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AgriGate

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An International Multidisciplinary Monthly e-Magazine

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From the Desk of Editor-in-chief

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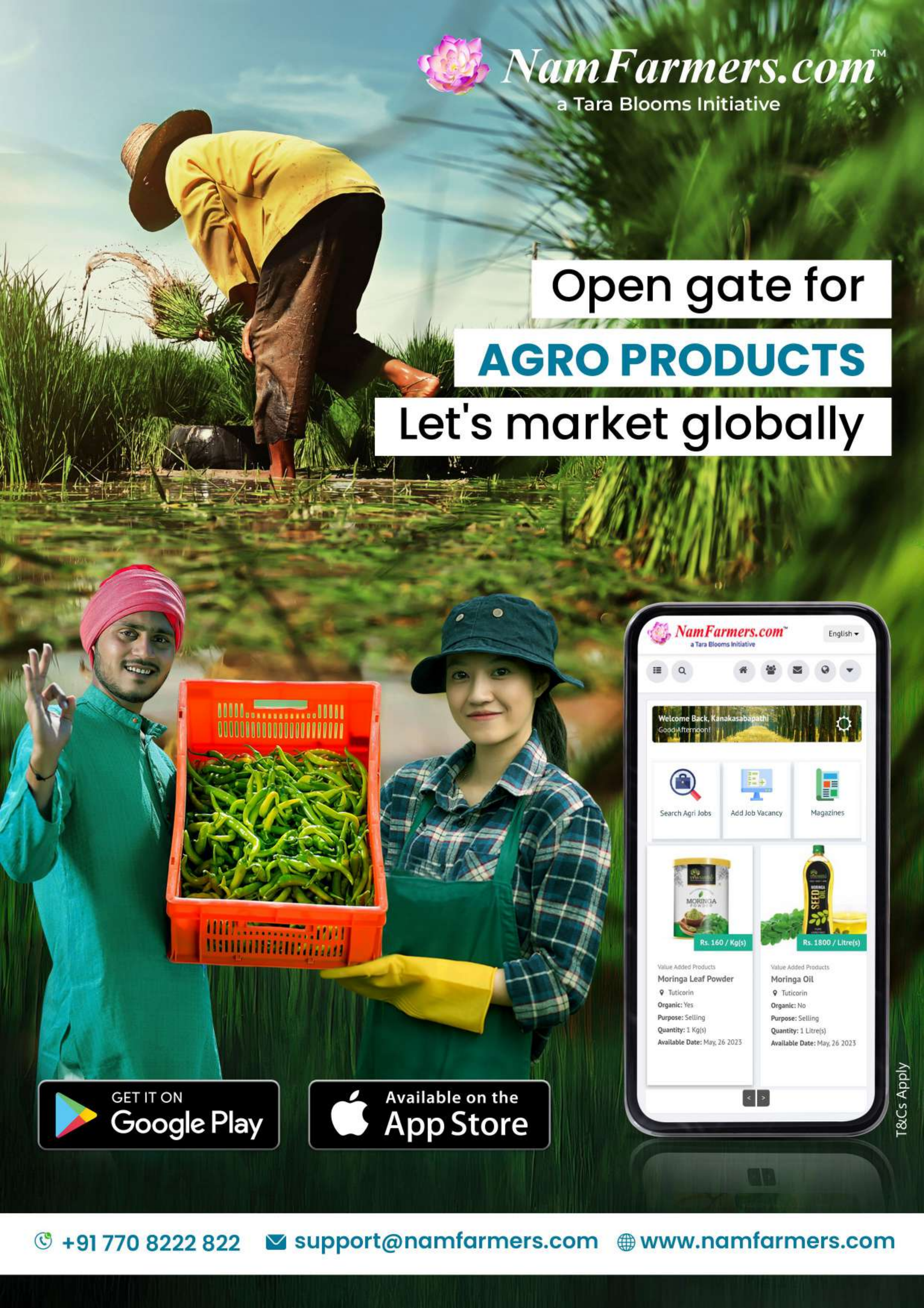
I would like to introduce the launch of **"AgriGate - An International Multidisciplinary Monthly e-Magazine Volume 03 Issue No. 07 – July 2023"** with immense pleasure. Our team is privileged to dedicate this issue to **World Youth Skills Day** (On 15th July) is celebrated every year to raise awareness about the importance of technical, vocational education & training and the development of other skills relevant to both local and global economies.

The main objective of the magazine is to provide a publishing platform to young researchers and scientists as well as an information hub for the enthusiast, progressive farmer and also common readers. We envisage providing an online platform that appreciates illuminating articles on various topics related to agriculture and allied sciences monthly that will appraise and update the students, farming community and the whole society at large on the updates in agriculture.

Last but not the least, I wholeheartedly thank the editorial team, authors as well as anonymous reviewers for contributing to the release of this issue.

Our team welcomes your constructive feedback and suggestions to improve delivering fruitful content to hungry minds.

Dr R Shiv Ramakrishnan
Editor-in-chief
AgriGate Magazine



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Volume: 03 Issue No: 07

ROLE OF RETORT PROCESSING TECHNOLOGIES IN FOOD PROCESSING INDUSTRIES

Article ID: AG-VO3-I07-01

Dr. K. Jothilakshmi*[1] and S. Ishwarya Lakshmi[2]

[*1]Asst.Professor (FSN), [2]Under graduate Student.

Community Science College and Research Institute, TNAU, Madurai, Tamil nadu

*Corresponding Authors Email ID: jothilakshmi.k@tnau.ac.in

ABSTRACT

Retort technology is one of the emerging methods of packaging where the food is sterilized after it is sealed. This process uses high heat and pressure to sterilize the food and increase its shelf life. The packages are usually flexible retort pouches which possess the properties of high mechanical strength, thermal stability, resistance to pressure, and excellent barrier properties. This process is used for fresh, semi-cooked and cooked foods. This process arrests any microbial growth present in the food, and also deactivates the enzyme action which increases its shelf-stability. It is also seen that this process retains the maximum nutritional value, taste, aroma and flavour at the time of consumption. This technology saves the processing time and there is no refrigeration needed, whereas the pouches are more prone to damage.

Key Words: Retort Process, Traditional Foods, Emerging Packaging Technology.

INTRODUCTION

Shelf life of a food product is inter-related to its packaging and the processing it undergoes. The innovation in food packaging technology has increased due to the increase in consumer demands. Retort technology is a unique combination of package, process and food product with potential economic benefits. The technology includes a series of steps like, packing the food into the pouches, hermetically sealing it, and then treating them under extremely high temperature and pressure. This is especially suitable for low acid foods like meat, fish, vegetables and rice.

PRINCIPAL

The retort uses steam as the processing medium to heat the packages. The packed food is heated up to 110 to 130˚C for several minutes under high pressure. This heat destroys all the microorganisms and inhibits the enzyme action of the food, thus prevents the food from spoilage. The compressed air is introduced into the processing cycle to provide the over pressure. This overpressure is necessary to prevent the package from damage during the process.

POUCHES

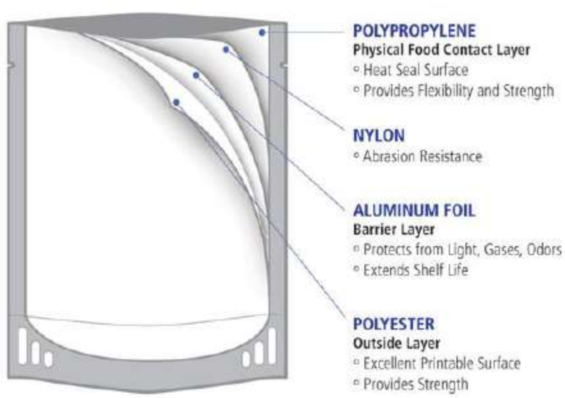
The ready-to-use retort pouches are specially designed which are flexible made from multi-layer plastic films. They are made up of heat resistant plastics, thus suitable for processing at a high temperature and is been evaluated for mechanical strength, oxygen barrier properties and compatibility with the food products, which helps to increase the shelf life up to 12 months under ambient conditions. The pouches are made up of four basic layers which are as follows:

- First Layer (Inner)

  It is made up of food-grade polypropylene which is in contact with the food.This acts as the heat sealing surface and provides both flexibility and strength.

- Second Layer

  This layer is made up of nylon which possesses the property of puncture resistance.



- Third Layer

  This layer is also called as barrier layer which is made up of aluminium foil. This possesses an excellent gas and water vapour barrier property and also protects the food from external light and odours. This also helps to increase the product shelf life.

- Fourth Layer

  This is the outer layer made up of polyester. This layer provides a rigid and gloss layer which is suitable for printing. It also withstands high temperature and is resistant transportation damage.

PROCESSING STEPS

The retort technology has a series of steps which is to be followed. They are:

i. **Filling**

The food product (raw/semi-cooked/cooked) is first filled into the retort pouches leaving a head space. The food is carefully filled into the pouches to avoid and contamination.

ii. **De-aeration**

Air inside the pouches is removed before sealing in order to create a vacuum, which allows uniform heat transfer during processing. The residual air after processing should be less than 2%. The vacuum ensures the product stability and prevents the pouch from bursting during retorting.

iii. **Sealing**

After removing the air the pouches are vacuum sealed under sterile conditions.

iv. **Traying**

Each filled and sealed trays are loaded into the specially designed retort trays. Each pouch accommodate in a separate slot, which ensure uniform exposure to heating medium and prevent pouch movement during retorting.

v. **Retorting**

This is also known as heat sterilization (or) overpressure autoclave. The processing temperature varies from 110-130˚C. The pressure of the retort operation would range up to 14 psi. The retort process is generally done with the combination of 75% of steam and 25% of air.

The complete steps of retort operation are as follows:

1. The trays are loaded into the retort and the door is closed securing all the bolts.
2. Now the stem is allowed into the retort with appropriate set points in the controller.
3. First, the drain valve is kept open to let out the water formed from condensing steam.
4. During the come-up time (time required to reach the process time) the vent and all the bleeders are kept open.
5. When the temperature is reached and the processing starts, the vent is closed but the bleeders are kept open to retain the steam circulation.
6. During the process it should be seen that the retort temperature does not fluctuate more than 0.5˚C.
7. By the end of the process, the steam valve is closed and water is let in for cooling.
8. At this step, excess air is let into the retort to maintain the retort pressure. Without this step, the retort pressure would collapse suddenly due to the condensation of steam upon the contact with the cooling water introduced into the retort. This cooling operation along with air pressure is called as pressure cooling. Also this over pressure is necessary to prevent the damage of pouches due to sudden fall in pressure.
9. The cooling is then stopped and the trays are unloaded from the retort.

vi. **Rinsing**

The processed pouches are rinsed in chlorine water (10 ppm) in order to remove the impurities attached and also prevent microbial contamination.

APPLICATIONS OF RETORT PROCESS

Retort process is applied to various food products and is also preferred by consumers as they do not need further processing. They product is directly heated and it is ready-to eat.

Various vegetarian and non-vegetarian are retort processed and are available in the market for consumption.The ready-to-eat products which are in the market are as follows:

- Butter Chicken

- Dal Makhani

- Paneer Makhani

- Briyani

- Pav Bhaji

- Upma

QUALITY OF RETORT FOOD

- Since there is no direct contact with the heat (or) pressure the nutritive value of the product is retained.
- There is no addition of chemical or preservatives for the purpose of increasing the shelf life.
- There is no change in appearance, taste, flavour of the food product.

ADVANTAGES

- The thin profile of the pouch provides rapid heat transfer for both preparation and for sterilization during processing.This process requires less energy for sterilization.

- Reduced heat exposure results in improvements in taste, colour, and flavour; thus there are also fewer nutrient losses.
- Storage space required for retort pouch is less.
- Refrigeration or freezing is not required and the pouches are easy to open.
- Pouches and containers do not corrode externally.

DISADVANTAGES

- Unlike cans they can easily be affected by rodents and hence require individual overlap.
- The rate of production is slow compared to those of cans.
- Detection of any leakage is not so easy.
- It possesses a higher investment cost.

CONCLUSION

Retort Technology provides the advantage of processing the food and packaging together which makes the filled product more commercial stable. This technique can used for commercialization of traditional or ethnic dishes which are important due to their delicacy and are high in demand. A consumer would prefer traditional food on a daily basis, provided a safe, tasty and processed option is available. This modern urban dynamic lifestyle leads to the genesis of discovery of ready-to-eat foods which can be achieved with retort processing.

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Volume: 03 Issue No: 07

ENHANCING CLARITY AND QUALITY: THE APPLICATION OF ENZYMES IN FRUIT JUICE CLARIFICATION

Article ID: AG-VO3-I07-02

Shubham Gangwar*

Research Scholar (Post Harvest Technology), Banda University of Agriculture and Technology, Banda, Uttar Pradesh 210001, India

*Corresponding Author Email ID: horticulturalshubham@gmail.com

Abstract

The clarity and quality of fruit juices are critical factors that determine consumer preference and marketability. To achieve superior clarity and improve the overall quality of fruit juices, the application of enzymes has emerged as a promising technique in the field of juice clarification. This paper presents an overview of the various enzymes employed in fruit juice clarification and their effects on the final product.Enzymes, such as pectinases, cellulases, and proteases, play key roles in the degradation and modification of macromolecules present in fruit juices. Pectinases target pectin, a complex polysaccharide responsible for juice turbidity, by breaking down its structure and reducing viscosity. This enzymatic action aids in the removal of suspended solids and enhances juice clarity. Cellulases act on cellulose, another polysaccharide found in fruit cell walls, facilitating the release of entrapped juice, thereby increasing juice yield. Proteases, on the other hand, target proteins, minimizing haze formation and improving juice stability. The application of enzymes in fruit juice clarification offers several advantages. It is a natural and environmentally friendly approach compared to traditional methods, which often involve harsh chemicals. Enzymes are highly specific in their actions, allowing for precise control over the desired changes in juice quality. Furthermore, enzymatic treatment is often time-efficient, reducing the overall juice processing time.

Introduction:

The production of fruit juices involves a series of processes to extract the natural goodness of fruits and deliver a refreshing, nutrient-packed beverage. One essential step in fruit juice production is clarification, which involves the removal of undesirable particles, cloudiness, and sediment to achieve a clear and visually appealing product. While traditional clarification methods such as filtration and centrifugation have been widely used, the application of enzymes has emerged as an effective and eco-friendly alternative. In this article, we explore the various ways enzymes are utilized in fruit juice clarification, enhancing clarity and quality.

Types of enzymes:

Out of 4000 known enzymes, about 200 are used commercially. Only Europe continent contributes around 60% of the world's enzymes. They are used to extract, clarify and modify juices from many fruits, including berries, stone and citrus fruits, grapes, apples, pears and even vegetables. So many enzymes are used to clarify fruit juices, including pectinases, amylases, cellulases, arabanase, fructozyme, dextranase, protease, amyloglucosidase, etc. The available commercial pectinase preparations used in fruit processing generally contain amylases, cellulases and a mixture of pectinesterase, polygalacturonase, and pectinlyase.

Enzymatic Clarification Process:

Enzymes are natural catalysts produced by living organisms, which speed up chemical reactions. In fruit juice clarification, enzymes are used to break down the complex components responsible for cloudiness, such as pectin and proteins. Pectin is a natural polysaccharide found in fruits that contributes to the viscosity and turbidity of the juice. Proteins, on the other hand, can cause haze and sedimentation. By employing specific enzymes, fruit juice producers can effectively target and degrade these substances, leading to improved clarity.

Pectinolytic Enzymes:

Pectinolytic enzymes, including pectinases and pectin methyl esterase's (PME), play a crucial role in fruit juice clarification. Pectinases break down the pectin, which is responsible for the formation of gel-like structures and cloudiness in the juice. These enzymes degrade the pectin molecules, reducing the viscosity and facilitating the separation of solids from the liquid phase. PME enzymes, in turn, hydrolyze the methyl ester groups present in pectin, making it more susceptible to the action of pectinases and further improving the juice's clarity.

Proteolytic Enzymes:

Proteins present in fruit juices can cause haze and sedimentation, impacting their visual appeal and quality. Proteolytic enzymes, such as bromelain and papain, are employed to degrade these proteins into smaller peptides and amino acids, preventing their aggregation and ensuring a clear and stable juice. The use of proteolytic enzymes not only enhances clarity but also improves the overall sensory characteristics of the juice by reducing bitterness and astringency associated with certain proteins.

Benefits of Enzymatic Clarification:

The application of enzymes in fruit juice clarification offers several advantages over traditional methods:

❖ Improved Clarity: Enzymes effectively break down complex components responsible for cloudiness, resulting in a visually appealing, clear juice. This enhances the product's marketability and consumer acceptance.

❖ Enhanced Nutritional Profile: Enzymatic clarification selectively targets unwanted components while preserving the natural nutritional content of the juice, including vitamins, minerals, and antioxidants. This ensures that the clarified juice retains its inherent health benefits.

❖ Reduced Processing Time: Enzymes act as efficient catalysts, accelerating the clarification process and reducing the time required for traditional clarification methods such as filtration and centrifugation. This increases production efficiency and reduces energy consumption.

- Eco-Friendly Solution: Enzymatic clarification reduces the dependency on chemical additives traditionally used for juice clarification. Enzymes are biodegradable, environmentally friendly, and do not leave harmful residues in the final product or wastewater.

Conclusion:

Enzymatic clarification has revolutionized the fruit juice industry by offering an efficient, eco-friendly, and high-quality alternative to traditional methods. Through the targeted action of pectinolytic and proteolytic enzymes, fruit juice producers can achieve optimal clarity, stability, and sensory attributes while retaining the nutritional value of the juice. The application of enzymes in fruit juice clarification not only benefits the producers but also meets consumer.

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ORGANIC VEGETABLE PRODUCTION (TOMATO)

Article ID: AG-VO3-I07-03

P Lakshmanakumar[1] and V Vasudevan[2]

[1]Associate Professor (Agronomy), Adhiyamaan College of Agriculture and Research, Athimugam, Krishnagiri, Tamil Nadu – 635 105

[2]Associate Professor (Horticulture), Adhiyamaan College of Agriculture and Research, Athimugam, Krishnagiri, Tamil Nadu – 635 105

*Corresponding Authors Email ID: laksh006@gmail.com

INTRODUCTION

Tomato *(Lycopersiconesculentum)* ranks third in priority after potato and onion in India but rank second after potato in the world. India ranks third in the area but fourth in the production. Tomato consumption in India is increasing gradually. Organic tomatoes are always in high demand in both local and whole sale market.

SOIL PREPARATION FOR GROWING TOMATOES ORGANICALLY

Tomatoes are not too finicky about soil type, while they will appreciate deep soil with plenty of room for their roots .Tomato plants grow best in neutral (pH) loam or sandy loam and don't love clay soil .If clay soil is there amend it with sand ,coco coir or peat moss to develop drainage and texture .If tomatoes are grown in a new bed use good quality potting soil mixed with aged compost .Soil is rich in compost and organic matter has a good balance of moisture retention and drainage alike perfect for tomatoes.

Good soil is the foundation for organic tomato production. Building soil with a combination of cover crops, greenmanures, compost and rock minerals, will give you with the high yielding tomatoes. Tomatoes prefer slightly acidic soils with a pH level of 6.0 to 6.8. Growing organic tomatoes on sandy soils which warm earlier in the spring, encourages early fruit production.

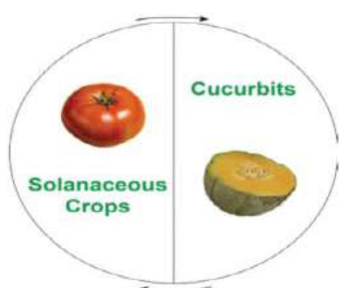
ORGANIC PRODUCTION OF TOMATOES

Organic agriculture consists of a system of farm design and management to make an ecosystem, which can achieve sustainable productivity without the use of artificial external inputs such as chemical fertilizers and pesticides. The main aims of organic agriculture are the production of quality agricultural products that contains no chemical residues, the development of environmentally friendly production methods, and the application of production methods that restore and maintain soil fertility. these are achieved by suitable plant selection and rotation, recycling of plant and animal residues, propertillage, and water management. Organic farm products are more expensive than inorganic crops. Crop yields drop sharply during the phase of conversion as it takes some time for the soil and plant to reach equilibrium. Though yield rise again, once management system getsestablished. As the present level of farming is less intensive with lower levels of application of chemical fertilizers and also pesticides transition to organic farming in the state will be comparatively easier.

Organic tomato production

CROP ROTATION

Crop rotation is the major component of organic farming, affecting soil conditions and pest cycles. Rotation with non-solanaceous crops like pulses or legumes is suggested to avoid pests and disease affecting tomato and also to enrich the nitrogen status of the soil.



Crop rotation with non-solanaceous crop

LAND PREPARATION

The land may be ploughed and harrowed 3 or 4 times to obtain a fine tilth. About 10 tonnes of farm yard manure (FYM) or vermicompost @1-1.5 t per acre is applied at the last ploughing. Green manuring is recommended for areas with assured rainfall and also for irrigated crops. Beds are prepared against the slope and after levelling the bed, field channels of 50 cm breadth are prepared at interval of 1m.

SOIL FERTILITY

Keep fertile soil by regularly adding organic matter to it. Rotate tomatoes with legumes once every year. So, the soil remains rich in nitrogen. By adding compost, farm yard manure and poultry litter will enrich the soil.

Tomato cultivation

PLANTING MATERIAL

Tomato is propagated by seeds and seed selection is an important aspect in organic tomato production. For raising nurseries, seeds of high yielding varieties with tolerance to pest and diseases can be used. They must be carefully selected from certified organic farms or from their seed plot which is raised organically. To start with, chemically untreated seeds from local high yielding tomato varieties could also be used, in the absence of organically produced seeds.

Tomato plants with No proper Staking and twinings- Low yield of 18-20 t/acre with poor quality fruits.

VARIETIES OF TOMATOES FOR GROWING ORGANICALLY

For organic farming of tomato, open pollinated varieties (OPV) are preferred. The local varieties are Swarna Lalima and Swarna Naveen are generally suitable for organic cultivation of tomato. Lakshmi NP 5005 popular in the state as it is resistant to bacterial wilt and leaf mosaic virus.

SEED RATE AND SEED TREATMENT

- For raising the seedlings in nursery bed 300 to 400 g/ha seeds are required. Hybridseeds are very costly so it should be sown in tray ,which require 70-90 g
- To avoid damping off treat the seed with *Trichoderma* by 5-10 g/kg seed.the treated seeds are dried in shade for 30 minutes and sown sparsely along the lines in ½ cm depth and then covered by the top soil

PLANT SPACING

The spacing recommended for the autumn –winter crop is about 75 *60 cm and for the spring –summer crop 75 * 45 cm.

IRRIGATION MANAGEMENT

Water requirements for tomato plants will vary with climate, soil type, and plant size. On average, tomatoes will use 1 to 1.2 inches of water weekly. Irrigation systems used in Tomato production contain surface and furrow flooding, overhead sprinklers, and drip or trickle. Flood irrigation requires the least equipment but is the least water –use efficient. Flooding is used for large scale plantings. Sprinkler irrigation is sometimes used, but wetting the fruits and leaves and splashing of water from the soil to foliage will increase the risk of disease. Drip irrigation system efficiently supplies needed moisture directly and at a more consistent rate to the crop plants compared to overhead irrigation systems but materials costs and labor are higher.

Tomatoes need careful irrigation that is just sufficient water at the right time. It is necessary to keep an even moisture supply. During summer, irrigation at every 5 to 7 days interval is necessary, whereas in winter 10 to 15 days interval is sufficient. A period of drought followed by sudden heavy watering during the period may cause cracking of tomato fruits.

CULTURAL PRACTICES

Effective, non-chemical weed management begins with well planned, diverse crop rotations, especially those including competitive cover **(smother) crop.** Attention is to be given to careful site selection to avoid introduction of weed seeds and other propagules. Weeds are a big nuisance as they take up the nutrients in the soil and can also harbor insects and diseases that cause harm to tomatoes.

These weeds start growing four to five weeks after transplanting the tomato saplings. Hence focus has to be on extensive weed control during this period. Weeds should not be allowed to grown in numbers. Organic weed control can be achieved by using organic matter as mulches as these restrict weed growth. Crop rotation, mulching, sanitation and shallow tilling also help in controlling weeds. After transplantation, regular weeding is require to be done to remove harmful weeds from the field. The plants can be provided support with the help of small bamboo sticks to increase the production.

FERTILIZER

Tomatoes need organic fertilizer at certain stages of their growth depending on the plant nutrients available in the soil

Some of the organic natural tomato fertilizer is given below:

COMPOST- a compost pile will produce rich, pure organic matter loaded with necessary nutrients and beneficial microbes. Compost has all the basic nutrients, both macro nutrients and micro nutrients, that are absent in synthetic fertilizers. Compost releases the nutrients gradually, thus providing long lasting nutrition. It not only helps in fertilizing tomatoes but help the soil to retain nutrients and water, neutralize the soil, and add beneficial microorganism to the soil.

EPSOM SALT-tomatoes use lot of magnesium while growing. It helps give tomatoes with the necessary magnesium. It helps in more blooms, stronger plants, more tomato production, deeper green color, along with taster, sweeter tomatoes. Make sure to cover the Epsom salt with a thin layer of dirt and before placing the tomato seedling in the hole.

FISH EMULSION-This is another natural tomato fertilizer that gives an extra boost, both at transplanting and during the growing season. Fish emulsion is available as a concentrated water –soluble liquid fertilizer made by blending different parts of the fish including bones.

ALFALFA MEAL – Alfalfa meal is a complete NPK fertilizer and is packed with loads of micronutrient and useful hormones. Tomatoes planted in compost and dressed with an alfalfa mulch cover thrive well. Mulch tomato plants to help reduce moisture loss from evaporation.

ADVANTAGES OF USING ORGANIC TOMATO FERTILIZER:

- Improves the soil long term by helping organic matter break down contains trace nutrients, rather than just the top their major nutrients such as nitrogen, phosphorus, potassium
- Releases nutrients gradually and lasts longer in soil
- Available in both granular and liquid (fish emulsion) forms

ORGANIC PEST CONTOL IN TOMATO PLANTS

Natural enemies of the pests are grown and then protected. For the weeds, the manual weeding process is done and weeds near the base of the plants are pulled out recycled as mulch in the field. Plant based repellents, neem seed kernel extracts, mechanical traps, pheromone traps, clay and chromatic traps are permitted for use in the organic farms.

Organic insecticides like neem fertilizer are another option itgets rids of common pest and diseases of the tomato plants. Also, frequent checks of the plant are another way to save the tomato plant from some common problems. In order to prevent damage to the crop from fruit borer, marigold should be raised in the adjoining plot to divert the attention of the fruit borer. IN case of eggs of the insect are found on the leaves of the plant trichocard can be applied. Incase, the intensity of pest attack increases ,4% solution of neem seed extract can be sprayed on plant at 15 days interval to control the insect. Biopesticides include living organism which can destroy pest.

DISEASES

Despite good management practices, diseases usually occur, presenting one of the greatest challenges to organic tomato growers. The diseases occurrence is regionally based and largely dependent on environmental conditions. Tomatoes are injured by pathogenic diseases caused by fungi, bacteria as well as physiological disorder

Pathogenic diseases develop through soil borne and above ground infections and in some instances are transmitted through insect feeding. Thus, the disease control programme is important at each stage of growth. Organic tomato disease control programs are important at each stage of growth. Organic tomato disease control programs are based on a combination of organic soil management practices, IPM and natural remedies. In order to prevent bacteria borne diseases, the resistant varieties can be adopted and as a preventive measure regular crop rotation may be adopted with non-solanaceous crop. Accordingly, potato, chilli, brinjal should not be cultivated successively along with tomato.

HARVESTING:

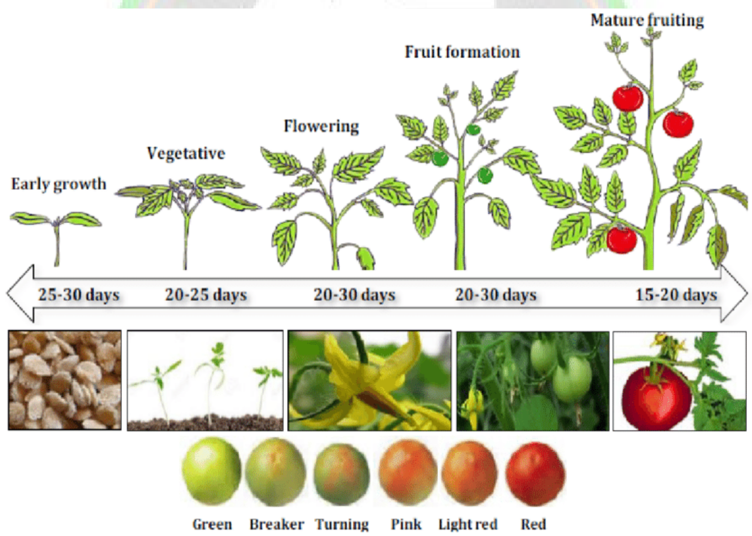
The first harvesting of tomato plants usually starts in 75 to 90 days from planting. While considering the market distance and transport mode, tomato fruits must be harvest as follows;

Green stage - for long distance market harvest the tomato at the maturity stage with green colour.

Pink stage- the tomato should be harvested by changing the color of the green color to the pinkish appeared. It is better to send such fruits to nearby markets.

Maturity stage -To sell the tomato in the local market, harvest after the fruit is reddish on the tree.

Full maturity- in this stage, the fruit is slightly red and fully reddish on the tree. Such fruits are useful to make durable materials such as ketchup, sauce, soup,etc.



YIELD

The average tomato crop yield per acre in India is about 10 tonnes although the yield varies from 15 to 20 tonnes per acre in case of irrigated crops.

CONCLUSION

Due to its high perishability in nature and disturbances in production and supply, tomato prices witness a high degree of volatility. The volatility present in recent years were 40,48,44,30 and 58 in Orissa, Andhra Pradesh, Karnataka, Maharashtra and West Bengal respectively.

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Volume: 03 Issue No: 07

EXPLORING THE POTENTIAL OF NEXT GENERATION SEQUENCING IN DETECTION OF UNAUTHORIZED GENETICALLY MODIFIED EVENTS IN INDIA

Article ID: AG-VO3-I07-04

Monika Singh*, Raghavendra Aminedi and Amit Kumar Singh

[1]Division of Genomic Resources, ICAR-National Bureau of Plant Genetic Resources,

New Delhi 110 012, India

*Corresponding Author Email ID: monikasinghnbpgr@gmail.com, monika.singh@icar.gov.in

Abstract

The unauthorized presence of genetically modified organisms (GMOs) in the supply chain needs to be monitored in the country with respect to their regulatory status. Widely employed GM detection methods such as Polymerase Chain Reaction (PCR) and real-time PCR have the application in case of the prior sequence availability of known unauthorized GM (UGM) events. To overcome this limitation, next generation sequencing (NGS) enables analysis for the detection of UGM in complex mixtures and food products, where the sequence information is partially known or unknown. In this article, potential of NGS in UGM detection where sequence information is either partially known or completely unknown, is being discussed in the Indian context. By integrating with real-time PCR, and bioinformatics tools and GMO databases, NGS could enhance the detection and monitoring of unauthorized GM events.

Keywords: NGS, sequencing, unauthorized GM detection

Introduction

As the approval status of a genetically modified (GM) event varies from country to country so a particular GM event is considered as unauthorized GM (UGM) event when it is not approved in a country though it may be deregulated in other countries. Based on the availability of sequence information of the inserted gene construct, the UGM may be categorized as: (i) GM events that are fully characterized (knowledge level 1) (ii) those transformed with the same genetic constructs as used in fully characterized GM events (knowledge level 2) (iii) GM events transformed with new combinations of genetic elements that include one or more elements as present in knowledge level 1, (iv) those transformed with only novel genetic elements or unknown genetic constructs (knowledge level 4)[1].

In India, looking into the current status of regulation of GM crops, only *Bt* cotton with four GM events (MON531 or Bollgard® I, MON15985 or Bollgard® II, Event1 and GFM) have been approved. Rest of other GM events of cotton such as Roundup Ready cotton and other crops are considered as UGM in the country. Most of the GM testing laboratories in the country are using GMO screening approaches targeting common promoters (such as *P-35S*, *P-FMV*) and terminators (such as *T-nos*), which can screen efficiently for known GM events or can give a fair idea of GM status. However, the detection of UGM events with partially known or unknown sequence information is challenging. Key challenges for UGM detection in the Indian context were identified as non-availability of insert/ sequence information to design markers for UGM detection, very low level or adventitious presence of UGM, and non-availability of reference material/ positive controls[1]. As a solution to challenges in UGM detection, appropriate strategies were designed for UGM detection in the Indian context.UGM belonging to categories knowledge levels 1-3 could be easily detected/ quantified using Real-time PCR targeting the known genetic elements. However, the detection and identification of UGM with partially known or unknown sequence information has posed a challenge in the area of GM detection.

Different methods for UGM detection in these cases have been thoroughly discussed in the review on GM detection by Fraiture and coworkers[2]. Sequencing approaches that can be used to detect UGM in the Indian context are summarized in **Figures 1 & 2**.

1. ***UGM detection if the sequence information is partially known*:** DNA walking allows identification of unknown sequences present adjacent to already known regions using the primers specific to the known sequence combined with the primers for DNA walking method (**Fig. 1a**). Final PCR products are then sequenced by Sanger sequencing, followed by the comparative analysis with the sequences available in the databases such as National Center for Biotechnology Information (NCBI) (https://www.ncbi.nlm.nih.gov/). This DNA walking strategy could be utilized in case the sample is homogenous, *i.e.*, comprises of only one type of matrix.

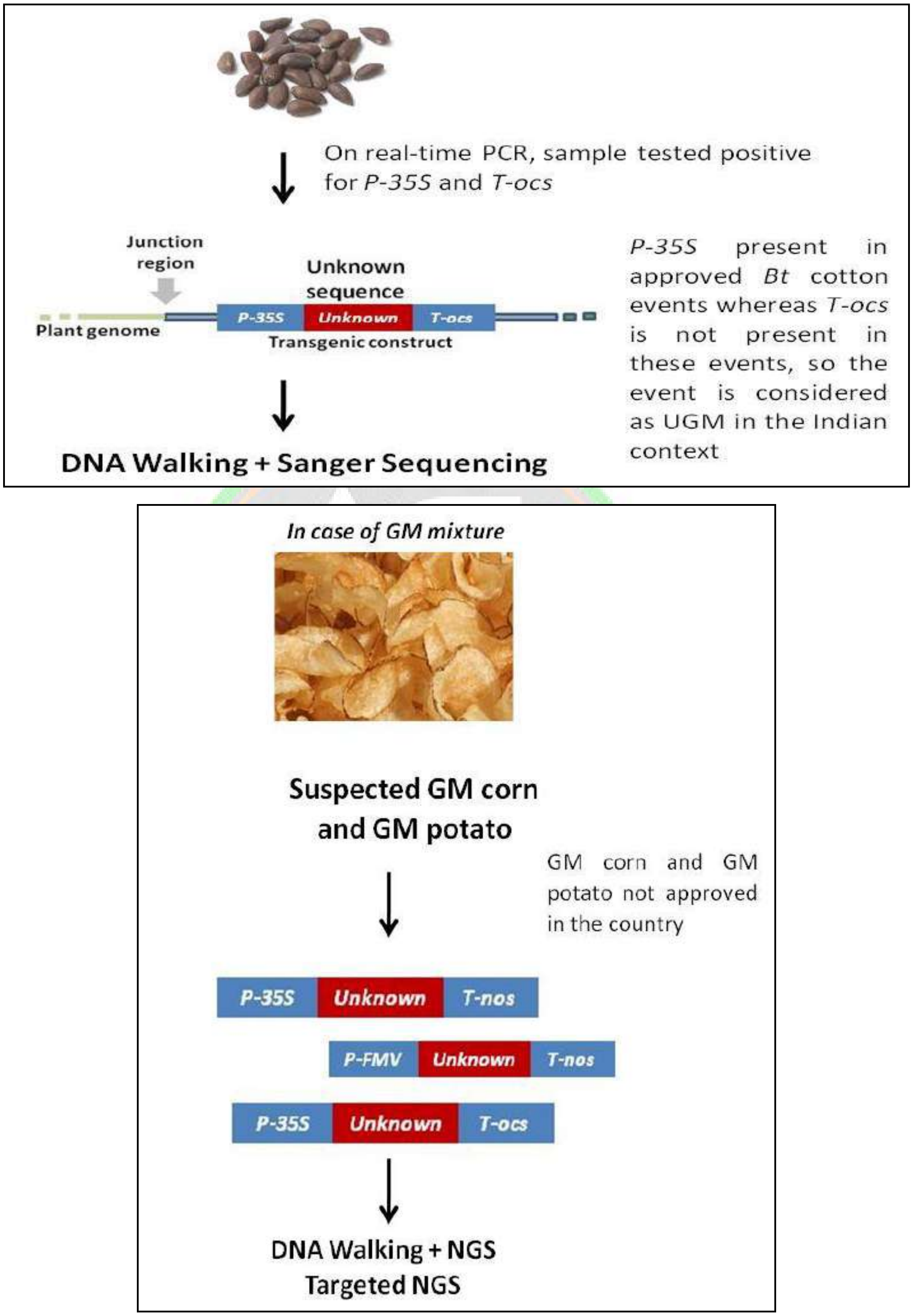

Figure 1: Theoretical approaches for detection of UGM with partially known sequences

In case of the samples comprising of mix of different matrices (as shown in Figure 1b), the targeted sequencing could be an option. In targeted sequencing, the specific regions of the genome can be selectively sequenced. NGS can be utilized in UGM detection by targeting the regions of known transgenic elements, such as promoters, marker genes, or other transgenic elements, to clearly identify the unauthorized GM events present in a sample, such as food sample comprising of ingredients from different crop matrices.

2. ***UGM detection if the sequence information is partially known*****:** In the case where sequence information is not known, the possibility of NGS for UGM detection could be explored (**Fig. 2**). NGS allows a massive sequencing of multiple samples in parallel, thereby generating millions of sequencing reads. Among NGS approaches, long-read sequencing technologies such as Single Molecule Real Time sequencing by PacBio and Nanopore sequencing by Oxford Nanopore Sequencing Technologies (ONT) can be very useful in detecting the UGM where the sequence information is not known.

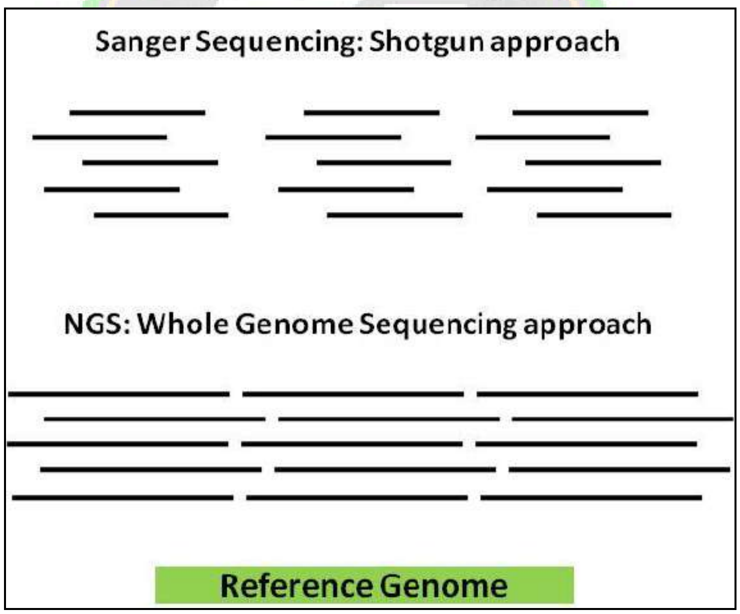

Figure 2: Theoretical approaches for detection of UGM with unknown sequence information

3. (Adapted from Fraiture and coworkers[2])

The sample to be tested for an unknown UGM comprising of a single type of genetically modified organism, such as, a consignment of wheat seeds, a whole-genome sequencing approach can be applied. UGM detection is more difficult in the case where test sample may be suspected to contain several GMOs/ GM ingredients as in the food products. A targeted NGS approach can be applied here, if the minimum prior information of genetic construct is available. In case no prior information is available, metagenomics can be applied. However, the use of such an approach is still challenging, especially with samples composed of several unknown GM events.

Conclusion:

The exploration of sequencing technologies, particularly NGS, holds significant potential in UGM detection in the country. NGS enables high-throughput sequencing, targeted sequencing, whole genome sequencing, and metagenomic analysis, overcoming the existing limitations of conventional GM detection methods in identification of UGM events with partially known or unknown information. By integrating with the PCR and bioinformatics tools, the accuracy and comprehensiveness of detection using NGS could be further enhanced. Nanopore sequencing could also facilitate UGM detection, particularly from the regulatory point of view, being providing rapid sequence analysis in a cost-effective manner.

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Disclaimer: *The views expressed in this article are those of the authors and do not necessarily of the organization they are affiliated to.*

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CHIRONJI: AN UNDEREXPLORED TREE CROP FOR THE FUTURE

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***Azadchandra S. Damor[1], Hiteksha I. Damor[2]**

[1]Assistant Professor, Department of Genetics & Plant Breeding, College of Agriculture, AAU, Jabugam, Gujarat-391155

[2]SRF, Department of Seed Science & Technology, B. A. College of Agriculture, AAU, Anand, Gujarat - 388110

*Corresponding Author Email ID: azad.damor@gmail.com

Introduction*:*

Buchanania lanzan Spreng. commonly known as Chironji or Charoli, is a tree species native to India and Southeast Asia. It belongs to the Anacardiaceae family and is highly valued for its edible seeds. chironji is a medium-sized deciduous tree that can reach a height of 10-15 meters. It has a spreading crown and smooth grayish bark. The leaves are alternate, elliptical or obovate in shape and leathery in texture. The tree produces small, inconspicuous flowers that are greenish-yellow in color. The seeds of chironji are the most valued part of the tree. They are small, kidney-shaped and light brown in color. The seeds have a rich, creamy flavor and a slightly sweet, nutty taste. It holds significant economic importance due to its various valuable products and applications.

Climate and Soil Requirements:

- **Climate:** Chironji shows high adaptability to adverse soil and climatic conditions. Itgrows well in tropical and subtropical climates. It prefers temperatures between 20 to 35 degrees Celsius.
- **Soil:** Chironji thrives in well-drained soils, including sandy loam and clay loam. It prefers a pH range of 6.5 to 7.5.

Propagation:

Chironji can be propagated through seeds or vegetative methods such as grafting or budding. Seeds are commonly used for propagation. The process of vegetative propagation in chironji is considerably more complex compared to seed propagation and the success rate of vegetative propagation through various methods is significantly lower.

Planting:

- **Land Preparation:** Prepare the field by removing weeds, loosening the soil and incorporating organic matter.

Seed Sowing:

- Chironji seeds are recalcitrant and reported to lose viability within 3 months.
- Sow the seeds in prepared beds or directly in the field.
- For achieving a high plant survival rate of 93-96%, it is recommended to sow Chironji seeds in the month of June. Planting one-year-old seedlings in pits measuring 60 cm x 60 cm x 60 cm is promising.

Crop Management:

- **Irrigation:** Chironji requires regular watering, especially during the dry periods. Irrigation may be given during hot summer seasons at an interval of 15 – 20 days. Adequate moisture is crucial for seed germination and subsequent growth.
- **Weed Control:** Weed management is essential to prevent competition for resources. Manual weeding or mulching can be employed to control weeds.
- **Fertilization:** Apply organic manure and balanced fertilizers according to soil nutrient deficiencies. Nutrient requirements can be determined through soil testing.
- **Pruning:** It is not advised to prune chironji regularly due to the issue of gum exudation that occurs during pruning. Additionally, chironji is considered a moderate light-demanding plant, which means the need for pruning during cultivation is minimal. However, it is important to prune any dead, damaged, or infested leaves and branches to maintain the quality of production.

Pest and Disease Management:

- **Pests:** Chironji can be affected by pests such as fruit borers, stem borers and aphids.

Regular monitoring and appropriate insecticide application can help manage pest infestations.

- **Diseases:**Chironji may be susceptible to diseases like powdery mildew and leaf spot. Fungicide sprays and maintaining proper plant spacing for good air circulation can aid in disease control.

Harvesting:

- Chironji trees typically start bearing fruit after 4-5 years. The fruits are harvested when they turn yellowish-brown and start to split naturally. Harvesting is done by shaking the tree or collecting fallen fruits from the ground.
- After harvest, the fruits are dried and the seeds are extracted for further processing and utilization.

Post-Harvest Management:

- Dried chironji seeds can be stored in cool and dry conditions to maintain their quality.
- Chironji cultivation requires careful attention to agronomic practices, including proper irrigation, nutrient management, pest and disease control and timely harvesting. By following these practices, farmers can ensure healthy tree growth, optimal yield and good quality chironji seeds for commercial use.

Here are some key aspects of the economic importance of chironji:

Nutritional Value and Culinary Use: Chironji seeds are rich in nutrients, including proteins, healthy fats, vitamins and minerals. They have a distinct flavor and are commonly used in Indian cuisine as a culinary ingredient in desserts, sweets and savory dishes. Chironji seeds are often roasted, ground or added whole to enhance the taste and texture of recipes.

Medicinal and Ayurvedic Applications: In traditional medicine systems like Ayurveda, different parts of *Buchanania lanzan* Spreng. have been utilized for their therapeutic properties. The seeds are known for their cooling and digestive properties and are used in remedies for treating digestive disorders, skin ailments and respiratory conditions. Chironji oil, extracted from the seeds, is also used in traditional medicine for its potential health benefits.

Cosmetic and Skincare Products: Chironji oil finds application in the cosmetics and skincare industry. It is used in the formulation of various beauty products, including creams, lotions and moisturizers. Chironji oil is believed to have moisturizing, rejuvenating and anti-aging properties, making it a valuable ingredient in natural and herbal skincare products.

Oil Extraction: Chironji seeds are a rich source of oil, which is extracted through cold-pressing methods. Chironji oil has a mild, nutty flavor and is used in culinary preparations, especially in traditional sweets and confectionery. The oil is also used in traditional Ayurvedic medicine for massage and as a base oil for herbal formulations.

Agro forestry and Income Generation: Chironji is cultivated as an agroforestry tree, providing farmers with a source of income. The tree has a long lifespan and can tolerate diverse climatic conditions. Its cultivation contributes to the diversification of income for farmers, especially in regions where it is commercially grown.

Livelihood Support: The collection and processing of Chironji seeds provide employment opportunities for rural communities. In some regions, especially in India, the seeds are collected from the wild, creating livelihood opportunities for local communities involved in seed collection and processing activities.

Export and Trade: Chironji seeds and products derived from *Buchanania lanzan* Spreng. have export potential, contributing to international trade. The demand for Chironji seeds, oil and other products exists in various countries, including India, where it is used domestically, as well as in the international market.

Conclusion:

Buchanania lanzan Spreng. (Chironji) offers economic importance through its nutritional value, culinary use, medicinal applications, cosmetic industry utilization, oil extraction, agroforestry cultivation, and livelihood support and export opportunities. Its versatile uses make it a valuable tree species with significant economic potential, benefiting individuals, communities, and industries involved in its cultivation, processing and trade.

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SPEED BREEDING FOR CROP IMPROVEMENT

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Nirubana V*, Rajesh kanna M, Amarnath K and Prakash J

Adhiparasakthi Agricultural College(APAC), G.B.Nagar, Kalavai - 632 506.Tamil Nadu

*Corresponding Author Email ID: nirujayammal@gmail.com

Abstract

Speed breeding has the potential to accelerate the rate of crop improvement. It reduces time required for cultivar development, release and commercialization. Speed breeding may be done in several ways, extending the period of plants, day by day publicity to light, mixed with genomic selection. We discussed about the conditions for speed breeding, opportunity and limitation and described the speed breeding for cereals, oil seeds, legumes, fruit and vegetable crops. It is a suite of techniques that which crop genotypes are developed as soon as possible to the next breeding generation by manipulating the environmental conditions.

Key words: Speed breeding, genetic benefit, drought tolerance, crop improvement

Introduction

For accelerating crop improvement through rapid generation advancement, speed breeding is used which shorten the crop breeding cycle. Growing crops in a speed breeding specific growth chamber speeds up research on adult plant phenotyping, crossing, mutants and transformation. By using speed breeding we can achieve upto 6 generations per year for spring wheat (*Triticum aestivum*), durum wheat (*Triticum durum*), barley *(Hordeum vulgare)* and chickpea (*Cicer arietinum*). Four generations of canola (*Brassica napus*) instead of 2-3 under normal glass house conditions.

Conditions for speed breeding

The main aim of speed breeding is to shorten the breeding cycle by promoting the vegetative and flowering stages.

The key changing elements are light, day duration extending photoperiod, temperature and humidity. Temperature greatly influences the rate of plant development.

Combining speed breeding with genomic selection

For improving the genetic benefit, speed breeding and genomic selections are used. It can improve the genetic benefits in a variety of crops. Meuwissen (2013) were the first to purpose of genomic selection. It shortens the breeding cycle and creates higher quality plant varieties in a short period of time, improving genetic gain. It can improve crop quality even more effectively.

To develop genetically stable lines, 4-6 generations of inbreeding are required. It is used for evaluate the agronomic traits and yield. In Thale cress (weed plant), *Arabidopsis thaliana* using phytohormone benzyl amino purine and plant auxin mimic picloram for seed setting 40-45 days after sowing.

Second generation seeds sown on half strength, hormone free MS medium results in accelerated time to flowering and fruiting compared to first generation. It is allowing upto 13 generation per year. In woody perennial plants, the environmental conditions affect the juvenile phase. In apple, field grown seedlings require 5 years to flowering but growth can be accelerated to reproductive phase in short time such as 10 months.

Cereals

In wheat, four to six generations of wheat were collected and harvested the immature seeds. After 15-20 days of anthesis, seeds were treated with H_2O_2 at low temperature. According to De Pauw and Clarke (1976) improved the germination response of wheat seeds by extending the duration of H_2O_2 at low temperature (11) and depending upon the cultivar, the generation was reduced by 12-23 days.In wheat, speed breeding technique used for rapid screening of multiple traits such as leaf rust, root architecture and evaluating plant height and flowering time. In barley, speed breeding was used for screening drought tolerance traits.

Oil seeds

In soybean, precocious germination was observed in viable seed production. Roumet and Morin (1997) demonstrated the growth cycle from 130-140 days using immature and pre-treated pods. Nagatoshi and Fujita (2019) standardized the rapid generation advancement protocol for high quality, Japanese soybean cultivar Enrej, reduced crop duration from 102-135 days to 70 days. Availability of these methods performs five generations per year instead of 1 to 2 generation in a year. Using embryo rescue method; Dagustu *et al*. (2012) established a short breeding period protocol for sunflower.

Legumes

Lentil can be grown *invitro* condition using tissue culture method. Agar is used as substrate and medium is Hestrin-Schramm, it enables eight generations within one year. It expanded *invitro* rapid generation technology of lentil to faba bean. It is evaluated the effect of the hydroponic method, tissue culture and intermediate method on accelerating anthesis time to seed set rate.

It results in 6-8 generation each year as opposed to one year in field and three years in green house. Rapid generation advancement strategy in pigeon pea demonstrating 100 per cent germination from immature seeds. The immature seeds harvested from 35 day old plants for growing 3-4 generation in a year.

Fruit crops

Many fruit crops undergo a long juvenile phase before flowering, in some species, taking >20 years. Speed breeding techniques have led to vigorous vegetative growth and early flowering in apple (ten months instead of five years). The development of a new cultivar with desirable traits was achieved in apple using speed breeding technology, which is based on transgenic, early flowering plants.Clonally propagated crops, such as banana, roots and tubers have begun to utilize speed breeding in order to reduce flowering time and increase flowering rate.

Vegetable crops

Vegetables such as pepper, tomato and amaranthus respond effectively to increased day light. These extend the photoperiod has shortened generation interval. Some methodologies can improve generation turnover by promoting early flowering involve higher expression of flowering gene such as CaFT-LIKE gene in pepper. Velez-Ramirez *et al.* (2014) demonstrated in tomato, introgression of the gene CAB-13, tolerance to continuous light.

Speed breeding to accelerate domestication

Plant domestication is the process where wild varieties of plants have been evolved into crop plants through artificial methods. The evidences regarding the plant domestication in combination with speed breeding has to be found in polyploidy plants such as peanuts and banana.

Multiple disease resistance by speed breeding

The plant breeders are exploring different ways to enhance the quality of crop production. Hickey *et al.* (2017) performed a research in which they applied the two-rowed barley cultivar scarlett with novel methods for rapid trait introgression.

Advantages of speed breeding

- Speed breeding is a powerful tool to accelerate crop research and breeding.
- Accelerate the transgenic plants.
- Opportunity to combine it with CRISPR-Cas 9 genome editing technique.
- Plant phenotyping for traits: flowering time, plant height, disease resistance, pod shattering, etc.

Limitations of speed breeding

- Different responses of different plant species when exposed to extended photoperiod.
- Initial investment is high.
- No universal protocol due to diverse response of plant species to photoperiod.
- The selection of significant traits through the rapid development of the breeding cycle may require specialist equipment.

