompose over 3 weeks (approximately 1 month, but possibly up to 3 months), where it is kept at room temperature or in the refrigerator until it is decanted or strained through a filter cheesecloth. Commercially, noni juice is manufactured in large vats and then sold as juice (pasteurization usually required). The concentration can also be 100%, but varies as some manufacturers incorporate other juices which simultaneously reduces the cost and/or covers unpalatable flavors (Nelson and Elevitch, 2006). Noni juice can also be used to create freeze-dried pills, concentrated extracts, powders, tinctures, and even fruit leather similar to dried fruit strips.

References

1. Atkinson N., (1956). Antibacterial substances from flowering plants. 3. Antibacterial activity of dried Australian plants by rapid direct plate test. Australian *Journal of Experimental Biology* 34, 17–26.
2. Chanda S., Dave, R., and Kaneria M., (2011). In vitro antioxidant property of some Indian medicinal plants. *Research Journal of Medicinal Plants*, 5(2), 169-179.
3. Dittmar A., (1993). *Morinda citrifolia* L. use in indigenous Samoan medicine. *Journal of Herbs, Spices and Medicinal Plants*, 1(3), 77-92.
4. Dixon A. R., Mcmillen H., and Etkin N. L., (1999). Ferment this: The transformation of Noni, a traditional Polynesian medicine (*Morinda citrifolia*, Rubiaceae). *Economic Botany*, 53(1), 51-68.
5. Furusawa E., Hirazumi A., Story S., and Jenson J., (2003). Antitumor potential of a polysaccharide-rich substance from the fruit juice of *Morinda citrifolia* (Noni) on sarcoma 180 ascites tumour in mice. *Phytotherapy Research*, 17, 1158-1164.
6. Hamid M., Bohari S. P. M., Bastami M. S., Ali A. M., Mustapha N. M., & Shari K., (2008). Evaluation of the insulinotropic activity of Malaysian traditional plants extract. *Journal of Biological Science*, 8, 201-204.
7. Hirazumi A., and Furusawa E., (1999). An immunomodulatory polysaccharide-rich substance from the fruit juice of *Morinda citrifolia* (Noni) with antitumour activity. *Phytotherapy Research*, 13(5), 380-387.
8. Hirazumi A., Furusawa E., Chou S.C., Hokama Y., (1996). Immuno-modulation contributes to the anticancer activity of *Morinda citrifolia* (Noni) fruit juice. *Proceedings of the Western Pharmacological Society* 39, 7–9.
9. Hornick C. A., Myers A., Sadowska-Krowicka H., Anthony C. T., and Woltering E. A., (2003). Inhibition of angiogenic initiation and disruption of newly established human vascular networks by juice from *Morinda citrifolia* (Noni). *Angiogenesis*, 6(2), 143-149.
10. Kamiya K., Tanaka Y., Endang H., Umar M., and Satake T., (2004). Chemical constituents of Morinda citrifolia fruits inhibit copper-induced low-density lipoprotein oxidation. *Journal of Agricultural and Food Chemistry*, 52(19), 5843-5848.
11. Krishnaiah D., Sarbatly R., and Nah N. L., (2007). Recovery of phytochemical components from various parts of *Morinda citrifolia* extracts by using membrane separator. *Journal of Applied Science*, 7(15), 2093-2098.
12. Liu H. Q., Zhang N., XU J. F., and XU G. Y., (2008). Determination of polysaccharide in fruits of *Morinda citrifolia* and analysis of its component. *Science and Technology of Cereals, Oils and Foods*, 5, 026.
13. Mc Clatchey W., (2002). From Polynesian healers to health food stores: Changing perspectives of *Morinda citrifolia* (Rubiaceae). *Integrative Cancer Therapies*, 1(2), 110-120.
14. Mohd Z., Abdul-Hamid A., Osman A., (2001). Antioxidative activity extracts from Mengkudu (*Morinda citrifolia* L.) root, fruit and leaf. *Food Chemistry* 78, 227–231.
15. Morton, J. F., (1992). The ocean-going Noni, or Indian Mulberry (*Morinda citrifolia*, Rubiaceae) and some of its "colorful" relatives. *Economic Botany*, 46(3), 241-256
16. Negori B. P., & Solanki R., (2011). Role of medicinal plants in wound healing. *Research Journal of Medicinal Plants*, 5(4), 392-405.
17. Nelson, S. C., (2001). Noni cultivation in Hawaii. Fruit and Nuts, 4, 1-4.
18. Pino J., Márquez, E., and Castro D., (2008). Volatile and nonvolatile acids of Noni (*Morinda citrifolia* L.) fruit. *Journal of the Science of Food and Agriculture*, 89 (7), 1247-1249.
19. Potterat O., & Hamburger M., (2007). *Morinda citrifolia* (Noni) fruit: Phytochemistry, pharmacology, safety. *Planta Medica*, 73(3), 91-199.
20. Ross I. A., (2001). Medical plants of the world. chemical constituents, traditional and modern medical uses. *Humana Press, New Jersey.*

21. Saludes J.P., Garson M.J., Franzblau S.G., Aguinaldo A.M., (2002). Antitubercular constituents from the hexane fraction of *Morinda citrifolia* L. (Rubiaceae). *Phytotherapic Research* 16, 683–685.
22. Sang S., Cheng X., Stark R. E., Badmaev V., Ghai G., Rosen R. T., and Ho C T., (2001). Flavonol glycosides and novel iridoid glycoside from the leaves of *Morinda citrifolia.journal of agriculture and food chemistry*, 49(9), 4478-4481.
23. Smith MBChB M. G. P., (2010). JPHC achieves MEDLINE status. *Journal of primary health care*, 2(3), 178-179.
24. Solomon N., (1999a). The tropical fruit with 101 medicinal uses, Noni juice. 2nd edition. Woodland Publishing. pp. 35.
25. Wang M. Y., West B., Jensen C. J., Nowicki D., Su, C., Palu A. K., and Anderson G., (2002). *Morinda citrifolia* (Noni): a literature review and recent advances in Noni research. *Acta Pharmacologica Sinica*, 23, 1127-1141
26. Wang M.Y. and Su C., (2001). Cancer preventive effect of *Morinda citrifolia* (Noni). *Annals of the New York Academy of Sciences* 952, 161–168.
27. Wang M.Y., West B., Jensen C.J., Nowicki D., Su C., Palu A.K., Anderson G., 2002. *Morinda citrifolia* (Noni): a literature review and recent advances in Noni research. Acta. *Pharmacologica Sinica*. 23, 1127–1141.
28. Yang J. I. A. N., Gadi R. A. M. A., and Thomson T. A. L. E. N. E., (2011). Antioxidant capacity, total phenols, and ascorbic acid content of Noni (*Morinda citrifolia*) fruits and leaves at various stages of maturity. *Micronesica*, 41(2), 167-176.

Artificial Intelligence in Agriculture

Article ID: 40926

Anjali Tomar[1], Rahul Dhankar[2]
[1]Ph.D. Scholar, Department of Agriculture Extension and Communication, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh.
[2]Assistant Professor, Shri Vishwakarma Skill University, Palwal, Haryana.

Introduction

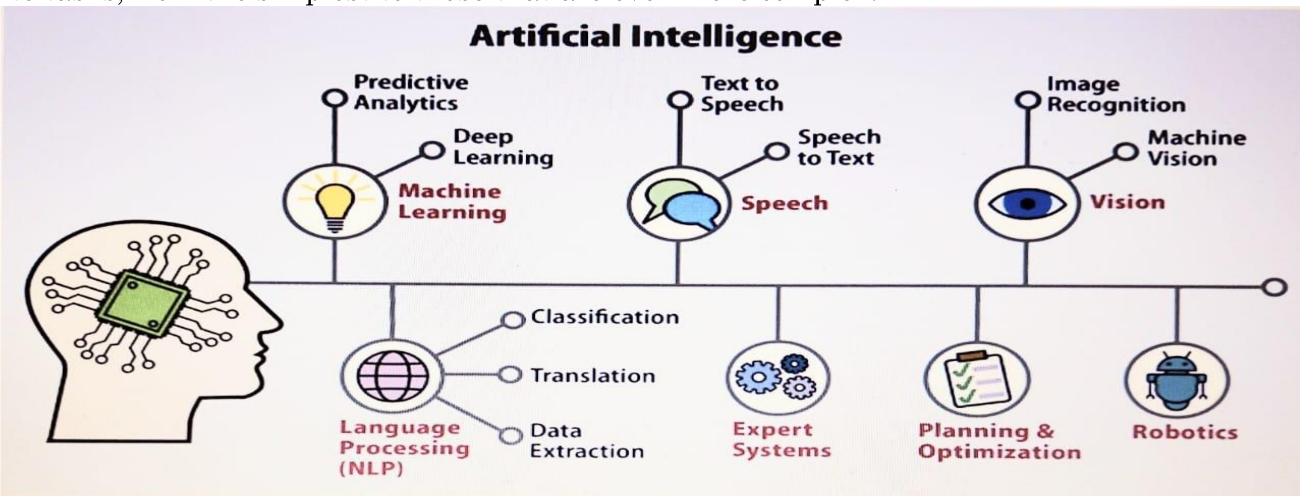
The global population is expected to reach 10 billion by 2050, which means increase in demand of agriculture produce in order to meet the needs of future generation, which is estimated about 70% increase in food production.

Farmers or farm enterprises require new and innovative technologies to meet and overcome these challenges and Artificial Intelligence can be the solution.

Intelligence: It can be defined as the capacity to learn and solve problems.

Artificial Intelligence (AI): It referred to the simulation of human intelligence by machines.

The term "Artificial intelligence" was introduced by John McCarthy (1955). Artificial intelligence is based on the principle that human intelligence can be defined in a way that a machine can easily mimic it and execute tasks, from the simplest to those that are even more complex.



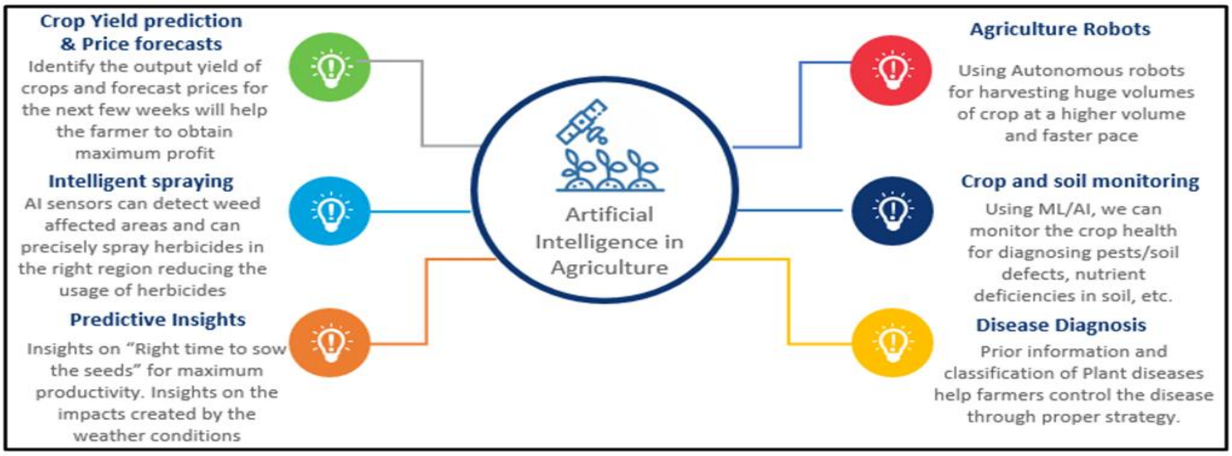
Artificial Intelligence attempts to develop tangible or intangible systems which not only behave intelligently but also displays behaviour to the same level as human beings think and act, achieving human like performance in all cognitive tasks using purely local reasoning. AI is intelligence demonstrated by machines in contrast to natural intelligence displayed by human and other animals. AI is automation of activities one can associate with human thinking like speech recognition, natural language understanding and translation, knowledge management, image analysis, decision making, learning etc.

The central principle of Artificial Intelligence include:

a. Reasoning, Knowledge, Planning, Learning and Communication.
b. Perception and the ability to move and manipulate objects.
c. It is the science and engineering of making machines, especially intelligent computer programs.

Applications of Artificial Intelligence in Agriculture

Despite being the oldest profession, the importance of agriculture has been increased in the light of growing danger of food security. Artificial intelligence powered technology is ensuring the long term viability of high quality food production.



Weather Forecasting by AI

With the issue of climate change and increasing pollution it is difficult for farmers to determine the right time for sowing seeds, but with the help of artificial intelligence farmers can be able to analyze weather conditions by using AI enabled weather forecasting techniques which help them to plan the type of crop to be grown and when should seeds be sown.

Monitoring Crop Health by Drones

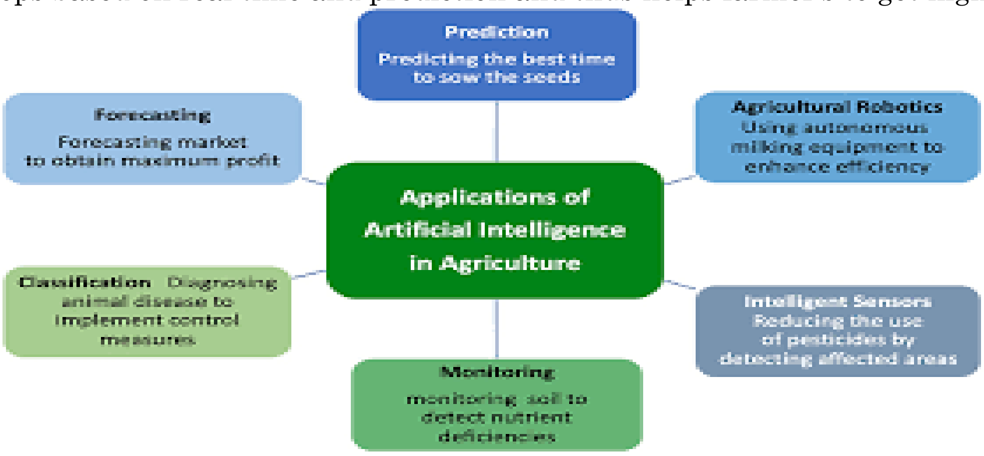
AI has brought drone-based Ariel imaging solution for monitoring crop health. In this technique the drone captures data from fields and then the data is transferred from drones to computers and analyzed by experts then the experts provide report about the current health of the crop/farm. It helps farmers to timely take precautions for pests and disease attacks.

Precision Farming

AI apps and tools assists farmers in performing correct and regulated farming by offering suitable advice. AI is seen transforming rural farm lands into smart connected farms through a combination of smart tools.

Some Other Application of AI

1. AI solutions helps farmers in knowing the right time of sowing for obtaining maximum productivity and will help them to reduce the hazardous impacts of weather and will contribute in increasing their income.
2. Artificial intelligence helps estimating the crop yields and forecasts price which help farmer's to get higher returns.
3. Sensors in AI helps in detecting the weed affected areas in fields for spraying herbicides and preventing the over exploitation and under usage of herbicides.
4. Artificial intelligence helps in monitoring crop and soil health, diagnosis of pests and nutrient deficiencies in crops based on real time and prediction and thus helps farmer's to get higher production.



Conclusion

The goal of Artificial Intelligence in agriculture is to create systems that are more efficient and effective in performing tasks at all levels from sowing to harvesting to storage to processing. This can done not just through the use of AI alone, but through the addition of human input as well. Furthermore, it benefits society as a whole by reducing the amount of manual labour required for doing various tasks of agriculture.

Circular Economy: Is India Prepared to Complete its Path of Sustainability?

Article ID: 40927

Divyanshu[1], Chandresh Guleria[2]
Ph.D Research Scholar[1] and Assistant Professor[2]
Department of Social Sciences, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.)-173230.

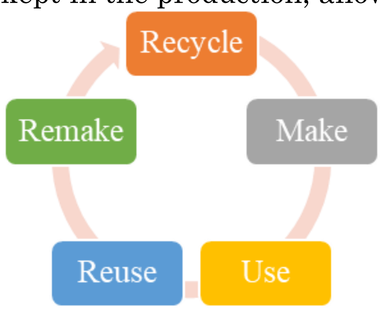
Introduction

The UN Climate Change Conference of the Parties (COP) takes place each year, bringing together global leaders to drive climate action. The recent COP, COP27, took place in Egypt from 6th to 18th November, 2022. The foundation participated in a number of events, taking this opportunity to demonstrate that the transition to a circular economy is an absolutely vital part of what is needed to tackle climate change and other global challenges including biodiversity loss, waste and pollution.

What is Linear and Circular Economy?

Linear economy: We take resources from the earth – we make materials/finished goods from them– and eventually throw them as waste in the environment.

Circular economy: We have taken something from environment – Made – Use – Recycle. By contrast, we stop waste being produced in the first place. A circular economy ecosystem refers to a closed-loop production model where resources are reused and kept in the production, allowing for more value generation.



The circular economy is based on three principles:
1. Eliminating waste and pollution, in turn reducing and avoiding emissions across the value chain.
2. Circulating products and materials, in turn enabling embodied emissions to be retained.
3. Regenerating nature, thereby also improving carbon sequestration.

Need of Circular Economy

We need to tackle the 55 per cent of emissions that arise from our energy system and secure the energy transition. We also need to address the 45 per cent of emissions that come from how we currently produce and consume. Carbon dioxide in the atmosphere warms the planet, causing climate change. Human activities have raised the atmosphere's CO_2 content by 50 per cent in less than 200 years. A circular economy transition from linear economy is a vital component of reducing these emissions as part of wider climate action.

How much Waste is Created in the World?

The world generates 2.01 billion tonnes of municipal solid waste annually. With at least 33 per cent of that not managed in an environmentally safe manner. Worldwide, waste generated per person per day averages 0.74 kg but ranges widely, from 0.11 to 4.54 kgs.

Table 1: Projected waste generation, by region (millions of tonnes/years):

Regions	Up to 2030	Up to 2050
Middle East and North Africa	177	255
Sub-Saharan Africa	269	516
Latin America and Caribbean	290	369
North America	342	396
South Asia	466	661
Europe and Central Asia	440	490
East Asia and Pacific	602	714

(Source: World Bank)

Up to 2050, South Asia's waste generation will be over 661 million tonnes per year. South Asia's most populous country is India. The majority of volumes will be generated in South Asia. Is it a matter of happiness today that maximal development will occur in South Asia, and only then will it be generated for? Isn't it unfortunate that we won't learn to recycle waste until 2050? As a result, we must comprehend how it should be recycled.

Global Waste Composition (Percent)

Food and green waste account for 44 per cent of total waste, glass waste (5%), metal waste (4%), paper and cardboard waste (17%), plastic waste (12%), rubber and leather (2%), wood (2%) and other waste (World Bank, 2018). Food and green waste accounts major share of the total waste. If properly disposed of, food waste is disposable. It can generate energy if we do it in a segmented manner. Various gases can be produced from municipal food waste like Gobar gas etc. So, seeing all these figures, it is understood that the waste is the biggest problem in the world and it has already started. Because we haven't learned not to recycle or recycle it yet.

Steps has India taken in Order to Achieve the Goal of Circular Economy

The 2022-23 Budget recognized the importance of sustainable growth. In sync with a circular economy, the government formulated:

1. Battery waste management rules, 2022
2. Plastic waste management rules as amended in 2022
3. e-waste management rules, 2022

These rules promote utilization of waste generated in line with the circular model by setting out target waste disposal standards for stakeholders such as manufacturers, producers, importers and bulk consumers. This move will pave the way for a more formalized transition to the circular economy regime in India. Further, the budget also recognizes the action plans formulated across 10 sectors including electronic waste, lithium-ion batteries, end-of-life vehicles, scrap metal, municipal solid waste, etc.

Circular Economy and Economic Growth (Waste Generated Market)

According to venture capital fund Kalaari Capital, if the global circular economy touches $ 4.5 trillion by 2030, then we're looking at a $ 45 billion opportunity provided India captures just 1 per cent of this market. However, according to estimates, it could only attract $ 1.8 billion between 2016 and 2021, clearly indicating investment deficits. We have a long way to go because we are unable to fully capitalize it.

According to the report "Circular economy in India: Rethinking growth for long-term prosperity, by Ellen MacArthur Foundation- It is estimated that if India embraces this path, it could bring in annual benefits of $ 624 billion by 2050, along with Greenhouse Gas (GHG) emissions reduction of 44 per cent.

Successful example of India: Surat is a frontrunning circular city that is generating about $ 17.9 million in revenues from reusing its waste water. Its municipal corporation now aims to be a net zero liquid discharge city.

The report emphasized sectors such as fashion, agriculture and construction that are ripe for such innovation. For instance, the food value chain in India is prone to high wastage. Food wastage and asset under-utilization are some of the areas circular economy startups can tap in to, thus creating annual benefits of $ 61 billion by 2050. Over the past five years companies in the circular economy ecosystem have attracted investments totaling only $ 1.8 billion across various sectors in India.

However, Progress Towards Circular Economy is Underwhelming in India Due to Following Challenges

1. Lack of a clear vision: There is lack of vision towards the end-goal of India's circular economy mission and gaps in actual implementation of the policies.

2. Sub-optimal outcomes: Another glaring concern here is that efforts are made at the very end of value chains, resulting in sub-optimal economic and environmental outcomes.

Reluctance of industries: Industry is also reluctant in adopting the circular economy due to: Supply chain limitations, Lack of incentives to invest, Complex recycling process and lack of information to support participation in reusing/recycling/re-manufacturing processes.

Conclusion

A circular economy transition from linear economy is a vital component of reducing emissions as part of wider climate action. Globally, food and green waste account for 44 per cent of total waste. So, it is understood that the waste is the biggest problem in the world and it has already started. Because we haven't learned not to recycle or recycle it yet. In Union Budget 2022-23, government had taken various steps and formulate various rules and these rules will pave the way for a more formalized transition to the circular economy regime in India. Over the past five years companies in the circular economy ecosystem have attracted investments across various sectors in India. However, progress towards a circular economy in India has been slow due to plenty of issues that should be tackled. The limitations may be overcome through Developing a unified legislation addressing the circular economy from a regulatory perspective, legislative mandates for the procurement of recycled/secondary raw materials in the initial stages of production cycles, a streamlined framework on circular for providing fiscal incentives to businesses to complete the supply chain will also help and the government's initiatives need to be in conjunction with implementable actions with industry collaboration to reap the benefits of the circular economy.

References

1. World Bank., (2018). Trends in Solid Waste Management. https://datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html.
2. Ministry of Finance., (2022). Union Budget Financial Year 2022-23. https://www.india.gov.in/spotlight/union-budget-fy-2022-2023.
3. Kalaari Capital., (2022). Circular Economy Report. 34pp.
4. Ellen Macarthur Foundation., (2016). Circular economy in India: Rethinking growth for long-term prosperity. 86p.

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

Could Insects be the Future Food of Our Planet?

Article ID: 40928

Viveka M [1]

[1]Assistant Professor, Department of Food Science and Nutrition, Adhiyamaan College of Agriculture and Research, Krishnagiri – 635105, Tamil Nadu.

Introduction

The practice of eating insects is known as **entomophagy.** The consumption of insects has been part of human history for millennia. It is estimated that insect-eating is practised regularly worldwide by atleast 2 billion people. More than 1900 insect species have been found to be edible insects in literature.

Commonly consumed insects include *Coleoptera* (beetles) (31%), *Hymenoptera* (ants, bees and wasps) (14%), *Lepidoptera* (caterpillars) (18%), *Orthoptera* (grasshoppers, locusts and crickets) (13%), *Isoptera* (termites) (3%), *Hemiptera* (cicadas, leafhoppers, planthoppers, scale insects and true bugs) (10%), *Odonata* (dragonflies) (3%) and *Diptera* (flies) (2%). Insect eating has recently captured public attention worldwide. Edible insects have the potential to become a major global future food due to the presence of high-quality protein, vitamins and minerals and also offers economic and environmental benefits. Further, they could become part of a strategy for achieving food security worldwide. The present article discusses the scope of edible insects as future food and challenges of entomophagy in terms of nutritional value, food security, environmental sustainability, food safety and consumer acceptance.

Common Edible Insects

		
Caterpillars	**Beetles**	**Crickets**
		
Termites	**Ants**	**Bees**

Nutritive Value of Edible Insects

Insects are a highly nutritious source of food that provide a good source of protein, easily digestible by humans. The average protein content in dry insect matter ranges between 35% (termites) and 61% (crickets, grasshoppers, locusts) and is as high as 77% in some of the latter species. Most edible insects meet the recommended levels of amino acids such as phenylalanine, tyrosine, tryptophan, threonine and lysine.

Insects contain particularly high amount of unsaturated fatty acids, with levels as high as 75% of total fatty acid content. The composition of omega-3 polyunsaturated and other fatty acids in mealworm is comparable to that found in fish and higher than that in pig and cattle. Limited information is available concerning the vitamin content of edible insects. Several species have been shown to contain relatively high levels of B complex vitamins (riboflavin, pantothenic acid and biotin), while vitamin C concentrations are low.

Large variations in mineral content have been found between different edible insect species. While insects are low in calcium, sodium and potassium, high levels of magnesium have been shown in crickets and locusts. Also, crickets and termites contain high concentrations of iron and zinc.

Food Security

Food security exists when food is available, affordable, evenly distributed and safe to consume. Although food security has increased globally, food scarcity and undernutrition resulting from adverse climatic conditions is still common in many countries. The **United Nation's Food and Agriculture Organization (FAO)** has predicted that the world population would rise to over 9 billion by 2050. On the other hand, there is a rapid decline in available land resources that are needed to produce additional food for the increasing population. Edible insects have been suggested to be capable of providing a valuable source of food to combat malnutrition and food insecurity since they are rich in nutrients such as protein, vitamins and minerals. Therefore, edible insect production sectors could therefore offer a policy solution to the problem of food insecurity.

Economic Benefits and Environment Sustainability

Edible insects are capable of providing economic and environmental benefits, as they seem to be a more sustainable source of quality protein when compared to animals. The use and marketing of edible insects as a sustainable food source requires insect farming on a considerably large scale to at least partially replace protein sources and conventional foods as part of human diet. At the same time, it is necessary to preserve wild populations and the environment. It is currently unknown whether the impact of energy needs, feed, processing and transportation associated with the scaling up of edible insect production is more sustainable than conventional food sources. It should not give way to equally harmful production methods employed for insect-based foods. Therefore, more research is required to assess the environmental impact and sustainable large-scale farming of edible insects in order to enable comparison with conventional livestock farming practices.

Consumer Acceptance of Edible Insects

Though edible insects are capable of providing a plethora of health benefits, consumer acceptance of insect foods still tends to be low in Western countries. Entomophagy is often viewed with feelings of disgust and consumers are more reluctant to accept insects as a nutrient source. The aversion to entomophagy can be attributed to various reasons such as prejudice, unfamiliar taste, sensory experience, gender, uncertainty about the origin of the food and diversity in cultural practices in different regions of the world.

In India, a complete of 245 species, 50 families and orders of edible insects have been documented as edible food so far and it is mostly practised in eight North Eastern states of India. The North-eastern region has different eating practices from the rest of India due to its distinct socio-cultural environment. In Assam, a red tree ant (Oecophylla smaragdina) is an important delicacy during the festival **"Bohag Bihu"**, celebrated in the month of April. The formic acid of these insects is believed to keep the body free from infection and diseases. In other states such as Tamil Nadu, Kerala, Karnataka, Madhya Pradesh, Odisha and Indian - Andaman Islands use termites, ants, locusts and bees as foods. In India, efforts are being made to create awareness and popularise entomophagy.

Conclusion

Entomophagy is generally practiced and is also a part of many cultures since time immemorial. The inclusion of edible insects seems to be an alternative and sustainable means of benefitting both the environment and human health. The nutrient profile of edible insects has the potential to improve immune function, GI health, decreases the risk of bacterial infection and chronic inflammation possibly associated with cardiovascular diseases and cancer. However, several challenges need to be addressed before employing the potential of edible insects in combating food insecurity and for inclusion of edible insects in human diet. Various avenues pertaining to entomophagy still need to be investigated in more detail in order to provide the basis for their promotion as a healthy food source.

References

1. Lange, K. W., & Nakamura, Y. (2021). Edible insects as future food: chances and challenges. *Journal of future foods,* 1(1), 38-46.
2. Nowakowski, A. C., Miller, A. C., Miller, M. E., Xiao, H., & Wu, X. (2022). Potential health benefits of edible insects. *Critical Reviews in Food Science and Nutrition*, 62(13), 3499-3508.
3. Pal, P., & Roy, S. (2014). Edible insects: future of human food–a review. *International Letters of Natural Sciences,* 21.

E-ISSN: 2581 - 8317

Farming for Nature -One Step Towards Sustainability

Article ID: 40929

Somrup De[1], Sutanwa Saha[2], Meraj Ahmed[3]

[1]Research Scholar, [2]Assistant Professor, [3]Assistant Professor, Department of Soil Science and Agricultural chemistry, School of Agriculture, Lovely Professional University, Jalandhar, Punjab-144411.

Abstract

Humans are burning the most precious resource of the earth and that is the soil. Chemical farming has become the killer of a sustainable system. We need to adopt organic farming to conserve the soil, water, and ecosystem and to provide ourselves a safe, healthy, tasty food. The conversion process is not easy, so farmers need to be patient. As the world is trying to adopt the system, we discuss the future of organic farming in India, its scope, and government intervention for its improvement. We also talk about the major states holding the organic farming area in India as well.

Introduction

We need a sustainable system of agriculture to meet the ever-increasing demand for food for humankind, and here comes an organic farming system that enhances the rural lifestyle without damaging the natural resource and the ecosystem. There are some serious drawbacks to our conventional agriculture system. Such as loss of productivity of soil, degradation of the nutrient content of the soil, growth rate, factor productivity, decreasing net cultivable area farm income, depletion of groundwater table, long term side effects of chemical pesticides and fertilizers (Ravisankar *et.al.*, 2019).

Organic farming is an alternative farming system that tries to mimic ecological processes while minimizing external inputs are often suggested as a more sustainable form of food production (Rigby *et al,* 2001).

Problems of Conventional Farming

Chemical-based farming is creating genetic mutation in insect pests and developed resistance to these chemicals. According to Pimentel (1995), Only 0.1% of pesticide is actually used for killing harmful insect pests and the rest is gone to the non-target organisms which harm them.

Farmers in India decreased the usage of pesticides in India from 2012 -2013 by around 15% more than the previous year. This is however properly due to the introduction of IPM and INM in Indian agriculture, and the introduction of biocontrol methods by the Indian Government. In general, more pesticide is applied in Cotton (37%) and in fruits (Grapes, 2%) and vegetables (13%) (Ravisankar *et. al.* 2019).

Benefits of Organic Farming

1. Better taste and nutritional value because food becomes naturally grown.
2. No pesticide insecticide and chemical fertilizer residue will be there in the soil and the food.
3. Prevent soil and water pollution.
4. Maintain soil fertility for a sustainable farming environment.
5. Doesn't harm the ecosystem.
6. It helps to prevent soil erosion (Dileep Kondepati, 2019).

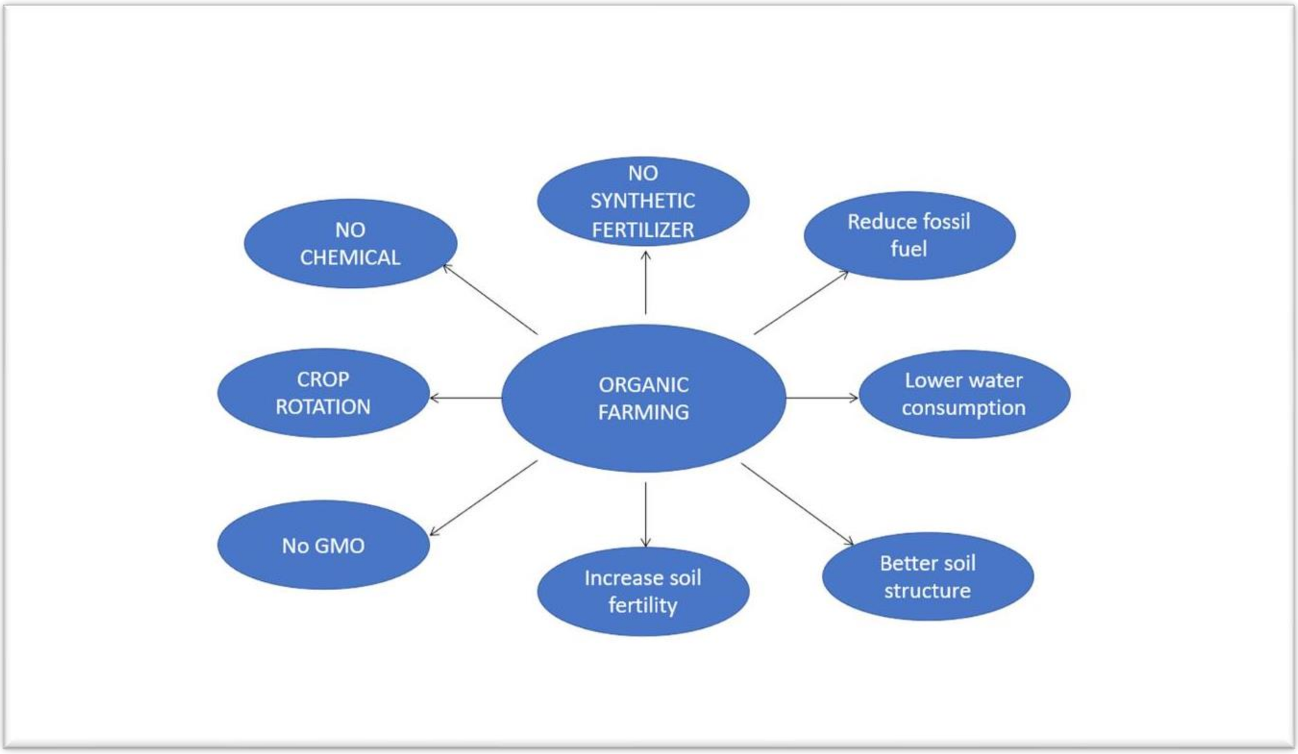


Figure: Different features of organic farming

The Transition Process of Synthetic to Organic Farming

First of all, farmers will have to conquer a dramatic negative change in the yield since the soil has to be given some time to restore it's nutrients and biological activity. The yield even can drop up to 65% in the next year. Although this period will last only up to about 2 years and then it'll start to produce a much higher, consistent yield with minimum external inputs (Gill and Prasad, 2009).

Table 1 Major state-wise area under organic farming in India:

State	Area (Ha)
Chhattisgarh	3008606
Gujrat	602248
Himachal Pradesh	203043
Madhya Pradesh	2370593
Maharashtra	1133668
Odisha	184034
Uttarakhand	113747
Uttar Pradesh	115590

(Source: https://apeda.gov.in/apedawebsite/organic/data.htm)

Future of Organic Farming in India

Many ICAR institutes and SAUs are working on the major limitations of organic farming in India. India is prevalently stronger in producing various plantation crops like Tea, coffee, spices, and medicinal ayurvedic plants. So, there's a big market for producing those organically and exporting them to other countries. Some regions of India like the Chotanagpur region and the North East) don't do very intensive farming. So, they'll be relatively easier to convert to organic farming (Raghuveer Singh *et. al.,* 2019).

The government is helping the farmers with various schemes like NPOF (National Project on organic farming), and NMSA (National Mission for sustainable agriculture) (Dileep Kondepati,2019).

The Indian consumer is getting conscious about consuming organic food day by day. So, the market demand for this is increasing. It'll create a lot more employment opportunities also (Raghuveer Singh *et. al*, 2019).

Conclusion

Organic farming provides a much higher net profit (21.5% higher) to the farmers although there is lower productivity of 14.6%. But large-scale conversion to organic right now will create a food shortage countrywide. There is a big gap between the currently available potential and the utilization of organic wastes properly. Organic farming is a renewable source of nutrient supply. Likewise, we are adopting renewable energy sources we should adopt organic farming as our primary method of producing food as well (Raghuveer Singh *et.al.*, 2019).

References

1. Elayaraja, Mr M., and C. Vijai. "Organic farming in India: Benefits and Challenges." European Journal of Molecular & Clinical Medicine 7.11 (2021): 3021-3029.
2. Meena, Rupesh Kumar, et al. "Organic farming-concept, principles, goals & as a sustainable agriculture: A review." International Journal of Chemical Studies 8.4 (2020): 24-32.
3. Singh, Raghuveer, et al. "Present Status and Future Prospects of Organic Farming in India." Sustainable Agriculture (2019): 275-299.
4. Ravisankar, N., et al. "Organic farming research in India: Potential technologies and way forward." (2021).
5. https://apeda.gov.in/apedawebsite/organic/data.html.

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

A Study of the Production and Capital Formation Scenario of Fisheries Sector in India

Article ID: 40930

Nandini Saha[1*], Prakash Athare[2], Geetha M. L[3]., Omprakash Naik N[4], Pramod Kumar[5], D. R. Singh[6]

[1,2,3&4]Research Scholar, Division of Agricultural Economics. ICAR – Indian Agricultural Research Institute, New Delhi.

[5&6]Principal Scientist, Division of Agricultural Economics. ICAR – Indian Agricultural Research Institute, New Delhi.

Fisheries refer to the activity of catching, processing, and selling fish and other aquatic animals. It is an essential sector that plays a crucial role in providing food, employment, and livelihoods to to around 820 million people around the world, from harvesting, processing, marketing and distribution. (FAO, 2020). Fisheries involve a wide range of activities, including wild capture fisheries, aquaculture or fish farming, and processing and marketing of fish and seafood products. India has a vast coastline of about 7,500 kilometres, which is home to a diverse range of marine and freshwater fish species. The country's fish production has grown significantly over the years, making it one of the top fish-producing nations in the world. The fisheries sector contributed 1.21% share in the total Gross Value Added (at current prices) in the economy during 2019-20 (National Account Statistics, 2021). India also ranks 4th in global exports of fish products with 43626.9 crore rupees worth of export (2019-20). India's overall Per Capita Fish consumption is 5.4 kg which is 6.6% of total animal source food consumption and per capita availability is 9 kg (NFDB, 2019). Inland fisheries and aquaculture constitute the main components of the fisheries sector in India from production point of view. Marine fisheries are also very important to nutritional security, income and employment generation and particularly for foreign exchange earnings of the country.

Blue Revolution

Blue Revolution also called as "Neel or Nili Kranti" in India was launched in 1985-1990 during the 7th Five-Year Plan. Again, The Government of India in December 2014 had launched 'Blue Revolution Mission" with a central outlay of Rs. 3000 crores to fully tap the total fish potential of the country both in the inland and the marine sector and triple the production by 2020. Apart from that, another major scheme **Pradhan Mantri Matsya Sampada Yojana** was officially launched on 10th September 2020 by the honorable Prime Minister of India with the main ai of increasing fish production, fish export and Doubling of incomes of fishers and fish farmers.

Production Scenario

The fish production in India has drastically changed over a span of last three decade. Production of fisheries increased from 4.15 million tonnes during 1991-92 to 14.16 million tonnes during 2019-20 with a Compound Annual Growth Rate of 4.48 per cent. From the calculation of Compound Annual Growth Rate (CAGR) which is given in Table 1, it was found that the highest growth was observed in case of inland fish production.

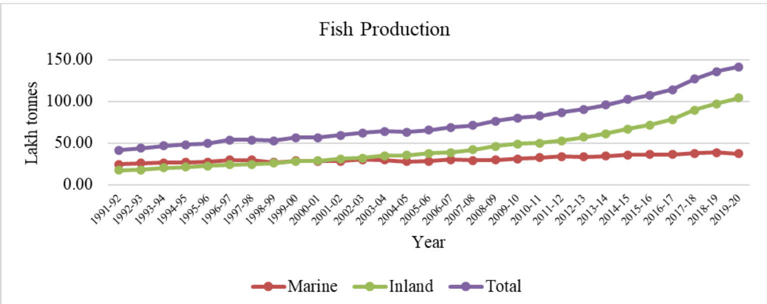


Figure 1: Total Fish Production in India (1991-92 to 2019-20)

Table 1: CAGR of Total, Marine and Inland Fish Production in India (1991-92 to 2019-20):

Particulars	CAGR
Total	4.48
Marine	1.51
Inland	6.67

Figure 2, 3 & 4 shows the states which produces the highest quantity of total fish, Inland, and marine fish production respectively. Top 3 producer of fish in India is Andhra Pradesh, West Bengal and Gujarat which together produces more than 6 million tonnes of fish.

Andhra Pradesh is the highest producer of Inland Fisheries, followed by West Bengal and UP. Gujarat is the highest producer of marine fisheries while Tamil Nadu and Andhra Pradesh occupy the 2nd and 3rd highest rank.

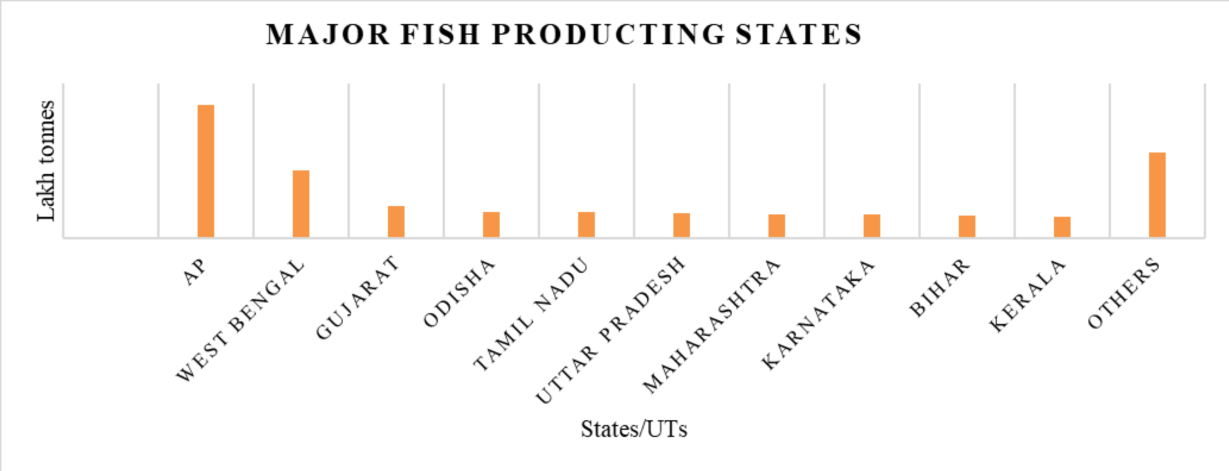


Figure 2: Major Fish Producing States (2019-20)

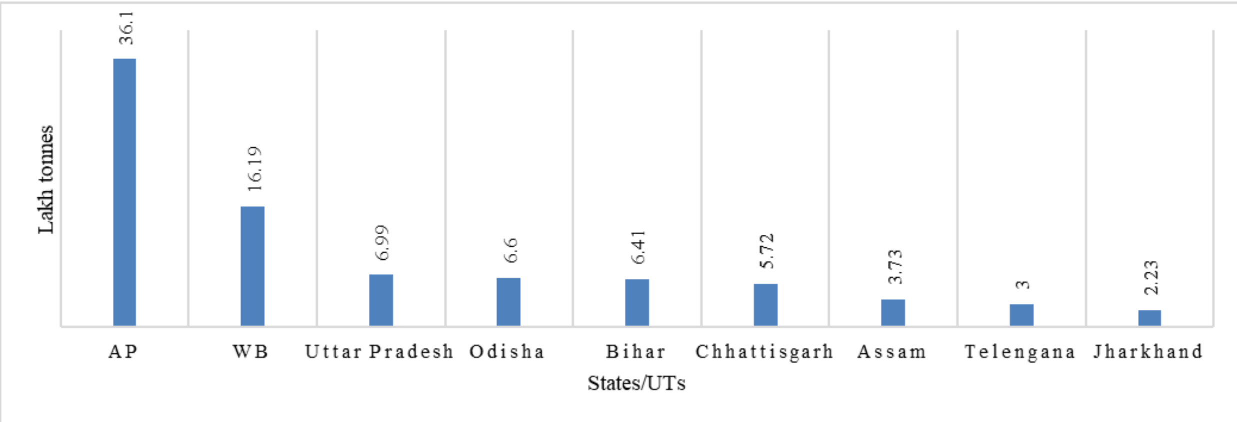


Figure 3: Major Inland Fish Producing States (2019-20)

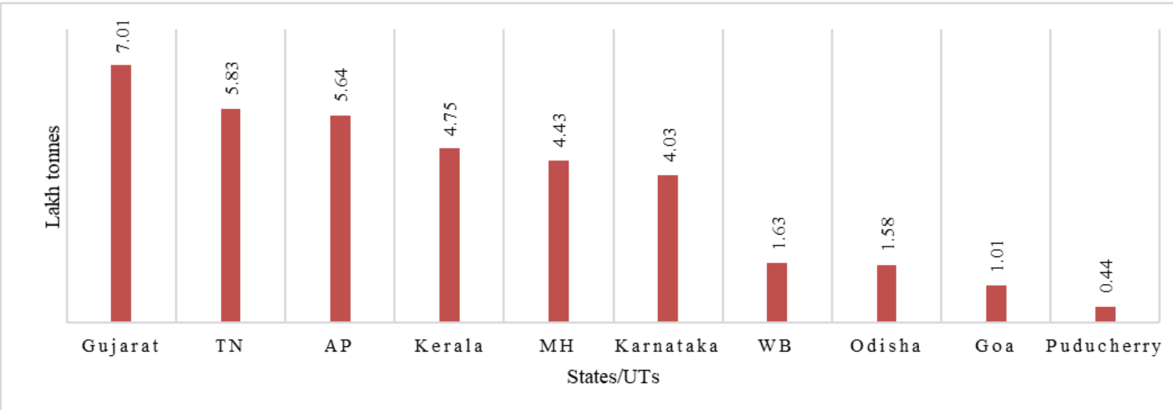


Figure 4: Major Marine Fish Producing States (2019-20)

Capital Formation in Fisheries Sector

It was observed that Gross Fixed Capital Formation in fisheries both in terms of current price and at 2011-12 constant price has increased substantially over the years and along with that, table 2 highlights that the share of GFCF of Fisheries sector in GFCF of Agriculture sector has increased over the years. However, the share of GFCF of Fisheries sector in GFCF of the total economy has declined. One of the reasons behind the decline of fisheries sector's contribution to total economies GFCF is that over the past couple of the years majority of contribution to total GFCF is made by service sector and manufacturing sector as well. Since the contribution of overall agriculture sector is declining. It could potentially cause the reduction in share to total economy.

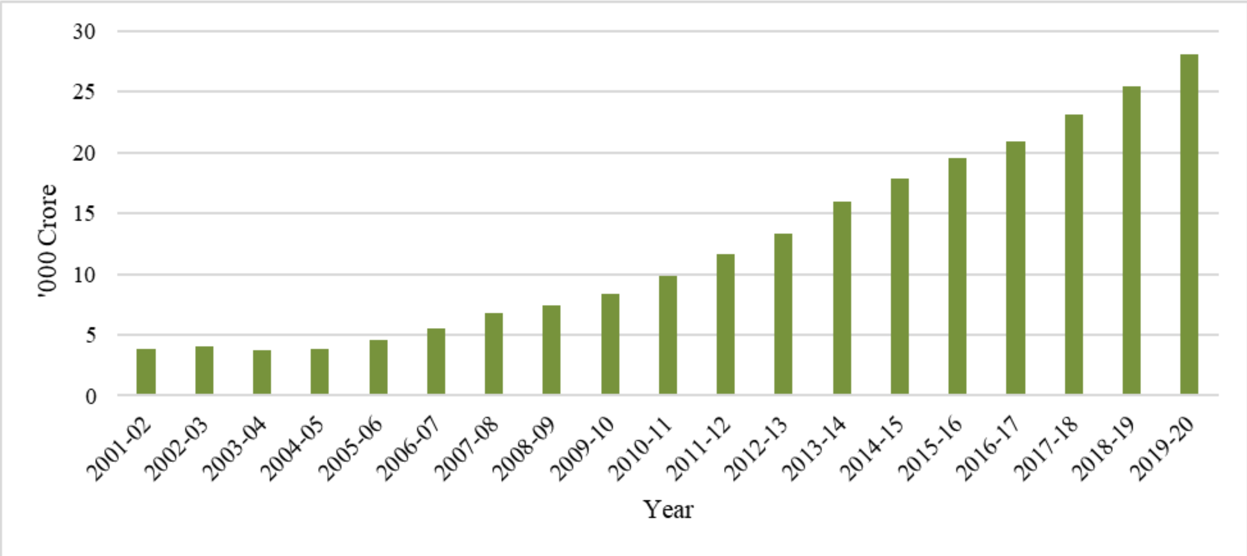


Figure 5: Gross Fixed Capital Formation (GFCF) in Fisheries Sector (Current Price)

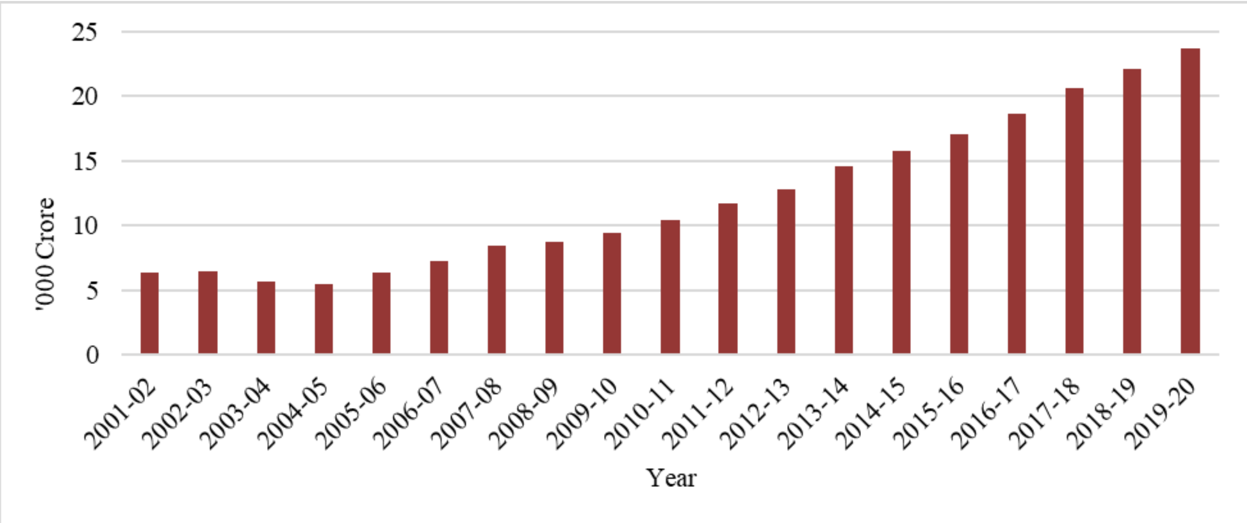


Figure 6: Gross Fixed Capital Formation (GFCF) in Fisheries Sector (Constant Price)

Table 2: Capital Formation for Fisheries Development (2001-02 to 2019-20):

Year	At Current Price		At Constant Price	
	Share of Fish GFCF to Total GFCF (%)	Share of Fish GFCF to Ag GFCF (%)	Share of Fish GFCF to Total GFCF (%)	Share of Fish GFCF to Ag GFCF (%)
2001-02	0.56	4.98	0.54	4.51
2004-05	0.39	4.26	0.39	4.37
2007-08	0.36	4.32	0.37	4.31
2010-11	0.39	4.39	0.40	4.40
2013-14	0.45	4.99	0.46	5.27
2016-17	0.48	6.25	0.49	7.22

2019-20	0.48	6.46	0.50	7.73

Conclusion

Fisheries sector has registered an average compound annual growth rate of 4.48 per cent. More than 14.1 million tonnes of production were achieved in FY 2019-20. AP, West Bengal and Gujarat being the highest contributors to the total fish production. Gross Fixed Capital Formation (GFCF) in fisheries sector has increased considerably from 2001-02. The rise in the share of fisheries GFCF in Agriculture GFCF depicts the importance the fisheries sector.

However, the fisheries sector also faces several challenges, including overfishing, habitat degradation, climate change, and inadequate management practices. Sustainable fishing practices and effective management of fisheries are essential to ensure the long-term viability of the sector.

In recent years, the government has taken several initiatives to promote sustainable fishing practices, encourage fish farming, and provide support to fishermen and fish farmers. With the growing demand for fish and seafood, there is immense potential for the fisheries sector in India to grow and contribute further to the country's economy.

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

Anemia in Pregnant Women: Causes and Prevalence

Article ID: 40931

Shubhra Singh[1], Alka Gupta[1]
[1]Department of Food Nutrition and Public Health, Ethelind College of Home Science, SHUATS Prayagraj.

Abstract

Anemia is one of the most common nutritional deficiency disorders affecting the pregnant women; the prevalence in developed countries is 14%, in developing countries 51%, and in India, it varies from 65% to 75%. Anemia is the second most common cause of maternal death in India. The main cause of anaemia in women of reproductive age globally is iron deficiency, resulting from prolonged negative iron balance, which accounts for 50% of anemia in women worldwide. Anemia also contributes to an increase in perinatal mortality, low birth weight, still birth and foetal wastage. The aim of this study was to assess the cause and prevalence of anaemia in pregnant women.

Keyword: Anemia, pregnant women, perinatal mortality, prevalence.

Introduction

Anaemia is a major public health problem with about two billion people being anaemia worldwide. Anemia in pregnancy is an important public health problem as it impacts not only on the pregnant woman but also significantly affects the unborn child. Anaemia in pregnancy is defined as haemoglobin concentration less than 11.0 g/dl. Anaemia was further divided into mild (haemoglobin = 10.0–10.9 g/dl), moderate (haemoglobin = 7.0–9.9 g/dl) and severe (haemoglobin < 7.0 g/dl) categories. Globally, anaemia affects half a billion women of reproductive age.

In 2011, 29% of non-pregnant women, and 38% of pregnant women aged 15–49 years were anaemic worldwide. Anaemia in pregnancy reduces tolerance to blood loss and leads to impaired function and cardiac failure. Anaemia impairs the capacity of blood to transport oxygen around the body and is an indicator of poor nutrition and health. Anaemia in pregnancy is a major public health issue throughout the world, particularly in the developing countries where it is an important contributor to maternal morbidity and mortality. It is also associated with increased risk of miscarriage, prematurity, stillbirth, low birth weight and consequently perinatal mortality.

The negative iron balance may be due to inadequate dietary iron intake or absorption, increased needs for iron during pregnancy, and increased iron losses as a result of menstruation, worm infestation and infections. Some genetic and socio-demographic and economic characteristics of women also influence the distribution of anemia and should be taken into consideration in designing preventive interventions for pregnancy anemia. The causes of anaemia during pregnancy in developing countries are multifactorial; these include micronutrient deficiencies of iron, folate, and vitamins A and B12 and anaemia due to parasitic infections such as malaria and hookworm or chronic infections like TB and HIV.

Causes of Anemia in Pregnancy

The most common anemias are iron-deficiency anemia and folate deficiency megaloblastic anemia. These anemias are more common in women who have inadequate diets and who are not receiving prenatal iron and folate supplements. Other less common causes of acquired anemia in pregnancy are aplastic anemia and hemolytic anemia. In addition, anemias such as thalassemia and sickle cell disease can have an impact on the health of the mother and fetus.

The most frequent causes of true or absolute anemia are nutritional deficiencies. Frequently, these deficiencies are multiple, and the clinical presentation may be complicated by attendant infections, generally poor nutrition, or hereditary disorders such as hemoglobinopathies. However, the fundamental sources of nutritional anemia embody insufficient intake, inadequate absorption, in-creased losses, expanded requirements, and insufficient utilization of hemopoietic nutrients.

Recommendations

We have the following recommendations to prevent and/or decrease the severity of anemia among pregnant women:

1. Awareness and Education programs should be generated to make people come to know about anemia, its complications, and ways to prevent it.

2. Woman of childbearing age should be motivated to take the required supplementation before conceiving and to continue with it till breastfeeding the baby.

3. Education of the male partner regarding the complications of the disease and the utility of the supplementary diet during pregnancy may help the pregnant woman a lot to execute these policies in her daily life.

4. Especially adolescent girls should be educated to make them aware of the upcoming problem if not taken care since the same age.

5. Advertisement programs should be generated to draw the attention of policymakers as anemia is one of the major global problems.

Prevalence

Pregnant women who consumed fish or snails regularly were less likely to become anemic compared to those who never consumed fish or snails. Nutritional anaemia is known to be the most common type of anaemia with pregnant women who take less than two meals a day, less diverse meals or less meat being more likely to be anaemic. Thus, balanced diet involving meat and vegetable and eggs is essential during pregnancy in preventing anaemia. The World Health Organisation (WHO) recommends intermittent iron and folic acid supplementation for menstruating women living in settings where the prevalence of anaemia is 20% or higher and daily iron and folic acid supplementation for pregnant women as part of antenatal care in order to prevent anaemia in pregnancy. Prenatal vitamins typically contain iron. Taking a prenatal vitamin that contains iron can help prevent and treat iron deficiency anemia during pregnancy. In some cases, your health care provider might recommend a separate iron supplement. During pregnancy, you need 27 milligrams of iron a day. To enhance the absorption of iron from plant sources and supplements, pair them with a food or drink high in vitamin C — such as orange juice, tomato juice or strawberries. If you take iron supplements with orange juice, avoid the calcium-fortified variety. Good nutrition can also prevent iron deficiency anemia during pregnancy. Dietary sources of iron include lean red meat, poultry and fish. Other options include iron-fortified breakfast cereals, dark green leafy vegetables, dried beans and peas.

Conclusion

A high prevalence of anemia in pregnant women apparently increases the maternal and fetal risks. To improve maternal and fetal outcome, it is recommended that the primary health care has to be strengthened, prevention, early diagnosis, good dietary management and treatment of anemia in pregnancy to be given priority, so every mother who are pregnant must screen for anemia and must take treatment as soon as possible along with foods rich in iron and also must have family support and care throughout pregnancy.

References

1. Marahatta R. Study of anaemia in pregnancy and its outcome in Nepal medical college teaching hospital, Kathmandu, Nepal. Nepal Med Coll J. 2007;9:270–4. [PubMed] [Google Scholar].
2. World Health Organization: Prevention and management of severe anaemia in pregnancy: report of a technical working group, Geneva, 20–22 May 1991. 1993.
3. World Health Organization: Global nutrition targets 2025: anaemia policy brief. 2014.
4. Abriha A, Yesuf ME, Wassie MM. Prevalence and associated factors of anemia among pregnant women of Mekelle town: a cross sectional study. BMC Res Notes. 2014;7:888. doi:10.1186/1756-0500-7-888.
5. Obse N, Mossie A, Gobena T. Magnitude of anemia and associated risk factors among pregnant women attending antenatal care in ShallaWoreda, West Arsi Zone, Oromia Region, Ethiopia. Ethiop J Health Sci. 2013;23(2):165–73.

Soil Organic Carbon

Article ID: 40932

Rahul Bhadu[1], Princy Thakur[2], Sutanwa Saha [2], Meraj Ahmed[2], Abdul Waheed Wani[3]
[1]Research Scholar, [2,3]Assistant Professor, School of Agriculture, Department of Soil Science, [2]Department of Horticulture, Lovely Professional University, Phagwara, Punjab, India – 144411.

Abstract
Soil organic carbon is a measureable synthesized decomposed component of soil organic matter. It originates from the stubbles, mulch and green manure present after harvesting. It plays an important role in increasing cation exchange capacity of soil reduces the loss of soil by erosion and nutrient leaching. Soil organic carbon cycle involves the decomposition of organic matter into an amorphous black-coloured humus-like substance with the help of microorganisms in optimum environment. Various practices for maintaining organic carbon include using manure and compost, taking cover crops, proper crop selection, conservation tillage practices, and crop residue management. The soil organic carbon ranges from 0.5% to 0.75% in Indian soils.

Keywords: Organic matter, Organic Carbon, Soil Health, NPK.

Introduction
The soil organic carbon is present in the soil after any substance made by living creatures partially decomposes is known as soil organic matter. It is a significant portion of soil organic matter and is thought to be essential for many ecological and soil activities. The local geology, climate, land use and management all affect how much organic carbon is present in a soil. The top soil is mostly where 'O' horizon is situated. Since there is twice as much organic carbon in the soil as there is in the atmosphere, soil serves as a significant carbon storage area (Tirtharaj *et al;* 2022).

Origin
In agricultural soils, primary organic carbon inputs may originate from:- Aboveground biomass that is not harvested, such as stubble, mulch and green manure. Organic fertilisers including animal excreta, compost and biogas digestate, root litter, dead old roots and rhizodeposits. The first two organic carbon sources enter the soil near the surface, and redistribution along the soil profile may only be accomplished via bioturbation, tillage and leaching of mobile organic carbon species. However, root-derived carbon penetrates the soil directly below the surface to a depth of 1 m or more. There are significant differences between various land uses and management approaches in the relative contributions of aboveground biomass, organic fertiliser, and roots to total carbon inputs. Cropland, on the other hand, receives a larger aboveground carbon input from harvest residues and stubble, whereas grassland receives a greater carbon input via roots and rhizodeposits (Pausch and Kuzyakov 2018).

Importance of Soil Organic Carbon
Farmers have a stake in maintaining and increasing soil organic carbon for specific fields because soil and yield typically improve as soil organic carbon levels rise, even though the agricultural industries have the potential to significantly impact the carbon cycle, frequently through the release of carbon. Higher soil organic carbon results in increased tilth or soil structure, which boosts physical stability. This improves water drainage and retention, boosts soil aeration, and reduces the possibility of soil compaction (soil oxygen content). Erosion and nutrient leaching.

The chemical make-up and biological productivity of the soil, which also includes soil organic carbon, have an impact on a field's fertility and ability to hold nutrients. The likelihood of other nutrients being lost to erosion and leaching is reduced by "sequestering" more carbon in the soil. While physical soil disturbances may cause a net loss of carbon into the atmosphere as a result of the production of carbon dioxide, an increase in soil organic carbon frequently leads to a more stable carbon cycle and greater overall agricultural productivity (Tirtharaj *et al;* 2022).

Effects of Soil Organic Carbon on Physicochemical Properties of Soil

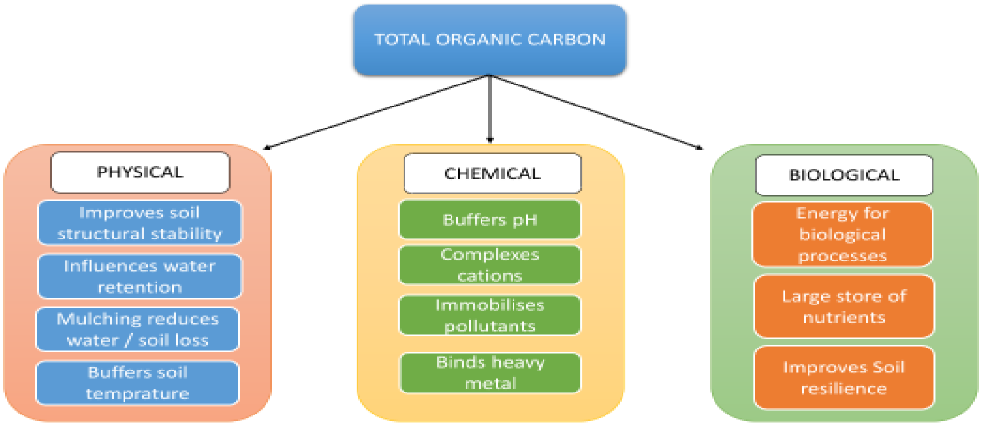


Fig 1: Flow chart of soil properties of soil organic carbon

Soil organic carbon maintains the pH of soil as it acts as buffer to soil, it also helps in the immbolisation and adsorption of complex ions and harmful pollutants in the soil which in turn maintains the soil quality, binds to the heavy metals and make them unavailable to soil. Soil organic carbon also have an influence on the physical properties of soil by maintaining the pH and temperature of soil, it acts as mulch for soil which reduces the water loss and holds the moisture into the soil and helps in retaining water by holding the water into its pores, thereby increases the stability of soil. Soil is the great home for various microorganisms and organic carbon helps in providing nutrients and energy to the soil for performing various life processes as it is the store house of a number of nutrients and also improves the soil elasticity.

Soil Organic Carbon Cycle

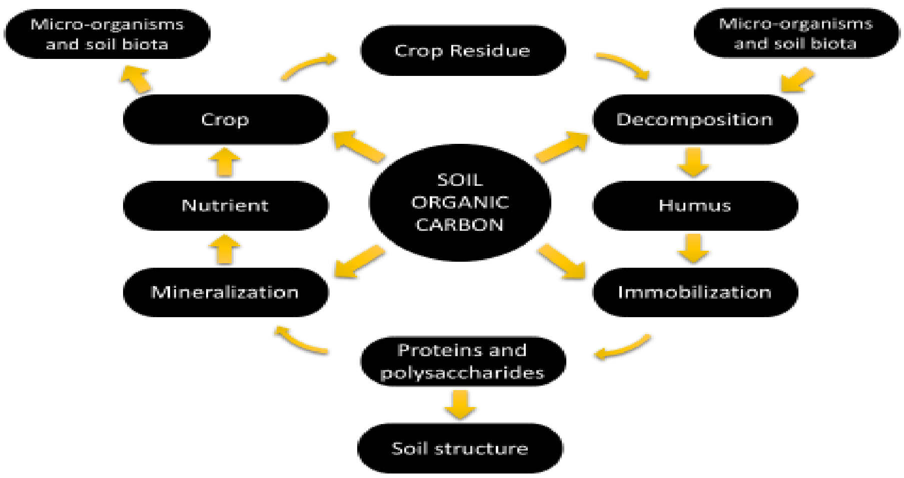


Fig 2: Flowchart of soil organic carbon cycle

Organic matter decomposition is mostly a biological process that happens in nature. Three main elements affect its reaction time: the quality of the organic matter, the physical environment, and the soil organisms. Carbon dioxide (Co_2), energy, water, plant nutrients, and newly formed organic carbon molecules are among the by-products of decomposition. A more complex organic compound known as humus is created by the sequential breakdown of dead materials and changed organic matter. Decomposition is the breakdown of organic materials found in soil through physical and biological means. Plant debris that has been dumped on or in the soil is called plant litter. The creation of humus, which is a class of meta-stable compounds, occurs simultaneously with litter decomposition. Humification is the name given to this process. Soil characteristics are impacted by humus. The soil becomes darker as it progressively decomposes, and it also improves soil aggregation and aggregate stability, boosts CEC (the capacity to attract and retain minerals), and adds N, P, and other nutrients. Organic matter in the soil serves as food for soil organisms, including microorganisms. Any extra nutrients (N, P, and S) are released into the soil as the organic matter is broken down in forms that plants can utilise. Mineralization is the term for this releasing process. Organic matter in soil is also created by microorganisms as waste. Although this waste material decomposes less quickly than the original plant and animal matter, it can still be utilised by a wide range of species. The ability of a soil to supply a crop with enough nutrients to produce a healthy crop depends on the soil biota, which plays the most significant role in nutrient cycle processes by destroying carbon structures and rebuilding new ones or storing the carbon into their own biomass. The capacity to store water and store (sequester) carbon from the atmosphere is increased by the organic matter content, particularly the more stable humus. Inorganic materials, including plant nutrients, are both liberated (mineralized) from and integrated (immobilised) into the decaying material during decomposition. Plant remains and animal remains are qualitatively very different. Animal remains may be significant locally, but they only make up a very small fraction of the organic matter added to a soil; therefore, we won't address them anymore.

Table 1: Management practices that can increase soil organic carbon and reduce carbon loss into the atmospheres:

S. No.	Management practices	Functions and explanation
1.	Cover crops	Cover crops helps in increasing the soil carbon content with the incorporation of topsoil and roots biomass as the cover crop requces the soil erosion rate and hence the soil particles comprising of carbon. Cover crops enhances the soil health and nutrient cycling after long run.
2.	Crop selection	Perennial crops have larger roots which binds the particles together and the decomposition of roots and stubbles after harvesting occurs which increases the organic carbon content in soil. On the other hand, carbon loss can also be minimised by using annual crops having more remainings.
3.	Conservation tillage practices	Conservation tillage includes the zero tillage or no tillage practices store the soil organic carbon which in turn helps to improve the physical stability of soil, organic carbon can be enhanced by applying conservation tillage practices along with stubbles and manure application.
4.	Manure and compost	Compost and manure acts as a binding agent for soil particles to enhance soil stability and carbon content which thereby raises the buffering capacity of soil.
5.	Crop residue management	The leftover remaining in field after harvesting have high C:N ratio which when decompose increases the organic matter content in soil.

Table 2: Proportion of organic carbon in soil:

S. No.	Particulars	Range
1	Low	Less than 0.5%
2	Medium	0.5-0.75%
3	High	More than 0.75%

Source: Walkley (1947)

Conclusion

Enormous and diverse array of carbon-containing compounds that make up soil organic matter interacts with both comparatively active and active parts of the global carbon cycle which is also responsible for climate change. Soil carbon management is a crucial strategy for improving soil quality, increasing crop yields, and reducing soil loss. Two benefits of soil carbon sequestration for agricultural output are the stabilisation of the global carbon cycle and the improvement of soil health and productivity.

References

1. Schneider, F., Amelung, W., Don, A., 2020. Origin of carbon in agricultural soil profiles deduced From depth gradients of C:N ratios, carbon fractions, δ13C And δ15N values. Plant Soil. 460, 123–148.
2. Cornell Nutrient Management Spear Program Agronomy Fact Sheet #91
3. Gill, H. K. and Ahmed, M. 2022. Black Heart of Soil. Vigyan Varta 3(10): 21-24.
4. https://www.fao.org/3/a0100e/a0100e05.htm#:~:text=Carbon%20cycle,matter%20(Brussaard%2C%201994).
5. Walkley, A. 1947. Critical examination of rapid method for determining organic carbon in soil, effect of variation in digestion conditions and of inorganic soil consitients Soil Sci 632 : 251.

Role Tea Polysaccharides in Gut

Article ID: 40933

Ramyashree S.R.[1]
[1]Dept. Food Science and Nutrition, UAS, GKVK, Bangalore.

Introduction

Tea has been cultivated and consumed for thousands of years, and it is deeply loved by consumers from many countries, such as China, Japan, and South Korea. Tea not only creates a lot of wealth but also generates tea culture and tea ceremony. Tea has become one of the most popular beverages in the world after water. The unprecedented popularity of tea is not only due to its unique aroma and taste, but also to the health benefits of drinking it. The primary bioactivities of tea, including anti-oxidation, hypoglycemic, antibacterial, hypolipidemic, and anti-cancer activities, have been studied and explored. Tea has also been broadly utilized in the food, medical, and health care industries. Tea's biological and pharmacological activities are mainly attributed to the diversity of its chemical components. The chemical features of tea mainly include tea polyphenols (TPPs), tea polysaccharides (TPSs), tea proteins, catechins, theanine, and inorganic elements. Tea polyphenols have received attention for their excellent antioxidant properties for which accumulating evidence has been presented. Modern pharmacological studies have shown that TPS, an important bioactive component along with TPP, is also the main tea compound that helps lower blood glucose and lipids, resist oxidation, and enhance the body's immune function. It also has excellent potential for development and application in the cosmetic industry.

Basic Composition of Tea Polysaccharides (TPS)

TPS is a nonstarch protein-bound acidic polysaccharide, which contains 44.2% neutral sugar, 43.1% uronic acid and 3.5% protein. The carbohydrate composition of TPS includes glucose (Glc, 128.4 μM), galactose (Gal, 101.4 μM), arabinose (Ara, 71.1 μM), rhamnose (Rha, 47.1 μM), xylose (Xyl, 25.0 μM), galacturonic acid (GalA, 24.0 μM), mannose (Man, 16.3 μM), ribose (Rib, 10.3 μM) and glucuronic acid (GulA, 5.6 μM). The second-derivative IR spectra of TPS had peak intensity around 1075 cm^{-1} and 1045 cm^{-1}, showing TPS characterizes galactopyranose in the backbone and arabinofuranose units in side branches. TPS can be divided into neutral polysaccharides (NTPS) and acid polysaccharides (ATPS). The crude water-soluble TPS could be separated by anion-exchange chromatography into five fractions, i.e., fractions A, B, C, D and E, among which fractions A and C had significant glucokinase-stimulating activity, in which fraction C showed the highest activity and could be further separated by gel filtration chromatography into fractions C-1 and C-2. The FC-1 is an acidic polysaccharide containing 8% GalA but no protein, with MW ca. 60 kDa.

Sugars and uronic acids are abundant in TPS. NTPS contains 82.7% total sugar, 12.9% of which is comprised of uronic acid, whereas ATPS contains 85.5% total sugar, 39.8% of which is made up of uronic acid. Sugar composition is mainly Gal (67.6%) in NTPS, but Rha, Ara, Gal and GalA are in ATPS. Nucleic acid was also detected in ATPS. TPS from some tea sources also bear rare earth elements (REE) including La, Ce, and Nd, in which La was more than 75% of total REE. Iron, magnesium, zinc and selenium were also detected in TPS.

Interaction of TPS with Gut Microbiota (GM)

TPS is a great candidate for application in functional foods as a natural product because of its Bioactivities. Recently, natural plant polysaccharides, regarded as superior prebiotics, have been shown to reach the large intestine, where they can interact with gut microbiota (GM).

Following this, the polysaccharides in the large intestine act as energy sources for GM, thereby influencing their composition and physiology. A dysbiotic GM composition is linked to obesity, diabetes, inflammatory bowel disease (IBD), and even neuro-degeneration disease. Currently, with technical advancement of quantitative PCR, 16S rRNA gene sequencing, and metagenomic sequencing, the structures of TPS is being investigated with greater sensitivity and resolution.

GM Metabolize TPS

In humans and some animals, only simple carbohydrates are digestible as energy sources, and complex carbohydrates such as glucan, cellulose, and lignin are not hydrolyzed because of their absence of carbohydrate-active enzymes (CAZymes). GM degrade polysaccharides in two stages: primary degradation and secondary degradation. During the primary degradation, polysaccharides are broken down into monosaccharaides or oligosaccharides.

During the secondary degradation, secondary metabolites are formed from the products of the previous stage, which are dominated by short chain fatty acids (SCFAs), including acetic acid, propionic acid and butyric acid, etc. Among all the SCFAs, acetic acid is at the most abundant and can be utilized by organ tissue. In addition, propionic acid can influence sterol metabolism in the liver; butyric acid supplies nutrients for intestinal epithelial cells, decreases the lumen pH, consequently inhibits pathogenic bacteria.

GM encode different CAZymes for degrading polysaccharide and oligosaccharide, including glycoside hydrolases (GHs), polysaccharide lyases (PLs), carbohydrate esterases (CEs) and glycosyltransferases, which are absent in the human genome. Studies have determined that GM can degrade polysaccharides through Sus-like transport systems ABC transport systems, and multienzyme complexes system. The Sus-like transport system is a major polysaccharide degradation system in Bacteroidetes. Bacteroides degrade polysaccharides through multiple polysaccharide utilization loci (PULs), each of which encodes a Sus-like system.

This system contains outer membrane proteins homologous to SusC and SusD, and is essential for polysaccharide uptake and degradation. The SusC-like protein transports oligosaccharides across the outer membrane, and the SusD-like protein captures oligosaccharides and delivers them to the SusC transporter. SusC-like and SusD-like proteins act synergistically with polysaccharide-degrading enzymes and outer membrane glycan-binding proteins to degrade polysaccharides. Firmicutes bacteria have less CAZymes for extracellular polysaccharide degradation, but they can use diverse transporters, such as ABC transporters, to import smaller sugars for intracellular processing.

The glycoside hydrolases degrade long-chain starch into shortchain malto-oligosaccharides, then the malto-oligosaccharides with a length of three to seven glucose units are recognized by two separate ABC transport substrate-binding proteins and imported into the cytoplasm. Additionally, multi-enzyme complexes system degrades cellulose and resistant starch, and this system has been found in *Ruminococcus champanellensis* derived from human fecal samples. The multi-enzymes complexes bring substrates, carbohydrate-binding modules and enzymes together through interacting with dockerins and cohesin domains to allow synergistic degradation of cellulose and hemicellulose.

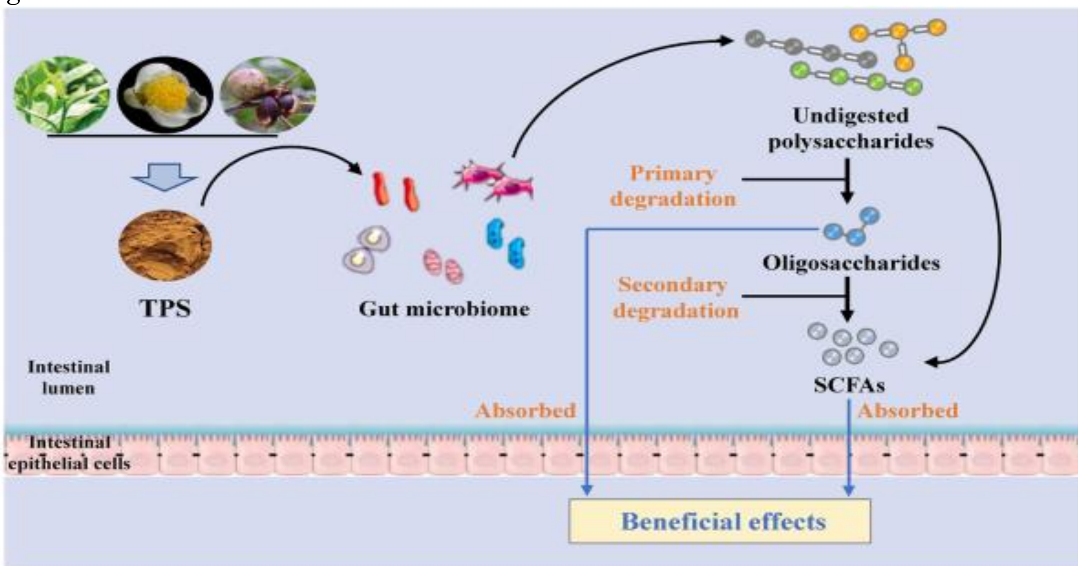


Fig. 1. GM degradation of TPS

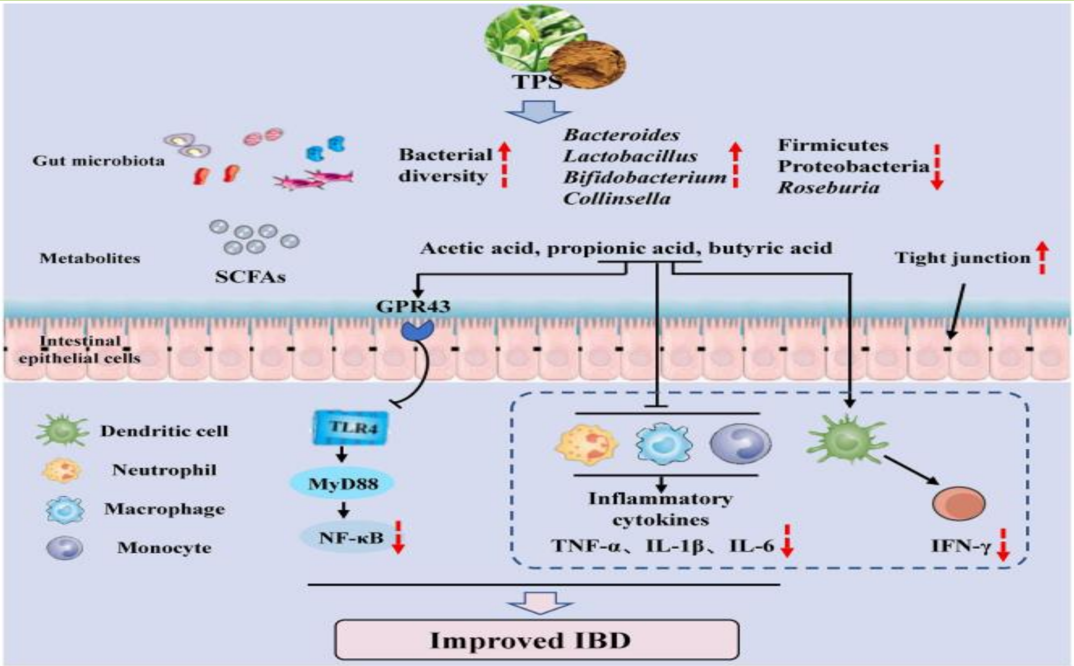


Fig. 2. Modulating GM and relieving IBD with TPS

Conclusion

TPS modulation on the diversity of GM and production of short chain fatty acids (SCFAs), and the health benefits of TPS through targeting GM. TPS has many bioactive activities, including relieving oxidative stress by enhancing endogenous antioxidant enzymes or directly scavenging free radicals, antitumor activity by suppressing the expression of VEGF and TNF and inhibiting tumor cell proliferation, anti-hyperglycemic activity by increasing IL-2 production and inhibiting starch digestive enzymes. Hence TPS can be used as a functional ingredient.

References

1. DU., QIU-YUE., LI-PING XIANG., AND XIN-QIANG ZHENG., 2016, Tea Polysaccharides and Their Bioactivities. *Molecules* **(21)**, 01-18.
2. GUOHUO WU., WEI GU., GUIJIE CHEN., HUIJUN CHENG., DAXIANG LI., AND ZHONGWEN XIE., 2023. *J. Funct. Foods*.102.

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

Impact of Mulching on Crop Production: An Article

Article ID: 40934

Md. Abid Haqqani[1], Shivani Thakur[2], Agnibha Sinha[2], Sutanwa Saha[2], Meraj Ahmed[2]
[1]Research Scholar, [2]Assistant Professor, School of Agriculture, Department of Soil Science, Lovely Professional University, Phagwara, Punjab, India – 144411.

Introduction

Mulching refers to the practice of covering the ground with a layer of a material, called "Mulch," in order to protect the soil and the plants growing in it. Mulching is a common technique used in commercial crop cultivation, as well as in growing fruit trees, vegetables, flowers, and young plants in home gardens. It can be beneficial for various types of gardening, including yard gardens, container gardens, and raised beds (Anonymous, 2016).

Mulching minimises weed infestation, reduces water evaporation, and also restricts soil runoff, soil loss and slows down soil deterioration. It enables soil moisture retention, which aids temperature regulation, enhances physical, chemical, and biological characteristics of soil, adds nutrients to the soil, and ultimately promotes crop development and production. The impact that mulching has on crop yield can vary based on the crop being grown, the mulch that is used, and the environmental factors present during growth. It has been observed that of uncovered fields in rainfed areas, mulching increases the crop production by 50–60% compared to not mulching (M. RAY, S. BISWASI,2016).

Types of Mulching

The two main types of mulch are organic and non-organic mulches.

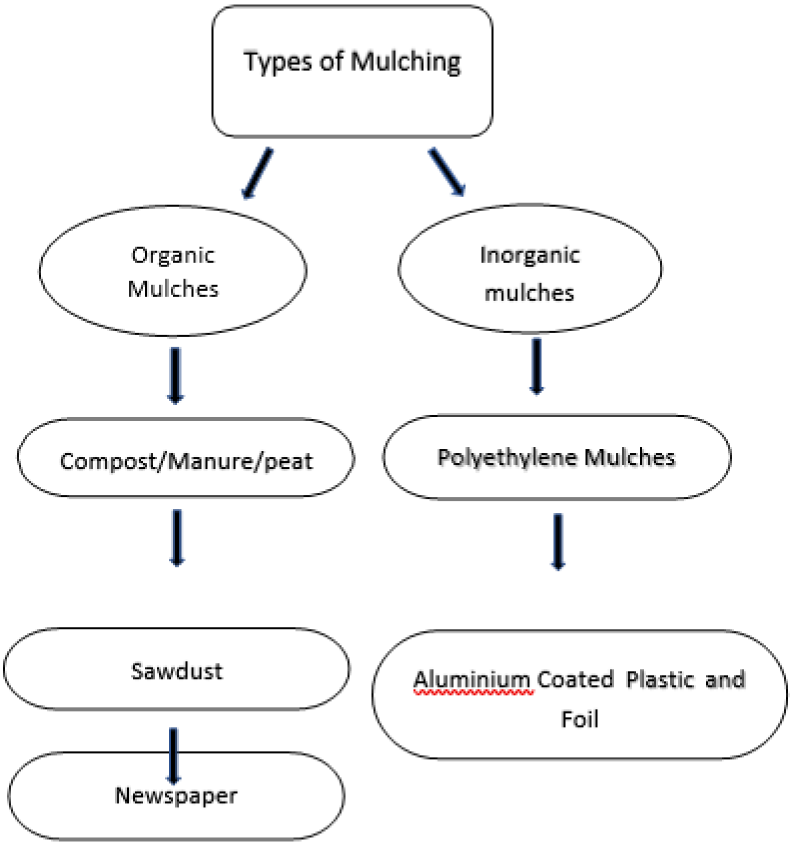


Table: Increase in Yield of Fruit and Vegetable Crops through Plastic Mulching:

	Yield(T/Ha.)		Increase in
Crops	Unmulched	Mulched	Yield (%)
Guava	18.36	23.12	25.93

Mango	4.93	7.16	45.23
Papaya	73.24	120.29	64.24
Banana	53.99	73.32	33.95
Litchi	111.0	125.0	12.61
Broccoli	15.64	25.14	60.74
Cauliflower	18.58	25.02	60.74
Brinjal	36.73	47.06	28.12
Tomato	69.10	94.85	37.26
Okra	6.91	8.56	23.88
Bitter Gourd	20.12	25.63	27.39
Cabbage	14.3	19.9	39.16

Source: NCPAH, New Delhi (National Committee on Plasticulture Application in Horticulture)

1. Organic mulches:

a. Compost/Manure/peat: The mulching materials are placed in a layer that is 2 to 3 inches thick on top of the soil surface. Before being applied, manure should be fully decomposed, as fresh manure can harm the crops if applied. Additionally, mulching with these materials can enhance soil fertility by increasing the amount of organic carbon in the soil (Pedda Ghouse Peera S.K. etal.2020).

b. Crop residue mulching: Materials like crop straw/stalk remaining in a field after a crop has been harvested are referred to as crop residues. These leftovers comprise leaves, seed pods, and stalks and stubble (Wikipedia,2013).

c. Sawdust: Sawdust as mulch has stimulating influence on nutrient content and microbial activity in the soil. It is prone to caking and includes significant amounts of carbon and nitrogen. As a result of the high C:N ratio and low nutritional status, decomposition takes time and also leads to immobilization of nitrogen (Sagar Maitra et al.2020).

d. Newspaper: Mulching using newspaper aids in weed control. Use of newspaper that is between 1-2 cm thick, and secure the edges with gravel, pebbles, or another substance. On a windy day, newspaper mulch application should be avoided. Newspaper makes a good, affordable, and practical mulch (TANU,2020).

2. Inorganic mulches:

a. Polyethylene Mulches: Over the past ten years, plastic mulch has seen a sharp rise in use in agriculture all over the world. It promotes an increase in soil temperature, reduction in weed pressure, moisture conservation, a decrease in attack of insects pests, improved crop yields, and more effective utilisation of soil nutrients (Kasirajan & Ngouajio, 2012).

b. Aluminium-coated plastic and foil: Insect pests are effectively repelled by aluminium coated plastic and foil mulches, particularly aphids (Aphididae) and thrips (Thripidae). When compared to bare ground, yields with black plastic are frequently higher (L. Greer, J. Dole,2003).

Types of Plastic Materials

Either PVC or polyethylene may be used as the plastic material. Because polyethylene is more permeable to long wave radiation, which raises soil the temperature around plants during night time when temperature outside is relatively cold.

Improve Quality and Yield

Mulch often prevents fruit rot, fruit cracking, as well as keeping clean fruits from touching the ground. Fruits typically have fewer scars and are smoother. When plastic mulch is put correctly, less soil splashes onto the plants during downpours, which can speed up the process of grading and hence promotes quality of produce. The yield of marketable fruit from the mulched plot was much higher than that of the bare soil

(Raju Lal Bhardwaj,2013). t has been demonstrated that black polyethylene mulch is found to be useful in achieving early harvest and yield of muskmelon. The yield of brinjal increased by 3.5-5.2 folds by white and black polyethylene over control probably due to slow water percolation and restricted nutrient loss from the top 15 cm of soil (Singh et al. 2006). Due to their ability to induce higher temperatures than white and reflecting plastics, red and black plastic mulches have been found to be helpful in achieving early tomato yields (Pedda Ghouse Peera S.K.et al.,2020).

Conclusion

Most of the study shown that mulch offers numerous advantages to crop production through soil and water conservation, improved chemical and physical soil qualities, and increased soil biological activity. It has various benefits like increased soil moisture retention, decreased water infiltration rate, decreased runoff and soil erosion followed by reduced weed growth and pest control, maintenance of soil temperature, increased plant growth and development which ultimately increases quality and yield. Mulching also encourages earlier crop harvest, reduced rate of fertiliser leaching, and protection of the soil's surface from unfavourable factors. Additionally, the organic mulch enriches the soil with organic matter and boosts its biological activity. Mulching is an efficient and sustainable strategy that can significantly increase crop productivity and it should be adopted by the farmers.

References

1. https://www.ugaoo.com/blogs/garden-maintenance/understanding-mulching#:~:text=What%20is%20Mulching%3F,flowers%2C%20nursery%20saplings% 2C%20etc.
2. M. RAY, S.BISWASI,Trends in Bioscience 9(14), Print : ISSN 0974-8431, 757-767, 2016
3. https://en.wikipedia.org/wiki/Crop_residue
4. Sagar Maitra, Dinkar J Gaikwad and Tanmoy Shankar, Protected Cultivation and Smart Agriculture
5. Subrahmaniyan Kasirajan & Mathieu Ngouajio ,Agronomy for Sustainable Development volume 32, pages501–529 (2012)
6. Aluminum Foil, Aluminium-Painted, Plastic, And Degradable Mulches Increase Yields and Decrease Insectvectored Viral Diseases of Vegetables | Semantic Scholar
7. Raju Lal Bhardwaj,2013, Effect of Mulching on Crop Production Under Rainfed Condition, Vol 34 (3), Pages 188-197
8. Pedda Ghouse Peera S.K., Subhankar Debnath and Sagar Maitra,2020, Mulching: Materials, Advantages and Crop Production, (page 55-66)
9. L. Greer and J. Dole Aluminum Foil, Aluminium-painted, Plastic, and Degradable Mulches Increase Yields and Decrease Insectvectored Viral Diseases of Vegetables 2003 DOI:10.21273/HORTTECH.13.2.0276

Risk Assessment of Heavy Metals in Soil

Article ID: 40935

Juhi[1], Meraj Ahmed[2]
[1]Research Scholar, [2]Department of Soil Science and Agricultural Chemistry, School of Agriculture, Lovely Professional University, Jalandhar, Punjab (India)-144411.

Abstract
Pollution caused by rapid industrial activities is becoming increasingly drastic, mainly its effect on plant and soil health. Currently, a study was conducted to examine the heavy metals (As, Cd, Cu, Hg, Pb, and Zn) concentrations increasing in soil and tends to the health risks of metals for humans through the consumption of contaminated food from urban agricultural areas. Which experiences that toxic accumulation of heavy metals.

Keywords – Heavy metals, Contamination, Pollution.

Introduction
These heavy metals are naturally present in the Earth's crust and cannot be destroyed. Heavy metals are dangerous or harmful for all living organisms because they tend to bioaccumulate, which means an increase in the concentration of a chemical in a biological organism. On the other side as trace elements, some heavy metals (eg. Copper, selenium, zinc, etc.) are important to maintaining the metabolism of the human body. Heavy metals are found in many components like -air, water, and soil. It can enter in water supply by industrial and consumer waste, also from acid rain (pH 4.0) which breaks down the soils and releases heavy metals into streams, lakes, rivers, groundwater, etc.

Types of Plastic Materials
Either PVC or polyethylene may be used as the plastic material. Because polyethylene is more permeable to long wave radiation, which raises soil the temperature around plants during night time when temperature outside is relatively cold.

Effects
At present, Environmental pollution and the greenhouse effect are increasing day by day. Amidst, potential environmental and human risks of exposure to heavy metals through diet becoming an important issue for public health (Masindi, Muedi,2018; Briffa et al.,2020). Heavy metals are all over the environment through both natural and anthropogenic activities. Anthropogenic activities mean human activities like mining, sludge application, solid waste disposal, industrial processing, wire of vehicle tires, and burning of fossil fuels are the main components for the contamination of heavy metals. (Sodango et al.,2018; Timothy and Tagui Williams,2019; Sharma et al.,2021). Last few years, many industries and land has been converted for other purposes. Mostly these facilities are situated in urban areas. So, the new use of land is often intended for housing and city parks. Knowledge of the potential ecological risk of soil pollution is. therefore, of great importance for the management of such sites. Before using the site, it should be inspected to check whether there is any pollution originating from the previous activities. Because in most of these cases, the pollutants that are often a problem of heavy metals The number of contaminated pollutants depends on the industrial activities (Radomirovic et al., page 2). Rapid urbanization, industrial production, number of motor vehicles, cause a large amount of heavy to be released into the environment. Road and street dust are the main carriers of heavy metals in the urban environment, originating from industrial smoke, traffic dust, etc. Soil has the great ability to absorb heavy metals, and therefore accumulation of these metals continuously in the soil.

Heavy Metal Polluted Soil
Heavy metals are elements that contain metallic properties such as ductility, malleability, conductivity, etc. Metals are present either as separate or in combination with other components of soil. Components contain insoluble inorganic metal compounds such as phosphates, carbonates, or non-exchangeable ions,

etc. (A.P.G.C. Marques, A. O. O. S. Rangel et al.). Minerals are present in the soil which represent the background soil metal concentration but they do not cause pollution problems as compared to those metals which are present in high concentrations in the soil. (L. Ramos, L.M. Hernandez, et al.). The main properties of soil affect metal availability in many ways. Harter reported that soil PH is the major factor affecting metal availability in the soil. Availability of elements Cd and Zn to the roots of *Thlaspi caerulescens* decreased with increases in soil PH. (A. S. Wang, j.s. Angle, et al.).

Effect of Heavy Metal on Plant Growth

Directly toxic effects of metals on plant growth due to the high metal concentration include inhibition of cytoplasmic enzymes and damage to cell structure due to oxidative stress (C.D.Jadia *et al.*). It is also the main reason of reducing of the activity of beneficial microorganisms in the soil which may lead to a decrease in organic matter decomposition leading to a decline in soil nutrients. Sometimes these toxic effects lead to a decline in plant growth which sometimes results in the death of the plant (A. Schaller and T. Diez).

The effect of heavy metal toxicity on the growth of plants varies according to the particular heavy metal involved in the process.

Heavy Metals	Plant Name	Toxic Effect On Plant	Reference
As (Arsenic)	Rice(*Oryza sativa)* Tomato (*Lycopersicon esculentum)*	Reduction in seed, germination, decrease in seedling height. Reduced fruit yield, decrease in leaf fresh weight.	A.R.Marin, S.R.Pezeshki, et al., Jornal of plant nutrition, vol. 16. ,1993. A.C.Barrachina ,F.B.Carbonell et al.,Journal of plant nutrion ,vol.18,1995
Cd (cadmium)	Garlic (*Allium sativum)* Maize (*zea mays*)	Reduced shoot growth, cd accumulation Reduced shoot growth, inhibition of root growth	W.Jiang ,D.Liu,et al.,Bioresource technology ,vol.76,2001 M.Wang,J.Zou et al .,Bioresource technology ,vol.98,2007.
Co (cobalt)	Radish (*Raphanus sativus)*	Reduction in shoot length, root length, total leaf area, and decrease in chlorophyll content.	D.C.Sharma *et al., Cereal Research Communications, Vol.21,1993*
Cr (Chromium)	Onion (*Allium sepa)*	Inhibition of germination process, reduction of plant biomass.	N.Nematshahi, *et al.*European Journal of experimental biology, Vol. 12,2012.
Cu (copper)	Bean (Phaseolus vulgaris)	Accumulation of cu in plant roots, root malformation, and reduction.	C.M. Cook *et al.Photosynthetica, Vol. 34,1997*
Hg(Mercury)	Rice *(Oryza sativa)*	Decrease in plant height, reduced tiller, and panicle formation; yield reduction; bioaccumulation in shoot and root of seedlings.	M.G.Kibra; Soil and Environment, Vol. 27,2008

Result and Discussion

Effluent treatment plant: It is a plant that is designed to treat the reuse of industrial wastewater. It helps to clean the toxic and non-toxic chemicals from the water and make it for reuse which is less harmful to the environment.

Sewage Treatment Plant: It is also a wastewater treatment plant that aims to remove the contaminants from sewage to produce an effluent that is suitable for discharge to the surrounding environment or make an id for reuse application.

Permissible Limits for Heavy Metals in Plants and Soil

Elements	Soil (Mg/Kg)	Plant (Mg/Kg)
Cd	0.8	0.02
Zn	50	0.60
Cu	36	10
Cr	100	1.30
Pb	85	2
Ni	35	10

Source: Denneman and Robberse 1990; Ministry of Housing, Netherlands 1994, WHO(1996).

Conclusion

This article highlighted that when plants growing in polluted soil show a reduction in the quality of plant growth and their yield due to the changes in their physiological activities, Heavy metals cause damaging implications for human health. Different body organs can be affected along with body systems. It accumulates in the human tissues through the food chain which causes both human health and environmental concerns. These heavy metals also harm the aquatic environment, plants, and living organisms. Therefore, when this compost is applied for agricultural purposes, make sure it should be free from pathogens and heavy metals.

References

1. Liu et al.,2022, Green and Sustainable Chemistry, a section of the journal Frontiers in Chemistry. Page no. 1 &2 ,Frontiers.
2. M.B. Ajani et al., Journal of Radiation Research and Applied Sciences, volume 15,2022, page no. 2, Science Direct.
3. Yalei He et al., International Journal of Environmental Research and Public Health,2021.

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

Indicators of Soil Health and Soil Security

Article ID: 40936

Jaismeen[1], Nongmaithem Shitaljit[1], Meraj Ahmad[3]
[1]Research scholar [2]Assistant Professor, Department of Soil Science and Agricultural Chemistry, School of Agriculture, Lovely Professional University, Jalandhar, Punjab.

Abstract

Soil health and soil security are important concepts that highlight the critical role that soil plays in supporting ecosystems and food production. They are closely related concepts that concerns the overall well-being of the soil. Soil health encompasses the physical, chemical, and biological properties of soil, while soil security focuses on the ability of the soil to provide essential ecosystem services now and in the future. Soil health is measured with the help of different indicators such as physical, chemical, and biological indicators. They work together to enhance soil services for better soil health. The main purpose of managing the soil health is to take a step towards sustainability.

Keywords: Physico-chemical and biological properties, Soil Health, Sustainability.

Introduction

Soil is a three-dimensional dynamic natural resource which sustains plant growth by providing nutrients, water, and mechanical support. Soil performs various functions in our ecosystem as it provides habitat for organisms which help in enhancing the soil structure, recycling of essential nutrients and help in the management of weeds, pests, and diseases.

Soil health is an integrative property, it is defined as the ability of the soil to function as an essential living system supporting plant growth and maintaining environmental quality. The status of soil health is assessed using soil health indicators, which are a composite set of quantifiable physical, chemical, and biological characteristics related to functional soil processes. (Amit Anil Sahane & Yashbir Singh Shivay, 2021). Healthy soil is an important step towards sustainability as all plant life form depends on it for nutrition.

The idea of soil health was developed as a result of considering soil as a limited and living resource (Joylata Laishram *et al*, 2012). Moreover, Soil security is the capacity of soil to maintain functions that contribute to the well-being of both human and the environment. A secure soil is needed for stable supply of food & fibre, clean freshwater, maintaining the biodiversity, etc. Capability, Condition, Capital, Connectivity, and Codification are the aspects of soil security. Hence, maintenance of soil health and soil security is crucial through monitoring and evaluating the indicators. It is necessary to use the physical, chemical, and biological indicators to determine the soil status and to carry out any remedial management actions to improve soil functions.

The soil properties which can alter quickly in response to natural or anthropogenic activity are considered as good soil health indicators. Bulk density, soil aggregate stability, and water holding capacity have all been determined to be the best physical markers. Chemical indicators including pH, EC, soil organic carbon, and soil nutrient status. However, most of them typically respond slowly compared to microbiological and bio-chemical features, like soil respiration, mycorrhiza, lipid profile and earthworms, since they are changed quickly due to disturbances caused by various agricultural management approaches (M. Raghavendra *et al,* 2020).

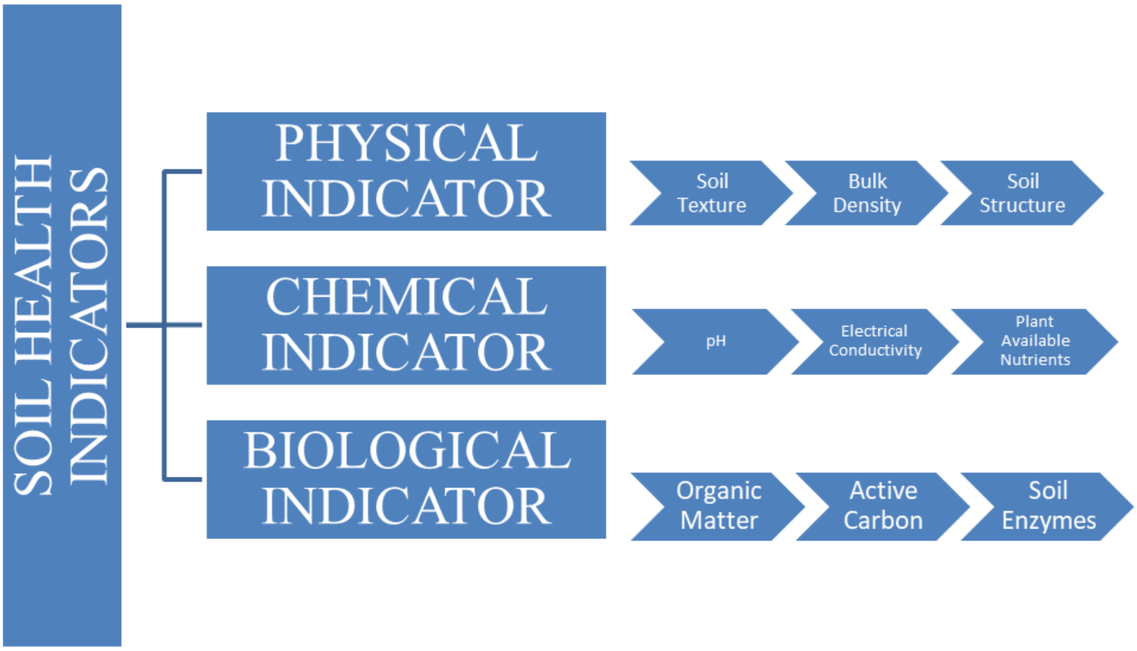


Fig.1: - Different types of Soil Indicators

Different Aspects of Soil Indicators

Soil health indicators are broadly classified into three groups, viz., physical indicators, chemical indicators, and biological indicators. In order to promote sustainable productivity, soil health depends on the physical, chemical, and biological activities of the soil working in co-operation.