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SILK PRODUCING WILD INSECT - *Cricula trifenestrata* (HELFER)

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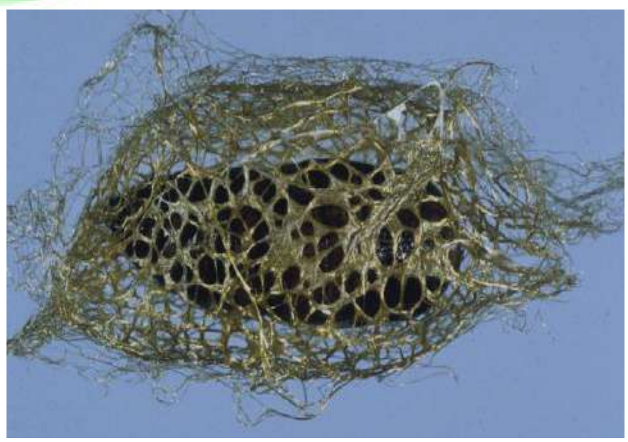
***Dr. S. Susikaran and Dr. L. Allwin**

Tamil Nadu Agricultural University, Coimbatore – 641 003, Tamil nadu

*Corresponding Author Email ID: susikaran.s@tnau.ac.in

INTRODUCTION

It is estimated that there are as many as 40 saturniids, species from India, and among them nine species are present in Northeastern India.Out of these nine species, the genus *Cricula* Walker (Helfer) is present in the north-eastern part of India and is comprised of three species viz., *Cricula trifenestrata*(Helfer), *C. andrei* and *C. andamanica* . Of these, *C. trifenestrata* is widely distributed in the Indian Sub-continent while *C. andrei* (Helfer) mostly present in the Northeast. This silk producing insect feeds on mango (*Mangifera indica* Lin.), som (*Litseamono petala* Kost.) and cashew plant (*Anacardium occidentale* Lin.) and produces an open ended 'net-like' cocoon of beautiful golden yellow colour. The silk is rich in luster and is used for making spun silk.



DISTRIBUTION AND HABITAT OF *CRICULA*

The *Cricula* is reported to be distributed fromIndian Sub-continent to Philippines, Sulawesi and Java and it possess ample scope for commercial exploitation. *Cricula andamanica*is reported from Andaman . The habitat of *Cricula trifenestrata* ranges from the low land to highland at an altitude of over 2000 m in Meghalaya, Assam, Tripura and West Bengal

HOST PLANTS OF *CRICULA*

The *Cricula*is polyphagous in nature and it feeds well on mango (*Mangifera indica* Lin.), som (*Machilusodo ratissima* Nees Watt), large cardamom (*Amomium subulatum*) and cinnamon (*Cinnamomumzeylanicum*). It has also been reported from West Bengal in India feeding on cashew (*Anacardiumoccidentale*) and termed as a sporadic pest. It has been reported to cause damage to cashew in isolated trees in certain localities in Rajasthan. *Cricula*was also reported to attack litchi (*Litchi chinensis*Sonn.), ber (*Zizyphusjujuba* Mill.) and pepper (*Litseacubeba* Pers.).

LIFE CYCLE

The entire life cycle of *Cricula* completes in 45-50 days in summer and 120-125 days in winter. The appearance of adults of *C. trifenestrata* is seasonal from April to November. This saturniid has 5 larval instars and passes 4 generation in a year.

UTILIZATION OF *CRICULA*

Cricula spins cocoons that are open at both ends, similar to that of Eri (*Samiacynthiaricini*) cocoons. The cocoons are cylindrical in shape and give a mesh-like appearance. The silk is rich in lusture, finer in denier and is used for making spun silk. The *cricula silk* is special due to its strong characteristics such as water resistant, very porous, soft, cool to wear, heat resistant, non-allergenic, anti-bacterial and anti-fungal. The spinnable silk content is comparatively very low, hence it is considered to be economically not viable to rear *Cricula* commercially.

CRICULA AS A PEST

An insect may be declared harmful when it destroys crops above a threshold level. If the insect grows naturally and unwantedly along with a beneficial insect, it may be termed as a pest. The population of the insect tends to fluctuate depending on the environmental conditions. Availability of large numbers of alternative host plants facilitates migration of this insect from place to place. The population of *Cricula* occasionally increases to a level of causing significant economic injury to the muga silkworm.

MANAGEMENT

The population of *Cricula*can be controlled mechanically as egg masses are easily seen on leaves of host plants and there a number of natural predators of this insect such as web weaving and hunting spiders, mantids and several other insect predators which are highly effective in controlling this insect. Outbreaks are rare and are quickly controlled by parasitoids, which achieve a very high rate of parasitization on *Cricula* eggs and pupae. The insect may also be controlled by spraying contact insecticide, cypermethrin, but this must be avoided if larvae of muga silkworms are also present.

CONCLUSION

Although *Cricula, an* insect producing a natural golden colour of silk, is considered a pest of som, mango, cardamom, cinnamon, cashew nut and tea, it can be converted into a beneficial insect providing sustainable livelihood to the local population, if it is reared for silk on a large scale, as is being done with other silk-producing insects.

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SUGAR ENHANCED SWEET CORN

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A. Thanga Hemavathy[1]* and R.Vinoth[2]

[1]Associate Professor (PBG), ADAC&RI,TNAU, Trichy, Tamil Nadu

[2]Teaching Assistant, IOA, TNAU, Kumulur, Trichy, Tamil Nadu

*Corresponding Author E-mail ID: hemavathy.tnau@gmail.com

Introduction

Sweet corn results from a mutation at the sugary locus (su), which causes the endosperm of the seed to accumulate twice as much sugar as field corn. New mutants (sh2 and se) have been developed to improve sweet corn's sweetness and other qualities. There are three major types of sweet corn. These types vary in their sweetness, keeping quality after harvest, and cold soil vigor. Each type is available in yellow, bi-color, and white varieties. Standard (su) sweet corn often does better than the other types in cold soils. Typically, it is not as sweet as the other types and the sugar content declines rapidly after harvest. Standard sweet corn is grown today primarily for processing, for early fresh market sweet corn, and for specialized markets.

Sugar-enhanced (se) sweet corn has higher sugar content and is tenderer than standard sweet corn. These types are grown primarily for direct retail sales and local wholesale markets. Supersweet (shrunken-2 or sh2) sweet corn has higher sugar content than standard sweet corn.

The sugar content does not decline rapidly after picking, so the corn remains sweet for several days after harvest. These types are grown primarily for wholesale shipping markets and local fresh markets. The seed of these varieties is smaller and lighter than seed of normal corn and typically does not do well in cold soil. For best results, do not plant until soil temperature reaches 60°F. Uneven stands and non uniform emergence are relatively common.

General details about sugar enhanced sweetcorn

The sugar enhanced types are newer and have an additional gene, the sugar enhancer (*se)* gene. The endosperm of these kernels can have twice as much sugar in them as sugary varieties. The *se* types have higher sugar content twice as much as normal sweet corn, extremely tender kernels, creamy texture and good corn flavour. Sugar conversion occurs at the same rate as for the $su_{1\ type}$ since the kernals contain more sugar, their sweet taste retain longer after harvest. There are two distinct groups within the varieties containing *se* gene: homozygous and heterozygous. The homozygous varieties (*sese* su_1su1) have higher sugar (20% to 35%) in 100% of their kernals. Whike the heterozygous varieties (*Sese su1su1)* have lower sugar (14% to 25%) and only 25% of the se type kernals and 75% su_1type.While this sugar still converts to starch, there's more sugar to begin with so the ears maintain their sweet taste for a longer time. Besides the sugar content, the pericarp (the outer part of the corn kernel) is much thinner in corn carrying the *se* gene.

The sugary enhancer gene, *se,* works in conjunction with *su-1*. The *se* gene increases the amount of sugar produced in the kernel and also increases the tenderness of the kernel. Some sweet corn hybrids are heterozygous for *se*. This means that the hybrid carries only one copy of *se*. Consequently the ears produced by a heterozygous *se* hybrid have approximately 75% normal sweet corn kernels, and about 25% sugary enhanced kernels. Homozygous *se* hybrids carry two copies of *se*, which results in ears with 100% sugary enhanced kernels. Sugary enhanced varieties start out with more sugar in the kernels so they stay sweeter longer (up to a week at 32 – 34°F). However, the sugars will eventually be converted to starch. Some people like the tender, creamy texture of sugary enhanced corn while others would term it mushy.

The SE gene gives varieties improved eating quality over SU varieties by slightly increasing the level and changing the types of sugars in the kernels. SE varieties also have a very tender pericarp (the outer layer of the kernel). The SE gene does not slow the conversion of sugars to starch but the harvest window is slightly longer than with SU varieties because of elevated sugar levels. SE varieties do not require isolation from SU varieties, but they do require isolation from SH2 and field or popcorn.

Some SE varieties are sweeter than others, depending on whether one or both of their parents were sugary enhanced. Varieties that get the SE gene from both their parents are homozygous for that trait, or ‘double SE,’ and all of their kernels have the SE characteristics. Varieties that have just one SE parent are heterozygous, or ‘single SE,’ develop 25% of their kernels with SE traits. Typically a homozygous SE will have better eating quality than a heterozygous SE. For example, Tablesweet™ varieties such as Parfait are homozygous SE with high sugar levels and slightly better holding ability.

Within the SU and SE genotypes, modifier genes are responsible for differences in flavor. A variety can be homozygous or heterozygous for a modifier gene, just like the SE gene. Modifier genes are what allow breeders to develop so many different varieties. They are why it’s possible to have an 80-day, bi-color homozygous SE corn that has better eating quality that another variety that shares those same features.

Varieties of sugar enhanced (se) sweet corn

Yellow *se*	**Bi-color*se***	**White*se***
• Buttergold, 63 days • Precocious, 66 days • Spring Treat, 67 days • Sugar Buns, 72 days • Colorow, 73 days • Bodacious R/M, 75 days • Tuxedo, 75 days • Incredible, 83 days • Merlin, 84 days • Miracle, 84 days • Kandy Korn EH, 89 days	• Sugar Baby, 65 days • Fleet, 69 days (Quickie type) • Bon Jour, 70 days • Trinity, 70 days • Bi-Licious, 72 days • Temptation, 72 days • Luscious, 73 days • Ambrosia, 75 days • Accord, 78 days • Brocade, 80 days • Lancelot, 80 days • Precious Gem, 80 days • Absolute, 81 days • Peaches and Cream Mid EH, 83 days • Delectable R/M, 84 days	• Spring Snow, 65 days • Sugar Pearl, 73 days • Whiteout, 73 days • Cloud Nine, 77 days • Alpine, 79 days • Silver King, 82 days (se version of Silver Queen) • Argent, 86 days

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BANANA PESTS AND THEIR MANAGEMENT

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Dr. L. Allwin, Dr. C. Harisudan and Dr. S. Susikaran

Tamil Nadu Agricultural University, Coimbatore-631004, Tamil Nadu

*Corresponding Author Email ID: allwin.dr@gmail.com

Introduction

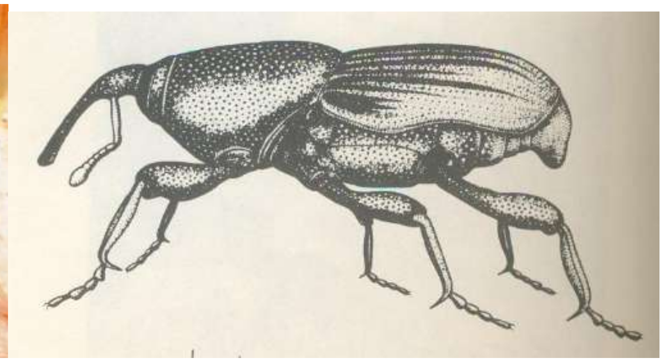
Bananas are among the most important food crops in the world. Despite their importance, banana yields are continuously declining due to attack by insect pests. Insects attack the banana rhizome, pseudostem, leaf and fruit. The most serious insect pest on a global basis is the banana weevil. Other pests include the sugarcane weevil, pseudostem weevil, banana scab moths, banana skipper, banana thrips and banana aphids. Pests of minor or localized importance include the spiraling whitefly, mealybugs, big-headed ant, chinese rose beetle and coconut scale. Thrips cause cosmetic damage directly to the fruit, reducing marketability. Most pests do not attack the bunch and cause indirect damage. For example, banana weevils attack the rhizome and pseudostem causing yield reductions through plant loss, delayed maturation and bunch weight reduction.

The rhizome weevil: *Cosmopolites sordidus* (Curculionidae: Coleoptera)

It is a major pest. Both adults and grubs burrow through the rhizome. As a result the central shoot is killed, showing premature withering. The leaves are fewer in number. The fruits become undersized. The suckers get killed outrightly.

Biology

Stout and reddish brown weevils lay eggs in small burrows on rootstock or within the leaf sheaths just above the ground level. Eggs hatch in 5-8 days. The larval period lasts 25 days. The larva is an apodous, yellowish grub with reddish head. It pupates in a chamber made near the surface of rhizome. Adults emerge in 5-6 days. Adult longevity is about one year.

The pseudostem borer: *Odoiporuslongicollis* (Curculionidae: Coleoptera)

In India and South East Asia some banana plants are attacked simultaneously by both the species of banana weevils so that both rhizome and pseudostem are tunneled. It is severe during November–March. If an affected pseudostem is split open, a number of larvae and adults can be seen inside. All commonly cultivated variety of banana, namely, Palayankoden, Poovan and Nendran are highly susceptible to the pest. Now it is a serious pest in Kanyakumari and Coimbatore districts of Tamil Nadu.

Damage symptoms

The damage is severely manifested in the post-flowering phase of the crop. Bunched plants and those nearing bunching are the worst affected. Incidence of the weevil is never observed in young plants below five months. The larva bores in the pseudostem and peduncles of the fruit. The tunnels often become infected with rots. In heavily attacked plants the pseudostem is so weak that it easily breaks. The first visible symptom is exudation of plant sap from the leaf sheath. This occurs when the larvae bore into the leaf sheath. In bunched plants, the peduncle decays resulting in the immature ripening of fruits. In plants which are nearing bunching, the flower primordia are destroyed within the pseudostem itself.

Biology

Adults are stout, reddish brown, 15-20 mm long. They lay eggs singly at random in the air chamber a the rate of one per chamber. The eggs hatch in3-5 days.The young burrowing larva makes long tunnels through the pseudostem and in some cases right up into the fruit bunch peduncles. The larval period may last 26 days. Pupation takes place inside a fibrous cocoon towards the periphery of the pseudostem. Adult weevils may emerge in 20-24 days.

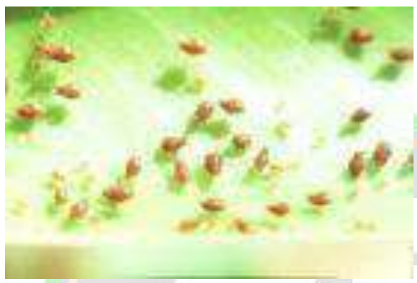
Management of both weevils

- Keep the garden free of dead leaves, debri and weeds to reduce the hiding places for the weevils.
- Prune the suckers every month.
- Avoid fresh planting in infested areas.
- The pseudostem after harvest should be made to dry quickly. Do not dump the infested materials in the manure pits. They should be chopped into pieces and burnt.
- Humidity of old stems attaract*O. longicollis.*
- Cover the cut surface of pseudostem with earth.
- Use clean, pest-free planting materials. Dip the suckers in 0.1 % quinalphos emulsion before planting.
- A histerid beetle *Plaesiusjavanicus* (native to Indonesia) preys on the grubs of *O. longicollis.*

- The weevils can be trapped with pieces of old rhizomes or pseudostems (1-2 feet long), split and placed on the plantation between plants. Attracted adult beetles migrate into these stems. They can be collected by hand and poisoned.
- For the rhizome weevil, apply lindane 1.3 % @ 20 g/plant or carbaryl 10 % @ 10-20 g/plant in the soil around the stem.

The banana aphid: *Pentlonianigronervosa* (Aphididae: Hemiptera)

- It is the vector of the 'Bunchy top' 'Cabbage top' or Strangle' virus disease of banana.



Disease symptoms:

1. Leaves are typically bunched together at the apex, forming a congested rosette, hence the name 'bunchy top'.
2. The younger infested plants are markedly structured.
3. In the leaves nodular dark green streaks along the secondary veins on the lower surface are seen on the basal portion of lamina.
4. At later stages the peducle of the bunch is elongated and the size of the fruits is greatly reduced with poor development.
5. At shooting, the bracts show leafy green tips.

- Cardamom, large cardamom and *Colocasiaaniti* are its alternative hosts.

Biology

They are brownish with black coloured veins on the wings. They live in colonies within the leaf axils or leaf whorls or at the base of the culm at the ground level. A female lays about 30-50 nymphs in a life span of 27-37 days. Viviposition begins on the day the female becomes adult. The nymphs have 4 instars of 2-3 days duration each. Toal life cycle lasts 8-9 days. There are 30-40 generations per year.

Management

- Enforce strict quarantine measures to arrest the spread of the disease.
- Destroy the infected plants and planting materials.
- Use virus-free suckers.
- Spray methyl-o-demeton25 EC 2 ml/litre, dimethoate 30 EC 2 ml/litre. The spray should be directed towards the crown and the pseudostem base at 21-day interval atleast three times.

Conclusion

The wise ideas of dovetailing these pests are to follow integrated approach in pest management to boost the international market standards thereby enhancing the farmer's livelihood.

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CROP RESIDUE MANAGEMENT: BOON FOR SOIL HEALTH ENHANCEMENT

Article ID: AG-VO3-I07-10

***Dr. S.R. Kadam[1], Dr. J. V.Kathepuri[2] , Dr. Anjali Mendhe, Dr.B.B.Bhingarde**

SMS (Agronomy), Krishi Vigyan Kendra (KVK), Jalgaon, Maharashtra 425001

*Corresponding Author Email ID: swayogpawar@gmail.com

Introduction

India accounts for about 2.4 % of the world's geographical area and 4.2% of its water resources, but supports about 17.6% of its population which highlights the fact that our natural resources are under considerable strain. The need for providing foodgrains for a growing population, while sustaining the natural resource base, has emerged as one of our main challenges. Foodgrain are a major source of energy and are thus vital for food and nutritional security. As such, food grains would continue to be the main pillar of food security and out of various crops grown, rice, wheat, and pulses are still part of the staple diet of most of the rural population. Harvesting of various crops generates large volume of residues both on and off farm. Ministry of New and Renewable Energy estimated that about 500 Mt of crop residues are generated annually. The generation of crop residues is highest in Uttar Pradesh (60 Mt), followed by Punjab (51 Mt) and Maharashtra (46 Mt).

Among different crops, cereals generate maximum residues (352 Mt), followed by fibres (66 Mt), oilseeds (29 Mt), pulses (13 Mt) and sugarcane (12 Mt). Cereal crops (rice, wheat, maize, millets) contribute 70%, while rice crop alone contributes 34% to the crop residues. Sugarcane residues consisting of top and leaves generate 12 Mt, i.e., 2% of the crop residues in India. Crop residues are primarily used as bedding material for animals, livestock feed, soil mulching, bio-gas generation, bio-manure/compost, thatching for rural homes, mushroom cultivation, biomass energy production, fuel for domestic and industrial use, etc. However, a large portion of crop residue is burnt 'on-farm' primarily to clean the field for sowing the next crop. The problem of 'on-farm' burning of crop residues is intensifying in recent years due to shortage of human labour, high cost of removing the crop residue from the field and mechanized harvesting of crops. As per available estimates, burning of crop residues is predominant in four states, namely, Haryana, Punjab, Uttar Pradesh & West Bengal.

Keywords:

Crop residue burning, Nutritional security, On Farm residue, Off Farm residue, Manure Production

Interventions to curb crop residue burning:

Crop residue management

In India, rice wheat cropping system produces huge quantities of crop residues. Majority of rice and wheat harvesting in North West India is combine harvester leaving residues in the field. The residues of cereal crops are mainly used as cattle feed. Rice straw and husk are used as domestic fuel, Mulching or in boilers for parboiling rice. Management of rice straw, rather than wheat straw is a serious problem, because there is very little turn-around time between rice harvest and wheat sowing and due to the lack of proper technology for recycling and the higher silica content than other crops.

Several management strategies are available to farmers for the management of crop residues are livestock feed, mushroom cultivation, incorporation, surface retention and mulching, and removing the straw.

As livestock feed

Traditionally, the crop residues likes wheat and paddy straw in India are utilized as animal feed such as or by supplementing with some additives. However, crop residues, being unpalatable and low in digestibility, cannot form a sole ration for livestock. The rice straw is considered poor feed for animals due to its high silica content. It differs from other straws in having a higher content of silica (12-16 vs. 3-5%) and a lower content of lignin (6-7 vs. 10-12%). The nutritional value of rice straw can be upgraded by different methods. Physical, chemical and biological treatments have been used to weaken and break down ligno-cellulose bonds in crop residues, thereby increasing their nutritional value (Kamla et al. 2015) [5].

As mushroom cultivation

Use of residues in mushroom production represents a valuable conversion of inedible crop residues into valuable food, which despite their high moisture content has two to three times as much protein as common vegetables and an amino acid composition similar to that of milk or meat (Harikrishna 2013) [4]. Wheat and rice straws are excellent substrates for the cultivation of Agaricus bisporus (white button mushroom) and Volvariella volvacea (straw mushroom), two of the four most commonly grown fungi. Straw for Agaricus cultivation is usually mixed with horse manure and hay and a very high conversion efficiency of the substrate into fungal bodies is possible (Salar and Aneja 2007) [8]. Rattan (2013) [7] also showed that paddy straw though does not provide good physical structure to compost but gave a good result when mixed with wheat straw in equal quantities.

Use of Crop Residue in Bio Thermal Power Plants

Another use of rice residue that is being encouraged by various institutions and departments is the use of rice residue for generation of electricity. The original system installed by BHEL i.e. firing the boiler with paddy straw in baled form, used to create innumerable problems like ash melting, snagging, super heater choking, clinkerisation, drop in boiler temperature due to moisture in the bales, etc. Hence, the fuel was changed from paddy straw to rice husk, wood chips, cotton waste, etc., in mixed form or rice husk alone to achieve the desired parameters. The total requirement of biomass is estimated to be 82,500 MT/annum at 100 % capacity utilization for optimum plant activity. Crop residues are bought from the farmers at Rs. 35 per quintal (which would otherwise have remained unutilized or burnt in the field). The farmers are being made aware of this offer through newspapers and other awareness activities. Apart from the generation of electricity for supply to state grid to meet the ever-increasing demand for energy in the state, the plant also reduces the Green House Gases (GHGs) emissions. As per Cleaner Development Mechanism (CDM) estimates, the plant would supply energy equivalent of approximately 417.9 million kWh to the grid in a period of 10 years (2002–2012), thereby resulting in total CO2 emission reduction of 0.3 million tonnes.

Incorporation of Crop Residue in the soil

Unlike removal or burning of crop residue put the adverse effect on soil climate and micro -organisms, so incorporation of straw increases soil organic matter and N, P and K contents in soil. Ploughing is the most efficient residue incorporation method (Adam John 2013) [1]. The incorporation of Crop Residues in the field is beneficial in recycling nutrients, but leads to temporary immobilization of nutrients (e.g., Nitrogen) and extra nitrogenous fertilizer needs to be added to correct the high C:N ratio at the time of residue incorporation (Singh et al. 2008) [9]

Production of bio-oil from Crop Residue

Bio-oil is a high density liquid obtained from biomass through rapid pyrolysis technology. It has a heating value approximately 55 % as compared to diesel. It can be stored, pumped and transported like petroleum based product and can be combusted directly in boilers, gas turbines and slow and medium speed diesels for heat and power applications, including transportation. Further, bio-oil is free from SO2 emissions and produces low NO2. Certain Canadian companies (like Dyna Motive Canada Inc.) have patented technologies to produce bio-oil from biomass including agricultural waste.

Crop Residue as animal bedding and compost

For preparing compost, crop residues are used as animal bedding and then heaped in dung pits. It has been found that the use of paddy straw bedding during winter helped in improving the quality and quantity of milk as it contributed to animals' comfort, udder health and leg health. Paddy straw bedding helped the animals keep themselves warm and maintain reasonable rates of heat loss from the body. In the animal shed each kilogram of straw absorbs about 2-3 kg of urine, which enriches it with N. The residues of rice crop from one hectare land, on composting give about 3 tons of manure as rich in nutrients as farmyard manure (FYM). The rice straw compost can be fortified with P using indigenous source of low grade rock phosphate to make it value added compost with 1.5% N, 2.3% P2O5 and 2.5% K2O (Behera 2018) [2] . Yadvinder Singh et al. (2004) [10] concluded that the wheat and rice straws used to be collected for their use as cattle feed and other purposes such as livestock bedding, thatching material for houses, and fuel.

Adverse Effect of Residue Burning

(a) Emission of green house gases and soot particles

(b) loss of plant nutrients and biodiversity

(c) mortality of active beneficial soil bacteria

(d) loss of soil nutrients and fertility

(e) loss of flora and fauna

(f) soil hardening and erosion due to no cover.

Conclusion

The recycling of crop residues has the great potential to return a considerable amount of plant nutrients to the soil. Particularly the yield stagnation consequent upon the declining soil organic carbon is a major threat to this system. Therefore it is a great challenge to the agriculturists to manage crop residues effectively and efficiently for enhancing sequestration of carbon and maintaining the sustainability of production. Different techniques as mentioned above can be used depending on type of residue and climate conditions.

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SUCCESS STORY ON IFS MODEL: AN EMERGING VOCATION FOR INCOME GENERATION IN THE HILLS

Article ID: AG-VO3-I07-11

R.S. Telem*[1], N. Jyotsna[2], Deepak Kumar[3] and Romila Akoijam[4]

[1,2&3]Krishi Vigyan Kendra- Senapati, Manipur

[4] ICAR RC NEH Region Manipur Centre, Lamphelpat, Imphal, Manipur

*Corresponding Author Email ID: telem.ratan@gmail.com

Introduction

Integrated farming systems are farming systems with several enterprises that interact in space and time and the interactions result in a synergistic resource transfer among enterprises. In IFSs emphasis is on interaction among and within the biological components of the system where there is explicit connectivity and less dependency on external inputs. . It is based on the concept that 'there is no waste' and 'waste is only a misplaced resource' which becomes a valuable material for another product.

Agriculture practiced with animal husbandry not only gives additional income and employment opportunity to the family members around the year and also livestock excreta utilized as manures lowered the cost of fertilizers. It involves the use of outputs of one enterprises component as inputs for other related enterprises wherever feasible, for example, cattle dung mixed with crop residues and farm waste can be converted into nutrient rich vermicompost. The emergence of Integrated Farming Systems (IFS) has enabled the feasibility of small sized farming operations in relation to larger ones. Integrated farming system is a commonly and broadly used word to explain a more integrated approach to farming as compared to monoculture approaches

Mr. Alex Maram, an unemployed youth now becomes a role model of IFS in Senapati District, hailing from T. Khullen, Kangpokpi Block. He had a land holding of 6 ha and initially started turmeric farming in 0.3ha of land. He continued with turmeric farming for 3 years but could not prosper in terms of income which is about Rs. 20,000/- (average) per year.

He came in contact with KVK staff in 2015-16 seeking means and way to enhance income from his farming activities and also to replace turmeric with suitable enterprise. He was then advised to shift to IFS model comprising of 6 enterprises/components namely Kiwi fruits, poultry, fishery, orange, Mosambi and Kachai lime and he was imparted skill based training accordingly on the 6 selected components of IFS and was provided with required critical inputs under TSP component.

Details of IFS Components

I. Poultry Unit

A poultry unit was established in the nearby fish pond with a capacity of 4000 broiler chicks, which is a fast growing and reared mainly for meat purpose. . He has constructed a climate resilient poultry house to mitigate low temperature stress. The built-up litter is used in horticultural crop as FYM.. His net income from the poultry component was Rs2,00000.00. This unit was recently established and it will enable the farmer to gain additional income from meat, thereby adding towards the overall income generation of the IFS.


II. Fishery Unit

A farm pond of 0.25 ha area with average depth of 2 meter was part of the IFS model for enhancing farm income. Common carp and grass carp fingerlings were stocked @stocking density of 6000/ ha in the fish pond which yields about 830 gm/fish after 9 months, the net profit gained from the fish pond was Rs. 1,20,000.00.


III. Kiwi- fruit unit

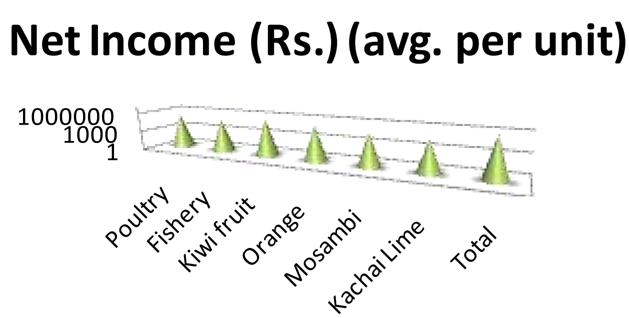
With the assistance from KVK, Senapati he was motivated to take up kiwi farming as an enterprise. He planted saplings of recognized varieties viz. Hayward, Allison, Monty, Bruno occupying an area of 2 hectare. At present he had around 350 plants which gives an average yield of 20-25 Kg/plant. He earns a gross income of approx. Rs. 5,00000.00 from selling of Kiwi.


IV. Other fruit crops unit

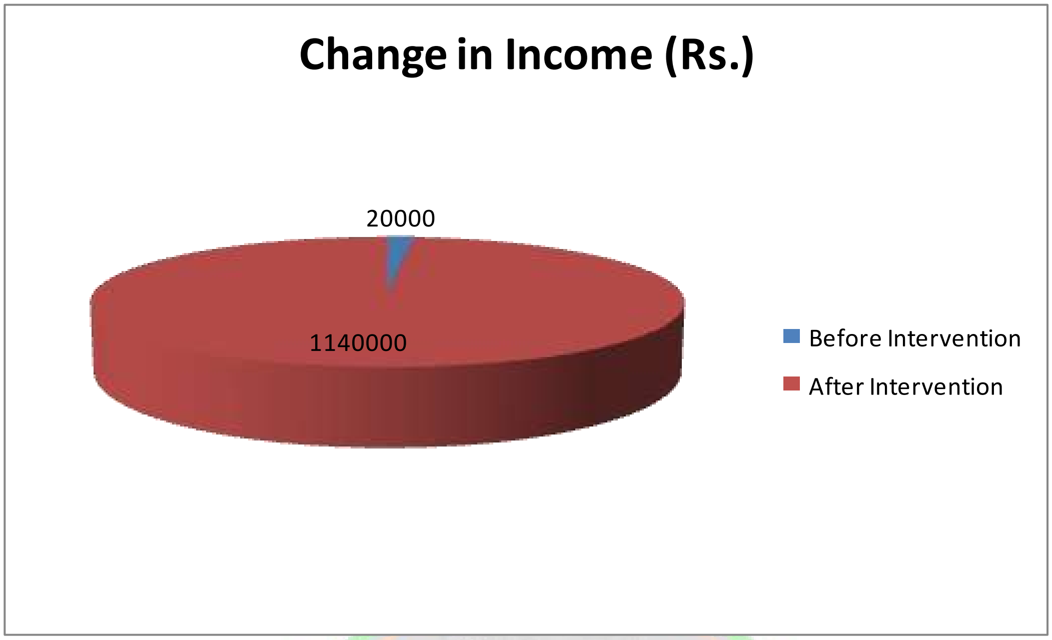
Around 3 ha area are utilized for growing horticultural fruit crops like, orange, mosambi and kachai lime. He earns a net profit of Rs.2,10,000.00, Rs.60,000, Rs.50,000 from selling orange, mosambi and kachai lime respectively.

Outcome and Impact

Based on the directions made by the KVK personnel, the outcome from the system is highly promising and neighbouring famers are also encouraged to take up such type of farming for sustainability and profitability.



	Poultry	Fishery	Kiwi fruit	Orange	Mosambi	Kachai Lime	Total
Net Income (Rs.) (avg. per unit)	200000	120000	500000	210000	60000	50000	1140000



Conclusion:

Mr. Alex Maram presently earns a total net income of Rs. 1140000/- from 6 components namely Kiwi fruits, poultry, fishery, orange, Mosambi and Kachai lime. This IFS system has created employment for 6 persons all the year round. He is now popularly known as agricultural leader in the district. Alex' farm has emerged as model of sustainable farming system based on IFS and his farm is visited by farmers, students, officials etc. very frequently.

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AUGMENTING THE COCONUT PROCESSING INDUSTRIAL WASTE: ENZYME ASSISTED EXTRACTION OF SOLUBLE COCONUT MILK DIETARY FIBER- A JOURNEY FROM KITCHEN TO LABORATORY

Article ID: AG-VO3-I07-12

Dr. D. Amirtham

ICAR-Post Doctoral Fellow, Division of Biochemistry,

ICAR-Indian Agricultural Research Institute, New Delhi -110012

*Corresponding Author Email ID: amirtham_d@yahoo.com

Introduction

Coconut is an integral part of south Indian cuisine. You might ask any south Indian and they would at least name 5-10 dishes that incorporate coconut in different forms. Coconut milk is one such commonly used ingredient. Me being a South Indian, in my kitchen, I have been using coconut milk for various recipes ranging from curries to desserts for years. But until recent times I didn't realize that as a biochemist I can explore far more avenues with this power ingredient than the recipes in the cook book.

There is this popular saying by Professor Andy Stanford-Clark, "**Innovation begins at home".** I realize the truth in his words as I pen down this article, even though mine started in my kitchen I remember searching for a concept for a new project, surfing through the internet, and sailing across an ocean of research papers seeking inspiration in vain.But unbeknown to me my inspiration laid discarded in the waste bin.

It was during one regular day that an irregular thought occurred to me. I was cleaning up my kitchen after extracting coconut milk, that was when I wondered if for extracting one cup of coconut milk we are eradicating half parts of coconut meal then how much residue is accumulated on a regular basis during mass production of coconut milk and other by-products. Just think about it. Being an agricultural scientist I am very much aware that India is one of the largest coconut producing countries in the universe with a share of 15.90% in area and 21.54% in yield. A large amount of coconut milk residue left unutilized in the coconut processing industries as a low priced by-product of the existing commercial coconut process, and imparting value addition to the byproduct will provide the scope of additional income to the coconut growers. And then the biochemist in me took control of the wheels.

Farm Kitchen Laboratory

'Innovation begins in the kitchen'

I started researching whether we can convert these discarded coconut meals into an improvised product in an economical and greenway, with further research. I learned that the coconut residue contains an enormous amount of digestible fatty acids, proteins, sugar, and dietary fiber (around 55% to 65%). Also it is a gluten-free, phytic acid-free vegan dietary fiber (i.e. fiber from a plant source). And the past decade has witnessed a growing interest of consumers towards foods rich in dietary fiber given to its plethora of health benefits. Various scientific researches prove that intake of dietary fiber in our daily routine aids in treating and preventing constipation, diverticulosis, and hemorrhoids, controlling blood cholesterol levels, protects against various forms of cancer; and help control weight by making us feel sated. All these scientific truth added strength to my research focus.

And hence I decided to carry forward this concept of mine and develop a suitable green technology with minimal usage of chemicals for producing soluble coco dietary fiber using enzymes. But this scientific journey was not a cakewalk for me, I have presented this concept in certain research forums earlier where I was criticized, stating my project to be a lame and hopeless idea. I remember one gentleman's not so kind comment, "This project could only be befitting for grinding coconut chutney." he remarked. But this is a thing that most of the scientists would have faced at some point in their life when they put forward their ideas and innovation hoping to make a difference.

But I was determined to make my idea work, I went ahead and presented my project for the Indian Council of Agricultural Research (ICAR) Post Doctoral Fellowship Programme and I am proud to say that my project was one among the ten projects that were selected out of the 67 competitive proposals at a national level. A concept that was ridiculed in a local forum was appreciated and got recognition from a national forum.

I was fortunate enough to start my postdoctoral research journey at the country's premier research Institute in agriculture, ICAR- Indian Agricultural Research Institute, New Delhiin October 2020 .With the encouraging results from my pilot study I was able to fine-tune my research work to come out with the development of a promising technology for extracting a value-added product from coconut residual waste under the expertise of senior eminent scientific community. And now after almost one year of extensive study and research, I have finally came out with the green technology called "**Enzyme Assisted Extraction of Coconut Residue Dietary Fiber**".

Why enzyme assisted extraction?

As the coconut milk residue incorporates lignin, pectin, starch, and proteins further to cellulose and hemicellulose, it is encouraged to use a multienzyme as opposed to an individual enzyme device for hydrolysis further to the chemical method. The degradation or disruption of plant cell walls and membranes, as a result accelerating the mass switch of goal compounds into extraction solvent and consequently enabling a higher release and extra efficient extraction of bioactive compounds via enzymes together with cellulase, protease and amylase have been widely used for pretreatment of plant material prior to conventional techniques for extraction which can also drastically reduce the amount of solvent requirement.

Optimization can be used to maximize the degradation of degradable solids to sugar.using multi-enzyme method for the extraction of crude polysaccharides isn't always appreciably reported in any literature. Therefore, the cutting-edge work is performed with the following targets i)To have a look at the effect of extraction methods on the yield and physicochemical homes of Coconut Residue dietary Fibre (CRDF) ii) to evaluate the physiochemical practical properties of CRDF extracted with chemical and iii) to discover the structural adjustments at the CRDF because of one of a kind extraction methods.

As an output of the above conducted systematic study, in addition to produce the soluble coconut dietary fiber and the technology to extract it, I was also able to progress my research in developing combo of fiber-fortified functional food products like 'Coco Fiber Fortified Nutri-Mix Powder, Coco Fiber Fortified Milk Shake Powder, and Coco Fiber Fortified Muffins".

Conclusion

The current milestone of my project the technology and the products are recommended for obtaining patent rights by the national level renowned project evaluation committee of ICAR. At the age of 46, with this being my last chance at pursuing my studies further owing to the age bar after this, I didn't expect to come this far in my postdoc journey especially during this pandemic. But I was determined to utilize my full potential and prove that this project of mine is not worthless and a waste of time but wealth from waste.

"The rejections we face motivates us to storm vigorously towards our aim if we take it in the right stride"

AgriGate- An International Multidisciplinary e-Magazine

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APPLICATION OF INFRARED HEATING IN FOOD PROCESSING

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Subhash Prasad*

Assistant Professor, College of Dairy Science, Kamdhenu University, Amreli, India

*Corresponding Author Email ID: subhashprasad85@gmail.com

Introduction

Foods and biological materials are heated primarily to increase shelf life and flavour. The process of food processing with a thermal method could cause a chemical and organoleptic properties damage and reduce nutrition or nutritional bioavailability. Heat is created outside of the item to be heated and is transferred to the substance by convection of hot air or thermal conduction. The thermal energy created by exposing an item to infrared (IR) radiation (wavelength of 0.78 to 1000 µm) can be absorbed by food ingredients. Certain properties of infrared heating, such as efficiency, wavelength, and reflectivity, distinguish it from others and make it more useful in some applications than others. Infrared heating is also becoming more popular due to its superior thermal efficiency and faster heating rate/response time when compared to conventional heating. Near-infrared (NIR), mid-infrared (MIR), and far-infrared (FIR) radiation can be categorized into three zones, corresponding to spectral ranges of 0.75 to 1.4, 1.4 to 3, and 3 to 1000 µm, respectively (Sakai and Hanzawa, 1994). FIR radiation is beneficial for food processing in general because most food components absorb radioactive energy in the FIR range.IR heating is used in food processing processes such as drying, dehydration, blanching, freezing, pasteurisation, sterilisation, and other miscellaneous food applications such as roasting, frying, broiling, and cooking, as well as in-depth pathogen inactivation testing.

Basic laws of infrared radiation

IR radiation impacting on any surface has a spectrum dependency because energy emitted by an emitter is comprised of several wavelengths, with the percentage of radiation in each band depending on the emitter's temperature and emissivity. The temperature of the IR heating components determines the wavelength at which maximum radiation occurs. The basic principles for blackbody radiation, such as Planck's law, Wien's displacemen law, and Stefan-Boltzman's law.

Interaction of IR radiation with food components

Food is a complex blend of biochemical molecules, biological polymers, inorganic ions, and water. The mechanical vibrations of molecules or specific molecular aggregation within a highly complicated phenomenon of reciprocal overlapping generate the infrared spectra of such mixtures. Amino acids, polypeptides, and proteins exhibit two distinct absorption bands at 3 to 4 and 6 to 9 µm. Lipids, on the other hand, exhibit substantial absorption phenomena over the whole infrared radiation spectrum, with three stronger absorption bands located at 3 to 4, 6, and 9 to 10 µm, whereas carbohydrates produce two strong absorption bands centered at 3 and 7 to 10 µm (Sandu, 1986).

Most organic materials reflect 4% of total reflection, resulting in a polished surface gloss. The remaining reflection happens when radiation reaches the food substance and scatters, resulting in diverse colours and patterns. Regular and body reflection can be seen in materials having a rough surface. For example, in the NIR wavelength zone (λ <1.25 µm), around 50% of the radiation is reflected back, but in the FIR wavelength range, less than 10% of the energy is reflected back (Skjoldebrand, 2001).

Sources of IR heating

Electric and gas-fired heaters are the two most common forms of infrared radiators used for process heating. The temperature ranges for these two types of IR heaters are normally 343 to 1100 °C for gas and electric IR, and 1100 to 2200 °C for electric IR solely. IR temperatures in the 650 to 1200 °C range are commonly utilized to avoid charring of items. Gas heaters have a greater capital cost but a lower operational cost than electric infrared systems. Electrical infrared heaters are popular due to their ease of installation, ability to create a rapid heating rate, and cleaner source of heat. Electric infrared emitters are very versatile in terms of providing the required wavelength for a given application. Electric IR heaters have an operating efficiency of 40% to 70%, whereas gas-fired IR heaters have an operating efficiency of 30% to 50% . The spectral area acceptable for industrial process heating runs from 1.17 to 5.4 µm, which corresponds to temperatures ranging from 260 to 2200 °C (Sheridan and Shilton 1999).

Applications of IR heating in foodprocessing operations

Because of its inherent benefits over traditional heating systems, the use of infrared radiation in food preparation has gained traction. Food items have been dried, baked, roasted, blanched, pasteurized, and sterilized using infrared radiation.

Drying and dehydration

FIR drying in the food sector is projected to constitute a novel technology for producing high-quality, low-cost dried foods (Sakai and Hanzawa, 1994). The use of infrared radiation technology for dehydrating foods has numerous advantages, including reduced drying time, alternate energy source, increased energy efficiency, uniform temperature in the product while drying, higher-quality finished products, less need for air flow across the product, a high degree of process control parameters, and a clean working environment. As a result, in recent years, FIR drying operations have been effectively used to the drying of fruit and vegetable items such as potatoes, sweet potatoes, onions, kiwifruit, and apples. Tunnel infrared dryers are also used to dry seaweed, vegetables, fish flakes, and pasta. Infrared drying has been used in food analysis to determine the water content of food items (Hagen and Drawert, 1986).

Solid solids, in general, absorb infrared radiation in a thin surface layer. Moist porous materials, on the other hand, are penetrated to some depth by radiation, and their transmissivity varies with moisture content. Energy and mass balance allows for heated particle shrinkage and infrared energy absorption. Theoretical simulations revealed that intermittent infrared drying with a 10 W/m^2 energy input becomes similar to convective drying with a heat transfer coefficient as high as 200 W/m^2 K.

Integrated drying technologies

IR and convective drying

The use of combined electromagnetic radiation and traditional convection heating is thought to be more efficient than either radiation or convective heating alone because of the synergistic effect. The development of a continuous drying apparatus outfitted with FIR heaters, NIR heaters, and hot air blast has the potential to minimize economic expenses, drying time, and operational temperature. To maximize drying efficiency, vegetable size should be limited to no more than 5mmin thickness (Sakai and Hanzawa, 1994). In sweet potatoes, combining IR heating with freeze-drying might cut processing time in half (Lin *et al.*,2005). The authors came to the conclusion that shorter wavelengths resulted in faster drying and consequently shorter drying times.

Enzyme inactivation

Infrared radiation can be used to effectively inactivate enzymes. Lipooxygenase, an enzyme responsible for soybean degradation, was inactivated 95.5% within 60 seconds after IR treatment. FIR has been used effectively to inactivate enzymes that cause off flavours in peas prior to freezing, as well as other enzymes and microorganisms in solution.

Pathogen inactivation

In both liquid and solid meals, infrared heating can be used to inactivate bacteria, spores, yeast, and mould. The effectiveness of infrared heating for microbial inactivation is dependent on the following parameters: infrared power level, food sample temperature, peak wavelength and bandwidth of infrared heating source, sample depth, types of microorganisms, moisture content, physiological phase of M/Os (exponential or stationary phase), and food material types.

IR heating in other miscellaneous food processing operations

IR heating has also been shown to be beneficial in a variety of other food processing applications, including roasting, frying, broiling, heating, and cooking meat and meat products, soy beans, cereal grains, cocoa beans, and nuts. Infrared radiation and jet impingement, as opposed to heating in a regular domestic oven, enhanced the pace of colour development of the crust and lowered the heating time of parbaked baguettes during postbaking (Olsson *et al.*,2005). Furthermore, combining infrared and impingement heating resulted in the quickest colour development. The rate of water loss rose as the heat transfer rate increased, while the total water loss decreased as the heating duration decreased. In general, the produced crust on IR-treated baguettes was thinner.

Quality and sensory changes by IR heating

For commercial success, it is critical and helpful to research the quality and sensory changes that occur during IR heat treatment. Several studies have investigated the quality and sensory changes in food ingredients caused by infrared heating.Infrared radiation applied in a stepwise way by gradually raising the power, with short cooling between power levels, resulting in less colour deterioration than intermittent infrared heating (Chua and Chou, 2005). Overall colour change was reduced by 37.6 and 18.1% for potato and carrot, respectively. Longer infrared heat treatments may cause browning and darken the colour of the onion.

Conclusions

IR heating is most appealing for surface heating applications. Combining IR heating with microwave and other common conductive and convective modes of heating offers enormous promise for achieving energy optimal and efficient practical applicability of IR heating in the food processing sector. It is very likely that the use of infrared heating in the food processing sector will increase in the near future, particularly in the areas of drying and minimum processing.

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RICE VARIETY CLASSIFICATION USING MACHINE LEARNING TECHNIQUE

Article ID: AG-VO3-I07-14

Dr. P. Prema*

Associate Professor (Computer Science), Agricultural College and Research Institute, TNAU, Madurai, Tamil Nadu

*Corresponding Author Email ID: pp76@tnau.ac.in

Abstract

Traditional rice varieties are rich in fibre and other essential nutrients. So these varieties are commonly preferred by many people. And farmers started cultivating these varieties because of their premium price in the market. Classifying traditional varieties can be of great use in breeding and educational purposes. In this paper, Machine learning technique is used to classify the traditional rice varieties based on physical parameters viz. Length, Breadth, L/B Ratio, Grain colour, Grain Shape, Size Class etc., Support Vector Machine (SVM) and Neural Network (NN) are the classifiers used for classification and also compared based on accuracy and training time. It is found that both the classifiers have same level of accuracy but the training time was higher in SVM than NN. So Neural Network (NN) can be employed for quicker classification of traditional rice varieties and further analysis.

Keywords: SVM, KNN, Machine learning

Introduction

Agriculture is one of the most important sector of the Indian Economy. The Indian agriculture zone accounts for 18 percent of India's gross domestic product (GDP) and provides employment to 50% of the international locations body of workers. India is the world's largest producer of pulses, rice, wheat, spices, and spice products. India remains among the main three as far as the production of different agricultural things like paddy, wheat, pulses, groundnut, rapeseeds, natural products, vegetables, sugarcane, tea, jute, cotton, tobacco leaves and so on. On the alternative hand, at the marketing front, Indian agribusiness is as yet confronting the troubles, as an instance, low stage of enterprise area reconciliation and integration, availability of reliable and handy information wanted by way of farmers on unique problems in farming. Indian is an agriculture-based country, where more than 50% of the population depends on agriculture.

The commitment of agribusiness within the countrywide income in India is all of the greater, finally, it is said that agriculture in India is a backbone for the Indian Economy. Tremendously, the demand for rice nowadays is increasing and this will affects the need for producing and sorting rice grain to produce faster and exceed the normal requirement. Rice classification refers to a process of determining and assigning rice into its classes and grade. In order for the rice supplier to determine the type and grade of the rice grain, there are a few manual techniques that are carried out such as milling system, alkaline test, deoxyribonucleic acid (DNA) technique, and to name a few. These manual techniques have a lot of disadvantages and hence technical knowledge and skill is required. Rice classification is essential in determining the quality and its price in the market. The demand for quality of grains is increasing due to some traders that cheat consumers by selling poor quality food grains. It is difficult for the consumers to check the quality of the type of rice that they bought as there are no suitable techniques to assist them. The only technique that consumers can use is only by using their own naked eyes inspection. Yet, researchers in stated that the naked eyes inspection of the rice quality result is inefficient.

DNA fingerprinting is one of the manual techniques used to determine the grades of rice, type, and quality. To maintain the uniqueness of rice varieties and to distinguish the different grades of basmati rice, it is particularly important to ensure the export quality. There are many effective techniques available for extracting DNA from rice, but for milled rice samples, extraction of DNA was only possible with commercially available kits such as the Nucleon PhytoPure DNA Extraction Kit. However, due to the multiple manipulation steps, this DNA extraction method is very time-consuming, laborious and expensive.

In this competitive modern world, people would prefer the new technologies instead of using manual and tedious techniques as mentioned. Everything is mostly now automated. In automating the process of rice grain classification, Machine Learning technique is used to overcome the weaknesses of the manual process. Machine learning techniques for the development of classification models are extensively applied in countless fields. Methods such as support vector machines (SVM) or artificial neural networks (ANN) have demonstrated their high reliability in the training of non-linear regression and classification models.

SVMs have arisen as very solid machine learning methods for supervised classification issues. SVMs are kernel-based algorithms that transform data into a high-dimensional space and construct a hyperplane that maximizes the distance to the nearest data point of any of the input classes. Although SVM are originally designed to train binary classifiers, an extension for multiple classes is possible by reducing the multiclass problem into several binary classification ones, using one-versus-all or one-versus-one approaches. ANN are machine learning models inspired on biological neural networks present in animal Brains. The first approaches of the ANN concept was exposed by, and afterwards resurfaced with the introduction of the error backpropagation concept. ANN are formed by units named processing elements (PE) having similar behaviors than a biological neuron. Different functions—as data input, output, storage or forwarding—are distributed among all the PEs. The layout of an ANN is composed of a number of layers (one-layer or multi-layer designs) and a number of PE per layer. NIR varietal classification have been carried out using ANN models in tea plants or herbal medicine. Most studies have developed PLS-DA based models under laboratory conditions from NIR spectroscopy obtained through destructive methods. Also, these models were constructed using only a few number of varieties as classes.

Machine Learning Techniques: Support Vector Machine Algorithm And Neural Network

The aim of this study are,

- Collection of input data i.e. Fourteen Traditional Paddy Varieties are selected as samples,
- Extraction of the features (feature set) from the collected samples.
- Classification of Rice variety using Machine Learning Techniques and Neural Network
- Finding the accuracy and training time of sample.

Machine Learning (ML) has proven to be one of the most game-changing technological advancements of the past decade. Machine learning is a subset of computer science that can be evaluated from “computational learning theory” in “Artificial intelligence”.Machine learning is also a method used to construct complex models and algorithms to make predictions in the field of data analytics. This section explains about the methods and techniques that are used for classifying and identifying traditional rice varieties using Machine Learning Techniques like Support Vector Machine Algorithm (SVM) and Neural Network.

Support Vector Machine or SVM is one of the most popular Supervised Learning algorithms, which is used for Classification as well as Regression problems. However, primarily, it is used for Classification problems in Machine Learning.

Fourteen Traditional Paddy Varieties are selected as samples. The selected traditional varieties of Paddy are ***Gullakar, Chinnar, Milagusamba, Kootthaalisamba, Annaigompan, Gulieyatichan, Karunguruvai, Norungan, Kichadaisamba, Sigappugowni, Chithiragar, Seeragasamba, Sornamasuri and Mappilai Samba***. These varieties are subjected to analysis of certain physical parameters such as Length (L), Breadth (B), L/B ratio, Grain shape, Grain colour, Size class, Thousand Kernel Weight, Moisture, Bulk Density, and Particle Density & Porosity.

Figure 1: Paddy Varieties

These physical parameters of the varieties are fed as inputs into the MATLAB software. MATLAB software is used for classification of varieties.Then using, Support Vector Machine (SVM) and Neural Ne**twork** these data are subjected to prediction analysis.Both the methods are compared based on the accuracy and training speed.The best method that produces more accuracy with less training time is chosen for classification of traditional varieties.

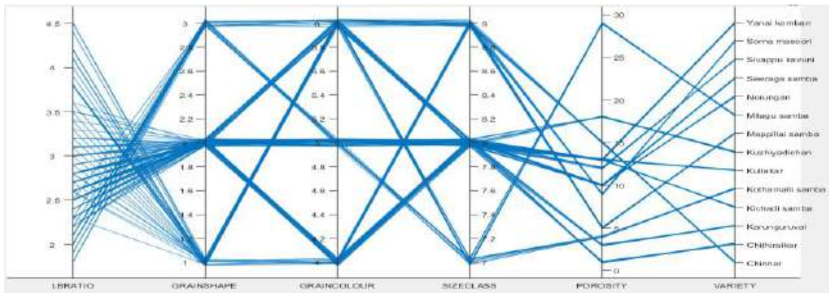

Figure 2 : Input Data

Conclusion

In this study, the SVM and ANN methods were applied for classification of traditional rice varieties using the experimental data registered along with the study. Using the confusion matrix obtained from Support Vector Machine (SVM), the accuracy and training time are determined. The accuracy shows 100% and training time is 12.099 sec. The confusion matrix of Neural Network gives the 100 % accuracy and the data gets trained in 0.9715 sec. On comparing both the accuracies and training time of the two methods, Neural Network is chosen as the best method for classification and prediction analysis as the training time is 0.9715 secs only. It means that the data gets trained quicker and results are processed rapidly with more accuracy.

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SOIL POLLUTION: A DEVASTATING RISK TO HUMANITY

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Dr. Deepali Suryawanshi* and Dr Yagya Dev Mishra**

*Assistant Professor, School of Agriculture, Vikrant University Gwalior Madhya Pradesh

** Scientist (Ag. Extension), Directorate of Extension Services, RVSKVV, Gwalior (M.P.)

*Corresponding Author Email ID: deepsuryaa@gmail.com

Introduction

Soil fertility and pollution is a serious matter in the environmental system and the whole world is struggling with this problem. In India, more than half of the population is directly employed through agricultural ventures and soil is an essential component for agriculture, yet our country is facing the problem of soil pollution. The problem is being addressed by various Governments and non-governmental organizations by running continuous awareness campaigns to prevent pollution and spread wakefulness about its hazardous consequences among people through different means of mass communication and even after publicizing its effects, the problem of soil pollution is a matter of serious concern for growing healthy food.

Soil is the prime and valuable property obtained through nature. It is a major contribution to the life of humans and animals for whom it's a source of water, energy and food attainment. It is the source of the food for all the people living on Earth, the creatures as well as the vegetation. If the soil is healthy and pollution free, then all the flora, fruits and vegetables produced from its womb will be clean and healthy. If we irrigate vegetables and fruits by using the polluted water of the factories, sewage and acid rain due to pollution, the result are harmful to the human and animal health.

Soil Pollution

Soil is the mother of plants, grains, trees and entire vegetation on earth. Clean and pollution free soil is a necessity for the growth and development of human kind, plants and animals. Any unbalanced presence of any of the elements found in the soil is considered as soil pollutant. The contaminated soils have a negative effect on crops and living bio-organisms available in the soils. The waste products from factories and homes are disposed in the open which leads to land pollution. The access use of pesticides, herbicides in growing crops is increasing every day also leads residual ill effects in the edible produce and soils as well. The raising quantity of waste products and lack of proper waste disposal options, the problem of soil pollution is increasing day by day.

When define soil pollution, we refer any unwanted change in the physical, chemical or biological properties of the soil, which affects humans or other organisms or which destroys the natural quality or usefulness of the soil, is called soil pollution. Degradation in the quality of the soil implies the rapid erosion of soil by wind or aquatic actions, deficiency of micro-organisms living in the soil, the decline or increase in moisture in the soil beyond normal limits, excessive ups and downs in the temperature, lack of humus in the soil, and the excessive growth in the amount of pollutants in the soil.

Causes of Soil Pollution

When some waste materials get accumulated on our land, they give rise to soil pollution. The major sources of soil pollution or land pollution are as follows-

1. **Natural pollutants**

- Natural accumulation of compounds in soil due to an imbalance between atmospheric deposition and percolation with rainwater (for example, concentration and accumulation of perchlorate in soil in arid environments)

- Natural production in soil under certain environmental conditions (for example, natural formation of perchlorate in soil in the presence of a chlorine source, using metal objects and wind energy)
- Leakage from sewer lines into the subsurface (For example, adding chlorine that can generate trihalomethanes such as chloroform).

2. **Man Made Pollutants**

- ***Mining activities-:*** mining activities related to the crushing and processing of raw materials, for example, heavy metals, emitting toxic substances;
- ***Accidental leakage during storage-:*** Accidental leakage and leakage during storage, transportation or use of chemicals (such as leakage of gasoline and diesel at gas stations);
- ***Foundry activities and manufacturing processes-:*** Foundry activities and manufacturing processes involving furnaces or other processes that result in the potential release of contaminants into the environment;
- ***Agricultural activities*** Agricultural activities related to the application of herbicides, insecticides and/or pesticides and fertilizers;
- ***Transportation activities*** producing toxic vehicle emissions
- ***Chemical waste dumping:-*** chemical waste dumping, whether accidental or intentional - such as illegal dumping;
- Storage of waste in landfills as waste products may leach into groundwater or generate polluted vapors

Effects of Soil Pollution

Soil affects almost all aspects of our daily lives. Sometimes we fail to understand it. As a result, we sometimes fail to understand how soil pollution affects our daily lives. Contaminated soil means stunted crops or even a toxic underground water table. Some major effects of soil pollution are highlighted here:

Effects on health-

Soil pollution can make people sick. They fall in the grip of serious and fatal disease. That's why we have to protect ourselves from it.

Agricultural impact

- ✓ Decreased soil fertility and nitrogen fixation
- ✓ Increase in erosion
- ✓ Large loss of soil and nutrients
- ✓ Deposition of silt in ponds and reservoirs
- ✓ Low and contaminated crop yield
- ✓ Imbalance in soil fauna and flora
- ✓ Residual effects in our food chain

Impact of industrialization

Impact of industrialization

- ✓ Dangerous chemicals entering the ground water
- ✓ Ecological imbalance
- ✓ Release of pollutant gases
- ✓ Health problems are arising due to
- ✓ the release of radioactive rays.
- ✓ Increase in salinity

IMPACT OF URBANIZATION

Impact of urbanization

- ✓ Clogged drains
- ✓ Public health problems
- ✓ Pollution of drinking water sources
- ✓ Leakage of toxic and smelly gas

Measures to prevent soil pollution

- ❖ ***Use of biodegradable materials:*** Use biodegradable materials instead of non-biodegradable materials wherever possible, because it is easy to dispose of biodegradable materials.

- ***Minimal use of chemicals:*** There are many types of chemicals used in the fields, so should avoid using harmful chemicals in the fields, these chemicals increase the yield but go on destroying the soil and human health too through residual effects.
- ***Plantation:*** If you plant trees, it reduces many types of pollution and also reduces soil pollution. Planting trees is a panacea. If you plant trees as much as possible, all types of pollution will start reducing rapidly.
- ***Proper disposal of waste materials:*** The garbage of the houses should never be thrown outside in the open. Whatever garbage is in the house, whether it is plastic, paper, any kind of waste, put it in the garbage heap or put it in the garbage trolley so that it goes to the right place. To reduce land pollution, the government and local bodies placed green bins and blue bins in small areas in the streets all over the country to collect the domestic waste for recycling. Moreover, we should adopt a routine of using such things which we can re-use again; hence we should adopt the habit of recycling.

Conclusion

As we firmly understood that the soil is a incredibly important part of our natural resources. Nowadays, it is hard to imagine healthy vegetation and human life due to increasing soil and surface pollution. And, if it is continues to be polluted with this trend, then in coming time the life of all the living beings will set off towards a highly unbalanced ecosystem, therefore we should save the soil from getting polluted for healthy life on earth.

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SILKWORM SERICIN: PROPERTIES AND ITS BIOMEDICAL APPLICATION

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Dr. S. Susikaran* and Dr. L. Allwin

Tamil Nadu Agricultural University, Coimbatore – 641 003. Tamil Nadu

*Corresponding Author Email ID: susi.agri@gmail.com

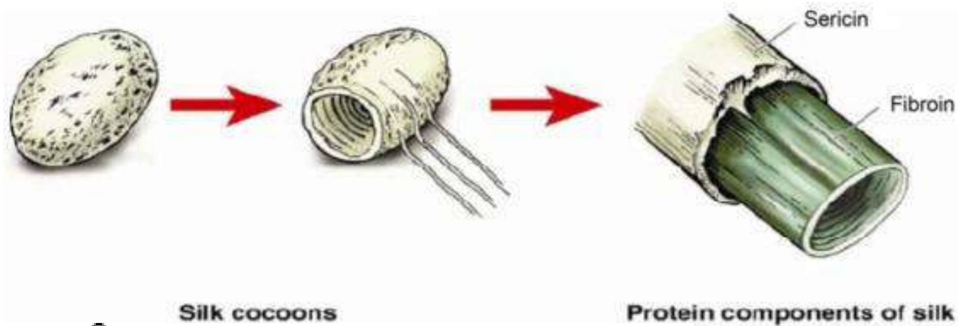
Abstract

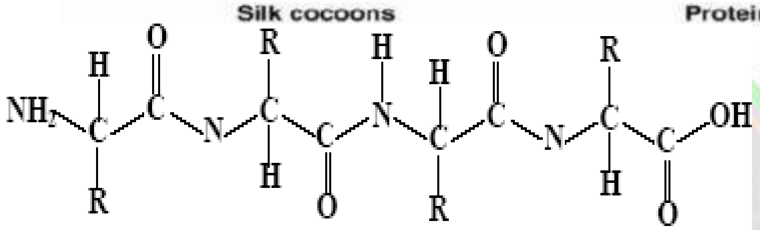
Introduction

Sericinis a protein produced by the silkworm, *Bombyxmori*, aholometabolous insect belonging to the Lepidoptera order and Bombycidae family. *B. mori*, which produces a great amount of sericin to the end of fifth larval instar and together with the fibroin, form the silk thread used inthe production of the cocoon, structure that provides the ideal conditions for the occurrence of larval metamorpho sisto adults. These ricinis a natural polymer, which acts as an adhesive joining two fibro in filaments in order to form silk yarn . The molecule is highly hydrophilic with a molecular weight that ranges from20 to 400 kDa and consists of 18 amino acids, including essentials. The polar groups (carboxyl, hydroxyl, and amino groups) of amino acid side chains and its organic composition, solubility, and structural organization enable cross linking, copolymerization's, and combinations with other polymers, which together convey unique properties to sericin as an antioxidant, moisturizing, healing, antibacterial, antimicrobial protection against ultra violet radiation, and anti tumour.

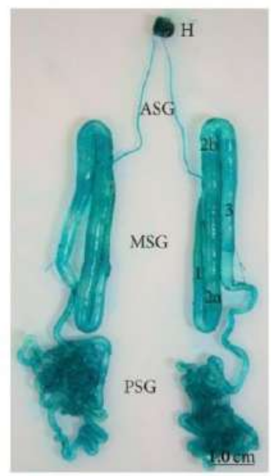
Sericin Synthesis

The sericin is synthesized in the labial gland of *B. mori*, commonly called silk glands, a pair tubular organ extending later ventrally to the digestive tract, beginning in the labial segment to the caudal region. The silk gland is a typical exocrine gland, and, due to morphological and functional differences along the length, it is divided in to three regions: theater or silkgland (ASG) that forms theex cretory duct and has about 200 cells; the middle silk gland (MSG) which secretes three types of sericin and is about 7 cm in length and approximately 300 cells; and the posterior silk gland(PSG),secretoryoffibroin,thatisabout15 cm long andabout500 secreting cells





Sericin



Silk Proteins:

Sericin and fibroin are two distinct families of proteins. Fibroin fibre is a glycoprotein secreted into the lumen of the posterior glands as a molecular complex comprising a heavy (H) chain of approximately 350 k Da and a light chain (L) of 25 k Da and P25 with 27 k Da. Sericin is a family of glycoprotein's generated by alternative splicing of sericin genes , and comprises 25 to 30% of the cocoon weight. Atleast three genes are responsible for sericin synthesis: *Ser1*,*Ser2* and *Ser3*.

Biomedical applications of sericin:

Studies of bio compatibility and antioxidant potential, both *invitro* and *invivo*, have demonstrated that sericin is immunologically inert and have proven the safety and open wide possibility of applications of sericin in biomedicine, such as the food and cosmetic industries, supplement in the culture media, cryopreservation, wound healing, anti tumour effect, various metabolic effect sin organic systems, and indicate your use in tissue engineer in gandasa vehicle for drug delivery

1. Sutures

Silk fibres have been used in the biomedical field as sutures, since their biocompatible characteristics make them a promising biomaterial. A few studies show the immune system activation front the silk protein sand, historically, the hyper sensitivity reactions were attributed to the sericin.

2. Antioxidants

Cocoons of *B. mori*can provide natural pigments typically flavonoids and carotenoids that accumulate in sericin layers. These pigments are known for their biological properties as antioxidants and anti tyrosinase.

3. Cosmetology

The use of sericinin cosmetic formulation, such as creams and shampoos, leads to an increase in hydration, elasticity, cleaning with less irritation, and anti aging and anti wrinkle effects and also prevent snails from chapping and brittleness

4. WoundHealing:

Several studies provide evidence of the healing properties of sericin, since it operates in stimulating the migration, proliferation, and production of collagen.

Conclusion

Silk protein sericin is a natural polymer produced and secreted by the silk gland insect *B. mori*. Sericin is a water-soluble glycoprotein and comprises 25 to 30% of the cocoon weight; it is characterized by the presence of 18 amino acids, with strong polar side groups (hydroxyl, carboxyl, and amino groups) and high content of serine, aspartic acid, and glycine, resulting in ahydrophilicprotein.Thephysicochemicalpropertiesofsericinaffectitsfunctionalpropertiesandma ke sericin a potential biocompatible material for biomedical applications.

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PRODUCTION & CONSUMPTION OF VEGETABLES IN INDIA: FUTURE DEMAND & GROWING CONCERNS

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Shiv Narayan Dhaker[1], Sangita Sahni[2] and BishunDeo Prasad[3*]

[1]Department of Horticulture, Dr.Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar

[2]Department of Plant Pathology, TCA, Dholi, Dr.Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar

[3]Department of Agricultural Biotechnology & Molecular Biology, Dr.Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar

*Corresponding Author Email ID: bdprasad@rpcau.ac.in

Abstract

India is the second-largest producer of vegetables in the world, with a production of around 204.61 million metric tons per year. The major vegetable producing states in India include Uttar Pradesh, West Bengal, Andhra Pradesh, Tamil Nadu, and Maharashtra. These states account for nearly 50% of the total vegetable production in the country. The country has a diverse agro-climatic zone, which supports the growth of a wide range of vegetables, such as tomatoes, onions, potatoes, carrots, peas, and cucumbers, among others. The vegetable sector in India contributes significantly to the country's economy and provides employment to millions of people.

Introduction

India is one of the largest producers of vegetables in the world, and the production and consumption of vegetables play a crucial role in the Indian economy. The country has a diverse range of climates, soil types and farming practices that allow farmers to grow a wide variety of vegetables, including tomatoes, potatoes, onions, carrots, cabbage, cauliflower, and okra. With the increasing population, urbanization, and rising income levels, the demand for vegetables has been increasing in India over the years.

However, the growing concern over food security and sustainable agriculture practices has put pressure on the Indian government and farmers to improve the vegetable production and supply chain. According to the Ministry of Agriculture and Farmers' Welfare, India produced 204.61 million million metric tons of vegetables in 2020-2021, making it the second-largest producer of vegetables in the world, after China. The majority of the vegetables are produced in the states of Uttar Pradesh, West Bengal, Maharashtra, Bihar, and Andhra Pradesh, which account for more than 50% of the total production (Choudhury, S. *et al.* 2020).

India has a large pool of small and marginal farmers who grow vegetables on their farms, and also a growing number of large commercial vegetable farms. The use of hybrid seeds, drip irrigation, and other modern technologies has increased the productivity and quality of vegetable production in India. However, the country still faces numerous challenges, including low yields, low-quality seeds, lack of storage and transportation facilities, and a lack of market access for farmers (Behera, T. K. *et al.* 2022).

Consumption of Vegetables in India

The consumption of vegetables in India has been steadily increasing over the years, and it is expected to continue to grow in the future. According to a study by the National Sample Survey Office (NSSO), the per capita consumption of vegetables in India was 264 gm /person/day in 2004 - 05, and it has increased to 102 grams per day in 393.76 gm/person/day in 2017-18. The increasing demand for vegetables is driven by the growing population, urbanization, and changing dietary habits, as people are becoming more health-conscious and looking for healthier food options (Mello Rodrigues *et al.* 2019).

However, the distribution and availability of vegetables remains a challenge in India, especially in rural areas. Many areas still lack proper storage and transportation facilities, which results in the loss of a significant portion of the produce. The lack of market access for farmers also means that they are unable to sell their produce at a fair price, and they are often forced to sell to intermediaries at low prices.

- India is the second largest producer of vegetable after China in the world.
- India contributes 14% of the total world production of vegetables.
- India is the leading producer of peas & okra in the world.
- India occupies 2nd position in production of brinjal, cabbage, cauliflower & onion.

- India occupies 3rd position in potato & tomato production in the world.
- Total horticulture production in 2021-22 is estimated to be 341.63 million tonnes, an increase of about 7.03 million tonnes.
- The production of vegetable is estimated to be 204.61 million tonnes compared to 200.45 million tonnes in 2020-21. (PIB Govt. of India)
- Vegetable availability of per capita in India has increased from 264 gm /person/day in 2004 -05 to 393.76 gm/person/day in 2017-18.
- Potato is one of the most widely produced and consumed vegetables in India, with an area of 3.24 million hectares and a production of 48.34 million metric tons in 2021-22.
- Tomato production in India in 2021-22 was around 15.5 million tonnes, grown over an area of 2.6 million hectares.
- Brinjal production in the same period was around 7.5 million tonnes, cultivated over an area of 1.3 million hectares.
- Chilli production was around 7 million tonnes, grown over an area of 1.1 million hectares.
- Okra production was around 5.5 million tonnes, cultivated over an area of 0.9 million hectares.
- Cucurbits, including cucumber and gourds, are also widely cultivated in India, with an area of 2.48 million hectares and a production of 11.57 million metric tons.
- Root crops, such as carrots, turnips, and radishes, are also widely produced in India, with an area of 1.15 million hectares and a production of 4.56 million metric tons.
- Legumes, including peas, and beans, are also commonly grown in India, with an area of 3.24 million hectares and a production of 18.32 million metric tons.
- Bulbous crops, including garlic and onion, were produced over an area of 0.8 million hectares, with a production of 7.2 million tonnes.
- Cole crops, including cabbage, cauliflower, and broccoli, were produced over an area of 0.7 million hectares, with a production of 7 million tonnes(Tiwari, A *et al.* 2021).

But the consumption is increasing along with population year by year. Supply & demand gaps varying with season, year, location & kind of vegetable result in shortage or overproduction & postharvest losses, instability in vegetable price that are often highly fluctuating

&unpredictable.So concerted efforts have to be made to increase it substantially within a decade to ensure nutritional security to everyone in India.

Future demand for vegetables in India

In the coming years, the demand for vegetables in India is expected to increase significantly due to several factors, such as rising urbanization, increasing income levels, and changes in food preferences. Urbanization is leading to a shift in consumer demand towards processed and convenience foods, which include a higher demand for fresh and frozen vegetables. The rising income levels of consumers are leading to an increase in the consumption of meat and dairy products, which will further increase the demand for vegetables as a source of dietary fiber and vitamins.

In addition, changing food preferences, particularly among the younger generation, are driving the demand for exotic and organic vegetables. The increasing health consciousness among consumers is also leading to a higher demand for fresh, nutritious, and organic vegetables. Moreover, the growing tourism industry is expected to create a demand for exotic and international cuisine, which will further boost the demand for vegetables.

Growing concerns in the vegetable sector in India

Despite the growing demand for vegetables in India, the sector is facing several challenges, such as limited access to technology, low productivity, and lack of infrastructure. The low productivity of the sector is due to the low adoption of modern farming practices and the lack of investment in research and development. The limited access to technology is hindering the growth of the sector, as farmers are unable to access modern seeds, fertilizers, and pesticides, which are essential for improving productivity and quality. Another major concern in the vegetable sector is the lack of infrastructure, such as proper storage facilities and transportation systems, which are crucial for maintaining the quality and freshness of vegetables. The absence of cold storage facilities and a well-developed transportation network results in the wastage of a large quantity of vegetables, leading to losses for farmers and higher prices for consumers.

Another challenge facing the vegetable sector in India is the lack of access to credit, which is essential for farmers to invest in modern technology and improve productivity. The lack of credit facilities also hinders the growth of small and marginal farmers, who form the majority of vegetable farmers in the country.

In addition, the lack of proper marketing channels and low bargaining power of farmers are other challenges faced by the vegetable sector in India. The absence of a well-developed marketing network and the absence of a unified platform for vegetable farmers result in a fragmented market, leading to low prices for farmers and higher prices for consumers.

Way forward

To overcome the challenges faced by the vegetable sector in India, the government and the private sector need to take several measures, such as investing in research and development, promoting the adoption of modern farming practices, and improving infrastructure. The government should invest in the development of cold storage facilities and transportation systems, which are essential for maintaining the quality and freshness of vegetables.

The private sector should play a crucial role in the development of the vegetable sector by investing in research and development, promoting the adoption of modern technology, and improving access to credit. The government should also promote the development of organic farming, which is gaining popularity in India due to the growing health consciousness among consumers. Private companies can also help in the development of proper marketing channels and in improving the bargaining power of farmers, which are crucial for the growth of the sector.

Conclusion

The demand for vegetables in India is expected to continue to grow in the future due to the increasing population and the rising awareness of the importance of a healthy diet. The government is also making efforts to promote vegetable production through various schemes and programs. However, there are several concerns that need to be addressed to ensure a sustainable future for the vegetable industry. Some of these include the need for better infrastructure for storage, transportation, and distribution, the need for improved farming techniques, and the need for better access to markets for small farmers. Addressing these challenges will help to ensure that the production and consumption of vegetables in India continues to grow, providing the necessary nutrition for the growing population and promoting a healthier lifestyle.

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SIGNIFICANCE OF SEED STORAGE AND FACTORS INFLUENCING SEED LONGEVITY DURING STORAGE

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S. Kavitha[1]*, A.ThangaHemavathy[2], R. Vinoth[3] and M. Ananthi[4]

[1]Associate Professor (SST), DSST, TNAU, Coimbatore, Tamil Nadu

[2]Associate Professor (PBG), ADAC&RI, TNAU, Trichy, Tamil Nadu

[3]Teaching Assistant (PBG), IoA, TNAU, Kumulur, Trichy, Tamil Nadu

[4]Teaching Assistant (SST), DPM, TNAU, Coimbatore, Tamil Nadu

*Corresponding Author Email ID: kavivibu@gmail.com

Introduction

Seed storage is preservation of seed with initial quality until it is needed for planting. Storage starts in the mother plant itself when it attains physiological maturity. After harvesting the seeds are either stored in ware houses or in transit or in retail shops. During the old age days, the farmers were used farm saved seeds, in little quantity, but introduction of high yielding varieties and hybrids and modernization of agriculture necessitated the development of storage techniques to preserve the seeds. Since the main objective of seed storage is maintenance of an acceptable capacity for germination and emergence, it can only be accomplished by reducing the rate of deterioration to the degree required to maintain an acceptable level of quality for the desired period.

Maintenance of seed vigour and viability in terms of germination from harvest until planting is of the utmost importance in any seed production programme. Care should be taken at every stage of processing and distribution to maintain the viability and vigour. The harvested seeds of most of the orthodox crop seeds are usually dried and stored for atleast one season until the commencement of the next growing season, except those of the recalcitrant seeds which require high moisture content for safe storage (once dried the viability will be lost. Eg. – Jack, Citrus, Coffee, Cocoa, etc.). In such recalcitrant seeds senescence starts in the mother plant itself. The dry weather alters moisture content of the seed, thereby reducing the viability. In most of the Agricultural crops ageing starts at physiological maturity, which is irreversible. Hence seeds become practically worthless if they fail to give adequate plant stands in addition to healthy and vigorous plants. Good storage is therefore a basic requirement in seed production.

High quality seed store better than low quality seed

The storage potential of seed is greatly affected by their quality at the time they enter storage, or their pre-storage history. The pre storage history of a seed lot encompasses all the "events" in the "life" of the seeds from the time functional maturity is reached until they are placed in storage. Seeds are highest in quality at the time functional maturity is attained. Since most kinds of seed reach maturity at moisture contents too high for mechanical harvest, the seeds are subjected to the field environment from maturation to harvest. The post-maturation pre-harvest period normally ranges from 1 to 4 weeks for the different kinds of seed. Adverse climatic conditions can result in rapid and severe deterioration of the seed, and so on. The degree of deterioration that occurs in seed prior to harvest determines their quality at harvest and conditions their performance in storage.

In like manner, mechanical, abuse to seed associated with harvesting, handling and processing operations, and damage caused by inadequate or improper aeration or drying can have both immediate and residual effects, i.e., performance of the seed might be affected at the time of injury or not until some later time during storage. In characterizing seed deterioration, we pointed out that the rate of deterioration of seed in storage varies among seed lots of the same kind and among individual seeds within a lot. These variations in storability are, of course, related to the pre-storage history of seed lots. Seed lots with a "good" pre-storage history (minimal field deterioration, mechanical damage, etc.) store well, while those with a "bad" pre-storage history store poorly.

Factors influencing seed storage

1. Biotic
2. A biotic

Biotic factors:

a. Factors related to seed

- Genetic makeup of seed
- Initial seed quality
- Provenance
- Seed Moisture content

b. Other biotics

- Insects
- Fungi
- Rodents
- Mishandling during sampling, testing

2. Abiotic factors

- Relative humidity
- Temperature
- Seed store sanitation
- Gaseous atmosphere
- Packaging material

1. **Biotic factors:**

a. Factors related to seed:

Genetic factors: The storage is influenced by the genetic make-up of the seed. Some kinds are naturally short lived (e.g) onion, soybeans, ground nut etc., Based on the genetic make-up seeds are classified into Micro biotic - short lived; Meso biotic- medium lived and Macro biotic - long lived.

Initial seed quality: **T**he seeds of high initial viability are much more resistant to unfavourable storage environmental conditions than low viable seed. Once seed start to deteriorate it proceeds rapidly. The seed which injured mechanically suffered a lot and loses its viability and vigour very quickly.

Effect of provenance: The place where the seed crop was produced greatly influences the storability.This is due to different climatic conditions and soil types prevailing in different places.

Seed moisture content: Most important factor influence 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 below 4% may also damage seeds due to extreme desiccation or cause hard seededness in some crops. Since the life of a seed largely revolves around its moisture content it is necessary to dry seeds to safe moisture contents. The sage moisture content however depends upon storage length, type of storage structure, kind / variety of seed type of packing material used. For cereals in ordinary storage conditions for 12-18 months, seed drying up to 10% moisture content appears quite satisfactory. However, for storage in sealed containers, drying upto 5-8 % moisture content depending upon particular kind may be necessary.

Harrington's thumb rule on seed moisture content:

For every one per cent decrease in seed moisture content the life of seed will be doubled. This is again hold good between 4- 12 C. Based on the tolerance and susceptibility of seeds towards moisture loss seeds are classified intoOrthodox and Recalcitrant seeds. Orthodox: The seeds able to tolerate moisture loss and less seed moisture favours the storage *i.e.* decreased moisture increased storage period. Eg. Rice, sorghum, and most of the cultivated species.Recalcitrant: Seeds not able to tolerate moisture loss. Required high moisture for viability maintenance.

Effect of weather: Fluctuating temperature during seed formation and maturity will affect seed storage. Pre-harvest rain may also affect the viability.

b. **Other biotic factors:** It includes microflora, insects and mites. The activity of all these organisms can lead to damage resulting in loss of viability.The microflora activity is controlled by Relative Humidity temperature and Moisture Content of seed. Treated seeds with fungicides can be stored for longer periods. Fumigation to control insects will also help in longer period of stroage. Fumigants - (e.g) methyl bromide, hydrogen cyanide, ethyline dichloride, carbon tetra chloride, carbon disulphide and napthalene and aluminimum phosphine.

2. **Abiotic factors:**

Relative humidity: Relative humidity is the amount of H_2O present in the air at a given temperature in proportion to its maximum water holding capacity. Relative Humidity and temperature are the most important factors determining the storage life of seeds. Seeds attain a specific and characteristic moisture content when subjected to given levels of atmospheric humidities. This characteristic moisture content called equilibrium moisture content. 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. At equilibrium moisture content there is no net gain or loss in seed moisture content.

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. The following thumb rules by Harrington are useful measures for assessing the effect of moisture and temperature on seed storage. These rules are as follows.

1. For every decrease of 1% seed moisture content the life of the seed doubles. This rule is applicable between moisture content of 5-14%.
2. For every decrease of $5^{o}C$ in storage temperature the life of the seed doubles. This rules applies between $0^{o}C$ to $50^{o}C$.
3. Good seed storage is achieved when the % of relative humidity in storage environment and the storage temperature in degrees Fahrenheit add upto one hundred but the contribution from temperature should not exceed $50\ ^{o}F$.

Seed store Sanitation

There are several other recognized procedures for good seed storage that most seeds men already know. Seeds should be stored in a seed warehouse, not a fertilizer, chemicals, herbicide, or feed warehouse. Good sanitation should be a continuous practice. It will minimize storage insect infestations. If storage insects are a problem, the judicious use of insecticides and fumigants, combined with sanitation, will alleviate the problem. The best procedure is not to place insect infested lots in storage with other lots unless all the insects have been killed by fumigation or insecticide treatment. In warehouse with concrete floors, seed bags should be stacked on wooden pallets to keep them from contact with the floor as considerable moisture can be transmitted through concrete floors. Seed warehouses should also be adequately ventilated (unless they are conditioned) and protected against rodents.

Gaseous atmosphere

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

Seed packaging material

In reality the seed package is a small storage container. Depending upon the cost, availability, period of storage, quantity of seed desired in each package and storage conditions the packaging materials are to be selected. Seed packing materials or containers are classified into moisture and vapour pervious containers, Moisture impervious but vapour pervious containers and moisture and vapour proof containers. Normally cereal seeds are being packed in cotton, jute and paper bags. Moisture vapour penetrates in these containers and they offer no protection against high relative humidity. In high humidity locations with inadequate seed storage facilities, consideration should be given to methods of packaging which can protect the seed from moisture vapour. Such moisture vapour proof containers include paper aluminium foil pouches, polyethylene bags of over 700 gauge thickness, sealed tins and gasketted rigid plastic containers. The costs of these are high, for the package of cereal seeds. Polyethylene bags have been regarded as the most attractive, because of their relatively low cost, compared to other kinds of sealed containers. Rigid plastic containers and sealed tins offer some possibility for hybrid seeds of cotton and vegetables, if the quantity needed is not great.

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EFFECT OF TERMITARIA SOIL ON SOIL ENVIRONMENT

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***Janaki. D, P. Gunavathi and M. P. Hemavarshini**

Agricultural College & Research Institute, TNAU, Kudumiyanmalai,
Pudukottai, Tamil Nadu -622 104
*Corresponding Author Email ID: janaki.d@tnau.ac.in

Introduction:

Termite mounds, a micro landform feature generally found in the lateritic landscapes of the tropical and subtropical regions. Termite mounds have distinct morphology compared with the surrounding topsoil. Generally, termite mounds are stable, erosion resistant and increase nutrient concentration and mineral reserves. Diets of termites are based on wood, grasses, litter, and nutrient-rich soil, so most of the termite's nest grows on wood soil interface and high biomass regions. Termite mound's growth, abundance and volume vary regionally due to variation in climate, vegetation cover, soil properties, biomass abundance, slope and groundwater depth. Biological agents like termites are important for pedological processes hence are termed as bioengineers.

Termites have great impact on soil properties including redistribution of soil particles with nutrient and minerals, nest building, repacking and cementing, feeding activity, interaction with the organism, organic matter (OM) decomposition, nutrient recycling, foraging behaviour and decaying. They also effects on soil properties by their chemical secretions and by bringing up subsoil to the soil surface for construction of mounds. Termites are the most important soil fauna which help to modify physicochemical properties of soil and built stable, microstructural and morphological features which are distinct from surrounding soil .

The effects of termites are not limited to their living area, they also effect inside the mound and surrounding foraging area. Research on termite mounds and their stability, erodibility, runoff, infiltration rate and physicochemical properties of termite's mound (as a whole) in relation to adjacent topsoil. The influence of termites is not restricted to their mounding and foraging area. The movement of material occurs both inside the mound and in the surrounding soil. Even species that do not ingest soil move particles because they mix soil particles with saliva with their mandibles to build their mounds. Estimates carried out based on the diameter and height of epigeal mounds show that, during mound construction, the termites transport large volumes of soil, which vary from 4-11 m^3 ha^{-1} to 7.5 m^3 /ha/ year or 13.0 t/ ha/ year of soil from deeper layers to the surface. These estimates corroborate the role of termites in the transport of material that results in changes in soil properties.

The impact of termites on the soil chemical properties is poorly known, especially considering different mound sections (top, center, and base) compared to the adjacent soil. compared internal sections of epigeal mounds with samples of adjacent areas and assessed their physicochemical properties. These authors considered a mound subdivided in top, center, and base and compared it to the adjacent soil within a radius of 1.5 m from the base of the epigeal mound. Also carried out studies considering mound sections and assessed the chemical and biological properties of the material, However, it is important to advance the knowledge of these alterations and their extension to the soil surface. The role of termitaria on the characterize of the physical and chemical soil properties, as soil amendment, biocontrol, biofertilizers and heavy metal reclamation and the organic matter of termite epigeal mounds is described below.

Termites are the most important soil fauna which help to modify physicochemical properties of soil and built stable, microstructural and morphological features which are distinct from surrounding soil .Intense cropping ,non-judicious management practices & over dose of fertilizers - demolishing the existing natural resources. Termites - soil engineers - key bio-turbators in tropical and subtropical soils.Feed on dead plant material.10% of the estimated 4,000 species - economically significant as pests. Termites with soils- effect on soil properties. Synergistic effect *decomposing ,cycling and nutrients availability*. The constituent from Termitaria -carbon *sequestration* and control the fluxes of N and C.Glycoprotein from fungi - soil binding material for soil stability, soil biocoenosis/ecological community.

Characteristics of termite mound

Characteristics of mound Termite mounds (as a whole) were approximately conical shaped with a height range from 33.22 cm to 241.30 cm and diameter range from 111.76 cm to 314.96 cm. The average height of termite mound was 252 cm, 184 cm and 161 cm in dense vegetation, dispersed vegetation and grassland area, respectively. In the study area, most of the mounds are conical in shape but few others cathedral configuration. Most of the termite mounds were compact and sealed with trees and bushes and some internal microhole or chamber in all of them to allow for ventilation and regulation of temperature (Dowuona*et al.*, 2012)

	
Bund Vegetation Termite mound	Cropping Area vegetation mound
	
Tree Vegetation Termite Mound	Waste Land Vegetation Termite

Termite Mound Soil as an Soil Amendment

Improvement of physical quality and, consequently, plant growth and health. ‘Hotspots’ for nutrient concentration in tropical and subtropical soils. The physiochemical parameters of termite mounds & surrounding soils are relatively different. Termite mound soil- used as fertilizer for rice growing in a village to enhance rice yield without purchasing chemical fertilize.

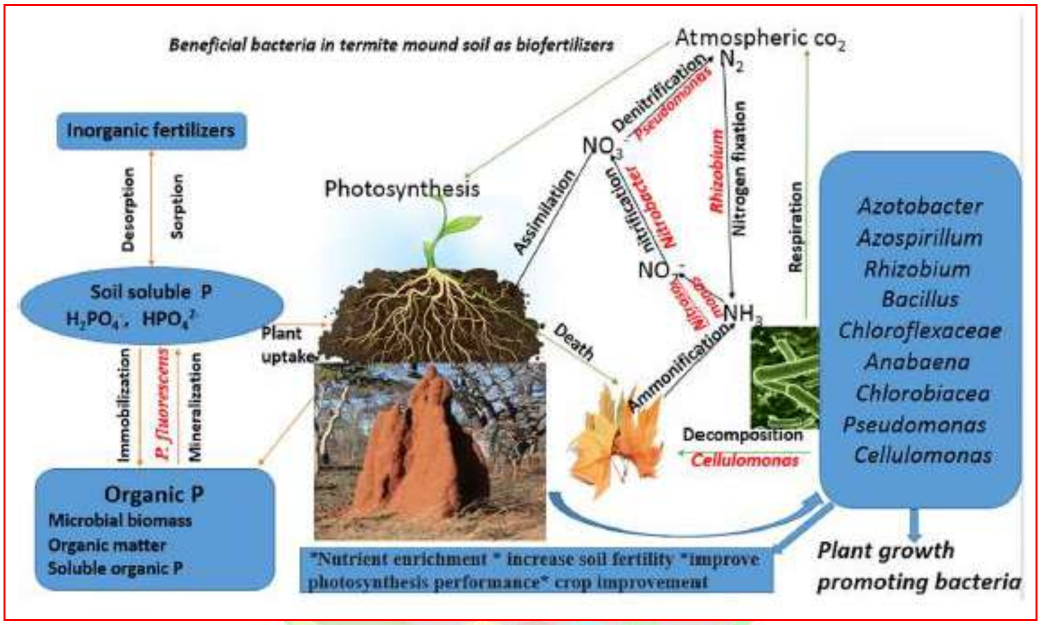
Termites play a role in soil nutrient availability and cycling at various spatial and temporal scales.The termite mounds constitute 27–53 kg ha^{-1}of total N &186.3–306 kg ha^{-1}of OC. P Mg & K contents in termite mound soil > adjacent soils by 90%, 36% and 188%.As a soil amendment shows great potential for *improving soil chemical fertility*. (Kumar *et al.*,2018). Organic carbon content is High, the *salivary or fecal materials* that are frequently used as adhesives. High quantities of available Phosphorus *i*n the mounds, can help alleviate this constraint, when mound soil is used as a soil amendment.

Termite Mound Soil Microbes

Termite mounds could be sites of great bacterial and fungal diversity. Fluorescent pseudomonads have been detected only in *M. subhyalinus* (a litter–forager termite) mound soil. The phylogenetic analysis showed that *these fluorescent pseudomonads mostly belonged to Pseudomonas monteilliispecies.P. monteillii* (isolate HR13) can stimulate the establishment of *ectomycorrhizal symbiosis* in tropical conditions and is considered as an MHB (mycorrhiza helper bacteria). MHB effect has been recorded with different fungal isolates, such as *A. holosericea and other Australian Acacia species.* Bacterial population - *high* in the sub-surface soil of closed termite mound (75.5 × 105 cfu/g of soil.Theopen termite mound (65.5 × 105 cfu/g of soil) compared to the normal soil (30.5 × 105 cfu/g of soil). Actinomycetes population - high in the sub-surface soil of both open and closed type of termite mounds. (V. Gomathi*et al.*,2009).*Bacterial* population of the fungus combs ranged from 25.6-36.2 x 10^{6}cfu / g sample dry weight.*Fungi and actinomycetes*populations ranged from 92.8-112.8 x10^{4} and 8.4 -13.1 x 10^{3}cfu / g sample dry weight, respectively. Fungi (pH-4.4)- higher than bacteria and actinomycetes. Actinomycetes -higher levels than bacteria and fungi apparently due to alkaline pH (±8).Isolated bacterial population- identified as *Bacillus, Azotobacter, Beijerinckia and Pseudomonas.*Fungi isolated -*Termitomyces, Aspergillus, Penicillium, Trichoderma, Fusarium, Xylaria and the actinomycetes as Streptomyces.*Carbohydrate: Lignin ratio of old combs- 1.55 to 2.08 (w/w).C: L ratio of New comb -0.6 to 0.86 (w/w). N,P,K of fungus comb - 0.75 to 1.8%, 0.175 to 0.193% and 0.075 to 0.08% on dry weight of fungus comb

Role of bacteria in termite mound soil as Bio-fertilizers

Termite mound soil - biofertilizers and inoculant in low-input cropping systems.Rich in nutrients and plant growth-promoting bacteria.*Kosakonia, Bacillus, and Pantoea*were isolated from termite mound soils.Phosphate-solubilizing bacteria - increasing soil fertility and their use as an inoculants concurrently increases plant P uptake and increase crop yield.Seeds of tomato inoculated with Pantoea sp. A3 and Kosakonia sp. A37- ~37% and ~53% increase in root length of tomato seedlings.*Bacillus cereus TSH77 and Bacillus endophyticus TSH42* isolated from termite mound soils were used to bacterize the rhizome of Curcuma longa. Both strains showed remarkable plant growth-promoting (PGP) activities. Curcuma longa growth and production – increases by 18% than control



Source: BenJesuorsemwenEnagbonma and OlubukolaOluranti Babalola.,2019

Reclamation of heavy metal contamination

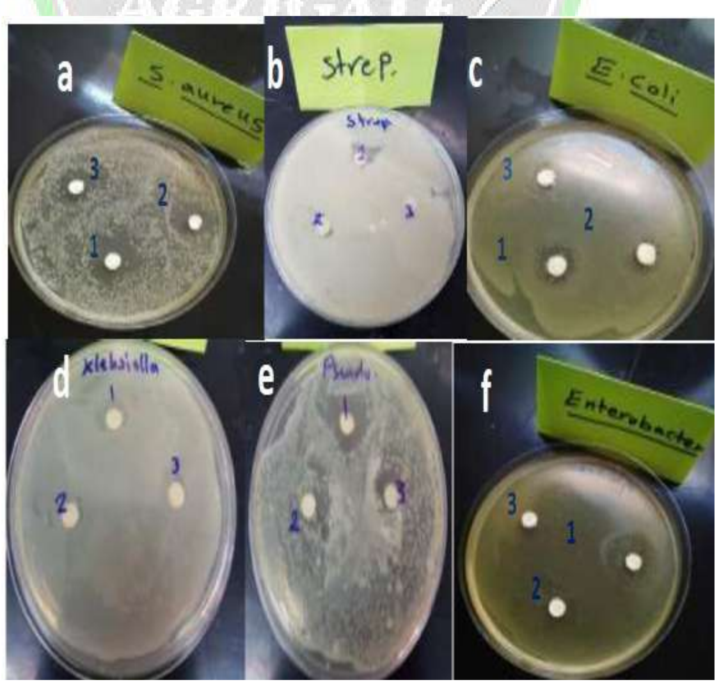
Fluorescent pseudomonads isolated from termite mound soil - Sorghum plants (S. bicolor) - soil amended with $CdCl_2$ (560 mg Cd kg−1 soil).All the bacteria isolates - improved *the shoot and total biomass* of sorghum plants. Fluorescent pseudomonad inoculation significantly increased AM colonisation in the contaminated soil.Bacterial inoculation significantly improved Cd uptake by sorghum plants. (Duponnois et al.,2006)Soils samples inoculated with pseudomonad strains presented a *higher use of ketoglutaric and hydroxybutyric acids,* as opposed to fumaric acid in soil samples not inoculated.Fluorescent pseudomonads could act indirectly in such metabolic processes by involving a lower rate of degradation of citric acid, in line with the effect of small organic acid on *phytoextraction of heavy metals from soil.*

Soil enzyme activity of termite mound soil

Soil enzymes key players of soil fertility and indicators of microbial activity.Termites play a key role in the carbon cycle of native soil ecosystems. The diet of termites is rich in *cellulose and hemicellulose. Cellulase, saccharase, Beta-glucosidase and dehydrogenase* – characterized in mound soil.*The soil stabilizing agents on the termitaria soil-Glycoprotein..The appropriate amount of the saturated stabilizing agent to be mixed with soil is estimated to be 75%.Comparative compression test of the soil mixed with water and soil binding agent was studied.Diluted sample of our soil binding agent in the ratio 1:4 gave 0.146 N/mm^2 suggesting that the Glycoprotein extract of mound soil mixed with laterite soil and compacted can withstand far more stress when compared to laterite soil mixed with water.*

Role of bacteria in termite mound soil as Bio-control

Some bacteria in the rhizosphere known as plant growth-promoting rhizobacteriainfluence physiology of the plant to a large extent. (G.M.Saleh, 2020) Suppress soil borne plant pathogens through the stimulation of plant-induced systemic resistance and the production of nematicidal, antiviral, and antimicrobial substances.*B. endophyticus* TSH42 and *B. cereus* TSH77 - slow down the growth of *Fusariumsolani*(a plant pathogen causing rot disease in crops like potato).



Inhibition zones of termitaria soil extract against pathogenic bacteria

B. cereus TSH77 are made up of fengycin and surfactin; B. endophyticus TSH42 contained fengycin, surfactin, and iturin- Rhizome rot diseases in *Curcuma longa L*. were controlled, by these three bacterial strains.*Staphylococcussaprophyticus* and *Bacillus methylotrophicus* - antifungal activity against *Fusariumoxysporum, Alternariabrassicae, Rhizoctoniasolani, Sclerotiumrolfsii, and Colletotrichumtruncatum.*Antimicrobial activity of *Streptomyces sp*. - against *Metarhiziumanisopliae* (a fungal entomopathogen).

CONCLUSION

Termites have important role to modify physical properties i.e. bulk density, porosity, soil structure and particle shape, texture and chemical properties i.e. soil pH, organic carbon, nitrogen, total exchangeable base cations, phosphorus, cation exchange capacity of soil. Mound soil are physiochemically and morphologically distinct from surface soil . Whereas bulk density, clay contents, soil pH, organic carbon, nitrogen, calcium, magnesium, sodium, exchangeable base cations, and cation exchange capacity were greater in mound soil than surface soil . But the lesser value of porosity, dispersion ratio, potassium, phosphorus, exchangeable acidity, and C: N ratio found in mound soil than surface soil . Conical shaped mounds were the dominant micro morphological features, which also recorded greater nutrient concentrations than the surrounding soil.

It is a cheap and best locally available source with *all plants essential nutrients and microbes for nutrient cycling and availability* which is an *eco-friendly*, pollution free source. Mound soil can rectify physical, chemical and biological issue in soil natural environment. Termitaria soil act as aanti microbial agent, bio remediation, lignocellulose degradation and biofuel production. As a best alternate source for agricultural crop production and management. Reclamation for heavy metal contaminated soil.Thenative species isolated from mound soil paves a way for nutrient availability. Thetermitaria as a flux of nitrogen and carbon sequestrates.

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WATER FOOTPRINT: UNFOLDING THE POTENTIAL OF VIRTUAL WATER

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Dr. T. Nivetha*

Assistant Professor, PGP College of Agricultural Sciences, TNAU, Namakkal, Tamil Nadu

*Corresponding Author Email ID: nivethathangavel58@gmail.com

Introduction

In the growing concerns of environment, more steps are taken by the researcher, environmentalist and governments to protect our natural ecosystems from air pollution, land pollution, water pollution, climate change and deforestations. The population is increasing day by day at an enormous amount and water sources are decreasing. To prevent the scarcity of water, we should conserve more and understand the concept of water footprint in 21st Century. The percentage of purity and level of ground water gets decreased due to increased usage of virtual water. Eg. Soft drinks.

Water Footprint

The water footprint of an individual, community or business is defined as the total volume of fresh water used to produce the goods and services consumed by the individual or community or produced by the business.

It includes the water it took to produce the food you eat, the products you buy, the energy you consume and even the water you save when you recycle. The use of water may be direct use or indirect use. Direct use is the usage of water by means of direct consumption. Eg: Waterwe use for gardening, cleaning vessels, bathing and washing clothes. ndirectuse is the virtual water use, you may not drink, feel or see this water but it makes up the majority of your water footprint. **For eg:**1 cup of coffee needs 140 litres of water which means, a cup of coffee needs 140 litres of water to grow, produce, package and ship the beans. It takes a lot of water to produce gasoline. On average, 1 mile driven = about 3/4 of a gallons of water.

A water footprint generally breaks down into three components: the blue, green and grey water footprint. The blue water footprint is the volume of freshwater that is evaporated from the global blue water resources (surface and ground water). The green water footprint is the volume of water evaporated from the global green water resources (rainwater stored in the soil). The grey water footprint is the volume of polluted water, which is quantified as the volume of water that is required to dilute pollutants to such an extent that the quality of the ambient water remains above agreed water quality standards **(Hoekstra and Chapagain,2007)**

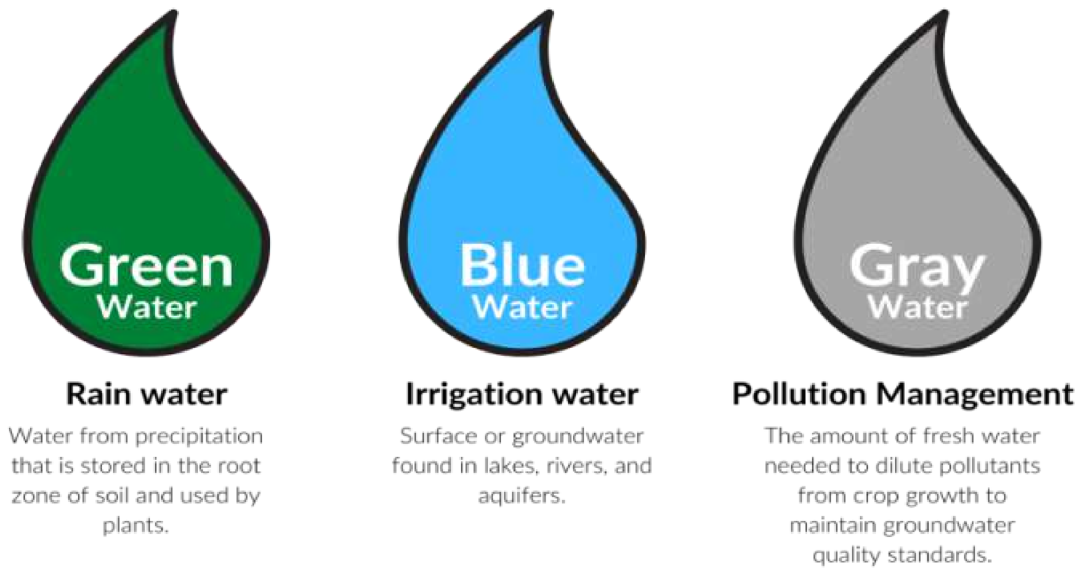

Fig 1: Green, Blue and Gray water (Source: www.waterfootprint.org)

Water footprint calculator

Numbers of websites are specially designed to calculate water footprints.For an illustration,https://www .active sustainability.Com /sustainable-life/ calculate- water- footprint/ for calculating our home water footprint.(Huellahidrica and United Explanations andUNESCO-IHE).

Water Footprint Calculator easycalculation.com

Home

When your house was built? After 1994

Does your household use a dishwasher? Yes

Showers/Week

Minutes to shower

Baths instead of showers/Week

Do you flush when you pee? Yes

Kind of Washing /machine Front Loading

Loads/Week

Outdoor

Do you have a greywater system in Home.? Yes

Do you have a rain barrel system in Home.? Yes

Poultry Servings Weekly

Pork Servings Weekly

Milk Cup Daily

Coffee Cup Daily

Transportation

Average fuel efficiency of car in m.p.g

Calculate Reset

Water consumed for diet gallons

Water consumed for transportation gallons

Daily Water consumption by human for personal needs gallons

Water consumed for Outdoor & Recycle gallons

Total Water Consumed gallons

Conclusion

This type of model should be developed in all fields (individual and national level) to know their water footprint. Limits should be monitored by the respective authorities to check the footprints level. Should measure water footprint continuously to keep the level as minimum as possible. As the world population expands, so does the need for fresh water. Maintaining fresh water level in our ecosystem is important because freshwater is vital to our daily life.

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SERICULTURE: A POTENTIAL AREA FOR STARTUPS IN J&K

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Kahkashan Qayoom* and Naveed Hamid

PhD scholar , SKUAST Kashmir, Srinagar, India

*Corresponding Author Email ID: kehkashanqayoom@gmail.com

Abstract

Sericulture, the process of rearing silkworms for silk production, has been an integral part of Jammu and Kashmir's heritage and economy for centuries. With its favorable climate and abundant mulberry plantations, the region has immense potential for sericulture-based start-ups. This article explores the opportunities and challenges in establishing sericulture start-ups in Jammu and Kashmir. It also discusses the various aspects of sericulture, including silk farming, cocoon production, silk processing, and marketing, and how start-ups can leverage these opportunities to contribute to the economic growth of the region.

Keywords: Sericulture; Jammu and Kashmir; Start-ups; Economic growth.

Introduction

Sericulture, often referred to as silk farming, is the process of cultivating silkworms and rearing them to produce silk. It is a labor-intensive and highly specialized industry that has been practiced in various parts of the world for thousands of years. Sericulture is a major agro-based industry that employs around 8.7 million people in India through a variety of on- and off-farm activities[1]**.**In Jammu and Kashmir, sericulture has a long history and has played a crucial role in the region's economy. The favorable climate, availability of mulberry plantations, and the abundance of skilled labor make Jammu and Kashmir an ideal location for sericulture-based start-ups.

Sericulture Potential in Jammu and Kashmir

Mulberry Cultivation

Mulberry cultivation forms the backbone of sericulture.Mulberry leaf quality is one of the factors that have the greatest ability to affect silkworm growth and development, as the leaf contributes approximately 38.20 percent to the successful rearing and production of high-quality cocoons [2]. Jammu and Kashmir has a favorable climate for mulberry farming, with its moderate temperature and abundant rainfall. The region has a significant area of land suitable for mulberry plantations, which can provide a steady supply of mulberry leaves for silkworms. Start-ups can capitalize on this advantage by implementing modern farming practices, promoting organic cultivation, and ensuring a sustainable supply of mulberry leaves.

Silk Farming

Silk farming involves the rearing of silkworms in a controlled environment. The eggs of the silkworm are hatched, and the larvae are fed with mulberry leaves until they spin cocoons. The rearing process requires careful attention to temperature, humidity, and nutrition. Start-ups can invest in state-of-the-art sericulture infrastructure, including temperature-controlled rearing houses, automated feeding systems, and advanced monitoring tools. By adopting advanced farming techniques, start-ups can ensure higher survival rates of silkworms and improve the overall quality and quantity of silk production.