Physical Indicators

Simple, quick, and inexpensive methods are frequently used as physical markers of soil health. The physical markers indicate the ability of soil to absorb, transfer, store, and deliver water, nutrients, and oxygen. This involves evaluating the bulk density, aggregate stability, infiltration rate, and distribution of pore size (M. Loganathan and Jothi Narendiran. N., 2014).

Soil Texture

Depending on the relative composition of (sand, silt & clay) agricultural fields can have a variety of soil textures. Soil texture significantly affects the water holding capacity of soil. For example- sandy soils have a higher percentage of water drainage than clayey soils (John Idowu *et al*, 2019).

Clay	< 0.002mm
Silt	0.05 to 0.002mm
Sand	2.0 to 0.05 mm

Table 1: - Relative sizes of Sand, Silt and Clay particles

Bulk Density

Bulk density measures how tightly soil particles are packed together. High levels of soil compaction reduce the amount of space available for air or water in the soil, which influences water infiltration and drainage, plant root growth, and soil microbial populations (John Idowu *et al,* 2019).

Soil Structure

Soil structure defines the distribution of soil aggregate within the soil which affect the movement of water, ability of the soil to resist erosion, and nutrient cycling. The pore size distribution and the soil's resistance to wind and water erosion are both influenced by the distribution of these aggregates' sizes (John Idowu *et al*, 2019).

Chemical Indicators

Soil properties that directly influence plant nutrition are related to chemical indicators. Plants need certain amount of constant nutrition for proper growth. Excess or insufficient amount of nutrients supply can retard the plant growth.

pH: pH is an essential indicator, measured on a scale from 1-14. The ph value of soil can affect the nutrient availability. The ideal range for most of the nutrient absorption is from 6.5-7.5. It also affects the microbial activity in the soil. Absorption and mobility of pesticides vary greatly according to the pH of the soil.

Electrical Conductivity (EC): It is used to measure the soluble salt concentration (Salinity) in the soil. Higher concentrations of salt can lead to decreased absorption of water due to the increased osmotic potential of soil which can stunt plant growth (Elizabeth Stockdale, 2023).

Plant Available Nutrients: For sustainability, adequate balance of the nutrients should be maintained in the soil (input efficiency= output).

Biological Indicators

The living plants, dead organic matter, bacteria, fungi, and a variety of other living species in the soil work together as the primary forces that sustain and even regenerate healthy soil processes (John Idowu *et al*, 2019).

Earthworms: Earthworm's are helpful in the decomposition of soil organic matter and responsible for aeration. The fecal matter of earthworms is high in organic matter concentrations. In addition to improving soil nutrient cycling, earthworms can increase soil water penetration and retention by forming channels in the soil as they migrate upward and downward in search of organic materials to feed (John Idowu *et al*, 2019).

Active Carbon: It is used to evaluate the carbon compounds present in the soil which the microbes can ingest. This promotes the nutrient cycling and availability (Anonymous,2020).

Organic Matter (OM): It is an important soil health indicator; the decomposition of OM is higher in light-textured soils (sandy loam) than in the heavy-textured soils (clays & clay loams (D.M. Sullivan et al, 2019). It improves aggregate stability, water infiltration and soil aeration.

Soil Enzymes: Enzymes present in the soil are responsible for breakdown of organic matter e.g. glucosidase as well as mineralization of nutrients e.g. urease. Enzymes are helpful in accelerating the plant residue decomposition rate to release available nutrient (Anonymous,2011).

Table 2: Measurement of Soil Health Indicators:

Soil Health Indicators	Optimum Values of the Indicators for Agricultural Soils	Unit Of Measurement
Soil texture	Clay 7-27%, silt 28-50% & 23-52% sand	12 classes based on composition of silt, clay and sand
Bulk density	1.33-1.35 Mg m^{-3}	Mgcm $^{-3}$
Aggregate stability	-	mm
Water holding capacity	It is specific to crop.	mm m^{-1}
Infiltration rate	-	mm $hour^{-1}$
Depth of hardpan	-	From surface till the hardpan is observed
Soil structure	Granular	
pH	6.5-7.5	From scale 1-14
Organic matter	-	%
Cation exchange capacity	-	Milliequivalent 100−1 gram soi
Porosity	50% of the total volume	%

(Amit Anil Shahane & Yashbir Singh Shivay, 2021)

References

1. Amit Anil Sahane & Yashbir Singh Shivay (2021). Soil health and its improvement through novel agronomic and innovative approaches. Front.Agron, Vol-3, Pages 1-31.
2. Joylata Laishram, K.G. Saxena, R.K. Maikhuri & K.S. Rao (2012). Soil Quality and Soil Health: A Review. International journal of Ecology and Environmental Sciences 38, Vol-1, Pages 19-37.
3. M. Raghavendra, M. P. Sharma, A. Ramesh, A. Richa, S. D. Billore & R. K. Verma (2020). Soil health indicators: Method and Application. Springer, pages 221-253.
4. M. Loganathan and Jothi Narendiran. N. (2014). characterization of soil quality indicators: A study. Journal of global biosciences, Vol-3(2), Pages 586-592.
5. https://www.soils.org/files/am/pdfs/soil-security-dimensions-brief.pdf
6. https://www.soilquality.org.au/factsheets/making-sense-of-chemical-indicators.

Soil Pollution

Article ID: 40937

Poonam Burdak[1], Meraj Ahmed[1], Sutanwa Saha[1]
[1]Department of Soil Science, School of Agriculture, Lovely Professional University Jalandhar- Delhi G.T. Road, Phagwara, Punjab (India)-144411.

Abstract

Minerals, water, air, organic materials, and countless organisms are complex mixture of soil. Variety of pollutants such as pesticides, insecticides, fertilizers, and chemicals, plastic gets mixed to the soil and cause soil pollution. Acid rain is a natural cause and also affects soil fertility indirectly. Deforestation is also one of the causes of soil pollution. As the number of the trees in the environment decreases, soil pollution will increase.

All these industrial, urban and agricultural wastes thrown in soil without processing and management will cause soil pollution to a massive amount and threatens the life of human, animal and other living beings.

Soil pollution is an environmental issue that effect on all form of life in order to decrease and limit soil pollution; the individuals particularly industrialists should follow all efficient control measures including environmental protection laws. Also, people should encourage the recycling and reuse of solid waste and maximum the trees planting.

Keywords: Soil pollution, industrialization, deforestation, Environmental.

Introduction

The presence of xenobiotic chemicals in the natural soil environment is main reason of soil contamination, soil pollution, or land pollution, which is a component of land degradation. Typically, the main sources of contamination are industrial activities, inappropriate waste disposal or overuses of agrochemicals. Petroleum hydrocarbons, polynuclear aromatic hydrocarbons, solvents, insecticides, lead, and other heavy metals are the most frequently used contaminants.

The level of industrialization and chemical material concentration are associated to contamination. The main concern of soil pollution includes health issues from direct contact with contaminated soil, inhalation of contaminant vapor, or secondary contamination of water sources contained within and under the soil (Mishra *et al.*, 2019).

Contaminated soil sites mapping and clean-ups are time-consuming and costly processes that need for knowledge of geology, hydrology, chemistry, computer modeling, and GIS in Environmental contamination, as well as an understanding of the development of industrial chemistry (George *et al.*, 2014; Jesiya *et al.*, 2019).

The magnitude of polluted soil is most understood in North America and Western Europe, with several of countries in these regions have a legislative framework in place to recognize and address this environmental issue.

Developing nations are typically less strictly regulated, despite the fact that some of them have had tremendous industrialization. It is crucial to realize that all soils contain compounds that are poisonous or hazardous to human and One of the following is frequently the primary contributor to soil pollution:
1. Excessive or incorrect use of pesticides in agriculture,
2. Industrial chemical discharges from mining and manufacturing of goods.
3. Inadequate waste management or ineffective garbage disposal.

The degree of soil pollution directly affects the difficulties in remediating the soil. The need for resources for remediation increases with contamination levels (Chen *et al.*, 2020).

What are the Pollutants that Contaminate Soil?

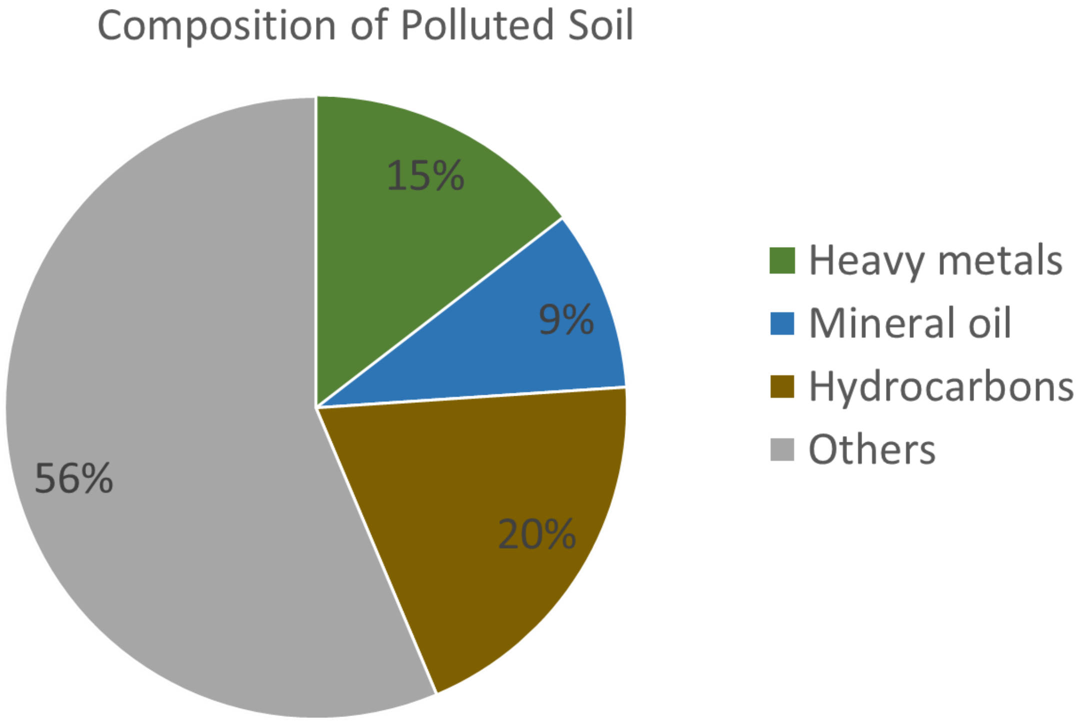


Fig 1: Composition of different soil pollutants

Heavy Metals

Heavy metals (such as lead and mercury, at excessively high amounts) can make soil extremely dangerous for people to consume. The most prevalent heavy metals in soil environments are, arsenic (As), cadmium (Cd), chromium (Cr), mercury (Hg), lead (Pb), copper (Cu), zinc (Zn) and nickel (Ni).

Table 1: Concentration of different heavy metals in soil:

Heavy metals	Concentration mg/kg in soil
Manganese (Mn)	309.36
Chromium (Cr)	157.87
Copper (Cu)	73.80
Arsenic (As)	1.44
Cadmium (Cd)	0.7
Bariium (Ba)	108.13
Mercury (Hg)	0.-24
Lead (Pb)	31.30

Note. From "Toxic and heavy metals contamination assessment in soil and water to evaluate human health risk," by Ahmad, W., Alharthy, R.D., Zubair, M. et al., 2021, *Sci Rep,* 11, p. 17006. https://doi.org/10.1038/s41598-021-94616-4. Copyright by CC-BY-NC.

1. Agricultural activities:

a. Soil pollution is cause by agricultural practices.
b. Excessive use of fertilizers.
c. Inappropriate use of pesticides.
d. Runoff of applied chemicals by rain or irrigation contaminates the local water system or deposited to other areas.
e. These pollutants penetrate deeply into the soil and contaminate the ground water.

2. Urban activities:

a. Human activities both directly and indirectly can cause soil pollution.
b. Increased runoff and improper drainage contaminate the nearby land or streams.
c. Improper disposal of trashes can release variety of chemicals.
d. Bacteria are more prevalent in the soil when there is an abundance of waste deposition.

e. Methane gas produced by bacterial decomposition contributes to the global warming and poor air quality. Additionally, it produces unpleasant smells and may lower quality of life.

3. Industrial waste:

a. Approximately 90% of soil pollution is brought by industrial waste.
b. Harmful chemicals are introduced to the environment through improper waste disposal
c. These pollutants have an impact on local water resources, drinking water supplies and plant and animal species.
d. Toxic vapours from landfills subject to regulation contain compounds that may return to the earth as acid rain and harm the soil profile.

4. Acid rain: It is caused when airborne contaminants combine with rain and fall back again on the ground. The contaminated water may dissolve some of the crucial elements in the soil and alter its composition, rendering it unusable for cultivation. This indicates that the food chain may be impacted by acid rain because it may badly harm plants and important soil bacteria (Chen *et al.*, 2020).

5. Oil spill: Oil leaks can occur during the storage or transport of chemicals. Chemicals in the fuel degrade the quality of the soil and render it unfit for future cultivation. Chemicals may also enter the groundwater via the soil, rendering the water unfit for human use.

Processes that Cause Soil Pollution

The process of soil pollution can be classified into two categories:
1. Naturally caused soil pollution
2. Man-made soil pollution (anthropogenic soil pollution).

Naturally caused soil pollution: Some contaminants spontaneously assemble in soils through few highly rare processes. This may happen as a result of differential deposition of the soil by the atmosphere. The movement of soil contaminants with precipitation water is another way that this kind of soil pollution may happen. For example, percolate anions ($ClO4^-$) can be formed in soils containing chlorine and certain metals during a thunderstorm.

Man-made soil pollution (anthropogenic soil pollution): Almost all incidences of soil contamination are caused by human activity. There are several human activities that might contaminate soil. Here is a list of some of these procedures.

a. Demolition of old structures can contaminate the adjacent soil with asbestos.
b. Lead-based paint used during building constructions, has the potential to contaminate the soil with dangerous levels of lead.
c. The hydrocarbons in petroleum may pollute soils when gasoline and diesel spill during transportation.
d. The dispersion of metallic pollutants into the neighboring soils is often a result of activities connected to metal casting plants (foundries).
e. Land may get contaminated with heavy metals as a result of underground mining operations.
f. Highly hazardous industrial and chemical waste that is improperly disposed of my seriously damage the earth. For instance, the disposal of hazardous material in landfills may cause soil contamination. Groundwater may also get contaminated by this garbage.
g. Chemical pesticides include a number of dangerous ingredients. Use of chemical pesticides too often or ineffectively may seriously pollute the soil.
h. Urban sewage production may potentially pollute the land (if not disposed of correctly). These wastes might potentially include a number of carcinogens.

Effect of Soil Pollution

Soil pollution causes a wide range of unfavorable effects that harm people, animals, plants, and the environment as a whole. Children are more vulnerable to illness; thus, contaminated soil is more dangerous to them. Some significant effects of soil contamination are given in subsection,

1. On ecosystem: Contaminants in soil may have a serious negative impact on ecosystems. Even at low concentrations, the hazardous compounds may cause drastic changes in soil chemistry. The metabolism of indigenous microorganisms and arthropods living in a certain soil environment may change as a result of these alterations. As a result, some of the fundamental food chains may be almost eliminated. This might have serious repercussions for predator or consumer species.

2. On plants and animals: Plant growth can be stunted because soil contamination is often accompanied by a reduction in the availability of nutrients. Soil pollution also increases soil salinity which makes the soil inhospitable for plant growth. Plants that are grown in polluted soil, can bioaccumulate the pollutants and these passed up through food chain which causes extinction of many desirable animal species.

3. On human beings: Depending on the kind of pollutant, the route of attack, and the susceptibility of the exposed population, there are a wide range of health effects associated with exposure to soil pollution. Soil pollution may cause a variety of health issues, starting with headaches, nausea, exhaustion, skin rashes, and eye irritation, it may end in a number of severe conditions including neuromuscular blockage, kidney and liver damage, and different cancers.

Control of Soil Pollution

1. Reducing chemical fertilizer and pesticide use: Applying bio-fertilizers and manures can reduce chemical fertilizer and pesticide use. Biological methods of pest control can also reduce the use of pesticides and thereby minimize soil pollution.

2. Reusing of material: Materials such as glass containers, plastic bags, paper, cloth etc. can be reused at domestic levels rather than being disposed, reducing solid waste pollution.

3. Recycling and recovery of materials: this is a reasonable solution for reducing soil pollution. Materials such as paper, some kinds of plastics and glass can and are being recycled.

4. Solid waste treatment: new areas for storage of hazardous waste should be investigated such as deep well injection and more secure landfills. Burying the waste in locations situated away from residential areas is the simplest and most widely used technique of solid waste management.

5. Reforesting: Control of land loss and soil erosion can be attempted through restoring forest and grass cover to check wastelands, soil erosion and floods. Crop rotation or mixed cropping can improve the fertility of the land.

Conclusion

High levels of noxious chemicals or other pollutants in the soil cause soil contamination. They endanger the ecology. Soil contamination is brought on by industrial activities, inappropriate waste management, acid rain, deforestation, and agricultural chemicals. Chemical fertilizers used in excess can affect the pH of the soil and damage the soil's structure. Zinc, nickel, and cadmium are three toxic elements that can build up in the soil and eventually make their way into fruits and vegetables. People should reuse and recycle materials in order to prevent soil pollution. To stop this pollution from having negative effects, action must be taken.

References

1. Chen, C., Zhang, X., Chen, J., Chen, F., Li, J., Chen, Y., & Hou, H. (2020). Assessment of site contaminated soil remediation based on an input output life cycle assessment. *Journal of Cleaner Production*, *263*, 121422.
2. Mishra, R. K., Mohammad, N., & Roychoudhury, N. (2016). Soil pollution: Causes, effects and control. *Van Sangyan*, *3*(1), 1-14.
3. George, R., Joy, V., Aiswarya, S., & Jacob, P. A. (2014). Treatment Methods for Contaminated Soils—Translating Science into Practice. *International Journal of Education and applied research*, *4*, 17-19. Cappuyns, V. (2013): Environmental impacts of soil remediation activities: quantitative and qualitative tools applied on three case studies. Journal of Cleaner Production; 52: 145-154.
4. Jesiya, N. P., & Gopinath, G. (2019). A Customized FuzzyAHP-GIS based DRASTIC-L model for intrinsic groundwater vulnerability assessment of urban and peri urban phreatic aquifer clusters. *Groundwater for Sustainable Development*, *8*, 654-666.

Hydroponics: The Modern Agricultural Technology

Article ID: 40938

Sameer Saharan[1], Rahul Bhadu[1], Princy Thakur[2], Sutanwa Saha[2], Meraj Ahmed[2]
[1]Research Scholar, [2]Assistant Professor, School of Agriculture, Department of Soil Science and Agricultural Chemistry, Lovely Professional University, Phagwara, Punjab, India – 144411.

Abstract
Hydroponics is a method of growing plants using mineral nutrient solutions in water, without soil. This method can be used to grow a wide variety of plants, including fruits, vegetables, and herbs, and is often used in controlled environments such as greenhouses or indoor settings. Hydroponics can be beneficial for increasing crop yields, reducing the use of water, and allowing for year-round crop production. It can also be a useful method for growing plants in areas where soil quality is poor or non-existent.

Importance of Hydroponics

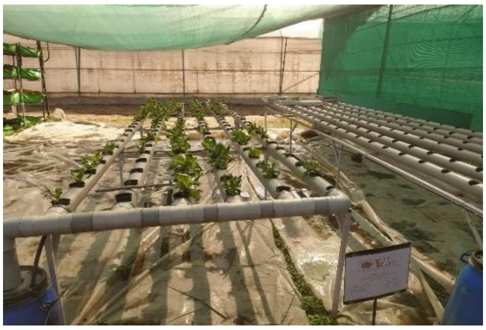


Figure 1: Hydroponics structure at Polyhouse Research farm, LPU

Increased crop yields: Hydroponic systems can produce higher yields per square foot than traditional soil-based systems, as plants are grown in a controlled environment and can receive the exact amount of water, nutrients, and light they need to thrive. Hydroponic systems use significantly less water than traditional soil-based systems, as the water can be recycled and reused in fig.1. Year crop production: Hydroponic systems can be used to grow crops indoors or in greenhouses, allowing for year-round crop production regardless of weather conditions. Soil-less gardening: It eliminates the need for soil, which can be beneficial in areas where soil quality is poor or non-existent.

Space-saving: Hydroponic systems can be set up in smaller spaces, such as apartment balconies or rooftops, making it possible to grow plants in urban areas where traditional gardening is not feasible. Reduced use of pesticides and herbicides: In a controlled environment, pests and diseases can be more easily controlled, reducing the need for pesticides and herbicides. Environmentally friendly: Hydroponics can reduce the carbon footprint by reducing the need for the transportation of crops and it could also be a solution for food production in arid regions or in places where water is scarce (Mamta & Shraddha 2013).

Methods of Hydroponics

Deep Water Culture: Plants are suspended in a container of nutrient-rich water, with their roots submerged. An air pump is used to add oxygen to the water and keep the roots healthy. Nutrient Film Technique: A shallow stream of nutrient-rich water is constantly flowing through a channel, and the plant's roots are suspended in the water. The constant flow of water ensures that the roots are oxygenated and the plants receive the necessary nutrients fig.2.

Drip Irrigation: Water and nutrients are delivered to the plants via a system of tubing and drippers. This method allows for precise control of the water and nutrient delivery and is often used in commercial hydroponic systems.

Ebb and Flow (Flood and Drain): A tray containing plants is periodically flooded with nutrient-rich water, and then drained. This method allows for oxygenation of the roots and can be easily automated.

Figure 2: Precise control of the water and nutrient delivery at Polyhouse Research farm, LPU

Aeroponics: Plant roots are suspended in the air and misted with nutrient-rich water. This method uses less water than other methods and allows for the highest oxygenation of the roots (Roberto, 2022).

Management Practices

Water and nutrient management: Maintaining the proper balance of water and nutrients is essential for healthy plant growth. This includes regularly testing the pH and nutrient levels in the water, nd adjusting as necessary. Adequate lighting is crucial for photosynthesis and plant growth. The type and intensity of lighting will depend on the type of plants being grown and the stage of growth.

Temperature and humidity: Proper temperature and humidity levels are essential for the growth and health of plants. This may involve using heating and cooling systems, as well as humidifiers and dehumidifiers. Pest and disease management: Hydroponic systems can be more susceptible to pests and diseases, so it's important to regularly inspect plants and act if any issues are detected. Adequate air circulation is important to ensure that the plants receive the necessary CO_2 for photosynthesis and that the roots are oxygenated.

Automation: Automation can make hydroponic management easier and more efficient. Automated systems can be used for watering, lighting, temperature and humidity control, and nutrient delivery. Regular cleaning and maintenance of the hydroponic system is important to ensure that it continues to function properly and to prevent the buildup of harmful bacteria and pathogens (Jyan and Meenakshi 2021).

Future of Hydroponics in India

Food Security: Hydroponics can help to increase food production in India, which is important for a country with a rapidly growing population. With the ability to grow crops year-round, hydroponics can help to ensure a steady supply of fresh produce, even in areas where traditional agriculture is not possible.

Control of contaminants: Contaminants need to be eliminated under a strictly sterile root-zone environment. This is essential for good plant vigour under a soil-less culture. This is the most difficult step as it is extremely hard to achieve and also maintain such an environment in the root zone. Still, it is critical to minimize population of plant pathogens like Fusarium and Verticillum which cause wilt and Pythium and Phytophthora which destroy all but the main roots. No effective fungicides have been discovered which can be safely used in hydroponics however complete heat treatment (at about 20-22 ^{o}C) of the solution is found to be effective in sterilization.

Water scarcity: Hydroponics can help to conserve water, which is a critical resource in India. Hydroponic systems use significantly less water than traditional soil-based systems, and the water can be recycled and reused.

Urban agriculture: With the increasing population density in urban areas, traditional agriculture is becoming increasingly difficult. Hydroponics can be set up in smaller spaces, such as apartment balconies or rooftops, making it possible to grow plants in urban areas where traditional gardening is not feasible.

Research and development: There are a growing interest in hydroponics in India, and research and development in this field is increasing. This will help to develop more efficient and sustainable hydroponic systems, and to improve the understanding of the technology (Madhuri Shrikant Sonawane 2018).

References

1. Ms. Mamta, D. Sardare, Ms. Shraddha V. Admane (2016) - A Review On Plant Without Soil – Hydroponics- volume 2, issue 3, page no. 299-304
2. Roberto S. Velazquez-Gonzalez , Adrian L. Garcia-Garcia , Elsa Ventura-Zapata , Jose Dolores Oscar Barceinas-Sanchez and Julio C. Sosa-Savedra (2022) -A Review on Hydroponics and the Technologies Associated for Medium- and Small-Scale Operations, Page no. 646
3. Madhuri Shrikant Sonawane March 2018 -Hydroponics : An upcoming and innovative way of future farming Vol 9 [1] page no 69-74.

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

Challenges and Opportunities in the Cultivation of Ashwagandha (*Withania Somnifera* Dunal)

Article ID: 40939

Koushik Mondal[1], Anusree Paul[2]

[1]Ph.D. Research Scholar, Department of Agronomy, Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan, West Bengal – 731236

[2]Ph.D. Research Scholar, Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal – 741252.

Abstract

Ashwagandha or Winter cherry (*Withania somnifera*) is an important medicinal plant that originated in India. The plant part of roots is extensively used in Ayurvedic medicine since ancient times. The roots are credited with numerous medicinal properties. A recent medical study proposes phytochemical withaferin which is present in the leaves possesses anti-cancer activity. It is a drought-tolerant annual crop that is grown in marginal soils by small and marginal farmers in Madhya Pradesh, Andhra Pradesh, Rajasthan, Karnataka, and other Indian states. Farmers are drawn to large-scale cultivation due to the ease of cultivation and the high price of the roots. In addition to the roots, leaves and seeds are marketed, increasing farmer profits. The future looks bright for expanding its cultivation and producing a wide range of value-added products from its roots.

Keywords: Ashwagandha, Challenges and opportunities, Uses, Winter cherry.

Introduction

Ashwagandha *(Withania somnifera)* is a valuable medicinal plant that has long been utilised in Ayurvedic and indigenous medicine. Ashwagandha is also known as Indian ginseng and Indian Winter Cherry, and its roots have been used in Ayurvedic and Unani ancient systems of treatment. Over 4000 years ago, sage Punarvasu Atreya addressed ashwagandha for the first time. The medicinal qualities of this plant were later noted in Ayurvedic treatises such as Charaka Samhita, Sushruta Samhita, Astanga Hridaya, and others. This plant is used in the preparation of 200 traditional medicinal formulations in the Ayurvedic, Siddha, and Unani systems. The entire plant is reputed to have therapeutic qualities (Singh and Kumar, 1998).

Farmers are attracted to large-scale cultivation due to the low cost of cultivation and the high value of the roots (Rao et al., 2012). It grows in subtropical dry areas like Rajasthan, Maharashtra, Madhya Pradesh, Haryana, Gujarat and Uttar Pradesh. Ashwagandha's demand for roots has increased in the domestic market over the last decade. The demand for ashwagandha alkaloids has also increased in the international market. The farming of Ashwagandha started in the late 90s and at the start of the 21st century, before that it was collected from forest areas to meet the domestic demand.

Uses and Pharmacological Activities

Modern research suggests that Ashwagandha may be advantageous for a variety of purposes. However, much remains unknown about how the plant interacts with the human body. A majority of the studies so far- while very promising- have been done on animals. This plant's preparations were used in folk medicine to treat asthma, arthritis, bronchitis, adenopathy, anthrax, cancer, candida, cold, cough, cystitis, debility diarrhea, dropsy, dyspepsia, fever, gynecopathy, hiccup, hypertension, piles, inflammation, lumbago, psoriasis, ringworm, scabies, senility, nausea, smallpox, sores, syphilis, typhoid and wounds.

Traditional systems of medicine use ashwagandha-derived drugs to treat nerve problem, stress, anxiety, high blood pressure, insomnia, ageing, sexual disorder. Leaves are used for treating fever, swelling, lesions, sore eyes and syphilitic sores. Green berries are used for treating animal sores, ringworm infection and horse's girth galls (Singh and Kumar, 1998).

Chemical Constituents

The biologically active chemical constituents of *Withania somnifera* (WS) include alkaloids (isopelletierine, Tropine, anaferine, cuseohygrine, anahygrine, cuscohygrine 3-tigloyloxtropine, 3-tropyltigloate, hygrine, mesoanaferine, choline, somniferine withanine, hentriacontane, visamine, and withasomnineetc.), steroidal lactones (withasomidienone, withanolides, Withanone, , withasomniferols A-C, withaferins) and saponins (sitoindoside VII and VIII) (Mishra et al., 2000). Ashwagandha's sitoindosides and acylsterylglucosides are anti-stress agents. Ashwagandha's active constituents, such as sitoindosides VII-X and Withaferin-A, have been shown to exhibit considerable anti-stress action against acute forms of experimental stress (Bhattacharya et al., 1987).

Opportunities

Due to its rich biodiversity, India is a treasure trove of medicinal plants and a gold mine of medicinal knowledge. It is the second largest exporter of medicinal plants in the world, after China, and is home to more than 300,000 herbal medicine preparations used in ancient healing systems like Ayurveda, Unani, and Homeopathy. The demand for medicinal plants is increasing globally and has the potential to generate a higher income for farmers than traditional crops. It encourages small farmers to implement a resource shift from cereals and low-value crops to medicinal and aromatic plants with high value. These high-value plants necessitate fewer inputs, resulting in greater income realisation for farmers and facilitating their production in harmony with the environment.

Global interest in this plant and the high demand for its roots provide great opportunities for commercial cultivation (Kattimani et al., 2001). Other opportunities are remunerative return, the present market price of the root, cultivation can be done in rainfed conditions, and in an integrated cropping system with traditional crops.

Value Addition

In addition to the traditional medicines derived from this plant, Ashwagandha is also used to make root powder, capsules, root extract, herbal beer, etc.

Health drinks, herbal tea, functional foods, nutraceuticals, and cosmeceuticals are examples of products with added value on which businesses can be founded.

Challenges

1. Market exploitation of farmers by middlemen: Profit-seeking middlemen pose the greatest obstacle to boosting farmers' income in India. Commission agents, traders, and wholesalers take a sizable portion of farmers' profits.

2. Limited exports: Most of the farmers cultivate the ashwagandha plant on a small scale and on fragmented land, they target only the domestic market. So, the export opportunity for small-scale farmers is very less, due to improper channel of distribution.

3. Price fluctuations of roots: Prices of agricultural products fluctuate more than those of manufactured goods. In other words, the price volatility of agricultural products is greater than that of manufactured goods. There are numerous factors that contribute to price fluctuations. Some of these factors cause temporary fluctuations, while others have longer-lasting effects. All factors that cause price fluctuations have direct or indirect effects on demand or supply.

4. Changing climatic conditions: The secondary metabolites of plants are the source of pharmaceutical industrially important biochemicals. The growth of a plant and the production of secondary metabolites are affected by environmental factors, such as temperature, humidity, light intensity, water, minerals, and CO2. The effects of climate change on the life cycles and distribution of the world's vegetation, including wild medicinal plants, are observable.

5. Patenting by foreign companies: Approximately eight patent applications have been filed in India by Indian and Japanese entities. Twelve additional patents mentioning Ashwagandha have been filed by Indian and American companies and institutes in India and the United States, demonstrating the interest shown by foreign companies in this plant. Approximately eight patent applications have been filed in India by Indian and Japanese entities. Twelve additional patents mentioning Ashwagandha have been filed by

Indian and American companies and institutes in India and the United States, demonstrating the interest shown by foreign companies in this plant. This is a challenge that needs to be addressed immediately.

6. long duration of the crop: The crop is ready for harvest 180-210 days after planting. Within this time any conventional crop harvested and the next crop also be sown, so farmers get more interest in conventional crops rather than medicinal crops like ashwagandha.

7. Pests and diseases infections reducing yield and resulting in plant mortality: A number of leaf-eating pests (mites, aphids, beetles) and diseases (seedling blight, leaf blight, die back etc.) are reported on Ashwagandha

8. Low root yields, high fibre content of the roots in some locations.

Side Effect

Small to moderate doses of ashwagandha is considered as generally well-tolerated. However, there are insufficient long-term studies to examine potential side effects. Women who are pregnant should avoid using ashwagandha because it can induce labour. The fact that Ayurvedic herb manufacturers are not regulated by the U.S. Food and Drug Administration is a potential source of concern (FDA).

Conclusion

Ashwagandha is a promising medicinal plant from India with possibilities for international trade. Even though it has potential as a medicinal crop, relatively little research has been done on it. On this crop, more academic study is badly needed. It is expected that extending its cultivation and production has a bright future.

References

1. Bhattacharya SK, Goel RK, Kaur R, Ghosal S. (1987). Anti-stress activity of Sitoindosides VII and VIII. New Acylsterylglucosides from *Withania somnifera*. *Phytother Res.*1(1) :32–37
2. Kattimani K.N., Reddy Y.N. and Rajeswara Rao B.R. (2001) J. Med. Arom. Pl. Sci., 22(4A) and 23(1A), 221–223
3. Mishra LC, Singh BB, Dagenais S. (2000) Scientific basis for the therapeutic use of Withania somnifera. (Ashwagandha): A review. *Alternative Medicine Reviews.*5 (4):334–346.
4. Rajeshwara Rao B R, Rajput D K, Nagaraju G and Adinarayana G. (2012). *Journal of Pharmacognosy*, 3. (2), 88-91
5. Singh S. and Kumar S. (1998) Withania Somnifera: The Indian Ginseng Ashwagandha, 293

Soil Pollution with Pesticides and its Influence: A Review Article

Article ID: 40940

Mayukh Barman[1], Princy Thakur[2], Sutanwa Saha[2], Meraj Ahmed[2]
[1]Research Scholar, [2]Assistant Professor, School of Agriculture, Department of Soil Science, Lovely Professional University, Phagwara, Punjab, India – 144411.

Abstract
There is a lack of comprehensive studies on soil biological activity, and little attention has been paid to the impact of various pesticides and their metabolites. It is crucial to monitor the effects of pesticides on soil health, as this remains a significant concern. This article provides a summary of the most recent scientific research on changes in soil enzymes, microbial activity, and subsoil biochemistry resulting from the use of pesticides. However, the diversity in pesticide structures and changes in degradation pathways makes it challenging to interpret the enzymatic and microbiological responses following pesticide application. Since soil-applied pesticides are typically composed of various active ingredients, it is difficult to study their effects on soil bioactivity.

Keywords: Soil Pollution, Green revolution, chemical fertilizers, pesticides, inorganic and organic contaminants, biochar, environment, human health.

Introduction
The objective of agriculture is to fulfill the current food demands of society and have a surplus for future needs and exportation. To increase agricultural productivity and production, the use of chemical inputs such as pesticides has become more prevalent. Pesticides are chemical substances created to exterminate pests. They may be chemical or biological agents such as viruses, bacteria, antimicrobials, or disinfectants that deter, incapacitate, or kill pests. Farmers use pesticides to eliminate or regulate a range of agricultural pests that can cause harm to crops and livestock and reduce farm productivity. Pesticides have been a blessing for farmers and people around the world since they have increased agricultural yields. The application of pesticides in Indian agriculture increased after the announcement of the Green Revolution, which aided the country in addressing the major issue of food scarcity. However, the use of pesticides also has long-term negative consequences on the environment and human health. Currently, India is the largest producer of pesticides in Asia and ranks twelfth in the world in their use.

Soil is a mixture of both organic and inorganic components and exists in three physical states - gas, liquid, and solid. It serves as a natural habitat for the growth and development of plants and microorganisms by providing a medium for storing water and essential nutrients. Despite variations in composition and environmental factors, soils are fundamental in sustaining plant growth by acting as a critical source of moisture and nutrients (Wołejko et al., 2020).

Soil is an environment that supports the growth and development of plants, consisting of both organic and inorganic elements in gas, liquid, and solid forms. Although soils can vary greatly in genetic composition and ecological conditions, they play a crucial role as storage for the water and nutrients necessary for the proper growth of plants and microorganisms.

Pesticides are the most frequent xenobiotic pollutants in soil. Their position is influenced by tremendous population expansion over the last 50 years, as well as an increasing demand for high-quality food. To deal with this condition, agricultural producers frequently implement pesticide-intensive processes, resulting in greater accumulation in the surface layers of soil and persistence in the environment.(Oberemok et al., 2015), in 2050, the use of pesticides in agricultural will be 2.7 times greater than in 2000, which probably will cause an increasing danger to human health for future generations.

Pesticides are a broad category of chemical substances, both inorganic and organic. The World Health Organization (WHO) categorizes their toxicity into four levels: extremely hazardous (Ia), very hazardous (Ib), moderately hazardous (II), and somewhat hazardous (III). The most dangerous levels, Ia and Ib, consist of 86 pesticides, including 5 herbicides, 8 fungicides, 51 insecticides, and 22 chemicals intended to control plant diseases.(*The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification 2009*, n.d.)

Pesticide active ingredients pollute the soil environment, impacting microorganisms that live there. As a result, they may disrupt the right order of metabolic processes in soil biogeochemical cycles (Verma et al., 2014).

Influence of Pesticides on Biological Soil Activity

The study of soil matrix is challenging due to its complex composition shaped by numerous intersecting environmental factors such as humic acids and pesticides. These parameters impact the activity of microorganisms and soil enzymes. Synthetic pesticides, in particular, pose significant environmental concerns due to their slow degradation process, which can lead to long-term contamination. These chemicals bind with organic and inorganic substances in the soil and can be toxic to both higher organisms and the microorganisms that inhabit the soil.

The effective breakdown of pesticides in soil depends on the ability of organisms to not only metabolize and break down the chemicals, but also to survive in contaminated environments. The rate of degradation is influenced by several factors such as the physical and chemical properties of the residue, soil characteristics, weather conditions (temperature, rainfall, and humidity), and the presence of microorganisms capable of decomposing the pesticides.

In soil, pesticides undergo various biochemical and physical transformations that result in the formation of various metabolites. Some of these metabolites have limited effects on microbes, while others can be harmful. Most pesticides cause the death of certain bacteria, leading to the emergence of new microbial populations. A study found that fungicides such as benomyl, captan, and chlorothalonil had a detrimental effect on some fungi in soil, causing a surge in bacterial activity. Soils can be polluted by various chemicals, which may include both simple inorganic ions and complex organic molecules. These pollutants can be broadly classified into two major groups: inorganic and organic contaminants.

The inorganic contaminants include metals (e.g., Cd, Cr, Cu, Hg, Mn, Ni, Pb, V, and Zn), metalloids (e.g., As, Bo, and Sb), nonmetals (e.g., Se), actinoids (e.g., U), and halogens (e.g., I and F). (Hooda, 2010)

Some elements are vital for life and are known as micronutrients, which can be beneficial in small quantities but become toxic when their levels exceed certain thresholds. These micronutrients include elements such as boron, chlorine, copper, iron, manganese, molybdenum, and zinc. However, there are also toxic elements that can be harmful at any concentration, such as mercury, arsenic, and thallium. Certain elements can also form organometallic compounds that are lipophilic and highly toxic, such as methylmercury and tributyl tin oxide. These elements are widely present in the environment and occur at concentrations lower than 100 mg kg-1, which are considered trace elements.

The geographical distribution of microorganisms responsible for excreting a range of enzymes also influences soil health.

Pesticides and Microbiological Activity in Soil

Soil microorganisms play a critical role in element circulation and the breakdown of organic matter leftovers, influencing the nitrogen and carbon cycles. Their strong activity is focused in the topsoil, which can range in depth from a few centimeters to 25 cm. Furthermore, microbes help to convert and degrade waste materials and manufactured organic molecules.

They also have an impact on the physical qualities of soil. As a result, microbes may be a good predictor of soil health change, offering an early indication of soil improving quality or an early warning of soil deterioration.(Mahdi et al., 2017)

Interestingly, microorganisms subjected to pollution create systems that allow them to adapt to their surroundings, which on bacterial enzymes support. This function is assumed to have developed so that microorganisms might benefit from the active ingredient in pesticides in the soil environment. Herbicides also impair bacterial metabolism, resulting in a reduction in soil enzymatic activity and therefore disruption of biological nitrogen binding.(Singh, 2016).

Pesticides' Harmful Impacts on Biology of Soil Activity that should be Avoided

Given the harmful impact of pesticide release on the environment, it is essential to find ways to increase soil biological activity while ensuring safe and effective pesticide degradation. However, the development of such methods is challenging due to a shortage of data on the use of pesticides along with other treatments that enhance their biodegradability and impact on soil microbial activity.

According to research, biochar is a viable solution for rehabilitating soil contaminated with pesticides. Biochar is created by heating agricultural waste such as wood, crop residues, and animal waste without oxygen.(Ahmad et al., 2014) It is a rich source of carbon and has been found to improve the properties of damaged soil, including pH, Cation Exchange Capacity, water retention, and fertility. Furthermore, studies have shown that biochar can decrease the availability of pesticides in the environment. With its high organic carbon content, biochar serves as a soil amendment, enhancing its physical and biological properties. An increase in organic carbon levels also enhances soil's water-holding capacity.

According to the literature, individual strains of bacteria or fungi can degrade the active component of a pesticide; but, this process is slower than that of a consortium of microorganisms. This is due to the fact that a consortium may include many types of bacteria and fungus. They can become active at various phases of decomposition and use pesticide degradation products, leading in pesticide breakdown that is faster.

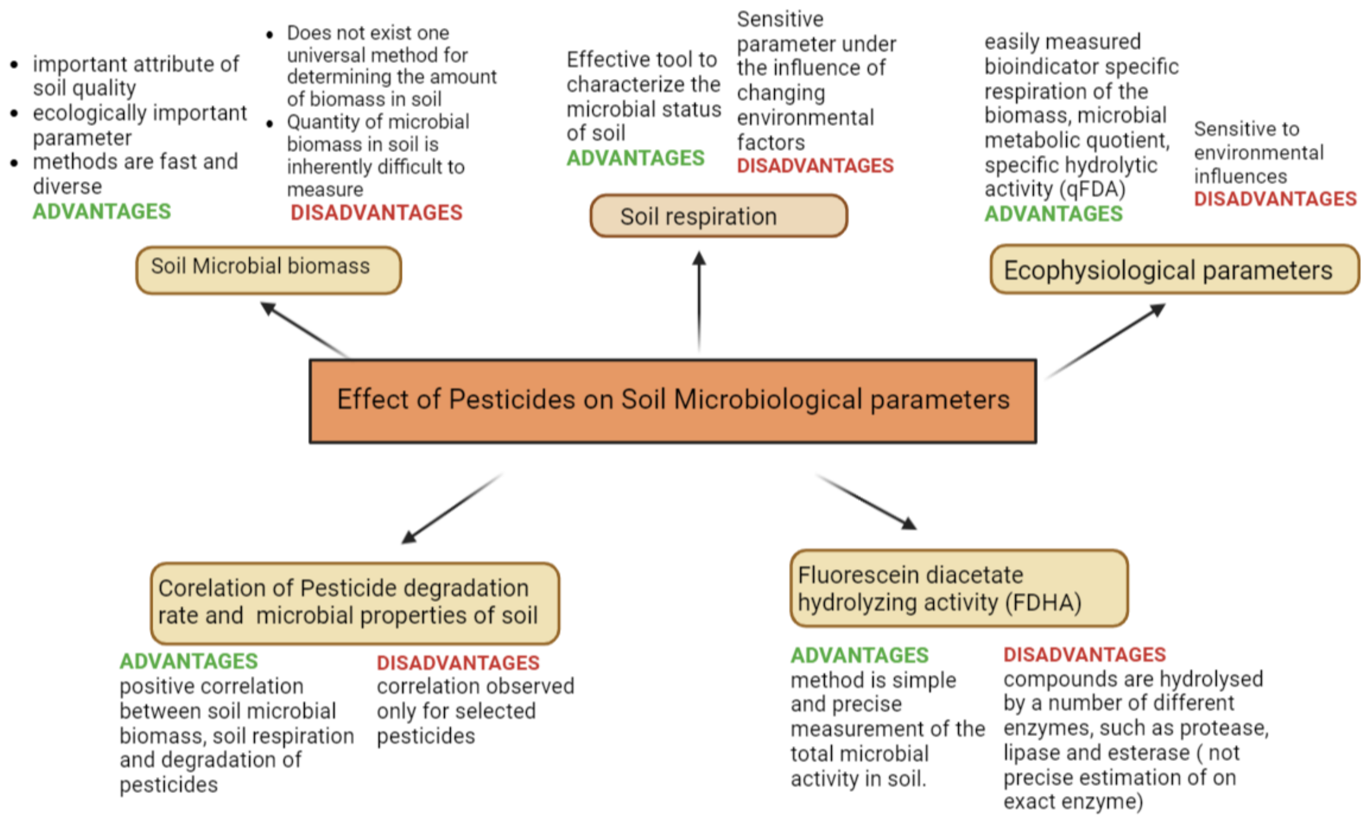


Fig. 1 Effect of pesticide on soil microbiological parameters

Minimizing the Adverse Effects of Pesticides on the Soil's Biological Functions

After reviewing the literature, it has been observed that farmers often do not take proper safety precautions when applying pesticides, leading to excessive use of these chemicals. This not only causes several human health diseases but also pollutes our air, land, and water. Since a significant proportion of the population depends on agriculture for subsistence, pesticides are widely used in agriculture to protect yields from potential threats. To protect human life and the environment from the harmful effects of pesticides, appropriate measures need to be taken. Organic farming is an environmentally friendly agricultural approach that promotes proper human health and is the solution to this problem. By adopting organic agriculture, we can take a step towards sustainability and move towards the course of our ancestors.

Organic farming is a holistic production and management system that supports the environment, health, and sustainability.

It has been observed that farmers frequently fail to take proper safety precautions when applying pesticides, resulting in the overuse of these chemicals. This not only causes various human health disorders but also pollutes our air, land, and water. Since a major section of the population depends on agriculture for livelihood, pesticides are routinely utilised in agriculture to safeguard harvests against possible hazards. Appropriate steps must be implemented to safeguard human life and the environment from the adverse effects of pesticides. Organic farming is the solution to this problem since it is an environmentally friendly agricultural technique that supports optimum human health. We may take a step towards sustainability and follow in the footsteps of our forefathers by adopting organic agriculture.

Summary

The widespread use of pesticides in agriculture has led to concerns about soil degradation caused by these chemicals. Pesticides are commonly found to persist in soil, undergoing both biological and physical changes that impact the growth of microbes and the activity of soil enzymes. According to Yang the persistence of pesticide-active chemicals in soil may lead to a worsening of soil degradation over time.

In the natural environment, the breakdown of pesticides by microorganisms involves the transformation of multiple compounds, while laboratory studies tend to focus on the degradation of a single active ingredient. Such laboratory experiments provide insight into the degradation mechanisms of specific pesticide components. However, few studies have explored the degradation of pesticide mixtures in soil, considering the influence of other physical and chemical soil variables. Advances in genetic engineering and biotechnological tools have allowed researchers to investigate how microorganisms break down pesticides. The creation of genetically engineered microorganisms with improved degradation capabilities holds the potential for more effectively breaking down complex mixtures of environmental contaminants, including pesticides.

Pesticides have undoubtedly had a negative influence on soil fertility. Pesticide-contaminated soil has received a lot of attention since it has a negative influence on human health and the natural ecology.

Bioremediation offers enormous promise for the cleanup of pesticide-affected soils. Pesticides can be removed from the environment by microorganisms found in soil. The biopesticide enzymatic degradation of contaminated environments is the most significant technique for pollutant removal, and the breakdown of persistent chemical compounds by enzymatic processes has been proven to have a high bioremediation potential.

As a result, bioremediation is a far more viable technique to overcoming pesticide pollution that will undoubtedly address the problem of pesticide contamination of soils. This method has repeatedly demonstrated its ability to breakdown not just pesticides but also different chemical substances. So now is the moment to put this eco-friendly technology to use for a brighter and safer future.(Baba et al., 2016).

References

1. Ahmad, M., Rajapaksha, A. U., Lim, J. E., Zhang, M., Bolan, N., Mohan, D., Vithanage, M., Lee, S. S., & Ok, Y. S. (2014). Biochar as a sorbent for contaminant management in soil and water: A review. Chemosphere, 99, 19–33. https://doi.org/10.1016/J.CHEMOSPHERE.2013.10.071
2. Baba, U., Mudasir, S., Nazir, R., & Uqab, B. (2016). Citation: Uqab B, Mudasir S, Nazir R (2016) Review on Bioremediation of Pesticides. J Bioremediat Biodegrad, 7(3), 343. https://doi.org/10.4172/2155-6199.1000343
3. Hooda, P. S. (2010). Introduction. Trace Elements in Soils, 1–8. https://doi.org/10.1002/9781444319477.CH1
4. Mahdi, J. E., Abbott, L. K., Pauli, N., & Solaiman, Z. M. (2017). Biological indicators for soil health: Potential for development and use of on-farm tests. Modern Tools and Techniques to Understand Microbes, 123–134. https://doi.org/10.1007/978-3-319-49197-4_8/COVER
5. Oberemok, V. V., Laikova, K. V., Gninenko, Y. I., Zaitsev, A. S., Nyadar, P. M., & Adeyemi, T. A. (2015). A short history of insecticides. Journal of Plant Protection Research, 55(3), 221–226. https://doi.org/10.1515/JPPR-2015-0033
6. Singh, K. (2016). Microbial and Enzyme Activities of Saline and Sodic Soils. Land Degradation & Development, 27(3), 706–718. https://doi.org/10.1002/LDR.2385
7. The WHO recommended classification of pesticides by hazard and guidelines to classification 2009. (n.d.). Retrieved January 19, 2023, from https://apps.who.int/iris/handle/10665/44271
8. Verma, J. P., Jaiswal, D. K., & Sagar, R. (2014). Pesticide relevance and their microbial degradation: a-state-of-art. Reviews in Environmental Science and Biotechnology, 13(4), 429–466. https://doi.org/10.1007/S11157-014-9341-7/METRICS

9. Wołejko, E., Jabłońska-Trypuć, A., Wydro, U., Butarewicz, A., & Łozowicka, B. (2020). Soil biological activity as an indicator of soil pollution with pesticides – A review. In Applied Soil Ecology (Vol. 147). Elsevier B.V. https://doi.org/10.1016/j.apsoil.2019.09.006.

The Impact of Drip Irrigation on Crop Yield and Quality: An Article

Article ID: 40941

Ankush Kumar[1], Dr. Yadvendra Pal Singh[1]
[1]School of Agriculture, Lovely Professional University, Punjab.

Abstract
Drip irrigation is a method of watering crops by applying water directly to the soil around the plant's roots in small, frequent doses. The impact of this method on crop yield and quality has been a topic of interest in agriculture research. Studies have shown that compared to traditional irrigation methods, drip irrigation can result in increased crop yields and improved crop quality. The use of drip irrigation can have a significant positive impact on crop yield and quality, leading to more sustainable and profitable farming practices.

Introduction
Drip irrigation is a modern and efficient method of watering plants that involves the slow, precise application of water directly to the root zone of individual plants or crops. The water is delivered through a network of small diameter tubes, called drip lines or emitters, which are placed directly at the base of each plant. This method is also known as micro-irrigation or trickle irrigation.

Drip irrigation offers several advantages over traditional irrigation methods such as flood or sprinkler irrigation. It uses significantly less water, as the water is delivered directly to the roots and there is little or no surface runoff or evaporation. This results in higher water use efficiency and reduces water wastage. Additionally, drip irrigation allows for more precise control of water application and can be tailored to meet the specific water requirements of different crops or plants.

Drip irrigation also has environmental benefits as it reduces soil erosion and nutrient leaching, minimizes weed growth, and helps to conserve water resources. It is widely used in agriculture, horticulture, and landscaping applications, and can be automated to further enhance its efficiency and convenience.

Overall, drip irrigation is an effective and sustainable method of watering plants that can help to conserve water resources, increase crop yields, and improve the health and quality of plants.

In this article, we will discuss the impact of drip irrigation on crop yield and quality.

Improved Water Management
Drip irrigation is an efficient method of irrigation that uses less water compared to other methods such as flood or sprinkler irrigation. This is because drip irrigation delivers water directly to the root zone of plants, reducing water loss through evaporation and runoff. This

method of irrigation also reduces soil erosion and nutrient leaching, which can have a negative impact on crop yield and quality.

Studies have shown that crops grown using drip irrigation have higher water use efficiency compared to crops grown using other irrigation methods. This means that crops grown using drip irrigation require less water to produce the same yield as crops grown using other irrigation methods. In regions where water is scarce, drip irrigation can help farmers to maximize crop production with limited water resources.

Improved Nutrient Management
Drip irrigation allows for precise application of fertilizers and other nutrients directly to the root zone of plants. This ensures that plants receive the nutrients they need for optimal growth and development. This method of nutrient management reduces fertilizer waste and runoff, which can have a negative impact on the environment. It also helps to reduce the cost of fertilizer application for farmers.

Studies have shown that crops grown using drip irrigation have higher nutrient use efficiency compared to crops grown using other irrigation methods. This means that crops grown using drip irrigation require less fertilizer to produce the same yield as crops grown using other irrigation methods. This can help to reduce the cost of fertilizer application for farmers.

Improved Crop Yield

Drip irrigation has been found to have a positive impact on crop yield. This is because drip irrigation delivers water and nutrients directly to the root zone of plants, providing a consistent supply of moisture and nutrients. This helps to maintain optimal growing conditions for plants, leading to increased crop yield.

Studies have shown that crops grown using drip irrigation have higher yields compared to crops grown using other irrigation methods. For example, a study conducted in India found that drip irrigation increased cotton yield by 109% compared to flood irrigation. Another study conducted in Israel found that drip irrigation increased tomato yield by 20% compared to furrow irrigation.

Improved Crop Quality

Drip irrigation has also been found to have a positive impact on crop quality. This is because drip irrigation delivers water and nutrients directly to the root zone of plants, allowing for precise control of growing conditions. This can lead to improved crop quality, including higher sugar content, better flavour, and improved colour.

Studies have shown that crops grown using drip irrigation have higher quality compared to crops grown using other irrigation methods. For example, a study conducted in California found that drip irrigation increased sugar content in grapefruit by 9% compared to furrow irrigation. Another study conducted in Israel found that drip irrigation increased the vitamin C content of peppers by 50% compared to furrow irrigation.

Challenges of Drip Irrigation

While drip irrigation has many benefits, it also has some challenges. One of the main challenges is the initial cost of installation. Drip irrigation systems can be expensive to install, especially for small-scale farmers who may not have the resources to invest in this technology.

Another challenge is the maintenance of drip irrigation systems. These systems require regular maintenance to ensure that they are functioning properly. This can include replacing clogged emitters, repairing leaks, and monitoring water pressure. Farmers who do not have the time or resources to maintain their drip irrigation systems may find it difficult to benefit from this technology.

Conclusion

Overall, the use of drip irrigation is a sustainable and effective method for improving crop yield and quality while reducing water usage and costs. It has the potential to contribute to food security and improve agricultural sustainability in areas with water scarcity or limited water resources.

A Review Article: Potential of Soil Organic Carbon to Mitigate Changing Climate

Article ID: 40942

Nischay Chaudhary [1], Princy Thakur[2], Sutanwa Saha[2], Meraj Ahmed[2]
[1]Research Scholar, [2]Assistant Professor, School of Agriculture, Department of Soil Science, Lovely Professional University, Phagwara, Punjab, India – 144411.

Abstract
Soil is a significant reservoir of carbon, containing more carbon than vegetation and atmosphere combined. Agricultural practices, including cultivation and soil disturbance, have led to soil carbon depletion and negative impacts on soil health and function. Carbon sequestration, through techniques such as conservation tillage, encloser management, and soil amendments, can help reduce atmospheric CO_2 levels and improve soil health and fertility. The stability of soil organic carbon (SOC) may increase with soil depth and association with minerals, but there is a lack of consensus on how long carbon needs to be stabilized in soil. The Climate-Smart Agriculture (CSA) technique has been introduced as a method for soil carbon sequestration, but small-scale farmers often cannot implement it. A version of CSA, Vulnerable-Smart Agriculture (VSA), has been suggested to address these issues and help small-scale farmers adapt to climate change. Agricultural ecosystems have significant potential for soil carbon sequestration, but need to be carefully managed to balance carbon inputs and losses. Restoring soil organic carbon can improve soil function and reduce negative impacts of SOC depletion through agroecological methods such as raising inputs of organic matter and limiting soil disturbance. Soil carbon sequestration is the process of storing carbon in soil organic matter and soil organic carbon through plants converting atmospheric CO_2 into organic carbon. The potential size of the soil carbon pool is influenced by climate and land use, and deforestation results in an increase in atmospheric CO_2 concentrations.

Keywords: Soil organic carbon, Soil carbon sequestration, atmospheric CO_2, Soil carbon sink, Climate change mitigation.

Introduction
Soil is the main reservoir of terrestrial carbon containing about 1,500 Gt of organic carbon (C) to 1m depth and 2,400 Gt C to 2m depth. Thus, the total size of the soil carbon reservoir exceeds the total mass of carbon in vegetation and atmosphere combined. About 45% of global soils are under some form of agricultural use (i.e., cropland and grazing land). In most soils, organic matter makes up a small fraction (~1–10%) of the total soil mass which is dominated by mineral matter (i.e., sand, silt, and clay particles); these are so-called "mineral soils. The impacts of climate change, a significant worldwide issue, are affected by the ongoing loss of soil carbon. We covered the significance of carbon sequestration in the context of climate change as well as suggested management strategies to stop the depletion of terrestrial carbon in this chapter. A common definition of soil C sequestration is the steady increase in the amount of carbon (C) in the soil. There are two main ways to do this: (a) by using methods that lessen soil C depletion, and (b) by adding more C sources to the soil. Therefore, stable carbon sources like biochar and better agricultural techniques like conservation tillage could aid in lowering atmospheric CO_2 levels. In addition to biochar and conservation tillage, deeper-rooted crops, agroforestry, better pastures, higher biomass production. Crop rotation, residue management, and effective fertilizer application could all work together to keep soil C balance high and encourage CO_2 outflow[1].

Due to decreased net primary production and export of harvested biomass, which reduce C inputs to soil, the majority of agricultural soils (both mineral and organic) are depleted in carbon in comparison to the native ecosystems from which they were derived; nutrient depletion, extensive soil disturbance, and soil erosion are additional contributing factors to soil C depletion. But there are three crucial things to note about soil C's pattern of gains and losses. First, soil C stocks trend toward a new equilibrium state with larger C inputs and/or slower breakdown rates. As a result, over a few decades, C gains attenuate and eventually become less [2]. Another factor to consider when setting aggressive targets for soil C sequestration is the requirement for additional nitrogen inputs. Mineral soils have narrow C:N ratio ranging from 8 to 20, while agriculture soils have C:N ratio of 10-12 as a general "rule-of-thumb". In order to remain equilibrium, soil organic matter was increased by 1.1 GtC/y of CO_2.[3]. The factors affecting soil C retention and release also have an impact on atmospheric CO2 levels 90% of all climate change mitigation strategies and 10% of emission reduction strategies involve soil carbon sequestration. The global atmospheric carbon dioxide emission is shown in *Fig.3*. In addition to its benefits for reducing climate change, soil carbon (C) sequestration plays an important function in absorbing atmospheric CO2 and has been linked to improved agricultural productivity, soil fertility, and soil quality. Due to soil organic carbon's (SOC) chemical and biological breakdown, wind and water erosion, and cultivation, there has been a significant loss of soil carbon. However, soil C sequestration occurs in carefully managed croplands can be significant and provides a potentially beneficial component for reducing the elevated CO2 levels in the atmosphere as shown in *Fig. 4*. There is broad consensus that many agricultural ecosystems have enormous potential for carbon sequestration in the soil, which could lower CO2 levels in the atmosphere and reduce its global emissions [4].

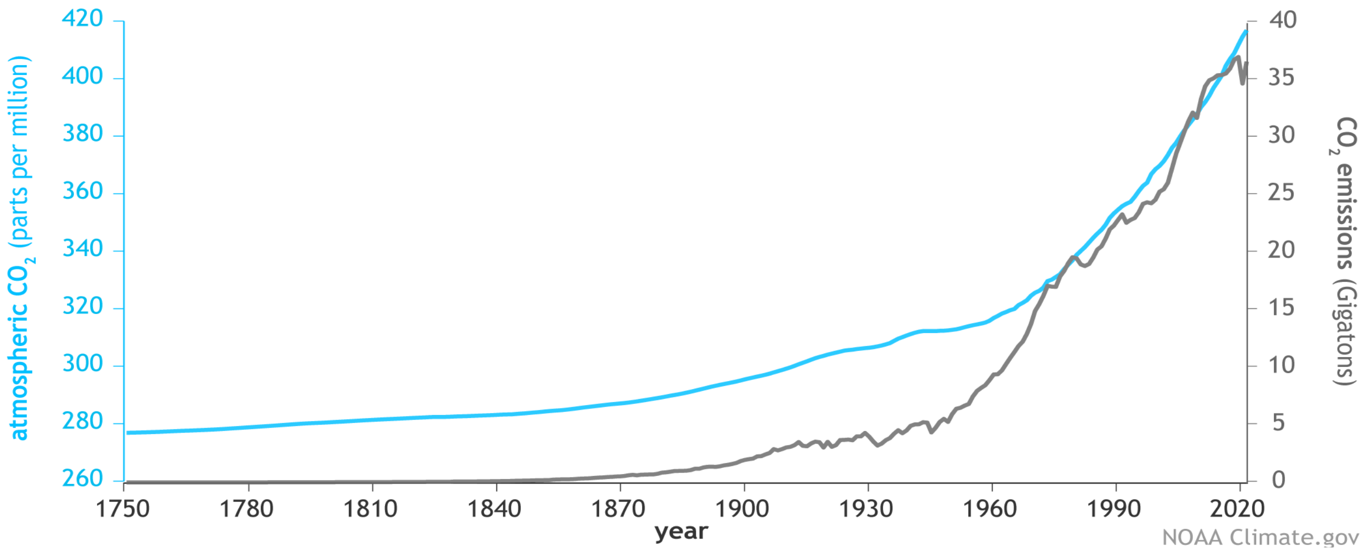


Fig.3 | Atmospheric Carbon dioxide annual emission 1750-2021. *Source:* Our World in Data based on the Global Carbon Project (2022). https://www.globalcarbonproject.org/.

Carbon dioxide emissions increased slowly to around 5 billion tons per year in the mid-20th century before rapidly increasing to over 35 billion tons per year by the end of the century. This increase in emissions is closely linked to the rise in atmospheric carbon dioxide levels, which can be seen in the blue line on the graph. The graph was created by NOAA Climate.gov, using data from NOAA and ETHZ for atmospheric carbon dioxide levels, and data from Our World in Data and the Global Carbon Project for human carbon dioxide emissions.

Soil organic carbon (SOC) increases from using sustainable agriculture practices have been proposed as a potential way to reduce climate change while also addressing larger societal issues. Agricultural soils do indeed lack SOC; since agriculture began, they have lost 116 Gt of SOC. This has significant ramifications for the characteristics of soil and the delivery of ecosystem services obtained from soil: Low accessible nutrient concentrations and high erosion rates resulting from poor aggregation and structure, which causes compaction, are characteristics of SOC-depleted soils. Additionally, they have a low capacity for water infiltration and storage and contain few soil organisms.

It is possible to restore these soil functions, and there are (agroecological) methods for recarbonizing agricultural soils that have lost SOC[5]. They rely on raising inputs of organic matter and/or lowering SOC loss by causing little soil disturbance.

Additionally, they have a low capacity for water infiltration and storage and contain few soil organisms. It is possible to restore these soil functions, and there are (agroecological) methods for recarbonizing agricultural soils that have lost SOC. They rely on raising inputs of organic matter and/or lowering SOC loss by causing little soil disturbance.

SOC Sequestration

Plants uses atmospheric carbondioxide and coverts it to organic carbon. The debris of plant acts as soil organic matter and after decomposition some carbon is emitted in the process of soil respiration while some remain as soil organic carbon. The SOC is the factor that determines the physical, chemical and nutritive. C exchange with the atmosphere will be important in the next few decades to buy time while new, C–saving, capture, and –sequestration technologies are developed. However, even as new strategies and technologies are developed, it will remain important for agriculture to continue developing and implementing successful soil C sequestration practices which maintain or enhance SOC and SIC pools[6]. The Carbon store in soil not really be locked in stable and inert form. However, carbon has to be immobilized before it is considered to be sequestered [7]. According to the study [8], the potential size of the soil carbon pool is primarily influenced by climate, with local substrate, terrain, and their effects on plant development making modifications. The amount of atmospheric carbon that the soil can absorb and store in flora and soil is capped by what has already been consumed by land use. According to studies, if all the carbon already released by vegetation cover, primarily deforestation, could be recovered by reforestation, atm CO2 would be reduced by 40–70 ppm by the end of the century. On the other hand, total global deforestation over the same time period would result in an increase in air concentrations of between 130 and 290 ppm.

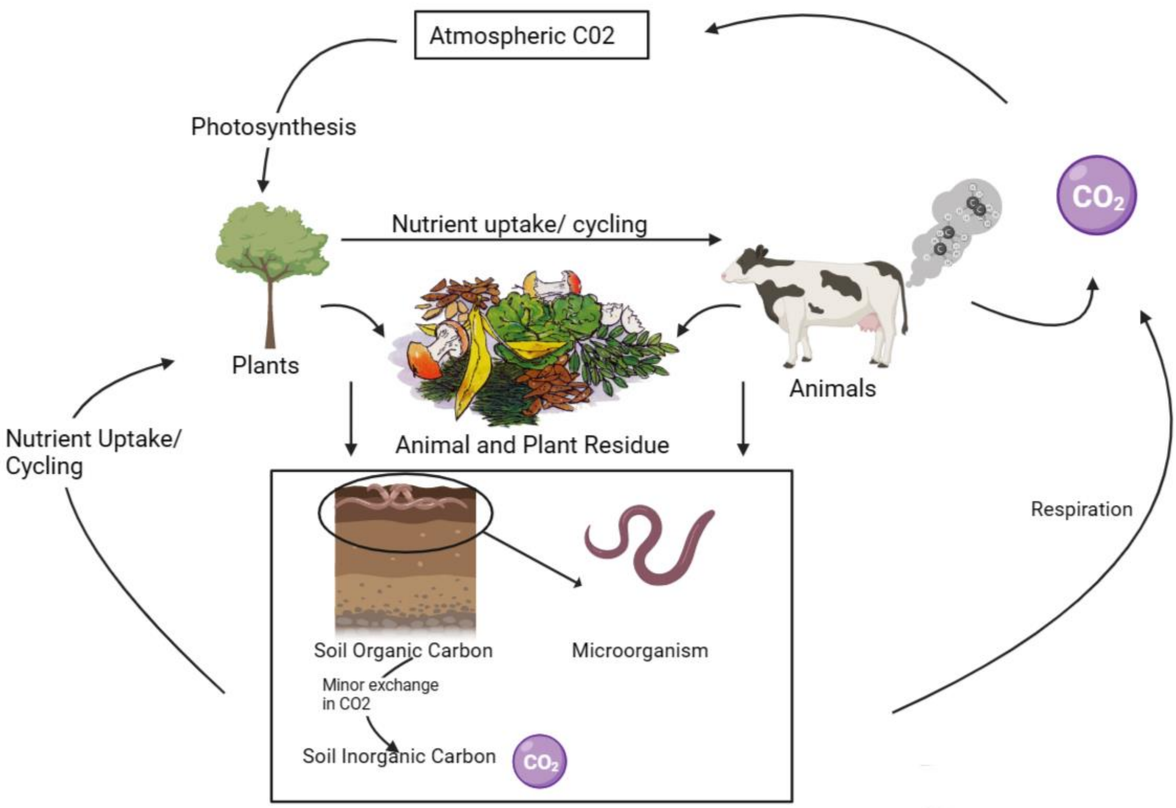


Fig. 4 | Soil Organic Carbon Sequestration | Created with BioRender.com

Soil Carbon Sink

Soil can be turned into C sink when properly managed, although evidence shows measures for SOC sequestration is successful in one soil and less successful in another [9]. All the Soil scientist are clear on the difference between Soil carbon stocks and sinks, some interested citizen and policymakers can understand it similar. The sink is when carbon is removed from atmosphere while stock is when a proper equilibrium is maintained between soil and atmospheric carbon.[8] suggested that forest in its mature state develops a equilibrium with prevailing environmental condition and sink function is lost, refilling soil carbon stocks. All soils may not turn int the notable SOC-sinks and if they are sink its limited[9].

Climate Change

During the subsequent years, SOC sequestration decreased again, as less and less new land would be included into the sequestration plan, and those soils already part of it would sequester less and less C[9].

The C sequestered in soil may in reality not always be locked up in a stable and inert form[7]. However, there is a lack of consensus over the period for which C has to be immobilized in soil. Thus, the association of SOC with minerals may be the most important factor in SOC stabilization, and stability of SOC may increase with increase in soil depth, irrespective of vegetation, soil type, and land use before it is considered to be sequestered[7]. Thus, the association of SOC with minerals may be the most important factor in SOC stabilization, and stability of SOC may increase with increase in soil depth, irrespective of vegetation, soil type, and land use[10]. A number of Climate-Smart Agriculture (CSA) techniques have recently been promoted as a methodical strategy to ensure soil carbon sequestration and sustainable food production [11]. According to the study by[12], Climate-Smart Agriculture (CSA) neglects very important element "small-scale farmer" who are unable to implement new practices and technologies and rather introduce a complete version of CSA "Vulnerable-Smart Agriculture". it is suggested that VSA be used as an effective extension of CSA to address issues of food security and climate change by incorporating adaptation and mitigation strategies at the farmer level. Its objective is to increase agricultural systems' ability to adapt to climate stress and, as a result, ensure that small-scale farmers are less vulnerable to climate change [13].

Agriculture Sector

SOC in croplands include increasing cropping frequency and growing high-residue crops. Alternatively, soil C losses can be minimized by reducing soil tillage (effectiveness is soil type and crop dependent), maximizing plant water use efficiency (more efficient rotations and improved irrigation management), and application of surface mulches that shade the soil[6]. A significant opportunity for sequestering C on agricultural lands in that a substantial proportion of the C is sequestered in woody biomass, thus creating a system that sequesters a large amount of C per unit area and for a longer duration than many other practices. It is estimated that 78 Pg of carbon (C) from the depletion of soil organic carbon (SOC) as a result of agricultural practices went toward world emissions. With the widespread adoption of more restorative, conservative land management techniques, some C that was lost due to more exploitative land management practices could potentially be re-sequestered as SOC [14].

Agroforestry

Agroforestry systems contribute to carbon sequestration and reduction in gas emissions from agricultural lands [15].

1. Increased plant biomass: Agroforestry systems often involve planting trees and crops together, which results in increased plant biomass and organic matter in the soil, leading to higher carbon storage.

2. Improved soil health: Trees in agroforestry systems can improve soil structure, fertility and water retention, which can enhance the growth of other plants and increase soil carbon storage.

3. Reduced tillage: Agroforestry systems often use reduced tillage practices that limit soil disturbance, allowing for the buildup of organic matter and increased carbon storage.

4. Increased root activity: Trees in agroforestry systems have deep roots that penetrate deep into the soil, which can help increase soil carbon sequestration by promoting the decomposition of organic matter and the stabilization of carbon in the soil.

Agroforestry, by storing carbon in both its above and below ground parts, can serve as a valuable carbon sink and help mitigate global warming by absorbing CO2 from the atmosphere[16].

Encloser Management

The enclosures had higher SOC content and stock compared to adjacent open-grazed areas[17].However, there was variability in SOC content and stock between different age categories of enclosures and open-grazed areas across different soil depths. The younger and older enclosures had 8-10% and 13-17% increase in SOC content respectively compared to the open-grazed areas, while the medium enclosures showed the greatest variability in SOC content across the soil depths. But revealed that the soil textural fractions varied across the age chrono sequence of the enclosures. The medium age enclosures had a relatively higher sand fraction compared to the younger and older enclosures. Meanwhile, the older and younger enclosures had significantly higher clay and silt fractions compared to the medium age enclosures. Despite this variation, the proportion of sand content was dominant in both management systems.

Soil Amendments

Soil amendments refer to organic and inorganic materials used to enhance the fertility of the soil. Crop residues can also serve as soil amendments when incorporated into the soil as they can improve soil fertility through decomposition. These amendments not only improve soil properties but also help reduce emissions of CO2 and methane. The addition of biochar has been shown to increase nutrient and water retention, improve soil physical characteristics, and boost crop growth.

Tillage and Residue Management

The transition from conventional agriculture to conservation tillage has the potential to enhance macro-aggregation and aggregate stability, leading to an increase in carbon storage between macro-aggregates. Moving from conventional agriculture to conservation tillage (zero tillage) has been shown to increase soil microbial biomass carbon and decrease CO2 evolution, resulting in higher additions and lower losses of labile carbon. This leads to higher carbon sequestration in the soil and can also improve macro-aggregation and aggregate stability, thereby promoting carbon storage in between macro-aggregates [16].

Conclusion

The soil could be turned into a C sink when properly managed, even though there is evidence that a measure that successfully increases the SOC content in one soil was less successful in another. Soil organic carbon (SOC) sequestration in croplands can be increased by increasing cropping frequency and growing high-residue crops, reducing soil tillage, maximizing plant water use efficiency and applying surface mulches. Large amounts of carbon can be sequestered by growing woody biomass. SOC sequestration has decreased over the years, with stability of SOC linked to its association with minerals and soil depth. Climate-Smart Agriculture (CSA) has been promoted as a strategy for soil carbon sequestration, but it overlooks small-scale farmers. Vulnerable-Smart Agriculture (VSA) is proposed as an extension of CSA to address climate change and food security at the farmer level, with the aim of making agricultural systems more adaptable to climate stress. A significant portion of the depletion of SOC due to agricultural practices has contributed to global emissions. Adoption of restorative land management techniques can lead to re-sequestration of lost SOC. SOC exchange with the atmosphere is crucial in coming decades as new carbon-saving technologies are developed.

References

1. Shahzad, K., Sintim, H., Ahmad, F., Abid, M. & Nasim, W. Importance of Carbon Sequestration in the Context of Climate Change. *Building Climate Resilience in Agriculture* 385–401 (2022).
2. Paustian, K., Larson, E., Kent, J., Marx, E. & Swan, A. Soil C Sequestration as a Biological Negative Emission Strategy. *Frontiers in Climate* vol. 1 Preprint at https://doi.org/10.3389/fclim.2019.00008 (2019).
3. Van Groenigen, J. W. *et al.* Sequestering Soil Organic Carbon: A Nitrogen Dilemma. *Environ Sci Technol* **51**, 4738–4739 (2017).
4. Elbasiouny Heba and Elbehiry, F. Soil Carbon Sequestration for Climate Change Mitigation: Some Implications to Egypt. in *Climate Change Impacts on Agriculture and Food Security in Egypt: Land and Water Resources—Smart Farming—Livestock, Fishery, and Aquaculture* (ed. Ewis Omran El-Sayed and Negm, A. M.) 151–181 (Springer International Publishing, 2020).
5. Rumpel, C. & Chabbi, A. Managing soil organic carbon for mitigating climate change and increasing food security. *Agronomy* vol. 11 Preprint at https://doi.org/10.3390/agronomy11081553 (2021).
6. Morgan, J. A. *et al.* Carbon sequestration in agricultural lands of the United States. *Journal of Soil and Water Conservation* vol. 65 Preprint at https://doi.org/10.2489/jswc.65.1.6A (2010).
7. Lorenz, K. & Lal, R. *Biochar application to soil for climate change mitigation by soil organic carbon sequestration*. *Journal of Plant Nutrition and Soil Science* vol. 177 (2014).
8. Mackey, B. *et al.* Untangling the confusion around land carbon science and climate change mitigation policy. *Nature Climate Change* vol. 3 552–557 Preprint at https://doi.org/10.1038/nclimate1804 (2013).
9. Sommer, R. & Bossio, D. Dynamics and climate change mitigation potential of soil organic carbon sequestration. *J Environ Manage* **144**, 83–87 (2014).
10. Schrumpf, M. *et al.* Storage and stability of organic carbon in soils as related to depth, occlusion within aggregates, and attachment to minerals. *Biogeosciences* **10**, 1675–1691 (2013).
11. Ambaw, G., Recha, J. W., Nigussie, A., Solomon, D. & Radeny, M. Soil carbon sequestration potential of climate-smart villages in East African countries. *Climate* **8**, 1–12 (2020).
12. Azadi, H. *et al.* Rethinking resilient agriculture: From Climate-Smart Agriculture to Vulnerable-Smart Agriculture. *Journal of Cleaner Production* vol. 319 Preprint at https://doi.org/10.1016/j.jclepro.2021.128602 (2021).
13. Campbell, B. M., Thornton, P., Zougmoré, R., van Asten, P. & Lipper, L. Sustainable intensification: What is its role in climate smart agriculture. *Curr Opin Environ Sustain* **8**, 39–43 (2014).
14. Murphy, B. Soil Carbon Sequestration as an Elusive Climate Mitigation Tool. *No-till Farming Systems for Sustainable Agriculture* 337–353 (2020)

15. Gross, C. D., Bork, E. W., Carlyle, C. N. & Chang, S. X. Agroforestry perennials reduce nitrous oxide emissions and their live and dead trees increase ecosystem carbon storage. *Glob Chang Biol* **28**, 5956–5972 (2022).
16. Pattnaik, R., Das, D. & Sethi, K. Soil carbon sequestration through various agronomic practices: A way to mitigate climate change impacts. *Journal of Pharmacognosy and Phytochemistry* **9**, 755–761 (2020).
17. Feyisa, K. *et al.* Effects of enclosure management on carbon sequestration, soil properties and vegetation attributes in East African rangelands. *Catena (Amst)* **159**, 9–19 (2017).

Stevia - Its Sugary Uses

Article ID: 40943

D. Kavya Gupta[1], Sadras Bhavana[2]
[1]Assistant Professor, Dept. of Food Science and Technology, Mallareddy University, Maisammaguda, Hyderabad.
[2]Assistant Professor, Dept. of Crop Physiology, Kaveri University, Gouraram, Siddipet.

Stevia, otherwise termed candy leaf because of its sweet taste was first identified in the year 1899, by a Swiss Botanist. It is said to be a native of Paraguay and Brazil. Guarani people of South America have started to consume stevia by adding it to medicines and teas for the past 1500 years. Being a native of Paraguay, stevia is majorly cultivated in South America and Asia. The other countries which actively cultivate stevia are Canada, China, Korea, the United States of America, and the United Kingdom.

FSANZ (Food Standards Australia New Zealand) in the year 2008 approved the active ingredient called steviol glycoside (stevia) to be suitable for use in food and beverages. FSSAI in India has also approved its use in various products like carbonated water, dairy products, desserts, flavored drinks, RTE cereals, etc. However, the crude extracts from *Stevia rebaudiana* were used as dietary supplements way back in the year 1995, but FDA authorization did not approve its further use in the year 2008, as it does not possess GRAS status.

More About- STEVIA

Stevia a no (zero) calorie sweetener, is extracted from the leaves of the plant. The sweetness in candy leaf is mainly due to the presence of two active compounds, which include stevioside and rebaudioside which are sweeter by 50 – 300 times than table sugar or 10 times sweeter than refined sugar.

Stevia is otherwise named as a no calorie sweetener, low-calorie sweetener, high-intensity sweetener, or non-nutritive sweetener because it reduces the craving for sweetness while providing great satisfaction. Stevia gives intense sweetness as table sugar and is also known as the honey leaf. A natural component ensuring good sweetness and is completely free from cholesterol. Stevia leaves can be used in fresh and dried forms. Fresh leaves are not processed and added to foods as such which gives an intensely sweet taste when consumed whereas dried leaves have increased flavor and taste, as it is processed by few steps such as drying and crushing, which releases sweeter components.

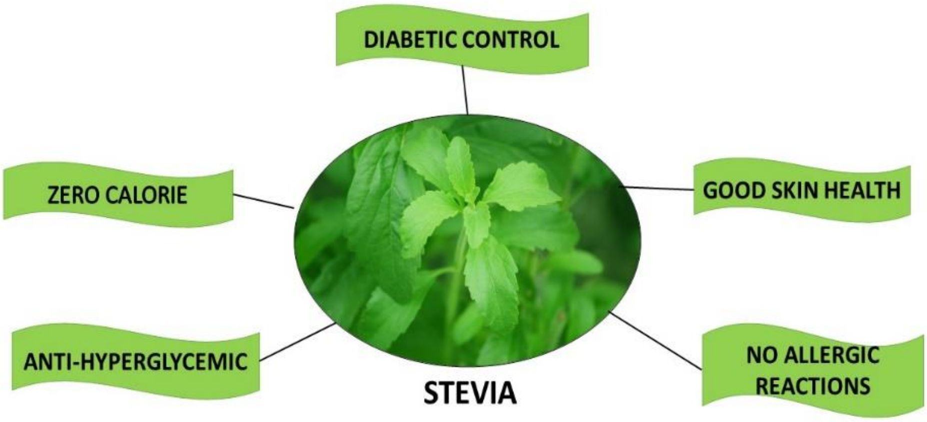
Usage of Stevia

According to FDA, the ADI (acceptable daily intake) of stevia is 4 milligrams per kilogram of body weight.

Health Benefits of Stevia

Stevia is known for its many health benefits.

1. It is **anti-hyperglycaemic:** All over the world 422 million people are suffering from diabetes, among which diabetes mellitus is the major one caused by hyperglycemia. By consuming stevia, insulin is secreted from beta cells of islets of Langerhans by the direct action of steviol and stevioside which are the bioactive compounds present in stevia leaves.
2. The use of sweeteners such as **saccharin and cyclamate** were minimized and replaced with stevia in the formulation of Coca-Cola in the year 1970s.
3. With the consumption of refined or processed, sugars increase in calories, obesity, etc. were observed. Stevia acts as a **good replacement** to reduce body weight as it is having least or zero calories.
4. Stevia is found to be rich in **antioxidants** and sterols which helps to reduce the risk of pancreatic cancer.
5. It contains glycosides that dilate blood vessels and increase the excretion of sodium thus, **controls blood pressure**.
6. By consuming stevia, **no allergic reactions** were noticed till day as the non-reactive steviol glycosides present in stevia have no effects on blood glucose.
7. Stevia is also known for its **anti-fungal, anti-bacterial, anti-inflammatory, and antiseptic** properties. The leaves reduce infection in the stomach and give good relief.
8. Stevia **reduces cavity problems and removes skin problems** like acne, dermatitis, eczema, etc. Wet sachets of stevia can be kept on the eyes for a cooling effect, it also reduces wrinkles by tightening the skin and finally improving the health of the skin.
9. Stevia when added to food products has a **good shelf life**.



Applications of Stevia

1. Stevia in **liquid concentrate** form is mainly used in beverages like soft drinks and chocolate drinks, in order to produce calorie-free drinks.
2. Stevia leaves are used in **baked food** products like biscuits, cakes & dairy products such as ice cream, tea, and coffee etc., and also in **confectionery** products such as candies.
3. Stevia **leaf powder** is also used in the preparation of desserts, puddings and bread making without affecting its textural properties.
4. It is also used in the **manufacturing** of chewing gums, pans, and mouth refreshers.

Conclusion

Artificial and processed sweeteners impart a high calorific value that may lead to obesity, diabetes, and cardiovascular diseases. A remedy to the risk caused by processed sweeteners is to use the naturally available miracle plant termed Stevia.

Keywords: Stevia, no calorie sugar, natural sweetener, anti-hyperglycaemic, etc.

Effect of Microplastic on Physiochemical Properties of Soil

Article ID: 40944

Vivek[1], Jaismeen[1], Yogesh Kumar Singh[1], Meraj Ahmed[2]
[1]Research scholar [2]Assistant Professor, Department of Soil Science and agricultural chemistry, School of Agriculture, Lovely professional university, jalandhar, Punjab.

Abstract
Plastic is a substance that is crucial to modern human life. Due to high use of plastic the environmental pollution increases which is a creates a problem for our soil, water etc. Smaller than 5 mm microplastic debris are recognized as a growing worldwide pollutant. Among other things, major sources of MP include leachate from landfills, waste water irrigation, spreading of sewage sludge and biowaste composts on land, and plastic mulching film used in horticulture areas. Six different types of MP particles—polyethylene (PE), poly (vinyl chloride) (PVC), polyamide (PA), polypropylene (PP), poly (ethylene terephthalate) (PET), and polystyrene (PS)—appears to be responsible for the majority of MPs that have so far been discovered in the environment. When it comes to sizes, forms, chemistries, states of weathering, and intentional and unintended additives, microplastics are a complex group of substances that encompass a wide variety of characteristics. They are either already created as tiny (5 mm or smaller) particles, known as primary microplastics, or they break into smaller pieces to become secondary microplastics.

Keywords: Microplastics, soil pollution, primary microplastics, secondary microplastics.

Introduction
The loose surface layer of the Earth's known as soil where plants can grow. It is crucial for maintaining environmental and energy security and safeguarding biodiversity. But in the terrestrial environment, soil also serves as a significant repository for microplastics. According to reports, over 90% of the plastic garbage generated on land either directly or indirectly affects the soil environment. Numerous earlier research has revealed that sewage sludge and compost contain significant levels of microplastic fibers or debris.

Plastics are useful in everyday human life because they are strong, flexible, versatile, lightweight, and economical to create (Browne *et al.*,2007). Massive amounts of plastic garbage that have been thrown have contaminated the environment and increased the frequency of plastic pollution as a result of ineffective and inadequate control methods (Jambeck *et al.*, 2015). On minor plastic contamination, more research is starting to pay attention.

Microplastic is described as plastic that is less than 5 mm in size and includes particles, pieces, films, and fibres (Thompson *et al.*, 2004). Microplastic are divided into primary and secondary categories based on their ancestry (Cole *et al.*, 2011). Primary Microplastic are chemically produced micro- or nanoparticles that are added to drugs and personal care products or utilised as raw materials in the production of plastics.

As a result, large quantities of primary microplastics that are challenging to remove at pollution treatment facilities are released into the environment (Long *et al.*, 2022; Yin *et al.*, 2021). Secondary microplastics are formed when large plastics are broken down via physical, chemical, and biological processes. Numerous studies have shown that microplastics are also found in terrestrial ecosystems, and as landfills account for over 80% of the world's plastic waste, soil is probably a significant source of microplastics.

The research on microplastics in soil is still in its infancy and requires greater attention, despite the fact that more academics have recently started to pay attention to the terrestrial environment. More importantly, microplastics can reach the soil environment through the weathering and degradation of mulch layer in agricultural areas, crushing of plastic trash in landfills, and air deposition (Shen *et al.*,2022).

Soil and Plastic Physiochemical Properties
Microplastic distribution is greatly influenced by soil characteristics such pH, texture, organic matter, and soil animals after they enter the soil ecosystem (Chia *et al.*, 2022). The dispersion of microplastics is affected

by soil texture because they easily move through soil layers (Thomas *et al*.,2020). Sandy soils have a higher likelihood of having microplastics penetrate to deeper layers, whereas clay soils' stickiness may hinder microplastics from doing so (Cao *et al*., 2021). Microplastics' negative effects on the infiltration properties of the three studied soils (loam, clay, and sand) were found to be influenced by particle size, with larger particles having the weakest effect. Some researchers believe that soil texture play a pivotal role in governing the effects of microplastics on soil hydraulic characteristics (Guo *et al*., 2022). By consuming or excreting microplastics, soil fauna can also influence the distribution of these particles in the soil layers. Additionally, their movement or disturbance may cause microplastics to travel back and forth between soil layers. Earthworms can consume topsoil microplastics and carry them to deeper soil layers, according to research by Yu *et al*. In addition, Zhu *et al*. discovered that tiny soil fauna, such as collembolans and mites, may promote the movement of microplastics in soil through surface attachment, grabbing, and pushing Collembola accelerated the migration of MPs in soil, but there were also notable differences in the migrant capacity between different collembola. The mode of action was that microplastics could attach to the cuticle of these micro-arthropods and then be transported further with additional movement (Maaß *et al*., 2017). The physical and chemical characteristics of various microplastic kinds will also influence how they are distributed in the soil environment in addition to the aforementioned variables. For instance, polyethylene, a long-chain polymer made up of thousands of ethylene monomers, is particularly challenging to breakdown due to its high molecular weight and hydrophobicity. (Chiellini *et al*., 2003). The refractory nature of each polymer, however, means that its effect might not be felt for some time.

Table 1. indicates the Distribution characteristics of micro plastics in some parts of the world (pieces of micro plastics determined per kilogram of dry weight of soil):

Country/region	Abundance	Composition	Size range	Literature
Mexico	2 770 pcs/kg	Polyethene, polystyrene	5-150mm	Huerta Lwanga et al. (2017)
Switzerland	593 pcs/kg	Polyethene, polystyrene, polyvinyl chloride	12.5–500 μm	Scheurer and Bigalke (2018)
Australia	300–67 500 mg/kg	Polyvinyl chloride, polyethene, polystyrene	< 5 mm	Fuller and Gautam (2016)
Hebei China	317 pcs/500 g	Polyethene, polypropylene, polyvinyl chloride	1.56 ± 0.63 mm	Zhou et al. (2016)
Shandong China	1.3–14.7125 pcs/kg	Polyethene, polypropylene, polystyrene	1 mm (60%)	Zhou et al. (2018)
China's Loess Plateau	< 0.54 mg/kg	Polyethene	> 100 μm	Zhou et al. (2018)
Yun Nan China	7 100–42 960 pcs/kg	Polyethene, polypropylene	10–0.05 mm	Zhang and Liu (2018)
Shanghai, China	62.59 ± 12.97 pcs/kg	Polyethene, polypropylene, polyvinyl chloride	0.03–16 mm	Liu et al. (2018)

Effect of Microplastics on Soil Physio-Chemical Properties

As, compare to normal plastic the microplastics are small particle size and vast surface area, microplastics considerably increase the adsorption capacity of other organic pollutants when they reach the soil environment. This alters the physical and chemical characteristics of the soil and has an impact on the whole environment (Li *et al.* 2020). The influence of microplastics (PP particle size 180 m) on soil soluble organic carbon (DOC), organic nitrogen (DON), organic phosphorus (DOP), PO4 3-concentration, fluorescein diacetate (FDA) hydrolase, and phenol oxidase activities. After 30 days of incubation, high microplastic concentrations significantly affected the levels of DOC, DON, DOS, humus, and fulvic acid (Liu *et al.* 2017). The effects of four widely-used microplastics on the microbiological composition and structure of soil. In a 5-week soil culture experiment, they evaluated the impact of microplastics on the microbial bulk density, water-holding capability, and functional link between microbial activity and water stabile aggregate. The results showed that different kinds of microplastics have varied effects. For example, Polyethene greatly increases the number of soil water-stable aggregates, in contrast to polyester, which might significantly decrease it. The variety of the soil microenvironment is drastically reduced when water-stable aggregates are reduced (De Souza Machado *et al.* 2019).

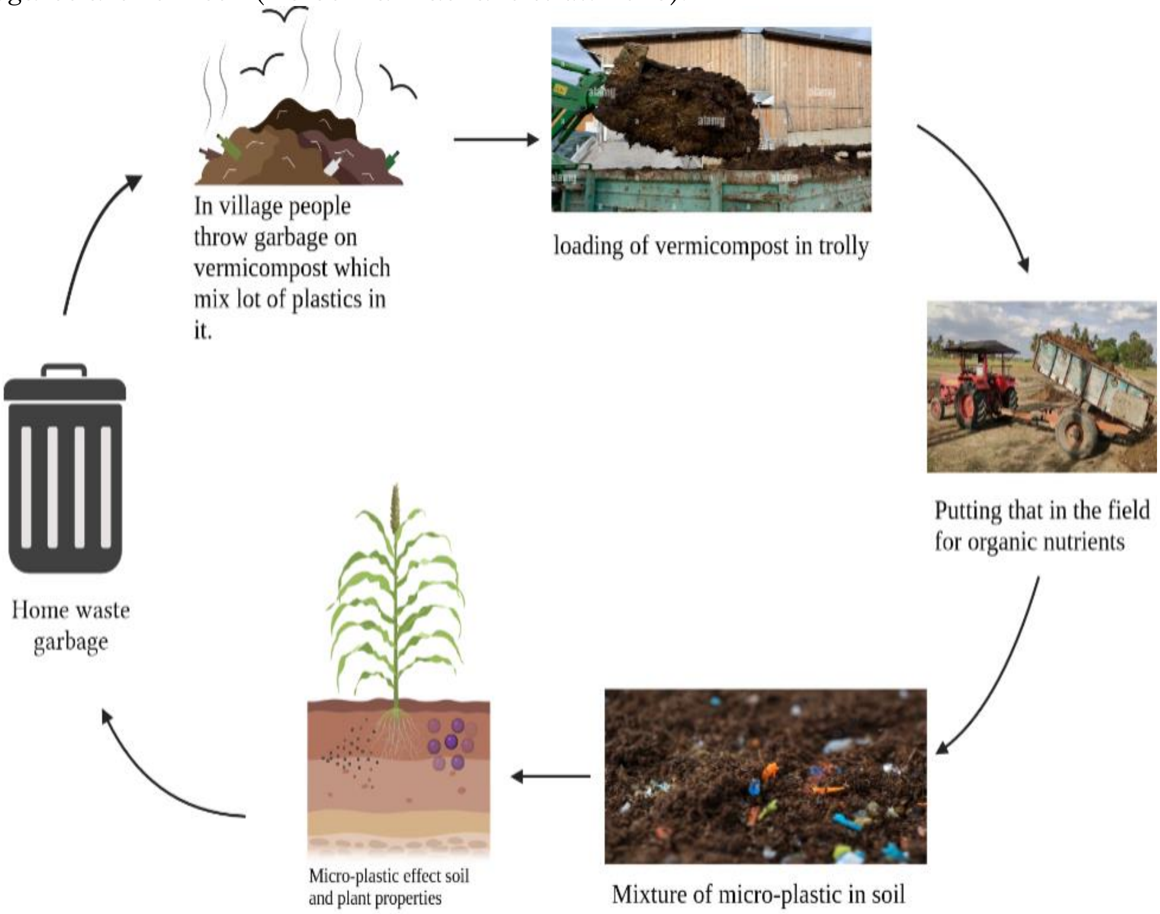


Fig 2. Flowchart diagram of microplastic in our daily life

References

1. Xiaofeng Wen , Lingshi Yin , Zhenyu Zhou , Ziyi Kang , Qiaoling Sun , You Zhang ,Yuannan Long , Xiaobao Nie , Zhiyuan Wu , Changbo Jiang(2022). Ecotoxicology and Environmental Safety. Elsevier Inc, 243, 113958
2. Chunhui Wang, Junhong Tang, Haixia Yu , Yiyi Wang , Huanxuan Li , Shaodan Xu , Gang Li and Qian Zhou(2022). Microplastic Pollution in the Soil Environment: Characteristics, Influencing Factors, and Risks.MDPI 14, 13405. (https://doi.org/10.3390/su142013405)
3. Browne, M.A., Galloway, T., Thompson, R., 2007. Microplastic–an emerging contaminant of potential concern? Integr. Environ. Assess. Manag. 3 (4), 559–561.
4. Jambeck, J.R., Geyer, R., Wilcox, C., Siegler, T.R., Perryman, M., Andrady, A.,Narayan, R., Law, K.L., 2015. Plastic waste inputs from land into the ocean. Science347 (6223), 768–771.
5. Thompson, R.C., Y, O., P, M.R., A, D., 2004. Lost at sea where is all the plastic? Science 304, 838.
6. Cole, M., Lindeque, P., Halsband, C., Galloway, T.S., 2011. Microplastics as contaminants in the marine environment: a review. Mar. Pollut. Bull. 62 (12), 2588–2597.
7. Long, Y., Zhou, Z., Yin, L., Wen, X., Xiao, R., Du, L., Zhu, L., Liu, R., Xu, Q., Li, H., Nan, R., Yan, S., 2022. Microplastics removal and characteristics of constructed wetlands WWTPs in rural area of Changsha, China: a different situation from urban WWTPs. Sci. Total Environ. 811, 152352.
8. Yang, L.; Zhang, Y.; Kang, S.; Wang, Z.; Wu, C. Microplastics in soil: A review on methods, occurrence, sources, and potential risk.Sci. Total Environ. 2021, 780, 146546.
9. Plastics Europe, E. Plastics—The Facts 2019. An Analysis of European Plastics Production, Demand and Waste Data. Available online: https://www.plasticseurope.org/en/resources/publications/1804-plastics-facts-2019 (accessed on 15 August 2022).
10. Shen, M.; Xiong, W.; Song, B.; Zhou, C.; Almatrafi, E.; Zeng, G.; Zhang, Y. Microplastics in landfill and leachate: Occurrence, environmental behavior and removal strategies. Chemosphere 2022, 305, 135325.
11. Rochman, C.M. Microplastics research—from sink to source. Science 2018, 360, 28–29.
12. Chia, R.W.; Lee, J.-Y.; Jang, J.; Kim, H.; Kwon, K.D. Soil health and microplastics: A review of the impacts of microplastic contamination on soil properties. J. Soils Sediments 2022, 22, 1–16.

13. Yu, L.; Zhang, J.; Liu, Y.; Chen, L.; Tao, S.; Liu, W. Distribution characteristics of microplastics in agricultural soils from the largest vegetable production base in China. Sci. Total Environ. 2021, 756, 143860.
14. Wang, F.; Wang, Q.; Adams, C.A.; Sun, Y.; Zhang, S. Effects of microplastics on soil properties: Current knowledge and future perspectives. J. Hazard. Mater. 2022, 424, 127531.
15. Cao, L.; Wu, D.; Liu, P.; Hu, W.; Xu, L.; Sun, Y.; Wu, Q.; Tian, K.; Huang, B.; Yoon, S.J. Occurrence, distribution and affecting factors of microplastics in agricultural soils along the lower reaches of Yangtze River, China. Sci. Total Environ. 2021, 794, 148694.
16. Guo, Z.; Li, P.; Yang, X.; Wang, Z.; Lu, B.; Chen, W.; Wu, Y.; Li, G.; Zhao, Z.; Liu, G. Soil texture is an important factor determining how microplastics affect soil hydraulic characteristics. Environ. Int. 2022, 165, 107293.
17. Yu, M.; Van Der Ploeg, M.; Lwanga, E.H.; Yang, X.; Zhang, S.; Ma, X.; Ritsema, C.J.; Geissen, V. Leaching of microplastics by preferential flow in earthworm (Lumbricus terrestris) burrows. Environ. Chem. 2019, 16, 31–40.
18. Zhu, D.; Bi, Q.-F.; Xiang, Q.; Chen, Q.-L.; Christie, P.; Ke, X.; Wu, L.-H.; Zhu, Y.-G. Trophic predator-prey relationships promote transport of microplastics compared with the single Hypoaspis aculeifer and Folsomia candida. Environ. Pollut. 2018, 235, 150–154.
19. Maaß, S.; Daphi, D.; Lehmann, A.; Rillig, M.C. Transport of microplastics by two collembolan species. Environ. Pollut.2017, 225, 456–459.
20. Chiellini, E.; Corti, A.; Swift, G. Biodegradation of thermally-oxidized, fragmented low-density polyethylene's. Polym. Degrad. Stab. 2003, 81, 341–351.
21. Nanda, S.; Sahu, S.S. Biodegradability of polyethylene by Brevibacillus, Pseudomonas, and Rhodococcus spp. N. Y. Sci. J.2010, 3, 95–98.
22. Huerta Lwanga E., Mendoza Vega J., Ku Quej V., Chi J. de los A.,Sanchez del Cid L., Chi C., Escalona Segura G., Gertsen H., Sa-lánki T., van der Ploeg M., Koelmans A.A., Geissen V. (2017):Field evidence for transfer of plastic debris along a terrestrial food chain. Scientific Reports, 7: 14071.
23. Fuller S., Gautam A. (2016): A procedure for measuring microplastics using pressurized fluid extraction. Environmental Science and Technology, 50: 5774–5780.
24. Scheurer M., Bigalke M. (2018): Microplastics in Swiss floodplain soils. Environmental Science and Technology, 52: 3591–3598.
25. Zhou Q., Zhang H., Zhou Y., Li Y., Xue Y., Fu C., Tu C., Luo Y.(2016): Separation of microplastics from a coastal soil and their surface microscopic features. Kexue Tongbao/Chinese Science Bulletin, 61: 1–8.
26. Zhou Q., Zhang H., Fu C., Zhou Y., Dai Z., Li Y., Tu C., Luo Y.(2018): The distribution and morphology of microplastics in coastal soils adjacent to the Bohai Sea and the Yellow Sea. Geo-derma, 322: 201–208.
27. Zhang S., Yang X., Gertsen H., Peters P., Salánki T., Geissen V.(2018): A simple method for the extraction and identification of light density microplastics from soil. Science of the Total Environment, 616–617: 1056–1065.
28. Zhang G.S., Liu Y.F. (2018): The distribution of microplastics in soil aggregate fractions in southwestern China. Science of the Total Environment, 642: 12–20.
29. Liu M., Lu S., Song Y., Lei L., Hu J., Lv W., Zhou W., Cao C., Shi H.,Yang X., He D. (2018): Microplastic and mesoplastic pollution in farmland soils in suburbs of Shanghai, China. Environmental Pollution, 242: 855–862.
30. Li M., Yu H., Wang Y., Li J., Ma G., Wei X. (2020): QSPR models for predicting the adsorption capacity for microplastics of polyethylene, polypropylene and polystyrene. Scientific Reports, 10: 14597.
31. Liu H., Yang X., Liu G., Liang C., Xue S., Chen H., Ritsema C.J., Geissen V. (2017): Response of soil dissolved organic matter to microplastic addition in Chinese loess soil. Chemosphere, 185: 907–917.
32. De Souza Machado A.A., Lau C.W., Kloas W., Bergmann J., Bachelier J.B., Faltin E., Becker R., Görlich A.S., Rillig M.C. (2019):Microplastics can change soil properties and affect plant performance. Environmental Science and Technology, 53: 6044–6052.
33. Yu J.R., Adingo S., Liu X.L., Li X.D., Sun J., Zhang X.N. (2022): Micro plastics in soil ecosystem – A review of sources,fate, and ecological impact. Plant Soil Environ., 68: 1–17. Available online https://doi.org/10.17221/242/2021-PSE.