Cocoon Production

Cocoon production is a critical step in the sericulture value chain. The quality and quantity of cocoons directly impact the quality and quantity of silk produced. Jammu and Kashmir has a significant potential for cocoon production, given its favorable climate and mulberry cultivation. Start-ups can focus on improving cocoon production techniques, including silkworm rearing, disease management, and silkworm seed production.Better sericulture techniques are now required in order to select potential cultivars based on disease resistance, biochemical properties, and their impact on the growth and economic parameters of many different races of *Bombyx mori* under various agroclimatic conditions[3].By collaborating with research institutions and experts, start-ups can develop disease-resistant silkworm varieties and implement effective disease control measures, ensuring higher cocoon yields and better silk quality.

Silk Processing and Value Addition

Silk processing involves various stages such as degumming, spinning, weaving, and dyeing. The state-of-the-art infrastructure for silk processing is crucial for start-ups to produce high-quality silk products. Start-ups can establish modern silk processing units equipped with advanced machinery and skilled workforce.37 reeling units exist in J&K, however, only 14 of them are active[4].The entire cocoon is not reeled in the reeling process; certain wastes are left from the good cocoons, such as deflossing waste, cooking waste, thread waste, charkha waste, basin waste, and re-reeling waste[5]and start-ups can explore value addition by diversifying into silk-based products like garments, accessories, home furnishings, and cosmetics. By incorporating innovative designs, sustainable production practices, and quality control measures, start-ups can cater to the evolving market demands and capture a wider customer base.

Opportunities for Start-ups

Employment Generation

Sericulture has the potential to create significant employment opportunities in Jammu and Kashmir. Start-ups can provide training and employment to local communities, especially women, who can actively participate in cocoon production, silk farming, and silk processing activities. This would not only empower the local population but also contribute to poverty alleviation and inclusive growth.

Economic Growth

The establishment of sericulture start-ups has the potential to contribute to the economic growth of Jammu and Kashmir. The production and export of silk and silk-based products can generate revenue, boost the region's GDP, and attract investments. The term "public-private partnership," or "PPP," is a generic one that is typically used to refer to a variety of contractual arrangements between the public and private sectors that permit increased production efficiency and innovation while promoting quick economic growth[6].Start-ups can also promote entrepreneurship and attract both domestic and international buyers, thereby enhancing trade and commerce. Additionally, by emphasizing sustainable and eco-friendly practices, start-ups can contribute to the preservation of the environment and promote responsible business models.

Challenges and the Way Forward

1 Infrastructure Development

To harness the full potential of sericulture, the development of infrastructure is crucial. Start-ups need access to modern technology, equipment, and research facilities for cocoon production, silk processing, and value addition. The government should focus on creating specialized sericulture zones and clusters with the necessary infrastructure and logistics support. This would require strategic planning, investment in research and development, and collaborations with relevant stakeholders.

2 Research and Development

Continuous research and development in sericulture are essential to improve productivity, quality, and sustainability. Start-ups should collaborate with research institutions, universities, and experts to develop innovative techniques, disease-resistant silkworm varieties, and efficient processing methods. The government should encourage public-private partnerships to facilitate research and development activities. By prioritizing R&D, start-ups can stay at the forefront of technological advancements, enhance product quality, and explore new market opportunities.

3 Marketing and Promotion

Effective marketing and promotion are vital for the success of sericulture start-ups. Start-ups should focus on branding, packaging, and creating a niche market for their silk and silk-based products. They can leverage digital marketing platforms, e-commerce channels, and social media to reach a wider customer base and establish their brand presence. The government can support start-ups through marketing assistance, participation in trade fairs and exhibitions, and facilitating tie-ups with domestic and international buyers. Collaborative efforts between start-ups and the government can lead to effective marketing strategies, increased market visibility, and sustained business growth.

Start-ups in Sericulture

The Lieutenant Governor of Jammu and Kashmir, along with the Prime Minister, has acknowledged the immense potential of sericulture in the region. They have emphasized the need to boost silk production and promote sericulture-based start-ups. The government has announced various schemes, subsidies, and financial assistance to encourage entrepreneurs and facilitate the growth of the sericulture industry in Jammu and Kashmir. Their statements highlight the government's commitment to creating a conducive ecosystem for start-ups and fostering economic development through sericulture.

1 Seri-business

Seribusiness is an entrepreneurial project that encourages young people to turn their ideas into successful businesses. Many people today have business ideas, but very few have the opportunity or aptitude to turn those ideas into successful businesses. The ability of young people to turn their ideas into profitable ventures is somewhat crucial to the success of small business start-ups. It is entirely up to the young person to decide whether to learn about an enterprise's potential profits and then put them to use. Sericulture is a business that employs people and includes high leaf-yielding mulberry types, silk reeling, recycling of seri-by-products, turning seri-waste into useful items, and cocoon art and craft, among other profitable activities. Finding the motivation for starting a business and developing a workable concept are the first steps in starting a profitable company. Following proper services like supplies, funding, and reliable suppliers, and this concept must be appealing and tested to determine how well it will meet customer needs.The final phase is to put the strategy into practise by launching a business and then creating a network of industry professionals to support the initiative [7].

2 ReshaMandi

ReshaMandi, the first digital sericulture start-up in India, was founded in Bangalore in 2020 by Mayank Tiwari and acts as a marketplace for farmers, stakeholders, and retailers across the nation. It connects farmers directly to consumers and is built on an IoT (Internet of Things) digital technology. It provides services including quality control, technical guidance, premium inputs, and market connections.[8]

Conclusion

Sericulture presents a promising opportunity for start-ups in Jammu and Kashmir. The Lieutenant Governor's and Prime Minister's statements on boosting silk production highlight the government's commitment to promoting sericulture-based entrepreneurship in the region. With its favorable climate, mulberry cultivation, and skilled labor, Jammu and Kashmir has the potential to become a hub for sericulture start-ups. By addressing challenges, developing necessary infrastructure, and promoting research and development, the government can create an enabling ecosystem for start-ups to thrive. Sericulture start-ups can not only contribute to the economic growth of the region but also preserve the rich heritage of silk production in Jammu and Kashmir. By harnessing the potential of sericulture, start-ups can empower communities, foster sustainable development, and position Jammu and Kashmir as a prominent silk-producing region in the global market.

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INHERITANCE OF DISEASE RESISTANCE IN VEGETABLE CROPS

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Shiv Narayan Dhaker[1], Sangita Sahni[2], BishunDeo Prasad[3*], Himanshu Shekhar[2] and Sarvani Gupta[2]

[1]Department of Horticulture, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar

[2]Department of Plant Pathology, TCA, Dholi, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar

[3]Department of Agricultural Biotechnology & Molecular Biology, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar

*Corresponding Author Email ID: bdprasad@rpcau.ac.in

Introduction:

In vegetable crops, disease resistance is an extremely important trait for crop productivity and yield. Disease resistance is the ability of a plant to withstand or tolerate a particular pathogen. Disease resistance in plants is a complex phenomenon and is influenced by many factors such as genetics, environment, and management practices. It is a multigenic trait that involves the interaction of multiple genes, and is known to involve both qualitative and quantitative traits. Over the past few years, considerable advancements have been made in the field of genetics of disease resistance in vegetable crops, providing a better understanding of the underlying mechanisms involved. This article will discuss the genetics of disease resistance in vegetable crops, including quantitative and qualitative resistance traits, modes of inheritance, and the identification and mapping of disease resistance genes.

Methods for Introducing Disease Resistance Genes:

There are several approaches to introducing disease resistance genes into vegetable crops. The most common approach is to cross a susceptible variety with a variety that carries a disease resistance gene. The offspring of this cross will then inherit the disease resistance gene from the resistant parent. This method is known as horizontal gene transfer.

Another method is to introduce disease resistance genes into a susceptible variety through genetic engineering. This approach has been used to create transgenic plants, which are plants that carry a gene from another species. Transgenic plants can be engineered to carry genes from different sources, such as bacteria, viruses, or other plants.

Quantitative and Qualitative Resistance Traits:

Disease resistance is a complex trait that involves the interaction of multiple genes and is known to involve both quantitative and qualitative traits. Quantitative resistance is the ability of the plant to limit the growth and spread of a pathogen. This type of resistance is usually polygenic, meaning it is controlled by multiple genes, and is often associated with environmental factors such as temperature, humidity, and light. Qualitative resistance is the ability of the plant to completely resist infection by a particular pathogen. This type of resistance is usually monogenic, meaning it is controlled by a single gene, and is associated with a higher level of resistance than quantitative resistance.

Modes of Inheritance: Monogenic and Polygenic Resistance:

Monogenic resistance is the most commonly studied form of resistance in vegetable crops and involves the inheritance of a single gene. These genes are usually dominant and are responsible for the expression of a particular trait. Monogenic resistance is usually highly effective and is typically associated with qualitative resistance traits. Polygenic resistance is the inheritance of multiple genes that interact with each other to produce a particular trait. These genes can be either dominant or recessive, and are usually associated with quantitative resistance traits. Polygenic resistance is typically less effective than monogenic resistance, but it can still provide some level of protection against certain pathogens.

Inheritance of resistance to the following

- Male sterility of tomato :- Single Recessive Gene
- Potato Virus A (potato): 2 independent dominant gene: Natbr, Netbr
- Hornworm of tomato: 3 recessive gene

- Heliothiszea of tomato: Single recessive gene
- Buck eye rot tomato: Single Dominant Gene (Br)
- Verticillium wilt of tomato: Single Dominant Gene (Ve)
- Tobacco mosaic virus of tomato: Two independent dominant gene (Tm-1 &Tm-2)
- Bacterial wilt of tomato: Polygene
- Anthracnose of brinjal: Single Dominant Gene
- Phomopsis blight of brinjal :- polygenic recessive
- Phytophthora of capsicum: Single Dominant Gene, Monogenic recessive (*Capsicum annum*)
- (Waxy Globe) and Leaf curl virus of chilli: - Single Recessive Gene (lc).
- Stalk rot of cauliflower:- Polygenic recessive gene
- Black rot of cauliflower:- Polygenic dominant gene
- Club root of crucifers:- Incomplete dominant and single recessive gene
- Cucumber green mosaic of cucumber:- Single Dominant Gene (Cgm)
- Angular leaf spot of French bean :- Single recessive gene
- Leaf hopper of French bean: Recessive gene
- Powdery mildew of pea: Two independent recessive gene (er, er-2)
- Bacterial wilt of pea :- single recessive gene
- Fusarium wilt, rust, near wilt, ascochyta foot rot :- Single Dominant Gene
- Powdery mildew of watermelon: Single dominant gene (Pm).
- Powdery mildew of turnip :- Single recessive gene
- Turnip mosaic virus resistance :- Single dominant gene
- Melon aphid: Single Dominant Gene (Ag)
- Red pumpkin beetle: Single Dominant Gene (41)
- Red pumpkin beetle of muskmelon: Single Dominant Gene (47)
- Fruit fly of cucurbits: Single Dominant Gene (Fr)
- Fruit fly of Cucurbita maxima: Single Dominant Gene (Fr)
- Onion downy mildew :- Single recessive gene

Identification and Mapping of Disease Resistance Genes

The identification and mapping of disease resistance genes is critical for understanding the genetics of disease resistance in vegetable crops. This process involves the use of genetic markers, which are gene sequences that can be used to identify and locate specific genes within a genome. Genetic markers are typically used in conjunction with traditional breeding techniques to identify and map disease resistance genes. Additionally, modern genomic techniques such as genotyping-by-sequencing (GBS) and whole-genome sequencing (WGS) can also be used to identify and map disease resistance genes.

Candidate Genes and Their Functional Characterization

Once disease resistance genes have been identified and mapped, the next step is to characterize the genes and their functions. This is typically done using molecular techniques such as transcriptome analysis or gene expression profiling. These techniques allow researchers to identify genes that are involved in disease resistance and can provide insight into the roles they play in the plant's defense system. Additionally, functional characterization of disease resistance genes can also provide insight into how they interact with other genes and how they may be used to improve disease resistance in vegetable crops.

Conclusion

In conclusion, disease resistance in vegetable crops is a complex trait that involves the interaction of many genes. Recent advancements in genetics have provided a better understanding of the underlying mechanisms involved in disease resistance. This review has discussed the genetics of disease resistance in vegetable crops, including quantitative and qualitative resistance traits, modes of inheritance, and the identification and mapping of disease resistance genes. Additionally, candidate genes and their functional characterization have also been discussed. These advancements in genetics are essential for improving disease resistance in vegetable crops and ensuring crop productivity and yield.

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EXPLORING THE COLOURFUL WORLD OF NATURAL EDIBLE PIGMENTS: A REVIEW

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Mangroliya Parita A[1]*, Hazra Tanmay[1], Sindhav Rohit G.[2], Ahuja Kunal K.[2]

[1]Dairy Chemistry Department, College of dairy Science,
Kamdhenu University, Amreli, 365601.
[2]Dairy Technology Department, College of dairy Science,
Kamdhenu University, Amreli, 365601.
*Corresponding Author Email ID: paritamangroliya0@gmail.com

Abstract

In the food and dairy industries, natural edible pigments are essential, as it provides attractive colours to various food products while also offering potential health benefits. This review aims to provide a comprehensive overview of the different natural edible pigments used in the food industry, including their sources, extraction methods and applications. Furthermore, the potential health gains associated with natural pigments, like antioxidant and anti-inflammatory properties of anthocyanin, betalain, curcumin are discussed. Overall, this review highlights the importance of natural edible pigments as a good substitute for artificial colours in the food industry.

Keywords: Anthocyanin, Betalain, Curcumin, Dairy, Natural edible pigment.

Introduction

Natural edible pigments have a long history that goes back to the earliest civilizations, when they were utilized to add vibrant colours to food and beverages. The Egyptians and Greeks employed saffron, derived from the Crocus sativus flower, to impart a golden yellow hue to their dishes.[1] Ancient Romans used murex sea snails to extract purple dye, while cochineal, a red pigment made from crushed insects, was used by various cultures.[2] Throughout the medieval and Renaissance periods, natural pigments like saffron, turmeric, and beet juice continued to be used for colouring food.[3] With the discovery of the New World during the colonial era, new natural edible pigments emerged, including annatto from the achiote tree and turmeric from Southeast Asia.[4,5]

Natural edible pigments have gained significant attention in the food industry as consumers increasingly seek natural and healthier alternatives to synthetic food colorants. These pigments, derived from various plant sources, offer a wide range of vibrant colours and contribute to the visual appeal of food products. Natural pigments such as anthocyanins from berries, beta-carotene from carrots, chlorophyll from leafy greens, and curcumin from turmeric have been extensively studied for their colour stability, health benefits, and sensory.[6] Research has focused on the extraction techniques, stability, and application of natural pigments in different food matrices, including beverages, confectionery, baked goods, and dairy products.[7] Moreover, studies have investigated the potential health-salubrious effects of natural pigments becauseof their anti-inflammatoryand antioxidant properties.[6] These research efforts contribute to a deeper understanding of the utilization of natural edible pigments in the food industry and their potential to meet consumer demands for clean-label, natural food products.

Resources

The majority of natural edible pigments come from the secondary metabolites of various animals, plants, and microorganisms. Many plants contain pigments that can be used as natural food colorants. Microorganisms and animals are another potential source of natural pigments. These sources of pigments are cultivated and processed to extract the pigments for use in food products. It has been traditionally used for colouring various food and beverage products. The brief details about resources op natural edible pigments were given in table 1.

Types of Natural Edible Pigments

The natural edible pigments were classified based on their solubility, resources, colour hue and chemical composition. Firstly, they can be divided into water soluble pigments (anthocyanin, betalain, etc.), lipid soluble pigments (carotenoids, chlorophylls, etc.), alcohol soluble pigments (annatto, curcumin, etc.). Secondly, it can divide into plant-based pigments

Table 1 Natural Edible Pigments and Their Resources

Types of Resources	Pigment Name	Source/Resource	References
Plant	Anthocyanins	Red and purple berries, grapes, apples, plums, red cabbage, red hibiscus, red rose, Black currant, onion, purple maize, Tea	8,9

		tree, Black-purple rice	
	Betalain	Beetroot, Prickly pear cactus, amaranth, dragon fruit	10
	Curcumin	Turmeric	11
	Carotenoids	Carrots, spinach, lettuce, tomatoes, sweet potatoes, broccoli, cantaloupe, winter squash	12
	Chlorophyll	Green vegetables. Spinach, alfalfa, Broccoli	13
	Annatto	Bixa orellana seed	5
	Lycopene	Tomatoes, pink guavas, apricots, watermelons, and pink grapefruits	14
Animal	Carmine	cochineal insect	2
	Tyrin purple	Murex snail	15
	Cuttlefish Ink	Cuttlefish	16
Microorganism	Spirulina	Blue-green algae	17
	Monascus	Monascus fungi	18
	Beta-glucan Yellow	Saccharomyces cerevisiae species	19

(Anthocyanin, betalain, carotenoids, chlorophylls, etc.), animal-based pigments (Tyrian Purple, etc.) and microorganism-based pigments (Spirulina, monascin, etc.). Further, it can also classify based on their colour hue into cool hue (Anthocyanins, spirulina, etc.), warm hue (lycopene, betalain, Carotenoids, curcumin, etc.) and others (Chlorophylls, melanin, cocoa pigment, etc.). The natural edible pigments cam divides into carotenoids, iridoids, indoles, polyphenols, pyridines, pyrroles, etc. according to their chemical structure.[20]The classification of natural edible pigment given in figure 2.

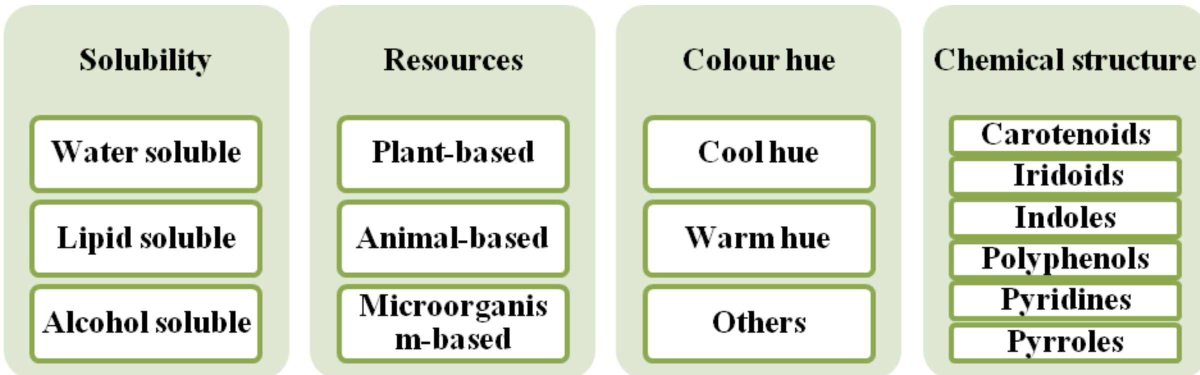

Figure 1 Classification Methods of Natural Edible Pigments

Extraction and Separation Methods

The majority of naturally occurring edible colours are intracellular compounds that diffuse into the solution through permeable membrane walls after being released from the intracellular environment. There were several extraction and separation methods such as, Soxhlet extraction, Maceration, Hydro-distillation, Supercritical fluid extraction, Pressurized liquid extraction, Microwave-assisted extraction, Pulsed-electric field (PEF) extraction, Ultrasound-assisted extraction, enzyme-assisted extraction, etc.[21] The advantages, disadvantages, solvent used and pigment separated by using different extraction methods were given in table 2.

Table 2 Advantages and Disadvantages of Extraction Methods (Modified from[*21])

Extraction Methods	Solvent	Pigment	Advantages	Disadvantages
Soxhlet extraction	Organic solvents (both polar and non-polar)	Anthocyanin, carotenoids, Chlorophyll	• Easy to handle • Low investment • Automated system	• Not suitable for heat-sensitive pigments • Long extraction time • Large solvent consumption
Hydro distillation	Water	Anthocyanin Betalain	• Easy to handle • Low investment • Automated system	• Not suitable for heat-sensitive pigments • Long extraction time
Supercritical fluid extraction	CO2 (non-polar) CO2 with	Anthocyanin Betalain carotenoids,	• Moderate extraction time • Applicable for	• Required sophisticated safety controls

	polar solvent	Chlorophyll Pheophytin	heat-sensitive pigments • Automated system	• High pressure leading to high capital and • operating costs
Pressurized liquid extraction	Organic solvents (both polar and non-polar)	Anthocyanin, Chlorophyll, Carotenoids	• Fast extraction • Small solvent consumption • Automated system	• Not suitable for heat-sensitive pigments • High investment
Pulsed-electric field (PEF) extraction,	Organic solvents (both polar and non-polar	Anthocyanin, Betalain	• Fast extraction • Applicable for heat-sensitive pigments	• Large solvent consumption • Filtration step required • Non-automated system
Ultrasound-assisted extraction	Organic solvents (both polar and non-polar)	Anthocyanin, Betalain, Chlorophyll, Lycopene, Pheophytin	• Fast extraction • Applicable for heat-sensitive pigments Simple	• Large solvent consumption • Filtration required • Non-automated system
enzyme-assisted extraction	Organic solvents (both polar and non-polar	Anthocyanin Lycopene carotenoids	• Applicable for heat-sensitive pigments • Easy to handle • Moderate solvent consumption	• Long extraction time • Filtration required • Non-automated system
Microwave-assisted extraction	Organic solvents (both polar and non-polar	Alizarin Puprin Betalain Carotenoid	• Fast extraction • Easy to handle • Moderate solvent consumption	• Not suitable for heat-sensitive pigments • Filtration step required • Non-automated system

Anthocyanin

Anthocyanins are pigments found in plants, fruits, and flowers that serve as visual signals to attract pollinators and seed dispersers. They are powerful antioxidants, protecting cells from damage caused by free radicals. They may also have anti-inflammatory, anti-microbial, and neuro protective properties, improving cardiovascular health, cognitive function, and managing conditions like diabetes and obesity.[8] Anthocyanins exhibit pH-dependent or pH-responsive colour changes, ranging from red, purple, and blue in acidic conditions to green or yellow in alkaline conditions. These changes are due to their structure and chemical reactions.[8]Anthocyanin colorants have potential applications in food science, cosmetics, and pH sensors due to their pH-responsive nature, making them ideal for developing indicators or dyes.[23]

Betalain

Betalains are pigments found in plants, primarily in the Caryophyllales order. They are water-soluble or alcohol-soluble and have two main types: betacyanins, which provide red-violet colours, and betaxanthins, which contribute to yellow-orange colours. These pigments exhibit colour-changing properties due to chemical reactions, and can undergo transformations due to factors like temperature, pH, light, and oxidation.[10]Betalains have potential health benefits, including antioxidant properties, which neutralize harmful free radicals and reduce oxidative stress. They may also have anti-inflammatory properties, potentially helping manage inflammatory conditions.[23]

Curcumin

Curcumin, a natural compound found in turmeric, has been studied for its antioxidant and anti-inflammatory properties. Its bright yellow colour and ability to neutralize harmful free radicals and reduce oxidative stress are associated with chronic diseases like cardiovascular disease, cancer, and neurodegenerative disorders. Curcumin also exhibits anti-inflammatory properties, inhibiting molecules and pathways involved in the inflammatory response, potentially alleviating inflammation. It has potential in modulating the immune system and supporting immune function, with immunomodulatory effects that enhance immune cell activity and regulate immune responses.[24] However, curcumin's bioavailability is relatively low, making it difficult for the body to absorb and utilize it efficiently. To enhance its bioavailability, curcumin is often combined with black pepper or other compounds.[11]

Application in food industry

Natural edible pigments are essential in the food and dairy industry, providing numerous applications and benefits. These pigments, derived from plant sources, enhance the visual appeal of food products, replace synthetic colorants, and offer potential health benefits.[9] They are commonly used in confectionery, bakery goods, beverages, dairy products, and processed foods. Natural edible pigments contain antioxidants and bioactive compounds that may have health-promoting properties. They can also be used in the dairy industry to create visually appealing products, such as yogurts, ice creams, and cheese. Natural edible pigments also help differentiate product variations and offer stability and resistance to processing conditions. The increasing demand for natural and healthier food options and regulatory restrictions on synthetic colorants have led to the extensive exploration and utilization of natural edible pigments in the food and dairy industry.[20]

Recently, Natural pigments also used in smart packaging combine visual appeal with functionality, offering vibrant colours, real-time product information, and health benefits. They align with sustainability goals and promote eco-friendly, renewable materials, making them a valuable addition to innovative, consumer-friendly smart packaging solutions.

Conclusion

In conclusion, natural edible pigments derived from various plant sources have gained significant attention in the food and dairy industry. This review paper discussed the sources, types, and extraction methods of these pigments, focusing on three prominent ones: anthocyanins, betalains, and curcumin, which are popular. Anthocyanins contribute vibrant red, purple, and blue colours, while betalains offer red-violet and yellow-orange hues, and curcumin provides a bright yellow colour. These natural pigments have shown potential health benefits, including antioxidant and anti-inflammatory properties. Furthermore, their applications in the food and dairy industry are vast, ranging from enhancing visual appeal, replacing synthetic colorants, and extending shelf life to meeting consumer demands for natural and clean label products. Overall, natural edible pigments hold promise as sustainable alternatives with functional properties for the food and dairy industry, catering to both aesthetic and health-conscious consumer preferences.

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MOLECULAR APPROACHES FOR SALINITY TOLERANCE IN PLANTS

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Nirubana V*, Sriram R and Dhanush B

Adhiparasakthi Agricultural College, TNAU, G.B.Nagar, Kalavai, Tamil Nadu – 632506

*Corresponding Author Email ID: nirujayammal@gmail.com

Abstract

Salt stress reduces land and water productivity and contributes to poverty and food security. Increased salinization caused by human practices and climate change is progressively reducing agriculture productivity. Soil salinity is a significant environmental problem and severely affects the yield of cereal crops due to numerous effects on plant-water relations, ion homeostasis and salt toxicity. Under high salinity, plants attempt to maintain cellular homeostasis through the production of numerous stress associated endogenous metabolites that can help to mitigate the stress. Both primary and secondary metabolites can significantly contribute to survival and maintenance of growth and development of plants on saline soils. The genetic diversity available within cultivated crops and wild relatives provides rich sources for trait and gene discovery that has yet to be sufficiently utilized. Transforming this knowledge into modern approaches using genomics, bioengineering and molecular tools for precision breeding will accelerate the development of tolerant cultivars for sustainable food production.

Keywords: Crop improvement, salt stress, salt tolerance, primary metabolites, secondary metabolites, bioengineering.

Introduction

More than 6% of world's total land area is affected by excess salts and considerable proportion of cultivated land is becoming saline because of human acts of land clearing, excessive irrigation and other factors related to climate change, including salt intrusion into coastal zones resulting from sea-level rise and an increased number of storms (Munns *et al.*, 2008). Excessive salt in soils has harmful effects on plant growth and productivity that can substantially reduce food production, particularly for major crops such as rice and wheat. The adverse effects of salt stress in reducing plant growth and productivity have two main causes namely (a) Osmotic stress reduces water uptake by roots and causes internal dehydration, with effects similar to those caused by drought, and (b) direct accumulation of salts leads to ion toxicity that disturbs metabolic processes, particularly in photosynthetic cells. Injury occurs when salts loaded in transpiring tissues surpass the ability of plants to extrude them from the cytoplasm, which largely relies on the mechanisms of Na^+ unloading from xylem, and Na+ sequestration in vacuoles. Primary metabolites (PM) are involved in plant growth and development, whereas secondary metabolites (SM) are derivative of primary metabolites, and both PM and SM play key roles in plant adaptation to environmental stresses, including saline stress (Kumari *et al.*, 2015).

Metabolic reprogramming in plants responding to salt stress

Various environmental stresses, such as salinity, drought and high temperatures, can lead to the hyper-accumulation of a wide range of metabolites in plants. The tolerance ability of plants against saline stress is typically based on their capacity to maintain a proper level of primary and secondary metabolic processes and defense responses. During the progression of saline stress, plants produce PMs and SMs as excretory products, which secrete from shoots, roots and leaves at different stages of plant development. As metabolites are the end products of various cellular processes, the plant metabolome is often considered to be the bridge between a plant’s genotype and phenotype.

Thus, metabolomic analysis can link the genotypic and phenotypic changes that occur in plants responding to saline stress, and help to investigate and identify the key differences between salt stress tolerant and salt stress sensitive plant species/genotypes. To understand the metabolic reprogramming under salinity stress, two general approaches have been used: targeted and non-targeted metabolomics. Targeted metabolomics is a tool for the identification, estimation and interpretation of specific or known metabolites in plants under stress. On the other hand, non-targeted metabolomics can produce a global overview of the most abundant metabolites found in plants under saline stress, when compared to unstressed control plants.

Effects of stress tolerance

Plant growth under saline environment is affected at two phase osmotic and ionic phase. The osmotic phase is due to the salt present outside the root, while ionic phase is due to the salt inside the root zone. The response observer in plant due to saline stress is inhibition of water uptake, root growth, cell elongation and leaf development. Salt stress also results in generation of ROS (reactive oxygen species). Major effects observed are yield reduction, inhibition of seed germination, inhibition of water uptake, inhibition of root growth, leaf senescence, oxidative stress, inhibition of protein synthesis, inhibition of enzyme activity and inhibition of photosynthesis.

Molecular response

Responses observed in plant due to salt stress in the molecular level stress responsive gene expression, expression of gene responsible for salt uptake, expression of gene with osmotic protective function, expression in gene responsible for tissue growth rate.

Mechanism of salt stress tolerance

Salt stress → Signal sensing → Transcription factor →

Gene activation → Salt tolerance

Bioengineering for improving salinity tolerance

Signaling transduction related genes

Transfer or over-expression of signaling genes resulted in salt tolerance. In transgenic tobacco plant SgNCEDI over-expression result in enhanced ABA accumulation which leads to reduction in transpiration, photosynthesis and stomatal conductance (Zhang *et al.,* 2006). Over expression of AtMPK3 and AtMPK6 activated by AtNDPK2 result in increased salt tolerance due to the reduction in concentration of ROS in plants (Moon *et al.*, 2003).

Regulatory gene

Transcription factor, the master regulator of plant growth and development are suitable for genetic engineering. Dehydration responsive element binding genes (DREB) are the important transcriptional factor responsible for salt tolerance. In rice, over-expression of

OsDREB2A improves salt tolerance. By adding the regulatory gene in the plant can greatly affect in salt tolerance (Mallikarjuna *et al.*, 2011).

Compatible Organic Solutes (COS)

Osmolytes are the low molecular weight organic compound which protect cell under stress condition. Solutes include proline, sugars, polyols and polyamines. Bioengineering of the gene related to this COS can increase the salt tolerance of the plant. In rice, over-expression of P5CS gene results in accumulation of proline, which in return increases the salt tolerance of the rice crop (Su and Wu, 2004).

Hormone gene

This plays the role in the signaling mechanism of plant in the stress condition which includes gibbrelic acid, jasmonic acid and salicylic acid. By improving the gene responsible for these hormones can greatly increase tolerance of plant against the salt condition (Wani *et al.*, 2016). In *Arabidopsis* overexpression of AtHD2c gene increase the ABA in the plant which reduces the salt stress of plant (Sridha and Wu, 2006).

Salt tolerant gene from halophytes for developing salt tolerant glycophytes

Depending on growth performance of the plant in the saline environment, plants are grouped into two halophytes (salt tolerant) and glycophytes (salt sensitive). Introduction of salt tolerant response gene from halophyte to the glycophytes by genetic engineering increases the salt tolerance of the plant.

Conclusion

The plant response to salinity stress through the changes of primary and secondary metabolites enable plants to maintain their minimal growth under such limited conditions. Many studies have shown that primary and secondary metabolites are involved in regulation of salt stress responses. The actions of metabolic compounds, such astrehalose, proline, glycine betaine, melatonin and Polyamines have been earlier recognized as effective priming agents against salt stress. The utilization of priming agents as protectants to enhance salt stress tolerance in plants is extremely promising. Furthermore, genetic manipulation based on altering the expression levels of metabolic genes to maintain the function and structure of cellular components has also proven to be a promising approach for improving saline tolerance in plants. Both the approaches can modulate those metabolic and regulatory genes in crop plants and increase their saline stress tolerance.

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INTEGRATED WEED MANAGEMENT APPROACHES IN SUGARCANE

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G. SENTHIL KUMAR*

*Associate Professor (Agronomy), Department of Rice, Tamil Nadu Agricultural University, Coimbatore – 641 003, Tamil Nadu, India

*Corresponding Author Email ID: senthilkolathur@gmail.com

Introduction

Sugarcane (*Saccharum officinarum* L.) a crop of tropical, provides around 80% of the world production of sugar and 35% of the ethanol. A member of the Poaceae, has tillers or stems bunched in to primary shoots, with a sucrose content of 10-12%.Major sugarcane producing states Uttar Pradesh, Maharashtra and Tamil Nadu.

Nature of weed problem

In sugarcane cultivation the nature of weed problem is quite different from other crops.

- It is planted with a relatively wider row spacing.
- Its growth is very slow in the initial stages, as it takes 30 to 45 days for complete germination and another 60-75 days for developing full canopy cover.
- It is grown under abundant water and nutrient supply conditions.
- In ratoon crop very little preparatory tillage is taken up, hence weeds that have established in the plant crop tend to flourish well.

Damage / losses caused by weeds

In India, the reported cane yield losses range from 12 to 72%.If weeds are not properly controlled in the initial stages, the yield loss could go upto 17.5 t/ha. Twining weeds like *Ipomoea* sp. which twine around clumps affect cane growth and cause around 25% loss in yield. Twining weeds escalating cost of cultivation and cause serious harvesting problem. The total cane yield loss in the country per annum is around 25 million tonnes (equivalent to 2.5 million tonnes of sugar) valued around INR 1500 crores. Poor growth of sugarcane resulting from weed infestation also causes quality deterioration. Bermuda grass (*Cynodondactylon*), Cogan grass (*Imperatacylindrica*) and other graminacious weeds are known to be alternate hosts to Ratoon Stunting Disease (RSD) of sugarcane. Weeds remove four times of N and P and 2.5 times of K as compared to sugarcane during the first seven weeks period.

Period of crop-weed competition

Weeds interfere with crops at anytime they are present in the crop. As a thumb rule, first 1/3rd of the growing period in many crops is critical period. The duration of a sugarcane crop is 12-16 months. So, in cane, the initial 120 days can be considered as critical period for crop-weed competition. Weeding around 100-120 days or 120-150 days after planting cane is as important as early weeding done in the initial crop growing period (30-40 days), as weed seeds keep on germinating because of wide row spacing and sun light reaching in the exposed inter row spaces (until full crop canopy development).Subsequently, frequent irrigations, heavy fertilizer dose and high temperature induce a number of new flushes of weeds, both grasses broadleaved weeds.

Weed flora

Sugarcane being a perennial crop (3-4 years in the same field) having all types of weeds, annual and perennials. Weeds which emerge only during rainy season are *Echinochloacolonum* and *Echinochloacrusgalli* (grasses), *Amaranthusviridis* and *Celosia argentia* (broad leaved weeds).Weeds which emerge before the start of monsoon are *Cyperusrotundus* (sedge), *Cynodondactylon* and *Sorghum halepense* (grasses).Annual weeds like *Chenopodium album, Lathyrus sativa*, *Vicia spp.*, Parasitic weeds Partial root parasite – *Striga lutea*

IWM approaches

Weed control is the process of limiting weed infestation so that the crops could be grown profitably and other activities of man conducted efficiently.

I. Cultural method

1. Intercropping

- Sugarcane is widely spaced slow growing sugarcane in the beginning; suitable intercrop not only reduces weed population but also produces additional yield (Singh *et al.,* 1993) and returns.

- Crops like greengram, blackgram, clusterbean, onion, okra in autumn planted sugarcane cropare taken up as intercrops.

2. Paired row planting with drip irrigation

- In paired row planting of sugarcane, 4 feet spacing is left between the centres of two adjacent beds. Distance between two lines of planting in paired row is 30 cm and 30,000 numbers of two budded sets are placed in such a way that sets are overlapping one another in succession
- The water soluble fertilizers are administered through drip irrigation in frequent interval and fertigation can be continued well up to10th month of crop growth.

3. Trash mulching

- 45 DAP trash mulching at 7.5 t/ha to an average thickness of 10-12 cm should be provided in between cane rows. Trash cover restricts sunlight and checks weed emergence.
- Besides, suppressing weeds, trash mulching also conserves soil moisture, and provides a potential source of organic matter.

4. Crop rotation

Certain weeds have association with sugarcane crop and hence, mono cropping of sugarcane may lead to severe crop-weed competition. Inclusions of green manure crops or fodder crops like sorghum not only suppress weeds but also help in crop diversification.

II. Mechanical method

1. Hand hoeing

Hoeing controls weeds and improves physical condition of soil which facilitates soil aeration and profuse cane root development. Generally, 3-4 hoeing are required after every irrigation during tillering phase of crop to check crop-weed competition.

2. Blind hoeing: It is helpful in controlling annual /perennial weeds and improving germination of sugarcane crop. Later, two hoeing/ inter- culture may be done when the crop is at knee height.

III. Chemical method

Herbicides are being extensively used for weed control in many sugarcane growing countries of the world for the following reasons.

- Labour is becoming scarce and costly.

- Conventional methods are inefficient.
- Initial weed growth cannot be controlled by conventional methods.
- Timely weeding is becoming difficult by conventional methods and becoming time consuming and costly.

Conclusion

The maximum cane yield could be obtained by three hoeing at 30, 60 and 90 days after harvest (or) Spraying of Atrazine @ 2.0 kg/ha as pre-emergence herbicide / 2,4-D @ 1.25 kg/ha as post-emergence at 90 days after harvesting / directed spray of glyphosate @ 1.0 kg/ha on 150 days after harvesting. Weed management in Sugarcane intercropping system is pre-emergence application of Thiobencarb @1.25 kg a.i / ha or PPI of Fluchloralin or Trifluralinor pre-mergence application of Alachlor.

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Momordica cymbalaria AN UNDER EXPLOITED MEDICINALLY VALUED VEGETABLE

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[1]Krishnan, V., [2]A.Anuratha,[1] V.Kandaswamy,[1] T.Anandhan, [1]A.Premkumar and [1]D. Umamaheswari

[1]Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, U. T. of Puducherry-609603.

[2] Agricultural College and Research Institute, Tamil Nadu Agricultural University, Keezhvelur, Nagapattinam district, Tamil Nadu-611104.

*Corresponding Author Email ID: anurathakrishnan66@gmail.com

Introduction

Momordica cymbalaria (2n = 22) is commonly called as Little Wild Gourd (in English), Karchikai (in Kannada), Athalakkai (in Tamil) or Kasarakayee (in Telungu) and Kakrol (in Hindi).It is a vine of the genus *Momordica* belonging to Cucurbitaceae (Pumpkin) family. It is a relative of bitter gourd (*Momordica charantia*) having higher levels of bitter components (Charantin and Momordicine) than bitter gourd. The other related species include *Momordica balsamina* (Balsam apple), *Momordica foetida* (the wild Cucumber found in Africa) and *Momordica cochinchinensis* (Scarlet eggplant found in Vietnam). *Momordica cymbalaria* have its origin from tropical regions of India and South East Asia and now found in African countries such as Eritrea, Ethiopia, Kenya, Sudan, Tanzania, Uganda, and Southeast Asian countries like India, Pakistan, Bangadesh, Srilanka and other Southeast Asian countries. In India, it is found in the Western and Eastern Ghats ofAndhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, and Tamil Nadu (Samaddar*et al*., 2015). In Tamil Nadu it is mostly cultivated in the black soils of Southern districts such as Virudhunagar, Madurai ,Dindukal, Thenkasi, Thirunelveli, Thoothukudi, Ramanathapuram and Kanyakumari. It is very popular in Sathur areas of Virudhunagar district. It is mostly found along the garden fences, water channels and as a perennial weed in black soils of Southern Tamil Nadu. The fruits and tubers were used in the traditional medicine and as well as vegetable food by the tribal farmers. This species is being conserved by farmers growing at the home province for ethnic usage as traditional knowledge. The nutritional and economic significance of this species is unexplored due to the lack of its popularity.

Botanical description

Herbaceous annual trailing pubescent herb arising from a small perennial turnip shaped tuberous rootstock. A limited number of perennial tubers survive in soil and produce single plant in the next season. Leaf blade reniform, orbicular, cordate or pentagonal in outline, obscurely sinuate to distinctly sinuate-toothed, slightly fleshy, glabrous or sparsely hairy especially on the nerves beneath, 7–30 mm. long, 12–47 mm broad, five angled or obscurely five lobed; petiole pubescent, 5–40 mm. long. Tendrils produced in leaf axils that are simple. The plant is monoecious with white to yellow coloured male and female flowers. Male flowers 1–4 apical on a 1–20 mm long peduncle, subtended by a minute bract; pedicels 3–8 mm. long; receptacle-tube obconic, 1.5–3 mm. long; lobes lanceolate, acute, pubescent, 3–6 mm. long; petals yellow, 7.5–12 mm long, 3–8 mm broad, 2 with scales inside at the base; stamens 3 or 2; thecae arcuate. Female flowers on 5 mm long stalks; ovary fusiform, glabrous or pubescent, 5–12 mm long, 1.5–2 mm across; lobes linear, 2.5–3 mm long. Fruit pyriform with eight sharp longitudinal ridges, resembling miniature ribbed gourd, on a 6–45 mm long stalk, fleshy, dark green, fusiform, shortly beaked, pubescent, 16–27 mm long, 7–10 mm across. Seeds sub-globose, 6–7 × 4–5 × 3–5 mm, rugose-appendaged at one end; testa smooth, obscurely sculptured in very low relief.

Growing condition

Momordica cymbalaria is a perennial warm season trailing vine that grows in summer (June and July) and autumn (September and October) and the matured fruits are harvested from November to January. It can grow in the warmer regions. The plants belonging to this family are frost-sensitive, drought tolerant, and intolerant to wet and poorly drained soils. They grow on barren lands and on field bunds as a weed. The plants are very sensitive to extreme condition of rainfall, but moderate rainfall is good for its growth.

Cultivation method

The Tubers can be planted on one sides of the raised beds which are three meters apart and plant to plant distance need to be 45cm and are planted at the depth of 10 cm with a spacing of 60×45 cm. The cultivation requires no special attention and it grows fast and vigorously and trails on the ground. It starts its flowering within 16-20 days and harvest of fruits can be done from 30 days after planting and continue up to 45 days. The fruits are borne on the underneath of trailing vine and care should be taken to collect all the fruits during harvest. The number of fruits per vine would range from 15-20. Individual fruit weight ranged from 16 -65 g and the average fruit yield per vine ranged from 30-35 g.

Vegetable value

The fruits are cooked as vegetable similar to Bitter gourd as a vegetable in a curry or as stir fries. The leaves are also edible, but due its bitter taste it is not preferred as a green vegetable. Though Little wild gourd have higher bitter taste than bitter gourd, they are tastier than bitter gourd. The fruits are 20-25 mm in length and can be easily prepared for cooking by just removing both the ends of the fruit. The fruits are easily digestible for all age group of people.

Nutritional value

The fruit of *Momordica cymbalaria* contains Carbohydrates 12.60 %, Protein 2.15 %, dietary fiber 6.42 %, Carotene 0.01 %, Calcium 72 mg, Sodium 40 mg, Potassium 500 mg, Iron 130 mg, Zinc 2.82 mg, Manganese 0.32 mg, Copper 0.18 mg, Phosphorus 5.5 mg and Vitamin C 290 mg. *Cymbalaria* fruit contains three times more Calcium, two times higher ascorbic acid and Potassium than its counterpart Bitter gourd. Hence, *Cymbalaria* fruit if taken can strengthen our bones and heart muscles due to higher calcium level;can heal wounds, repair and maintain bones and teeth due to higher ascorbic acid content and can maintain normal fluid levels and support normal blood pressure due to higher levels of Potassium (Jha*et al.*, 2018).

Nutraceutical value

The plant is traditionally used for the treatment of *Diabetes mellitus*, rheumatism, ulcer, skin disease, and diarrhoea. The fruit of this plant have been reported to possess hypoglycemic, hypolipidemic, cardio protective, hepatoprotective, nephroprotective and antioxidant properties.The fruit of *Momordica cymbalaria* contains significant amount of such as phenolic acids, flavonoids, carotenoids cucurbitanetriterpenoid and phytosterolIt contains bitter glucoside, beta-sitosterol, steroidal saponin and starch.

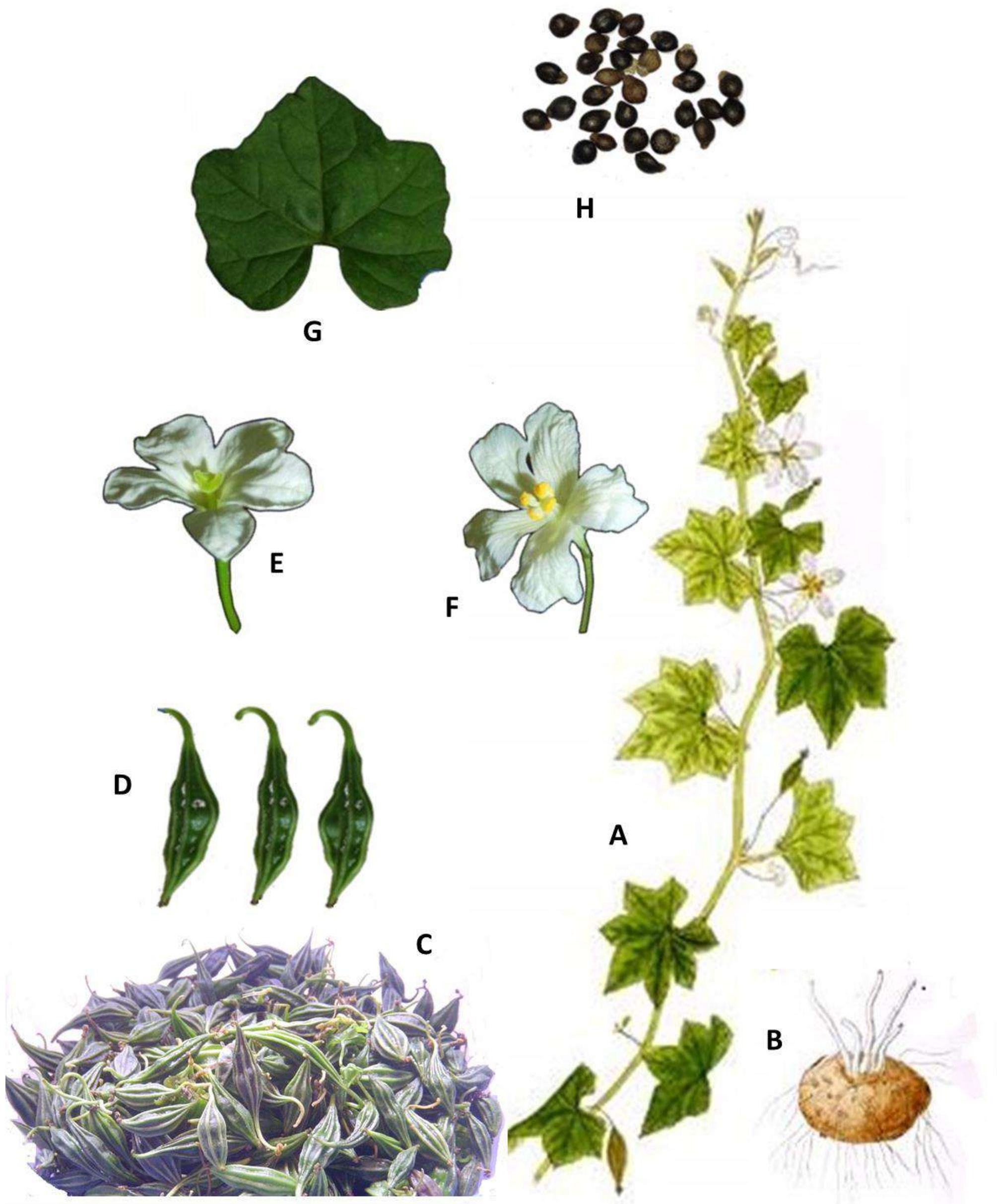

Fig.*Momordica cymbalaria* – Little Wild Gourd. A. Plant, B. Root tuber, C. Harvested fruit, D. Siingle fruit, E. Female flower, F. Male flower, G. Single leaf and H. Seeds

It also contain Cucurbitacin like other cucurbitaceous vegetable which is a terpinoids that has a hypoglycemic property (Jha*et al*., 2018). The root contains Oleanane type of triterpinodsaponin which has antidiabetic activity (Koneri*et al*., 2014). The seed contains conjugated fatty acids which were found to be Punicic acid which has antidiabetic, antiobesity, antiproliferative, and anticarcinogenic activity against various forms of cancer. The triterpinoidsaponin of *Momordica cymbalaria* show neuroprotective activity and improves muscular grip strength, reaction time to pain sensation and nerve conduction velocity (Samaddar*et al*., 2016). The steroidal saponin of *cymbalaria* fruit can prevent carcinogenesis in breast cancer due to its antiestrogenic and antioxidant activities (Jha*et a*l., 2018). Further the root extract of this plant have antimicrobial activity against *Staphlococcus aureus*, *Klebsiella pneumonia*, *Escherichia coli*, *Pseudomonas acruginosa* and *Aspergillusniger* (Balkhanda and Surwase, 2013).

Health benefits

1.Little wild gourd fruits are considered as a tonic, stomachic, hypolipidemic, cardioprotective, hepatoprotective, nephroprotective, antidiabetic, stimulant, laxative, antioxidative and useful in treating gout, rheumatism and sub-acute cases of spleen and liver diseases.

2. Fruit juice is employed for diabetes, malaria, colic, sores and wound infections, worms and parasite control as an emmenagogue to control measles, hepatitis and different fevers.

3. The leaf tea is useful in controlling worms, parasites and related fevers.

4. The seeds possess antihelmintic activity and eliminates worms from intestine.

5. The root act as astringent, abortifacient, aphrodisiac and useful to treat constipation, indigestion, control diabetes, diarrhoea and rheumatism.

6. *Momordica cymbalaria* herb can revive testicular damage by improving the levels of testosterone and antioxidants in alloxan-induced diabetic mellitus. Hence, this plant could be considered as a source of herbal remedies to treat male infertility associated with diabetes mellitus.

7. Theleaves of this crop are also used for therapeutic uses as these contain flavonoids, steroids, Tri terpenes, Saponins (PramodKumar *etal*., 2010).

8. Tubers have been reported to contain sterols, Triterpenes, Cardiac glycosides, and Saponins(Fernandes*et* al., 2007).This crop can act as a weapon against malnutrition and hunger.

Advantages

1. It can be easily propagated through root tuber or even by its portion of tuber that contains the germinating bud.

2. It sprouts on the onset of monsoon and remain dormant during dry summer period.

3. It has a short life cycle of around 45 days and begins to flower and fruit within a month.

4. It need no special cultivation practices and can grow perennially year after year, once planted.

5. Since, the fruit has a bitter component, it is not attracted by animals and birds and hence no protection against them is needed.

6. It comes up well during *kharif* as well as *rabi* seasons and can be cultivated year around as a continued income year around.

7. The plant is a trailing on ground and hence requires no support or trellis for cultivation.

8. Because of its multiple health benefits there is a great demand for its fresh fruits in the urban as well as rural vegetable markets.

9. The fruits can be pickled for use in off-season as well as preserved as a dry fruits for regular use.

10. All plant parts have health benefits and hence have high economic value if cultivated.

Disadvantages

1. Because of high bitter principle component it is not preferred by many people and need to create awareness

2. The fruits need to be cooked within a short period of time as the seeds germinate by bursting of fruit.

3. Once established, they remain permanent and difficult to eradicate from the field. They keep on sprouting year after year and eradication as a weed plant is very difficult.

4. The market potential of this fruited medicinal vegetable need to be taped for getting a reasonable income from its cultivation.

5. It need to be sold within a short period after harvest as its seed germinate and spoil the market value of the fruits.

Conclusion

Momodica cymbalaria is an underutilized fruited vegetable having high therapeutic and heath benefits. It is less known to the common people, the farming community and it is cultivated is specific locations by very few farmers who know the values and market secrets of the crop. This vegetable is rich in nutrients such as calcium, Vitamin C, Potassium, Iron and various phyto-factors that have high nutraceutical values. This a very short duration crop and have export value if properly cultivated and processed. This underutilized medically valued fruited vegetable need awareness measures to increase the income status of the economically deprived poor dryland farmers of Tamil Nadu.

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TEXTILE WASTE RECYCLING - RECLAIMED FIBRES

[1*]Mrs. Radhika Damuluri and [2]Dr. Sudha Babel

[1*]Assistant Professor, Dept. of Apparel and Clothing, College of Community Science, PJTSAU, Hyderabad, Telangana.

[2]Professor, Dept. of Textiles and Apparel Designing, College of Community and Applied Sciences, MPUAT, Udaipur, Rajasthan.

*Corresponding Author Email ID: radhikackrishna@gmail.com

Introduction

Sustainability in textile industry has become the necessary approach due to the ecological concerns. The term sustainability encompasses not only the manufacturing process, also includes the environmental concerns, the use of renewable resources and finally adoptability of sustainable products by larger segment of consumers. The fashion cycle durations are decreasing, leading to fast acceptance, and fast obsolescence of the fashion clothing, which is causing fast growth in textile wastes. However, a promising solution for this problem is recycling of textile wastes, for developing value-added products. Hence, many textile waste recycling technologies are developed by textile waste management systems worldwide.

Textile waste:

Textile production waste includes all the production remnants of raw materials used in textile industry, filament or fibre manufacturing waste, spinning, weaving and knitting wastes and wastes of reprocessed materials. The textile production wastes can be classified in to three categories

Cotton spinning mill waste

1. Trashy waste: waste which requires cleaning before reprocessing. E.g.: blow room wastes, carding waste, carded flat strips and filter waste.