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

Horticulture in India: An Overview

Article ID: 40945

Adesh Gaurav[1], Lalit Kadu[1], Dr. Amit Kotiyal[1]
[1]Assistant Professor, Department of Horticulture, School of Agriculture Lovely Professional University, Phagwara, Punjab- 144001, India.

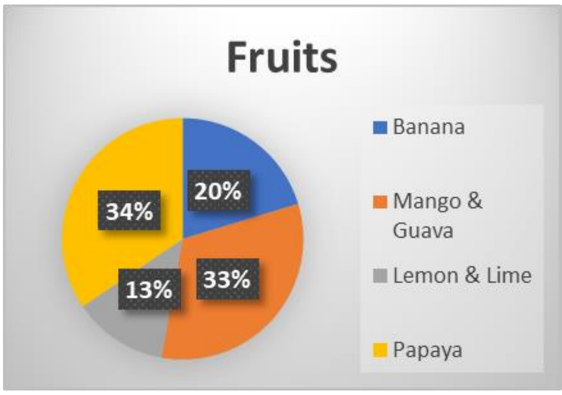
Abstract
Horticulture is an integral part of agriculture as it produces a high quantity of fruits, vegetables, flowers, plantation crops and spices. India is the world's second-biggest supplier of fruits and vegetables of total worldwide output. Horticultural produce area has grown about 86% from year 1991-92 to 2015-16 over the last 25 years. Improvements in planting material quality, the use of high-yielding cultivars, F hybrids, and disease, and pest-resistant varieties, combined with appropriate production technologies, have significantly increased horticultural produce.

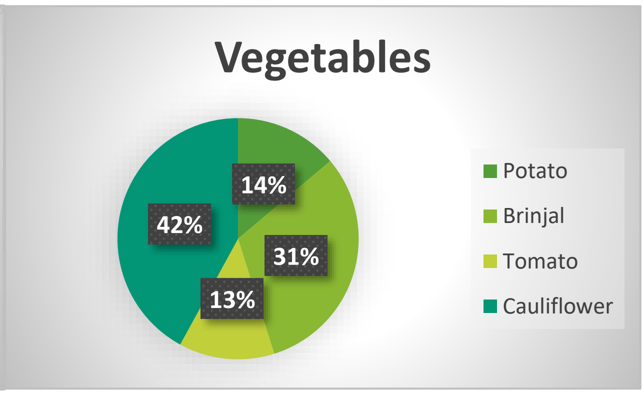
Introduction
India has a diverse range of climates and soils, allowing for the cultivation of a broad range of agricultural commodities such as fruits, vegetables, potatoes, tropical root crops, mushrooms, decorative, medicinal, and fragrant plants, farm crops, and spices.

Historical Perspective
Following freedom in 1947, the Government of India placed a strong focus on reaching self-sufficiency in the food supply, particularly grains. However, following the Green Revolution in the 1960s, it became apparent that gardening, which is well-suited to the Indian terrain and agro-climate, is a perfect way of attaining small-holding viability. However, the Government of India only recognized the need for diversifying in the mid-1980s to make agriculture more lucrative through effective land use, skilled jobs for rural people and women, and optimizing natural resource utilization. (Soil, water, and environment). Previous attempts have resulted in greater output and efficiency of agricultural products. The shifting landscape promotes private investment. As a result, gardening has progressed from agricultural to business enterprises, and it has begun to draw youth because it has proven to be cognitively gratifying and monetarily lucrative.

Diversification to Horticulture
Diversification to horticulture is the best option in Indian agriculture today because it produces more biomass per unit area than field crops, resulting in more efficient use of natural resources; is highly remunerative for replacing subsistence farming and thus alleviating poverty in rainfed, dryland, hilly, arid, and coastal agro-ecosystems; and has the potential for wasteland development through planned development.

Status of Indian Horticulture





India's position in global horticulture: After China, India is the world's second-biggest supplier of fruits and veggies, accounting for 12.2 and 10.7% of total worldwide output, respectively. It is, however, the world's biggest provider of okra, accounting for 73.6% of global output. In addition, India makes 21.04% grapes, 10.4% citrus products, and 14.96% pineapple.

Status of Horticulture in India: Horticultural produce area has grown from 12.8 million hectares in 1991-92 to 23.8 million ha in 2015-16, representing an 86% growth over the last 25 years. During the same time span, overall output grew by 193.3%, rising from 96.6 million MT to 283.3 million MT. In the same time span, typical output increased significantly from 7.5 to 11.7 MT/ha, representing a 56% rise. The overall output and average yield of agricultural products would have been much higher if it hadn't been for the vast regions under tree fruits, which stay dormant for 3-5 years after sowing.

Status of different group crops: During 2015-16, the share of vegetable and root crops in total area and output of total gardening products was the greatest, at 40,250 hectares and 58.80 million MT, respectively. Fruit products came next, with 26.93% of the territory and 32.27% of the output. Floriculture currently has the lowest acreage and output. However, there was a substantial rise in overall spice output, while the growth rate of farm products was the slowest of all.

During the last 25 years, the area of various crops grew at a rate ranging from 60 to 122.9%, with farm crops experiencing the slowest development and citrus crops experiencing the fastest. While fruit output increased by only 123% in area and 219% in yield over the last twenty-five years, veggie harvests increased by 71 and 185% respectively.

Except for vegetable products, where output rose from 10.47 in 1991-92 to 17.40 in 2015-16, productivity followed a similar pattern. Spices, however, saw the greatest rise in output (105.30), followed by veggies. (66.27). There was also a decent rise in fruit crop yield, despite the fact that a big cultivated region over the last 3-4 years is still not producing. It was lowest in farm products. (28.79).

Status of important fruit crops: Between 1991-92 and 2015-16, the area under the vine increased nearly four times, followed by citrus and papaya (3 times), and guava, mango, pineapple, and banana (2 times). (About 2 times). Apple had the smallest rise in size. (1.4 times). However, the output of citrus, berry, guava, and papaya increased by 4% or more. Over the last 25 years, the output of papaya, banana, citrus, apple, and grape has increased significantly. Fruit crop output rose from 9.96 to 14.51 MT/ha during the time, which was made feasible by improved sowing material and the use of high-tech gardening practices.

Status of important vegetable and tuber crops: During 2015-16, vegetable and root crop production accounted for roughly 58.8% of the total agricultural crop output in the nation. This includes over 40 veggies from the Solanaceous, Cucurbitaceous, Leguminous, Cruciferous (cole crops), root crops, and green vegetable families produced in India's tropical, subtropical, and temperate zones, as well as potato and tuber crops and mushrooms. Beans, bottle gourd, brinjal, cabbage, carrot, cauliflower, chili, cucumber, muskmelon, okra, onion, pea, pumpkin, radish, tomato, and watermelon are among the most important food products produced in the nation. Furthermore, our nation grows 15 distinct tuber-producing food types. Two main crops (cassava and sweet potato); aroid species (*Calocacia, Amorphophallus, Xanthosomas, Alocacia*, and *Cyrtosherma* sp.); yams (lesser, larger, and white yam); and smaller tuber crops are among them. (Yam bean, coleus, arrowroot etc).

Improvements in planting material quality, the use of high-yielding cultivars, F, hybrids, and disease, and pest-resistant varieties, combined with appropriate production technologies, have significantly increased vegetable and tuber crop productivity from a national average of 10.47 MT/ha in 2011-12 to 17.40 MT/ha in 2015-16.

Status of important floriculture crops: Traditional blooms grown in India include jasmine, marigold, chrysanthemum, tuberose, crossandras, and aster. Commercial cultivation of cut flowers, such as roses, orchids, gladiolus, carnations, anthurium, daisy, and lilies, has also grown in popularity, especially under controlled culture. However, floriculture accounts for only 1.2% of overall agricultural produce output in the nation. In 2015-16, the total area and output of blooms was expected to be 2.43 lakh hectares, with a total production of 1.5 million MT. Cut flowers account for 691 of these, while stray flowers account for 1.5 MT.

Status of important plantation crops: India's main agricultural products include arecanut, cashewnut, cacao, coconut, and oilpalm. These products are primarily grown in South Indian regions. During 2015-16, the total area under nursery crops was stated to be 3.68 million hectares, with an output of 16.6 million MT accounting for 15.48% of the total area and 5.46% of total garden crop production.

Status of important spice crops: Spices are a low-volume, high-value agricultural commodity that is described as vegetable products or mixtures of vegetable products used for flavoring, dressing, and adding fragrance to meals. India is known as the spice kingdom, providing a broad range of spices such as black pepper, cardamom (small and large), chili, coriander, cumin and garlic, ginger, turmeric, and a variety of tree and seed spices, accounting for 2.2% of the country's total agricultural crop output.

Garlic is the most grown spice crop (1.4 million MT), spanning an area of 2.61 lakh hectares and accounting for 8.00 and 22.05% of total area and output under spices, respectively. This is followed by desiccated jalapenos, which span the most land at 7.089 lakh hectares (21.87%), but yield only 1.38 million MT. Ginger (1.10 million MT) accounts for 17.46% of total spice production, turmeric (9.57 lakh MT) accounts for 15.07%, cilantro (5.66 lakh MT) accounts for 8.9%, and cumin (3.74 lakh MT) accounts for 5.89% of total spice production. Tamarind and fenugreek add 1.92 lakh MT (3.02%) and 1.38 lakh hectares (2.17%), respectively, to overall planted crop output.

Status of important medicinal and aromatic plants: India's agro-climatic circumstances are perfect for the natural development of a wide range of therapeutic plants and botanicals used in the pharmaceutical business. The country's entire medicinal and fragrant plant area is expected to be 6.17 lakh hectares and 1.16 lakh MT. Both established and emerging nations are seeing a rise in demand for these species. Even contemporary medications contain about 25% chemicals taken from vegetation. Aloe, ashwagandha, brahmi, dioscorea, guggal, isabgol, patchouli, and periwinkle are all important therapeutic herbs.

Aromatic plants are used to make flavourings, natural makeup, perfumes, and other products. While there is a significant market possibility, the grade of substance gathered or created leaves much to be desired. Lemon grass, vetiver, patchouli, palmarosa, citronella mints, geranium, lavender, basil, jasmine, and other fragrant plants are essential.

Conclusion

India is one of the world's top makers of fruits and vegetables and is regarded as one of the leaders in agriculture output globally. Through enhanced production methods, field automation to boost gathering and processing effectiveness, and acquisition of best-quality growing materials to create high-quality products, the gardening industry can experience further development and prosperity.

References

1. Handbook of horticulture (2019). New Delhi: ICAR. 3 to 10 p.
2. Horticulture in India: Its growth and future (2022) GeeksforGeeks. GeeksforGeeks. Available at: https://www.geeksforgeeks.org/horticulture-in-india-its-growth-and-future/.

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

Soil Fertility and Soil Health

Article ID: 40946

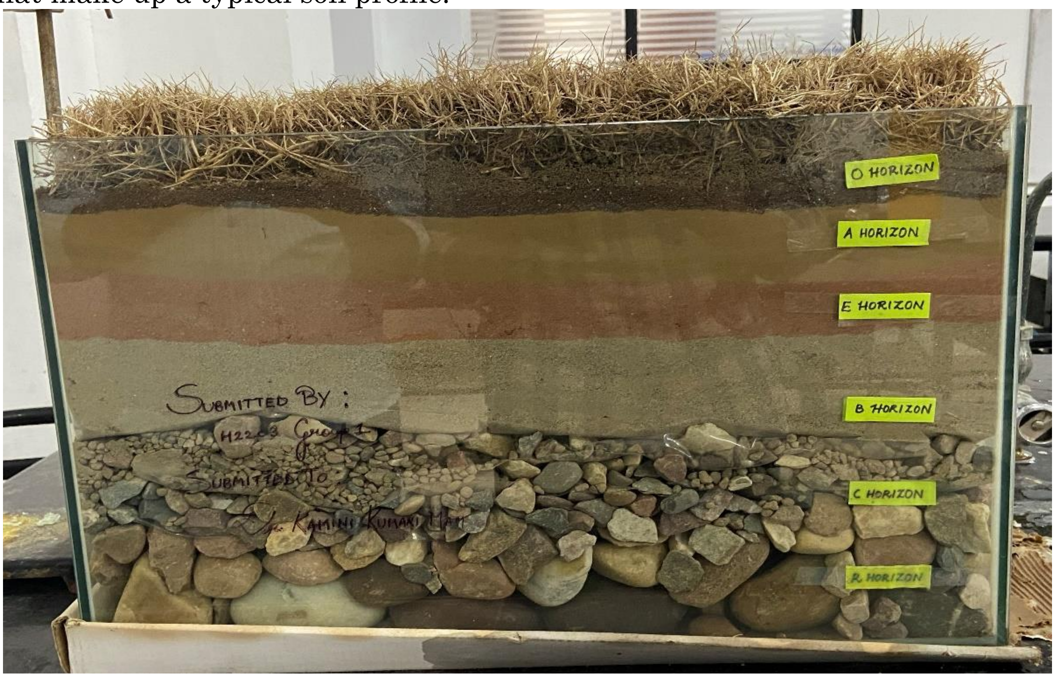
Rahul Sihag[1], Sutanwa Saha[2], Meraj Ahmed[2]
[1]Research Scholar, [2]Assistant Professor, School of Agriculture, Department of Soil Science, Lovely Professional University, Phagwara, Punjab, India – 144411.

Abstract
The soil is a crucial part of the ecosystem that sustains all species on Earth. The output and sustainability of the soil are significantly influenced by two key factors: soil fertility and soil health. When discussing soil, the terms "soil fertility" and "soil health" are used interchangeably. Soil fertility refers to the soil's capacity to supply the essential elements and conditions for plant growth. The notions of soil fertility and soil health are covered in this review paper along with their significance and management options for sustainable agriculture.

Soil Fertility
Numerous elements, including soil organic matter, pH, and soil texture, as well as important plant nutrients like nitrogen, phosphate, and potassium, have an impact on soil fertility. Agriculture depends heavily on soil fertility because it affects product quality and yield potential. Low crop yields, poor crop quality, and decreased farmer profitability can all be caused by inadequate soil fertility.

Using fertilisers, either organic or inorganic, is one method to keep soil fertility. Organic fertilisers enhance soil health by adding organic matter that supports soil microorganisms and enhances soil structure, while inorganic fertilisers, which are frequently more concentrated, give nutrients straight to plants. On the other hand, excessive fertiliser use can cause environmental issues like water pollution, soil acidification, and soil deterioration.

Soil Profile
The vertical arrangement of various soil horizons, or layers, that make up the Earth's surface is referred to as the soil profile. Each layer has unique properties that have been moulded through time by natural processes like weathering, erosion, and biological activity. The topsoil, subsoil, and bedrock are only a few of the layers that make up a typical soil profile.



The layer nearest to the surface is the topsoil, often referred to as the A horizon, and it contains organic material, nutrients, and bacteria that support plant growth. A deeper layer called the subsoil, or B horizon, has a higher concentration of minerals and less organic stuff. The layer nearest to the bedrock is known as the C horizon, or parent material, and it is made up of unconsolidated or partially weathered minerals. Understanding the physical and chemical characteristics of the soil, as well as its suitability for various agricultural, environmental, and engineering applications, requires knowledge of the soil profile.

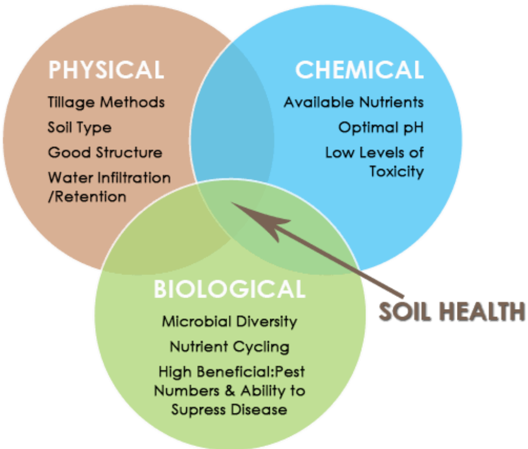
Soil Health

The physical, chemical, and biological characteristics of the soil are all included in the broader notion of soil health. It includes the relationships between plants, the environment, and soil organisms. Because it has an impact on the output and long-term viability of the soil ecosystem, soil health is significant. Important ecosystem functions like carbon sequestration, water regulation, and nutrient cycling can be provided by healthy soil.

Utilizing sustainable farming techniques like conservation tillage, crop rotation, cover crops, and integrated pest management is one way to enhance soil health. These techniques can enhance soil biodiversity, decrease erosion, increase soil organic matter, and better soil structure.

Relationship Between Soil Fertility and Soil Health

Both soil health and fecundity are interdependent and can affect each other. By supplying the essential nutrients for soil microorganisms, encouraging plant development, and enhancing soil structure, increasing soil fertility can improve soil health. On the other hand, by increasing nutrient availability, lowering nutrient losses, and encouraging nutrient cycling, boosting soil health can increase soil fertility.



(Source: BTN Biologicals)

Conclusion

The output and sustainability of soil are two factors that are significantly influenced by soil fertility and soil health. Sustainable cultivation depends on preserving soil fertility and enhancing soil health. The fertility and health of the soil can be increased by using sustainable agricultural techniques like integrated pest control and conservation tillage. The use of fertilisers and other chemicals, which may have detrimental effects on the ecosystem and the health of the soil, should be kept to a minimum.

References

1. Brady, N.C., and Weil, R.R. (2010). The Nature and Properties of Soils. Prentice Hall.
2. Karlen, D.L., and Stott, D.E. (1994). A framework for evaluating physical and chemical indicators of soil quality. In J.W. Doran, D.C. Coleman, D.F. Bezdicek, and B.A. Stewart (eds.), Defining soil quality for a sustainable environment (pp. 53-72). Soil Science Society of America.
3. Lal, R. (2014). Soil health and sustainability: managing the biotic component of soil quality. Soil Health and Sustainability (pp. 1-14). Springer.
4. Paul, E.A., and Clark, F.E. (1996). Soil microbiology and biochemistry. Academic Press.
5. Pimentel, D., Hepperly, P., Hanson, J., Douds, D., and Seidel.

Organic Farming: A New Revolution in Agriculture

Article ID: 40947

Bhawana Burdak[1], Dr. Meraj Ahmed[1]
[1]School of Agriculture, Lovely Professional University, Punjab.

Abstract
Organic farming is a vision towards a healthy nation. Organic farming also protects the environment and has a greater socio-economic impact on a nation. India is a nation which provides native abilities and growing potential for organic agriculture. A country like India's health is greatly impacted by organic farming since it promotes sustainable growth. But in these days due to immense use of pesticides and chemicals have hostile effects on health and food quality. As people are getting more conscious about health, the demand of organically grown foods has been increased drastically over the last decade. Consumers may get fresh, natural agricultural products thanks to contemporary, sustainable farming practices like organic farming.

Keywords: Organic farming, Natural, Healthy, pesticides.

Introduction
Organic farming is a system of agriculture which use the fertilizers of organic origin like green manure, compost manure and bone meal. Organic farming, also known as ecological farming or biological farming. Organic farming is a new system of farming or agriculture that repairs, maintains, and improves the ecological balance. It is a production system without using fertilizer, pesticides, growth regulator and livestock feed additives. Organic farming originated to show the change in farming practices in early 20th century. Organic farming also thinks globally. It provides opportunities to people to educate others. Eating organically cultivated food is really good for health. Organic farming played an important role in dealing with the environmental harms rooted in traditional agricultural techniques. Organic farming not only produces fine and healthy food products but also improves the fertility and quality of soil. People are paying attention towards the organic farming and adopt the organic cultivation of crops because they use high amount of chemicals and fertilizers, reducing the quality of food (Shir Y.V. Singh and J.P.S Dabass-2020).To conserve the organic matter, it is necessary to maintain the levels of tillage. The lack of fertilizers and pesticides resulting in better quality of produce.

Types of Organic Farming
Organic farming is divided into two types, namely:
1. Integrated organic farming
2. Pure organic farming.

Pure organic farming means avoiding all unnatural chemicals. Pure organic farming is totally a natural process. In this process of farming, all the fertilisers and pesticides are obtained from natural sources such as bone meal or blood meal for high productivity pure organic farming is best (Vijay Kumar-2021).

Integrated organic farming comprises combining pest control with nutrition management to meet ecological needs and demand **(**Hussain Saiyad-2005).

Advantages of Organic Farming
Soil: The soil is not harmed by organic farming. Pesticides and fertilisers are substituted in this manner. Because organic farming doesn't utilise chemicals, it has a smaller environmental impact. The National Academy of Agricultural Sciences (NAAS) recommended a holistic approach involving integrated nutrient management (INM), integrated pest management (IPM) for enhanced input use efficiency, and adoption of region-specific promising cropping systems as an alternative organic farming strategy for India and to begin with the practice of organic farming should value crops like spices, medicinal plants, fruits, and vegetables (P. Bhattacharya and G. Chakraborty-2005).

2. Good return on Investment: With the usage of cheaper and local inputs, a farmer can make a good return on investment and there are no extra expenses.

3. High demand: There is a huge demand for organic products in India and across the globe, which generates more income through export.

4. Nutritious food: nutritional value is higher in organic food because it is free of insecticides and pesticides food also tastes better. It also allowed animals to graze on the pasture and generate dairy products which are high in Vitamin E and omega -3s.

5. Climate-friendly and easier on the environment: Organic farming reduces carbon dioxide emissions by 25% and saves the water required to farm organic crops. it does not harm the environment.

6. Increased resistance to pests and disease: Organic farms are resistant to pests, weeds, and diseases because they are typically kept without the use of pesticides, herbicides, and synthetic fertilisers.

7. Sustainable: In contrast to conventional farming, organic farming is more sustainable for the future because it's more environmentally friendly and less destructive to the land. Organic farming is a great alternative to conventional farming practices (Brar SK and Sarma SJ.)

Techniques Involved in Organic Farming

1. Crop rotation – It is a technique which helps to grow various crop in the same area according to different season. In this technique no single crop is planted in same place because it will decrease the nutrient content of the soil

2. Soil Management- In India, soil management is primary technique of organic farming. It is a process of recharging the soil with all necessary nutrients. To increase the fertility of soil we use natural ways and this is main objective of organic farming (Anonymus-2023)

3. Biological pest control – In this we have to maintain the soil fertility and protect the crop. It is a method in which pests are controlled by living organisms with or without the use of chemicals.

Conclusion

The goal of organic farming is to create a healthy society. Foods grown organically are healthier and more nutrient-dense. It is an eco-friendly procedure that maintains healthy soil, which will benefit future generations as well as us. Food that is organic provides high quality while also guaranteeing food safety. Because of the increased use of chemicals and pesticides, which lower product quality and have a negative impact on human health, we have noticed a decline in the quality of food goods over the past few decades. Therefore, we must employ contemporary farming techniques that maintain the ecosystem in order to protect it for the current and upcoming generations. The farmers of ancient India adhered to the natural laws and this helped in maintaining the soil fertility over a relatively longer period of time (S. Chandra and S. K. Chauhan-2004).

References

1. S. Chandra and S. K. Chauhan, "Prospects of organic farming in India," Indian Farming, vol. 52, no. 2, pp. 11–14, 2004.
2. P. Bhattacharya and G. Chakraborty, "Current status of organic farming in India and other countries," Indian Journal of Fertilizers, vol. 1, no. 9, pp. 111–123, 2005.
3. Brar SK and Sarma SJ. Bio-Hydrogen Production: A Promising Strategy for Organic Waste Management. Hydrol Current Res S. 2013;5:002.

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

Rhizosphere & its Importance on Fruit Crops

Article ID: 40948

Aashish Dudi[1], Amit Kotiyal[1]
[1]Department of Horticulture, School of Agriculture, Lovely Professional University, Jalandhar, India.

Abstract
The rhizosphere plays a critical role in the growth and development of fruit crops. Microbes in the rhizosphere help plants acquire essential nutrients and protect them against soil-borne pathogens. Recent research has shown that the composition of microbial communities in the rhizosphere can vary depending on the cultivar and soil type, highlighting the importance of understanding the rhizosphere microbiome in fruit production. By promoting the growth of beneficial microbes in the rhizosphere, farmers can improve fruit quality and yield while reducing the need for chemical pesticides. This article explore the effect of the rhizosphere on fruit crops by justifying evidence from the latest research.

Introduction
The rhizosphere is the soil environment surrounding plant roots, where complex interactions between plants, microorganisms, and soil particles occur. The rhizosphere plays a critical role in plant growth and development, and can have a significant impact on fruit crops. The rhizosphere is home to a diverse community of microorganisms, including bacteria, fungi, and archaea. These microorganisms play an essential role in nutrient cycling and soil health, and can influence plant growth through a variety of mechanisms. For example, some bacteria can produce plant growth-promoting hormones, while others can solubilise nutrients like phosphorus, making them more available to plants.

Recent research has shown that the rhizosphere can have a significant impact on fruit crop growth and yield. For example, a study on strawberry plants by Hultberg et al. (2010) found that the composition of the rhizosphere microbial community was closely linked to plant growth and fruit yield. The researchers also conclude that plants with a more diverse microbial community had higher yields and better root architecture than those with less diverse communities. They also observed that specific microbial taxa were associated with increased fruit yield and quality. Another study on apple trees found that the rhizosphere can influence fruit quality and pest resistance. The researchers found that trees with a more diverse rhizosphere microbial community had higher levels of secondary metabolites, which are compounds that can improve fruit quality and enhance pest resistance. Additionally, they observed that specific bacterial taxa were associated with improved fruit quality and pest resistance (O'Leary et al.,2019). These findings highlight the importance of maintaining a healthy and diverse rhizosphere microbial community for fruit crop production. However, agricultural practices such as tillage and the use of synthetic fertilisers and pesticides can disrupt the rhizosphere and reduce microbial diversity. To maintain a healthy rhizosphere, farmers can employ practices such as cover cropping, reduced tillage, and the use of organic fertilisers.

Effect of Rhizosphere on Plant Physiology
The rhizosphere is the narrow zone of soil surrounding plant roots where soil microbes interact with plant roots and influence plant growth and health. The rhizosphere plays a vital role in the growth and development of fruit crops by providing essential nutrients and protecting plants against pathogens. Li et al. (2021) investigated the effects of different soil amendments on the rhizosphere microbial community and fruit quality of kiwifruit plants. The study found that the addition of organic fertiliser and biochar significantly increased the abundance of beneficial microorganisms, such as *Bacillus*, *Pseudomonas*, and *Trichoderma*, in the rhizosphere of kiwifruit plants. These changes were associated with improvements in soil nutrient availability and fruit quality, including higher sugar content, better color, and increased vitamin C levels. Recent research has highlighted the importance of the rhizosphere in fruit production. For example, a study published in the Journal of Applied Microbiology by Herrera et al. (2018) found that microbial communities in the rhizosphere of strawberry plants varied depending on the cultivar and soil type. The researchers also observed that the rhizosphere of some cultivars had higher levels of beneficial

microbes, such as *Pseudomonas* and *Bacillus*, which are known to promote plant growth and protect against pathogens.

A study conducted by Zhang et al. (2021) investigated the effects of rootstock on the rhizosphere bacterial community and apple tree growth. The study found that the bacterial community in the rhizosphere of apple trees was significantly affected by the rootstock genotype. The rhizosphere of trees grafted on the M.9 rootstock had a higher abundance of beneficial bacterial taxa, including Bacillus, Artharobacter, and Streptomyces, compared to trees grafted on the MM111 rootstock. The study also showed that trees grafted on the M.9 rootstock had a higher biomass, leaf area, and photosynthetic rate compared to trees grafted on the MM111 rootstock. A study conducted by Pérez-Jaramillo et al. (2021) investigated the effect of the rhizosphere on plant growth and resistance to pathogens. The study found that plant growth-promoting rhizobacteria (PGPR) present in the rhizosphere of Arabidopsis thaliana plants increased plant growth and induced resistance against pathogens. The PGPR altered the expression of genes associated with plant growth and defence responses and also modulated the composition of the rhizosphere microbiome.

Another study by Chen et al. (2021) investigated the effects of microbial inoculants on the rhizosphere microbiome and growth of peach trees during the vegetative stage. Microbial inoculants are live microorganisms that are added to soil to enhance plant growth and productivity. The study found that the addition of a microbial inoculant significantly increased the abundance of beneficial bacterial taxa, such as *Bacillus*, *Rhizobium*, and *Azospirillum*, in the rhizosphere of peach trees. This led to improved plant growth, including increased shoot length and biomass, compared to control trees. The study demonstrates the importance of microbial communities in the rhizosphere during the vegetative stage of fruit crops.

Mechanism Behind Rhizosphere Influence on Plant

The main mechanism behind rhizosphere interaction is the exchange of nutrients between plant roots and microorganisms. Plants exude a range of compounds such as sugars, amino acids, and organic acids from their roots into the rhizosphere, which serves as a food source for microorganisms. In return, microorganisms provide plants with essential nutrients such as nitrogen, phosphorus, and potassium, which are essential for plant growth and development. This exchange of nutrients between plant roots and microorganisms is known as the *Rhizosphere Effect.*

The Rhizosphere effect has been shown to have a positive impact on fruit tree crops. For example, a study conducted on apple trees showed that the rhizosphere microbial community was significantly different between healthy and diseased trees, indicating the potential role of rhizosphere microorganisms in disease resistance (Xiong et al., 2020). Another study on peach trees found that the application of beneficial rhizosphere bacteria led to a significant increase in fruit yield and quality (Tian et al., 2019).

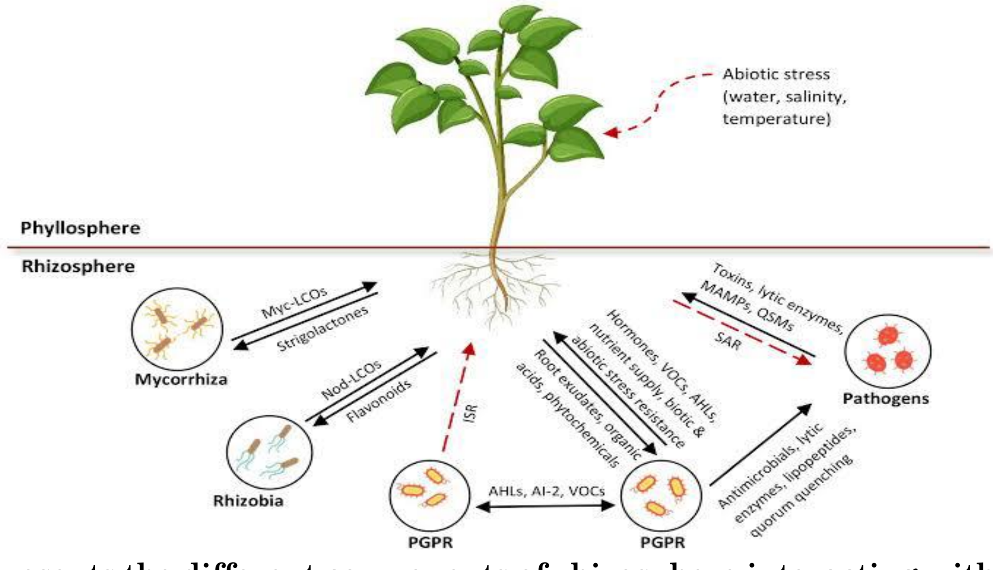


Fig.1. Represents the different components of rhizosphere interacting with plant and effecting directly or indirectly their growth | *Source: Fatima Jamil, Hamid Mukhtar, ORCID, Mireille Fouillaud, ORCID and Laurent Dufossé, Rhizosphere Signaling: Insights into Plant–Rhizomicrobiome Interactions for Sustainable Agronomy,* Microorganisms *2022,* 10*(5), 899*

Application of Rhizosphere on Fruit Tree

The rhizosphere, which is the zone of soil surrounding plant roots, plays an important role in the growth and development of fruit trees. Here, we will discuss the role of the rhizosphere on fruit trees, supported by valid references from recent research.

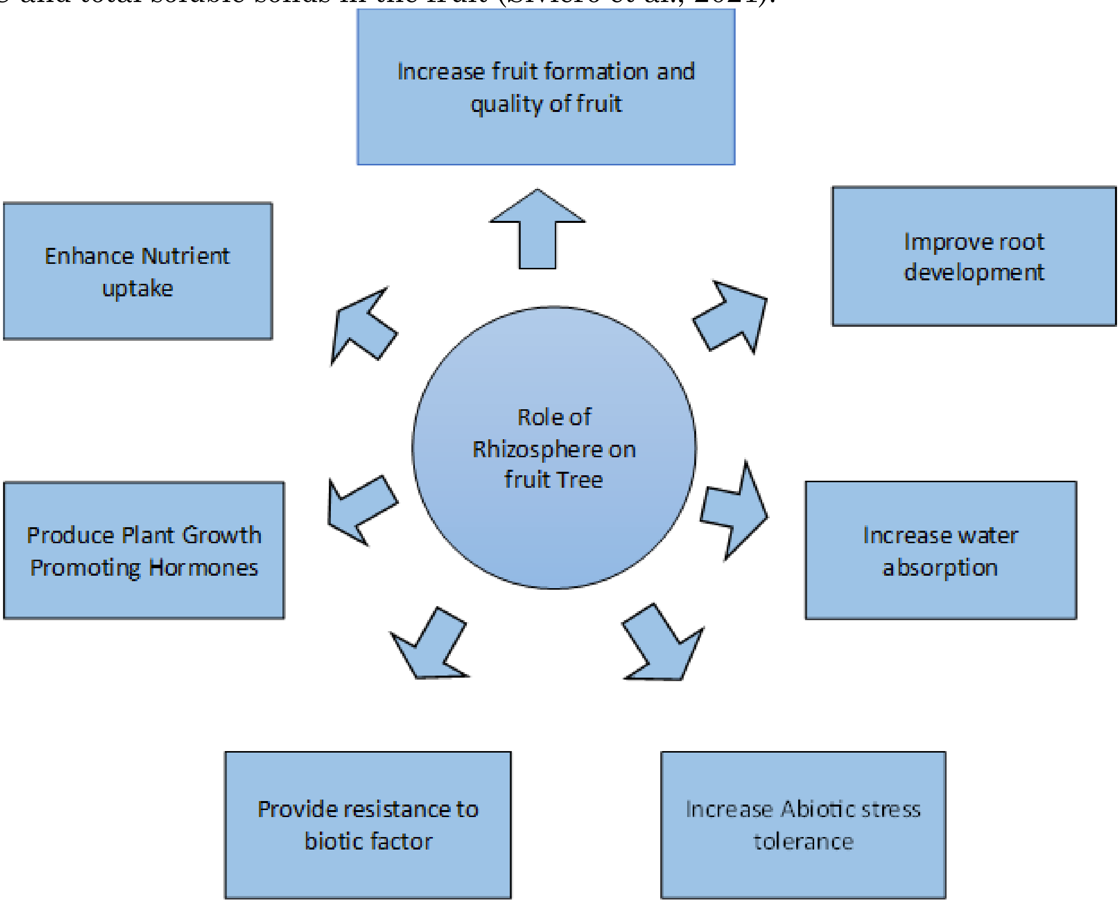
Nutrient Acquisition: The rhizosphere plays a crucial role in nutrient acquisition by fruit trees. The microorganisms in the rhizosphere help to break down organic matter, releasing essential nutrients such as nitrogen, phosphorus, and potassium, which are required for plant growth. A study conducted on apple trees found that the rhizosphere contained a higher concentration of available phosphorus than the bulk soil, indicating that the rhizosphere plays a critical role in phosphorus acquisition by apple trees (Zhu et al., 2019).

Disease Suppression: The rhizosphere of fruit trees contains a diverse microbial community that plays a significant role in disease suppression. Beneficial microorganisms in the rhizosphere can outcompete plant pathogens for nutrients and space, preventing their growth and development. A study conducted on peach trees found that the application of a biocontrol agent containing a beneficial fungus to the rhizosphere reduced the incidence of root rot disease by up to 75% (Qin et al., 2020).

Water absorption: The rhizosphere is important for water absorption by fruit crops. Plant roots release compounds that create a favourable environment for water uptake, and soil microorganisms can help retain water in the soil and make it available to the plant.

Stress Tolerance: The rhizosphere also plays a crucial role in stress tolerance by fruit trees. Beneficial microorganisms in the rhizosphere can help to alleviate abiotic stresses such as drought, salinity, and heavy metal toxicity. A study conducted on grapevines found that the application of a biofertilizer containing beneficial microorganisms to the rhizosphere improved grapevine growth and yield under drought stress conditions (Rao et al., 2020).

Fruit Quality: The rhizosphere can also influence fruit quality by affecting nutrient uptake and translocation. A study conducted on citrus trees found that the application of a biofertilizer containing beneficial microorganisms to the rhizosphere increased fruit size and weight, as well as the concentration of vitamin C and total soluble solids in the fruit (Siviero et al., 2021).



Role of Rhizosphere in Commercial Orchid Cultivation

The rhizosphere plays a critical role in commercial orchid cultivation, as it helps to provide the necessary nutrients for orchid growth and development. Orchids are epiphytes, which means they do not require soil for growth, but rather rely on nutrients from the air and the rhizosphere of the host plant or growing medium. In commercial orchid cultivation, the use of appropriate growing media is essential to provide the necessary nutrients for orchid growth. The growing medium should be able to provide the necessary nutrients while allowing for adequate drainage and aeration. The addition of beneficial microorganisms to the growing medium can also help to improve nutrient availability and uptake. Recent research has shown that the application of biofertilizers containing beneficial microorganisms to the rhizosphere of orchids can lead to improved growth and development (Alori et al., 2017). A study conducted by Osorio et al. (2016) on Phalaenopsis orchids found that the application of a biofertilizer containing mycorrhizae and other beneficial microorganisms to the growing medium led to an increase in root and shoot growth, as well as improved flower quality.

Conclusion

In conclusion, the rhizosphere plays a critical role in fruit crop growth and development, influencing factors such as yield, quality, and pest resistance. Recent research has shown that a diverse and healthy rhizosphere microbial community is essential for optimal fruit crop production. By implementing practices that promote microbial diversity and soil health, farmers can improve fruit crop yields and sustainability. The microorganisms in the rhizosphere of fruit trees such as nitrogen-fixing bacteria and mycorrhizae help to increase soil fertility, leading to higher fruit yield and quality.

In recent years, the application of biofertilizers that contain beneficial microorganisms to the rhizosphere of fruit trees has gained importance. The use of biofertilizers can help to improve nutrient availability and uptake, leading to improved growth and development of fruit trees and orchids. These biofertilizers help to increase the population of beneficial microbes in the rhizosphere, leading to improved nutrient acquisition and disease resistance (Subramanian et al., 2016). For example, a study conducted on mango trees found that the application of a biofertilizer containing nitrogen-fixing bacteria to the rhizosphere led to an increase in fruit yield by up to 29%. By understanding the importance of the rhizosphere and promoting the growth of beneficial microorganisms, farmers and orchid growers can improve crop yield and quality while reducing the need for chemical fertilisers and pesticides.

References

1. Hultberg, M., Alsanius, B. W., & Sjöholm, I. (2010). Influence of root exudates and organic fertilisation on soil microorganisms in strawberry. Acta horticulturae, (868), 277-282.
2. Verbon, E. H., Liberman, L. M. (2016). Beneficial microbes affect endogenous mechanisms controlling root development. Trends in Plant Science, 21(3), 218-229.
3. Herrera, P., Baeza-Yates, R., Monsalve, L., Poblete-Echeverría, C., Gajardo, G. (2018). Effect of cultivar and soil on the bacterial community associated with the rhizosphere of strawberry plants. Journal of Applied Microbiology, 124(4), 1054-1066.
4. O'Leary, B. M., Neale, H. C., Geisen, S., Chen, D., Bonkowski, M., Griffiths, B. S., & Ryan, M. H. (2019). Rhizosphere microbial communities differ according to nitrogen inputs and are influenced by the microbiome of apple trees. Plant and Soil, 440(1-2), 363-376.
5. Alori, E. T., Glick, B. R., & Babalola, O. O. (2017). Microbial biofertilizers: advantages and applications in crop production. In Microbial Inoculants in Sustainable Agricultural Productivity (pp. 43-62). Springer, Cham.
6. Osorio, N. W., López, C. C., & Mendoza, E. M. (2016). Rhizosphere: The Hidden World of Orchids. In Orchids: Latest Researches and New Aspects (pp. 161-176). InTech.
7. Subramanian, S., Sivakumar, S., & Parthasarathy, U. (2016). Biofertilizers in fruit crop production–An overview. Journal of Applied and Natural Science, 8(1), 251-258.
8. Qin, S., Wang, Y., Fan, X., Zhang, M., Gao, X., & Liu, X. (2020). Control of peach root rot disease using a biocontrol agent Bacillus amyloliquefaciens B1408 in the rhizosphere. Plant Disease, 104(7), 1931-1938.
9. Rao, N. N., Arshi, U., Bharathi, N., Reddy, N. N., & Reddy, D. D. (2020). Rhizosphere microbial consortium alleviates drought stress in grapevine (Vitis vinifera L.). Journal of Applied Microbiology, 129(3), 674-688.
10. Siviero, A., Cocco, C., Musetti, R., & Carimi, F. (2021). Effects of a microbial-based biofertilizer on the growth and fruit quality of citrus trees. Frontiers in Plant Science, 12, 663868.
11. Zhu, L., Liu, S., Zhang, J., Li, X., Li, Y., & Liang, X. (2019). Soil phosphorus fractions and phosphatase activities in the rhizosphere and non-rhizosphere of apple trees. Soil Science and Plant Nutrition, 65(1)
12. Pérez-Jaramillo, J. E., Carrión, V. J., de Hollander, M., Raaijmakers, J. M., & van der Putten, W. H. (2021). The rhizosphere microbiome as a toolbox to improve crop production and plant resilience. Plant Physiology, 186(3), 1290-1303. https://doi.org/10.1093/plphys/kiab163

13. Li, L., Wu, Y., Wang, X., Wu, Z., Wu, Q., Zhang, L., ... & Wang, S. (2021). Effects of soil amendments on the rhizosphere microbial community and fruit quality of kiwifruit plants. Frontiers in Microbiology, 12, 722670.
14. Zhang, L., Wang, X., Guan, J., Wu, Z., Li, L., Li, X., ... & Wang, S. (2021). Effects of rootstock on the rhizosphere bacterial community and growth of apple trees. Microorganisms, 9(1), 28. https://doi.org/10.3390/microorganisms9010028
15. Chen, L., Chen, Y., Chen, J., Tang, L., & Cao, K. (2021). Microbial inoculants affect the rhizosphere microbiome and growth of young peach trees during vegetative growth. Microorganisms, 9(4), 741. https://doi.org/10.3390/microorganisms9040741
16. Khan, N., Bano, A., & Babar, M. A. (2020). Rhizosphere: a key nexus for plant growth-promoting rhizobacteria. Archives of microbiology, 202(4), 803-823.
17. Tian, B., Yang, L. T., Liang, X., Chen, J., & Li, J. (2019). The application of beneficial microorganisms in peach trees: effects on soil microorganisms, soil nutrients, and tree growth. Frontiers in microbiology, 10, 1-10.
18. Xiong, C., Zhu, Y. G., Wang, J. T., Singh, B., & Han, L. L. (2020). Rhizosphere microbiota and disease resistance: a review. Plant pathology, 69(4), 617-631.

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

Drip Irrigation: The Smart Solution for Watering Plant

Article ID: 40949

Sudhanshu Shekhar[1], Dr. Yadvendra Pal Singh[1]
[1]School of Agriculture, Lovely Professional University, Phagwara, Punjab.

Introduction

Drip irrigation is a revolutionary technique for delivering water to plants in a precise and controlled manner. Unlike traditional irrigation methods that use sprinklers, drip irrigation systems involve the use of small holes in plastic pipes, known as emitters, that deliver water directly to the roots of the plants. This targeted approach to watering offers a number of benefits, including increased water efficiency, improved crop yields, and reduced labor costs. As a result, drip irrigation has become an increasingly popular choice for farmers and gardeners looking to conserve resources and maximize their yields.

With the global population on the rise, the demand for food and other agricultural products is also increasing, making it more important than ever to find efficient and sustainable ways to grow crops. Drip irrigation offers a promising solution, as it reduces water waste and ensures that crops receive the exact amount of water they need to thrive. Additionally, drip irrigation systems can be easily customized to fit the unique needs of different crops, making it a versatile and adaptable solution for a wide range of agricultural applications. Overall, drip irrigation is a smart and effective way to water plants, and it has the potential to revolutionize the way we grow food and other crops in the years to come. Water source: This can be a water tank, a well, or a municipal water supply.

Components of Drip-Irrigation System

Filtration system: A filter is necessary to remove any impurities or debris from the water before it enters the system. This helps to prevent clogging of the drip emitters.

Pressure regulator: A pressure regulator ensures that the water pressure is at the correct level for the drip system. This helps to prevent damage to the system and ensures that water is delivered evenly to all plants.

Distribution tubing: This is the main supply line that carries water from the water source to the drip emitters. The tubing can be made of PVC, polyethylene, or other materials.

Drip emitters: These are small devices that release water slowly and evenly directly to the base of the plants. Drip emitters come in different types, including drippers, micro-sprayers, and micro-sprinklers.

Fittings and connectors: These are used to connect the distribution tubing to the drip emitters and other components of the system.

Timer or controller: A timer or controller is used to automate the watering schedule and ensure that the plants receive water at the appropriate times. The timer can be set to water the plants at specific intervals, and some controllers can be connected to weather sensors to adjust the watering schedule based on weather conditions.

Advantages

Water efficiency: Drip irrigation systems are highly efficient in terms of water usage because they deliver water directly to the root zone of plants, minimizing water loss due to evaporation and runoff.

Reduced soil erosion: Since the water is delivered directly to the root zone, there is less water on the soil surface, which reduces soil erosion.

Reduced weed growth: Drip irrigation only delivers water to the plants, which reduces the growth of weeds.

Increased plant growth: Drip irrigation provides water and nutrients directly to the roots, leading to increased plant growth and yields.

Reduced labor costs: Once the system is installed, it requires less labor than other irrigation methods.

Disadvantages

Initial cost: Drip irrigation systems can be more expensive to install than other irrigation systems due to the cost of materials and labor.

Clogging: The emitters used in drip irrigation systems can become clogged, reducing the system's efficiency and requiring maintenance.

Root intrusion: The pipes used in drip irrigation systems can be susceptible to root intrusion, which can cause damage to the system.

High salinity levels: Drip irrigation can lead to high salinity levels in the soil, which can affect plant growth.

Uneven water distribution: If the system is not properly designed and installed, it can lead to uneven water distribution, which can affect plant growth.

Conclusion

In conclusion, drip irrigation is a smart solution for watering plants as it offers several advantages over traditional irrigation methods. By delivering water directly to the roots of plants, drip irrigation ensures that water is used efficiently and reduces the risk of water wastage. It also helps to prevent diseases caused by overwatering, reduces weed growth, and minimizes soil erosion. Additionally, drip irrigation is highly customizable and can be easily adjusted to suit different types of plants and soil conditions. Overall, investing in drip irrigation can lead to healthier plants, reduced water usage, and ultimately, a more sustainable approach to gardening and agriculture.

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

Hydrogel the Super Absorbment

Article ID: 40950

B. Pawan Kumar[1], D. Naga Harshitha[1]
[1]College of horticulture, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Hyderabad-500030.

The optimization of the utilization of water resources is strategic for the long-term competitiveness of the agricultural industry in the world. Water management is considered one of the major challenges of the near future. Irrigation water stress is one of the major limiting factors that, affect the crop growth, fruit productivity and quality. Crop productivity is often also limited by adverse physical and chemical soil properties such as low infiltration rates as well as low water retention and low cation exchange capacity.

The hydrogel is a soil conditioner able to retain water and plant nutrients. Hydrogel is commercially available as Stockosorb/Raindrop/Agrosorb. Stockosorb releases water and nutrient to the plants, when surrounding soil near root zone of plants starts to dry up. Hydrogel polymers are synthetic, water absorbing monomers of high molecular weight. Polymers differ from each other in the specific monomer building block, amount of water absorbed per gram of material, particle size and distribution, response to salinity and cost. Benefits derived from polymer application to soil or artificial medium include increase in water-holding capacity, increase in pore size/number, increase in soil nutrient reserves, and reduction in soil compaction. Initial use of polymers was reported in greenhouse production in the late 1970s, but is now used in the production of fruits, vegetables, and turf.

The damage caused by water deprivation, different soil conditioners have been assayed in crops and landscape plants would mitigated by hydrogels. These hydrogels are (Polymers) play important role in agricultural sector (Dehkordi, 2017). Research evidence suggests that, when the soil is treated with super absorbent polymers (SAP), the water volumetric content of the soil increases significantly and as the soil dries, the stored water is released back slowly into soil. Further, fertigation is also possible by the application of SAP to the soil as the same is capable of absorbing the fertilizer and releasing the same with water (Rajiv et al., 2014). Additionally, polymers are effective in correction of aggregation, prohibiting of capillary water soar, decreasing cumulative evaporation and improving growth, efficiency in vast range of plant species. In arid and semiarid regions of the world, use of super absorbent polymers (SAP) may effectively increase water and fertilizer use efficiency in crops.

Mode of Action for Polymer Hydrogel

When the hydrogel is mixed with the soil, it forms an associate amorphous gelatin-like mass on hydration and it helps in absorption and desorption for an extended time, thus acts as a slow release of water within the soil. Due to the respectable volume reduction of the hydrogel as water is released to the plant, hydrogel creates at intervals the soil, free pore volume providing further space for air and water infiltration, storage and root growth (Azzam, 1980). Hence, the hydrogel polymer delivered an affective transfer of property as a slow-release basis of water and dissolved fertilizers in the soil. The water conservation by hydrogel creates a buffered setting being effectiveness in short-run drought and losses reduction in institution phase. Once polymers are mixed into soil, they preserved vast quantities of water and nutrients reach up to hundred times of its original weight and conserve regarding ninety-five percent of keep water out there for plant absorption (Johnson, 1984) and which are released as required by the plant, therefore, plant growth was enhanced with limited water supply, however, in rainfall region adding hydrogel polymer to soil implement soil infiltration rates.

Uses Hydrogels in Horticulture

In greenhouse: Growers were searching for methods that would increase the number of days between watering crops as well as reduce the total amount of water needed to grow their crops to maturity. Crop response to the addition of polymers in soil and/or soilless media appeared to be greatest when incorporated in sands or media with low organic matter. The rates of polymer application were recommended by manufacturers range from 1 to 5 lb yd^{-3} of media. One unusual use of a polymer modified soil was found for rooted cuttings. Banko (1984) also reported that, an improvement in rooted cuttings of holly and azalea from polymer incorporation into the rooting media. One potential application of polymers in greenhouse production is the use of polymer modules as a substrate for tomato production developed in England (American Greenhouse Vegetable Growers News, 1989). In comparison to tomato growth in rockwool, there was no difference in yield with the polymer substrate. However, the advantage of using polymers is the ease of disposal compared to other soilless substrates.

In fruit crops: Various research findings suggested that the lower tree mortality in newly established orchards and sustained active growth in established orchards under stress conditions. Several injection machines were developed to inject hydrated polymers as well as dry polymers. Good results were obtained with placement of the polymer in the drip-line area. The optimum polymer rate has been calculated to be 8 oz of polymer in 80 gal of water per tree in orchards (C.B. Wilde, personal communication). However, the rate of polymer application at each location should be determined by tree size, tree species, location, soil type, and rainfall amount and distribution patterns.

Effect of hydrogel on water management in *Citrus limon:* Planting of citrus on steep hill slopes and lack of supplementary irrigation and application of nutrients, cause gradual decrease in their productivity. To overcome this problem hydrogel polymer (stockabsorb) @100g was used. It was observed that stockosorb retains water considerably for a longer time than without stockabsorb application. Due to application of stockabsorb the water holding capacity of the soil increased from 28.74% to 34.63% this was in accordance with the study by (Pattanaaik, *et al*., 2015) for the increased yield of citrus reticulata by the application of hydrogel. This may be due to the fact that the soil was wet for a longer time increasing the microbial activity and availability of nutrients. This also helps in reducing the fruit drop due to water stress. Moreover, with respect to growth of the plant, it has been found that there is appreciable increase in the growth of the tree. With regard to total thickness of the peel as well as thickness of the alvido, there was significant increase when compared to normal ones. The productivity of the crop can be increased by 43 per cent by application of 100gm of stockosorb per plant in comparison to the control. The application of stockosorb also produced lemon fruits having high juice content. This also increases the nutrient use efficiency of soil treated with stockosorb.

Effect Of Hydrogel on Flowering, Yield and Nutrition: In banana increasing amount of applied polymer significantly shortended the flowering and harvesting time of plants. Time to flowering tended to decrease with increasing water quantity. High applying polymer dose (1500 gm mat^{-1} $year^{-1}$) also high amount of irrigation (8000 m^3 fed^{-1} $year^{-1}$) decreased the period of flower compared with the control and the other polymer and irrigation treatments (361.7, 346.3 against 411.7, 418.3 days or 425 & 420 days) in both tested seasons. Time to harvesting of plants was clearly decreased by increasing the amount of polymer in both seasons. In this respect manner, 1500 and 1000 gm mat^{-1} $year^{-1}$ treatments were shortened the period to harvesting (122.7, 120.7 and 125, 123.7 days) in both tested seasons, respectively. The interaction between the SAP and the water regime indicated that the decrease of days to flower and period to harvest was detected when applied SAP at the doses of 1500 and 1000 g mat-1 year-1 with the 87.5% (7000 m3 fed^{-1} $year^{-1}$) water regime comparing with the other treatments (Kassim *et al*., 2017).

Barakat *et al.* (2015) reported that, the increased banana bunch weight (27.75 to 27.88 kg $plant^{-1}$), hand number per bunch (11.00 to 11.21), net bunch weight (2.31 to 2.36 kg), number of fingers per bunch (189-194) and finger weight (123.98 to 133.70 g) was recorded by using 150 g $plant^{-1}$ of hydrogel with irrigation by 80% of IR. The stockosorb technology was applied in the Khasi mandarin along with application of recommended doses of N: P: K (i.e., 450, 450 and 900 g, respectively, to each tree). Irrigation was applied equally to all the plants. Yield per tree were recorded the maximum number (283) of fruits for the treatment 100 g of stock absorb application. This was the highest yield among all the treatments (Pattanaaik *et al.,* 2015).

Hydrogel application minimizes micronutrients from washing out to water tables and increase water consumption efficiency; also, they reduce the quantity of fertilization, since the nutrient leaching is prohibited by decreasing runoff. The nutrients are release and soil nitrification (El-Hady, 1981), increase in nutrient absorption, osmotic moisture of soil and decrease in transplanting stresses that cause an improvement in plant growth reaction and increase in yield and reduction in production costs of plant. The highest values of macro (870.50 to 890.20, 93.6 to 95.2 and 1390 to 1412.40 mg 100 g $^{-1}$ NPK) and micro-nutrients (42.6 to 43.8, 17.3 to 18.0 and 14.0 to 14.08 mg kg-1 Fe, Mn and Zn respectively) was obtained from potato receiving 150 kg N fed-1 and soil amending with VH under 26 days irrigation intervals (Abd El-Badea *et al*., 2011).

References

1. Abd El-Badea S., Ezzat Aml A El-Awady., Hamdino M.I. Ahmed., (2011). Improving Nitrogen Utilization Efficiency by Potato (*Solanum tuberosum* L.). B. Effect of Irrigation Intervals, Nitrogen Rates and Veterra Hydrogel on Growth, Yield, Quality and Nutrient Uptake. *Nature and Science* 9(7):34-41.
2. Azzam R.A., (1980). Agricultural polymers. Polyacrylamide preparation, application and prospects in soil conditioning. *Communications in Soil Science and Plant Analysis*. 11(8):767-834.
3. Banko T.J., (1984). Medium amendment plus watering system may improve rooting. Amer Nurseryman 5:51-53.
4. Barakat M.R., El-Kosary S., Borham TI., (2015). Effect of hydrogel soil addition under different irrigation levels on Grand Nain banana plants. *Journal of Horticulture Sciences & Ornamental Plants* 7(1):19-28
5. Dehkordi K.D., (2017). Effect of superabsorbent polymer on salt and drought resistance of *Eucalyptus globulus*. *Applied Ecology and Environmental Research* 15(4):1791- 1802.
6. El-Hady O.A., Tayel M.Y., Lofty A.A., (1981). Super gel as a soil conditioner: its effect on plant growth, enzymes activity, water use efficiency and nutrient uptake. *Acta Horticulture* 119:257-265
7. Johnson M.S., (1984). Effect of soluble salts on water absorption by gel forming soil conditioners. *Journal of Science and Food Agriculture* 35(10):1063-1066.
8. Kassim F.S., El-Koly M.F., Hosny S.S., (2017). Evaluation of super absorbent polymer application on yield, and water use efficiency of Grand Nain banana plant. *Middle East Journal Agricultural Research* 6(1):188-198.
9. S.K.Pattanaaik., L. Wangchu., Barun Singh., B.N.Hazarika., S.M.Singh and A.K.Pandey., (2015).“Effect of hydrogel on water and nutrient management of Citrus reticulate, *Research on Crops* 16 (1), pp. 98-103.

E-ISSN: 2581 - 8317

Aloe Vera - A Miracle Plant

Article ID: 40951

Sreenivas M[1]
[1]Assistant Professor, Department of Plantation, Spices, Medicinal and Aromatic crops, College of Horticulture, SKLTSHU Rajendra Nagar, Hyderabad, Telangana, IN.

Introduction

Scientific Name: *Aloe barbadensis*
Family: Asphodelaceae (Liliaceae)
Origin: South-east Arabian Peninsula
Chromosome number: 2n=14

It is a shrubby or arborescent, perennial, xerophytic, succulent, pea- green color plant. It grows mainly in the dry regions of Africa, Asia, Europe and America. Oldest medicinal plant ever known and the most applied medicinal plant worldwide. Aloe is a succulent plant widely used in alternative medicine. Aloe vera is a stemless or very short-stemmed plant growing to 60–100 centimetres (24–39 inches) tall, spreading by offsets. Aloe vera is a useful source of vitamins. Aloe vera gel contains a large range of vitamins - even vitamin B12, Vitamin A, contains B-Group vitamins, Vitamin C, Vitamin E and folic acid. There are nearly 150 species of Aloe, among them, *Aloe barbadensis* is the only one species that has legendary medicinal reputation dating back to thousands of years. The word 'Aloe' is derived from the Arabic word "Alloeh" meaning "bitter" because of its bitter liquid found in the leaves. This bitter juice is often prepared as a flavoured drink and is used to help with digestive problems.

Chemical Constituents

Aloe contains two classes of Aloins: (1) nataloins, which yield picric and oxalic acids with nitric acid, and do not give a red coloration with nitric acid; and (2) barbaloins, which yield aloetic acid ($C_7H_2N_3O_5$), chrysammic acid ($C_7H_2N_2O_6$), picric and oxalic acids. The plant produces at least 6 antiseptic agents such as lupeol, salicylic acid, urea nitrogen, cinnamonic acid, phenols and sulphur. All of these substances are recognized as antiseptics because they kill or control mold, bacteria, fungus and viruses, explaining why plant has the ability to eliminate many internal and external infections. Lupeol and salicylic acid present in the juice are two very effective pain-killer.

Medicinal Properties

Aloe vera is the oldest medicinal plant ever known and the most applied medicinal plant worldwide. Extracts of Aloe vera is a proven skin healer. Aloe vera help to soothe skin injuries affected by burning, skin irritations, cuts and insect bites and its bactericidal properties relieve itching and skin swellings.

1. Aloe is a powerful detoxifier, antiseptic and tonic for the nervous system.
2. It also has immune-boosting and anti-viral properties.
3. It also acts as a laxative; beauty enhancer and it has an effect on lowering blood sugar levels in diabetics. It acts as a natural fighter against all sorts of infection, an efficient anti-oxidant, helps in treating all digestion related problems, heartburn, arthritis, stress, diabetes, rheumatism pain, asthma, cancer and AIDS.
4. Useful in various diseases such as type II diabetes, arthritis, eye disease, tumor, spleen enlargement, liver complaints, vomiting, bronchitis, asthma, jaundice and ulcers. Relieves constipation, maintains a good gastric pH, helps in inflammatory bowel diseases, non-ulcer dyspepsia, gastric and duodenal ulcers.
5. Gives relief from side-effects of radiotherapy.
6. Promotes hair growth and delays aging process.
7. Useful in treating skin ailments and dermatritis.

Mycorrhiza: A Solution for Sustainable Agriculture

Article ID: 40952

Rahul R Bakade[1], Pradosh K Paramaguru[1], Jyotirmay Ghosh[1]
[1]ICAR-National Institute of Secondary Agriculture.

Sustainability is capacity of the ecosystem to co-exist for long run including human. It has three major aspects, i.e. environmental, economic and social and it based on the principle that without compromising the ability of future generations, we must meet the needs of the present to meet their own needs. Now it right time to think and work to make a system which helps in economic competitiveness, conserving the resources, social supports and environmental safety. Fundamentals of sustainability in agricultural system is focus on the development of technologies and practices_which are safe for environmental, economic to farmers and lead to improvements in food productivity. Hence, management of natural resources is the prime importance of sustainable agriculture.

The healthy ecosystem is the root for efficient and sustainable agriculture system and in agriculture, soil occupies the major part of this system where many biological processes occur like waste decomposing, nutrient cycling, biological nitrogen fixation, etc. in association with microorganism.

In modern agriculture the use of chemical fertilizers and pesticides are contributing towards groundwater pollution in soil and these fertilizers creates soil acidity because of its acid radicals. The microbiome of soil is very sensitive to these chemicals added into the soil and have the adverse effects on them. So, the population of these microbiome is getting destroyed after the application of chemical fertilizers and neds to be reintroduced the efficient strains of microorganisms in the soil frequently to restoring the soil ecosystems required for long run and sustainable agriculture. Under the circumstances of climate change, sustainable agriculture is a promising concept to achieve food security to meet the need of increasing world population and to manage the increased food production without any adverse effect on the ecosystem is a challenging task. Hence, to develop sustainable crop production enrichment of the beneficial microorganisms associated with crops is the promising approaches. This microbiome of soil has the tremendous potential to increase biotic/abiotic stress tolerance, nutrient acquisition, disease resistance and increase the growth of crops. The progress towards the sustainable agriculture streamlines the aspects of crop production by replacing agrochemicals with the microbial biofertilizers and pesticides and it is documented in the literature since 1965.

There are n number of microbes present in soil which keeps the ecosystem healthy and mycorrhiza is for the most important among them. They invade the feeder root tissues and form modified roots called mycorrhizae (fungus roots), which greatly increase the efficiency of nutrient and water uptake.

Mycorrhiza is a fungus which has symbiotic relationship with more than 80% plants on earth. Mycorrhiza is categorised into seven different groups i.e. arbuscular, ecto, ectendo, arbutoid, monotropoid, ericoid, orchidaceous mycorrhizae but it is broadly divided into two broad groups, i.e., ectomycorrhiza and endomycorrhiza and ectomycorrhizae are the most abundant and widespread.

Ectomycorrhizas

Hyphae of ectomycorrhizal fungi do not penetrate individual cells within the root. Structurally, ectomycorrhizas are characterized by the presence of a fungal mantle that envelops host roots and a Hartig net that surrounds root epidermal and/or cortical cells and provides a large surface area for resource exchange. Hormonal interactions between plant and fungus lead to dramatically altered root architecture including the suppression of root hairs (Fig. 1). These hyphae sometimes coalesce into macroscopic structures called rhizomorphs that attach the mycelium to sporocarps or can be morphologically similar to xylem and serve in water uptake.

Endomycorrhizas

Hyphae of endomycorrhizal fungi penetrate the cell wall and invaginate the cell membrane. It enters into the plant cells, producing structures that are either balloon-like (vesicles) or dichotomously-branching invaginations (arbuscules) (Fig. 1). The structure of the arbuscules greatly increases the contact surface area between the hypha and the cell cytoplasm to facilitate the transfer of nutrients between them. Most plants used in agriculture and horticulture, as well as some forest species, form arbuscular mycorrhizas (AM), but other mycorrhizal types are important in particular situations.

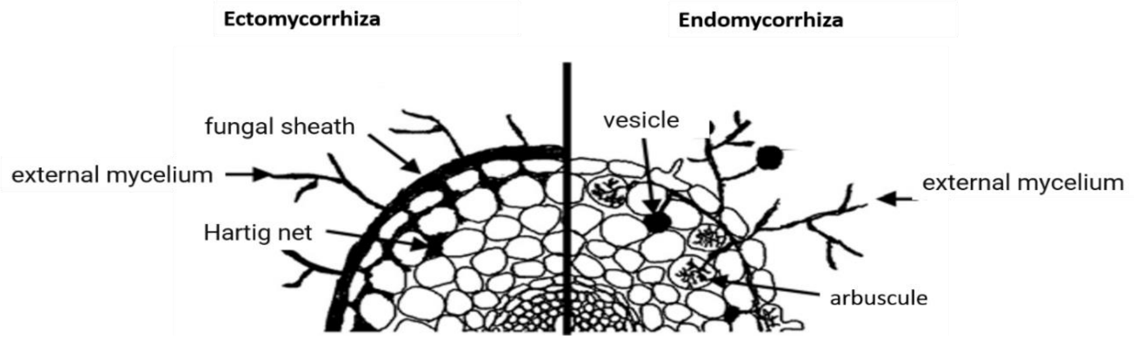


Fig. 1 Schematic Diagram of two major Mycorrhiza i.e. Ectomycorrhiza and Endomycorrhiza

Mitigation Strategies on Stress Tolerance

Mainly two types of stresses, abiotic and biotic, affects the plant and may be responsible for reduction in yield. Mycorrhizal association with plant can promote growth of plant in stress condition and possible to achieve sustainable agriculture goals. Along with the increase output and food quality this may also reduce the use of artificial fertilizers, avoiding environmental harm and lowering input costs. Plant associated with mycorrhiza can effectively managed any type of stress conditions including.

1. Abiotic Stresses: The abiotic stress, like drought, salinity, heat, and cold, causes severe yield losses worldwide due to hampering severe distortion in the morphological, biochemical, physiological, and molecular parameters of plants. mycorrhiza play a significant role in the adverse abiotic stress to reduce the detrimental effects on plant growth that have been already reported.

a. Salinity stress: Total salinity affected area is about 20% of the arable land and is increasing slowly every year mostly in dry and semiarid regions and irrigation by saline water or high-salt-containing ground water is the major cause for salinity development (Gianinazzi-Pearson, *et. al.,* 1996). Mycorrhizal association possessed the capacity to tolerate high-salinity stress and provide normal grow and development of associated plants. Mycorrhiza are able to improve water uptake, provide high-nutrient accumulation especially phosphorus activates plant hormones. It also modifies many physiological and biochemical mechanism of plants under salinity stress. mycorrhiza increased the activity of catalase and peroxidase in wheat leaves and roots which are hindered in saline condition because of its alkalinity.

b. Drought stress: Drought stress affects plant life by having shortage of water to roots reduces rate of transpiration as well as induces oxidative stress and affects enzyme activity, ion uptake, and nutrient assimilation. In drought condition to reduce the transpiration rate the stomata will get close which results in reduction in CO_2 influx and it affects the photosynthetic activity, it also leads to carbon partitioning, acceleration in generation of reactive oxygen species (ROS), reducing phosphate availability, oxidative stress and other nutrient supply and ultimately reduces crop quality. Mycorrhizal association with plants are able to manage many physio-biochemical processes which results in moisture stress tolerance. The extraradical mycelia of mycorrhiza helps in extension of host root system and provide required nutrients and water from the soil-root interface by increases root size and efficacy. The phosphorus and nitrogen assimilation will get improved in mycorrhizal association, also synthesis fungal aquaporins which regulate osmotic conditions in the plant. The mycorrhizal hyphae in the host plant directly absorb NO_3 or NH_{4+} to take up nitrogen. It increasing the photosynthetic efficiency, by influencing the stomatal behaviour defining the water vapor efflux and CO_2 gas exchange, relative water content (RWC) and leaf water potential (LWP), water use efficiency (WUE) of host plants, and maintains water status in drought condition (Boomsma, 2008).

2. Biotic Stress: Pest and diseases are known to reduction in yield and there is a risk of resistance development in the use of chemical pesticides. Hence, biocontrol agents are the best solution to avoid these. Mycorrhiza forms a matt around the root Directly work as a first line of barrier and form a Hertig net in cellular spaces which act as second line of barrier. Its association also stimulate the defence mechanism in the plant system which triggers the defence related genes. Obligate biotrophic mycorrhiza can have symbiosis with more than 80% of the plant species and offers several modifications to host plants one of which include development of resistance against pathogens and pest (Gopal *et. al.,* 2014). Different mycorrhizal isolates show different effects in terms of resistance or tolerance to biotic pressures for specific pathogen plant interactions.

a. **Mitigation for Biotic Stress:** Bio-protection via mycorrhization is involved several modes rather than single. mycorrhizal symbiotic association also has systemic effects to upper parts of plant and not limited to root zone and has two crucial systems that protect them against aerial diseases and pests may be involved. The pathogen recognised by the above ground part recognition signal detected by the root zone where mycorrhizal symbiotic association start uptake of extra nutrients by host plants. The process of mycorrhiza-induced resistance (MIR) remains deceptive, despite the fact that regulation of plant defence mechanisms by mycorrhiza was thought to be one of the key processes engaged in the battle against aerial diseases and insects/pests (Jung, S.C. *et al.,* 2012). Nutrient or mineral assimilation is one of the important aspects, get enhanced by mycorrhizal symbiosis which makes the plant more robust and plant itself develops more tolerant or resistant to pathogen attack. Improving nutritional status is not the only sole mechanism for protection against pathogens. It is build-up jasmonic acid (JA) in plants which is key element for general plant defence and the genes for peroxidase, phenylalanine ammonia-lyase, and chitinase gets upregulated these enzyme activate defence mechanism in plant (Pozo, & Azcon-Aguilar, 2007). Mycorrhiza induces resistance called Mycorrhizal induce resistance (MIR). It confers traits systemic resistance (SAR) when a pathogen infects a plant and induced systemic resistance (ISR) when beneficial bacteria colonize the roots. MIR is also linked with SA-dependent genes in similarity with SAR-like priming, such as genes encoding a PR protein and this relate with SA pathways combines MIR with a response similar to SAR, unlike ISR, in which it aggregates the protective compounds antecedent to pathogen attack.

Future Prospectives

Mycorrhizal association with plants dramatically alters the host plant's physiology and this transformation has a positive impact in relation to its biotic interaction. Basically mycorrhizal association with plant and its symbiosis with plant make it more tolerant to survive any kind of stress. This Mycorrhizal associated defence is the association of plant defence system, fundamental changes in the rhizosphere and roots and nutritional management of plant. increase plants' defences against invaders appears to be strongly dependent on jasmonate signalling. The production of trehalose, phytohormones, glomalin, proline, antioxidant enzymes, aquaporins, and higher nutritional content by mycorrhizal association plays a valuable and effective role under abiotic stress conditions. In all the way mycorrhiza found the better solution as the alternative to chemical fertilizer and pesticides and the goals of sustainable agriculture where minimal use of synthetic fertilizers and other chemicals will surely be achieved by this. This not only reduce the soil pollution but will boost both, crop growth and production. It may surpassing the expanding consumption needs of the world population. Hence, a strong encouragement is required to ensure that eco-friendly technologies like mycorrhizal use in agriculture.

References

1. Boomsma, C. R., & Vyn, T. J. (2008). Maize drought tolerance: Potential improvements through arbuscular mycorrhizal symbiosis? *Field Crops Research*, *108*(1), 14–31. https://doi.org/https://doi.org/10.1016/j.fcr.2008.03.002
2. Gianinazzi-Pearson, V., Dumas-Gaudot, E., Gollotte, A., Tahiri-Alaoui, A., & Gianinazzi, S. (1996). Cellular and Molecular Defence-Related Root Responses to Invasion by Arbuscular Mycorrhizal Fungi. *The New Phytologist*, *133*(1), 45–57. http://www.jstor.org/stable/2558635
3. Gopal, S., Kim, K., Hu, S., & Sa, T. (2014). Effect of Salinity on Plants and the Role of Arbuscular Mycorrhizal Fungi and Plant Growth-Promoting Rhizobacteria in Alleviation of Salt Stress. B *Physiological Mechanisms and Adaptation Strategies in Plants Under Changing Environment* (Том 1, с-ци 115–144). https://doi.org/10.1007/978-1-4614-8591-9
4. Jung, S. C., Martinez-Medina, A., Lopez-Raez, J. A., & Pozo, M. J. (2012). Mycorrhiza-induced resistance and priming of plant defenses. *Journal of Chemical Ecology*, *38*(6), 651–664. https://doi.org/10.1007/s10886-012-0134-6
5. Pozo, M. J., & Azcón-Aguilar, C. (2007). Unraveling mycorrhiza-induced resistance. *Current Opinion in Plant Biology*, *10*(4), 393–398. https://doi.org/10.1016/j.pbi.2007.05.004.

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

Soil Health Under Organically and Conventionally Managed Soils

Article ID: 40953

Keniya Bhavikkumar J.[1], Zinzala, V. J.[2]

[1]Keniya Bhavikkumar J., Ph. D. (Agri.) Scholar, Department of Soil Science and Agril. Chemistry, N. M. College of Agriculture, Navsari Agricultural University, Navsari.

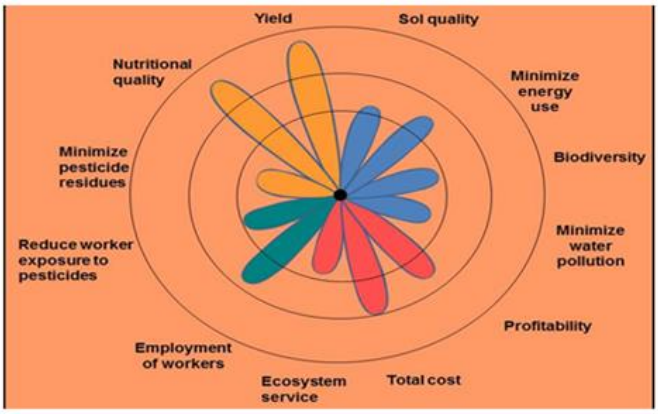
[2]Zinzala, V. J., Associate Professor, Department of Soil Science and Agril. Chemistry, N. M. College of Agriculture, Navsari Agricultural University, Navsari.

Summary

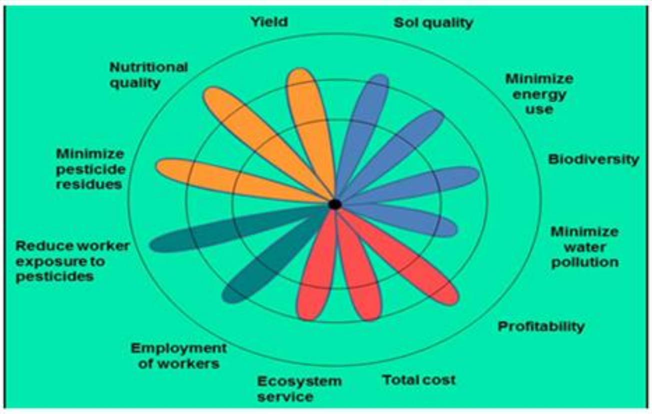
Soil organic carbon has come down from 1 % to 0.3 % after Green Revolution in the past 70 years. There is limited addition of organic source of nutrients under conventional farming. Therefore, for attaining sustainable production in long run, soil health is the most important point to be kept in mind which is maintained by organic sources. Though, continuous and injudicious use of these high energy inputs is leading to decline in production and productivity of various crops as well as deterioration of soil health and environment. Soil health is governed by soil physical, chemical and biological properties. Conventional farming causes soil degradation, decrease in micro nutrient content, organic matter of soil and microbial diversity, *etc.* but results in comparatively higher yield. While organic farming improve soil structure and aggregation, increase in organic matter of soil and microbial diversity, increase in porosity and water holding capacity of soil, *etc.* but results in comparatively lower yield. Organic farming system better balance four areas of sustainability as compared to conventional farming.

Introduction

Soil health is a crucial topic for the future of agriculture because the ability of soil to support plant growth depends on the interactions between soil physical, chemical and biological properties. Additionally, human health and well-being are closely connected with soil. Therefore, soil plays an important role in future agricultural policy, environmental protection and climate change. Knowledge of soil dynamics is necessary to prevent soil quality decline, especially in terms of soil organic matter (SOM) content and nutrient availability. Soil organic carbon has come down from 1 % to 0.3 % after Green Revolution in the past 70 years. The declining soil quality of present agricultural system which rely on high energy input that have deleterious impact on soil causing degradation in form of erosion, alkalinity, salinity, acidification, micronutrient deficiency, *etc.*



Conventional Farming



Organic Farming

Fig. 1: Assessment of Organic Farming relative to Conventional Farming in four major areas of Sustainability (Reganold and Wachter, 2016)

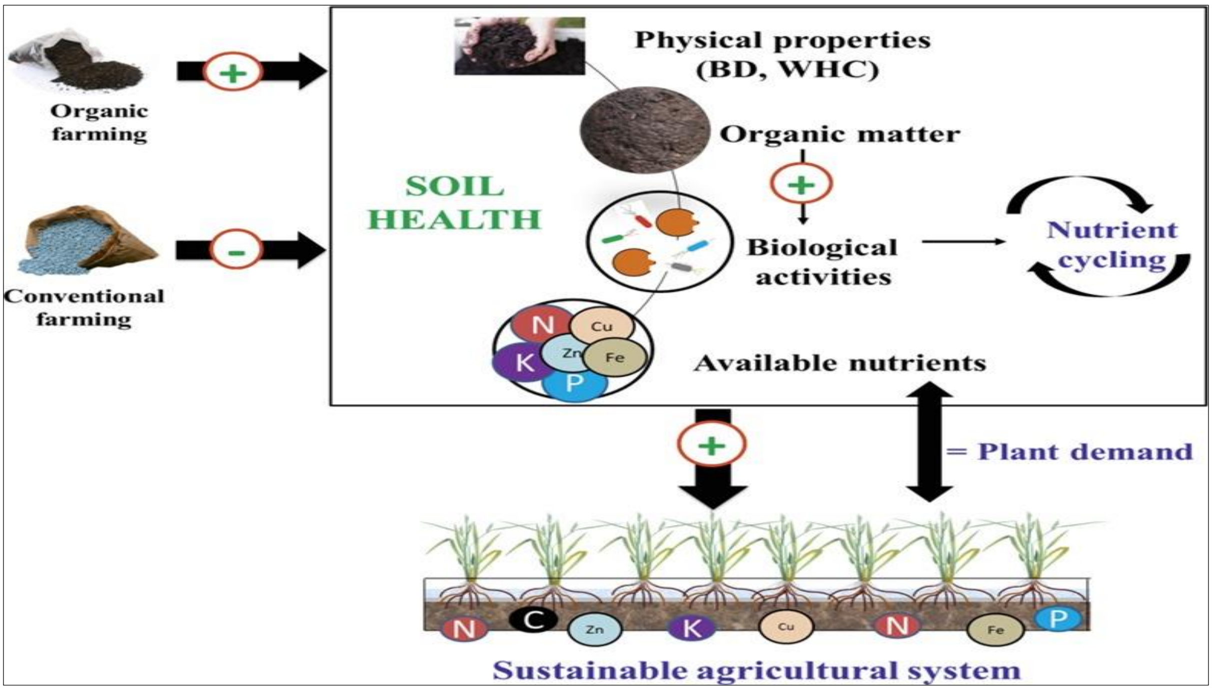


Fig. 2: Conceptual Diagram relating Physical, Chemical and Biological Indicators of Soil Health under Organic and Conventional Farming Systems (Sihi *et al.* 2017)

Case Study

Korat and Mathukia (2022) enumerated that available nitrogen, phosphorus and potassium content were found significantly higher in soil of conventional farm as compared to soil of organic farm. Jaggi *et al.* (2018) enumerated that total bacterial count and dehydrogenase, FDA and urease activity were observed higher in soil of organic block as compared to soil of conventional block. Glodowska and Krawczyk (2017) found that organically cultivated soils recorded higher cadmium and zinc content while conventionally cultivated soil recorded higher cobalt, chromium and nickel content. Kaswala *et al.* (2013) reported that electrical conductivity, organic carbon, iron, manganese, zinc and copper content except for bulk density, available nitrogen and potassium content which were found higher in soil of conventional farm. Bhaskaran and Krishna (2009) found that soil applied with vermicompost significantly improved bulk density, water holding capacity and porosity as compared to soil applied with recommended dose of fertilizer. Bharambe *et al.* (1999) reported that the soil treated with sorghum stubbles @ 5 t/ha + cellulolytic organism-B recorded significantly lower bulk density and higher infiltration rate as compared to soil applied with recommended dose fertilizer.

Conclusion

From the foregoing discussion, it can be concluded that the soil managed under organic farming has found to improve physical (*i.e.,* bulk density, infiltration rate, water holding capacity and porosity), chemical (*i.e.,* organic carbon, electrical conductivity, iron, manganese, zinc, copper content except available nitrogen, phosphorus and potassium content) and biological (*i.e.* enzymatic activity and total bacterial count) properties of soil as compared to conventional farming. They also noted that heavy metal concentration was higher in conventionally managed soil. However, cadmium and zinc were found higher in organically managed soil. Therefore, soil health can be maintained and/or improved by organic sources which would result in sustainable production in long term.

References

1. Bharambe, P. R., Tajuddin, A. H., Oza, S. R. and Shelke, D. K. (1999). Effect of irrigation and crop residue management on crop and soil productivity under soybean-sorghum cropping system. *Journal of Indian Society of Soil Science*, 50(3): 233-236.
2. Bhaskaran, U. P. and Krishna, D. (2009). Effect of Organic Farming on Soil Fertility, Yield and Quality of Crops in the Tropics. *UC Davis: Department of Plant Sciences,* 16, pp, 1-5.
3. Glodowska, M. and Krawczyk, J. (2017). Heavy metals concentration in conventionally and organically grown vegetables. *Quality Assurance and Safety of Crops and Foods,* 9(4): 497-503.

4. Jaggi, V., Joshi, S., Dasila, H., Mahapatra, B. S. and Sahgal, M. (2018). Evaluation of Soil Health in Short Term Organic Vs Conventional Practices during Paddy Cultivation. *International Journal of Current Microbiology and Applied Science,* **7**(4): 495-504.
5. Kaswala, A. R., Kolambe, B. N., Patel, K. G., Patel, V. S. and Patel, S. Y. (2013). Organic Production of Greater Yam: Yield, Quality, Nutrient Uptake and Soil Fertility. *Journal of Root Crops,* 39(1): 56-61.
6. Korat, H. V. and Mathukia, R. K. (2022). Effect of natural farming, organic farming and conventional farmingon soil physical, chemical and biological properties. *The Pharma Innovation Journal,* **11**(7): 924-928.
7. Reganold, J. P. and Wachter, J. (2016). Organic agriculture in the twenty-first century. *Nature Plants,* 2(2): 1-8.
8. Sihi, D., Dari, B., Sharma, D. K., Pathak, H., Nain, L. and Sharma, O. P. (2017). Evaluation of soil health in organic *vs.* conventional farming of basmati rice in North India. *Journal of Plant Nutrition and Soil Science,* 180(3): 389-406.

Significance of Millet Cultivation in India: International Year of Millets-2023

Article ID: 40954

R. P. Singh[1], Amit Tomar[1], A. K. Mishra[1], S. P. Singh[1], H. H. Khan[1], Prachi Patel[1]
[1]ICAR-Krishi Vigyan Kendra, Gajraula, Amroha, (Directorate of Extension), Sardar Vallabhbhai Patel University of Agriculture Science & Technology, Meerut.

Introduction

The U.N. General Assembly recently adopted a resolution, sponsored by India and supported by more than 70 countries, declaring 2023 as the International Year of Millets.

1. Millet is a common term to categorize small-seeded grasses that are often termed nutri-cereals or dryland-cereals.
2. The three major millet crops currently growing in India are jowar (sorghum), bajra (pearl millet) and ragi (finger millet).
3. Major producers include Rajasthan, Andhra Pradesh, Telangana, Karnataka, Tamil Nadu, Maharashtra, Gujarat and Haryana.
4. kodo (kodo millet), kutki (little millet) are also cultivated in some parts.

Statistics

1. India, Nigeria and China are the largest producers of millets in the world, accounting for more than 55% of the global production.
2. For many years, India was a major producer of millets. However, in recent years, millet production has increased dramatically in Africa.
3. Bajra is the fourth-most widely cultivated food crop in India after rice, wheat and maize.

Advantages of Millet Cultivation

1. Sustainable agriculture:

a. Most millets are xerophilic:
b. Which means they can reproduce with limited water input
c. Millets generally consumes 25-30% less water than sugarcane and rice, according to Food and Agriculture Organization.
d. For ex: Pearl millet/ bajra can grow on poor sandy soils and is well suited for dry climates due to its ability to use moisture efficiently.

2. Climate resilient crop:
a. Millets are generally thermophilic i.e thriving at relatively higher temperatures.
b. Small millets such as finger millet and Kodo millet can be grown in adverse climatic and soil conditions.
c. It has ability to grow on poor soils, hilly terrains and with little rain.

3. Carbon sequestration:
a. Millets are C4 carbon sequestrating crops contributing to the reduction of CO_2 in the atmosphere.
b. Economic security:
c. Low investment required:
d. Millets can be grown on dry, low-fertile, mountainous and rain-fed areas.
e. It requires little irrigation and no fertilizers at all.
f. A survey conducted by Deccan Development Society (DDS) indicates that 97 per cent of the households did not use fertilisers for millets.

4. Short cropping duration: Millets has cropping duration of 70-100 days, as against 120-150 days for paddy/wheat >> which allows millets to be a part of multiple cropping systems in both rain-fed and irrigated areas.

5. Millets are photo-insensitive: Which means it do not require a specific photoperiod for flowering.

6. More shelf life than rice/wheat: Millets can be stored for a considerable amount of time under appropriate storage conditions, therefore making them 'famine reserves.

7. Export potential:
a. Millets with its high nutrients has a good market in developed regions of the world.
b. Promotion of millets will ensure food and livelihood security to small and marginal farmers and inhabitants of rainfed areas, especially in remote tribal areas.

8. Nutritional security:
a. Millets has higher levels of protein with more balanced amino acid profile.
b. Also they are high in dietary fibre.
c. They are also rich in micro nutrients like iron, zinc etc.
d. It high Iron content can fight high prevalence of anaemia in India women of reproductive age and infants.
e. Ragi is known to have the highest calcium content among all the food grains.

9. Health benefits:
a. Gluten free >> makes them easily digestible and non-allergenic foods
b. They have a low glycemic index (a relative ranking of carbohydrate in foods according to how they affect blood glucose levels) >> suitable for diabetic patients.
c. They contains phytate >> which is associated with reducing risk of cancer.
d. They also contain phyto-nutrients, including phytic acid, which is believed to lower cholesterol.

10. International Relation:
a. India exported about 15.4% of the world's Bajra to roughly 60 countries from 2013 to 2018
b. More than 40% of global millet consumption is held by African countries mainly Niger, Mali, Nigeria, Burkina, and Sudan, where food and nutritional security are the major challenges.
c. India can become an effective exporter to develop better relation with these countries.

Initiatives

1. Re-branding:

a. The Union Agriculture Ministry, in April 2018, declared millets as 'Nutri-Cereals', considering their 'high nutritive value' and also 'anti-diabetic properties'.
b. It was previously called 'coarse cereals'.

2. Initiative for Nutritional Security through Intensive Millet Promotion (INSIMP):
a. The scheme aims to catalyse increased production of millets in the country >> to enhance India's nutritional security.
b. It involves providing input kits, establishment of units for processing and value-addition etc.
c. It is a part of the Rashtriya Krishi Vikas Yojana.

3. National year of millets: 2018 was observed as 'National Year of Millets".

4. U.N. declaration of 2023 as International Year of Millets: The resolution is intended to increase public awareness on the health benefits of millets and their suitability for cultivation under tough conditions marked by climate change.

5. Hike in MSP: Government has recently substantially hiked the minimum support price (MSP) of millets so that more and more farmers may opt for cultivation of these less water consuming crops.

6. Encouraging consumption: Millets are being purchased at the support price and are also being included in the mid-day meal scheme and public distribution system, for encouraging its consumption.

Challenges

1. Historical policy neglect of these crops:
a. Our post-green revolution period witnessed skewed focus on rice and wheat neglecting other crops such as millets and pulses.
b. Government support such as MSP, public procurement etc are largely restricted to rice and wheat.
c. Therefore India has witnessed a 60 per cent decline in the area under millets since 1960s. What made up nearly 50 per cent of the total national cereal production has virtually been squeezed out of the agricultural scenario.

2. Low acreage of millets and production shortage:
a. India currently has only 14 million hectares of land under millets cultivation; as compared to 29 million and 44 million of wheat and rice respectively.
b. As per FAO, India fall short of 40% of millet production by 2023.

3. Lack of infrastructure:
a. Lack of reach of improved methods of production and technologies.
b. Lack of appropriate post-harvest processing technologies for small millets.

4. Lack of coverage in PDS: National Food Security Act of 2013 – which entitles three-fourths of all households to 5 kg of wheat or rice per person per month at Rs 2 and Rs 3 per kg, respectively – has reduced the demand for millets.

5. Decreased consumer demand due to difficult in usage:
a. Kneading dough and rolling roti's is much easier with wheat than with millet flour.
b. The reason for this is wheat has gluten proteins that swell and form networks on adding water to the flour, making the dough more cohesive and elastic. The resultant chapattis come out soft, which isn't possible with millets that are gluten-free.

6. Increased penetration of imported millets:
a. There is an increased penetration of imported millets, which is not native to the Indian geography or cuisine.
b. Quinoa is a prominent example that has seen increasing domination in urban diets.
c. Competition from other market friendly remunerative crops.

Suggestions to Improve Cultivation

1. Demand push.

2. Increasing awareness on nutritional and health benefits of millets:
a. General perception is that the millets are increasingly seen as "poor person's food".

b. Therefore, it is necessary to re-brand coarse cereals/millets as nutri-cereals and promote their production and consumption.

3. Certification programme for jowar,ragi and bajra:

a. To improve marketability in international market.
b. Inclusion of millets in Public Distribution System and Mid-Day Meal scheme.

4. Supply side.

5. Value addition: Promotion of processed millet products such as ragi cookies, bajra biscuits, jowar namkeen.

6. Focus on indigenous millets:

a. There is an increased tend towards use of non-native millets such as Quinoa, especially among urban consumers.
b. Under the 'Vocal for Local' campaign, indigenous crops must be lent more support and focus.

7. Input support:

a. Supply of certified seeds through KVKs
b. Establishment of Custom hiring centres (CHCs) for farm machineries
c. Support for soil health improvements
d. Concessional credit to farmers moving towards millets from paddy/wheat.

8. R and D: Government supported research on innovative millet cultivation methods

9. Strengthening supply chain:

a. Empower women farmers and self-help groups (SHG), by equipping them with advanced packaging techniques, agro-marketing, financial literacy and other entrepreneurial skills.
b. Grassroots workers like the anganwadi and ASHA workers must be further involved as nutrition ambassadors and entrepreneurs in the millet revolution.

10. Introducing millet cultivation in areas where farmers' distress is visible:

a. In regions of distress millet production will be more attractive to farmers.
b. For instance, the cotton dependency of Vidarbha's farmers and economy is well-known, especially in the arid zones. The region in Maharashtra is also known as the farmer suicide capital.
c. Perhaps one of the most important solutions is to encourage cotton farmers to diversify into millet production after careful feasibility studies and feedback from the farmers themselves.
d. Traditionally, the region of Vidarbha was rich in millet cultivation, and more so because of its predominant rain-fed agricultural landscape.
e. Such an inclusive policy will protect the rights of the average farmer, who are under stress and debt due to the expensive cotton economics, and help women farmers engage in productive agriculture.

11. Training and capacity: Dedicated programmes with proper training and capacity-building initiatives that urge farmers to move away from loss-making crops toward diversification via millets

Best Practice

1. Dindori model:

a. International Fund for Agricultural Development (IFAD), a United Nations agency has supported an initiative in 2013-14 to revive kodo and kutki cultivation in Dindori district of Madhya Pradesh.
b. The identified farmers were supplied good-quality seeds and trained by scientists from the Jawaharlal Nehru Agricultural University and local Krishi Vigyan Kendra – on field preparation, line-sowing and application of compost, zinc etc.
c. Further, a federation of the farmers' self-help groups undertook procurement of the produce and also its mechanical de-hulling.
d. The project started in 2013 with 1,497 women-farmers growing millets in 749 acres has risen to 14,301 women-farmers in 2019-20. So has the total acreage to 14,876 acres.
e. This has been enabled by the federations taking up production of 'kodo bars' (millets + jaggery + ghee + groundnut). It is being supplied to anganwadi centres in the state.

f. Hence the project has helped in meeting nutritional goals (fighting malnourishment among children) and reviving millet cultivation (crop yields are 1.5-2 times higher than before).

2. Inclusion in mid-day meal scheme: Government of Karnataka proposed inclusion millets in school mid-day meal programmes.

Conclusion

Millet cultivation in India could achieve the twin objective of 'doubling farmers income' and 'malnutrition free India.'

Overcoming the Challenges of Covered Smut Disease in Wheat Farming

Article ID: 40955

Archana Kumawat[1], Hansa Kumawat[2], Mayank Bishnoi[3], Shashikant Kumar Sabal[4], Mradula Bhadouria[3]

[1]Research Scholar, Department of Plant Pathology, Sri Karan Narendra Agriculture University, Jobner-303329, Jaipur, Rajasthan, India.

[2]Research Scholar, Department of Soil Science and Agriculture Chemistry, Rajasthan College of Agriculture, Udaipur, Rajasthan, India.

[3]Department of Plant Pathology, Jawaharlal Nehru krishi vishwa vidhalya, College of Agriculture Jabalpur-482004, Madhya Pradesh, India.

[4]Research Scholar, Department of Agronomy, Rani Laxmi Bai Central Agriculture University, Jhansi, Uttar Pradesh, India.

Covered smut, or bunt, or stinking smut of wheat occurs in all wheat-growing areas of the world. There are actually three kinds of bunt caused by related but different fungi:

1. Common bunt: Which now is controlled easily by treating the seed with fungicides and therefore causes few losses in most developed countries;

2. Dwarf bunt: Which still cannot be controlled and therefore continues to cause severe losses in many parts of the world, including the Pacific Northwest of the United States; and

3. Karnal bunt: Named after the town Karnal of India where it was first observed in 1931, affects wheat and triticale (a hybrid of wheat and rye) on which it causes a covered smut. Karnal bunt is caused by the fungus *Tilletia indica*, known previously as *Neovossia indica*. Karnal bunt is also known as partial bunt because only a portion of the wheat kernels is affected. Bunt destroys the contents of infected kernels and replaces them with the spores of the fungus. Bunt also causes slight to severe stunting of infected plants, depending on the species of bunt fungus involved.

Infected plants are usually more susceptible than healthy plants to certain other diseases and to winter injury. When bunt is not controlled, it may cause devastating losses, but even with the effective control measures practiced in the United States today, the disease continues to cause severe losses. In addition, bunt causes market losses by reducing the quality, and the price, of wheat contaminated with smutted kernels or smut spores. Such wheat is discoloured, has a foul odour, and is suitable for feed uses only. Bunt, moreover, results in explosions in combines and elevators during threshing or handling of smutted wheat because of the extreme combustibility of the oily smut spores in the presence of sparks from machinery

Symptoms

1. Plants infected with the common bunt fungi are usually a few to several centimetres shorter than healthy plants and May sometimes be only half as tall.

2. Plants infected with the dwarf bunt fungus may be only one fourth as tall as healthy plants and may show an increase in the number of tillers. Infected plants may appear slightly bluish green to greyish green in colour, but this is not easily distinguishable.

3. Distinct bunt symptoms, however, are shown by the heads of infected plants. Infected heads are slimmer and are usually bluish green rather than the normal yellowish green, and their glumes seem to spread apart and form a greater angle with the main axis.

4. Infected kernels are shorter and thicker than healthy ones and are greyish brown rather than the normal golden yellow or red. When mature kernels are broken, they are found to be full of a sooty, black, powdery mass of fungus spores that give off a distinctive odour resembling that of decaying fish. During the harvest of infected fields, large clouds of spores may be released in the air.

Pathogens

1. *Tilletia caries* (*T. tritici*) and *T. laevis* (*T. foetida*) cause the common bunt, whereas *T. controversa* causes dwarf bunt and *T. indica* causes Karnal bunt. The first two species are similar in their life histories and disease development. The biology of *T. controversa* is different and somewhat similar to that of *T. indica*.

2. The pathogens produce teliospores with different sets of wall markings. The mycelium is hyaline. During sporulation, most cells are transformed into spherical, brownish teliospores, while the rest of the mycelial cells remain hyaline and sterile.

3. On germination of a teliospore a basidium is produced, at the end of which 8 to 16 basidiospores develop in *T. caries* and *T. laevis*, whereas 14 to 30 basidiospores develop in the dwarf bunt fungus *T. controversa* and 32 to 128 in *T. indica*. Basidiospores, usually called primary sporidia, fuse in pairs through the production of lateral branches between compatible mating types and appear as H-shaped structures.

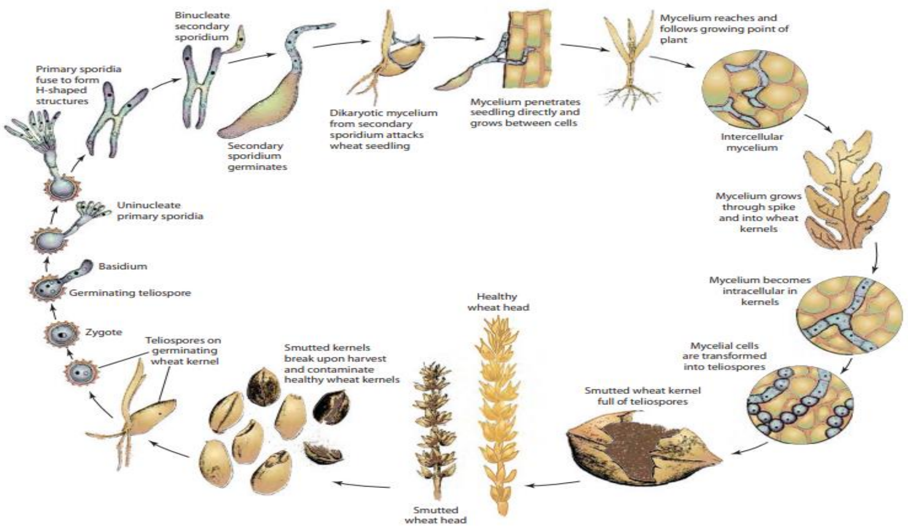
Development of Disease

1. The pathogens of common bunt overwinter as teliospores on contaminated wheat kernels and less frequently in the soil. Teliospores of the common bunt fungi are short lived in wet areas, losing viability within two years.

2. The dwarf bunt and Karnal bunt fungi may remain viable in any soil for at least three years and often for as long as 10 years. When contaminated seed or healthy seed is sown in bunt-infested fields, approximately the same conditions that favor the germination of seeds favor the germination of common bunt teliospores. Teliospores of the common bunt fungi germinate readily, and as the young seedling emerges from the kernel, the teliospore on the kernel or near the seedling also germinates through the production of the basidium, primary sporidia, and secondary sporidia.

3. The secondary sporidia then germinate, and the dikaryotic mycelium they produce infects the young seedling. Teliospores of the dwarf bunt fungus, however, germinate slowly even under optimum conditions of temperature (3–8°C) and moisture, requiring from 3 to 10 weeks for maximum germination. Persistent snow cover, providing soil surface temperatures of -2 to 2°C, is consistently correlated with high dwarf bunt incidence.

4. Dwarf bunt infections apparently originate from teliospores germinating at or near the soil surface from December through early April. Germinating secondary sporidia penetrate the tiller initials of wheat seedlings after seedling emergence. The more tiller initials formed during the infection period, the greater the incidence of bunted plants and of bunted heads per plant. Germinating seedlings and older tillers apparently are not susceptible to infection by the dwarf bunt fungus. After penetration, the mycelium grows intercellularly and invades the developing leaves and the meristematic tissue at the growing point of the plant.



5. The mycelium remains dormant in the seedling during the winter; however, when the seedling begins to grow again in the spring, the mycelium resumes its growth and grows with the growing point. When the plant forms the head of the grain, the mycelium invades all parts of it even before the head emerges. As

the head fills and becomes mature, the mycelial threads increase in number and soon take over and consume the contents of the kernel cells.

6. The mycelium, however, does not affect the tissues of the pericarp of the kernel, which form a rather sturdy covering for the smutted mass they contain. At the same time, most hyphal cells are transformed into teliospores. Smutted kernels are usually kept intact while on the plant, but break and release their spores on harvest or threshing. The liberated spores contaminate the healthy kernels and are also blown away by air currents, thus contaminating the soil.

Control

1. Resistant varieties: Among recent wheat varieties, PBW 502 is resistant while the cultivars Pastour, N-75-3 and N-75-5 are partially resistant. Some lines of wheat and allied genera (*Aegilops*) were found to be resistant to bunt and this resistance can be manipulated for transferring into bread wheat.

2. Seed treatment: Many viable spores on the seed can be eliminated by seed treatment but do not protect wheat plants from infection if the seed are planted in infected soil. Seed treatment with fungicide is not effective for removal of complete infection, as the fungus is soil borne, but it may minimize the chances of infection.

3. Fungicide seed treatment: This method has been used to reduce the spread of inoculum via seed, however, there are only a few fungicides currently registered for use against bunts. Hexachlorobenzene and cyano (methylmercuric) guanidine prevented germination of teliospores of *T. indica*. A number of chemical companies are seeking to register fungicides such as PCNB and carboxin + thiram (Vitavax 200 or RTU-Vitavax-Thiram) for use against Karnal bunt since they have shown to restrict the germination of seed borne spores in Mexico. The main problem of using current fungicides is that Karnal bunt spores may germinate when the chemical is washed off the spore.

4. Fungicide foliar treatment: Applying fungicides on a routine basis is often cost prohibitive. The incidence of Karnal bunt can be effectively reduced by the application of foliar fungicides between late boot and flowering. Some effective fungicides are Propioconazole, Agrozim and Bavistin (carbendazim) and Bayleton (triadimefon). Foliar spray by fungicide, propiconazole (Tilt 25EC20.1%) should be given at the time of anthesis as the disease is air borne. It is less expensive and an environment friendly method for the control of Karnal bunt of wheat.

5. Soil fumigation: Fumigation of soil with chemicals such as methyl bromide, metham-sodium and formaldehyde has been partially successful for killing teliospores, but is not likely to be cost effective except for eradicating a new introduction of fungus

6. Bio-control agents: Integration of propiconazole with bioagent fungus (*Trichoderma viride*) gives almost complete control. The bioagent spray should be done before ear head emergence followed by spray of chemical at start of ear head emergence.