2. Clean waste: waste that does not require any further cleaning. E.g.: comber waste, card draw frame waste, combed sliver waste, filter waste from draw frames, speed frames, wastes from ring and rotor spinning machines.
3. Hard waste: some textile waste gets entangled and hardened due to constant exposure to climatic factors such as high temperature, humidity and rains, which needs to be opened and detangled with special purpose machines.
4. E.g.: twisted roving, yarns and textile fabrics - woven rags and knitted rags.

Wastes from textiles can be also classified as

1. **Pre-consumer waste:** sometimes, if the textile materials do not meet the standards, they are discarded before selling in retail stores. These waste materials can be sold as it is to third party buyers, who use them for consumer products, they can be broken down and remade in to similar or different materials. these wastes consist of waste by-products of fibre, yarn, textile and apparel manufacturing. It includes mill ends, clippings, scraps and damaged goods. Most of these are reclaimed as raw materials for furniture, automobiles, mattress, home furnishings, coarse yarns, paper and other industries.

Pre-consumer waste

2. **Post-consumer waste:** Any textile product that is no longer needed or used and decided to discard due to wear or damage, includes worn clothing, drapes, curtains, towels, sheets, blankets, clean rags, sewing remnants, table cloths, hand bags, belts, shoes and socks etc.

Table.1. Types of waste produced in different production industries:

S. No.	Production type	Types of waste
1.	Spinning waste, yarn waste	Opening Waste, Carding Waste, Sliver Waste, Roving Waste, Combed Noil, Bonda soft waste, Pneumafil Waste, Bonda hard waste from ring spinning, winding and doubling.
2.	Waste from clothing production	Fibre and yarn wastes from knitting and weaving industries, wastes from woven and knitted fabric cutting.
3.	Nonwovens production waste	Thermally and chemically bonded, lightweight webs, needled webs, coated, uncoated.
4.	Carpet mill waste	Needle felt, tufted carpet, cut waste, coated, uncoated
5.	Used textiles	Old clothing

Benefits of Recycling Waste:

- Reducing cost of purchasing materials.
- Increasing profitability.
- Minimizing costs of disposal and treatments.
- Minimizing environmental impacts by reducing use of new raw materials and producing products from earlier one.
- Recycling of textile wastes consumes less energy than other recycling of other wastes.
- The textile waste recycling does not produce any toxic by-products.
- Reduction in landfills
- Provision of raw materials for products

Reclaimed fibres:

One of the key approaches for the sustainable textile waste recycling is reclaimed fibres. Reclaimed fibres are obtained from the secondary cycle of processing. The fabric or yarn stage of textile material waste is mechanically broken down to the fibre stage. the waste is subjected to cutting or picking action. The textile material is transported through a drum like structure having steel pins, which will break down the textile in to fibres with repetitive picking action.

Reclaimed fibres

Why reclaimed fibres :

- In this process the functional properties of the material are maintained intact such as fibre tenacity, non-flammability etc., which can be made use several times.
- The reclaimed fibres are of low cost.
- Availability of raw materials and waste disposal ae a becoming more and more expensive in case of synthetic fibres.
- In the light of ecological aspects also it is essential to recycle household and industrial textile waste. Reclaimed fibres are the solution.
- Considering consumption of energy for recycling of textile waste, when compared to other physical and chemical methods of recycling viz. re-granulation and fibre production, breaking down the textile material to reclaimed fibres is most economical.

Characteristics of reclaimed fibres :

Reclaimed fibres are most suitable to production of nonwovens and yarns. When compared with primary fibres, their characteristics differ because they are subjected to lot of damage and may consists of large volume of short length fibres, threads and pieces of fabric not broken up. Generally, the fibre content may be made of blends. It is difficult to find a single polymer component in reclaimed fibres. Preparation of non-woven, whether from fresh fibres or reclaimed fibres require long lengths of fibres, to undergo spinning and web formation. Hence optimum breaking down process is essential. Present day technologies allow fibres of 10 mm length or more to be utilized from reclaimed fibres.

As compared with primary fibres, the quality of reclaimed fibres is difficult to define. The blends of reclaimed fibres are heterogeneous, rich in short fibres and short pieces of textile material (bits and pieces of thread and fabric). Hence test equipment used for testing textile properties differs from those used for primary fibres.

The most important parameters of consideration to assess the quality of reclaimed fibres are the degree of breakdown of material, fibre length and distribution of fibre length.

The ***degree of breakdown*** indicates the sprectrum of materials resulting from the break down process. It is defined as the proportions of fibres, threads, bits and remains of fabric in a specimen of 3g or 10g blend of reclaimed fibres, depending on proportions of unopened pieces by manual separation, in units of mass percent.

The ***proportion of fbires*** can be added together where the waste material is processed by means of carding to make nonwovens. Further processing may be done in case of yarn production. But spinning process adopted effects the yarn quality, if spinning is overdone, damages yarn quality.

Attempts are being made to use image processing, but problem is faced with singling of fibre specimen as well as the definite attribution of fibres at those points, where they cross each other. Both producers and users of reclaimed fibres should know the material composition of the blend of fibres. It can be defined by quantitative chemical analysis of reclaimed fibres, which will decide the cost of the product. Reclaimed fibres can be manufactured from a wide variety of textile waste. Quality and processability of reclaimed fibres depend on the type of waste. Pure sorted high-quality fibres are manufactured from spinning fibre waste. Whereas reclaimed fibres made from end of the life textiles are of poorer quality. Usually reclaimed fibres will be of heterogeneous nature.

Products made from reclaimed fibres:

1.Yarns:

Yarns are most commonly manufactured from reclaimed fibres. Recycled wool has been used industrial processes since long time. Rotor spinning, yarn covering process, friction spinning DRFE are used for economical yarn production. It was found in a research study on the rotor spinning, that the recovered fibres can be blended with pure fibres without much change in quality. It was found from the studies that the introduction of 15 and 25% waste fiber into the cotton will not affect the tenacity, the irregularity and the rotor yarn elongation.

Yarns made from reclaimed fibres are used for produce fabrics for garments, household textiles and technical applications. However, yarns made from reclaimed fibres are dark in nature and may not be used in making of garments or household textiles. *

2. Home textiles:

In every weaving operation 3-4% of weft yarn, catch selvedge yarn strip are unavoidable wastes and are sold at minimal price. The fibres are separated from this waste by a garnetter. The resultant fibre is used for stuffing of pillows and quilts, making of fancy composites for floor coverings. Wool fibre recovered from catch selvedge can be used to make blankets. By -products from wool industry, inferior quality wool, not suitable for spinning are a great source of renewable biopolymers. Hairs and feathers are made up of keratin, which can be transformed in to products suitable for various end uses such as fibres, packaging, disposables, membranes, agricultural films and coatings.

3. Nowovens:

More than yarn production, reclaimed fibres are mostly used for making of nonwovens. The nowvens made with reclaimed fibres have high strength compared to ring spun yarns

- Good roughness
- High volume than rotor or ring spun yarns
- Good processability due to low hairiness (reclaimed fibres are blended with primary fibres for easy processability)
- Good capacity to serve as in-depth filters

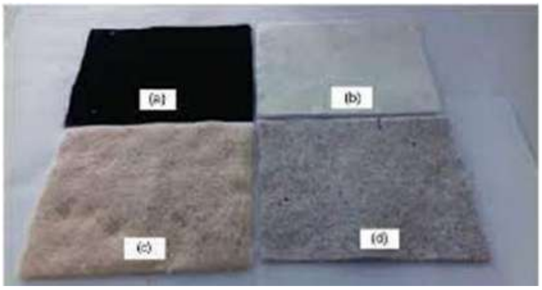
Nonwoven made from reclaimed fibres:

- Reclaimed fibre-based nonwovens include materials used to cover surfaces, to insulate materials, agrotextiles and geotextiles.
- High grade woollen fibre used in laminated nonwovens is used to make upholstery composites for motor vehicle seats.
- Aramid fibres used to protect against cutting or impact penetration
- Micro-fibres used for insulation or cleaning

❖ Needle-punched warp knitted nonwoven materials are used to substitute the components made of polyurethane foam in laminated composites.

Other nonwoven products made from reclaimed fibres:

Insulation materials: Nonwovens made from reclaimed fibres are used to manufacture insulation materials. Insulation materials are an important requirement in construction work. Many types of nonwovens are used for ventilation purposes such as thermal insulation, conduction and radiation. They are key to managing balance of energy consumption.



Nonwoven insulation mat materials

Carpet underlay: carpet underlay is a thin layer of cushioning used in different forms of carpets for purposes such as absorption of moisture, noise and heat. There are different types of materials used to make underlays such as reclaimed fibres, sponge, rubber, foam and crumb rubber.


Carpet underlay

Stuffed toys: low-coststuffed toys are made with fibre fill and nonwovens made from reclaimed fibres.


Stuffed toys

Shoe insoles: they are used underneath, inside the shoes to provide more comfort and protection to the wearer. They can be easily removed. These insoles are made from nonwovens of reclaimed fibres.

Nonwovens of reclaimed wool used for water cleaning: Industrial sewage cleaning requires a filter of high standards to meet the Govt. regulations. A nonwoven made of reclaimed fibres is of good value, can substitute costly synthetic fibre materials. The nonwoven can be used to absorb heavy metal ions, oils. This requires surface modification treatment. Hence a woollen nonwoven is treated with biopolymer chitosan and low temperature plasma to ensure that heavy metals are better absorbed. Research has shown that woollen reclaimed fibres are suitable to absorb Pb+2 ions. The absorption of Cu and Zn was also improved through chitosan and plasma treatment.

4. Technical textiles:

Reclaimed fibres are finding application in various kinds of technical textiles. Pre-requisites to use reclaimed fibres for technical textiles are:

The following parameters should be well defined by manufacturers

- Kind of fibre material, blend of fibre material
- Colour of fibre, fibre blend and shades
- Fibre lengths
- Fibre strength, fineness
- Waste pre-treatment – is the waste washed or cleaned from dust, is the waste separated from non-textile components, is the waste sorted with respect to colour and polymer contained in it, is the waste pre-cut or pre-broken etc. the waste should be blended depending on the final product required.
- Variation of process parameters, while breaking down the waste – based on the kind of waste, good quality reclaimed fibres can be produced. Energy conservation can be maintained at lowest level possible.
- After-treatment – should focus on further enhancement of the quality parameters reached in the breaking down process, so that reclaimed fibres become more competent. The steps should be taken to clean from dust, blending, eliminating short fibres etc.
- Quality assurance – improving quality of reclaimed fibres means, lower cost with regard to pre-treatment, higher efficiency of the production technology and better process ability.

Mat made from reclaimed fibres: conventional perforated drums are used in every breaking down unit. These perforated drums suck in the material taken from the drum and clean it from dust. During this process, formation of a mat structure similar to an entangled web takes place, which is fed in to the succeeding breaking down unit. The textile mats are fixed by needle punching or by thermo-fusion (fixing and moulding). Eg: roof top green mats.

Mat made from reclaimed fibres

5. Blends of reclaimed fibres and foam particles:

Textile fibres are blended with foam particles and then, using an entanglement process, made in to nonwovens which are used for insulation. The foam particles may be recycled from end of the life vehicle seats. However, it is not easy to ensure homogeneous blend production and web formation. Mechanical bonding by needle punching is most suitable process. Bonding is done by thermos-fixation.

6. Industrial applications:

Table. 2. Industrial applications of reclaimed fibres:

S. No.	Industry	Application area
i.	The non-woven industry	Automobile industry: the products made from reclaimed fibres i) Insulating webs -provide sound and heat insulation ii) Hardpressed materials used for floor coverings, interior coverings, lining of trunk, etc., felted materials are used for carpeting.
ii.	Furniture industry	Mattress covers, mattress webs, bottom webs for seating in furniture, upholstery material, wadding material. Wiping cloths Needled webs.
iii.	Carpet industry	Bottom felts for carpeting
iv.	Building industry	Sound and heat insulating webs, filter products, nonwoven coating substrates, and footfall sound insulation. The sheared pieces of textile wastes can be used in insulation materials also in concrete used for road construction.
v.	Textile industry	Spinning waste, blended yarns or 100% waste yarns for spinning to the DREF or rotor spinning process (wiping cloths, blankets, and home furnishings), comforters made of acrylic knit goods waste.
vi.	Agriculture industry	Covering webs, seed carrier webs.
vii.	Paper industry	Wearing felts for paper production, Crude felts for bitumen roofing felts.

Limitations of recycling:

- No special incentive is given for waste reduction.
- Low values, high transportation cost or lack of market demand for recovered materials
- Most of the recycling units are able to recover small to medium scale only, which is not encouraging the investments in recycling units.

Conclusion

A large amount of textile waste is disposed of in landfills each year, which not only poses economic and environmental problems to the society but also represents a severe waste of resources. Hence there is a need to develop efficient fibre recycling technologies. Industries should adopt technologies to produceand market, value-added products, technical textiles and composites and nonwovens made from reclaimed fibres.

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VARIETAL DESCRIPTION OF NON-RICE CROPS UNDER RAINFED UPLAND ECOLOGY

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[*1]Priyamedha,[2]B. C. Verma, [3]S. Saha, [4]A. Banerjee, [5]S. Roy and [6]N.P. Mandal

[*1]Senior Scientist (Genetics & Plant Breeding), CRURRS (ICAR-NRRI), Hazaribag, Jharkhand-825301

[2]Senior Scientist (Soil Science), CRURRS (ICAR-NRRI), Hazaribag, Jharkhand-825301

[3]Scientist (Agronomy), CRURRS (ICAR-NRRI), Hazaribag, Jharkhand-825301

[4]Senior Scientist (Plant Pathology), CRURRS (ICAR-NRRI), Hazaribag, Jharkhand-825301

[5]Senior Scientist (Genetics & Plant Breeding), CRURRS (ICAR-NRRI), Hazaribag, Jharkhand-825301

[6]Principal Scientist (Genetics & Plant Breeding), CRURRS (ICAR-NRRI), Hazaribag, Jharkhand-825301

*Corresponding Author Email ID: priyamedha.pb@gmail.com

Introduction

Rice based cropping system is the practice in which rice as the major crop is followed by subsequent cultivation of other crops. Intercropping as well as mixed cropping of rice and other compatible crops which include cereals, pulses, oilseeds, millets etc are widely practiced in many regions of India. In rice growing areas, several crop combinations are in practice based on agro-ecological conditions. Intercropping of rice with other crops is a common practice under upland conditions in north and north-eastern part of the country including Jharkhand state in which rice is intercropped with blackgram, greengram, pigeon pea, sesame, groundnut, soybean, maize, finger millet, etc. Relay/paira/utera cropping of rice is also common in both upland and lowland rice culture in which the seed of succeeding crops like lentil, gram, pea, lathyrus, berseem, linseed etc. is sown broadcast in maturing rice crop. This practice saves time, money and utilizes residual fertility of soil. Sequential cropping system of rice includes the crops like chickpea, linseed, rapeseed-mustard, niger, wheat, barley grown as succeeding with rice.

Rice based ecosystems for Jharkhand state is divided into three groups: upland or tanr land ecosystem, medium land ecosystem and low land ecosystem. Upland ecosystem includes three types of land i.e. Tanr I, Tanr II and Tanr III, in which mainly direct seeded rice are grown. The soil in tanr lands isacidic, sandy loam to loam with poor organic matter and water holding capacity. Upland ecosystem is suitable for direct seeded rice and other crops including oilseed, pulses and millets. Medium land ecosystem includes two types of land i.e. Don III and Don II in which mainly transplanted rice are grown. The soil in Don IIis clay loam, which is best for rice production. This type of land rarely affected by drought. Don III are drought prone with clay loam soil and suitable for short duration rice. Low land ecosystem includes Don I with clay loam soil suitable for long duration transplanted rice.

Rainfed upland rice is having an area of about 6.0 million hectares (m ha) with its maximum coverage of about 4.61 m ha in Eastern region, comprising the states of Assam, Bihar, Jharkhand, West Bengal, Odisha and eastern parts of Madhya Pradesh and Uttar Pradesh. Rice-rice system and rice fallows are not very productive in this region. The rice fallows have a great potential for cultivation of short-duration pulses and oilseeds. It is expected that nearly 3.0 m ha area of rice fallows can be brought under cultivation, which can provide about 1.5-2.0 million tonnes of additional food grain production and help in meeting the increasing demands of pulses and oilseeds. Introduction of legumes can provide a sustainable production base to the continued rice mono-cropped system, which is otherwise declining the total productivity. Crop and varietal diversification of the rice based cropping systems is the necessity to improve the productivity and profitability of the systems.

Also, to mitigate the risk of climate change rice-based crop diversification is a viable option. In Eastern India, farmers cultivate rice during rainy/*kharif* season i.e. from June to September and land leftovers fallow after rice harvest in the post-rainy season (November-May) due to lack of sufficient rainfall and irrigation facilities. However, sufficient residual soil moistures are available in rice fallow in the months from November to March, can be utilized for raising second crops in the region. Implementation of suitable crop/varietal diversification is thus very much vital to achieve this objective. For example, dry season crops following short duration rice cultivars are toria(profitable when sown earlier) and greengram (for delayed sowing) which perform better in terms of grain yield and are profitable.

Major crop that are grown in rice based cropping system are divided based on their cropping season. Kharif crops like maize, finger millet, groundnut, pigeon pea, sesame and black gram can be grown in place of rice or as mixed or intercrop with rice. Some crops can be grown as sequential crop, for example maize can be grown in rice-potato-maize cropping pattern. Rabi crops like linseed, chick pea, lentil, niger, rapeseed-mustard, wheat and barley can be grown either as paira or sequential crop in rice fallow land. Varietal description of rice and non-rice crops that can be grown in rice based cropping system under rainfed upland condition is as follows.

1. **Rice:** Ricevarietiessuitable for rainfed upland situation are of short duration i.e. very early maturing (<100 days) to early maturing (100-110 days), semi dwarf to semi tall, drought tolerant and can be grown under direct seeded condition. Description of some varieties suitable for the rainfed upland situation are as follows:

- **Vandana**: This variety has been developed by CRURRS, Hazaribag, suitable fordrought-prone rainfed upland areas of Jharkhand, Bihar, and Odisha. Highly drought tolerant, semi-tall (100-110 cm) and early maturing (90-95 days) variety. It is suitable for direct seeding with long-bold type of grain. It produces yield in 2.5-3.0 t/ha and 3.5-4.0 t/haunder direct seeded and transplanted conditions, respectively. Vandana is moderately resistant to leaf blast and brown spot. It has good weed competitive ability.
- **Anjali** :This variety has been developed by CRURRS, Hazaribag, suitable for rainfed drought-prone upland areas in Bihar, Jharkhand, Odisha, Assam and Tripura states of Eastern and Northeastern India. Anjali is moderately drought tolerant, semi-tall (95-100 cm) and early maturing (90-95 days) variety. This variety is suitable for direct seeding. It possesses short-bold grains. Yieldpotential is 3.0 and 4.0 t/haunder direct-seeded and transplanted conditions, respectively. Anjali is moderately resistant to leaf blast, brown spot and gall midge biotype 1 and 5.
- **Virendra**: This variety has been developed by CRURRS, Hazaribag, suitable for drought-prone rainfed upland areas of Odisha,Gujarat and Jharkhand. Virendra is a moderately drought tolerant shortduration (95 days) and semi-tall (95-100 cm) variety with shortbold

grains. It has a yield potential of 2.5 to 3.0 t/haunder directseeded condition. Virendra is resistant to gall midge, and moderately resist to leaf blast and brown spot.

- **CR Dhan 103:** This variety has been developed by CRURRS, Hazaribag, suitable for drought-prone rainfed upland areas ofJharkhand.CR Dhan 103 is a drought tolerant, semi-tall (95-110 cm), early maturing (95 days) variety. It has good grain quality with long-slender grains. The variety is suitable for direct seeding and gives yield of 2.5-3.0 t/ha. CR Dhan 103 is resistant to blast and moderately resistant to brown spot.
- **Sahbhagi Dhan**: This variety has been developed by CRURRS, Hazaribag in collaboration with International Rice research Institute (IRRI), Manilla, Philippines. It has been released and notified in 2009 and 2010, respectively. It is highly drought tolerant variety and recommended for cultivation in rainfed upland and lowland areas of eastern states, particularly in Jharkhand, Bihar, UP and Odisha. Sahbhagi dhan is maturing in 105-110 days in plain areas and 110-115 days in upland. Seed of Sahbhagi dhan is long and bold and having intermediate amylose content and high HRR. Yield of Sahbhagi dhan is 2.0-2.5 t/ha under drought stress and 3.8-4.5 t/ha without stress.
- **Birsa Dhan 108:**Suitable for rainfed upland, early maturing (70 days) variety, resistant to blast.
- **Birsa Vikas Dhan 109**: Suitable for rainfed upland, early maturing (85 days) variety, resistant to blast.
- **Birsa Vikas Dhan 110**: Suitable for rainfed upland, early maturing (95 days) variety, resistant to blast.

2. **Maize:** Maize can be grown in place of rice as well as intercropped or as sequential crop with rice under rainfed upland conditions. The varieties of very early (75-80 days) to early (89-90 days) duration are suitable for intercropping in rainfed condition or can be grown as summer crop. Description of some such varieties are as follows:

- **Birsa Makai 1:** It is anearly maturing variety (80-85 days) with plant height varying from 160 to 180 cm. Grains are yellow in colour and flint type. It is moderately resistant to Mydis and highly resistant to Turcicum leaf blight and not susceptible to major pests. It is recommended for rainfed upland and medium upland of Chhotanagpur regions of Jharkhand. Under normal conditions its yield varies from 35 to 40 q/ha.

- **Rattan(Quality Protein Maize):** It is a medium maturing variety (95-100 days) with 10% protein and 3.46% lysine. It is recommended for cultivation in under both rainfed and irrigated conditions. Grains are yellow coloured, semi flint and soft. It is tolerant to top borer and downy mildew and yields 40-45 quintals/ha.
- **Shaktiman 1,2,3,4 (Quality Protein Maize)** : These are composite variety of maize with high protein content and recommended for cultivation in Bihar.
- **Vivek 27 (**Hybridmaize, suitable for *kharif* season), **Suwan Composite 1**(Composite variety, suitable for *rabi* season)and **D994**(Composite variety, suitable for *kharif* season): These maize varieties are extra early maturing (75-80 days) and recommended for rainfed condition of Jharkhand.

3.Finger millet:

Finger millet, commonly known as ragi, is one of the important millet crops grown for grain and fodder purpose under varied agro-climatic conditions in India. The crop requires low input and less affected by major pests and diseases and matures in 90-120 days. Finger millet contains about 65-75% carbohydrates, 8% protein, 15-20% dietary fibre and 2.5-3.5% minerals. Grains of finger millet are highly nutritive and is known for its highest amount of calcium (344mg /100g grain), iron, zinc, dietary fibre and essential amino acids.

- **A 404**and **BM 2**: This variety of finger millet released from BAU, Ranchiand recommended for Bihar and Jharkhand. It is early maturing and resistant to neck and finger blast.
- **VL 146**: This variety of finger millet released from VPKAS, Almora and recommended for Uttar Pradesh, Jharkhand, Odisha, Uttarakhand, Maharashtra, Madhya Pradesh, Karnataka. It is early maturing.
- **GPU45:**This variety of finger millet released from UAS, Bangalore and recommended for Gujarat, Jharkhand, Karnataka, Madhya Pradesh and Maharashtra. It is drought tolerant.
- **RAU8:** This variety of finger millet released from RAU, Bihar and recommended for Bihar and other states. It is early maturing and resistant to neck and finger blast.

4. Groundnut:

Selection of a suitable variety of groundnut for a particular area depends on soil type, rainfall distribution, season of cultivation, market preference, resistance to major pests and diseases of the area. Spreading types are preferred under rainfed conditions where the rainy season is longer.

- **TG 51:** This variety of ground nut was released by BARC, Mumbai for West Bengal, Odisha, Jharkhand and Assam. It is tolerant to stem rot and root rot, suitable for *rabi-summer* season, with average yield of 2675 kg/ha.
- **TG 37A:** This variety of ground nut was released by BARC, Mumbai for Rajasthan, Punjab, Gujrat U.P, West Bengal, Odisha, Jharkhand and NEH states. Suitable for both *rabi-summer* season, with yield of 2837 kg/ha and *kharif* season, with average yield of 2084 kg/ha and 48% oil content. It is an early maturing (110-115 days), suitable for rainfed condition and tolerant to collar rot disease.
- **Mallika:** This variety of ground nut was released by RAU, Hanumangarh for all over India. It is resistant to collar rot, bold seeded, with a yield of 2579 kg/ha and 48% oil content. It is semi spreading type suitable for *kharif* season, matures in 125-130 days.
- **Vijetha:** This variety of ground nut was released by UAS, Raichur for West Bengal, Odisha, Jharkhand, Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. It is resistant to peanut bud necrosis disease, suitable for *rabi-summer* season with average yield of 1600 kg/ha and 47% oil content.
- **Girnar 3:** This variety of ground nut was released by DGR, Junagarh for West Bengal, Odisha and Manipur. It is tolerant to leaf miner and thrips, semi spreading recommended for *kharif* season with average yield of 1520 kg/ha and 45% oil content.
- **GJG-18:** This variety of ground nut was released for West Bengal, Jharkhand, Odisha and Manipur. It is moderately resistant to peanut bud necrosis disease and recommended for *kharif* season with average yield of 1520 kg/ha and 45% oil content.
- **Phule Morna:** This variety of ground nut was released for Gujarat, Rajasthan, Odisha, West Bengal, Jharkhand, Manipur, Tamil Nadu, Andhra Pradesh, Karnataka and South Maharashtra It is moderately resistant to rust and leaf spot with average yield of 2212 kg/ha and 44% oil content.
- **Birsa Bold:** Released by BAU, Ranchi and recommended for rainfed area of Jharkhand.

5. Pigeonpea:

Pigeonpea is a crop for rainfed environments, it adapts well in sole crop and intercropped conditions (with cereals, millets, oils seeds and pulses) for enhancing the system productivity and net income to the small and marginal farmers across the globe. More than 80 % production of pigeonpea comes from Maharashtra, MP, Karnataka, UP, Gujrat and Jharkhand.

- **Bahar**: It is a selection from local material from Bihar. It is a late maturing variety which takes over 250 days when planted in July.
- **Birsa Arhar 1** and**BR 65** are also recommended for rainfed condition of Jharkhand.
- **NDA2**: This variety ofchickpea matures in 240-260 days with average yield of 25-28 q/ha suitable for U.P., Bihar, WB, Assam and Jharkhand.

6.Sesame:

Sesame is the oldest indigenous oilseed crop, with longest history of cultivation in India. Sesame is commonly known as. Sesame seed contain 50% oil, 25% protein and 15% carbohydrate.

- **Krishna**: This variety of sesamum matures in 88-95 days, yields 700-750 kg/ha with oil content varying from 45-48 %. It is black seeded and tolerant to Alternaria, suitable for Bihar and Jharkhand.
- **TKG 21** and**TKG 22**: Suitable for West Bengal, High oil content, resistant to Phytophthora blight and Cercospora leaf spot.
- **TC 25**: It is included in the early maturing varieties. It takes 90 to 100 days for the crop to be ready. The height of the plants of this variety is 90 - 100 cm above the ground surface. The sesame seeds that come out of it are white in color, in which the amount of oil is 48-49 percent. The crop yield is 170-180 kg per acre of land.
- **Kanke Safed**: This variety is white seeded and suitable for cultivation under rainfed condition in Jharkhand.

7.Black Gram:

Black gram or Urd bean is one of the important pulses crops, grown throughout the country. The crop is resistant to adverse climatic conditions and improve the soil fertility by fixing atmospheric nitrogen in the soil.The highest yield was recorded by the state of Bihar, Sikkim and Jharkhand in Black gram.

- **Pant Urd 31:** This variety is cultivated in Bihar and Jharkhand, suitable for *kharif* season, resistant to yellow mosaic virus, matures in 75-80 days, yield 1500-1600 kg/ha.
- **Kota Urd 4**:This variety is cultivated in Bihar and Jharkhand, suitable for *spring* season Resistant to CLS and moderately resistant to yellow mosaic virus, less incidence of pod borer, tolerant to major biotic stresses, matures in 75-80 days, yield 1100-1200 kg/ha.

8.Linseed:

Linseed is an important oilseed crop grown for both seed and fibre as well. The cultivation of linseed or flax started even before the middle age where it was usually grown for fibre. Linseed or flax cultivation was started first for its fibre which is known to be the first woven and spun vegetable fibre. In India it is primarily grown for oil.

- **Divya**: This variety of Linseed was released by BAU, Ranchi with average seed yield 15-16q/ha, oil content 39.81%, matures in 127-130 days, highly resistant to rust, moderately resistant to Alternaria blight, powdery mildew and wilt, also moderately resistant to bud fly under natural and artificial condition.
- **Priyam**: This variety of Linseed was released by BAU, Ranchi with average seed yield 12-13 q/ha, oil content 37.48%, matures in 128-130 days. highly tolerant to rust, wilt, Alternaria blight and powdery mildew, also tolerant to bud fly under natural condition.

9.Chick pea:

Gram commonly known as chick pea or Bengal gram is the most important pulse crop of India. It is used for human consumption as well as for feeding to animals. Fresh green leaves are used as vegetable while straw of chickpea is an excellent fodder for cattle. On basis of size, colour and shape of seeds, gram is divided into two group: Desi or brown gram, Kabuli or white gram.

- **BG 3043**:It is a Desi chickpea variety which matures in 127-134 days with average yield 16-17 q/ha. Escaping terminal drought and heat stresses, moderately resistant to wilt and tolerant to dry root rot, collar rot, stunt, Ascochyta blight.
- **GNG 2207**:It is a Desi chickpea variety which matures in 130 days with average yield of 16-17 q/ha, tolerant to fusarium wilt disease.
- **Birsa Chana-3**:This variety of chickpea was developed by BAU, Ranchi. It is a Desi chickpea variety which matures in 115-118 days with average yield of 18-20 q/ha. resistant to lodging, shattering, wilt disease and tolerant to gram pod borer.

10. Lentil:

Lentil is grown in different agro-climatic zones, from tarai regions of Himalya to central India, from north eastern to north western plain of India. UP, MP, Bihar, West Bengal, Chhattisgarh and Jharkhand states are major lentil growing states. Lentil are primarily grown as rainfed crop.

- **IPL 220:** This variety is adopted in Eastern Uttar Pradesh, Bihar, West Bengal and Assam. It yields 1400-1600 kg/ha. It is a biofortified variety with Fe (73-114 mg/kg) and Zn (51-63 kg/ha) in their seeds. Resistant to major diseases including rust, Fusarium wilt and stemphylium blight.
- **HUL 57**: Small seeded, matures in 112-115 days with average yield of 12.26 q/ha, resistant to rust and tolerant to wilt.
- **WBL 77**: Small seeded, matures in 115-120 with average yield of 14-15 q/ha,resistant to rust.

11. Niger:

Niger is a minor oilseed crop that is grown predominantly under rainfed conditions. Niger seed is used as a human food. The seed contains 37- 47% oil, which is pale yellow with nutty taste and a pleasant odour. The oil is used for culinary purposes, anointing the body, manufacturing paints and soft soaps and for lighting and lubrication. Andhra Pradesh, Assam, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha and West Bengal are the states where Niger is grown. It can be grown as both kharif or rabi crop.

- **Birsa Niger 3:** This variety ofniger was developed by BAU, Ranchi for cultivation in Jharkhand, Chhattisgarh, MP, Odisha, Maharashtra, AP, WB, Kerala. It is early maturing (85 days) and drought tolerant variety.
- **BNS 10 (Pooja -1)**:This variety ofniger was developed by BAU, Ranchi for cultivation in all over India. It matures in 95-100 days with average yield 650-700 Kg/ha with oil content 36-38 %. It has Shining black seed, resistant to pests, diseases.
- **Jawahar Niger Sel-28**: This variety ofniger developed for cultivation in all over India. It gives an average yield of 550-650 Kg/ha with oil content 34-36 %. It is resistant to Cercospora and Alternaria leaf spot

12. Rapeseed-Mustard:

Rapeseed-mustard, are primarily cultivated as an important source of edible oil. Rapeseed-mustard (Oilseed *Brassica*s) are a group of highly diverse crop plants comprises six cultivated species, namely Indian mustard, toria, yellow sarson, brown sarson, gobhi sarson, karan rai. Among the seven annual edible oilseeds cultivated in India, rapeseed-mustard contributes nearly 30 percent in the total production of oilseeds. In India rapeseed-mustard are the second largest oilseed crops after the groundnut and grown mainly in north-western and central part of India in different ecosystem and cropping sequences.

Indian mustard:

- **NRCHB 101**: This variety was identified for rainfed agro-ecological condition of Bihar, Jharkhand, West Bengal, Odisha, Asom, Chhattisgarh and Manipur in the year 2016. Plant height varies from 170-200 cm with average seed yield 1498 kg/ha and 42 % oil content. This variety matures in 120-125 days and suitable for late sown rainfed and irrigated conditions.
- **DRMR 150-35:** This variety was identified for rainfed agro-ecological condition of Bihar, Jharkhand, West Bengal, Odisha, Asom, Chhattisgarh and Manipur in the year 2015. Plant height varies from 170-190 cm with average seed yield 1828 kg/ha and 39.8 % oil content. This variety matures in 114 days and suitable for early sown rainfed conditions. This variety is early maturing and tolerant to powdery mildew and Alternaria blight disease.
- **Pusa Mustard-25 (NPJ-112):** This variety was identified in the year 2010. Plant height varies from 154-175 cm with average seed yield 1489 kg/ha and 38.5 % oil content. This variety matures in 94-120 days. This variety is early maturing and suitable for early sown condition and as a catch crop between *Rabi* and *Kharif* crop.

Yellow Sarson:

- **NRCYS-05-02**:This variety was identified in the year 2009 for yellow sarson growing area of the country. Plant height varies from 110-120 cm with average seed yield 1477 kg/ha and 42-46 % oil content. This variety matures in 110 days. This variety is early maturing with high oil content.
- **YSH 401**: This variety was identified in the year 2009 for yellow sarson growing area of the country. Plant height varies from 110-130 cm with average seed yield 1462 kg/ha and 43-45 % oil content. This variety matures in 115-120 days. This variety is bold seeded with high oil content.
- **Pitambari:** This variety was identified in the year 2010 for yellow sarson growing area of the country. Plant height varies from 135-145 cm with average seed yield 1591 kg/ha and 43-48 % oil content. This variety matures in 110-115 days. This variety is bold seeded with high oil content responsive to high fertility.

Toria

• **Uttara:** This variety was identified in the year 2010 for toria growing area of the country. Plant height varies from 101-120 cm with average seed yield 1283 kg/ha and 42 % oil content. This variety matures in 93-101 days. This variety is moderately resistant to white rust, downy and powdery mildew diseases.

• **PT 303:**This variety was identified for irrigated areas of Asom, Bihar, Jharkhand, Haryana, Punjab, Uttar Pradesh and West Bangal. Plant height varies from 100-110 cm with average seed yield 1137 kg/ha and 41-43 % oil content. This variety matures in 91-98 days. This variety is early maturing with high oil content.

• **BR23:** This variety was identified for rainfed and irrigated areas of Bihar and Jharkhand. Plant height varies from 80-90 cm with average seed yield 1000 kg/ha and 43 % oil content. This variety matures in 100 days.

13. Wheat:

Wheat is the world's most widely cultivated cereal crop. Sowing of wheat in Jharkhand generally starts from November and ends in late December. Under late sown conditions, wheat face low temperature in the earlier part and high temperature in the later part of the growing season and require favourable moisture for better growth and development. Late planting of wheat is one of the major reasons of yield reduction because of rice- wheat cropping system. In Jharkhand, late planting of wheat expressed to high temperature at reproductive stage causes reduced grain yield. About 80 per cent of the wheat crop cultivated at late sowing condition after harvesting the transplanted rice.

• **DBW 252**: It is a timely sown variety of wheat for restricted irrigated conditions. It is recommended for Eastern Uttar Pradesh, Bihar, Jharkhand, Odisha, West Bengal, Assam and plains of North Eastern States. The seed yield of 37.0 q/ha, plant height of 97 to 99 cm, matures in 125-130 days, highly resistant to wheat blast disease and tolerant to drought.

• **DBW 187**: It is a timely sown variety of wheat for irrigated conditions. It is recommended for Eastern Uttar Pradesh, Bihar, Jharkhand, Odisha, West Bengal, Assam and plains of North Eastern States. The seed yield of 48.8 q/ha, plant height of 100 cm, and matures in 110-140 days. It has good biscuit spread factor (8.6cm), high Fe content (43.1 ppm), resistance to yellow and brown rust.

- **DBW 107**: It is a late sown variety of wheat for irrigated conditions. It is recommended for Eastern Uttar Pradesh, Bihar, Jharkhand, Odisha, West Bengal, Assam and plains of North Eastern States. The seed yield of 41.3 q/ha, plant height of 89-91 cm, matures in 109 days. It is resistant to brown rust and tolerant to terminal heat.

14. Barley:

Barley is a cereal grain used in bread, beverages, stews, and other dishes. As a whole grain, barley provides fiber, vitamins, and minerals. These nutrients may enhance heart health, help prevent cancer, and reduce inflammation, among other benefits.

- **Karan-201, 231 and 264:** These are high yielding varieties and good for chappati making. All of them are huskless varieties. These varieties fit in well in the multiple and relay cropping systems. These can be grown in problem soils too, like dry lands, alkaline and saline soils, etc. They can also be grown on lands lying fallow after a paddy crop has been taken. The average yield of Karan 201, 231 and 264 are 38, 42.5 and 46 quintals per hectare, respectively.
- **BCU 73 and K 551**:These are high yielding varieties and good for malt making. It can be grown under irrigated and timely sown conditions of Eastern UP, Bihar, Jharkhand, Odisha, West Bengal, Assam and plains of N.E. states. The average yield of BCU 73 and K 551 are 21.60 and 37.64 quintals per hectare, respectively.
- **K 560 and K 603**: These are high yielding varieties and good for food making. It can be grown under rainfed and timely sown conditions of Eastern UP, Bihar, Jharkhand, Odisha, West Bengal, Assam and plains of N.E. states. The average yield of K 560 and K 603are 29.07 and 37.64 quintals per hectare, respectively.

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LUMPY DISEASE: TRANSMISSION, SYMPTOMS, PREVENTIVE MEASURES AND TREATMENT

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Reena Rawat[1], Nitin Sartkar[2] and Arvind Kumar Singh [3]
Faculty of Agriculture Sciences, Mandsaur University, Mandsaur[1]
Faculty of Agriculture Sciences Mangalayatan University Jabalpur[2]
RNB Global University Bikaner, Rajasthan[3]
*Corresponding Author Email ID: drreenarawat23@gmail.com

Introduction

In Zambia in 1929, lumpy skin condition was first identified. It gradually spread across the bulk of Africa over the course of the following 85 years. In 2015, the virus spread to Russia, the Caucasus, and Greece on the continent of Europe. The virus continued to spread in 2016 as it moved further east into the Balkans, north into Moscow, and west towards Kazakhstan. It is currently regarded as a serious disease that is rapidly emerging. When epidemics seriously hurt productivity and trade, it is reportable. India produces the most milk globally and has the most animals per square km. As a result, states including Rajasthan, Gujarat, Punjab, Himachal Pradesh, Andaman and Nicobar, and Uttarkhand were affected by the lumpy virus sickness as well as other states. According to the most recent data from the government, lumpy skin disease has already infected over 2.4 million animals and caused the deaths of over 110,000 cattle in India.

HOW LUMPY VIRUS CAME TO INDIA?

The lumpy skin disease virus (LSDV), which belongs to the genus Capripoxvirus in the family Poxviridae, is what causes lumpy skin disease (LSD). The other two virus species in this genus are the sheeppox virus and the goat pox virus. In the majority of African nations, LSD is endemic. It has swiftly expanded throughout the Middle East, southeast Europe, and West and Central Asia since 2012. throughout the middle of 2019 Bangladesh was where LSD first became widespread throughout Asia. Then it expanded to Thailand, Vietnam, Myanmar, Bhutan, India, and Nepal. The initial epidemic was reported by Kaiyari hamlet in Lakhpat Taluka of the

Kutch region of Gujarat. Following that, it moved to Rajasthan before ascending to the northern states of Punjab, Haryana, and Himachal Pradesh. Then, it impacted almost two million animals and spread like wildfire across 251 districts in 15 states. Affected states include Goa, West Bengal, Andhra Pradesh, Gujarat, Rajasthan, Punjab, Uttarakhand, Himachal Pradesh, Madhya Pradesh, Jammu & Kashmir, Uttar Pradesh, Haryana, and Maharashtra. In India, this disease claimed the lives of about 110,000 animals and infected over 2.4 million, according to government figures.

HOW IS LUMPY SKIN DISEASE CAUSED?

Cattle are susceptible to the viral illness lumpy skin disease. It is spread by ticks or other insects that feed on blood, such as some types of flies, mosquitoes, and ticks. Particularly in animals that have never been exposed to the virus before, it can also result in mortality and cause fever and skin nodules.

WHAT IS THE SYMPTOM OF LUMPY SKIN DISEASE?

The presence of the typical skin nodules is strongly suggestive of Lumpy Skin Disease (see below).The symptoms include high fever, reduced milk production, skin nodules, loss of appetite, increased nasal discharge and watery eyes, too much of salivation and discharge of water from eyes and nose and formation of nodules on the body.

Is milk is healthy for drinking of effected animal?

The spread of the virus has causes concerns around consumption of milk. However, A senior official from Indian Veterinary Research Institute has assured that it is safe to consume milk from cattle infected by lumpy skin disease, a non-zoonotic disease and not transmissible from animals to humans.

How Is Lumpy Disease Treatable?

Lumpy Skin Disease has no special treatment. Once an area has been contaminated, it is difficult to stop cattle attacks by infected vectors (flies, etc.). Risky actions raise the likelihood that an illness will spread from one place to another. The homologous live-attenuated LSD vaccine "Lumpi-ProVacInd" was created by the ICAR-National Research Centre on Equines (ICAR-NRCE), Hisar (Haryana), the ICAR-Indian Veterinary Research Institute (IVRI), Izatnagar,Uttar Pradesh.At a ceremony in the nation's capital, the new technology was unveiled by Union Agriculture Minister Narendra Singh Tomar and Union Fisheries, Animal Husbandry, and Dairy Minister Parshottam Rupala. Despite the lack of conclusive evidence of human infection, there are rising concerns about its zoonotic implications as a result of its recent proliferation in artificial hosts, according to the ICAR. When a homologous LSD vaccine is not available, a heterologous vaccination (based on the SPV and GPV viruses) is typically approved to generate cross-protection against LSD in cattle. In order to control LSD in cattle; the Centre has also approved the use of the goatpox vaccination. But according to the ICAR, heterologous vaccinations only offer a limited level of protection and are less effective than homologous vaccines.

The virus was initially isolated in 2019 by NRCE researchers, who have since been working to create a live-attenuated vaccine. At IVRI Mukteshwar, calf experiments were carried out following the vaccine's first safety and immunogenicity tests in lab animals at NRCE, Hisar. Additionally, in the field, the vaccine's safety has been confirmed in cattle and buffaloes of all ages, including breastfeeding and pregnant ones. The vaccine is safe and induces protective immunity in animals against LSD, according to the results of experimental and field testing, the ICAR claimed.

DISINFECTION AND CLEANING MEASURES

Affected Premises, vehicles plying through the affected animal holdings should be carried out with appropriate chemicals/disinfectants [Ether (20%), chloroform, formalin (1%), phenol (2%/15 minutes), sodium hypochlorite (2- 3%), iodine compounds (1:33 dilution) and quaternary ammonium compounds (0.5%)].

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MUSHROOM RECIPES

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Dr. G. Sridevi [*1] and Dr. K. Manikandan[*2]

Assistant Professor (SS& AC) [*1], Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore-641 003

Assistant Professor (SS& AC) [*2], Tamil Nadu Rice Research Institute, TNAU, Aduthurai – 612 101

*Corresponding Author Email ID: smathareddy@gmail.com

Introduction

Mushrooms are collected and consumed from times immemorial. Mushrooms are liked owing to their unique taste, delicacy, flavour and texture. Mushroom recipes appear in top ranking menu in restaurants, marriages and other celebrations. Mushroom is one of the good sources for protein. But still it is not reached to the doorstep of all peoples owing to the unawareness about mushroom cooking. Mushroom is a recently introduced vegetable of fungal origin and hence it is new to common populace of India. Further there is a need to cook mushroom according to Indian taste so as to take mushroom to all people.

Harvested mushroom in general contain certain debris and casing soil adhere to it. Further mushroom suffers to some other contaminant during handling. Washing of mushroom thoroughly in clean water helps to remove these debris and contaminants. It is better to cook recently harvested mushroom as stored mushroom subjected to certain kind of decays. Washed mushrooms needs to be sliced in to two to three pieces depending upon the mushroom size and recipe. Mushrooms affected with pest and diseases needs to discard.

Sometimes larvae can be found inside the mushroom and these mushrooms are discarded at the time of slicing by careful observation. Mushroom retains their texture without melting at the time of cooking. This is one of the unique attribute of mushroom compared to other vegetables. Single steam pressure is sufficient for cooking mushroom.

India is a diverse country and accordingly people differ in their food preference. Thus it is better to cook mushroom by following their own style. There is no defined or fixed rule for mushroom cooking. Hence, this section is introduced in this book by the authors, which highlights about how to cook few mushroom recipes.

1. Mushroom Biryani

Mushroom briyani are power house of nutrition , have high antioxidants, nutrients and it increases immunity . They have a high protein content and certain vitamins and minerals like iron, magnesium, potassium, sodium, and vitamin C

Ingredients

Fresh mushrooms	- 500 g
Rice	- 2 cup
Onion chopped in lengths	- 2 medium
Ginger pieces	- 2" pod
Garlic crushed	- 5-6 cloves
Red chillies	- 2 table spoon
Coriander leaves chopped	- 50 g
Mint leaves (chopped)	- 20 g
Tomato puree	- 1 cup
Milk (double toned)	- ½ cup
Curd	- ½ cup
Cassia (Tej patta)	- 2
Cloves	- 4
Garam Masala	- 2 table spoon
Green cardamom	- 2
Black cardamom	- 2

Mace (Javitri)	- 1 piece
Cumin seeds	- 1 table spoon
Turmeric powder	- ½ table spoon
Saffron	- 1 pinch
Salt	- to taste

Preparation Method

- Cut washed mushrooms into four pieces
- Soak rice for ½ hour.
- Prepare a ginger and garlic paste by grinding in mixer grinder
- Boil four cup water in a pan
- After boiling, add cassia, clove, cardamom, cinnamon, mace and one table spoon of salt and boil till the spices start leaving their colour and flavour
- Add washed rice and cook in such a way that rice slightly less cooked
- Keep this rice content closed
- Fry the onion separately in non-stick pan till golden brown colour obtained
- Add garlic-ginger paste and other spices and cook till desired consistency obtained
- Add beaten curd, masala powder, coriander leaves, mint leaves and salt and cook for 2 minutes
- Now add mushrooms and cook on high flame for 3-5 minutes till the mushrooms stop leaving water
- Take sufficient boiled rice and add mushroom masala into layers one by one adding coriander leaves and sprinkle saffron milk after every layer in a oven-proof dish.
- Top layer should be of rice and sprinkle coriander leaves and saffron milk.
- Seal the dish with foil and put it in the pre-heated oven for 10 minutes at 70^0C temperature.
- It can be served hot with pudina chutney and curd.
- In south Indian conditions, boiled rice is directly mixed with fried mushroom masala
- While serving it is sprinkled with fresh coriander leaves along with other curries, onion-curd mix and chips.

2. Kadai Mushroom

Ingredients

Fresh mushrooms pieces	- 500 g
Onion	- 2 (paste)
Ginger	- 2 teaspoon
Garlic	- 2 table spoon
Capsicum-sliced, seed removed	- 2
Peas boiled	- ½ cup
Whole red chillies	- 4
Chilly powder	- 2 table spoon
Green chillies, chopped	- 2
Tomato puree	- 1 cup
Cumin seeds, kasoori methi	- as per taste
Garam masala, salt	- as per taste

Method

- Fry the cumin seeds till brown colour obtained
- Add mushrooms and cook in high flame for 2-3 minutes
- Add peas, capsicum, salt and masala powder and cook for 2-3 minutes
- Remove from the stove and keep aside.
- In another pan, fry the whole red chillies till deep brown colour
- Add onion and ginger- garlic paste and fry till golden brown obtained
- Add green chillies and tomoto puree and stir over low heat till the oil separates out
- Add salt and other spices to it
- Now add the gravy over the cooked mushrooms in pan and cook for 5 minutes
- Now mushroom kadai is ready for serving after sprinkling with kasoori methi and coriander leaves on surface.

3. Mushroom Cabbage Salad

Ingredients

Fresh button and oyster pieces	- 150 g

Capsicum	- 50 g
Cabbage	- 50 g
Onion	- 1
Spring onion (chopped)	- 50 g
Cooking oil	- 50 g
Soya sauce	-1 table spoon
Corn flour mixed with a little water	- 2 table spoon
Green chilly sauce	- 1 table spoon
Tomato sauce	-2 table spoon
Salt and pepper	- to the taste

Preparation Method

- Fry the mushrooms till water evaporates in a pan
- Add petalled onion and cook for two to three minutes
- Add cabbage, capsicum, spring onion and stir together on high flame
- mix all the sauces and ingredients together when cabbage starts wilting
- Cook this content till sauce has heated enough.
- Now content is ready for serving

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USE OF SILVER NANOPARTICLES IN DAIRY INDUSTRY

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Miss. Aprna Sharma[1], Dr. Ashwini Mugale[2] and Dr. Vijay Kele[2]

[1]Department of Dairy Technology CODSFT, Raipur (C.G)

[2]Department of Dairy & Food Technology, Parul Institute of Technology, Parul University, Vadodara (GJ)

*Corresponding Author Email ID: ashwini55mugale@gmail.com

Introduction

Recent advances in nano-science and nanotechnology radically changed the way we diagnose, treat, and prevent various diseases in all aspects of human life. Silver nanoparticles (AgNPs) are one of the most vital and fascinating nanomaterials among several metallic nanoparticles that are involved in biomedical applications. AgNPs play an important role in nanoscience and nanotechnology, particularly in nanomedicine. Although several noble metals have been used for various purposes, AgNPs have been focused on potential applications in cancer diagnosis and therapy. In this review, we discuss the synthesis of AgNPs using physical, chemical, and biological methods. We also discuss the properties of AgNPs and methods for their characterization. More importantly, we extensively discuss the multifunctional bio-applications of AgNPs; for example, as antibacterial, antifungal, antiviral, anti-inflammatory, anti-angiogenic, and anti-cancer agents, and the mechanism of the anti-cancer activity of AgNPs. Silver nanoparticles (AgNPs) are increasingly used in various fields, including medical, food, health care, consumer, and industrial purposes, due to their unique physical and chemical properties. After synthesis, precise particle characterization is necessary, because the physicochemical properties of a particle could have a significant impact on their biological properties.

To evaluate the synthesized nanomaterials, many analytical techniques have been used, including ultraviolet visible spectroscopy (UV-vis spectroscopy), X-ray diffractometry (XRD), Fourier transform infrared spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS), dynamic light scattering (DLS), scanning electron microscopy (SEM), transmission electron microscopy (TEM), atomic force microscopy (AFM).

Milk is a product that needs to be kept cold until thermal processing, and milk that waits on the farm between milkings may not be kept cold at all times. Bacteria may grow before and during transport, The best solution is to inhibit bacteria from growing in the first place. Silver nanoparticles (**AgNP**) can be used in conjunction with current processes to keep milk safer until it reaches the thermal processing step. Particles <500 nm are called nanoparticles, and nanoparticles are measured in nanometers (1 nm = 10^{-9} m). Even though silver is beneficial to use against bacteria, its use has been severely limited due to expense. With current nanotechnology, however, bacteria can be killed more effectively and cost efficiently using AgNP compared with pure silver, because silver is expensive. Reported that 1 g of AgNP could be used to coat 1,000 to 3,000 m^2 of surface.

Milk spoilage continues to be a major problem. Incorporation of silver into milk packaging might solve this problem. We evaluated the antimicrobial and chemical effects of silver in milk. Antimicrobial experiments were performed by measuring milk acidification by *Streptococcus thermophilus* at temperatures of 43, 33 and 23 °C and concentrations of silver nanoparticles at 10, 50, 100 and 200 mg/L. Chemical interactions were investigated using potentiometric measurements. Ag^+ interacted with milk constituents. Nanosilver was antimicrobially effective at all temperatures and at 100 mg/L. At least 5 mg/L are required by using $AgNO_3$. Practical use of silver for dairy applications is not expected, due to the required high silver concentrations. Bacteria are killed by AgNP mainly because silver has a high affinity for sulfur and the particles separate the disulfide bonds (-S-S-) of bacteria.

Objectives of this study were to investigate the antimicrobial effects of small diameter (6–8 nm) AgNP in cow milk by studying the effects of accelerating voltage, time, and temperature on total aerobic count (**TAC**), and by exploring the particles effects on counts of yeasts and molds, coliform bacteria, *Escherichia coli*, and *Staphylococcus aureus* counts. The nano silver technology can be used in conjunction with the current technologies and can be useful to small farmers, small and medium businesses, and large dairy companies.