7. Crop rotation: Crop rotation is also useful in managing the disease. The number of viable teliospores in the soil can be reduced by increasing the time between wheat crops. Rotation with non-host crops may reduce viable spores sufficiently to control the disease. Crop rotations should always be considered when cropping decisions are made as it provides many benefits in addition to disease control.

8. Mulching: The temperature of the soil rises considerably by practices of polythene mulching and wheat straw burning after mechanical harvesting. Polyethylene mulching increased the soil surface temperature to 54.5°C and straw burning raised the temperature of the soil surface, 5 cm and 10 cm depth of soil to 92.5°C, 67.0°C and 58.0°C, respectively, and enabled the soil to be disinfected from the bunt propagules.

9. Controlled irrigation: Controlling irrigation at the time of heading and flowering, deep ploughing, and planting cover crops will help in minimizing Karnal bunt disease. Farmers may need to consider altering irrigation schedules that develop suitable climatic conditions for restricted development and spread of *T. indica*.

10. Changing sowing time: Karnal bunt disease can also be managed by avoiding sowing of highly susceptible cultivars in the endemic areas. In some places, changing the sowing time may alter flowering to less favorable conditions for infection.

a. Harvesting or handling equipment contaminated by spores can introduce the pathogen into seed lots harvested in following seasons.
b. Good hygiene during harvest, storage, and transport will reduce the chance of the disease spreading to healthy grain.
c. Delaying drilling of a second wheat crop, after harvesting an infected wheat crop, also reduces infection risk. This is because any wet spell causes the soil borne bunt balls to germinate before they can infect the following crop.
d. Sowing winter crops early in the fall when temperatures are still above 15°C at the critical first 11 days reduces the risk of infection by *Triticum tritici* and *Triticum laevis*. Since *Triticum controversa* mostly attacks the 2-3 leaf stage, this is less effective for this fungus.

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

Toxic Effects of Heavy Metals in Honey Bees

Article ID: 40956

Katta Subramanya Sai Teja[1], Dr. Nagendra Kumar[1], Dr. Mukesh Kumar Singh[1]
[1]Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar.

Introduction

Heavy metals are toxic pollutants that can be found in various environments due to human activities such as industrial processes, mining, and agriculture. Honey bees are essential pollinators that play a crucial role in the food chain, contributing to the reproduction of numerous plants, including many crops that are important to human consumption. However, the exposure of honey bees to heavy metals can have harmful effects on their behavior, physiology, and overall health. Heavy metals such as lead, cadmium, zinc, and copper have been detected in honey bee hives and surrounding environments, mainly through contaminated soil, water, and air. Honey bees can be exposed to these heavy metals through their food, water, and the soil where they forage.

Classification of Heavy Metals

Heavy metals can be classified in various ways, depending on the context and the criteria used. Here are some common classification methods:

1. Based on their density: Heavy metals are generally defined as metals that have a density greater than 5 g/cm3. Some examples of heavy metals based on this criterion include lead, mercury, cadmium, arsenic, chromium, and copper.

2. Based on their toxicity: Heavy metals can be classified according to their level of toxicity. For example, some metals such as lead, mercury, and cadmium are considered highly toxic, while others such as copper and zinc are essential nutrients at low concentrations but can be toxic at high concentrations.

3. Based on their function: Heavy metals can also be classified based on their function in living organisms. For example, some metals such as iron, copper, and zinc play important roles in enzymatic reactions and are required for many biological processes. Other metals, such as lead and mercury, have no known biological function and can be toxic even at low levels.

4. Based on their mobility: Heavy metals can be classified based on their mobility in the environment. For example, some metals such as cadmium and lead are relatively immobile and tend to accumulate in soils and sediments, while others such as mercury and arsenic can be more mobile and can travel through the air and water to contaminate other areas.

Entry of Heavy Metals into Honeybees

Heavy metals can enter honeybees through both direct and indirect methods.

Direct Methods of Entry Include

1. Contact with contaminated surfaces: Honeybees can come into contact with contaminated surfaces, such as soil, water, or vegetation, which can lead to heavy metal absorption through their exoskeletons.

2. Ingestion: Bees may directly ingest contaminated pollen or nectar from plants, or contaminated water, which can lead to heavy metal accumulation in their bodies.

Indirect Methods of Entry Include

1. Trophallaxis: Honeybees engage in trophallaxis, which is the transfer of food or fluids between individuals. If a bee has accumulated heavy metals in its body, it can transfer these metals to other bees in the colony through trophallaxis.

2. Contaminated honey: Honeybees may store contaminated nectar in their hives, which can lead to the accumulation of heavy metals in the honey. Other bees in the colony may then consume the contaminated honey, leading to heavy metal absorption.

Once heavy metals enter a honeybee's body, they can accumulate in various tissues, including the gut, fat body, and brain. This accumulation can lead to various negative effects on the bee's health and behavior, including reduced foraging activity, impaired navigation, and decreased survival rates.

Effects of Toxic Heavy Metals on Honey Bees

Toxic heavy metals can have adverse effects on honey bees, impacting their health, behavior, and overall colony survival. Here are some key effects of toxic heavy metals on honey bees:

1. Reduced lifespan: Exposure to heavy metals such as lead, cadmium, and mercury can shorten the lifespan of honey bees. These metals can accumulate in the bees' bodies over time, leading to increased oxidative stress and cellular damage, ultimately affecting their longevity.

2. Impaired foraging behavior: Heavy metal exposure can disrupt honey bee foraging behavior. Studies have shown that bees exposed to metals like cadmium and copper exhibit reduced foraging activity, including decreased flight duration, reduced visitation to flowers, and altered navigation abilities. These effects can lead to reduced resource collection and overall colony productivity.

3. Altered learning and memory: Heavy metals can impair honey bees' learning and memory abilities, which are crucial for tasks such as navigation, foraging efficiency, and communication within the colony. Exposure to metals like aluminum and copper has been found to negatively affect bees' associative learning, making it more challenging for them to remember and recognize important cues.

4. Weakened immune system: Toxic heavy metals can weaken honey bees' immune system, making them more susceptible to diseases and pathogens. Exposure to metals like lead and cadmium has been linked to immunosuppression in bees, compromising their ability to fight off infections and increasing colony vulnerability to diseases.

5. Disrupted reproduction: Heavy metal exposure can disrupt honey bee reproductive processes. Research has shown that metals like cadmium and zinc can affect the development of honey bee brood, leading to reduced larval survival and impaired queen reproductive abilities. These effects can hinder colony growth and long-term viability.

6. Colony collapse disorder (CCD): Although the exact cause of CCD is multifactorial, heavy metal contamination has been considered a contributing factor. Prolonged exposure to toxic heavy metals can weaken honey bee colonies, making them more susceptible to other stressors such as pesticides, diseases, and habitat loss, potentially leading to colony collapse.

Heavy Metals Alter Feeding Behavior

The study by Burden *et al*. (2019) investigates the impact of acute sublethal exposure to toxic heavy metals on the feeding behavior of honey bees (*Apis mellifera*). The research aims to understand how environmental contaminants affect honey bee foraging, which is crucial for their survival and the pollination services they provide. The study conducted laboratory experiments where honey bees were exposed to sublethal concentrations of four heavy metals: lead (Pb), cadmium (Cd), copper (Cu), and aluminum (Al). The researchers observed the effects of these heavy metals on the bees' feeding behavior by monitoring the duration and frequency of their feeding bouts.

The results of the study revealed significant alterations in honey bee feeding behavior following exposure to heavy metals. Bees exposed to lead and cadmium showed reduced feeding durations and increased inter-bout intervals compared to control bees. Copper exposure led to increased feeding durations, while aluminum exposure did not significantly affect feeding behavior. These findings suggest that acute sublethal exposure to certain heavy metals can disrupt honey bee feeding behavior, potentially impacting their nutritional intake and overall health. Since foraging behavior is vital for honey bee colony growth and survival, these alterations could have significant implications for honey bee populations and their pollination services.

Heavy Metals Alter Brain Biogenic Amines

The study conducted by Sovik *et al*. in 2015, examines the effects of manganese exposure on honeybee foraging behavior. Manganese is a common metal found in the environment and is known to have neurotoxic effects on various organisms. However, its impact on honeybees and their foraging activities had not been thoroughly investigated before this study. The researchers aimed to determine whether exposure to manganese affects the foraging behavior of honeybees, as foraging is a crucial aspect of their colony's survival and productivity. To conduct the experiment, the researchers exposed honeybees to different concentrations of manganese in their food sources. They monitored the foraging activity of the bees using radiofrequency identification (RFID) technology, which allowed them to track individual bees and analyze their behavior. The study involved both laboratory experiments and field observations.

The results of the study revealed a significant negative impact of manganese exposure on honeybee foraging behavior. Bees that consumed food with elevated levels of manganese exhibited reduced foraging activity compared to the control group. The affected bees had lower flight duration, visited fewer foraging sites, and had shorter foraging distances. The study also identified a possible mechanism for this behavioral change. The researchers found that manganese exposure caused alterations in the levels of a key neurotransmitter called octopamine in the honeybees' brains. Octopamine plays a crucial role in regulating honeybee foraging behavior, and disruptions in its levels can lead to impaired foraging activity.

Overall, the study highlights the detrimental effects of manganese exposure on honeybee foraging behavior. Given the essential role of honeybees in pollination and maintaining ecosystem balance, understanding the factors that affect their foraging activities is crucial for their conservation and the sustainability of agriculture.

Cellular Alterations in Midgut Cells of Honey Bee

The research conducted by Dabour, Al Naggar, Masry, Naiem, and Giesy in 2019 focused on investigating the cellular alterations in the midgut cells of honey bee workers (*Apis mellifera* L.) when exposed to sublethal concentrations of cadmium oxide (CdO) or lead oxide (PbO) nanoparticles, as well as their binary mixture. The study aimed to assess the potential toxic effects of these nanoparticles on honey bees. To conduct the study, honey bee workers were exposed to sublethal concentrations of CdO nanoparticles, PbO nanoparticles, or a combination of both. The researchers then examined the midgut cells of the exposed honey bees using various cellular and histopathological techniques to evaluate any alterations or damage.

The results of the study revealed that exposure to CdO or PbO nanoparticles, as well as their binary mixture, caused significant cellular alterations in the midgut cells of honey bee workers. These alterations included changes in cell shape, disintegration of cell boundaries, alterations in the size and number of mitochondria, and disruption of the endoplasmic reticulum. These cellular changes indicated the presence of cytotoxic effects and potential damage to the midgut cells. The study by Dabour *et al.* suggests that exposure to CdO and PbO nanoparticles, even at sublethal concentrations, can lead to cellular alterations in honey bee midgut cells. The midgut is crucial for nutrient digestion and absorption in bees, and any disruption in its cellular integrity can have adverse effects on their overall health and survival.

References

1. Burden, C.M., Morgan, M.O., Hladun, K.R., Amdam, G.V., Trumble, J. J. and Smith, B.H. 2019. Acute sublethal exposure to toxic heavy metals alters honey bee (*Apis mellifera*) feeding behavior. *Scientific reports*, 9(1), p.4253.
2. Dabour, K., Al Naggar, Y., Masry, S., Naiem, E. and Giesy, J.P. 2019. Cellular alterations in midgut cells of honey bee workers (*Apis millefera* L.) exposed to sublethal concentrations of CdO or PbO nanoparticles or their binary mixture. *Science of the Total Environment*, 651, pp.1356-1367.
3. Sovik, E., Perry, C.J., LaMora, A., Barron, A.B. and Ben-Shahar, Y., 2015. Negative impact of manganese on honeybee foraging. *Biology letters*, *11*(3), p.20140989.

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

Millets: Present Magic in Food Processing

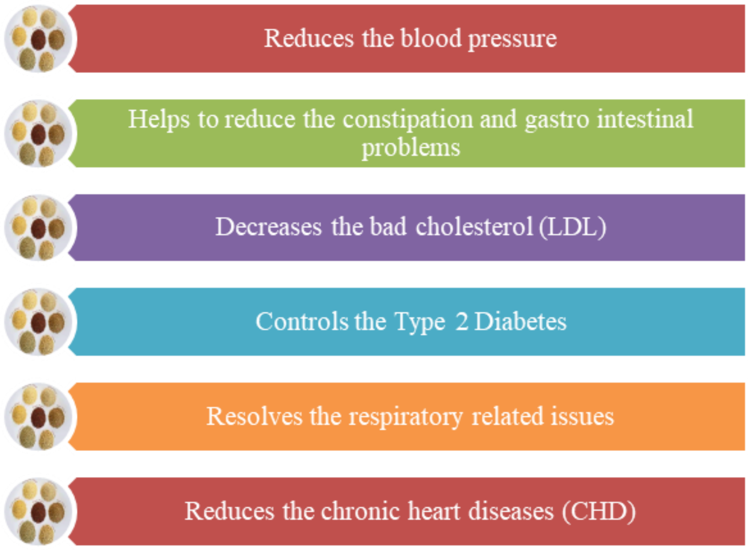
Article ID: 40957

Samuel Jaddu[1]
[1]Department of Food Process Engineering, National Institute of Technology, Rourkela.

Introduction

Millets were very ancient food crops and small sized cereal grains. Now a days, these are called as nutri cereals because of their rich nutritional profile contains fibre and protein, Ca, Fe, Zn etc. Millets are majorly classified as two types such as major millets (Finger millet, Italian millet, pearl millet) and minor millets (foxtail millet, little millet, kodo millet, proso millet, barnyard millet, brown top millet). India stands in first position for producing millets in the world followed by African countries are Sudan, Niger, and etc.

Potential Health Benefits of Millets



Commercial Applications

Millets are extensively processed in recent years in bulk production. Many commercial products are available in the market such as biscuit, bread, cake, instant millet mix, millet dosa mix, millet idli mix, millet chakki, millet laddu, millet infant foods with several flavors etc. In addition to this, plenty of cottage industries have come up traditional recipes using millets.

Conclusion

Millets have gained their importance and significance throughout the world. This year (2023) being celebrated as "International year of millets". Millets has acquired lot of popularity due to their health benefits specifically they consists of high fiber and having nature of low glycemic index helps to reduce blood glucose levels and other chronic diseases.

Reference

N. A. Nanje Gowda, Kaliramesh Siliveru, P. V. Vara Prasad, Yogita Bhatt, B. P. Netravati and Chennappa Gurikar (2022). Modern Processing of Indian Millets: A Perspective on Changes in Nutritional Properties, *Foods, 11, 499*.

The Indian Silk Saga

Article ID: 40958

Sangeeta Dash[1]

[1]Ph.D. Scholar, Department of Agricultural Entomology, IARI, New Delhi.

Abstract

The Queen of Textiles, silk, is an emblem of prosperity and opulence. It is a celebrated natural fibre of commercial importance. Sericulture as an agro-based industry imprisons huge opportunities for generation of rural employment and earning of foreign exchange. It refers to the generous manipulation and interference with life cycle of silkworms to yield shimmery silk fibres of unparalleled grandeur. India is unique in the sense that it yields all five types (mulberry silk, tasar silk, oak tasar silk, muga silk, eri silk) of commercial silks. Indian silk sarees are best-preserved reminders of the exemplary skills of weavers across the Indian subcontinent. This made India an acerage of sheen and dreamy fabrics that are exclusive in designs, colour, patterns, textures, geometry and durability. This article thus aims to highlight the specific weaving techniques and designs adopted and promoted over time across the vast geographical reign of the country.

Keywords: Sericulture, silk, textiles.

Introduction

India is considered as land of diversity. Indian silks stand distinguished with its delicate textures and appealing properties. Silk fabrics reflect the traditional and cultural importance of specific geographical areas in which they are spun. India holds second position in silk production globally and also the largest consumer of the fabric at the same time. The Indian sericulture industry is very vast generating high scale employment opportunities in rural and urban sector. Here, we present a brief overview of the different kinds of natural silks and silk fabrics found in India. Specialised silk centres of India are Dharamvaram, Venkatagiri, Narainpet, Pochampalli (Andhra Pradesh), Sualkuchi (Assam), Bhagalpur (Bihar), Surat, Cambay (Gujarat), Srinagar (Jammu and Kashmir), Kollegal, Bangalore, Ilkal, Anekal, (Karnataka), Champa, Raigarh, Chanderi (Chattisgarh), Paithan (Maharashtra), Kanchipuram, Tanjavur, Kumbhakonam (Tamil Nadu), Bishnupur, Birbhum, (West Bengal) Varanasi (Uttar Pradesh).

Mulberry Silk: It is widely used type of silk cultured in India. The biggest manufacturers are acknowledged being states like Jammu & Kashmir, Karnataka, West Bengal and Andhra Pradesh. This silk is developed from *Bombyx mori* (Fig. 1).

Tasar Silk: Also spelled as Tassar, Tussar, Tussur, Tussah, Tussore or Tusser silk. West Bengal, Odisha, Jharkhand, Bihar, Chattisgarh and Maharashtra are the states where it is largely produced. The Tasar silk, which is also made in India, comes in a better variant called Oak Tusar. The larvae of *Antheraea mylitta*, which is found in wild woods, produce tasar silk ("wild silk"). India is second-largest producer of this silk (Fig. 2).

Eri silk: It is produced from the Assamese native domesticated silkworms *Philosamia ricini* and *Samia synthia*. The cocoons are open ended. It is well known as "Silk of peace or Ahimsa" since it is produced without harming the silkworm. So it is preferred and promoted by Buddhist monks in Japan, China, and India. Eri is less costly than the other types of manufactured silks. It is nicknamed "poor man's silk." This silk, is valued for its durability and capacity as a thermal insulator (Fig. 3).

Muga silk: It is a unique speciality of Assam. It is demanded for its glossy glistening texture and utmost toughness. The larva of an *Antheraea assamensis* produces this silk. Muga silk has a distinctive natural yellowish-golden hue and is regarded as one of the toughest natural fibers. It is used to produce mekhela chador (Assamese clothing), sarees, stoles, etc. The silk fabric's classic designs and complex weaves enhance its popularity. A muga fabric is said to outlive its user frequently (Fig. 4).

Bhagalpuri silk: Bhagalpur (Bihar) is regarded as the "Silk City" and is also referred for its unique Bhagalpuri sarees. These sarees have brilliant colors and fascinating patterns in addition to the silk strands that were utilized to make them.


Fig. 1: Mulberry


Fig. 2: Tasar


Fig. 3: Eri


Fig. 4: Muga

Kosa silk: Chhattisgarh produces Kosa silk, a kind of Tasar silk. These sarees are prized for their distinctive patterns and beautiful motifs that draw inspiration from nature and tribal myths. The traditional Kosa silk sarees stand out for their dull golden tones. Kosa silk threads are colored using natural dyes to make vibrant sarees.

Banarasi silk: One of the unique silk cultured in Indian lands is called banarasi silk. The zari embroidery is made using threads on the exquisite fabric of this silk, which is mostly woven in Varanasi, Uttar Pradesh. These silk sarees are grand for their splendor and finesse around the world. On a light color backdrop, they are applauded for their rich and meticulously woven patterns of leaves, flowers, fruits, birds, etc. The Banaras kinkab is renowned, woven with shimmering strands of silver and gold.

Kanjeevaram silk: This silk is considered for its sturdiness, glossy brilliance, and grandeur since it is made from very pure and authentic mulberry silk strands. This silk has long been used to enhance the attractiveness of Indians with its vibrant colours, enticing wide borders, and mesmerizing motifs. This saree's unique feature is that the border of the saree and its body are always woven separately and then connected later (Fig. 5).

Baluchari silk: The Baluchari silk, a symbol of West Bengal, from the hamlet of Baluchar, where a strong weaving heritage dates back more than 200 years. A Baluchari silk saree's distinctive characteristic is the intricate use of silk threads to depict legendary themes on its pallu and borders (Fig. 6).

Chanderi silk: This silk originates from the Madhya Pradesh town of Chanderi. The exquisite texture, opulent feel, and delicate pastel colours of the classic Chanderi silk sarees seduce wearers (Fig. 7).

Mysore silk: Karnataka's Mysore silk is distinguished for its brilliance, toughness, and lack of crushability. The flawless gold zari embroidery on the mono-tuned sarees is the defining characteristic of silk sarees of Mysore.

Pochampalli silk: The beautiful Pochampalli sarees are made in the Telangana town of Pochampally. These sarees are known for the stunning patterns and intricate motifs that the fine Pochampalli cloth captures via the ikat dyeing technique. (Fig. 8).


Fig. 5: Kanjeevaram


Fig. 6: Baluchari


Fig. 7: Chanderi


Fig. 8: Pochampalli

Konrad silk: The Konrad silks (Tamil Nadu) are lighter sarees that are typically patterned in bold checks or striped patterns.

Chettinad silk: The production of Chettinad silk is attributed to the southern Tamil Nadu town of Chettinad. An excessive use of colors and patterns is what distinguishes Chettinad sarees (Fig. 9).

Patola silk: It is endemic to Patan region of Gujarat. The tie-dye Patolas with double ikat weaving is stunning. The silk sarees, reputed for their elegance and vibrant patterns, take a year to make. They are

E-ISSN: 2581 - 8317

renowned for their accuracy, nuance, and beauty. Here, the dye resist process is used to dye the warp and weft in a variety of six classic hues, including red, blue, emerald green, indigo and black (Fig. 10).

Ikat silk: The beautiful Ikat silk sarees originate in the coastal region of Odisha. Ikat silk frequently has geometric designs, animals, birds, fish, rudraksha beads, and temple tops in its design. This saree's outstanding characteristic is that both sides display the same vibrant themes and patterns. The yarn resist technique is utilized for the warp and weft of the Orissan tie-and-dye textiles known as ikats, with a dispersed effect. Ikats are created by both mulberry and tasar silks (Fig. 11).

Bandhani silk: The tightly knotted, beautifully woven cloth used in bandhini is colored to create a unique pattern. The Kutch bandhini are unparalleled for their exquisiteness of the intricately woven knots, the splendor of the colors, and the flawless patterns (Fig. 12).

			
Fig. 9: Chettinad	**Fig. 10: Ikat**	**Fig. 11: Patola**	**Fig. 12: Bandhani**

Conclusion

Weaving on a handloom is still a representation of the adaptability and originality of live craft. The variety of skill presented by the weavers and craftsmen across the country is commendable. Thus, awareness and promotion of these ethnic wears not only promotes status of Indian textile industry but also keeps our culture and tradition alive for years to come.

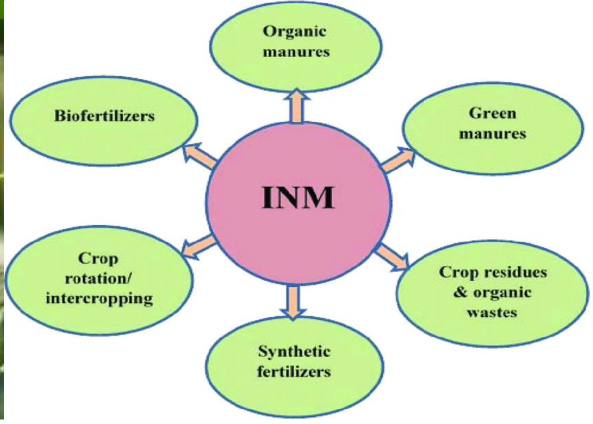
AGRICULTURE & FOOD: E-NEWSLETTER
WWW.AGRIFOODMAGAZINE.CO.IN
E-ISSN: 2581 - 8317

Integrated Nutrient Management in Oilseed Crops

Article ID: 40959

Rahul Dhankar[1], Sushil Kumar Singh[2], Anjali Tomar[3]
[1]Assistant Professor, Shri Vishwakarma Skill University, Palwal, Haryana.
[2]Assistant Scientist, CCS Haryana Agriculture University, Hisar, Haryana.
[3]Ph.D. Scholar, Department of Agriculture Extension and Communication, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh.

Integrated Nutrient Management (INM) is an approach to crop production that combines the use of chemical fertilizers with organic inputs such as farmyard manure, compost, and green manure. This approach aims to improve soil fertility, crop yield, and quality, while also reducing the negative impact of chemical fertilizers on the environment. In oil seed crops, INM has been found to be an effective way of increasing productivity while minimizing the risk of nutrient depletion and soil degradation.



Oilseed crops are an important source of edible oils, industrial oils, and oilseed meals, which are used in animal feed. They include crops such as soybean, canola, sunflower, and flax. These crops have high nutrient requirements, especially for nitrogen, phosphorus, and potassium, which are essential for growth, development, and yield. However, excessive use of chemical fertilizers can lead to soil acidity, nutrient imbalances, and environmental pollution. INM offers a way of optimizing nutrient use efficiency and reducing nutrient losses, while also improving soil health and crop productivity.

Principles Underlying INM System

Six basic principles of sustainable INM system laid out by Dennis Greenland (quoted by Meelu, 1996) include:
1. Nutrients removed by crops must be returned to the soil.
2. Soil physical conditions should be maintained and upgraded.
3. Organic carbon levels of soils should be maintained and enhanced.
4. Build-up of abiotic stress should beminimal.
5. Degradation of land occurring due to soil erosion must be controlled.
6. Soil quality with respect to soil acidity, salinity and sodicity or toxic elements build-up must be minimized.

Components

INM involves the application of chemical fertilizers in combination with organic inputs such as farmyard manure, compost, and green manure. Farmyard manure is a good source of organic matter, nitrogen, phosphorus, and potassium. It also improves soil structure and water-holding capacity, and enhances soil microbial activity. Compost is a rich source of nutrients, organic matter, and beneficial microorganisms. It improves soil fertility, reduces soil erosion, and suppresses soil-borne diseases. Green manure, which involves growing leguminous crops and incorporating them into the soil, is a good source of nitrogen, phosphorus, and other nutrients. It also improves soil structure and suppresses weeds.

Integrated Nutrient Management on Soil Fertility

The increasing fertility of soil and crop productivity through use of chemical or synthetic fertilizers has oftenly affected negatively on biogeochemical cycles was also reported by Roberts (2008). The removal of nutrients by crops from the soil exceeded their restoration through fertilizers; manures causing unbalanced nutrients in soil were also reported by Gangawar and Prasad (2005). It was also observed by Kumar et al., (2009) that organic manures in combination with fertilizers will surely enhance crop growth.

The INM approach involves careful selection and management of the different nutrient sources, taking into account their nutrient content, availability, and timing of application. It also requires proper management of soil fertility and pH, as well as crop rotation and intercropping to enhance nutrient cycling and reduce pest and disease incidence.

Several studies have shown that INM can significantly increase oilseed crop yield and quality, while reducing the negative impact of chemical fertilizers on the environment. For example, a study conducted in India on soybean crop showed that the application of a combination of chemical fertilizers and farmyard manure resulted in higher yields and better quality of oil and protein compared to the use of chemical fertilizers alone. Another study conducted in China on canola crop showed that the use of INM resulted in higher yields and better nutrient use efficiency, as well as reduced environmental pollution.

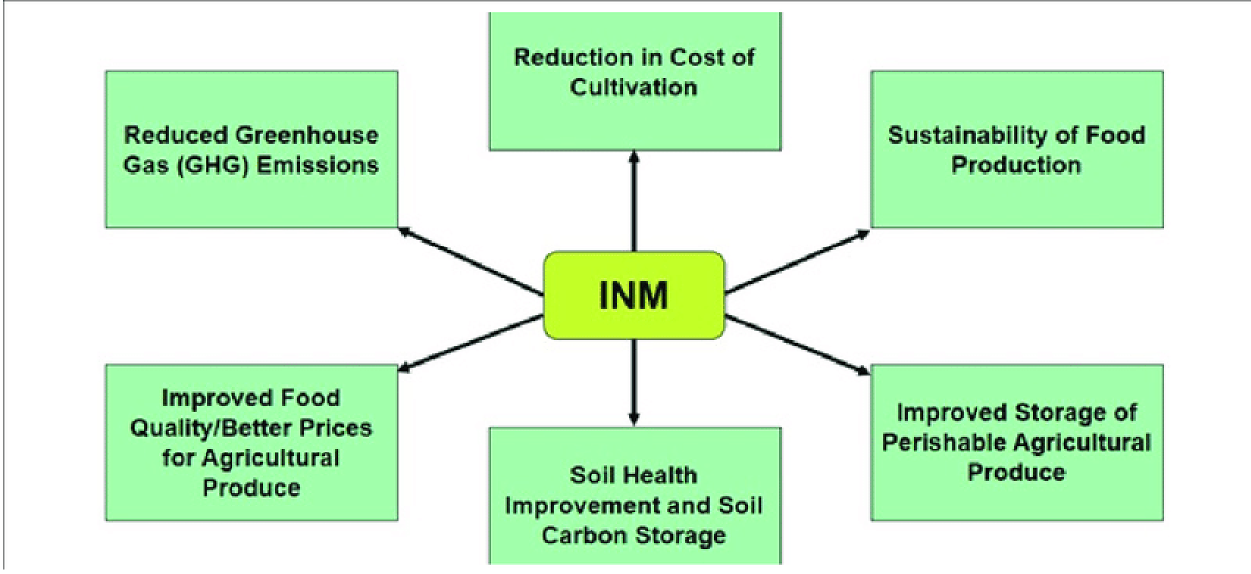


Fig.- Benefits of Integrated nutrient management

In conclusion, INM is an effective approach to nutrient management in oilseed crops, which can improve crop yield, quality, and sustainability. The use of INM should be based on the principles of soil fertility management, crop rotation, and intercropping, as well as careful selection and management of nutrient sources. INM can also contribute to the achievement of sustainable agriculture and food security goals, while also reducing the negative impact of chemical fertilizers on the environment.

References

1. Gangwar, B., Prasad, K. 2005. Cropping system management for mitigation of second generation problems in agriculture. Indian Journal of Agriculture Science 75: 65-78.
2. Roberts TL. 2008. Improving nutrient use efficiency. Turkish Journal of Agriculture and Forestry32:177-182.
3. Kumar, A.S., Sharma, A., Mishra S. 2009. Application of farmyard manure and vermicompost on vegetative and generative characteristics of Jatropha curcus. Journal of phytology 1(4): 206- 222.

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

Soil Pollution

Article ID: 40960

Rahul Bhadu[1], Mukhtiar Singh[1]
[1]Research Scholar, Associate Professor, School of Mechanical Engineering, Lovely Professional University, Phagwara, Punjab, India – 144411.

Abstract

This article discusses the causes and types of soil pollution, which is a form of land degradation caused by the presence of xenobiotic chemicals or changes in the natural soil environment. The primary contributors to soil pollution include excessive or incorrect use of pesticides in agriculture, industrial chemical discharges from mining and manufacturing, and inadequate waste management or garbage disposal. The article also provides information about pollutants that contaminate soil, such as heavy metals, polycyclic aromatic hydrocarbons (PAHs), industrial waste, pesticides, and improper waste disposal. The effects of soil pollution on human health, such as central nervous system disorders, immune system disorders, cancer, and birth deformities are also discussed. The article emphasizes that soil pollution is a global issue and that remediation requires an understanding of geology, hydrology, chemistry, computer modeling, and GIS in Environmental contamination.

Keywords: Soil pollution, industrialization, deforestation, Environmental.

Introduction

The presence of xenobiotic (man-made) chemicals or other changes in the natural soil environment are the main reason of soil contamination, soil pollution, or land pollution, which is a component of land degradation. Typically, the main sources of contamination are industrial activities, inappropriate waste disposal or overuses of agrochemicals. Petroleum hydrocarbons, polynuclear aromatic hydrocarbons, solvents, insecticides, lead, and other heavy metals are the most frequently used contaminants. The level of industrialization and chemical material concentration are associated to contamination. The main concern of soil pollution includes health issues from direct contact with contaminated soil, inhalation of contaminant vapor, or secondary contamination of water sources contained within and under the soil. Contaminated soil sites mapping and clean-ups are time-consuming and costly processes that need for knowledge of geology, hydrology, chemistry, computer modeling, and GIS in Environmental contamination, as well as an understanding of the development of industrial chemistry (George *et al.*, 2014; Ji *et al.,* 2012; Rao *et al.*, 2017; Yang *et al.*, 2021). The magnitude of polluted soil is most understood in North America and Western Europe, with several of countries in these regions have a legislative framework in place to recognize and address this environmental issue. Developing nations are typically less strictly regulated, despite the fact that some of them have had tremendous industrialization. It is crucial to realize that all soils contain compounds that are poisonous or hazardous to human and One of the following is frequently the primary contributor to soil pollution:

1. Excessive or incorrect use of pesticides in agriculture,
2. Industrial chemical discharges from mining and manufacturing of goods.
3. Inadequate waste management or ineffective garbage disposal.

The degree of soil pollution directly affects the difficulties in remediating the soil. The need for resources for remediation increases with contamination levels (Chen *et al;* 2020).

The primary pollutants which causing soil pollution are,

a. Heavy metals: 31%
b. Mineral oil: 20%
c. Hydrocarbons: 42%
d. Other: 7 %.

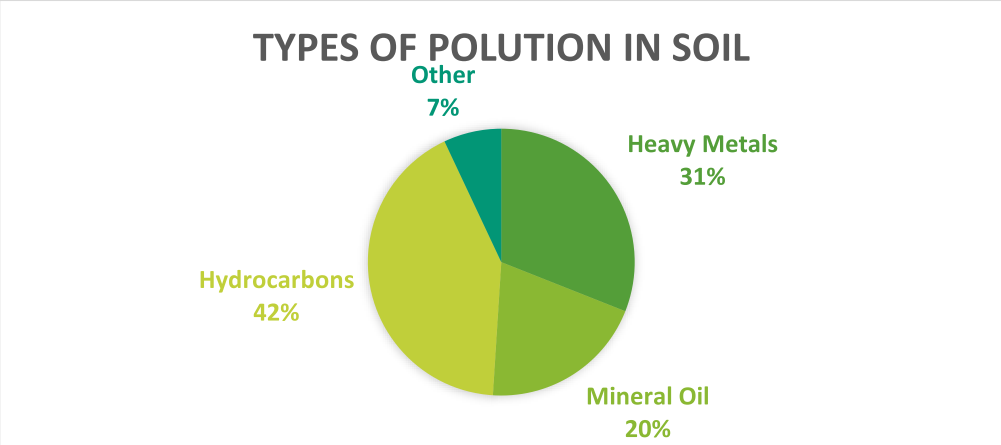


Fig. 1: Different types of pollutants that are found in contaminated soil (after BYJU'S, 2019).

Heavy Metals

Heavy metals (such as lead and mercury, at excessively high amounts) can make soil extremely dangerous for people to consume. The most prevalent heavy metals in soil environments are, arsenic (As), cadmium (Cd), chromium (Cr), mercury (Hg), lead (Pb), copper (Cu), zinc (Zn) and nickel (Ni) (Osama *et al ;* 2020).

Polycyclic Aromatic Hydrocarbons

Organic molecules known as polycyclic aromatic hydrocarbons (PAHs) are those that have more than one aromatic ring in their chemical structure and only include carbon and hydrogen atoms. Structures. There are various types of cancer that have been associated to exposure to polycyclic aromatic hydrocarbons. Humans can develop cardiovascular problems as a result of certain chemical substances. Coke (coal) processing, automobile emissions, cigarette smoking, and shale oil extraction are all potential sources of soil pollution caused by PAHs (Li *et al*., 2020).

Industrial Waste

Soil pollution can occur when industrial waste is dumped on top of the ground. Industrial waste is a common source of several soil contaminants, including:1) Chlorinated industrial solvents, 2) Dioxins created during pesticide production and waste incineration, 3) Plasticizers/dispersants, and 4) Polychlorinated biphenyls (PCBs). Many petroleum hydrocarbon waste chemicals, including benzene and methylbenzene, are produced by the petroleum industry and are known to have cancer-causing properties. (Zhang *et al*., 2020).

Pesticides

Pesticides are chemicals (or chemical mixes) used to eradicate or prevent the spread of pests. The following are examples of common insecticides used in agriculture:

1. Herbicides (triazines, carbamates, amides, henoxyalkyl acids, and aliphatic acids) are substances that are used to eradicate or control weeds and other undesirable plants. (Qisse *et al*., 2020)

2. Insecticides (organophosphates, chlorinated hydrocarbons, arsenic-

containing compounds, and pyrethrum) – used to kill iinsects (Pérez-Mayán *et al*., 2020),

3. Fungicides which include copper sulphate, thiocarbamates, and compounds containing mercury, are used to eradicate or stop the growth of parasitic fungi. (Sudoma *et al*., 2021)

Human health is at risk from these toxins in several ways. Diseases of the central nervous system, immune system disorders, cancer, and birth deformities are a few examples of the health risks associated with pesticides.

Processes of Soil Pollution

Natural Soil Pollution: Some contaminants naturally accumulate in soils in some incredibly uncommon mechanisms (e.g., Shaltami, 2014). This may happen as a result of the different soil deposition by the Atmosphere. The movement of soil contaminants with precipitation water is another way that this kind of soil pollution can happen. The buildup of substances containing the perchlorate anion (ClO_4^-) in some dry, arid habitats is an example of natural soil pollution. It is crucial to remember that some pollutants might be formed naturally in soil under the influence of specific environmental factors. For instance, perchlorates can occur during a thunderstorm in soils that contain metals and chlorine. (Tao *et al.,* 2020).

Anthropogenic Soil Pollution

Almost all instances of soil pollution are caused by human activity. There are numerous human activities that might contaminate soil. However, these are a few of the Soil contamination causes.

1. Accidental Spills and Industrial Accidents: Toxins and other pollutants, such radiation, can contaminate the soil as a result of industrial mishaps (like the Chernobyl Nuclear Disaster). Both the ecosystem and human health may be seriously impacted by them. Even bulk-stored agrochemicals could present a serious risk in the case of an accidently spilled substance. It may, in rare circumstances, result in a devastating explosion. (2020 Beirut Industrial Disaster) (BYJU'S, 2020).

2. Acid rain: High hydrogen ion concentrations make acid rain acidic. This rain can negatively alter the chemistry of the soil when it seeps into the ground. This indicates that the food chain may be impacted by acid rain because it may badly harm plants and significant soil bacteria. (Chen *et al*., 2012).

3. Chemical Agents of War: The possibility exists for harmful or lethal chemicals that are created to leach into the soil and remain active (Li *et al*., 2020).

4. Coal Ash: Along with flue gases, these tiny particles are expelled from coal-fired boilers. These particles have minute amounts of hazardous substances like arsenic, cadmium, and mercury. (Komonweerak *et al*., 2015).

5. Corrosion of Underground Storage Tanks: If storage tanks that hold dangerous chemicals or substances that could alter soil chemistry begin to deteriorate, they could become a source of soil pollution.(Hudak *et al*., 1999).

6. Discharge of Sewage: Untreated wastewater can cause toxins to seep into the soil if it is released back into the environment. Water-borne illnesses may develop if these toxins get into water supplies. (Chung *et al*., 2011)

7. Mining: Mining operations may have an impact on the soil by generating soil erosion, sinkhole development, or leaching chemicals from the mining process into the ground. (Gyamfi *et al*., 2019).

8. Nuclear Wastes: Humans are at grave danger from nuclear waste. Therefore, it can make a place uninhabitable if this kind of garbage is not properly disposed of. (An *et al*., 2020).

Effects of Soil Pollution

Soil pollution refers to the presence of toxic substances in the soil that can have harmful effects on plants, animals, and humans. Here are some of the effects of soil pollution:

Reduced crop yields: Soil pollution can reduce the fertility of soil, making it difficult for crops to grow. This can result in lower crop yields and poor quality of produce.

Contaminated food: Plants grown in contaminated soil can absorb toxic substances, which can then accumulate in the tissues of the plant. Consuming such food can lead to health problems.

Health risks: Exposure to soil pollution can lead to a range of health problems, such as skin rashes, respiratory problems, and neurological disorders. This is particularly true for people who work with contaminated soil, such as farmers.

Soil degradation: Soil pollution can result in the degradation of soil structure, leading to soil erosion and decreased water holding capacity. This can further exacerbate the effects of pollution on crops and other plants.

Water pollution: Soil pollution can lead to the contamination of groundwater and surface water, which can have far-reaching consequences for the environment and human health.

Biodiversity loss: Soil pollution can impact the biodiversity of an ecosystem, affecting the plants and animals that depend on it for survival.

Economic costs: Soil pollution can have significant economic costs, including decreased agricultural productivity, increased healthcare costs, and the cost of remediation efforts.

Control of Soil Pollution

Agriculture is a major contributor to soil pollution, but it can also be a part of the solution to control soil pollution. Here are some ways agriculture can help control soil pollution:

Reduce chemical use: Farmers can reduce the use of chemical fertilizers and pesticides, which are major contributors to soil pollution. Instead, they can use organic farming practices, such as crop rotation and natural pest control methods, to maintain healthy soil and crops.

Proper waste disposal: Farmers can ensure that agricultural waste, such as animal manure and crop residue, is properly disposed of or recycled. These materials can be used as natural fertilizers or as a source of energy.

Soil conservation: Farmers can adopt soil conservation practices, such as contour farming and no-till farming, to prevent erosion and maintain healthy soil.

Integrated pest management: Integrated pest management is a holistic approach to pest control that includes a combination of cultural, biological, and chemical methods. This approach can help reduce the use of harmful chemicals and prevent soil pollution.

Precision agriculture: Precision agriculture uses technology to optimize crop production while minimizing inputs such as fertilizer and pesticides. This approach can help reduce the use of chemicals and prevent soil pollution.

Soil testing and monitoring: Regular soil testing and monitoring can help farmers identify any soil pollution issues and take appropriate action to control them.

Conclusion

Soil pollution is a serious environmental issue caused by various human activities, such as the excessive or incorrect use of pesticides, industrial chemical discharges, and inadequate waste management. Heavy metals, polycyclic aromatic hydrocarbons (PAHs), industrial waste, pesticides, and improper waste disposal are the primary pollutants that contaminate the soil. The degree of soil pollution directly affects the difficulties in remediating the soil, and the need for resources for remediation increases with contamination levels. Soil pollution poses significant health risks to humans, including diseases of the central nervous system, immune system disorders, cancer, and birth deformities. Soil contamination mapping and clean-ups are time-consuming and costly processes that require expertise in geology, hydrology, chemistry, computer modeling, and GIS. It is crucial to recognize and address this environmental issue worldwide and develop strict legislative frameworks to combat it.

References

1. Dr.Rajesh Kumar Mishra, DR. Naseer Mohammad and Dr N.R. Roychoudhary 2015 soil pollution: cause effect and control Van Sangyan Vol. 3 No.1 issue 2016
2. Osama R. Shaltami, Namat M. Hamed, Fares F. Fares, Hwedi Errishi, Farag M. EL Oshebi,2020, Soil Pollution – A Review Journal,Virtual Conference on Environment and health (VCEH) Page No. 44-5
3. George, R., Joy, V., Aiswarya , S., & Jacob, P. A. (2014). Treatment Methods for Contaminated Soils—Translating Science into Practice. International Journal of Education and applied research, 4, 17-19.
4. Cappuyns, V. (2013): Environmental impacts of soil remediation activities: quantitative and qualitative tools applied on three case studies. Journal of Cleaner Production; 52: 145-154.
5. Chen, C., Zhang, X., Chen, J., Chen, F., Li, J., Chen, Y., Hou, H. and Shi, F. (2020): Assessment of site contaminated soil remediation based on an input output life cycle assessment. Journal of Cleaner Production; 263: 121422.
6. BYJU'S (2019): Soil pollution (avaliable at https://byjus.com/chemistry/soil-pollution/).
7. BYJU'S (2020): Causes Of soil pollution (avaliable at https://byjus.com/biology/causes-of-soil-pollution/).
8. Krcmar, D., Tenodi, S., Grba, N., Kerkez, D., Watson, M., Roncevic, S. and Dalmacija, B. (2018): Preremedial assessment of the municipal landfill pollution impact on soil and shallow groundwater in Subotica, Serbia. Science of The Total Environment; 615: 1341-1354.
9. Zhou, Y., Sun, J., Wang, L., Zhu, G., Li, M., Liu, J., Li, Z., Gong, H., Wu, C. and Yin, G. (2021): Multiple classes of chemical contaminants in soil from an e-waste disposal site in China: Occurrence and spatial distribution. Science of The Total Environment; 752: 141924.

Recent Advances and Reclamation for Salt-Affected Soil: An Article

Article ID: 40961

Samrat Mondal[1], Somrup De[2], Meraj Ahmed[3]
[1&2]Research Scholar [3]Assistant Professor, Department of Soil Science and Agricultural chemistry, School of Agriculture, Lovely Professional University, Jalandhar, Punjab-144411.

Abstract
Soil amendments are materials that are added to soil to improve its physical, chemical, and biological properties. The use of soil amendments has become increasingly important in modern agriculture due to depletion of nutrients in soil and the need to increase soil fertility. This practice can lead to better soil structure, enhanced water-holding capacity, improved nutrient availability, and increased microbial activity. Soil amendments can include both organic and inorganic materials. Overall, the use of soil amendments can improve soil health and fertility, leading to increased crop yields and a more sustainable agriculture system.

Keywords: Soluble salts, Soil Amendments, Soil health, Soil Fertility.

Introduction
When salts more soluble than calcium carbonate and gypsum are present in the soil and affect crop growth and yield of most crops these soils are considered as salt affected soil. Salt affected soils are unproductive unless excess salts are reduced or removed. These soils occur most extensively in arid climates, but these soils are also found in coastal sea areas where soils are inundated by ocean or sea water.

Types of Salt Affected Soils
1. Saline Soil
2. Sodic Soil
3. Saline-Sodic Soil
4. Degrade Alkali or Sodic Soil

Saline Soils: (Solonchak, Russian term): Saline soils defined as a soil having a conductivity of the saturation extract greater than 4 dSm^{-1}, ESP: less than 15, pH: less than 8.5. Formerly these soils were called white alkali soils because of surface crust of white salts.

Fig. 1: Saline soil suffering from excess amount of salt (Source: AgriHunt)

Sodic Soils: (Fig 2) (Solonetz-Russian term): Alkali or sodic soil is defined as a soil having EC: less than 4 dSm^{-1}, ESP: greater than 15, pH: 8.5-10.0. Formerly these soils were called black alkali soils and the soil so formed is called solod, soloth or degraded alkali or sodic soil.

Fig. 2: Sodic Soil of Arid & semi-arid region, contain $CaCO_3$ (Source: Food and Agriculture Organization)

Saline-Sodic Soil: Saline soils defined as a soil having a conductivity of the saturation extract EC: greater than $4dSm^{-1}$, ESP: greater than 15, pH is variable and usually above 8.5 depending on the relative amounts of exchangeable sodium and soluble salts.

Fig. 3: Saline-Sodic Soil (Sometimes contain gypsum, when such soils are leached, calcium dissolves and the replacement of exchangeable sodium) (Source: Times of Oman)

Degraded alkali or Sodic Soil: If the extensive leaching of a saline-sodic soil occurs in the absence of any source of calcium or magnesium, part of the exchangeable sodium is gradually replaced by hydrogen. Resulting may be slightly acid with unstable structure. This type of soil is called as degraded alkali or sodic soil.

Fig. 4: Degraded alkali or Sodic Soil (Absence of lime)(Source: Follow Green Living)

Sources of Soluble Salts

1. Primary Minerals: It is original and important source of all salt constituents. During the process of chemical weathering, which involves hydrolysis, hydration, solution, oxidation & carbonation, various constituents like Ca^{2+}, Mg^{2+} and Na+ are gradually released and made soluble.

2. Arid & Semi-arid climates: Salt affected soils are mostly formed in arid and semi-arid regions where low rainfall and high evaporation prevails.

3. Ground Water: Ground water contains large amounts of water-soluble salts which depends upon the nature and properties of the geological material with which water remains in contact where water table and evapotranspiration rate is high, salts along with water move upward through capillary activity and salts accumulate on the soil surface in the form of crystallization.

4. Excessive use of basic fertilizers: Use of basic fertilizers like sodium nitrate ($NaNO_3$), basic slag etc. may develop soil alkalinity.

5. Ocean or Sea water: Sea water enters the land by inundation and deposited salt on the soil surface.

6. Irrigation water: The application of irrigation water without proper management increases the water table and surface salt content in the soil.

Soil Amendment

Soil amendment is any substance which is intended to change the chemical or physical characteristics of soil. Amendments are added to soil to change and improve it. Unlike fertilizers, which add nutrients to soil, amendments modify the condition of the soil itself. Fertilizers impact plant growth directly, while soil amendments affect growth indirectly and sometimes deliver nutrients as a bonus. Soil amendment can strongly reduce the availability of PTE (Potentially toxic element) to plants, thus reducing phytotoxicity and facilitate the revegetation of contaminated sites.

There are Two Basic Types of Soil Amendments have been Used to Improve Soil Fertility and Stabilize Site Conditions

1. Organic Amendments: It is the composition of organic moieties derived from biomass and/or living beings. It generally includes compost, wood chips, biochar, animal manure, straw, husk, geotextile, and sewage manure. These substances are extremely rich in organic matter and macro & micro elements that increase the fertility of soils by ameliorating microclimate conditions and provide substrates and microbial growth. The application of mulch on the dump surface had a significant influence on the rhizosphere temperature and moisture content. A significant reduction in the rhizosphere temperature can be observed under mulch cover, while it was found to be higher in the unclaimed dump.

2. Inorganic Amendments: These amendments are generally contained minerals associated with soil fertility. Gypsum is commonly used to decrease soil pH by bonding high sodium salts and lime or limestone to decrease the soil pH. Coal combination by-products, like fly ash, have received much attention as soil amendments but may contain high amounts of trace elements. It has been observed that the addition of soil amendments but may contain high amounts of trace elements. It has been observed that the addition of soil amendments has great potential for increasing soil pH, reducing the solubility of trac metals by more than 80%, and stabilizing the soil.

States	Waterlogged		Salt affected area			Total
	Canal command	Total	Canal command	Outside canal	Coastal	
Andhra Pradesh	266	339	139	391	283	813
Bihar	363	363	224	176	Nil	400
Gujarat	173	484	540	327	302	1214
Haryana	230	275	455	Nil	Nil	455
Karnataka	36	36	51	267	86	404
Kerala	12	12	NA	NA	26	26

Madhya Pradesh	57	57	220	22	Nil	242
Maharashtra & Goa	6	111	446	NA	88	534
Orissa	196	196	NA	NA	400	400
Punjab	199	199	393	127	Nil	519
Rajasthan	180	348	138	984	Nil	1122
Tamil Nadu	18	128	257	NA	84	340
Uttar Pradesh	455	1980	606	689	Nil	1295
West Bengal	NA	NA	Nil	NA	800	800
Total	2190	4528	3469	3027	2069	8565
Tyagi, N.K. CSSRI						

Conclusion

Soil amendments can be a useful tool for improving the structure and fertility of salt-affected soil. Organic amendments can provide essential nutrients and improve the soil's ability to retain water, while inorganic amendments can help reduce soil pH and stabilize trace elements. However, the choice of amendment will depend on the specific characteristics of the soil, including its texture, pH, and the types and amounts of soluble salts present. It is important to note that while amendments can improve soil structure and fertility, they may not always completely remediate salt-affected soils. In some cases, it may be necessary to combine amendments with other soil management practices such as leaching.

References

1. Dilip Kumar Das., (2020). Introductory Soil Science, Kalyani Publishers, Chapter 15: Soil Salinity and Alkalinity, 262-266.
2. Maiti, S. K., & Ahirwal, J. (2019). Ecological Restoration of Coal Mine Degraded Lands, Chapter 3: 3.3.7 Use of Amendments and Superabsorbent, 95-97.