Synthesis of AgNPs Using Physical and Chemical Methods

The synthesis of nanoparticles has been carried out using three different approaches, including physical, chemical, and biological methods. In physical methods, nanoparticles are prepared by evaporation-condensation using a tube furnace at atmospheric pressure. Conventional physical methods including spark discharging and pyrolysis were used for the synthesis of AgNPs. The advantages of physical methods are speed, radiation used as reducing agents, and no hazardous chemicals involved, but the downsides are low yield and high energy consumption, solvent contamination.

Chemical methods use water or organic solvents to prepare the silver nanoparticles . This process usually employs three main components, such as metal precursors, reducing agents, and stabilizing/capping agents. The reduction of silver salts involves two stages (1) nucleation; and (2) subsequent growth. In general, silver nanomaterials can be obtained by two methods, classified as **"top-down"** and **"bottom-up"**. The **"top-down"** method is the mechanical grinding of bulk metals with subsequent stabilization using colloidal protecting agents. The **"bottom-up"** methods include chemical reduction, electrochemical methods, and sono-decomposition.

The major advantage of chemical methods is high yield, contrary to physical methods, which have low yield. The above-mentioned methods are extremely expensive. Additionally, the materials used for AgNPs synthesis, such as citrate, borohydride, thio-glycerol, and 2-mercaptoethanol are toxic and hazardous. Apart from these disadvantages, the manufactured particles are not of expected purity, as their surfaces were found to be sedimented with chemicals. Chemical methods make use of techniques such as cryochemical synthesis, laser ablation, lithography, electrochemical reduction, laser irradiation, sono-decomposition, thermal decomposition, and chemical reduction. The advantage of the chemical synthesis of nanoparticles is the ease of production, low cost, and high yield; however, the use of chemical reducing agents are harmful to living organisms.

Characterization

The physicochemical properties of nanoparticles are important for their behavior, bio-distribution, safety, and efficacy. Characterization is performed using a variety of analytical techniques, including UV-vis spectroscopy, X-ray diffractometry (XRD), Fourier transform infrared spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS), dynamic light scattering (DLS), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and atomic force microscopy (AFM).

Characterization of silver nanoparticles (AgNPs) prepared from *Bacillus* species using various analytical techniques.

1.UV-Visible Spectroscopy

UV-vis spectroscopy is a very useful and reliable technique for the primary characterization of synthesized nanoparticles which is also used to monitor the synthesis and stability of AgNPs. AgNPs have unique optical properties which make them strongly interact with specific wavelengths of light. In addition, UV-vis spectroscopy is fast, easy, simple, sensitive, selective for different types of NPs, needs only a short period time for measurement, and finally a calibration is not required for particle characterization of colloidal suspensions.

2.X-ray Diffraction (XRD)

X-ray diffraction (XRD) is a popular analytical technique which has been used for the analysis of both molecular and crystal structures. qualitative identification of various compounds, quantitative resolution of chemical species, measuring the degree of crystallinity, isomorphous substitutions, particle sizes, etc. When X-ray light reflects on any crystal, it leads to the formation of many diffraction patterns, and the patterns reflect the physico-chemical characteristics of the crystal structures. XRD is a primary technique for the identification of the crystalline nature at the atomic scale.

3. Dynamic Light Scattering

Physicochemical characterization of prepared nanomaterials is an important factor for the analysis of biological activities using radiation scattering techniques. DLS can probe the size distribution of small particles a scale ranging from submicron down to one nanometer in solution or suspension. Dynamic light scattering is a method that depends on the interaction of light with particles. This method can be used for the measurement of narrow particle size distributions, especially in the range of 2–500 nm.

4. Fourier Transform Infrared (FTIR) Spectroscopy

FTIR spectroscopy is frequently used to find out whether biomolecules are involved in the synthesis of nanoparticles, which is more pronounced in academic and industrial research

5. X-ray Photoelectron Spectroscopy (XPS)

XPS is a quantitative spectroscopic surface chemical analysis technique used to estimate empirical formulae. XPS is also known as electron spectroscopy for chemical analysis

❖ **Biological Applications of AgNPs**

AgNPs have been used extensively in house-hold utensils, the health care industry, and in food storage, environmental, and biomedical applications. Several reviews and book chapters have been dedicated in various areas of the application of AgNPs. Herein, we are interested in emphasizing the applications of AgNPs in various biological and biomedical applications, such as antibacterial, antifungal, antiviral, anti-inflammatory, anti-cancer, and anti-angiogenic.

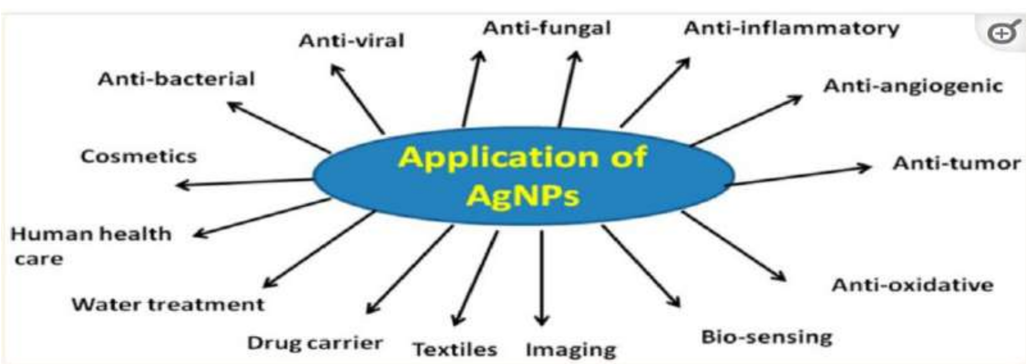

Fig : Applications of AgNPs

Conclusions

Silver nanoparticles controlled bacterial growth whether duration of treatment was 1s, 1h, or 10h. The particles started losing their inhibitive properties after 10h, which indicates that the particle-treated fluid milk could be used to produce cultured dairy products such as yogurt.

Treatment with the AgNP-coated wires was most effective at 22°C. The AgNP100 treatment was most effective at controlling microbial load. For all microorganisms (TAC, coliforms, yeasts and molds, *E. coli*, and *Staph. aureus*), the highest counts were found in control samples, followed by initial load, AgNP100, and pasteurized samples, indicating that AgNP inhibited microorganism growth and is useful in complementing the cooling chain and thermal processes. The results warrant further research to address sensory properties of fluid milk as well as properties of cheese and yogurt made with the particle-treated milk, and the long-term safety of these products.

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AGRONOMIC PRACTICES IN LINSEED

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Vaibhav Baliyan, Devender Singh, Rahul Kumar Verma and Vikender Kaur*

ICAR-National Bureau of Plant Genetic Resources, New Delhi

*Corresponding Author Email ID: vikender.kaur@icar.gov.in

Abstract

Linseed is an important minor oilseed crop with hitherto unexplored potential for commercial production in relation to industrial, nutritional and nutraceutical utility. It has been cultivated for seed oil and stem fibre (linen) since ancient times. The oil has industrial utility in paints and varnishes because of its unique drying properties attributable to its distinctive fatty acid composition. Its oil has very high content of α-linolenic (ω-3) polyunsaturated fatty acids (PUFA), which is essential for humans since it can’t be synthesized in body. Besides, the highly desirable ω-6/ω-3 fatty acid ratio of 0.3:1, linseed is also rich source of Secoisolariciresinoldiglucoside (SDG), major bioactive lignan which provides protection against certain types of cancers and hormonal disorders. However, despite such excellent profile for industrial and nutritional utility, this crop has remained unexplored and neglected in India and its national productivity remained far lower than the world average. This article is intended to briefly describe the agronomic practices to be followed in linseed for higher and sustainable production.

Introduction

Linseed (*Linumusitassimum* L.) belongs to the family Linaceae. It is a dual-purpose crop grown for fibre (flax) and seed or oil purpose.It is an annual herbaceous plant with a height of 30 to 120 cm. Fibre types are tall growing and less branched than the seed types. The stem is glabrous grayish green with narrow and alternate leaves. Fruit is an indehiscentglobular capsule. Seeds are ovate, brown or yellow in colour and may be lustrous or dull. The oil content of the seed varies ranges from 33 – 47%. In India, it is grown mainly in the states of Madhya Pradesh, Uttar Pradesh, Bihar, Chhattisgarh, Maharashtra, Jharkhand, Orissa, Assam, West Bengal, Nagaland, Andhra Pradesh, Rajasthan, and Himachal Pradesh.

Field view of linseed crop

Climate, soil and irrigation

Linseed is a cool season *rabi*crop well suited to areas with an average annual rainfall of 45 to 75 cmand moderate temperature ranging from 21º -26º C. Drought and high temperatures at early and seed filling stages lead to yield and quality reduction.Linseed is sownin second fortnight of October in Northern or November in central India. This crop is under cultivation in three ecosystems *utera*, rainfed and irrigated.It grows perfectly in well drained, fertile, medium and heavy soils with a pH range of 5.5 – 7.5especially on silty loam, clay loam and silty clays free from weeds and other debris. Moisture and good drainage are essential for linseed.It is generally grown in rainfed areas by marginal and resource poor farmers in India. For optimum yield, two to three irrigations, one at 30-40 days after sowing, second just before flowering (65 days after sowing) and third at grain filling stage are required.

Cropping systems

1) **Intercropping:** Linseed isusually grown as an intercrop, in rotation with hybrid maize, sorghum, pearlmillet, soybean, groundnut, and cowpea. For example,

i. Linseed + chickpea

Row ratio: 2-3:1

States:West Bengal, Bihar, Bundelkhandregion of Uttar Pradesh, Madhya Pradesh, Punjab, Maharashtra,Karnataka

ii. Linseed + wheat

Row ratio: 2-3:1

States:West Bengal, Maharashtra, Karnataka, Uttar Pradesh

iii. Linseed + sunflower

Linseed+ potato

Row ratio: 3:1

States:Karnataka,Bundelkhand region of Uttar Pradesh

***Piara* or *utera* cropping**:

Utera cropping is practiced for efficient utilization of moisture of standing rice crop by sowing the next crop seeds before harvesting rice under rainfed agro-ecosystem. About 25% of the linseed areain India is under *utera* cropping. Linseed is broadcasted in standing rice crop 15 days before harvest of rice, and is grown on residual nutrients and moisture. Crack system followed by utera is adopted in areas where sufficient water is available to achieve better yields.

Land preparation and sowing

Soil should have sufficient moisture at the time of sowing for good germination of seeds. It requires 2 to 3ploughingswith subsequent 2 to 3 harrowings. Linseed is sown in fine weed free seed beds in rows/lines by broadcast or drilling. An inter-row spacing of 20-30 cm and intra-row spacing of 7-10 cm are ideal. The seed rate is 35-40 kg/ha for broadcasting and 20-30 kg/ha for line-sowing. Rainfed crop requires early sowing. The seed should be placed 2-3 cm below the soil based upon soil moisture content.For protection of seedlings against white-ants and cutworms, 25-30 kg per ha of Aldrin or 5% Chlordane dust is mixed with soil before sowing. The seed-rate is 35-40 kg/ha in case of broadcasting and for line-sowing, it is 20-30 kg/ha. Seeds can be treated with Capatan or Agrosan GN @ 2.5 g/kg seed before sowing to protect seedlings against seed borne diseases.

Fertilizer application

Linseed crop can be grown without manuring, however, application ofFYM/compost @ 8-10 tonnes per hectare is ideal before sowing. Crop requires 20-60 kg N as urea, 30-40 kg P_2O_5

and 30-60 kg K_2O per hectare of fertilizer under irrigated conditions. Nitrogen is applied in two splits, half as basaldose and the second half with first irrigation at around 35-40 days after sowing.20-30 Kg/ha S and Zn and 1.5 Kg Bis recommended as basal doses.

Recommended/optimum doses of NPK:

Rainfed crop: 40:20:20 kg NPK/ha

Irrigated crop: 90:40:30 kg NPK/ha

***Utera* crop:** 10 to 20 kgs N/ha

Plant protection

Linseed is highly prone to competition by weeds for moisture and nutrients and therefore requires intensive weed control. The important weeds of linseed include *Anagallisarvensis, Viciahirsuta, Fumariaparviflora, Melilotus spp., Chenopodium album, Phalaris minor*andparasite *Cuscuta* sp.Twohand weedings after 3 and 6 weeks of sowing are recommended. Seeds should be treated with Bavistin @ 1.5 g/Kg seed or Thiram @ 3 g/Kg seed orTopsin-M @ 2.5 g/Kg seed and Azadirachtin 300 ppm (in 2 applications)to protect the crop from seed-borne diseases. Pre emergence application of Pendimethalin at 1Kg/ha and post emergence application of Isoproturon @1Kg/ha at 30-35 DAS, Pronomide @ 1.5 Kg/ha and MCPB @ 0.5 Kg/ha are also effective.

Recommended sprays against major diseases and insect pests

Annual broad-leaved weeds -MCPB @ 0.5 Kg/ha

Flaxseed gall fly and Flaxseed caterpillar - Endosulfan 0.05%

Fusarium wilt - Bavistin @1.5 g/l or 2.5g/kg seed, Zineb@ 2.5kg in 1000l water/ha(Zones I, II, III)

Rust -Dithane M-45 @ 1250 g in 500l water/ha, mancozeb 75 @ 2 kg in 1000l water/ha, sulphur dust@20 kg/ha,Indofil Z-78@500g in 150l water(Zone I)

Powdery mildew -Sulfex @ 3 Kg/ha in 1000 liters of water (Zone III)

Insect and pests –Endosulfan @1-1.5l in 1000l water/ha, 0.03% PhosphamidonSL (Zone I, II, III)

Harvesting and yield

The crop matures in March-April and takes about 130-150 days to mature. It is harvested by sickle when the leaves get dry, capsule becomes brown and the seeds become shiny. Plants are left on threshing floor for 4-5 days for drying. Plants are tied in bundles and are threshed by beating with sticks. The crop yields1.5-2.0 tonnes of seeds per hectare under irrigated conditions and <1 ton/ha under *utera* conditions. The test weight is about 5-6 g/1,000 seeds.The yield and quality of linseed depends upon the number of capsules per unit area.Flax fiber is harvested mechanically by a specialized flax harvester or manually by pulling up along with roots targeted to maximize fiber length, and are then left in fields for retting and subsequent dressing by scutching, and heckling.

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CULTIVATION OF MILKY MUSHROOM – *Calocybe indica*

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Dr. K.Manikandan[*1] and Dr.G. Sridevi[2]

[*1]Assistant Professor (SS& AC), Tamil Nadu Rice Research Institute, TNAU, Aduthurai – 612 101, Tamil Nadu

[2]Assistant Professor (SS& AC), Department of Soil Science and Agricultural Chemistry Tamil Nadu Agricultural University, Coimbatore-641 003

*Corresponding Author Email ID: smathareddy@gmail.com

Introduction

Milky mushroom is native to India. This is a tropical mushroom and most popular in Tamil Nadu and Andra Pradesh. In recent times, it is getting little popular in north India too. Pungent smell and fibrous texture are the disadvantage of this mushroom which restricts popularization of this mushroom. These adverse characteristics can be possibly to overcome through genetic improvement proammes.

Scientific name : *Calocybe indica*

Common name : Milky mushroom

Taxonomy

Kingdom	: Fungi
Phylum	: Basidiomycota
Class	: Agaricomycetes
Order	: Agariclaes
Family	: Lyophyllaceae
Genus	: *Calocybe*
Species	: *indica*

Description

1. **Cap:** It is rounded, initially hemi-spherical in shape and expanding to become flat, 5-10 cm in diameter, whitish or creamish white, margin with fragments of ring

2. **Stem:** Short, cylindrical, up to 6 cm in length and 2-3 cm in diameter, white, smooth and without annulus.

3. **Gills:** Free, pink to purple brown in colour and crowded.

4. **Flesh:** Whitish in colour and become reddish brown on bruising

5. **Spores:** Spore print is brown. Spores are oval to round and size of about 4.5-5.5 x 5-7.5 µm

6. **Habitat:** Found in soils rich in organic matter

Cultivation technology

a) Ingredients required

i) Wheat / Paddy straw
ii) Urea
iii) Gypsum
iv) Calcium carbonate

b) Methodology

i) Substrate preparation

Chopped wheat straw (2-4cm) is soaked in water for 12-16 hours. The soaked straw is pasteurized/sterilized in any of the following means;

Steam pasteurization: Wetted wheat straw is pasteurized in tunnel in which straw is subjected to 60^{0}C for 6-8 hours.

Wetting of straw

Compost output

a) Hot water treatment: Wet straw is submerged in hot water for 45 minutes at 90^{0}C. This is applicable to small scale application.

b) Autoclave sterilization: Two to three kg of prepared substrate is filled in poly bags and sterilized at 15 psi pressure for 2 hour in autoclave.

Bag filling

Autoclaving

C.Chemical sterilization:

In this technique, wheat straw is subjected to soaking in a chemical solution of carbendazim 50% WP (37.5 ppm) and formaldehyde (500 ppm) for 16-18 hour towards sterilization. For this, initially 10 kg straw is soaked in 90 litre water in plastic drum over which 10 litre of chemical solution containing 7.5 g of Bavistin and 125 ml of 40 % formaldehyde is added. After thorough mixing and submergence, drum is covered with polythene and kept as such for 18 hour. This kills all unwanted microbes from straw. This chemically sterilized straw can be used for spawning purposes.

D.Composting method

It is recommended for hardy residues such as cotton, maize and leguminous stubbles. In this method, urea at the rate of 0.5-1% and lime at the rate of 1% on dry weight basis is added after wetting. Organic manures viz., horse manure, chicken manure, etc. can be used at the rate of 10% dry weight to avoid inorganic fertilizers use. The ingredients are mixed together homogeneously. Thereafter heaps of not more than one meter height is made. The compost heap is turned on every second day and heap is made again. Fifth day, compost is ready for spawning.

ii) Spawn run

Five kg of above prepared substrate is filled in poly bag and spawned at the rate of 4-5 % on wet weight basis. Spawning may be of either layer or thorough spawning. Spawned bags are incubated at 25-35^{0}C and RH is maintained at 80%. Spawn run completes within 15-20 days which is identified by full whitish mycelial colonization over the surface.

Spawn run stage

iii) Case run

Casing materials should composed of certain proportion of loam soil. Loamy soil is the ideal casing medium for milky mushroom. Loam soil is mixed with sand in 75:25 proportions and pH is adjusted to 7.5 – 8.0 with lime powder. This substrate is either sterilized in autoclave at 15 psi pressure for two hour or chemically sterilized by treating with 4% formaldehyde solution and kept as such for one day after covering with polythene sheet. In case of formalin treatment, turning of casing soil is essential before casing to remove residue formalin.

Spawn run completed bags are leveled and treated with solution of carbendazim (0.1%) + formaldehyde (0.5%). Thereafter pasteurized casing material is applied for a thickness of 3-5 cm. Cropping room temperature is maintained at 30-35^{0}C and 85% RH. Case run completes in 10-15 days.

Cased bags

Case run completed bags

iv) Cropping

Fresh air is introduced when mycelium reaches surface of casing material. Air temperature of 30-35^{0}C and 85% RH is maintained in cropping room. In addition light is provided for 10-12 hours on daily basis.

Pin head formation **Needle shaped mushroom** **Harvesting stage**

Moisture in casing soil is maintained at saturation level by regular water spraying. In 3-5 days, needle shaped fruiting bodies will be initiated and these matures in next 5-7 days. Matured mushrooms are harvested, cleaned and packed for marketing.

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SEED HUB PROJECT ON "CREATION OF SEED HUBS FOR ENHANCING QUALITY SEEDS AVAILABILITY OF MAJOR OILSEEDS CROPS - GROUNDNUT": A SUCCESS STORY AT JAU, JUNAGADH

Article ID: AG-VO3-I07-34

J. B. Patel, C. A. Babariya*, J. R. Sondarva and D. V. Savaliya

Department of Seed Science and Technology, College of Agriculture

Junagadh Agricultural University, Junagadh, Gujarat

*Corresponding Author Email ID: megaseed@jau.in

Introduction

Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi has approved the project **"Creation of Seed Hubs for Enhancing Quality Seeds Availability of Major Oilseeds Crops – Groundnut"** and allotted to Junagadh Agricultural University, Junagadh in 2018-19.

Method of working

- Certified seed of less than 10 years old varieties is produced under the Seed Hub.
- Certified seed procurement price (given to seed producers of groundnut seeds) and seed selling price of certified seed for commercial seed production is fixed by the Government of Gujarat, Gandhinagar for Gujarat State Seed Corporation, Gandhinagar. JAU, Junagadh approves same rate as seed procurement price and seed selling price for university produced seeds for all crops including groundnut.
- Transportation charge of certified seeds (sealed by Seed Certification Officer of GSSCA at farmers field) from farmers field to godown of university is paid to the farmer @ Rs. 0.50 per 1 kg (distance not taken into consideration)
- When sealed certified seed reached to godown, around 90-95 per cent as seed procurement payment of market price (this also fixed by the GSSC, Gandhinagar) is being paid to the farmers immediately. After processing of pods in Groundnut Rotary

Grader (a machine approved by GSSCA for groundnut pod processing), whatever "A" grade certified pods recovered, on that quantity, the final seed procurement payment is made to the farmers as per the same rate fixed by the Government of Gujarat for GSSC, Gandhinagar.

- Final seed procurement payment of GSSC (fixed by Gujarat Government) includes the seed procurement incentives (production subsidy/*sahay*), that is to be paid to the farmers. Government of Gujarat is giving this production incentive separately to the GSSC as per the norms of NFSM and NMOOP, that is Rs. 2500/- per 1 (one) quintal in oilseeds. JAU, Junagadh with good collaborative efforts with the officials of Director of Agriculture, Government of Gujarat, tried for inclusion of production incentives for university produced certified seed and getting the production incentives from 2018-19 in groundnut.
- The university is selling the certified seed with same price that is being fixed by Government of Gujarat for GSSC, Gandhinagar. However, GSSC, gandhinagar is getting the seed distribution subsidy from different schemes (RKVY, NFSM, NMOOP etc.) and selling the seed with subsidy benefit of Rs. 40/- per kg in oilseeds. JAU, Junagadh, also submitting the project entitled "Seed Replacement Rate Enhancement" to the Director of Agriculture, Govt. of Gujarat, for getting help of such seed distribution subsidy under RKVY for every year since 2017-18 in the month of December for the next financial year.

Seed production against the target under the seed hub - groundnut at JAU, Junagadh

Crop	Variety	Seed production target (q)					Seed produced (q)				
		2018-19	2019-20	2020-21	2021-22	2022-23	2018-19	2019-20	2020-21	2021-22	2022-23
Groundnut	GJG 22	600	750	800	500	500	891.00	1041.25	804.65	1038.65	439.25
	GJG 32	-	-	200	500	500	-	-	288.05	1094.30	1778.00
Grand Total		**600**	**750**	**1000**	**1000**	**1000**	**891.00**	**1041.25**	**1092.70**	**2132.95**	**2217.25**

Revolving fund status of seed hub - groundnut at JAU, Junagadh

Year	Opening Balance	Release	Income	Total	Expenditure	Balance available under RF at the end of year
2018-19	100.00	100.00	0.00	100.00	47.24	52.76
2019-20	-	52.76	80.06	132.82	63.18	69.64
2020-21	-	69.64	102.36	172.00	68.73	103.27
2021-22	-	103.27	134.31	237.58	119.53	118.05
2022-23	-	118.05	286.65	404.70	191.49	213.21

Creation of infrastructure facility under seed hub - groundnut at JAU, Junagadh

Allocation (Rs in lakhs)	Gran allotted (Rs in lakhs)	Expenditure (Rs in lakhs)	Infrastructure created
50.00	50.00	50.00	1. Seed Storage Godown at Sagdividi Farm 2. Renovation of Threshing Yard at Sagdividi Farm 3. Seed Sell Office at Seed Hub Godown

 Seed Hub Godown at Sagdividi Farm	 Groundnut Rotary Grader
 Renovated Threshing Yard at Sagdividi Farm	 Stored Certified Groundnut Seeds
 Seed Sell Office at Seed Hub Godown	 Brand Logo of JAU

Direct benefit of subsidy to the farmers of Gujarat from 2018-19 to 2022-23 under RKVY Seed Replacement Rate Enhancement Project at JAU, Junagadh

Year	Variety	Stage	Farmer category			Quantity of seed sold (q)	Direct benefit of subsidy (Rs.)
			General + OBC	SC	ST		
Kharif 2018-19	GG 20	Certified	103		2	296.40	1136200
		Truthful	87			154.20	539700
		Foundation	7			21.90	83950
	GJG 22	Foundation	58			172.20	660100
		Certified	285	1	4	489.00	1874500
	Total		**540**	**1**	**6**	**1133.70**	**4294450**
Kharif 2019-20	GJG 22	Certified	322	2	2	828.30	3313200
	Total		**322**	**2**	**2**	**828.30**	**3313200**
Kharif 2020-21	GJG 22	Certified	449	1	11	1092.9	4371600
	GJG 32	Certified	16	0	0	31.2	124800
	Total		**465**	**1**	**11**	**1124.10**	**4496400**
Kharif 2021-22	GJG 22	Certified	327	2	2	808.20	3232800
	GJG 32	Certified	102	0	0	287.70	1150800
	Total		**429**	**2**	**2**	**1095.9**	**4383600**
Kharif 2022-23	GJG 22	Certified	424	4	6	1065.60	4262400
	GJG 32	Certified	416	3	6	1083.00	4332000
	Total		**840**	**7**	**12**	**2148.6**	**8594400**

Production subsidy/incentives given to groundnut seed producers under the project "Certified seed production of groundnut under NMOOP"

Sr. No.	Year	Grant sanctioned and allotted (Rs.)	Subsidy given to the farmers under seed production @ 75 % (Rs.)	Subsidy meet to the Department/University under seed production @ 25 % (Rs.)
1	**2018-19**	20,31,000	15,23,257	5,07,743
2	**2019-20**	24,19,500	18,14,625	6,04,875
3	**2020-21**	25,65,750	19,24,313	6,41,437
4	**2021-22**	51,19,500	38,39,624	12,79,876
5	**2022-23**	50,00,000	37,50,000	12,50,000

Key for success of Groundnut Seed Hub, JAU, Junagadh

- Same procurement price and selling price adopted by Gujarat State Seed Corporation.
- Regardless of distance transportation charge paid to the farmer is Rs. 0.50 per 1 kg
- 90-95 per cent seed procurement payment of market price is being paid to the farmers immediately
- Final seed procurement payment- production subsidy of Rs. 2500/- per 1 quintal in oilseeds and production incentives of Rs. 50 lakh in groundnut seed hub programme (*kharif* 2023)
- Seed distribution subsidy is Rs. 40/- per kg in oilseeds

Suggestions for successful implementation of Seed Hubs

- Appreciation to good performing center crop wise and year wise
- State Department of Agriculture are not taking any seeds from seed hubs for demonstrations under various schemes in terms of MINIKIT, so this should be implemented in strong way
- There should be a MoU for seed selling/distribution with NSC at National level and at state level with State Seed Corporation or with FPOs.

- As Government Public Sector like State Seed Corporation gave the seed procurement incentives or Seed Distribution subsidy, such things should be implemented at national level by the Nodal Agency/Center of respective seed hubs for successful revival of seed hubs.
- Provide contact number or contact details of FPOs running at national level

Best Performing Groundnut Seed Hub Centre Award

Groundnut Seed Hub running at the Department of Seed Science and Technology, Junagadh Agricultural University, Junagadh has been adjudged as the Best Performing Groundnut Seed Hub Centre for the period from October 2021 to to December 2022 during the Annual Groundnut Workshop held at Junagadh Agricultural University , Junagadh during May 24-26, 2023. The award certificate received by Dr. J. B. Patel, Professor and Head, and Dr. C. A. Babariya, Assistant Professor of Department of Seed Science and Technology, JAU, Junagadh by the hands of Dr. T. R. Sharma, Deputy Director General (Crop Science), ICAR, New Delhi and Dr. Sanjeev Gupta, Assistant Director General (Oilseeds & Pulses), ICAR, New Delhi in the auspicious presence of Dr. V. P. Chovatia, Hon'ble Vice Chancellor, JAU, Junagadh.

Acknowledgement: Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi, ICAR-DGR, Junagadh and ICAR-IIOR, Hyderabad for funding and supporting the project of creation of groundnut seed hub.

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PROTECTING HORTICULTURAL CROPS: STRATEGIES FOR ENSURING HEALTHY HARVESTS

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Dharmendra Kumar Gautam[1]*, Om Prakash[1], A. K. Shrivastava[1], Subhash Chandra Singh[1], Balaji Vikram[2], Vikash Kumar[1], Sidharth Kumar[1] and Rohit Kumar[2]

[1]Department of Fruit Sciences, [2]Department of Post Harvest Technology

College of Horticulture, Banda University of Agriculture and Technology, Banda, U.P.-210001

*Corresponding Author Email ID: gautam1998dharmendra@gmail.com

Introduction

Horticultural crops play an important role in global agriculture, providing a wide range of fruits, vegetables, flowers and ornamental plants. Crop protection helps keep plants healthy and maintain sustainable yields. The choice of plant protection strategy depends on the type of crop grown and the hazard. However, these crops face many challenges including pests, diseases and environmental factors and changing climatic conditions. Protective measures are essential to ensure a healthy harvest and sustain the horticulture industry. Farmers are protecting their crops, increasing their income and reducing their environmental impact.

Integrated Pest Management (IPM)

Integrated Pest Management is an eco-friendly approach to pest control that combines multiple techniques to manage pests effectively. It involves monitoring, identifying, and understanding pest populations and their natural enemies. Farmers can then implement various control methods such as biological control (introducing natural predators or parasites), cultural control (crop rotation, sanitation practices), mechanical control (traps, barriers), and judicious use of pesticides. IPM reduces chemical dependency, minimizes environmental impacts, and promotes long-term sustainability.

Disease Management

Horticultural crops are susceptible to a wide range of diseases caused by fungi, bacteria, viruses, and other pathogens. Disease management involves preventive measures such as using disease-resistant cultivars, practicing proper crop rotation, maintaining good sanitation practices, and implementing strict quarantine measures. Additionally, cultural practices like proper irrigation, pruning, and timely removal of infected plant parts can help control the spread of diseases. You can protect your yield against diseases by using one of the following methods:

- The application of chemicals
- Culture rotation
- Deep plowing
- Organizing quarantine
- Cultivation of disease-resistant species
- Heat treatment
- Regular monitoring of plant conditions

Temperature stress is a frequent plant disease cause. For example, creating drainage to divert moisture during heavy rains or providing additional irrigation during droughts. When necessary, targeted fungicides or bactericides can be used following recommended guidelines.

Environmental Controls

Environmental factors such as temperature, humidity, light, and air circulation significantly influence the growth and development of horticultural crops. Implementing protective structures like greenhouses, shade nets, or row covers helps create a controlled environment, shielding crops from extreme weather conditions, pests, and diseases. Such structures also allow for season extension, enabling year-round cultivation and protection against adverse weather events.

Weed Management

Weeds compete with horticultural crops for essential resources like water, nutrients, and sunlight, reducing yields and overall crop quality. Effective weed management strategies include cultural practices (mulching, hand weeding), mechanical methods (hoeing, tilling), and chemical control (herbicides). Integrated weed management combines multiple approaches to minimize weed pressure while minimizing environmental impacts and herbicide resistance.

Nutrient Management

Providing adequate nutrition is crucial for the growth and productivity of horticultural crops. Soil testing helps determine nutrient deficiencies, allowing farmers to formulate appropriate fertilizer programs. Balanced fertilization, based on crop requirements, improves plant health and resilience against pests and diseases. Additionally, organic matter management, cover cropping, and composting contribute to the overall fertility and health of the soil.

Water Management

Efficient water management is vital for horticultural crops, especially in areas prone to drought or water scarcity. Drip irrigation, micro-irrigation, or precision irrigation systems reduce water wastage and ensure targeted water delivery to plant roots. Mulching and soil moisture monitoring help conserve soil moisture and prevent water stress. Proper drainage systems and water recycling practices minimize the risk of waterlogged soils and prevent nutrient leaching.

Conclusion

Protection of horticulture crops is essential to maintain agricultural productivity and meet the demands of growing population. By using crop rotation, co-planting, natural predators, house mixes, physical barriers, integrated pest management, disease control, environmental protection, weed and nutrient management, you can create a healthy and sustainable farm that produces high quality crops year after year. produces products with, Organic pest control provides effective strategies to protect your crops without harming the environment or your crops. By adopting these practices, farmers can reduce risk, reduce losses, and promote sustainable horticultural production for a healthier and more prosperous future.

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EARTHEN DAMS: ENHANCING WATER CONSERVATION AND SUSTAINABLE RESOURCE MANAGEMENT

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Gatkal N. R[1*], Nalawade S. M[1] and Pawase P. P[1].

[1]Department of Farm Machinery and Power Engineering, Dr. Annasaheb Shinde College of Agricultural Engineering and Technology, MPKV, Rahuri., Ahmednagar, Maharashtra Pin-413722, India.

*Corresponding Author Email ID: narayan96378@gmail.com

Abstract

Management of soil and water resources for enhancing production is of growing concern worldwide and this is especially true for developing countries like India. Efficient management and utilization of these resources are very important to increase the agriculture production and productivity per unit area. One of the principal reasons for the low productivity in agriculture is the progressive deterioration of soil due to erosion. The factors for soil erosion in this area are excessive deforestation, overgrazing and faulty practices. Consequently, valuable top soil is lost and its fertility gets depleted resulting in poor agriculture yield. Soil erosion mainly occurs due to high velocity of runoff flowing over the land surface. It is dependent on land slope, crop cover and rainfall characteristics in a micro-watershed. The various soil and water conservation structures have good potential for conserving the soil and water.

Keywords: Earthen Dam, Diaphragm, Zoned, Cutoff Trench, Casing.

1. Introduction:

An earthen embankment is a raised confining structure made from compacted soil. The purpose of an earthen embankment is to confine and divert the storm water runoff. It can also be used for increasing infiltration, detention and retention facilities. Earthen embankments are generally trapezoidal in shape and most simple and economic in nature. They are mainly built with clay, sand and gravel, hence they are also known as earth fill dams or earthen dams. They are constructed where the foundation or the underlying material or rocks are weak to support the masonry dam or where the suitable competent rocks are at greater depth. They are relatively smaller in height and broader at the base.

2. Components of An Earthen Dam

The various components of an earthen dam are shown in Figure 1.

i. Shell, Upstream Fill, Downstream Fill or Shoulder: These components of the earthen dam are constructed with pervious or semi-pervious materials upstream or downstream of the core. The upstream fill is called the upstream shell and the downstream portion is the downstream shell.

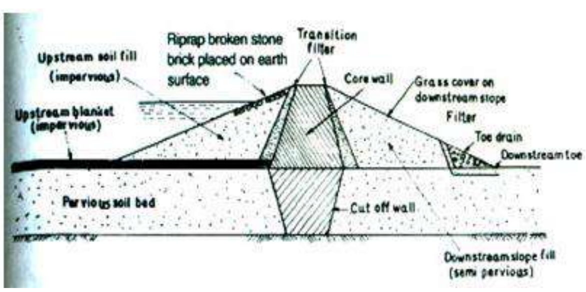
ii. Upstream Blanket: It is a layer of impervious material laid on the upstream side of an earthen dam where the substratum is pervious, to reduce seepage and increase the path of flow. The blanket decreases both the seepage flow and excess pressure on the downstream side of the dam. A natural blanket is a cover of naturally occurring soil material of low permeability.

iii. Drainage Filter: It is a blanket of pervious material constructed at the foundation to the downstream side of an earthen dam, to permit the discharge of seepage and minimize the possibility of piping failure.

iv. Cutoff Wall or Cutoff: It is a wall, collar or other structure intended to reduce percolation of water through porous strata. It is provided in or on the foundations.

v. Riprap: Broken stones or rock pieces are placed on the slopes of embankment particularly the upstream side for protecting the slope against the action of water, mainly wave action and erosion.

vi. Core Wall, Membrane or Core: It is a centrally provided fairly impervious wall in the dam. It checks the flow of water through the dam section. It may be of compacted puddled clay, masonry, or concrete built inside the dam.



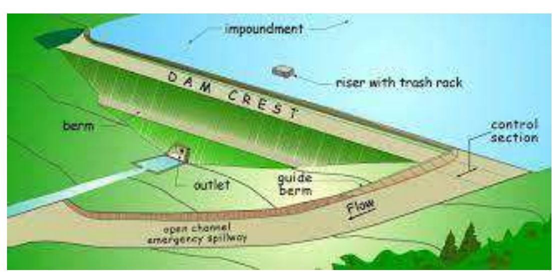


Fig. 1. Cross-section of an Earthen Dam with Various Components. (Michael and Ojha, 2012)

vii. Toe Drain: It is a drain constructed at the downstream slope of an earthen dam to collect and drain away the seepage water collected by the drain filters.

viii. Transition Filter: It is a component of an earthen dam section which is provided with core and consists of an intermediate grade of material placed between the core and the shells to serve as a filter and prevent lateral movement of fine material from the core.

Advantages

a) Design procedures are straightforward and easy.
b) Local natural materials are used.
c) Comparatively small establishment and equipment are required.
d) Earth fill dams resist settlement and movement better than more rigid structures and can be more suitable for areas where earth movements are common.

Disadvantages

a) An earthen embankment is easily damaged or destroyed by water flowing on, over or against it. Thus, a spillway and adequate upstream protection are essential for any earthen dam.
b) Designing and constructing adequate spillways is usually the most technically difficult part of any dam building work. Any site with a poor quality spillway should not be used.
c) If it is not adequately compacted during construction, the dam will have weak structure prone to seepage.
d) Earthen dams require continual maintenance to prevent erosion, tree growth, subsidence, animal and insect damage and seepage.

3. Types of Earthen Dam

1. Based on the method of construction:

(a) Rolled Fill Earthen Dams: In this type of dams, successive layers of moistened or damp soils are placed one above the other. Each layer not exceeding 20 cm in thickness is properly consolidated at optimum moisture content maintained by sprinkling water. It is compacted by a mechanical roller and only then the next layer is laid.

(b) Hydraulic Fill Earthen Dam: In this type of dams, the construction, excavation and transportation of the earth are done by hydraulic methods. Outer edges of the embankments are kept slightly higher than the middle portion of each layer. During construction, a mixture of excavated materials in slurry condition is pumped and discharged at the edges. This slurry of excavated materials and water consists of coarse and fine materials. When it is discharged near the outer edges, the coarser materials settle first at the edges, while the finer materials move to the middle and settle there. Fine particles are deposited in the central portion to form a water tight central core. In this method, compaction is not required.

2. Based on the mechanical characteristics of earth materials used in making the section of dam:

(a) Homogeneous Earthen Dams: It is composed of one kind of material (excluding slope protection). The material used must be sufficiently impervious to provide an adequate water barrier, and the slopes must be moderately flat for stability and ease of maintenance (Fig. 2).

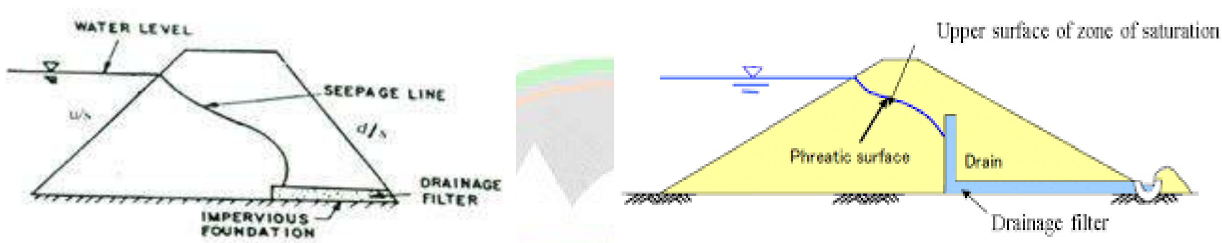


Fig. 2. Homogenous Earthen Dam. (Michael and Ojha, 2012)

(b) Zoned Earthen Dams: It contains a central impervious core, surrounded by zones of more pervious material, called shells. These pervious zones or shells support and protect the impervious core (Fig. 11.3).

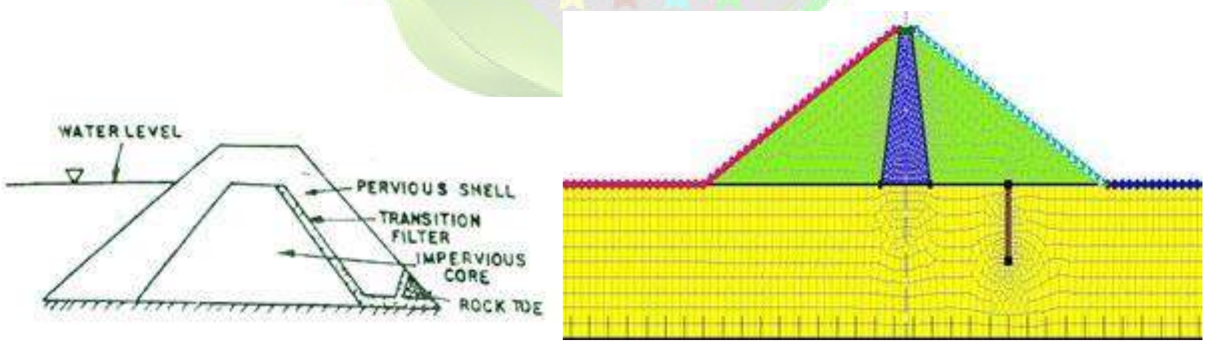


Fig. 3. Zoned Earthen Dam. (Michael and Ojha, 2012)

(c) Diaphragm Earthen Dam: This type of dam (Fig. 4) is a modified form of homogenous dam which is constructed with pervious materials, with a thin impervious diaphragm in the central part to prevent seepage of water. The thin impervious diaphragm may be made of impervious clayey soil, cement concrete or masonry or any impervious material. The diaphragm can be constructed in the central portion or on the upstream face of the dam. The main difference in zoned and diaphragm type of dams depends on the thickness of the impervious core or diaphragm. The thickness of the diaphragm is not more than 10 m.

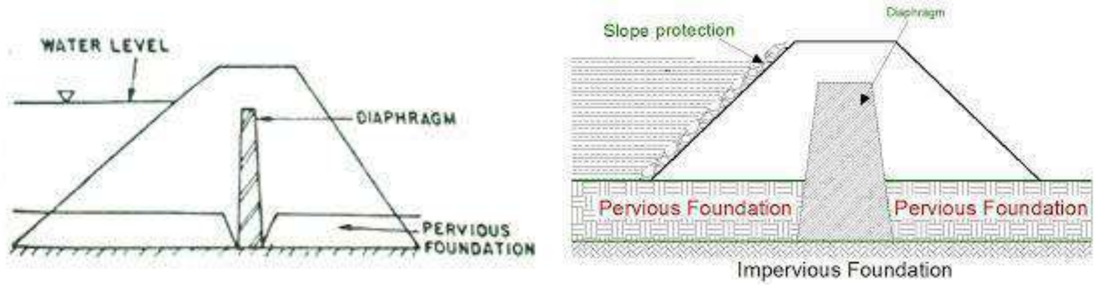


Fig.4. Diaphragm Earthen Dam. (Michael and Ojha, 2012)

4. Design Criteria

Following main design criteria may be laid down for the safety of an earth dam:

1. To prevent hydraulic failures the dam must be so designed that erosion of the embankment is prevented. For this purpose, the following steps should be followed:

(a) Spillway capacity is sufficient to pass the peak flow.

(b) Overtopping by wave action at maximum water level is prevented.

(c) The original height of structure is sufficient to maintain the minimum safe freeboard after settlement has occurred.

(d) Erosion of the embankment due to wave action and surface runoff does not occur.

(e) The crest should be wide enough to withstand wave action and earthquake shock.

2. To prevent the failures due to seepage:

(a) Quantity of seepage water through the dam section and foundation should be limited.

(b) The seepage line should be well within the downstream face of the dam to prevent sloughing.

(c) Seepage water through the dam or foundation should not remove any particle or in other words cause piping.

(d) There should not be any leakage of water from the upstream to the downstream face. Such leakage may occur through conduits, at joints between earth and concrete sections or through holes made by aquatic animals.

3. To prevent structural failures:

(a) The upstream and downstream slopes of the embankment should be stable under all loading conditions to which they may be subjected including earthquake.

(b) The foundation shear stresses should be within the permissible limits of shear strength of the material.

5. Design of Earthen Dam

The preliminary design of earthen dam is done on the basis of past experiences. For designing purpose several parameters, given below should be considered.

a) Top Width
b) Free Board
c) Settlement Allowance
d) Casing or Outer Shell
e) Cut-off Trench
f) Downstream Drainage System

1. **Top Width**: Minimum top width (W) should be such that it can enhance the practicability and protect it against the wave action and earth wave shocks. Sometimes it is also used for transportation purposes. It depends upon the height of the earthen dam and can be calculated as follows:

$$W = \frac{H}{3} + 3 \text{ for very low dam} \qquad \ldots 1$$

$$W = 0.55\sqrt{H} + 0.2H \; (H \leq 30) \qquad \ldots 2$$

$$W = 1.65\sqrt[3]{H + 1.5} \; (H \geq 30) \qquad \ldots 3$$

where H = the height of the dam (m), for Indian conditions it should not be less than 6 m.

Free board: It is the vertical distance between the top of the dam and the full supply level of the reservoir or the added height. It acts as a safety measure for the dam against high flow condition that is waves and runoff from storms greater than the design frequency from overtopping the embankment. The Recommended values of free board for different heights of earthen dams, given by U.S.B.R., are given in Table 1.

Table 1. Recommended Values of Free Board given by U.S.B.R.

Nature of spillway	**Height of dam**	**Free board**
Free	Any	Minimum 2 m and maximum 3 m over the maximum flood level

Controlled	< 60 m	2.5 m above the top of the gate
Controlled	> 60 m	3 m above the top of the gate

If fetch length or exposure is given then the free board can also be calculated by Hawksley's formula:

$$h_w = 0.014 D_m^{0.5} \quad \ldots 4$$

where, = wave height (m); Dm = fetch or exposure (m).

2. Settlement Allowance: It is the result of the settlement of the fill and foundation material resulting in the decrease of dam storage. It depends upon the type of fill material and the method and speed of construction. It varies from 10% of design height for hand compacted to 5% for machine compacted earthfill.

3. Casing or Outer Shell: Its main function is to provide stability and protection to the core. Depending upon the upstream and downstream slopes, a recommendation for the casing and outer shell slopes for different types of soils given by Terzaghi is presented in Table 11.2.

Table 11.2. Recommended Slopes of Earthen Dam (Sources: S.K. Garg, 2008)

Sl. No.	Types of material	u/s slope	d/s slope
1.	Homogenous well graded material	$2\frac{1}{2}:1$	$2:1$
2.	Homogenous coarse silt	$3:1$	$2\frac{1}{2}:1$
3.	Homogenous silty clay or clay a) Height less than 15 m b) Height more than 15 m	$2\frac{1}{2}:1$ $3:1$	$2:1$ $2\frac{1}{2}:1$
4.	Sand or sand and gravel with clay core	$3:1$	$2\frac{1}{2}:1$
5.	Sand or sand and gravel with R.C. core wall	$2\frac{1}{2}:1$	$2:1$

Cutoff Trench: It is provided to reduce the seepage through the foundation and also to reduce the piping in the dam. It should be aligned in a way that its central line should be within the upstream face of the impervious core. Its depth should be more than 1 m. Bottom width of cutoff trench (B) is calculated as:

$$B = h - d \qquad \ldots 5$$

where h = reservoir head above the ground surface (m); and d = depth of cutoff trench below the ground surface (m).

4. Downstream Drainage System: It is performed by providing the filter material in the earthen dam which is more pervious than the rest of the fill material. It reduces the pore water pressure thus adding stability to the dam.

Three types of drains used for this purpose are:

a) Toe Drains

b) Horizontal Blanket

c) Chimney Drains.

Conclusion:

Earthen dams have been used for centuries all over the world to store water for irrigation, drinking water, and hydroelectric power. They are an important part of our infrastructure and can help reduce the impacts of floods and droughts. Dam failures can cause significant damage and loss of life, so we must take steps to ensure their safety. So, it is necessary to learn about earthen dams and how to inspect them so they can be a part of keeping our communities safe.

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SURGICAL MANAGEMENT OF SQUAMOUS CELL CARCINOMA IN THE BOVINE HORN

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Dr. Prafull Kumar Singh*

Ph.D. scholar,Department of Veterinary Surgery and Radiology, College of Veterinary Science and Animal Husbandry, Acharya Narendra Dev University of Agriculture and Technology, Kumarganj, Ayodhya- 224 229, Uttar Pradesh, India

*Corresponding Author Email ID: prafullkumarsingh1325@gmail.com

Abstract

Squamous Cell Carcinoma of horn, also known as horn cancer, is a prevailing type of cancer in cattles especially Bosindicus. It is one of the most prevalent disease in Indian bullocks often resulting in death and huge economic losses to farmers. Here, 6 to 8 year old age cow with growth on the right horn, foul smell and bleeding was presented to Veterinary Clinical Complex,Kumarganj, Ayodhya. On clinical examination the horn growth is characterised by granulation tissue at the base of the horn with offensive odour and was spongy, greyish white discharge like having rough and verrucous surface and was diagnosed as horn cancer. The horn tumor was removed surgically from the base and the animal was recovered uneventfully. The histopathology of the tumour revealed the squamous cell carcinoma. The present communication describes a report of ten cases of the horn cancer in bovine.

Key words: Bovine, H&E Staining, Squamous Cell Carcinoma, Surgical Management

Introduction

Cancer is a complex disease caused by multiple etiological factors and affects almost every species of mammals present on earth. Various types of cancer prevalent in farm animals causes moderate to severe economic losses to the farmers. Squamous Cell Carcinoma (SCC) is one of the most common cancer capable of metastatic spread and is observed in various forms across many animals and humans[12].The accumulation of genetic and epigenetic alterations in cancer cells endows them with unwanted proliferative and metastatic potential. Horn cancer is a widespread cancer reported in Indian zebu cattle (Bosindicus) with higher frequency in Kankrej breed than other zebu cattle, nondescript cattle or crossbred[3]. It is a type of SCC with poorly defined genetic landscape, which arise from pseudo stratified columnar epithelium of the horn core mucosa, reported only in Bosindicus. Horn Cancer often results in death of an animal in the event of metastasis[2]. Horn cancer is a common condition in bullocks in India affecting approximately one percent of population[11]. Horn cancer is generally unilateral and is encountered in cattle in the age group of 5-10 years[9]. The disease is associated with chronic irritation of horns at their base[8]. A few cases of horn cancer were also reported from Sumatra Brazil, and Iraq. Castrated male animals i.e. bullocks make up 95% of the affected animals and cows 5%, and rarely observed in bulls, buffaloes, sheep and goats[7].The most consistent clinical signs are frequent head shaking, tilting at the affected side, bending of affected horn and increase nasal discharge on the affected side in advance cases[3]. For treatment of horn cancer amputation of horn alone or along with chemotherapy using Vincristine were on reports[10]. The present case describes treatment of horn cancer in bovine and its successful surgical management.

History and symptoms

Ten non-descript breed of cow age between 6 to 8 years old age cowwere presented to the Veterinary Clinical Complex (VCC), College of Veterinary Science and Animal Husbandry, Acharya Narendra Dev University of Agriculture and Technology, Kumarganj, Ayodhya- 224 229, Uttar Pradesh, India, with history of gradual bending of the horn with foul smelling, purulent pus discharge from the base of horn. In two case the left horn had already fallen 4 months ago due to fight with other bullocks. There were pink soft cauliflowers like growths which were very friable and bleed easily (**Fig.A**).

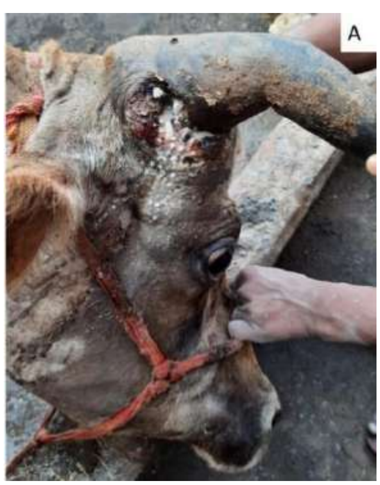

Fig.A: Purulent, pink soft cauliflowers like growthsat base of horn cancer

On theBased on the history, tentatively diagnosed and clinical examination, of affected horn, as horn cancer and amputation of horn was performed. All the animals had to undergo a corrective/curative surgery which involves amputation of their horn.The owners of the animals were informed about the experimentand the samples were collected from the amputatedhorn during the corrective/curative amputationsurgery. No animals were euthanized or died during the surgery.

Treatment

The animal was restrained in standing position and the surgical site was prepared for aseptic surgery. Xylazine Hydrochloride (Xylaxin^{R}, Indian Immunologicals, Siddipet Telangana, India) @ 0.1 mg/ kg intramuscularly to sedate the animal. An amount of 20ml 2% Lignocaine hydrochloride (Xylocaine^{R}, Zydus Healthcare Ltd.) was infiltrated in a fan pattern to desensitize the cornual nerve parallel to the frontal crest at its middle one third. After adequate analgesia dehorning was done by Flap method as suggested[4]. The incision was extended in an elliptical manner around the corium and the underlying tissues are separated at base of horn to raise full thickness dorsal and ventral skin flaps. Following skin incision the cornual artery were located on its ventral aspect and ligated by chromic catgut No.1 to prevent haemorrhages. The exposed horn was then dehorned closely to its base by using sterilized gigli wire saw. The remaining attachment to the bone was chiselled out with bone chisel. The cavity was thoroughly curetted to get rid of neoplastic cells. To avoid any possibility of haemorrhage, gauze soaked in clotase was applied in the cavity for some time. The entire skin flap was sutured by simple interrupted pattern using silk No.2 and wound is covered with Tincture Benzoin seal to prevent haemorrhage. Post-operative treatment included administration of amoxirum forte (7mg/kg intramuscularly), Meloxicam (0.2 mg/kg intramuscularly) for 7 days and chlorpheniramine maleate (10ml intramuscularly) for 3 days. Daily dressing of the suture line was performed with 0.05% Povidone iodine solution and applied Himax ointment around the wound. The skin sutures were removed on 10th post-operative day.

Histopathology

Histopathology examination Representative sample of the tissue were collected in 10% neutral buffered formalin. the tumor tissue was processed for histopathological examination and stained with hematoxylin and eosin by standard procedure as suggested[6]. Microscopically the tumour revealed neoplastic epithelial cells extendedinto dermis forming focal islands, cords and trabeculae and showed variable degree of squamous differentiation. In addition epidermal hyperplasia, hyperkeratosis, fibrosis was also noticed. The amount of keratin seen as intracytoplasmic, eosnophilicfibrillar material showed distinct keratin “pearls”. The neoplastic cells forming focal islands were round with moderate amount of pale to basophilic cytoplasm. The connective tissue stroma was profuse along with numerous thin walled blood vessels. The entire histopathoogical features suggested that the growth were of squamous cell carcinoma **(Fig. B).**

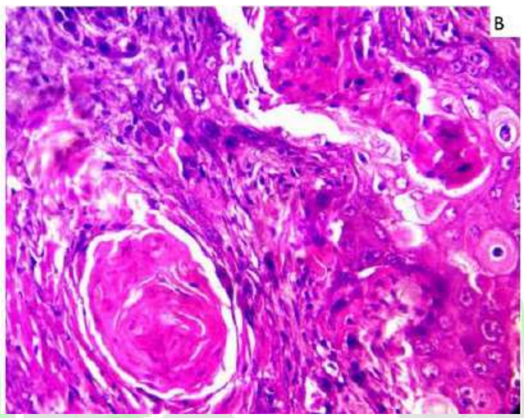

Fig.B: Squamous cell carcinoma of horn tumor showing distinct keratin Pearls.

Results and Discussion

In the present case the recovery was uneventful and observed complete cure without any recurrence as reported[1]. The specific chemotherapy including antineoplastic drugs could not be undertaken due to economic considerations[11] while, successfully used of vincristine sulphate @ 0.025mg/kg intravenously thrice at interval of seven days for squamous cell carcinoma of horn after surgical excision[5]. Carcinoma of horn core in cattle is primarily squamous cell neoplasm. Histological examination of cancerous tissue collected from middle region of horn core revealed typical keratinizing squamous cell carcinoma with characteristic epithelial pearls as same observed[1]

Conclusion

Ten cases of unilateral horn cancer in bovine with successful surgical management and their histopathological studies have been reported. Early Diagnosis and treatment is essential for good prognosis. The cases of unilateral horn cancer in cattle can be successfully managed by surgical method if it is diagnosed in early stage.

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BOOSTING AGRICULTURAL PRODUCTIVITY: HARNESSING THE POWER OF BUNDS TO CONSERVE WATER

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Gatkal N. R[1*], Nalawade S. M[1]. and Pawase P. P[1].

[1]Department of Farm Machinery and Power Engineering, Dr. Annasaheb Shinde College of Agricultural Engineering and Technology, MPKV, Rahuri., Ahmednagar, Maharashtra Pin-413722, India.

*Corresponding Author Email ID: narayan96378@gmail.com

Abstract:

Bunding is an engineering measure of soil conservation that involves placing an impediment in the course of surface runoff to slow down the flow of water. It helps to reduce soil erosion by retaining the runoff water in the watershed. Bunds are simple embankment-like constructions that run the length of a land slope. In watersheds, many forms of bunds are used to reduce erosion and conserve moisture.The design of bund depends on many factors such as bund spacing, top and bottom width, side slope, type of soil. The design of bund also discussed in details.

1. Introduction:

Bunding is an engineering soil conservation measure used for retaining water and creating obstruction to the surface runoff for controlling soil erosion. Bunds are simple earthen embankments of varying lengths and heights, constructed across the slope. When they are constructed on the contour of the area, they are called as contour bunds and when a grade is provided to them, they are known as graded bunds. For bunding, the entire area is divided into several small parts; thereby the effective slope length of the area is reduced. The reduction of the slope length causes not only reduction of the soil erosion but also retention of the runoff water in the surrounding area of the bund. Bunds are similar to the narrow based terrace, but no agricultural practices are done on bunds except at some places, where some types of stabilization grasses are planted to protect the bund.

2. Types of Bunds

Bunds are of two types: (1) Contour bund and (2) Graded bund

1) Contour Bund

When the bunds are constructed following the same contour, they are called contour bunds. Figure 1 shows the layout of contour bunds in the field. Contour bunds are recommended for areas with low annual rainfall (<600 mm), agricultural field with permeable soil and having a land slope < 6%. The major requirements in such areas are prevention of soil erosion and conservation of rain water in the soil for crop use.

Contour bund absorbs the runoff water stored at the upstream side of the bund. Proper height of the bund is necessary to avoid overtopping during floods. During monsoon, even in a low rainfall region, the entire runoff water cannot be stored and the excess is liable to flow over the bund. To avoid damage, waste or surplus weir (Fig. 2) is provided on the bunds to dispose off excess water into the next bund. This prevents water-logging.

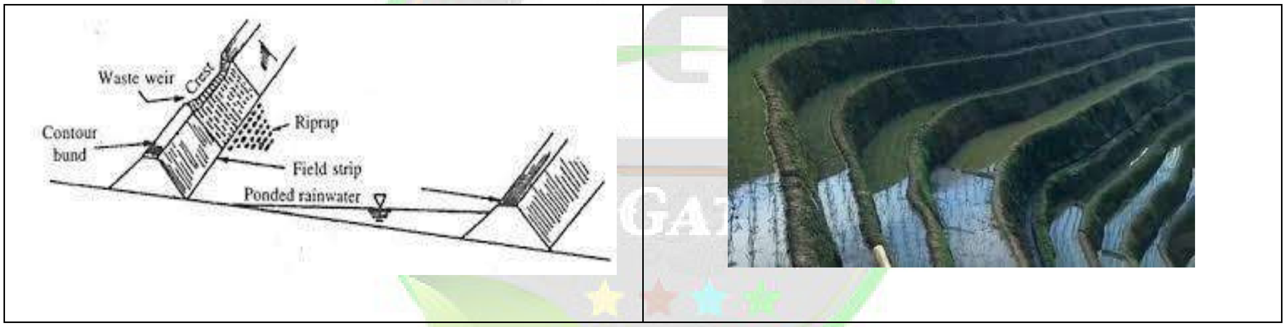

Fig. 1: Layout of contour bunds in field. (Das, 2002)

Contour bunding can be adopted on all types of permeable soil except for the clayey or deep black cotton soils as these soils have the problem of crack development causing bund failure. Clayey soil also has the problem of water-logging near the bund section, which makes the bund construction infeasible.

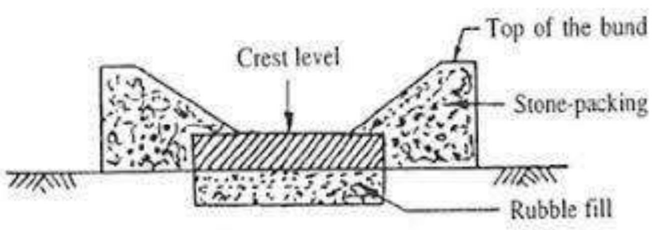

Fig. 2. Clear overfall stone weir. (Das, 2002)

2) Graded Bund

When a grade is provided along the bund for safe disposal of runoff water over the area between two consecutive bunds, they are called graded bund. Graded bunds are adopted in case of high or medium annual rainfall (>600 mm) and relatively less permeable soil areas. Graded bunds are designed to dispose excess runoff safely from agricultural field.

3. Design of Bunds

3.1. Design of Contour Bund

The design parameters required for contour bunds are

1) Vertical interval

Calculation of Vertical Interval (V.I) and Horizontal Interval (H.I)

For low rainfall areas

$$VI = 0.15\,S + 0.6\ (m)$$

$$HI = \frac{VI \times 100}{S}$$

Where,

VI = Vertical interval, m

HI = Horizontal interval, m

s = Original land slope, %

2) Calculation of Storage Required for Runoff Volume

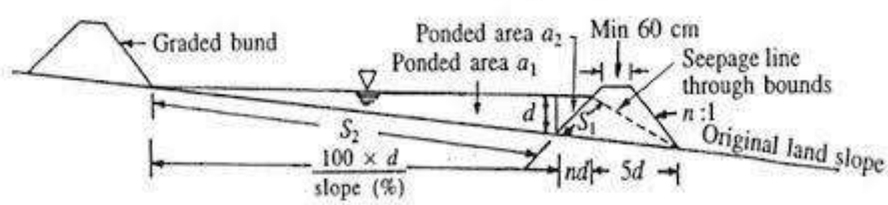

Fig. 3. Layout of contour bund. (Das, 2002)

$$P_e = P - I$$

$$A = HI \times L$$

So, Runoff volume to be stored

$$R_v = P_e \times A,\ m^3$$

Where,

P = Precipitation, m

Pe = Excess rainfall depth or surface runoff, m

I = infiltration depth, m

H.I = Horizontal interval, m

L = Length of bund behind which the runoff is stored, m

A = Area of watershed behind two bunds, m^2.

RV = Runoff volume to be stored, m^3.

3) Calculation of Storage Volume

$$Ponded\ arae\ (a_1) = \frac{1}{2} \times \frac{100d}{S} \times d\ \text{m}^2$$

$$Ponded\ arae\ (a_1) = \frac{1}{2} \times nd \times d\ \text{m}^2$$

Area of water stored behind the bund = $(a_1 + a_1)$, m^2

Storage volume (SV) = area of water stored behind the bund × length of bund (m3)

where,

d = depth of water stored behind the bund (m)

n : 1(H:V) = side slope of the contour bund

4:1 (H:V) = Seepage line slope of the bund

4) Calculation of Depth of Water Stored Behind Bund

For total runoff absorbed by the bund,

Runoff volume (RV) = Storage volume (Sv)

Using this relationship, the depth of water stored behind bund is calculated.

5) Calculation of Bund Cross Section

$$Total\ height\ of\ bund\ (H) = (d + 20\%\ of\ d\ as\ free\ bund)$$

$$Base\ bund\ (B) = (nd + 4D), (m)$$

$$Base\ bund\ (T) = (B - 2nH), (m)$$

(6) Calculation of Earth Work due to Bunding

$$Lenght\ of\ contour\ bund\ per\ hectare\ (L) = \frac{10^4}{HI}\ for\ main\ bund$$

$$= \frac{10^4}{HI} \times 1.3\ for\ main\ bund\ with\ side\ and\ lateral\ bund$$

$$Earthwork\ per\ hecatre$$

$$= Cross\ ectional\ area\ of\ bund\ per\ hecatre\ \times lenght\ per\ hectare$$

$$= \left[\frac{1}{2} \times (B + T) \times H\right] \times L \frac{m^3}{ha}$$

Height of the contour bund should be enough to store the expected peak runoff for a 10 years recurrence interval. A free board of about 20% should be provided for the settlement of height.

3.2. Design of Graded Bund

Graded bund is designed based on 1h rainfall intensity for desired recurrence interval. In general, a grade of 0.2 to 0.3% is provided in graded channel. In graded bund free board of 15 to 20% of desired depth is provided.

Recommended Dimension

I. Height of bund ≤ 45 cm
II. Top width = 30 to 90 cm
III. Velocity of runoff should be less than critical velocity.

Fig. 4: Graded bund

Table 1: Recommended side slope for graded bund (Source: Das,2002)

Type of soil	**Side slope, (Horizontal: Vertical)**
Clayey	1:1
Loamy	1.5:1
Sand	2:1

Table 2: Recommended seepage line slope for graded bund (Das, 2002)

Type of soil	**Side slope, (Horizontal: Vertical)**
Clayey	3:1
Sandy Loam	5:1
Sand	6:1

(1) Calculation of Vertical Interval (VI) and Horizontal Interval (HI)

For medium and high rainfall areas

$$VI = 0.1\ S + 0.6\ (m)$$

$$HI = \frac{VI \times 100}{S}$$

Where,

VI = Vertical interval, m

HI = Horizontal interval, m

s = Original land slope, %

(2) Calculation of Peak Runoff Rate y rational formula

$$Q = \frac{CIA}{360}\ (m^3/s)$$

Where,

QP = Peak runoff rate (m3/s)

C = Runoff coefficient

I = Rainfall intensity (mm/h) for duration equal to time of concentration.

Time of concentration (min) is calculated by

$$t_c = 0.0195 \left(\frac{L}{\sqrt{S}}\right)^{0.77}$$

Where,

tc = Time of concentration (min)

L =Length of water flow = (length of bund + distance between two bunds) in (m)

S = H/L = gradient or slope causing water flow

H = Elevation difference causing water flow

= (elevation difference causing length of bund + elevation difference of land)

= (L X g + HI X s) (m)

g = grade of channel (%)

A= Drainage area (ha)

= (L X HI)

(3) Calculation of Discharge Capacity of Graded Bund

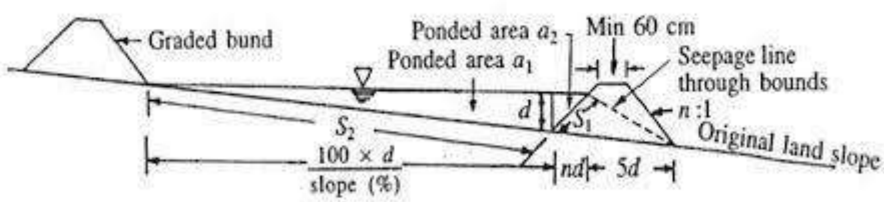

Fig.5. Design layout of graded bund. (Das, 2002)

From the design layout of contour bund

$$Ponded\ arae\ (a_1) = \frac{1}{2} \times \frac{100d}{S} \times d \text{ m}^2$$

$$Ponded\ arae\ (a_1) = \frac{1}{2} \times nd \times d \text{ m}^2$$

Area of water stored behind the bund = $(a_1 + a_1)$, m^2

Wetted perimeter of water ponded (P) = (P_1+P_2)

Storage volume (SV) = area of water stored behind the bund × length of bund (m3)

$$P = \left[\sqrt{\left(\frac{100d}{S}\right)^2 + d^2} + \sqrt{(nd)^2 + d^2}\right]$$

Where,

d = depth of water stored behind the bund (m)

n:1(H:V) = side slope of the graded bund

5:1 (H: V) = Seepage line slope of the bund for sandy loam soil

Hydraulic radius(R) by manning equation

$$R = \frac{d}{A} \text{ m}$$

$$\text{Mean velocity}\left(\frac{m}{s}\right) = \frac{1}{n} \times R^{\frac{2}{3}} \times g^{\frac{1}{2}},\ \text{m/s}$$

Where,

n= manning roughness coefficient

Discharge capacity(Q)=(a_1+a_2) x V (m^2/s)

If, Q>$Q_p$then the design is proper

(4) Calculation of Bund Dimension

$$Total\ height\ of\ bund\ (H) = (d + 20\%\ of\ d\ as\ free\ bund)$$

$$Base\ bund\ (B) = (nd + 4D), (m)$$

$$Base\ bund\ (T) = (B - 2nH), (m)$$

(5) Calculation of Earth Work due to Bunding

$$Lenght\ of\ contour\ bund\ per\ hectare\ (L) = \frac{10^4}{HI}\ for\ main\ bund$$

$$= \frac{10^4}{HI} X\ 1.3\ for\ main\ bund\ with\ side\ and\ lateral\ bund$$

$$Earthwork\ per\ hecatre$$
$$= Cross\ ectional\ area\ of\ bund\ per\ hecatre\ \times lenght\ per\ hectare$$

$$= \left[\frac{1}{2} \times (B + T) \times H\right] \times L \frac{m^3}{ha}$$

Bund Construction

In India, construction of bund is done by manual labor, but bullock-drawn buck scrapers, tractor plough, tractor pulled grade terraces, bulldozers and motor graders are also popular.

Conclusion

Contour bunds are defined as bunds that are built along the contours with small deviations to respond to practical situations. Graded bunds are those that have a slight incline to them. By holding runoff water in the watershed, it helps to decrease soil erosion. Bunds are straightforward embankment-like structures that run the length of a land slope. Bunds are used in watersheds to minimise erosion and store moisture in a variety of ways. Bunds built along contours with modest deviations to respond to practical requirements are known as contour bunds. Bunds with a small inclination are known as graded bunds.

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BIOMOLECULE STRUCTURE AND IMPORTANCE OF THE NATURAL DYE

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Dr.R. Nandhikumar, C. Anitha[2] and Dr.D.Elumalai[3]

[1,3]Adhiyamaan College of Agriculture and Research, Hosur, Tamil Nadu

[2]Department of Mathamatics, Islamiah women's arts and science college Vaniyambadi, Tirupatthur, Tamil Nadu

*Corresponding Author Email ID: nandhikumar@gmail.com

Introduction

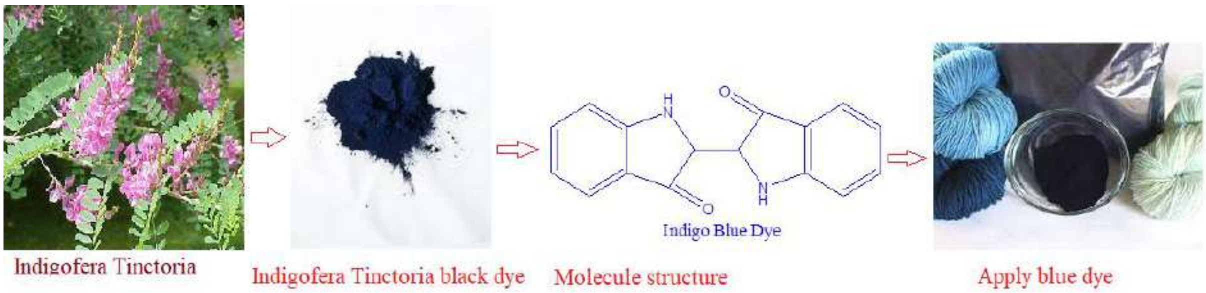
Dyes mean coloring components and have different colors with different chemical molecules. These dye molecules give the color of the compounds and attraction of commercial activity. Generally, dye is obtained from two methods one is the extraction of dyes from natural resources and another one is synthesized from a chemical reaction. Natural dyes have been used to color textiles, food, and cosmetics from ancient times, but in the 19th century, synthetic dyes replaced natural dyes after the discovery of mauve colorants. Natural dye means any dye, pigment, or any other substance derived from natural sources, such as plants, animals, and minerals, which are renewable and sustainable resource products like eco-products. These natural dyes are used for the coloring of textiles, food substrates, and protein fibers (wool, silk and cotton, and leather) as well as food ingredients and cosmetics.

Types of natural dyes

Natural dyes are mainly derived from plant sources, insects (kermes, cochineal, and lac) are also included. Natural dyes are containing complex mixtures of structures derived (extracted) from plants, animals, or minerals. Several numbers of plants like herbs, shrubs, and trees extracted some useful dyes. Then some insects, animals, microbes, and minerals molecules also have been identified, and extraction of dye compounds. Red, yellow, brown, blue, black, green, and orange colors can be obtained from natural dyes.

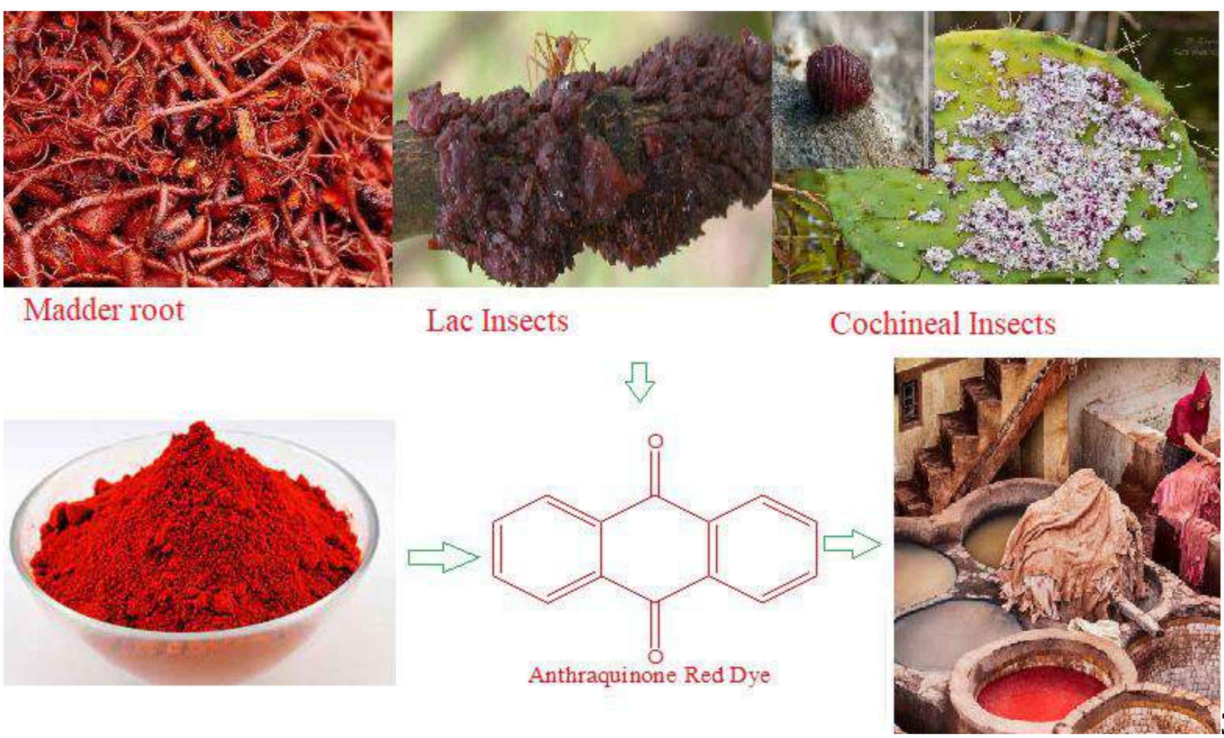
1.Indigoid dyes:

This group includes Indigo and Tyrian purple dye. Indigo dye is extracted from the Indigoferatinctoria plant and is considered the simplest dye. Isatistinctoria (Wood plant) also has indigo dye as the chief blue color dyeing molecule.



2.Anthraquinone dyes:

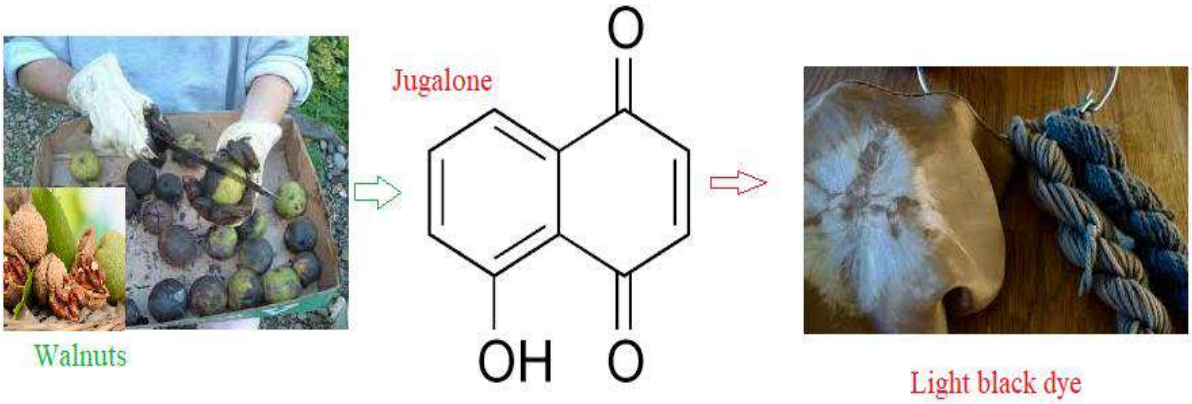
Anthraquinone dye is very important because this dye provides red to the objects and cheapest one. These types of dyes are obtained from both plants and minerals. These dyes' structures are fused benzene-like compounds containing two keto groups. Anthroquinone dyes are obtained from the bio-resources like Madder, Lacs, Cochineal, etc. Alizarin and purpurin are the main chromophores in Rubiatinctorum and these molecule arrangements give the red dyes.



3.

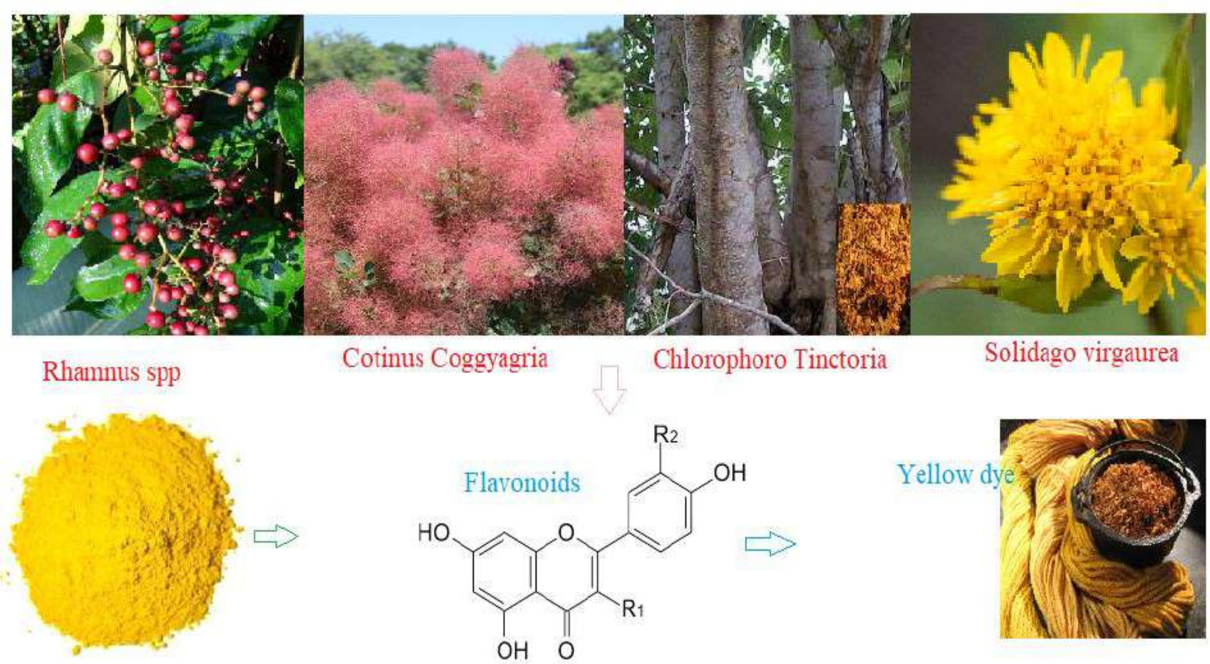
Alpha naphthoquinones:

Henna (Lawsone) is the most important biomolecule structure of Alpha naphthoquinones dyes and juglone. Juglone molecules are isolated from the shells of unripe walnut components (black dye).



4. Flavonoids:

Flavonoid-like molecules play a very important role in the natural dyes history because it gives bright yellow dyes. Further, it is classified into several types like flavones, isoflavones, aurones, and chalcones molecules. These light and dark yellows dyes are found in a variety of plants (bioresources), including Rhamnusspp (Persian berries), Cotinuscoggygria (young fustic), Chlorophoratinctoria (old fustic) and Solidagovirgaurea (yellow wood).



5. Di-hydropyrans:

Dihydropyrans dyes are obtained from some plant wood materials like Logwood and Sappan-wood. These dihydropyran's molecule structure resembles flavone molecules. It gives the darkest on cotton, wool, and several types of silk.

6. Anthocyanidins:

Anthocyanidin dyes are obtained from natural resources like the leaves of Bignonia chica and it gives orange dyes. Carajurin is the main biomolecule in this category.

7. Carotenoids:

Carotenoids are the best and cheap dye obtained from the carrot and give orange color pigment. These color compounds are responsible for the presence of chromophores (conjugated double bonds) and due to the presence of long unsaturated double-bond compounds. Generally, orange, red, and yellow colors come in this group and they can be derived from different plant sources and give different colors like orange and yellow color dyes.

Methods of Extraction of natural dyes from plants

1. Extraction
2. Isolation of dye molecule
3. Dyeing
4. Dye fixing

Application of Natural dyes

Generally, the plant produces two types of Biomolecule that is Primary and Secondary metabolites so these dyes come under secondary metabolites and give good dyes and have a lot of antibacterial activity. Then these types of natural dyes are easily biodegradable and environmentally friendly products. Nowadays scientists also find new types of dyes from plants because it's low economical and biodegradable methods. All types and all colors of dye are obtained from plants so it's easy methods to extract the dyes.

Conclusion

Although naturally dyed textiles are promising to provide functional properties such as antimicrobial, UV protection, and mosquito as well as moth repellence, still the stability-related issues with natural dyes also need to be significantly addressed. Natural dyes produce an extraordinary diversity of rich and complex colors that complement each other. Dye extracts may look a little expensive at first, but they are very economical when their concentration has been taken into account. So much work has already been done on most of the old dyes that the need for newer dye sources has emerged to keep alive the use of these dyes. Many scientists/researchers are doing a great deal of work in the area of amelioration of natural dye, and this period can be considered the renaissance of natural dyes. The increasing knowledge of different natural sources providing beautiful colors is expanding the shade cards of different fabrics. Revamping of this ancient art has another distinctive attribute, that is, the empowerment of such tribes that used to thrive on this form of art.

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MICROGREEN

Article ID: AG-VO3-I07-40

Sankari A[1] and Kayalvizhi K[2]*

[1]Professor (Horticulture), HC & RI, TNAU, Coimbatore, [2]Teaching Assistant (Horticulture), IOA,TNAU, Kumulur, Trichy

*Corresponding Author Email ID: kkayal.flori@gmail.com

Introduction

Microgreens are the first true leaves produced from a seedling of vegetables and herbs that are about 2-3 inch tall. Many varieties of plants including turnips, radishes, broccoli, cauliflower, carrots, celery, chard, lettuce, spinach, arugula, amaranth, cabbage, beets, parsley and basil that can be grown as a microgreen for a wholesome and nutritious addition to daily meals. The tiny leaves of most of the microgreens ready for harvest in 12 to 14 days and are packed with nutrition and intense flavours imitating their mature counterparts. For example, beetroot microgreens taste just like beetroot and coriander microgreens taste like coriander.

Microgreens contain considerably higher levels of vitamins and carotenoids - about five times on an average - than mature counterparts. Such soaring levels of nutrients help lower the risk of cancer, Alzheimer's, osteoporosis and boost heart health.Microgreens are incredibly easy to grow due since they are harvested at the first true leaf stage and can be grown effortlessly on a sunny windowsill. Microgreens get ready to eat in just two weeks. Microgreens are tiny, the concentration of flavours makes them a favourite of food lovers around the world. According to a study done by University of Maryland, microgreens have a higher concentration of nutrients than mature vegetables and herbs with some microgreen varieties having up to 40 times more nutrition than grown vegetables.

Potting Soil

Planting Soil works the best, use any garden soil. The soil should not contain any chemical or pesticide quantities, in order to grow Microgreens organic and healthy.

Pot/Tray

A seed tray is available at any hardware store or a nursery. A regular planting pot or a baking dish that is 4-5 inches deep will also use.

Light Source

Microgreens require an essential amount of sunlight natural light for at least 3-4 hours a day. A bright windowsill or a balcony that receives sunlight will be a good spot for seed germination.

Water

Water is a necessary element for Microgreens. The soil being used is to be kept moist at all times. A hand sprinkler works best for the plant, due to its micro outlets.

Procedure:

The first step is filling the tray/container with soil. Since the roots of Microgreens do not reach that deep, 3-4 inches soil height should be good enough.

After the soil is ready, Microgreen seeds are to be spread on the soil surface. The spacing between the seeds does not need to be completely even, so hand sprinkling works fine.

Now cover the seeds with a very thin layer of soil and gently pat the surface in order to make the seeds settle well in the container.

Next making the soil damp with water. Spray enough water over the soil surface in order to make the surface completely moist, but do not flood it with water.

The container can be kept at room temperature for about two days until germination occurs. Then choose a sunny spot to place the plant, where it receives a good amount of sunlight for at least 3-4 hours in a day.

Sprinkle a little water over the growing greens, twice a day. In 3-4 days seeds will germinated and observe small leaves growing over the soil with little shoots at the bottom.

Once the plants are 2-3 inches taller, they are ready to be harvested.

Harvesting Microgreens is using scissors or a sharp knife and cut the Microgreens, holding them vertically, from just over the roots.

After harvesting Microgreens, wash them with cold running water

List of microgreens

1) Rocket Microgreen (*Eruca sativa*)

Rocket is a part of the larger brassica plant family. Packed with antioxidants, Vitamins A, C, K, Calcium, Folate, Iron, Magnesium, Phosphorus, Beta Carotene, and cancer-fighting phytochemicals. Add the rocket microgreen leaves to your favourite pizza for a peppery taste. Arugula or rocket microgreen seeds can germinate in room temperature and grow faster in cooler weather.

2) Radish Microgreen

One of the fastest growing microgreens is radish. Radish microgreens are a good source of vitamin B, C, Zinc, Magnesium and Phosphorus and antioxidants. The peppery radish zest in tiny green leaves would make a flavoursome addition to the texture and colours in the meals. Radish microgreen seeds can be sown throughout the year and grow well at room temperature.

3) Broccoli Microgreen

The anti-inflammatory properties of broccoli microgreens will help reduce toxins in the body. Broccoli microgreens are packed with vitamin A, C, E, K, protein, and calcium including significant amounts of iron, magnesium and phosphorus. Spread a handful of broccoli microgreens in soup, smoothie or sandwich to get the best versatile green. Broccoli microgreens seeds will grow best in soil based medium and will be ready for harvest in 8 to 10 days.

4) Beetroot Microgreen

Beetroot microgreens are bright red and purple colour very attractive. Beetroot microgreens are charged with Zinc, Iron, Calcium, Potassium, Magnesium, and vitamins A, B, C & K. Use beetroot microgreens generously on top of green salads, pizza and sandwiches. Beetroot microgreen seeds sown throughout the year and harvest them in 18-20 days after sowing.

5) Parsley Microgreen

The parsley microgreens are packed with Iron, Calcium, Magnesium, Potassium, Fibre and Vitamins A, C & K. Parsley microgreens are good for improving liver health and have been known to discourage the growth of certain types of cancers. Parsley microgreen seeds prefer a soil-based growing medium and have a high germination rate.

6) Garden Cress Microgreen

Garden cress microgreens are a great way to add the much needed spicy and fresh flavours to sandwiches and salads. These microgreens contain all the essential amino acids, Vitamins A, B, C & E, Potassium, Phosphorus, Calcium, Magnesium, Iron, Niacin and antioxidants. The Garden cress microgreen seeds will start germinating in 3-4 days.

7) Spinach Microgreen

The dark green leaves of spinach microgreens are sweet in taste and are complement the juices and smoothies very well with their mildly sweet taste. Spinach microgreens are a wonderful source of Iron, Potassium, Calcium, Vitamins A & C. Spinach microgreen are good in keeping the blood pressure in check, preventing cancer and reduce chances of diabetes. Spinach microgreens seeds will grow uniformly in a fairly sunny spot and in good airflow.

8) Sunflower Microgreen

Sunflower microgreens are full of essential nutrients including vitamin A, B, C, Calcium, Iron, Manganese, Phosphorus, Potassium, Sulphur and Zinc. Sunflower microgreens also pack the cancer-fighting compounds and antioxidants about 5 to 10 times than the mature plants. The nutty, slightly sweet flavour of sunflower microgreens great with different salads. Sunflower microgreen seeds should be presoaked in cold water for 8 - 12 hours for better germination.

9) Pak Choi Microgreen (*Brassica rapa* subsp. *chinensis*)

The mild and slightly mustard like the taste of pak choi microgreens makes a great choice for garnish. Pak choi microgreen is full of Vitamin E, C, K, Iron and Beta-carotene and is good for lower cholesterol, improving heart and bone health. Pak Choi microgreen seeds are sensitive to light conditions and must be kept in low to medium light only.

10) Alfalfa Microgreen

Alfalfa microgreens are very mild and crunchy in flavour and can be added to salads or sandwiches to slightly nutty flavour. Alfalfa microgreens are rich in Vitamin A, B1, B6, C, E, and K, Potassium, Iron, Calcium and Zinc..

These microgreens can play an important role in preventing breast cancer, reduce the chances of diabetes and improve bone health. Alfalfa microgreen seeds can be sown throughout the year and will be ready for harvest in 10 to 14 days.

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WIND CIRCULATION EFFECTS ON INDIAN SUMMER MONSOON

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Yashi Singh*, Simranjeet Kaur, R. K. Pal

Department of Climate Change and Agricultural Meteorology, Punjab Agricultural University, Ludhiana-141004, Punjab

*Corresponding Author Email ID: 1yashisingh99@gmail.com

Introduction

Monsoon is a change in wind patterns that frequently ushers in either a very wet or a very dry season. It occurs in many tropical and subtropical climates, including some locales in the United States, even though they are typically associated with areas of Asia.Although it is primarily thought as heavy downpour for a few weeks, but actually rainy season is a part of monsoon. Monsoon is more than just rainin fact; it can also cause dry weather. The word monsoon is derived from the Arabic word *mausim*, which means “season”.

Cause of Monsoon:

A seasonal change in the wind triggers monsoon. Because the temperatures of the land and the ocean vary with the seasons, the winds also change. For instance, the land warms up more quickly than the ocean at the start of summer. Winds always move from chilly to warm conditions. In the summer, circumstances are created that reverse the direction of the wind.

Summer monsoon close to the Indian Ocean are the ones that provide the most precipitation. Ocean heat evaporation rises into the atmosphere. In nations like India and Sri Lanka, as a result, the wind shifts, and moisture blows in the direction of the land. The wet, warm air then condenses into rain. As a result, there may be months-long periods of high humidity and significant rainfall.A winter monsoon occurs when the wind reverses direction in the winter. In these areas close to the Indian Ocean, winter monsoons are often dry.

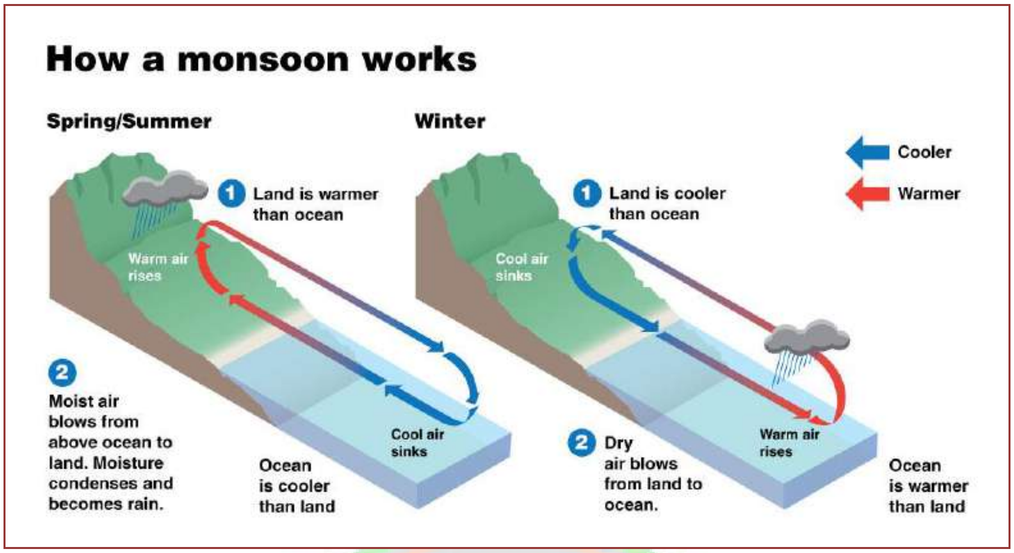

Fig 1: Seasonal temperature differences between the land and ocean
(https://scijinks.gov/what-is-a-monsoon/#:~:text=A%20monsoon%20is%20caused%20by,blow%20from%20cold%20to%20warm**)**

The most notable monsoon system in the world, the Indian monsoon predominantly impacts India and the nearby water bodies. During the colder months, it blows from the northeast, and during the hottest months of the year, it switches directions to blow from the southwest. Large volumes of rain occur in the area in June and July as a result of this process.

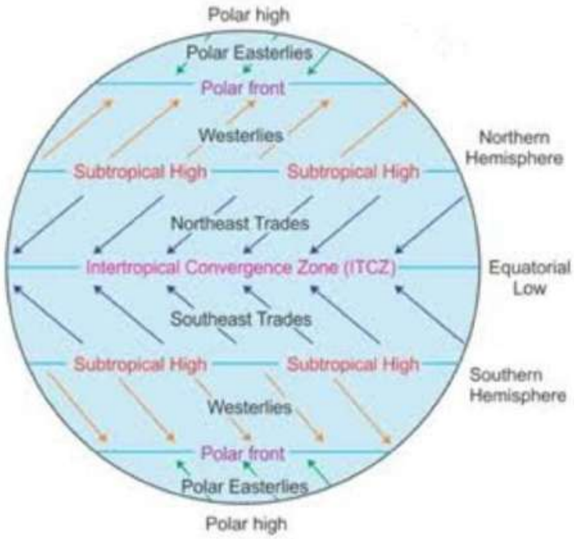

Fig 2: General Global Circulation of Wind(https://brainly.in)

Ways in which Geographical Location of India influences monsoon

i) The region near India is unusual at the equator in that westerly winds are dominating or common at the surface virtually year-round; easterlies only reach latitudes about 20° N in February, and even then they contain a very strong northerly component.

ii) The upper-air circulation rapidly shifts as they quickly withdraw to the north**.** This is a transitional period between one monsoon's finish and the start of the next.

iii) The high-sun season goes farther north and reaches the Equator by the end of March. Convectional clouds, or rising and turbulent clouds, and rain are also brought on by it.

iv) The surface winds are north-easterlies, while the westerly subtropical jet stream still dominates the airflow over northern India.

Indian Summer Monsoon 2023:

a) Delayed monsoon in Kerela

Monsoon was found to be delayed in Kerela by 8 days than its normal onset of 01 June. Although, following the westerly wind patterns onset of monsoon was expected early, but due to a series of atmospheric phenomenon it got delayed:

i) Firstly, a cyclonic circulation was formed which later intensified into a depression (on 30 May) over the Southeast Arabian Sea.

ii) This further led to reduction of cloud cover off the Kerela coast. Cloud cover is a major condition which is required for the onset of the monsoon.

iii) Further, westerly winds again prevailed over South Arabian Sea, which cited the cyclonic circulations over the Southeast Arabian Sea.

iv) These developments led to the cloud cover being more organized and concentrated over the area.

v) Finally, the monsoon was observed to reach the Kerela coat on June 8 (as opposed ro typical date of June 1).

vi) The IMD confirmed the onset of the monsoon has after analyzing rainfall measured at weather stations in the southern state of Kerala and westerly wind speeds.

b) Advancement of monsoon in Punjab and North-Western regions:

i) Although the monsoon was delayed in Kerela, it advanced in Punjab, which is quite encouraging because the agrarian states of Punjab and Haryana have so far had more than average rainfall in June.

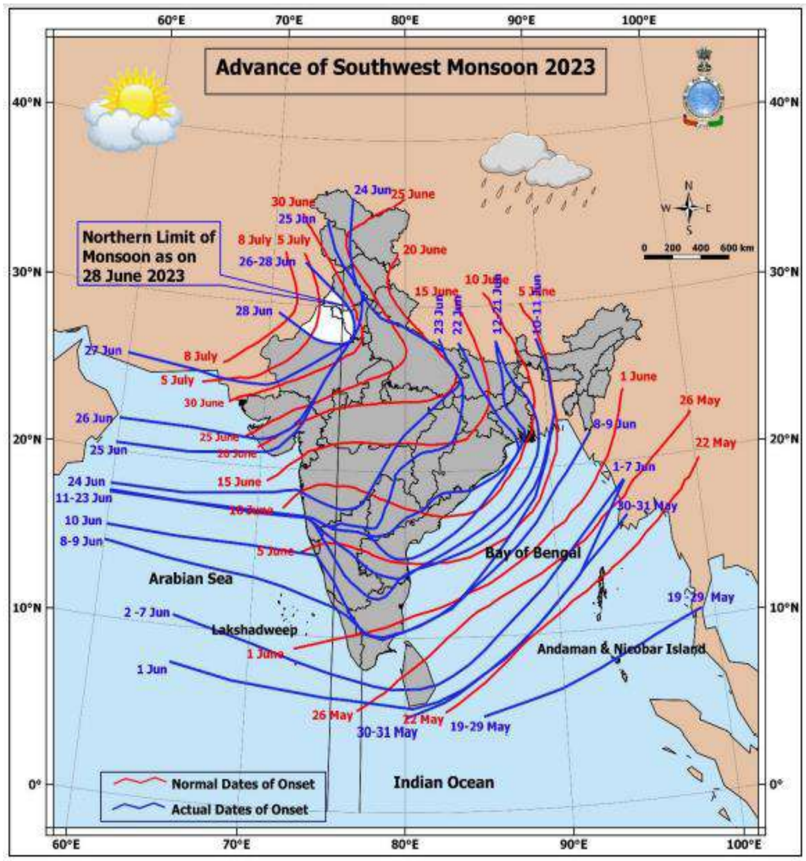

Fig 3: South-west monsoon 2023

([https://internal.imd.gov.in/press_release/20230629_pr_2401.pdf)](https://internal.imd.gov.in/press_release/20230629_pr_2401.pdf)

ii) North Madhya Pradesh's core regions and the surrounding regions were observed to be in Low Pressure zone.

iii) In the lower troposphere, the heart of the Low Pressure Area is traversed by an east-west trough that extends from northwest Rajasthan to Nagaland. At mean sea level, the off-shore trough stretches from Kerala's coast to Maharashtra's coast.

iv) In the intermediate troposphere, a cyclonic circulation was observed to spread across south Gujarat and the surrounding area.

These developments in the atmosphere have led to an advance onset of monsoon in North-west India.

Significance of Indian summer monsoon

The monsoon rains in India refill reservoirs and groundwater, facilitating irrigation and increasing hydropower generation. A successful monsoon season will also lessen the need for government-subsidized diesel, which is used to pump water for irrigation from wells, the ground, ponds, and rivers.

i) Nearly 70% of the rain required to irrigate India's agriculture and refuel reservoirs and aquifers is brought in by the monsoon, the engine that drives the $3 trillion Indian economy.
ii) Recently, the strength of the monsoon winds has been tapped to boost energy output. It is advantageous that these sources of energy are renewable.
iii) Additionally, it provides protection from the worst of the heat.
iv) The planting of rice, cotton, corn, soybeans, and sugar cane might be delayed if the June-September rains arrive late, according to merchants, as about half of India's cropland is dependent on them in the absence of irrigation infrastructure.
v) It helps India's agriculture. In actuality, the monsoons are crucial to the nation's whole agricultural sector.
vi) It restores the nation's groundwater table.
vii) It restocks all of the water storage facilities.

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POST HARVEST HANDLING AND COLD CHAIN MANAGEMENT IN CUT FLOWERS

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[1]S. Kavinilavan and C. Ravindran*[2]

[1]Research Scholar, HC & RI, TNAU, Coimbatore

[2]Associate Professor and Head, HRS, TNAU, Kodaikanal, Tamil Nadu

*Corresponding Author Email ID: ravi.vini@gmail.com

Introduction

Floriculture is one of the important commercial trades in agriculture as the demand for flowers continues to increase. The production of flowers is estimated at 2151.96 thousand tonnes of loose flowers and 828.09 thousand tonnes of cut flowers in 2020-21. The country has exported 23,597.17MT of floriculture products to the world. 771.41 Crores/ 103.47 USD Millions in 2021-22.

A flowering crop should also be grown free from toxic wastes, gases, factories that damage leaves and flowers. Flowers damaged by pathogens, insects and mites show high ethylene production, resulting in poor vase-life. Exporters must plan and monitor effective quality control measures from production to post-harvest, storage and transportation.

Grading

The cut flowers are graded based on stem length, bud diameter, degree of bud opening, free from injury, pest and diseases.

Cut flowers **grading**

Rose deleafing

Rose packing

Grading of Gerbera

Orchids holding solution

Pre cooling

- Pre-cooling referred to subjecting flowers under cold storage conditions immediately after harvest to brings down the respiration rate and field heat and ultimately to enhance the vase life and quality of cut flowers.
- The pre-cooling temperature varies with the species and cultivars.

There are seven principal methods of pre-cooling fresh produce:

1) Room cooling
2) Forced-air cooling
3) Hydro-cooling
4) Ice cooling
5) Vacuum cooling
6) Cryogenic cooling
7) Evaporative cooling

Room cooling

The simplest method of cooling cut flowers is to stand them in buckets of preservative solution in a cold room.

Cold Wall

A permanent false wall or air plenum contains an exhaust fan that draws air from the room and directs it over the cooling surface

Vacuum Cooling

Vacuum precooling is based on the principle that water evaporates spontaneously under low vacuum conditions.

Pre-cooling temperature for certain flowers

S. No	Crop	Pre-cooling temp. (^{0}C)
1.	Rose	1-3
2.	Anthurium	13
3.	Gerbera	4
4.	Dendrobium	5-7
5.	Carnation	0.5-1
6.	Chrysanthemum	0.5-4
7.	Cymbidium	0.5-4
8.	Gladiolus	4-5
9.	Bird of Paradise	7-8

Special Treatments

1) Pulsing
2) Impregnation
3) Bud opening
4) Conditioning

Pulsing

The loading of flowers with high concentration of sucrose and anti-ethylene compound for a short duration is known as pulsing.

Impregnation

The ends of stems can be impregnated with high concentration of Silver nitrate ($AgNO_3$) or nickel chloride ($NiCl_2$) or cobalt chloride ($CoCl_2$) solution for 10 minutes.

Bud opening

Those flowers which are harvested at stage earlier than that of commercial stage require special treatments for opening of flower are treated with some specific chemical solutions known as bud opening solutions.

Conditioning

Conditioning or hardening is a simple process where the flowers are kept standing loosely in a large container of water to restores the turgidity of cut flowers from water stress during storage and transportation.

Carnation Pre-treatment

Controlled Atmosphere Storage

Room cooling

Vacum cooling

Role of Special Treatments on Vase-life of Flowers

For evaluation of longevity, temperature of 20-23°C and relative humidity of 40 to 80%, continuous light (12 hours daily) from cool white fluorescent lamps at 1000 to 2500 lux are most suitable conditions.

Germicides used as Floral Preservative

Name of compound	Commonly used symbol	concentration range
8-Hydroxyquinoline sulfate	8-HQS	200-600 ppm
8-Hydroxyquinoline citrate	8-HQC	200-600 ppm
Silver nitrate	$AgNO_3$	10-200 ppm
Silver Thiosulfate	STS	0.2-4 mm
Thiopendazole	TBZ	5-300 ppm
Quaternary ammonium salts	QAS	5-300 ppm
Slowly releases chlorine compounds		50-400 ppm of CI
Aluminumsulfate	Al(SO4)	200-300 ppm

Packaging

It is advantageous to wrap bunches of flowers in paper or cellophane and then, place them in corrugated fiber board cartons to protect flowers against physical damage, water loss and external conditions detrimental to the flowers.

Storage

It results in orderly marketing, reduced retailer's hazards resulting from unforeseen decline for demand, anticipating holidays, improved production efficiency; elimination of greenhouse production in deep winters, saving energy and making possible long term shipment.

Storage

A. Cold storage

i. Wet storage

ii. Dry storage

B. Controlled atmospheric storage (CA)

C. Modified atmospheric storage (MA)

D. Low pressure storage (LPS) /Hypobaric storage

A. Cold storage

The Cold storage of cut flowers facilitates the adjustment of flowers and other planting material supplies against the market demand and enables the accumulation of large quantities of flowers.

1. **Wet storage**

- In wet storage, flowers are stored with their base dipped in water or preservative solution for a short time.
- During wet storage, flowers are kept at 3-4oC temperature slightly higher than that used for dry storage

Flowers	Temperature (°C)	Shelf life (weeks)
Antirrhium	4	4
Carnation	4	4
Chrysanthemum	1	3
Gladiolus	0.5-5	10
Gerbera	4	3-4
Lily	0-1	6
Rose	4	4
Tulip	-0.5-0	2-3

2. **Dry storage**

Dry storage method is used for long term storage. In this method, fresh flowers are harvested in the morning, graded and sealed in plastic sleeves/ bags or boxes to prevent the loss of moisture.

Flowers	Temperature (°C)	Shelf life (weeks)
Anthurium	13	(weeks)

Carnation	0-1	4
Cattleya	7-10	16-24
Dendrobium	5-7	2
Gladiolus	4	2
Lily	1	4
Rose	1	6
Strelitzia	8	3
Tulip	0-1	4

B. Controlled atmospheric storage (CA)

The principles of controlled atmosphere storage for cut flowers are based on the close regulation of three parameters viz. temperature, oxygen and carbon dioxide.