Salt Affected Soils and Management - An Article

Article ID: 40962

Satvik Rana[1], Somrup De[2], Meraj Ahmed[3]
[1&2]Research Scholar ,[3]Assistant Professor, Department of Soil Science and Agricultural chemistry, School of Agriculture, Lovely Professional University, Jalandhar, Punjab-144411.

Introduction

Like we all are aware and well known about the soil of our surroundings, but most of us will not be getting the point that soils are also of different kinds like us human's. INTERESTING! You may be surprised to hear "dirt" described as "big". However, in the late 1800's scientists began to recognize that soils are natural bodies with rocks, roots, animals, and other parts. And just like other bodies, soil systems provide integrated functions that are greater than the sum of their parts. Unfortunately, many human activities degrade and pollute soils, lessening the ecosystem services provided by soils and making some soils and their runoff water harmful to our environment and human health.

Salinization

It is the buildup of salts in salts in soils to a point that they physical and chemical properties of soil and make it impossible for plants to take up water from the soil. The salt-affected soils occur in the arid and semiarid regions where evapo-transpiration greatly exceeds precipitation. The accumulated ions causing salinity or alkalinity include sodium, potassium, magnesium, calcium, chlorides, carbonates and bicarbonates.

The Salt-Affected Soils can be Primarily Classified as Saline Soil and Sodic Soil

1. Saline Soils- Saline-alkali / sodic soil is defined as a soil having a conductivity of the saturation extract greater than 4dSm-1. An exchangeable sodium percentage greater than 15. The pH is variable and usually above 8.5 depending on the relative amounts of exchangeable sodium and soluble salts. When soils dominated by exchangeable sodium, the pH will be more than 8.5 and when soils dominated by soluble salts, the pH will be less than 8.5.

2. Alkali/ Sodic soils- A conductivity of the saturation extract less than 4dS m-1. An exchangeable sodium percentage greater than 15. pH is usually between 8.5-10.0. Most alkali soils, particularly in the arid and semi- arid regions, contain $CaCO_3$ in the profile and constant result in the maintenance of higher pH is calcareous alkali soils than that in non- calcareous alkali soils.

Difference between Saline and Sodic Soils

Saline soil is a term used to describe excessive levels of soluble salts in the soil water (soil solution), high enough to negatively affect plant growth, resulting in reduced crop yields and even plant death under severe conditions. The primary effect of excessive soluble salts on plants is to limit the ability of plant roots to absorb soil water even under wet soil conditions. Soil watr flows from higher osmotic potential to lower osmotic potential (high salt concentration). A soil solution with low osmotic potential due to the higher concentration of salts will not allow plant roots to extract water from soil solution. Hence the plant shows drought-like symptoms in the plants (Seelig, 2000). That process is called "osmotic effect". (Figure 1).

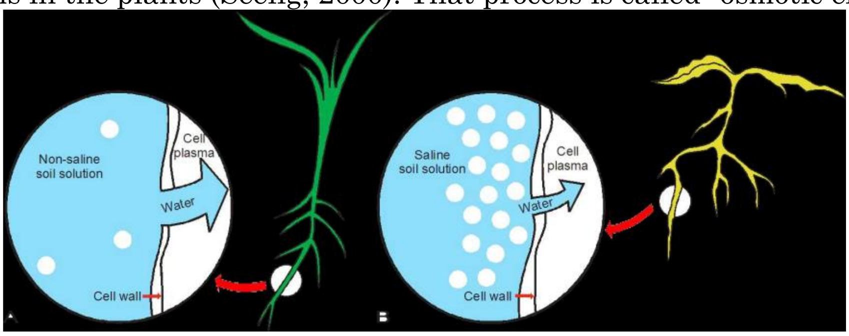


Figure 1: Excessive soluble salts causing draught like symptoms

In contrast to saline soils, sodic soils have excessive levels of sodium (Na+) adsorbed at the cation exchange sites. Soil sodicity causes degradation of soil structure. That process is called soil dispersion.

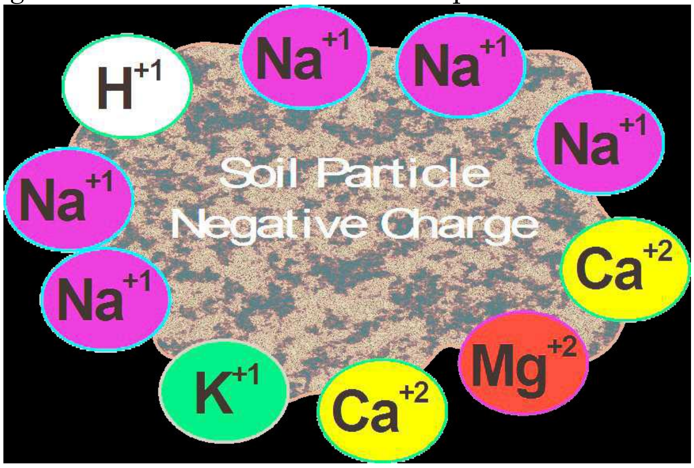


Figure 2: Example of a sodic soil aggregate with more than 15 percent of its cation exchange sites occupied by sodium ions.

The forces that hold clay particles together are greatly weakened when excessive sodium is adsorbed at the negative charges of clay particles (Figure 2), forming sodium-clay particles (Seelig, 2000). When wet, sodium-clay particles get easily disintegrated or dispersed from the larger soil aggregates. Once dry, sodium-clay particles clog the soil pores and settle down in dense layers.

Sensitive (0-4mS/cm)	Moderately Tolerant (4-6 mS/cm)	Tolerant (6-8 mS/cm)	Highly Tolerant (8-12 mS/cm)
Field beans (Dry) Red, Ladino, & Alsike Clovers Strawberry Onion Pea Carrot Lettuce	Corn Grain Sorghum Soybean Bromegrass	Oats Wheat Triticle Sunflower Alfalfa	Barley Rye Bermudagrass Asparagus Coconut

Table 1: Salt tolerance levels of different crops

Management of Saline Soils

Because salts can only be leached downward in the soils with soil water, attention to drainage is very important. Assessment of where the water comes from that result in the high water table is particularly important. These soils are easy to reclaim for crop production if adequate amounts of low-salt irrigation water or rainfall are available and internal drainage of the soil is good. Saline soils cannot be reclaimed by chemical amendment, conditioner or fertilizer. Reclamation consists of applying enough good-quality water to thoroughly leach excess salts from the soil. Water should be added in sequential applications, allowing time for the soil to drain after each application. The quantity of water necessary for reclamation varies with initial salt level, desired salt level, irrigation water quality, and how the water is applied. If sequential applications are used, 8 to 10 inches of leaching water may be necessary to remove 70 percent of total salts for each 12 inches of soil to be leached.

Sodic and Saline-Sodic Soils Management

Reclamation of sodic soils is different; excess sodium must first be replaced by another cation and then leached. Sodic soils are treated by replacing the sodium with calcium from a soluble source. Gypsum ($CaSO_4 \cdot 2H_2O$) is considered the cheapest soluble calcium source for reclamation of sodic soils. On calcareous soils (soils with excess CaCO3 present), elemental sulfur (S) may be added to furnish calcium. Which increases water infiltration and permeability, speeding up the reclamation process. In reclamation of saline-sodic soils, the leaching of excess soluble salts must be accompanied (or preceded) by the replacement of exchangeable sodium by calcium. If the excess salts are leached and calcium does not replace the exchangeable sodium, the soil will become sodic.

Conclusion

Salt-affected soils can severely reduce land value and productivity. Soil tests can determine if salt accumulation is a problem. Problems include high total salts (saline soils), excess exchangeable sodium (sodic soils), or both (saline-sodic soils). These soil conditions can severely affect crop growth. Crops react differently to salt-affected soils. Soil reclamation is possible but not always economically feasible.

References

1. https://www.ndsu.edu/soilhealth/wp-content/uploads/2014/07/Saline-and-Sodic-Soils-2-2.pdf
2. https://bookstore.ksre.ksu.edu/pubs/mf1022.pdf

Effects of Salinity on Soil, Crops, and Soil Mirobiota: An Article

Article ID: 40963

Pratyaksha Singh[1], Somrup De[1], Meraj Ahmed[2]
[1]Research scholar [2]Assistant Professor, Department of Soil Science and Agricultural Chemistry, School of Agriculture, Lovely Professional University, Jalandhar, Punjab-144411.

Introduction

"If you want to have food, then conserve the soil dude" is a famous quote stating the importance to avoid food shortage. Talking about Saline soils, it is a threat that needs to be rehabilitated to manage the agricultural demand of the Growing population in the coming times. Whereas Microbiota refers to the micro-organisms which constitute less than 0.5% (w/w) of the soil mass, but plays a key role in soil properties and processes as soil demands high microbial activity for mineralization of organic into plant available nutrients.

Salt-affected soils are all over the world, mainly in arid and semi-arid regions. The total area of global salt-affected soil is 1 billion ha, and in India, an area of nearly 6.74 million ha^{-1} is salt-accumulated, out of which 2.95 million ha^{-1} is saline soil (including coastal).

Salinity which Means a High Concentration of Soluble Salts Affects Plants and Microbes in Two Ways

1. Osmotic effect: Osmotic potential means more negative ions are increased by the soluble salts of soil water, leading to drawing water out of cells, resulting in the killing of microbes and roots through Plasmolysis (Figure:1). Low osmotic potential also means it is difficult for roots and microbes to remove excess water from the soil, As the Synthesis of Osmocytes requires larger amounts of Energy resulting in reduced growth and activity. Because plants and microbes adapt the ability to low osmotic potential by accumulating osmolytes leading to the dying and lysis of cells.

2. Specific ion effect: Specific ion toxicities are due to the accumulation of sodium, chloride, and/or boron in the tissue to damaging levels. The damage is visible as foliar chlorosis and necrosis and, if severe enough, will affect soil productivity.

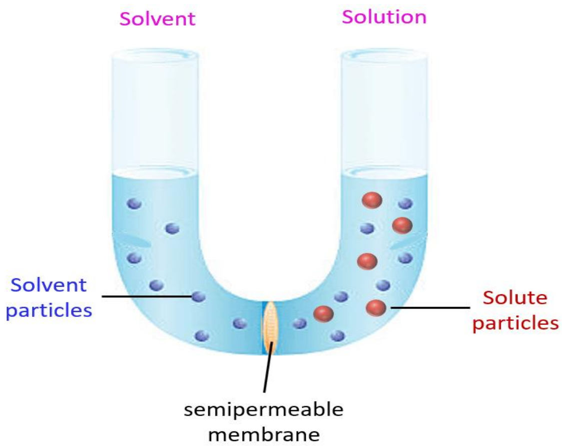


Figure: 1

Toxic osmolytes component: Proline and Glycine betaine are the main organic osmolytes and potassium cations are common osmolytes accumulated. All of these are Toxic.

Classification

Salts-affected soils can be classified according to how salinity is developed-

1. Primary salinity: It is where the soil parent is natural. (Figure 2).

2. Geothermal salinity: It results in salt affected soil. (Figure 3).

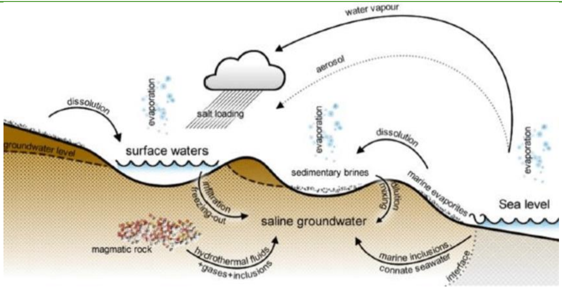


Figure: 2

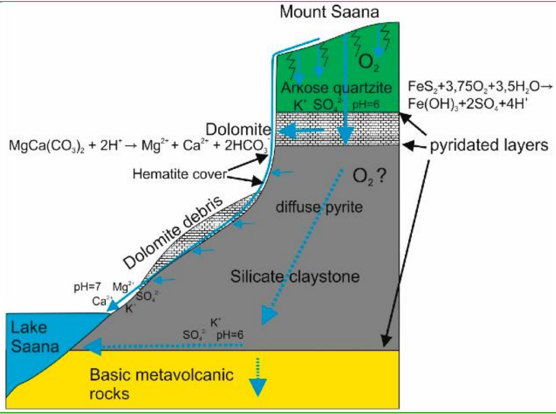


Figure: 3

Other Causes of Salinity

Salinization is also caused to due to Human Activities:
1. Irrigation management
2. Insufficient drainage
3. Improper cropping pattern.

Major Soluble Salt Ions in Saline Soil

Cations- Na^+, Ca^{2+}, Mg^{2+}, k^+
Anions- Cl^-, $No3^-$

Microorganisms

Studies show that Fungi are more sensitive to salt than bacteria (Figure 4), but sensitivity to salinity stress in bacteria has also been reported.

Case Study

In recent decades, due to the rapid increase in water demand and greater usage of water for irrigation from surface canals, waterlogging problems have been created in the southwest zone of Punjab, coupled with a stagnation in saline zone formation due to salinity ingression. To understand these salinity issues, the present study has been conducted in three districts (Muktsar, Fazilka, and Faridkot) in Punjab to understand the root cause. To this end, groundwater samples were collected from 142 piezometers developed at 40 sites. Electrical conductivity (EC) observations were taken in the field, and collected samples were analyzed for isotopes in the laboratory. Results found that salinity in groundwater arises from the combination of evaporation enrichment and salt dissolution. The dissolved salts may be acquired due to salts from aquifer materials or salts from surface soils dissolving and leaching down with the recharging water. Besides, the zone of interaction is mapped using stable isotopic composition. The study suggests that the zone of interaction between aquifers can be effectively used in groundwater augmentation, management, and contamination control at regional and/or global scales to curb water demand in the future.

Conclusion

Salinity is becoming more of a hazard due to anthropogenic activities like inappropriate resource use. Secondary salinization is a significant element in the deterioration of soil fertility and the productivity of areas that can be used for agriculture. Leaching is one of the different management techniques that is thought to be more cost-effective and effective. Mulching considerably prevents future salinization of the soil because it lowers evapotranspiration. Monitoring the salinity of irrigation water, using controlled irrigation, and blending it with water of high quality all help to achieve a manageable level of salinity. Since soil salinity is not constant, proper management of saline soil is necessary to advance the goal of global food security. It is still possible to treat saline soil in a sustainable manner.

References

1. The ecology of soil decomposition CAB International 2003, Wallingford UK (2003).
2. The nature and properties of soils Prentice Hall, New Jersey (2002).
3. Dehydrogenase activity and microbial biomass carbon in salt-affected soils of semiarid and arid regions, Arid Land Research and Management, 11 (1997), pp. 295-303.
4. Response of microbial biomass to alternate moist and dry conditions in a soil incubated with C-14 labeled and N-15 labeled plant material, Soilless Biology Biochemistry, 17 (1985), pp. 329-337
5. The nature and properties of soils, Prentice Hall, New Jersey (2002) Nyman et al., Effects of the microbe and mussel-based diets on the gut microbiota in Arctic charr (Salvelinus alpinus), Aquacul rep. (2017).

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

A Review – Prospect and Application of Biochar in Climate Resilient Agriculture

Article ID: 40964

Amit Kumar[1], Dr. Umesha C[2]
[1]M.Sc Scholar, Department of Agronomy, (Naini Agricultural Institute), Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, U.P, India.
[2]Assistant Professor, Department of Agronomy, (Naini Agricultural Institute), Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, U.P, India.

Introduction

Soils have the ability to absorb carbon dioxide and influence its concentration in the atmosphere. Biochar can be used to increase the ability of soils to sequester carbon and simultaneously improve soil health. The goal of this paper is to introduce the concept and origins of biochar, discuss its production process, potential uses, and the benefits and costs of biochar in its key roles in agriculture and climate change mitigation. Biochar is just charcoal made from biomass—which is plant material and agricultural waste—hence the name 'biochar'. It is a fine-grained charcoal produced from pyrolysis: the slow burning of organic matter in a low- or no-oxygen environment. What differentiates biochar from charcoal is its purpose; it is produced as an additive to soils, mainly to improve nutrient retention and carbon storage. Although the history of biochar extends thousands of years, It's science is still relatively poorly understood.

Climate resilience is a fundamental concept of climate risk management. In this context, resilience refers to the ability of an agricultural system anticipate and prepare for, as well all adapt to, absorb and recover from the impacts of changes in climate and extreme weather. Climate-resilient agriculture (CRA) is an approach that includes sustainably using existing natural resources through crop and livestock production systems to achieve long-term higher productivity and farm incomes under climate variabilities. Greenhouse gas (GHG) emissions from agri-food sectors represent 34 percent of total GHG emissions, caused mainly by deforestation, livestock production, soil and nutrient management, food loss and waste. For Agriculture to become part of the climate solution and to feed an increasing world population of 9.9 billion by 2050, agri-food systems to be transformed and strengthened through effective climate change adaptation and mitigation, for people to have access to sustainable, affordable and healthy diets, now in the future. Agri-food systems contribute to GHG emission and are at the time extremely vulnerable to climate change.

Possible Ways of Crop Residue Management in CRA

Crop Residue Retention
Manure Application
Composting
Direct seeding by zero-till or Happy seeder
Crop residue incorporation
Biochar

Climate Change Mitigation through Application of Biochar

Biochar has been given a lot of attention recently as one means of addressing climate change. It has the capacity to do so in three ways: the storage of carbon over long periods; the reduction of greenhouse gases such as methane (CH_4) and carbon dioxide (CO_2) that can be generated from waste disposal, waste processing or recycling; and the production of renewable energy. Through the production process, around 50 per cent of the feedstock's carbon content is retained in the biochar. This compares to the 10 to 20 per cent that remains in biomass after 5 to 10 years of natural decay, and the less than 3 per cent that remains in ash after complete burning. [17] Some analyses have suggested that 'up to 12% of the total anthropogenic [carbon] emissions by land use change can be off-set annually in soil, if slashand-burn is replaced by slash-and-char'. [18] If it proves practicable to replace traditional slash-and-burn practices with slash-and-char methods, biochar may present a real quantifiable and verifiable option for storing carbon in the long term.

What is Biochar?

1. Biochar - It is fine-grained charcoal produced from pyrolysis.
2. Pyrolysis - the slow burning of organic matter in a low- or no-oxygen environment.
3. Biochar is mix of carbon (C), hydrogen (H), oxygen (O), nitrogen (N), sulfur (S) and ash in different proportion.
4. Biochar is characterised by high carbon content, a stable chemical structure resistant to decay, high porosity, and a high specific surface area.
5. Biochar has great potential for climate change mitigation and soil quality improvement for sustaining food security for the future generation.

Physio-Chemical Properties of Biochar Physical Properties

1. Bulk density/Particle density
2. Particle size
3. Porosity
4. Specific surface area
5. Water holding capacity
6. pH – Alkaline
7. C/N ratio
8. Electrical conductivity
9. Cation exchange capacity
10. Macro and micro nutrient content.

Beneficial Impacts of Biochar on Soil Properties

Soil Physical Properties:

a. Improved water holding capacity and infiltration rate results from increased porosity and pore sized distribution
b. Reduction in soil bulk density as a result of biochar's low density, which could improve soil workability and plant growth in heavy soils
c. Potential for improved aggregate stability and soil structure.

Soil Chemical Properties:

a. Increased Cation Exchange Capacity resulting from negative charges on biochar's high surface area
b. Liming Effect (increased soil pH) which can make nutrients more available in acidic soils
c. Reduced nutrient loss through leaching and associated improved fertilizer efficiency, tied to increased CEC and water retention.
d. Reduced nitrogen loss through gaseous emissions (methane and nitrous oxide), tied to CEC and the sorption properties of biochar.
e. Soil Biological Properties:
f. Increased habitat for micro-organisms in the porous structure of biochar
g. Increased abundance of beneficial organisms and increased microbial activity.

Biochar is Composed of Three Main Components

1. Ash is the inorganic portion and any readily available nutrients in biochar will be in this fraction. This fraction is usually quite small, and alkaline.

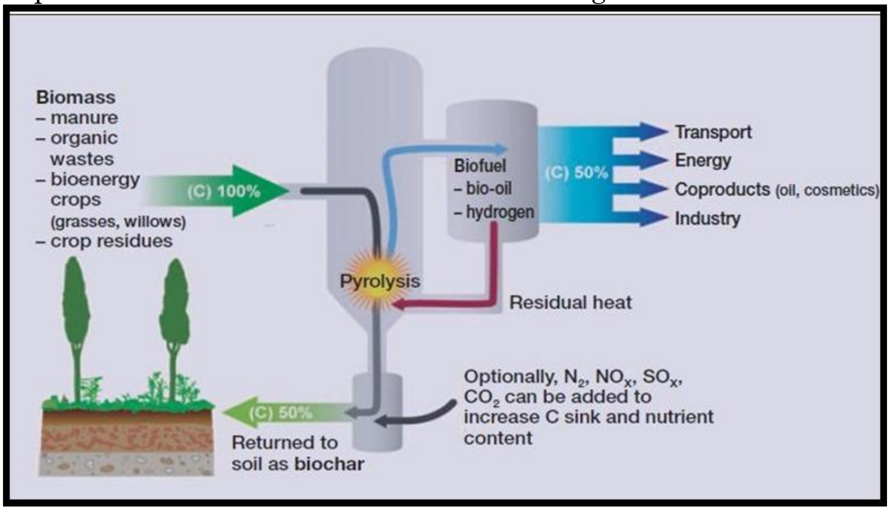
2. Labile carbon is the portion of the biochar that is susceptible to decomposition by soil microorganisms and the carbon in this portion will be lost in the form of CO2 from respiration like normal organic matter.

3. Recalcitrant carbon is the portion that is highly stable and resistant to decomposition by soil organisms for a very long period of time. It is this portion that is responsible for biochar's ability to sequester carbon in the soil.

The relative proportions of the above three fractions vary with the pyrolysis process and feedstock material. Other important properties that vary are pH, cation exchange capacity (CEC), electrical conductivity (EC), sur- face area, nutrient content, and porosity.

Production of Biochar

The biochar production process begins with biomass being fed into a pyrolysis kiln—a furnace that burns with little or no oxygen. The biomass could be cropping residue, wood and wood waste, certain animal manure, or various other organic materials. At the end of this, two main products come out of the kiln. The first is biochar, usually representing about 50 per cent of the carbon content of the biomass. The other is biofuel. The biofuel is often syngas, which is a mixture of mainly hydrogen and carbon monoxide, with a little carbon dioxide. The proportions of the three gases vary according to the processes used to create the syngas. However, the important point is that syngas is combustible and so can be used as a fuel source. Depending on the process, the biofuel from the kiln could also be bio- oil, which can be used as a substitute for diesel in some engines. The pyrolysis occurs at temperatures below 700˚C; but some parameters can be altered, such as the rate of pyrolysis, or the quantity of oxygen. Generally, faster pyrolysis results in more oils and liquids, slower pyrolysis produces more syngas. Minimising the oxygen present during pyrolysis optimises the production of biochar. Pyrolysis can be followed by a second stage: gasification. Gasification liberates more energy- rich syngases from the char (usually hydrogen-based). There may also be a 'gas cleanup' stage to remove some of the particulates, hydrocarbons and soluble matter from the gas. The biofuel generated from the pyrolysis process can be used to create the electricity needed to power the kiln or secondary stages of the process. So, it is possible for the system to run autonomous of external power sources. The pyrolysis process described is summarized in the fig no.1.

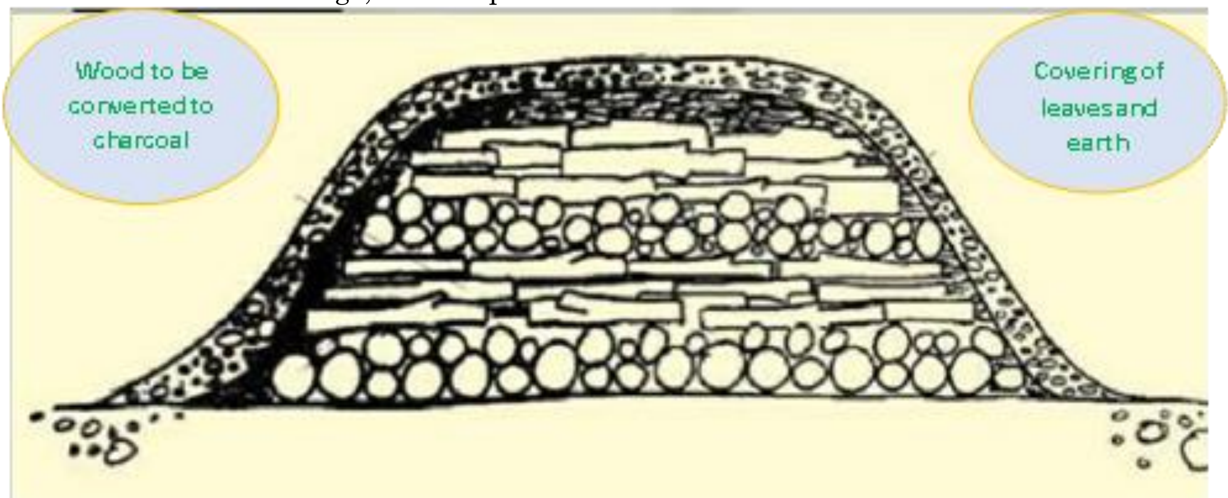


Production Techniques

1. Heap Method:

a. Structure- pyramid like

b. Feed material- wood logs, roots of plant.



c. Vents are opened starting from the top and working downwards ➢ Feed material- *Prosopis julifera.*

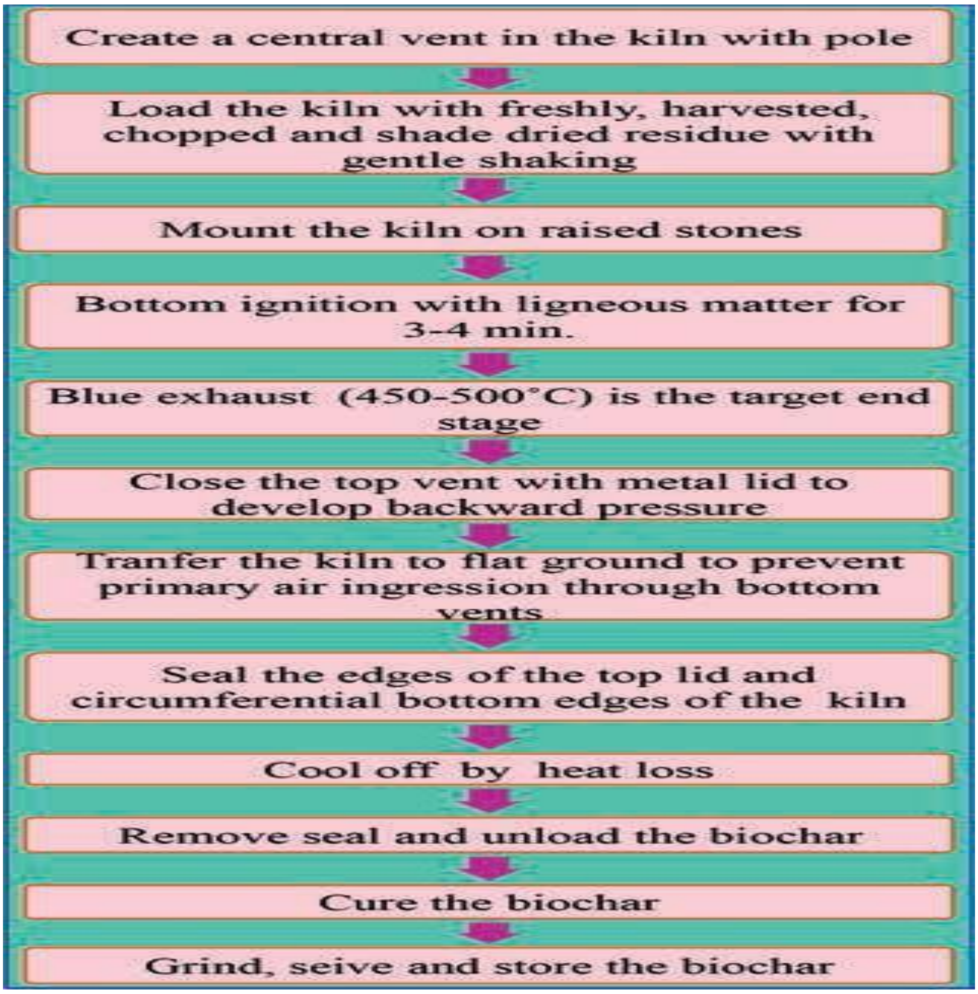
d. Converting time- Entire wood logs are converted into charcoal after burning inside the heap for days.

Traditional Earth Klin

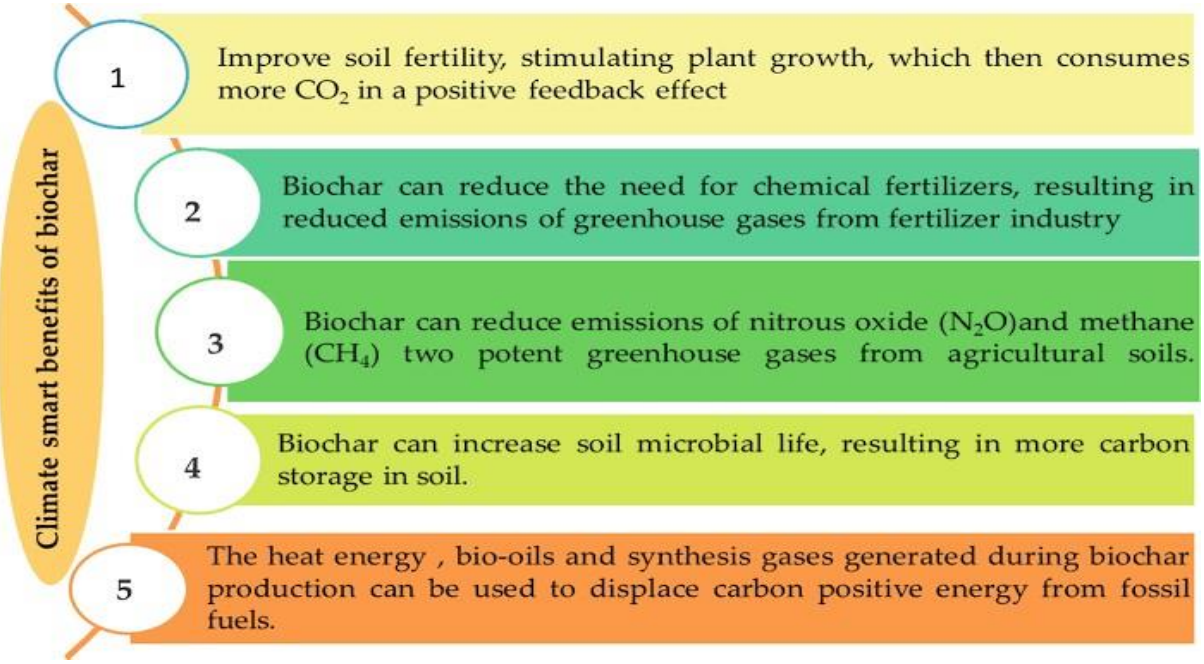
2. Biochar Preparation at IARI:

a. Drum used for preparation of biochar.
b. Drum filled with maize stover
c. Drum covered with lid
d. Drum placed inside the firebrick kiln heating provide at the base of drum externally
e. Biochar removed from drum
f. Biochar the final product with little percentage of ash.

Biochar Kiln at CRIDA



Potential Benefits of Biochar

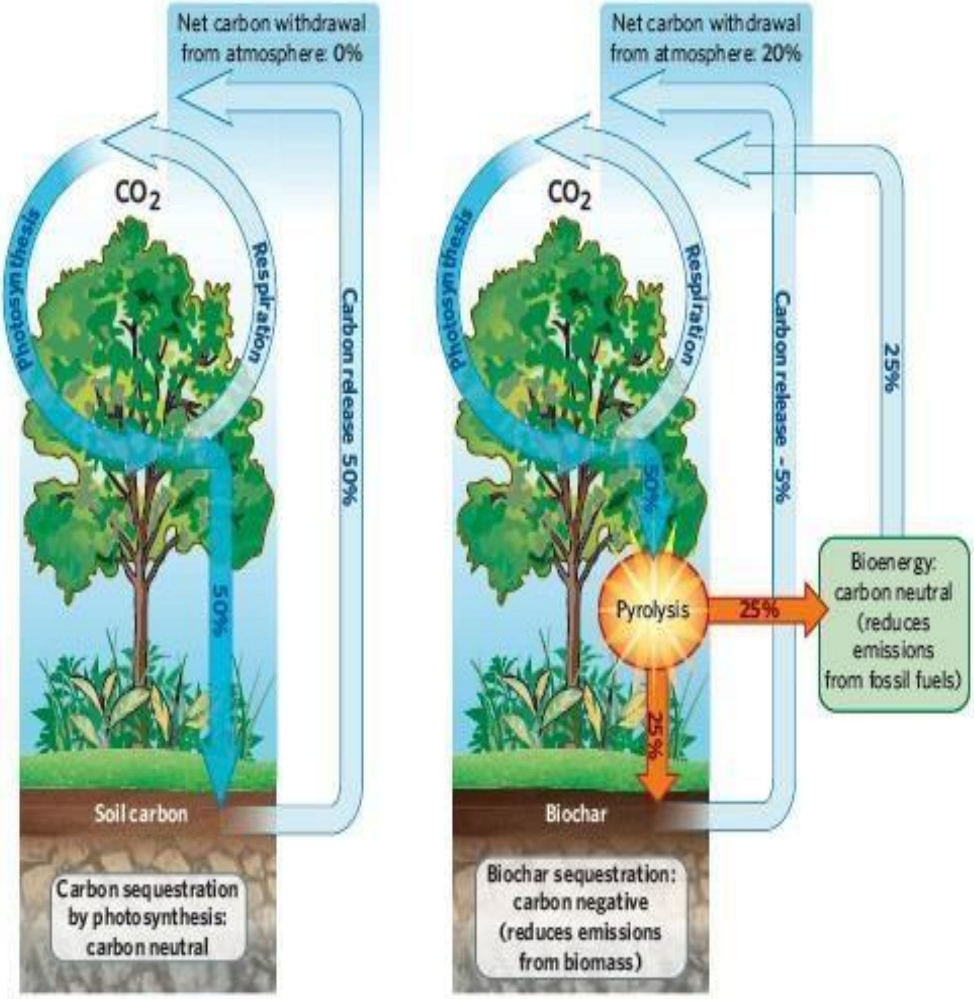


Soil C Sequestration and Climate Change Mitigation

Carbon dioxide (CO_2) is a major greenhouse gas contributing to global warming. Photosynthesis by plants removes CO_2 from the atmosphere, but when plants decay, CO_2 is released back into the atmosphere as organic matter decomposes. The pyrolysis of organic matter alters its chemical structure, resulting in an organic form of carbon that is resistant to decay. Once biochar is applied to soil, the carbon is expected to remain in the soil (out of the atmosphere) for centuries to over a thousand years. There are other means of increasing soil carbon in agriculture.

Biochar has the Potential to be Carbon Negative and Reduce Atmospheric Carbon

1. Soils store nearly 4x more organic C than the atmosphere
2. Annual plant uptake of CO_2 is 8x greater than anthropogenic CO_2 emissions
3. Diverting merely 1% of annual net plant uptake of CO_2 into biochar would mitigate nearly 10% of current anthropogenic CO_2 emissions (Gaunt & Cowie, 2009).



The image above (left) indicates the carbon cycle in which the amount of CO_2 taken up by plants is equal to the amount of CO_2 released back into the atmosphere through plant respiration and normal soil processes. The right side illustrates how biochar reduces the amount of CO_2 released from soil processes, thereby resulting in a net withdrawal of atmospheric carbon. Source: Lehmann, 2007.

Constrains Related to Biochar Use in India

1. The crop residues are used for various purposes like animal feeding, mulching, bio manure, thatching and fuel for domestic and industrial use
2. Heterogeneous nature of biochar, cost of production of biochar for research and field application is likely to remain a constraint until commercial-scale pyrolysis facilities are established.
3. Practical constraints with biochar in agricultural systems-remains permanent once applied to soil, unavailability of enough biochar, dry biochar is liable to wind erosion, low response of local communities to adopt (Adtiya *et al.,* 2014)

4. Unavailability of farm labour, higher wage rates for collection and processing of crop residue, lack of appropriate farm machines for on-farm recycling of crop residue and inadequate policy support/ incentives for crop residue recycling (Venkatesh *et al.,* 2015).

Conclusion

Application of biochar to agricultural land for soil amelioration and agricultural productivity improvement. It has been found to improve soil parameters such as soil pH, cation exchange capacity and soil water holding capacity. Better nitrogen use efficiency and crop productivity can be obtained with biochar use. Biochar has the potential to reduce greenhouse gas emissions through carbon sequestration, as well as potential of decreasing methane and nitrous oxide emissions from the soil.

References

1. Agbede, T. M., A. S. Odoja, L. N. Bayode, P. O. Omotehinse, and I. Adepehin. 2020. Effects of biochar and poultry manure on soil properties, growth, yield and quality of cocoyam (*Xanthosoma sagittifolium* Schott) grown in sandy soil. *Communications in Soil Science and Plant Analysis* 51 (7):932–47. doi:10.1080/00103624.2020.1744621.
2. Aslam, Z., M. Khalid, and M. Aon. 2014. Impact of biochar on soil physical properties.
3. *Scholarly Journal of Agricultural Science* 4 (5):280–84.
4. Coumaravel, K., Santhi, R., and Maragatham, S. 2015. Effect of biochar on yield and nutrient uptake by hybrid maize and on soil fertility. *Indian Journal of Agricultural Research* ***49***(2):185-188.
5. Gaunt, J. and Cowie, A. 2009. Biochar greenhouse gas accounting and emission trading. In: *Biochar for environmental management* (J. Lehmann and S. Joseph eds.), Science and Technology, Earthscan, London. pp 317-340.
6. International Biochar Initiative. Biochar Can Help Renew the Earth. *International Biochar Initiative.* (Online) (Cited: October 2, 2010.) www.biochar-international.org.
7. Kannan P, Ponmani S, Prabukumar G, Swaminathan C (2016) Effect of biochar amendment on soil physical, chemical and biological properties and groundnut yield in rainfed Alfisol of semi-arid tropics. *Archives of Agronomy and Soil Science* ***6***:1293–1310.
8. Laird, D.A. 2008. The charcoal vision: A win-win-win scenario for simultaneously producing bioenergy, permanently sequestering carbon, while improving soil and water quality.
9. *Agronomy Journal*, 100: 178-181.
10. Lehmann, J., Gaunt, J. and Rondon. 2006. 'Bio-char sequestration in terrestrial ecosystems— a review', *Mitigation and Adaptation Strategies for Global Change*, 11:403–27.
11. Lehmann, J. and Joseph, S. 2009. *Biochar for environmental management*, Earthscan publishing, London.
12. Lehmann, J. and Rondon, M. 2006. Biochar soil management on highly weathered soils in the humid tropics. *Biological Approaches to Sustainable Soil Systems* pp 517-530
13. Ministry of Agriculture. 2012. Government of India, New Delhi. Web: www.eands.dacnet.nic.in retrieved on dated 11-04-2021.
14. Nur, M.S.M., Islami, T., Handayanto, E., Nugroho, W.H. amd Utomo, W.H. 2014. The use of biochar on calcareous soil of East Nusa Tenggara, Indonesia: 2. Effect on the yield of
15. maize (*Zea Mays l*) and phosphate absorption. *American-Eurasian Journal of Sustainable Agriculture* ***8***:105-111.
16. Rogovska, N., Fleming, P., Cruse, R. and Laird, D. 2008. Greenhouse gas emissions from soils as affected by addition of biochar. Abstracts of 2008 International Annual Meetings ASA CSSA SSSA. No. 666-5.
17. Rondon, M., Ramirez, J.A. and Lehmann, J. 2005. Charcoal additions reduce net emissions of greenhouse gases to the atmosphere. In: *Proceedings of the 3rd USDA Symposium on Greenhouse Gases and Carbon Sequestration*, Baltimore, USA, March 21-24, 2005.
18. Srinivasarao, Ch., Vankateswarlu, B., Lal, R., Singh, A.K., Sumanta Kundu, Vittal, K.P.R., Balaguruvaiah, G., Vijaya Shankar Babu, M., Ravindra Chary, G., Prasadbabu, M.B.B. and Yellamanda Reddy, T. 2012. Soil carbon sequestration and agronomic productivity of an Alfisol for a groundnut-based system in a semiarid environment in southern India.
19. *European Journal of Agronomy* ***43***: 40-48. Steiner, C. 2010. Biochar in agricultural and forestry applications. *Biochar from agricultural and forestry residues – a complimentary use of waste biomass*, U.S.- focused biochar report: Assessment of biochar's benefits for the United States of America.
20. Uzoma. K. C., Inoue, M., Andry, H., Fujimaki, H., Zahoor, A. and Nishihara, E. 2011. Effect of cow manure biochar on maize productivity under soil condition. *Soil Use and Management* ***27***:205-212.
21. Venkatesh, G., Korwar, G.R., Venkateswarlu, B., Gopinath, K.A., Mandal, U.K., Srinivasarao, Ch. And Grover, M.T. 2010. Preliminary studies on conversion of maize stalks into biochar for terrestrial sequestration of carbon in rainfed agriculture. *National Symposium on Climate Change and Rainfed Agriculture*. CRIDA, Hyderabad, 18-20 February, 2010. pp 388-391.
22. Warnock, D.D., Lehmann, J., Kuyper, T.W. and Rillig, M.C. 2007. Mycorrhizal responses to biochar in soil - concepts and mechanisms. *Plant and Soil* ***300***: 9-20.
23. Yanai, Y., Toyota, K. and Okazani, M. 2007. Effects of charcoal addition on N_2O emissions from soil resulting from rewetting air-dried soil in short-term laboratory experiments.
24. *Soil Science and Plant Nutrition* ***53***: 181-188.

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

Assessment of Soil Health: Past Results, Current Practices, and Future Prospects

Article ID: 40965

Nitesh Kumar Singh[1], Agnibha Sinha[2], Shivai Thakur[2]

[1]Research Scholar, [2]Assistant Professor, School of Agriculture, Department of Soil Science, Lovely Professional University, Phagwara, Punjab, India – 144411.

Abstract

One of the most divisive issues that the community of soil scientists has ever argued is the evaluation of soil quality. Examining the past, current state, and possible uses of soil is our goal. Using quality assessment as a technique, managers may keep an eye on the physical, chemical, and biological implications of management choices that could have an impact on soil and water resources. Different methods for evaluation and differences between intrinsic and dynamic soil quality are discovered and explored. The Cornell Soil Health Test, Soil Conditioning Index, Soil Management Evaluation Framework, and Agroecosystem Performance Assessment Tool (AEPAT) are four evaluation indices that are looked at. The SCI forecasts changes in soil organic matter (SOM) and According to research, cultivating continuous maize (Zea mays *L.*) had poorer soil pH, decreased macro-aggregate stability, and lower microbial biomass carbon, but producing at least three years of forage had higher index values. The long-term objective is to give tools to assist guide soil management and usage decisions and so maintain the sustainability of our soil, air, and water resources. Opportunities for collaboration to further develop the SMAF are highlighted.

Keywords: Soil Health; Soil Conditioning Index (SCI), Soil Restoration.

Introduction

The quantity of carbon in soil is twice as much as in the atmosphere and two to three times greater than in any other place on Earth's surface (2157-2293 Pg) than the total number of living things. Because soils store such a vast amount of carbon, even slight changes in their carbon status may have a big impact on the global carbon cycle and, consequently, on climate change . In a heterogeneous solid medium where chemical and physical conditions change at the size of the molecule and the cell, soils contain a complex network of plants and bacteria. Because of this, it is challenging to comprehend the differences in soils without knowledge acquired from both chemical and biological techniques.

When microorganisms are browsed by microbivores like protozoa and nematodes, nutrients immobilized in microbial biomass are subsequently liberated. Within the soil science community, the ideas of soil quality, soil health, and soil quality/health assessment are fiercely contested since numerous feel that such phrases have oversimplified and generalised the body of knowledge. They propose that rather than concentrating on soil quality or soil health, research and education should concentrate on creating effective soil management practises. Although soil scientists have long recognised the numerous distinctive and significant qualities and processes offered by fragile soil resources, supporters of soil quality claim that outside the agricultural sector, soils continue to be a resource that is widely underappreciated. (Karlen et al., 2003). The evaluations are seen as instruments designed to notify users about soil resource issues that have occurred or may arise, similar to how a "consumer price index" would do. We argue that both parties genuinely desire the same results: a greater understanding of the value of soil resources among the general public and better soil conservation knowledge of the effects of short-term economic actions on long-term processes and attributes. "Soil: The Final Frontier" in order to emphasise the significance of this resource and to emphasise our limited understanding of soil characteristics, processes, and functions.

Quality of the Soil

One of the earliest techniques for evaluating soil quality in the 1990s was the creation and application of soil quality scorecards, and others were some other methods to give a "hands-on" comprehension of how soil physical, chemical, and biological qualities and processes vary through time and from location to site. The kits are used to assess soil nitrate, bulk density, water infiltration, soil pH, electrical conductivity, water-filled pore space, soil water content, and soil respiration at field capacity. Once more, the use of soil pits and visual inspection was not a novel method of assessing soil, but when used in conjunction with a soil test kit that numerous conservationists, soil and crop consultants, and. In contrast to "inherent soil quality," which is determined by fundamental soil forming factors and is generally unresponsive to recent management.

Biomass Carbon: Gives an indication of the level of biological activity in a soil. It displays the nutrient cycle procedures necessary for supplying crops with nutrient growth. Additionally, management practises including crop type (annual vs. perennial) and crop residue management techniques have an impact.

Ion-exchange capacity: Ability to exchange ions. The soil's ion-exchange capacity reveals how well it can give essential plant nutrients, namely calcium, magnesium, and potassium. In particular, the amount of soil colloids, organic matter, and clay, which are negatively charged and allow the soil to retain cations, is directly connected to the cation exchange capacity (CEC). The CEC is impacted by pH and salt concentration changes. Examples of limiting variables for soil productivity and health include aluminium toxicity, which can develop in some soils at pH levels below 5, and soil dispersion, which can result in major structural losses.

Conclusions

Strong public and private funding for soil quality/health research and technologies must be maintained by offering high-quality, scientifically sound evaluations emotional or activist viewpoints that are unsupported by scientific studies on physical, chemical, and biological processes and properties ought to be avoided. Globally, Assessment of soil health and quality is here to stay. To inform choices on sustainable land use and soil management, new and improved technologies will be required twenty-first century. Traditional instruments, such as the and SCI, were and are still extremely helpful, but they are unable to evaluate all facets of soil quality. To thoroughly assess the effects of actions, such as when and where to collect crop residues for biofuels or when and where to apply animal manures, it is necessary to have tools sensitive to soil biological, chemical, and physical markers.

References

1. Allan, D.L. and R. Killorn. 1996. Assessing soil nitrogen, phosphorus, and potassium for crop nutrition and environmental risk. Pp. 187-201. *In*: J.W. Doran and A.J.
2. Jones. (eds.). Methods for assessing soil quality. SSSA Special Publication No. 49. Soil Science Society of America, Inc., Madison, WI
3. Andrews, S.S., and C.R. Carroll. 2001. Designing a decision tool for sustainable agroecosystem management: Soil quality assessment of a poultry litter management case study. Ecol. Applic. 11:1573-1585.
4. Andrews, S.S., D.L. Karlen, and J.P. Mitchell. 2002a. A comparison of soil quality indexing methods for vegetable production systems in northern California. Agric. Ecosyst. Environ. 90:25-45.
5. Andrews, S.S., J.P. Mitchell, R. Mancinelli, D.L. Karlen, T.K. Hartz, W.R. Horwath, G.S. Pettygrove, K.M. Scow, and D.S. Munk. 2002b. On-farm assessment of soil quality in California's Central Valley. Agron. J. 94:12-23.
6. Andrews, S.S., D.L. Karlen, and C.A. Cambardella. 2004. The soil management assessment framework: A quantitative evaluation using case studies. Soil Sci. Soc. Am. J. 68:1945-1962.
7. Arshad, M.A., B. Lowery, and B. Grossman. 1996. Physical tests for monitoring soil quality. Pp. 123-141. *In*: J.W. Doran and A.J. Jones. (eds.). Methods for assessing soil quality. SSSA Special Publication No. 49. Soil Science Society of America, Inc., Madison, WI Baumhardt, R.L. 2003.
8. Dust Bowl Era. Pp. 187-191. *In:* B.A.Stewart and T.A. Howell (eds.) Encyclopedia of Water Science, Marcel-Dekker, NY.
9. Doran, J.W., D.C. Coleman, D.F. Bezdicek, and B.A. Stewart(eds.). 1994. Defining soil quality for a sustainable environment. SSSA Special Publication No. 35. Soil Science, Society of America, Inc. and the American Society of Agronomy, Inc., Madison,
10. WI Doran, J.W. and T.B. Parkin. 1994. Defining and assessing soil quality. Pp. 3-21. *In*: J.W. Doran, D.C. Coleman, D.F. Bezdicek, and B.A. Stewart (eds.) Defining soil quality for a sustainable environment. SSSA Special Publication No. 35.
11. Soil Science Society of America, Inc. and the American Society of Agronomy, Inc., Madison, WI. Doran, J.W. and A.J. Jones (eds.). 1996. Methods for assessing soil quality. SSSA Special Publication No. 49. Soil Science Society of America, Inc. Madison, WI.
12. Doran, J.W., M. Sarrantonio, M.A. Liebig. 1996. Soil health and sustainability. pp. 1-54. In: Sparks, D.L. (ed.) Advances in Agronomy. Vol. 56. Academic Press, San Diego, CA.
13. Harris, R. F., D. L. Karlen, and D. J. Mulla. 1996. A conceptualframework forassessment and management of soil quality and health. p. 61-82. In: J.W. Doran and A. J. jones (eds.) Methodsfor Assessing Soil Quality, SSSA Spec. Pub. No. 49, Soil
14. Science Society of America, Inc., Madison, WI. Hillel, D. 1991. Out of the Earth: Civilization and the life of thesoil. Univ. of California Press, Los Angeles.
15. Hubbs, M. D., M. L. Norfleet, and D. T. Lightle. 2002. Interpreting the soil conditioning index. pp. 192-196. In E. V. Santen (ed.) Making conservation tillage conventional: Building a future on 25 years of research. Proc. 25th Annual Southern

ConservationTillage Conf. for Sustainable Agriculture. Spec. Rept No. 1.Alabama Agricultural Experiment Station and Auburn University.

16. Karlen, D.L., N.C. Wollenhaupt, D. C. Erbach, E. C. Berry, J. B. Swan, N.S. Eash, and J. L. Jordahl. 1994a. Crop residue effects on soil quality following 10 years of no-till corn. SoilTillage Res. 31:149-167.
17. Karlen, D.L., N.C. Wollenhaupt, D.C. Erbach, E.C. Berry,J.B.Swan, N.S. Eash, and J.L. Jordahl. 1994b. Long-term tillage effects on soil quality. Soil Tillage Res. 32:313-327.
18. Karlen, D.L., M.J. Mausbach, J.W. Doran, R.G. Cline, R.F. Harris, and G.E. Schuman. 1997. Soil quality: A concept, definition,and framework for evaluation. Soil Sci. Soc. Am. J. 61:4-10.
19. Karlen, D.L., S.S. Andrews, and J.W. Doran. 2001. Soil quality: Current concepts and applications. Adv. Agron. 74:1-40.