Flowers	CO2 concentration (%)	O2 concentration (%)	Temperature (0C)	Shelf life (weeks)
Carnation	5	1-3	0-1	30
Freesia	10	21	1-2	20-22
Gladiolus	5	1-3	1.5	21
Lily	10-20	21	1.0	21
Rose	5-10	1-3	0	20-30
Tulip	5	21	1.0	10

C. Modified atmospheric storage (MA)

- MA storage is a less precise form of CA storage. The flowers are in sealed bags leads to reduction in O2 and increase in CO2 levels due to respiration of the tissue.
- This increased level of CO2 reduces the biosynthesis of ethylene and hence increases the flower longevity.

D. Low pressure storage (LPS) /hypobaric storage

- In this storage method, flowers are stored under reduced pressure, low temperature and cooled moist air.

In LPS, gaseous substances like CO_2 and ethylene produced flowers through stomata and intercellular spaces much quicker under low pressure than at normal pressure.

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PROSO MILLET: A HIGHLY PROFITABLE CROP

Article ID: AG-VO3-I07-43

K.Sathiya[1], A. Nirmalakumari[1], T.S. Sukanya[2] and C. Vanitha[1]

[1]Centre of Excellence in Millets, TNAU,Athiyandal, Thiruvanamalai

[2]University of Agricultural Science (UAS), Bangalore

*Corresponding Author Email ID: sathiya.k@tnau.ac.in

Introduction

Prosomillet is scientifically called *Panicum miliaceum* with the common names of common millet, Kashfi millet,broomcorn millet, hog millet, red millet and white millet.It comes under the grass subfamily Panicoideae. The crop is extensively cultivated ininhalf a million acres every yearin all over the world like Russia, China, India, Ukraine, Nepal,the Middle East, Belarus, Romania, Turkeyand the United States.

- The crop is highly demanded due to its high-quality protein which varies from 11.5 to 13% with a maximum of about 17%, minerals and vitamins. It's also rich in potassium as well as iron and manganese.
- The crop is notable for its short lifecycle (65-70 days), low water requirement and producing grain more efficiently per unit of moisture than any other grain species.

- It occupies summer fallow which helps to achieve continuous crop rotation.
- It has a profuse net-work of superficial and flat root system.
- It is highly drought-resistant crop, hence, suitable for the regions with low water availability and longer periods of dry spell.
- The soil should be light or medium-heavy with good drainage and compaction of soilis to be avoided.
- Proso millet does not tolerate soil wetness caused by dammed-up water.

Plant biology

Proso millet (*Panicum miliaceum*) is an annual crop growing to a height of 90-120 cm. The inflorescence is a drooping panicle varying for degree of compactness with more or less naked branches bearing ovate pointed spikelets. The main rachis of the panicle is glabrous, laterals being ribbed and hairy and swollen at the tip where the spikelets are born. The spikelets are about 0.5 cm long and contain two florets, partially enclosed by glumes. The outer glume is short while the inner glume is as long as the spikelet. The lower floret of the spikelet is sterile consisting of a lemma and very much reduced palea, while the upper floret is perfect bearing grain. The perfect floret has three stamens,two lodicules and an ovary with a long styleand a feathery bifid stigma. Proso millet normally has self-fertilising florets and produces nearly a globular grain enclosed tightly in the persistent lemma and palea. The husk is variously coloured (yellow,cream, grey or red) and very smooth. The inner grain is normally white or yellow in colour.

Proso millet plant

Reason for low yield

- Cultivated as rain-fed crop
- Soils are low fertile in nature
- Not adopting proper cultivation practices
    - Soil health maintenance
    - Use of quality seeds
    - Proper spacing
    - Population maintenance
    - INM, IWM, IPM

To overcome the above reasons for low yield potential,adoption of the following technologies for getting higher yield is essential.

High yielding technologies

Climate

Proso millet is a warm climate crop and is grown widely in warm regions of the world. They are grown where the annual average rainfall receipt ranges from 400-500 mm.

Season

The growing periods are determined based on the rain receipt, potential evapotranspiration (PET) and temperature. It is known that some portion of the world is not suitable for cultivation at any time and some part is suitable year round.It mainly depends on the distance of countries from the equator.

In Tamil Nadu, the following seasons are followed:

S.No.	Agro ecological zones	Districts	Season
1.	North Eastern Zone	Vellore, Thiruvannamalai, Cuddalore, Villupuram, Thiruvallur Kancheepuram	Feb-March (Masipattam)
2	North Western Zone	Salem, Namakkal, Dharmapuri and Krishnagiri	June-July (Adipattam)
3	Western Zone	Coimbatore, Erode, Karur, Tiruppur and Dindigul	

<table>
<tr><td>4</td><td>Cauvery Delta Zone</td><td>Tiruchy, Thanjavur, Thiruvarur, Nagapattinam, Pudukkottai, Perambalur, Ariyalur</td><td rowspan="3">Sep-Oct (Puratassipattam)

May-June (Vaikasi Pattam)</td></tr>
<tr><td>5</td><td>Southern Zone</td><td>Madurai,Theni, Pudukottai, Sivagangai, Virudhunagar, Ramanathapuram, Tirunelveli Thoothukudi</td></tr>
<tr><td>6</td><td>Hilly and High Altitude Zone</td><td>The Nilgris</td></tr>
</table>

Varieties

Selection of suitable varieties based on season and soil type helps to reduce the vagaries of climate change on agriculturalcropping systems and to ensure stable production in agriculture. The following varieties are having higher yielding potential.

Variety	Common Name	Year of release	Duration in days	Yield kg/ha	Special attributes
CO(PV)5	Cross derivative of PV 1403 x GPUP21	2007	70	2318	Profuse tillering, Short duration, Drought tolerant, Palatable straw
TNAU 145	Cross derivative of PV 1454 x TNAU 96	2007	70	1819	Released as national variety, Long panicle with more branches, Resistant to lodging, Bold grains
TNAU 151	Cross derivative of TNAU 96 x PV1673	2008	72	1860	Released as national variety, Tolerant to shoot fly, Resistant to lodging, Bold grain

TNAU 164	Cross derivative of TNAU 137 x CO4	2009	70	1893	Resistant to lodging, Tolerant to shoot fly, Tolerant to rust
TNAU 202	PV 1454 x TNAU 96	2017	70	1819	Released as national variety, Tolerant to shoot fly, Resistant to lodging, Bold grain
ATL 1 (TNPm 230)	TNAU 164 x IPM 19	2018	70-75	2152	Tall, non- lodging and non- shattering Drought tolerant Resistant to rust, brown spot, sheath blight and grains smut.
ATL 2	Pure line selection from IPM 19	2022	65-70	2140	Strong culm ;non-lodging; semi-compact long panicle; non-shattering grains and suitable for machine harvesting; bold grains with high milling out turn.

Soil

Proso millet has wider adaptability to different soils from very poor to very fertile and can tolerate a certain degree of alkalinity. The best soils are alluvial, loamy and sandy with good drainage.

Field preparation

Soon after harvesting the previous crop, the field should be ploughed to expose the soil to the sun which helps to control:

- All weeds including problematic weeds population
- Pest and disease problems
- Restore moisture which it rains.

Before sowing the land should be ploughed twice or thrice and then finally leveled. In summer, before land preparation, one irrigation should be given. As soon as the soil comes to working condition, the seedbed should be prepared by running harrow or country plough thrice followed by planking.

Proso millet needs a **firm and clean seedbed** but do not respond to deep ploughing for its shallow rooting.

Ploughing – removal of pest by birds **Pulverizing the soil**

Seed

Seed is the most important in-put source in agriculture. Sowing good quality seeds leads to lower seed rate, better emergence (>70%), more uniformity, less replanting, and vigorous early growth which helps to increase resistance to insects and diseases, and decrease weeds.

Seed rateand method of sowing

There are different methods of sowing followed in the farmer's field.

Method of sowing	Seed rate
Line sowing (kg)	10
Broadcasting (kg)	12.5
Spacing (cm)	25 x 10

Line sowing ensures better germination, cuts down seed requirement, facilitates intercultural operations and due to non-crowding, reduced pest and disease problems compare to broadcast sowing.

Formation of lines for sowing

Seed treatment

Seed treatment techniques protect seeds and plants and improve the establishment of healthy crops in the early stage itself especially in shorter duration crops like Proso millet. For chemical seed treatment 1 kg of seed is mixed with 2 gram of thiram or carbendazim, which should be done before 24 hours of bio-fertilizer treatment.

For liquid bio-fertilizer seed treatment, 4-5 ml per kg of seed is required, mixed well and dried in the shade before sowing. Afterwards, the seeds are sown in required spacing.

Seed treatment with liquid biofertilizer

Depth of sowing

The depth of sowing plays major a role in germination. The depth of sowing decides

- Days to germination
- Vigour of the crop
- Leaf development

The optimum depth of 2 -3 cm helps to give better germination of Proso millet crop

Manures and Fertilisers:

Proso millet being a short-duration crop, it requires relatively less amount of nutrients compared to other cereals. For one hectare 44 kg nitrogen, 22 kg P2O5 and 20 kg K2O were recommended. From this, half of the nitrogen and whole amount of phosphorus and half of the potash are applied as a basal dose at the time of sowing. The remaining half of the nitrogenand potash should be applied after the first weeding (20-30 DAS). If organic manure is available, it may be added to the soil about a month before sowing at the rate of 12.5 tonnes per hectare.

Nutrients are very much essential to plant growth, root growth and grain development.

Plant growth, root growth and seed formation

Micronutrient mixture

Mix 12.5 Kg of micro-nutrient mixture mixed with sand to make a total quantity of 50 kg/ha and applied evenly over the bed without incorporating the mixture in to the soil.

Fertilizer and micro nutrient mixture application

Water Management:

Proso millet sown during the *Kharif* season generally does not require any irrigation. However, at tillering stage, if a dry spell prevails for a longer period, then one irrigation must be given to boost the yield. In summer, the crop requires two to three irrigations depending upon soil type and climatic conditions. First irrigation at 15-20 days after sowing and second irrigation at 40-45 days after sowing. Due to the shallow root system of Proso millet, deep irrigation is not advisable.

Weed Control

For getting a high yield potential and minimizing loss of soil moisture and nutrients, the field should be kept weed-free up to 35 days of sowing. Weeding may be done with a hand hoe or wheel hoe.

Weeding and weed free field

Harvest

GenerallyProso millet is ready for harvest after completion of mentioned duration of the crop varieties. Harvesting the crop at physiological maturity will increase the yield quantitatively and qualitatively. The grains in the primary branches ripe and shatter before the grains in latterbranches in the panicles. Therefore, the crop should be harvested when about two third of panicles are ripe. Harvest manually or useing a mechanical harvester.

Harvesting stage

Machine harvesting

Threshing

Green immature ear-heads if harvested will contaminate the grains with immature grains and interfere with cleaning, drying and grading. Dry ear-heads until grain moisture content is 12-15% and separate manually by threshing with bamboo stick or machine thresher.

Pre-cleaning, drying and storing

Threshed grains should be pre-cleaned before sundrying, seeds must be dried to 12% moisture before grading.Generally high moisture content in seed reduces storage life due to mould growth and very low moisture content below 4% may also damage seeds due to extreme desiccation or cause hard seeds.

Economics

For one acre cultivation of Prosomillet, the total expenditure is Rs. 6500 – Rs. 7000. The yield obtained from one acre is 550 to 660 kg. From this 65-70 days of cultivation, farmers can get Rs. 15000 to Rs. 17500 per acre.

Farmers point

The following points were collected from the farmers as a feed-back, why they are not cultivating Prosomillet like other cash crops:

- Lack of awareness about cultivation and nutritional benefit
- Non-availability of quality seeds and Seed banks
- No crop insurance
- No crop loan
- No Community level threshing floor
- No procurement at minimum support price rates
- No Marketing and processing facilities

Interventions

The following ideas may create awareness and increase the Proso millet and other small millet production

- Conducting demos through various schemes
- Development procurement policies like Rice and Wheat
- Adoption of various cropping systems
- Supply of Proso millet rice through Public Distribution System

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SUCCESS STORY ON SEED PRODUCTION OF THREATENED CATFISHES IN CAPTIVE CONDITION BY SANWAR HOSSAIN MAHALDAR, MURSHIDABAD, WB

Article ID: AG-VO3-I07-44

***Mr. Samiran Patra and Dr. Uttam Roy**

[1]SMS (Fishery Science) , [2]Senior Scientist and Head, Murshidabad KVK, Milebasa, Murshidabad

*Corresponding Author Email ID: samiangelindia@gmail.*com*

Introduction

Name	Sanwar Hossain Mahaldar
Address	Bhagwangola-I, Murshidabad-742135
Age	42 yrs.
Education	Class-VIII
Contact no.	9609097476
Email Id	San.his2014@gmail.com
Size of land holding (acre)	0.39

Mr. Sanwar Hoassain Mahaldar, a rural youth from Murshidabad, West Bengal, is practicing fish farming on 0.39acre area. Previously he was engaged with the producing mainly of monosex tilapia in his farm and getting annual income of Rs. 14000.0. He faced different problems like more feed cost and non-availability of good quality fish seed etc. He tried to breed catfishes like singhi, magur and koi several times and wanted to establish a catfish hatchery but he failed to breed these catfishes by his own. Then he came to our KVK for suggestion and as per our guidance he participated in a skill-based training programme conducted under STRY (Skill Training for Rural Youth) on Entrepreneurship development

through seed production of pabda and koi in 2021 by Murshidabad KVK conducted under the coordination of Directorate of Research, Extension and Farms, West Bengal University of Animal and Fishery Sciences, Kolkata. This training programme helped Mr. Mahaldar in acquiring knowledge and skill required for setup a catfish hatchery and production of good quality fish seed till date. In this year (2022) 5 nos. of jar hatchery established for better hatching of catfishes.

Profit: The farmer used to get annual income of Rs. 14000.0from monosex tilapia culture in cemented tank before attained the training. Now, he is able to generate an income of Rs.14500.0/- per month.

KVK contribution:

With KVK interventions like, giving need-based training on seed production of catfishes through induced breeding technique, by which he produces his own seed required for that system. And also advised to apply organic juice for reducing feed cost and produce huge amount of zooplankton which serve as primary live food during larval rearing.

Impact on other farmers/ youth:

1. Now he smoothly runs his hatchery with low investment in backyard.
2. He is confident enough to develop and take his hatchery production in next level in the coming year.
3. Serving as a master trainer and source of motivation for other fish farmers.

Coverage of this training programme:

The main objectives of this STRY training programme were to developed self-sufficient hatchery experts in all the aspects to recognize as a successful entrepreneur. For that we designed suitable training programme where 16 nos. of theory class and 4 nos. of practical classes covered that included pond management, food and feeding habit of pabda fish, and water quality management, pre-stocking and post stocking management, diseases management of pabda, culture of koi in seasonal fish pond, water quality management in koi fish pond, selection of brood fishes of pabda and koi for successful induced breeding, hatching and larval management of pabda and koi, fish harvesting, marketing process and project preparation for pabda and koi fish culture.

Farmer's field:

 **Singhi and bata fish culture in biofloc system**	 **Induced breeding of singhi in cemented tank**
 **Singhi and bata fish culture in biofloc system**	 **Hormone injection to brooder catfishes**
 **New jar hatchery established for catfish breeding**	 **Induced breeding programme on breeding tank**

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ANTI-NUTRITIONAL MIRACLE CROP- GLIMPSE OF QUINOA

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***P S Devanand, K. Hemaprabha, B Sivakumar, K. B. Sujatha, P. Kumar, K. Sivakumar**

Faculties, Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam 641301

*Corresponding Author Email ID: devps7@yahoo.com

Introduction

Quinoa or quinua (*Chenopodiumquinoa* Willd.) is native to the Andes Mountains of Bolivia, Chile, and Peru. This crop (pronounced KEEN-WAH), has been called "vegetable caviar" or Inca rice, and has been eaten continuously for 5,000 years by people who live on the mountain plateaus and in the valleys of Peru, Bolivia, Ecuador, and Chile. Quinua means "mother grain" in the Inca language. This crop was a staple food of the Inca people and remains an important food crop for their descendants, the Quechua and Aymara peoples who live in rural regions.

Quinoa field

This annual species is in the goosefoot family and is related to the weed, common lambsquarters (*Chenopodium album* L.), canahua (*C. pallidicaule* Aellen), and wormseed (*C. ambrosiodes* L. *anthelminticum*). Possible hybrids between quinoa and common lambsquarters have been observed in Colorado. Quinoa is also in the same botanical family as sugarbeet, table beet, and spinach, and it is susceptible to many of the same insect and disease problems as these crops. Quinoa is sometimes referred to as a "pseudocereal" because it is a broadleaf non-legume that is grown for grain unlike most cereal grains which are grassy plants. It is similar in this respect to the pseudocereals buckwheat and amaranth.

Uses:

Quinoa is a highly nutritious food. The nutritional quality of this crop has been compared to that of dried whole milk by the Food and Agriculture Organization (FAO) of the United Nations. The protein quality and quantity in quinoa seed is often superior to those of more common cereal grains. Quinoa is higher in lysine than wheat, and the amino acid content of quinoa seed is considered well-balanced for human and animal nutrition, similar to that of casein.

Quinoa is used to make flour, soup, breakfast cereal, and alcohol. Most quinoa sold in the United States has been sold as whole grain that is cooked separately as rice or in combination dishes such as pilaf. Quinoa flour works well as a starch extender when combined with wheat flour or grain, or corn meal, in making biscuits, bread, and processed food.

Seed coats (pericarp) are usually covered with bitter saponin compounds that must be removed before human consumption. Saponins may also be toxic to fish. Deresination (removal of the pericarp and the saponins by mechanical or chemical means) does not affect the mineral content of the seed. The marketable seed is usually white in color. The leaves are frequently eaten as a leafy vegetable, like spinach. Seed imported from growers in South America is sold in the United States in health-food stores and gourmet food shops at high prices.

Quinoa grain has a lower sodium content and is higher in calcium, phosphorus, magnesium, potassium, iron, copper, manganese, and zinc than wheat, barley, or corn. The determination of the mineral content from Colorado quinoa trials showed a similar relationship, but differences from other grains were less conspicuous.

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INDUSTRIAL PRODUCTION OF NON-STARCH POLYSACCHARIDE (NPS) DEGRADING ENZYMES AND THEIR APPLICATIONS

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Shreya Mandal

Ph.D. Research Scholar, Division of Biochemistry, Indian Agricultural Research Institute, New Delhi-12

*Corresponding Author Email ID: shreyamandal1008@gmail.com

Abstract

Non-starch polysaccharides (NSP), major part of dietary fibre are complex carbohydates that escape its intestinal digestion in lower intestine by the human body. NSP degrading enzymes, including xylanase, glucanase, cellulanase, and mananase, key player various industries such as brewing, beverage, food processing, pharmaceuticals, textiles, and waste management. They offer economic benefits and have been developed using two standard protocols: Solid State Fermention (SSF) and Submereged Fermented (SmF). However, high costs and technological limitations hinder their commercialization. Acquiring more knowledge about enzyme production can help develop an economical production plant that can adapt to larger scales.Hence, the wide range of applications of these enzymes,enzyme producing technologies, ongoingchallenges and how they can be mitigated tomaximize the enzyme yield are discussed in the article.

Keywords: polysaccharides, enzyme, production, microbial fermentation, industry

Introduction:

A few types of fiber are known as non-starch polysaccharides (NSP); that term is just another way of referring to them.In the large intestine, non-starch polysaccharides undergo fermentation. They are bulky carbohydrates that are not digested.Polysaccharidescontain monosaccharide generallymore than 20 units, but several polysaccharides have as many as thousands of monosaccharide units. Starches belong to digestible polysaccharides. Polysaccharides remain undigested in human body since they lack essential amylolytic enzymesrequired to hydrolyze the glycosidic bond that links sugar molecules to each other.These nondigestible polysaccharides(nonstarch polysaccharides)arepectin, chitin, glucans, inulin(except lignin). Hemicellulose, pectin like NSPof oats, barley, rye, and beans are soluble that reduce hepatic cholesterol content while cellulose like NSP of wheat, maize, and rice are insoluble that facilitate smooth bowel movement while There is a roughly equal ratio of soluble to insoluble water in vegetables compared to fruits. A daily increase of 13 to 18 g is recommended.

NSP Supplementation in our diet is crucial since:

• Helps the digestive system to function (ccea.org.uk)

• Prevents various bowel disorders such as constipation, diverticular disease, and bowel obstruction, colon cancer, appendicitis, and haemorrhoids (ccea.org.uk)

• Can help people to control their body weight because high fibre foods are filling (kupdf.net)

• Maintains energy balance and reduce obesity (ccea.org.uk)

• Slows down rate of glucose absorption (ccea.org.uk)

• May reduce serum cholesterol concentration(ccea.org.uk)

Non-starch polysaccharide	Non-starch polysaccharide Degrading Enzyme	Applications of Non-starch polysaccharide Degrading Enzyme
1. Glycogen	a. Glycogen Phosphorylase b. Phosphoglucomutase c. Glucose-6-phosphatase	Biosensors
2. Cellulose	a. Endocellulases b. Exocellulases c. Cellobiases	a. Beverage industry b. Animal feed c. Agri-industry d. Oil extraction e. Carotenoid extraction industry f. Detergent g. waste management h. Bioethanol i. Textile j. Pulp and paper industry
3. Hemicellulose A. Xylan	Xylanase	a. Bakery b. Animal feed c. Brewing industry d.Pharmaceuticals
B. Mannose	Mannanose	a. Bio-bleaching of pulp and paper b. Slime control agent c. Coffee extraction industry d. Biomedical e. Animal feed
C. Glucan	Glucanase	a. Beverage b. Animal feed
4. Pectin	Pectinase	a. Fruit juice b. Coffee-Tea extraction c. Degumming d. Textile industry e. Paper and Pulp industry f. Animal feed g. Animal feed
5. Dextran	Dextranase	Sugar industry
6. Chitin	Chitinase	Protection against fungal pathogens
7. Chitosan	Chitosanase	
8. Fructan A. Inulin	Inulinase	Prebiotics a. Medicine b. food-processing industry c. cosmetic
B. Levan	Levanase	

Figure 1. A comprehensive list of Nonstarch polysaccharides (NSP), NSP degrading enzymes along with their industrial applications

Behaviour of Non-Starch Polysaccharides and NPS enzymes:

The remarkable properties of dietary NSPs are water dispersibility, viscosity effect, bulk, and fermentability into short chain fatty acids (SCFAs) (vegetablepharm.com).Chemical behaviour NPSs in the human digestive tract is linked to microbiota composition (science.gov). Plant-based foods have different molecular structures and matrix compositions that profoundly affect micronutrient and macronutrient bioavailability. NSP enzyme is a multi-enzyme that digests and absorbs non-starch polysaccharides. Solubilization of pectin(a constituent of cell wall)by pectin methyl esterase and polygalacturonaseincreasespore size.

Industry standard protocols for producing NSP degrading enzyme:

Technological advancements have routed towards the development of novel enzymes of multiple applications according to the wider range of specificities. Two major industrial fermentation methods are Solid state Fermentation (SSF) and Submerged Fermentation (SmF) (Bioresources.edu). SSF involves the cultivation of microorganisms on a solid substrate with a low moisture content while SmF the cultivation of microorganisms in a liquid medium which has more than 95% water content (differencebetween.com;Samanthi, 2019).

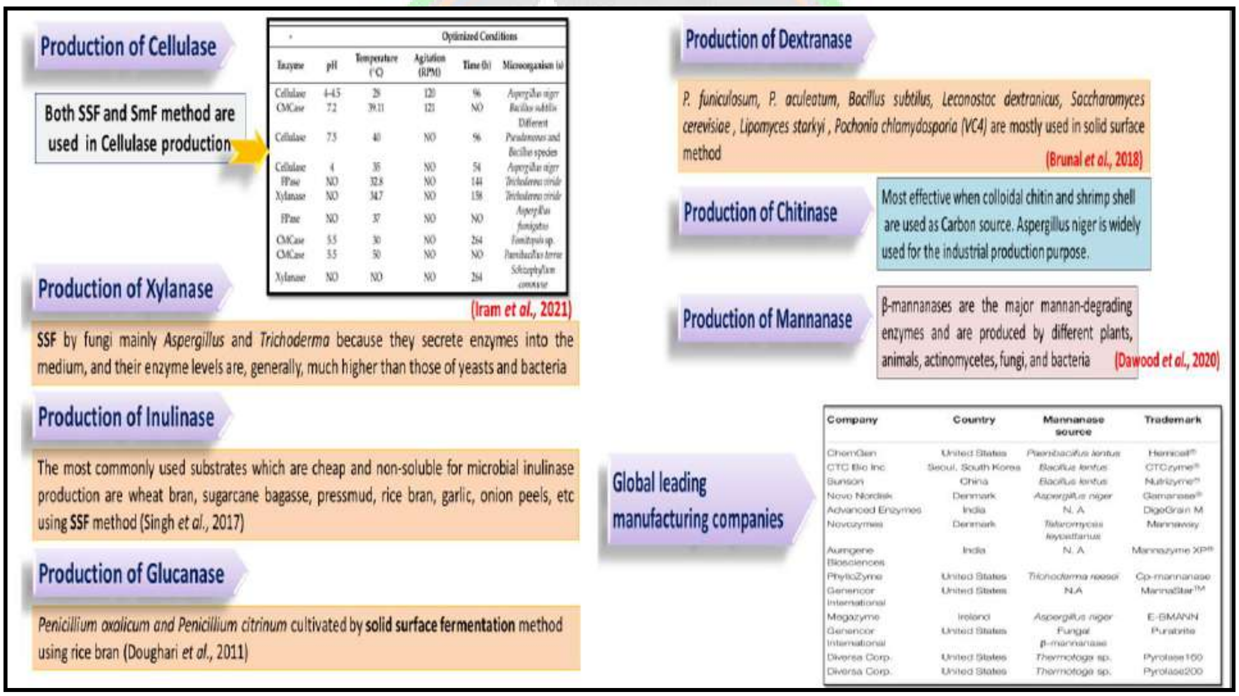

Figure 2. Production strategies of several vital NSP degrading enzymes and list of largest manufacturing companies in the world

SmF is mostly preferred in large scale industrial enzyme production. Example of such NPS is Inulinase.The mostly used insoluble substrates as a source of nutrients (C, N) for microbial(bacteria, yeast, fungusadhered to the solid substrate)inulinase production are cheap and easily available agriculture by products such as wheat bran, sugarcane bagasse, rice bran, garlic, onion peels, etc using SSFmethod (Singh *et al.*, 2017).

Solid State Fermentation Vs Submerged Fermentation

SSF	SmF
Substrates need less pretreatment compared to liquid media	Use of expensive media and expensive equipment
Restricted contaminations	Availability of high water content for the growth of microbes
Minimized downstream process	Complex and expensive downstream process and difficulty in the waste disposal
High volumetric productivity	Easiness of measuring process parameters
Difficulties in monitoring	High power consumption
Removing of metabolic heat is a problem in large scale solid-state fermentations	Ability to control growth conditions
Low moisture level may restrict the growth of microorganisms	Even distribution of nutrients and microorganisms

(Samanthi, 2019)

Figure 3. Prominent differences between SSF and SmFindustrial fermentation technologies

Challenges of Enzyme Production

It is always challenging to adapt enhancement strategies fundamentally depended onoptimization of microbial biomass and genetic manipulation on an industrial scale. On some sites of enzyme production, the ideal feedstock is distantly located from the main bioreactor facilities of enzymes. Feedstocks have different characteristics (moisture content) for different microbial processes. A given microbial strain show variable productivitybased on its feedstock matrix. When scaling up a production process, factors like oxygen mass transfer and agitation rate cannot be easily monitored.These arepredominant in aerobic microbes. Even, the size of the reactor has a major impact on enzyme activity rates, so scaling up enzyme production technologies is difficult.

Future Perspective of Enzyme Production

In the foreseeable future, research should be directed toward developing techniquesthosecan effectively utilizethe low-cost and readily obtainable such as agro-industry byproductsas feedstocks and require less energy for pretreatment.

Conclusions

There is widespread use of enzymes in industries. Enzyme-based and enzymatic hydrolysis technologies are now preferred over chemical ones because these are ecologically safe, super affordable,controllable, productive. SSF and SmFfermentation technologies produce microbial enzymes relatively efficient as compared to alternative plant and animal enzyme sources. Production of microbial enzymes on a large scale is certainly simple. Moreover, manipulation of microbial enzymes through advanced biochemical as well as latest molecular techniques. Overexpression of structural gene in microbes maximizes yield of catalytic efficient NSP degrading enzyme. There is still much to learn about many microbial enzymes, and there are possibilities for expanding their use in industry.

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DISTILLED WATER: THE SOUL OF THE LABORATORY

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Priyanka[1], Deepak Kumar Jaiswal[2] and Rohit Kumar Singh[2]

[1]Research Scholar, School of Engineering and Sciences, G.D. Goenka University, Gurugram, Haryana (122103)

[2]Bioscience Division, Institute of Pesticide Formulation Technology, Gurugram, Haryana

*Corresponding Author Email ID: deeraj3024@gmail.com

Abstract

Distilled water is inevitable part of the laboratory to conduct routine activities. The distilled water is water purified by boiling it and condensing it back to liquid. Its use cannot be contested, nor can the fact that many litres of fresh water are required to produce a few millilitres of distilled water. The distillation water unit requires modern instrumentation, but this comes at a cost in terms of dependability, which must also be addressed. By upholding the integrity of studies, researchers may be sure that any observed effects are brought on by the medications under investigation rather than any external factors. As a result, laboratories use distilled water as a general purpose component. With further more research the wastage of water during formation of distilled water may be curtailed to increase water use efficiency.

Keywords: Water, distillation, condensation and solvent.

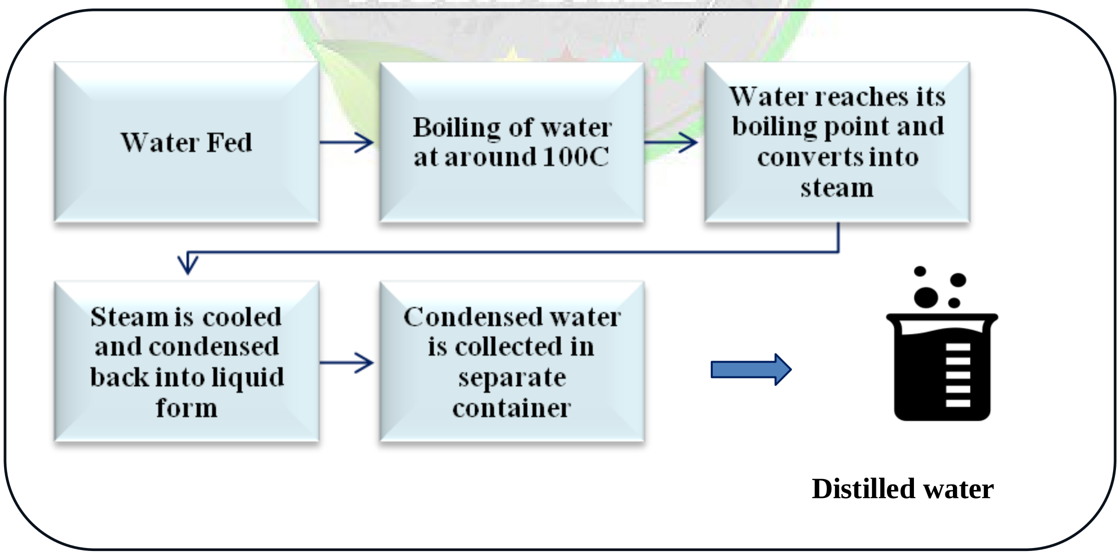
Introduction

Water, a supernatural potion, is essential for the survival of all living creatures on the earth. Though there are numerous sources of water but these resources vary, which indicates that not all types of water come from the same source. It contains a variety of components, but the cleanest form of water is called distilled water. Water contains various extra minerals and toxins, whereas distilled water is free of all minerals, impurities, contaminants and so on.

The distillation of water has been practised since the time of Aristotle. According to Alexander of Aphrodisias, it has been used to desalinate seawater since at least 200 AD stated by Liebmann, A. J. (1956). Distilled water is obtained by the distillation process and it is free from dissolved sediments, microbes, chemicals, and minerals. Generally, distilled water is utilised in pharmaceutical enterprises, laboratories and many other places.

"Water is life's matter and matrix, mother and medium. There is no life without water." – Albert Szent-Gyorgyi, M.D. Discoverer of Vitamin C

In a study by Abou Assi, R., (2021) corroborated that 200 L of fresh water is required to produce approximately 2.5 L of distilled water on average/day in a Laboratory. There are certain critical aspects *viz.*, correctness, reliability, clarity and purity in laboratories that directly improve or degrade experimental results or scientific study outcomes. Though a range of solvents are used in laboratory but distilled water is an excellent solvent, meaning that it can dissolve many different kinds of molecules because of its unique features. It is very much important to know how the distilled water is prepared under laboratory conditions. The process of formation is depicted through a diagram given below.



Features of Distilled water

- Reduces cross contaminations
- Reduces interferences and undesirable reactions in chemical reactions and analytical methods
- Acts as neutral solvent
- Provides baseline of purity for instruments calibration
- Increases the longevity and optimal performance of their equipment

Undoubtedly water is an inevitable part of laboratory but it does have some limitations -

- It does not provide necessary nutrients or co-factors required for biological processes.
- A huge amount of fresh water is wasted in the production.
- It can absorb carbon dioxide and can form carbonic acid causing disruption of pH leading to make it acidic.
- It can cause leaching of the contaminants causing introduction of unwanted impurities.
- The absence of the micro-elements can impact cell viability and cell growth.
- It can cause mineral imbalance if included in the regular diet.

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CONSUMER AND MARKETING PREFERENCE TRAITS OF VEGETABLE PIGEONPEA

Article ID: AG-VO3-I07-48

Dr.A.Thanga Hemavathy[1], Dr.R. Vinoth[2] and Dr.S.Kavitha[3]

[1]Associate Professor (PBG), ADAC&RI, TNAU, Trichy, Tamil Nadu

[2]Teaching Assistant (PBG), IOA, TNAU, Kumulur, Trichy, Tamil Nadu

[3]Associate Professor (SST), Dept. of SST, TNAU, Coimbatore

*Corresponding Author Email ID: hemavathy.tnau@gmail.com

Introduction

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 study 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 (*Pisumsativum*), 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. Saxena et al. (1983) studied the effect of pod colour on important organo-leptic properties of vegetable pigeonpea. They found that 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. Yadavendra and Patel (1983) reported that 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 seed coat are preferred because the cooking water remains clear when such seeds are cooked. Sweetness of fully grown immature seed is also a preferred trait.

Marketing preferences For Vegetable pigeon pea:

In India, Vegetable pigeon pea is grown in Backyards, in fields and also for commercial purpose. Vegetable pigeon pea cultivars having long pods and large bean size (weighing at least 15 g/100 beans when dry) are preferred mostly for marketing Since they fetch good price in the Market. 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. Sweetness of fully grown immature bean is also a preferred trait.

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. (K.B.saxena, 2010). 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 (K.B.Saxena, 2010).

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.

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GROUNDNUT CULTIVATION AND MECHANIZATION

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***Harisudan. C, M. Arivazhagan and L. Allwin**

Regional Research Station, Vridhachalam, Tamil Nadu, India

*Corresponding Author Email ID: harisudan@tnau.ac.in

Abstract

Groundnut is an important oil seed crop cultivated in India. Immediately after receipt of rain soil moisture availability is limited to a short period and hence timely sowing is crucial for good crop establishment for groundnut cultivated in rainfed condition. Traditional methods of field operations require high number of labour and more time ultimately leads to an increase in cultivation cost. To overcome the labour shortage and to perform the field operation at the right time and to utilize the limited resources in dryland condition, the farmers can go for mechanized crop cultivation. Mechanized groundnut cultivation is the need of the hour that could replace the traditional labour-intensive method of groundnut cultivation.

Keywords : Mechanization, labour intensive, groundnut, rainfed.

Introduction

Groundnut (*Arachis hypogea L.)* is a significant oil seed crop which plays an important role in the Indian oil economy. Globally groundnut is 4th most important edible oil source and 3rd most important source of vegetable protein (Harisudan and Subrahmaniyan, 2020). The groundnut kernel contains 45% oil and 26% protein which has multi-beneficial usage. Groundnut cultivation involves sowing, weeding, earthing up and harvesting which is highly labour-intensive and involves a high cost of cultivation. Mechanized crop production is essential to reduce labour and reduce the cost of cultivation in groundnut (Govindaraj and Mishra, 2011).

Land Preparation

Land preparation is done by ploughing the soil to make it a good seed bed for germination. Tillage operation in groundnut is an important operation where the land has to be prepared to fine tilth so that pegs can penetrate easily and produce higher pod yield. Hence primary tillage is like disc plough, mould board plough and chisel plough used to penetrate up to a depth of 30- 60 cm for essential in groundnut cultivation system. After primary tillage operation, secondary tillage machinery like disc harrow and rotavator is used to prepare a good seed bed for the sowing process. (Liaqat Ali Shahid *et al.*, 2010).

Chisel plough

Sowing

Sowing is the process of placing the seeds at a particular depth for good germination and crop establishment. Sowing time is critical, especially in rainfed condition where the soil moisture is limited.

Groundnut is sown mainly by manual labour through dibbling and sowing behind the country plough.The traditional method of sowing is a time-consuming process that involves a lot of labour force leading to a high cost of cultivation (Awadhwal and Babu, 1994) so; mechanized sowing is the need of the hour. By mechanized sowing, we can cover a large area per unit time and proper spacing is maintained. (Mohanty and Bihara, 2017)

Intercultural operations

Weeds create a major problem in the production and productivity of crops. Weed management plays a significant role in crop production. Weeding at the right time ensures good crop yield. Hand weeding and herbicide application are now commonly practiced to eliminate weeds. Mechanized weeding reduces the labour required for weeding and the operations can be done in time. Further mechanized weeding stirs the soil so as it makes the soil environment favourable for peg penetration is also possible. Tractor drawn weeder will cover 4- 5 ha/ day and a large area will be weeded in a limited time (Govindaraj and Mishra, 2011). In groundnut, the loss in yield ranges from 13 per cent to 100 per cent depending on the season, cultivar, weed competition and package of practices adopted (Yaduraju *et al.*, 1980; Kalaiselvan *et al.*, 1994; Devidayal and Ghosh, 1999).

Harvesting and Threshing

In groundnut, harvesting is the major operation that involves a huge number of labours and high cost of cultivation. Mechanized harvesting is possible through groundnut digger, shaker cum windrower, groundnut fresh pod thresher, groundnut fresh pod stripper, dry pod thresher and groundnut combine harvester. After harvesting manual stripping is the major problem that involves more labour and time-consuming process. Groundnut strippers are very useful and combined harvester will finish the post harvesting process easier (Madhusudhana Reddy *et al*., 2019).

Groundnut stripper

Decorticating equipment

Decortication is the process of separation of kernels from the dried pod. Groundnut decorticators can be used for decortication of pods. Power-operated groundnut decorticator capacity is 250-300 kg/ha. Huge quantities of groundnut pods are shelled within a short period of time (Madhusudhana Reddy *et al*., 2019).

Conclusion

Groundnut cultivation is high labour-intensive crop; hence mechanized groundnut cultivation is prerequisite to face the labour scarce situation. Mechanising sowing, weeding, earthing up, plant protection measures and mechanized harvest will save the cost of cultivation, labour energy and also increase the work efficiency in time.

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COCONUT BLACK-HEADED CATERPILLAR AND THEIR MANAGEMENT

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***L. Allwin, C. Harisudan and S. Susikaran**
Tamil Nadu Agricultural University, Coimbatore
*Corresponding Author Email ID: allwin.dr@gmail.com

The Coconut Black-Headed Caterpillar: *Opisinaarenosella* (Cryptophasidae: Lepidoptera)

The black–headed or leaf–eating caterpillar is a serious pest of the coconut plam, very common in the coastal and backwater areas of India, Sri Lanka and Burma. The pest is active throughout the year but usually breaks out in serious proportions during the hot months of March, April and May, especially after the pre– South–West Monsoon showers. The population generally subsides after the onset of heavy rains.

Damage symptoms

The larvae feed on the green matter of the leaflets from the under surface, reducing the functional leaf surface as well as the yield. They construct small tunnels or galleries with silk and excreted matter and remain inside throughout, feeding on the green parenchymatous tissues of the leaflets, leaving a thin parchment-like upper epidermis undamaged.

The infested leaflets slowly turn greyish brown and dry up in patches along the area where each larva has been feeding. When a large number of leaves are affected, the crown presents a scorched up appearance with substantial decline in the yield.

The young palms, at times, die due to the attack.

Life cycle

The adult moth is greyish with elongated forewings bearing some finely scattered blackish scales. It lays eggs near the tips of the leaflets of the older leaves. The eggs are very small and the total number of eggs laid by a single female varies from 60 to 250 with an average of 137. The eggs hatch out in 5 days. The newly emerged larvae construct silken tunnels or galleries on the undersurface of the leaflets where they live and feed. The larva is light green in colour with a dark brown head and is about 15 mm. It is characterized by the presence of one reddish brown stripe on the dorsal side and two each on the sides. The average larval period is about 45 days. Pupation takes place inside the galleries.The adults emerge after apupal period of about 12 days.The total duration of the life cycle from the egg stage to adult is about two months.The pest often occurs in overlapping generations so that all the stages, viz. adults, eggs, larvae and pupae may be found at the same time at any one place of Infestation.

Management

- The infested leaves showing the presence of larval galleries should be cut and burnt in order to reduce the pest population and its further spread. However, this becomes feasible only in cases of stray attacks in isolated gardens.
- Light traps are useful to attract the adult moths. This is very effective immediately after the summer showers. Nevertheless, since natural enemies are also attracted to the light, the use of light traps is not recommended in coconut gardens.
- Regulate the microclimatic conditions of the garden through intercropping.
- Root feeding with monocrotphos is effective.

- Application of systemic insecticide through a cavity in the base of the petiole 'petiolar well' has been demonstrated to be useful in Sri Lanka.
- The bacteria *Serratiamarcesens* causes septicaemia in *O. arenosella.Aspergillusflavus*can also infect the larva.
- *Bacillusthuringiensis* at 0.3-0.5 kg/ha is toxic to the caterpillars.
- The carabid beetles, *Parenalacticincta* and *Calleidasplendidula* are predacious on the caterpillars. The chrysopid*Malladaastur* is an egg early–larval predator.
- The safest and most economical method is to release parasitoids as listed below:

Parasitoid	Family	Stage attacked
Braconbrevicornis	Braconidae	Larva
Braconhebetor	Braconidae	Larva
Goniozusnephantidis	Bethylidae	Larva
Elasmusnephantidis	Elasmidae	Pre-pupa
Brachymerianosatoi	Chalcididae	Pupa
B. nephantidis	Chalcididae	Pupa
Trichospiluspupivora	Eulophidae	Pupa
Xanthopimplapunctata	Ichneumonidae	Pupa
X. nana nana	Ichneumonidae	Pupa
Coryphusnursei	Ichneumonidae	Larva/pupa

- Release the parasitoids on the trunk at 1.2 m from the ground level as the parasitoids prefer to crawl on the tree rather than flying. They reach the crown in 15-20 minutes.

Conclusion

Controlling this pest through parasitoids minimize the usage of pesticides and thereby reducing the hazards to the environment.

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SOILLESS CULTIVATION: A NEW HOPE FOR URBAN FOOD SUPPLY

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Narendra NathHansda[1]* and Anmol Giri[2,3]

[1]Research Scholar, Department of Vegetable Science, Bidhan Chandra KrishiViswavidyalaya, Mohanpur, Nadia- 741252, West Bengal

[2]Assistant Professor, Department of Agril. Economics, School of Agriculture, GIET University, Gunupur, Rayagada -765022, Odisha

[3] Research Scholar, Department of Agricultural Economics, Bidhan Chandra KrishiViswavidyalaya, Mohanpur, Nadia- 741252, West Bengal

*Corresponding Author Email ID: hansdanarendranath0@gmail.com

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Abstract

The rapid urbanization of recent decades has posed significant challenges to meeting the increasing demand for fresh and sustainable food within cities. Traditional agriculture methods face limitations in urban areas due to transport constraints, limited land availability, high water consumption, climate change impacts, and reliance on pesticides and fertilizers. However, soilless cultivation techniques, such as hydroponics and aeroponics, offer a promising solution for urban food supply. This innovative approach allows crops to be grown in controlled environments without traditional soil, providing several advantages in urban settings. Soilless cultivation reduces transportation costs, maximizes space utilization through vertical and rooftop farming, increases resource efficiency, enables year-round production, and avoids soil limitations and contamination issues. Furthermore, soilless farming aligns well with the integration of innovation and technology, making it suitable for urban areas where automation and data-driven practices can enhance productivity. By adopting soilless cultivation, urban areas can create a resilient and sustainable food system, meeting the growing demand for fresh and locally sourced produce.

Keywords: urbanization, hydroponics, aeroponics, soilless cultivation, sustainable food system.

Introduction:

As urbanization continues to rise in recent decade, the demand for fresh and sustainable food for our consumption within cities is becoming gradually challenging to meet. India had an urbanization rate of 1.34% in 2021. The urbanization rate in India increased by 1.5% on a year-on-year basis in 2021. Between 2010 and 2021, the indicator increased by 19.6%. The urbanization rate in India was highest in the year 2021 and lowest in the years 2010 and 2011, between 2010 and 2021 (globaldata.com, 2023). So, traditional agriculture methods and fresh food from rural region to urban region often face limitations such as transport, limited land availability, high water consumption, lower in production due to climate change and reliance on pesticides and fertilizers. However, a new and promising solution is emerging: soilless cultivation in the urban region for fulfilment of urban family people. This innovative technique offers a hope for urban food supply by enabling the growth of crops in controlled environments without the need for traditional soil.

Soilless plant cultivation is a relatively new method of cultivation that is almost exclusively utilised in greenhouses and takes place in an almost entirely controlled environment. For a very long time, efforts have been made to solve the soil-related issues in greenhouses. These include the previously mentioned high salt content or low soil fertility as well as soil-borne illnesses. In particular, hydroponic culture in greenhouses has assumed a leadership position among cultivation technologies as a result of the development of adequate growing media with ideal physical and chemical qualities during the past 30 to 40 years. Modern fertilisation techniques, automation technology, and improvements in plant nutrition and irrigation have all favoured its development (Khan, F.A., 2018).

Soilless cultivation is a method, also known as hydroponics or aeroponics,The term hydroponics was derived from the Greek words *hydro*, meaning water, and *ponos*, meaning work (Biebel, 1960). It involves growing plants in nutrient-rich water solutions or in air with added nutrients or soil less media (Savvas et al., 2013) viz. Cocopeat, perlite etc. This method eliminates the reliance on traditional soil and provides several significant advantages for urban areas where abandoned area and above the rooftop.

Why soilless cultivation in Urban area instead of import from rural areas?

Soilless cultivation in urban area has gained popularity for several reasons. While importing food from rural areas is still a viable option in the geographical location. Soilless cultivation offers some diverse advantages in urban settings. Here are a few reasons why soilless cultivation is preferred in urban areas instead of importing it from rural areas: -

1. Reduced transportation costs: By cultivating food locally within geographical urban areas, it reduced the need for long-distance transportation and significantly reduced the associated costs. It providesthe people who are residing in urban areas with fresher produce, reduced carbon emissions to mitigate climate problems, availability and also lower the prices for consumers.

2. **Utilization of space:** Urban areas often face the challenge due to limited land availability butsoilless cultivation allows for vertical farming, terrace farming and rooftop farming,where crops are grown in stacked layers or vertically suspended systems and within the premises of the places people are residing. This in turn, maximizes the use of limited space by growing plants upward, instead of spreading them horizontally over large areas.

3. **Increased efficiency:**The farming methods can be highly efficient in terms of resource utilization in urban area. Water, nutrients, and light can be carefully managed and utilized and therefore it results insignificantly higher crop yields per unit of land compared to traditional farming methods in rural areas. This efficiency helps meet the high demand for food in densely populated urban areas.

3. **Year-round production:**In recent days shortage of supply and production of vegetables in urban area can be mitigated by soil less cultivation. It allows for year-round production of crops, regardless of seasonal limitations (Tzortzakis et al. 2020). By controlling environmental factors like humidity, temperature, and lighting, urban farmers or family can create optimal growing conditions in their area, and can harvests produces throughout the year for their own consumption or also as a revenue generating source.

4. **Avoiding soil limitations:** In many urban areas or adjoining area, soil quality may be poor or contaminated due to industrial activitiesor other factors in geographical settlements. Hence,

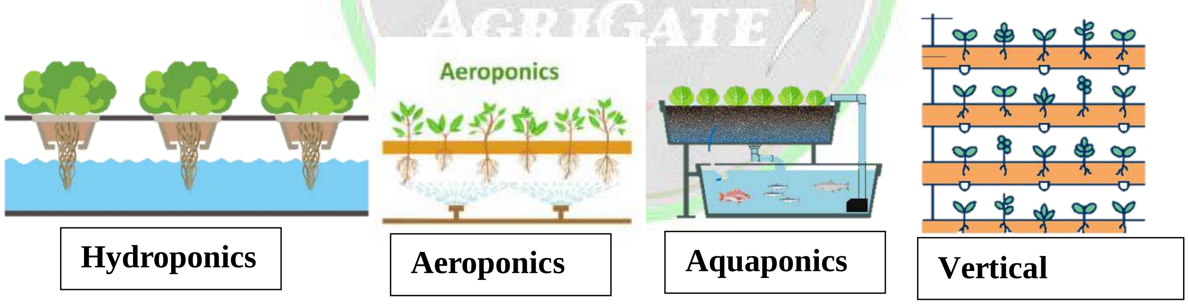
soilless cultivation eliminates the dependence on soil, allowing plants to grow in nutrient-rich solutions or inert substrates in urban areas (Putra et al. 2015).

5. **Innovation and technology integration:** Urban areas are the hubs of innovation and technology adoption. So, people can easily are always looking for an opportunity to adopt automation using technology available, and recent trends like IoT (Internet of Things), and data-driven farming practices in food production for own. These technologies can increase the productivity, reduce labour requirements (family member can help), and enable availability of fresh and self-harvested greens in the kitchen.

Different methods of soil less farming in urban areas:

There are several methods of soilless farming that can be implemented in urban areas. Here are some commonly used techniques:

a) Hydroponics: It is a soilless farming method, where plants are grown in a nutrient-rich water solution and the roots are directly exposed in to the solution (Sardare et al., 2013), which provides all the necessary nutrients according to need of the crops.



b) Aeroponics: Aeroponics is another technique that involves suspending plant roots in the air (not a solution) and misting them with a nutrient rich solution (Gopinath et al. 2017, Sardare et al., 2013). The plant roots receive oxygen from the air, and the nutrient mist artificially provides for the necessary nourishment. This method also is known for its efficient use of water and nutrients.

c) Aquaponics: Aquaponics is a combine method of hydroponics and aquaculture (fish farming) in a symbiotic system. Selected fish are raised in tanks, and their waste provides nutrients for the plants so, the plants, in turn, filter the water, creating a sustainable cycle where both fish and plants benefited like a symbiotic relationship (Fussy and Papenbrock 2022).

d) Vertical farming: It maximizes space utilization urban area by growing plants in stacked layers or vertically inclined structures (Tzortzakis et al. 2020). This method often utilizes hydroponics or aeroponics and can be implemented indoors or in vertical farming towers. The farming allows for high-density cultivation and efficient use of artificial lighting (Fussy and Papenbrock 2022).

e) Container gardening: Container gardening includes growing plants in containers, bags or pots filled with a soilless growing medium, such as coconut coir, perlite, or rockwool that provides essential benefit for growing. This method is suitable for smaller-scale urban farming, including balconies, rooftops, or even indoor spaces.

Container gardening

Green walls

Rooftop gardens

Indoor farming with artificial lighting

d) Green walls: Green walls, also known as living walls or vertical gardens, where the vertical structures covered with plants. These walls can be designed to incorporate soilless growing systems, such as hydroponics or aeroponics.

e) Rooftop gardens/farming: Rooftop gardens or rooftop farming utilizes soilless techniques or even using soil inclusive methods to grow plants on building rooftops or any unutilized or free space for cultivation of crops.

d) Indoor farming with artificial lighting: It involves growing of plants in controlled indoor environments using artificial lighting, temperature, humidity into the systems. Soilless techniques like hydroponics or aeroponics are often employed for plant growth. This method allows for year-round cultivation in any location, irrespective of external climate conditions.

Each respective method has its own advantages and considerations, and the choice depends on factors such as rules and regulation of urban area, available space, resources, crop selection, and specific goals of the urban farming.

Advantages of Soil-Less Culture:

1. Healthiest crops with high yields and consistent reliability (Savvas D. 2002).

2. Clean and easy gardening requiring minimal effort (Silberbush et al., 2001).

3. Direct feeding of nutrients to roots, resulting in faster plant growth with smaller roots.

4. Closer plant spacing possible, requiring only 1/5th of overall space.

5. 1/20th of total water needed compared to soil-based culture (Silberbush et al., 2001).

6. No risk of soil-borne insect pests, diseases, or weed infestation.

7. Efficient nutrient regulation and higher density planting.

8. Increased yield per acre and better produce quality.

Limitations of Soil-Less Culture

1. Commercial and large scale application requires technical knowledge and high initial investment.

2. Soil-less culture is limited to high-value crops due to the high cost involved.

3. Plant health control requires careful attention and management.

4. Certain crops may not thrive or be well-suited for soil-less culture.

5. This reliance on technology and energy can make the system vulnerable to power outages or technical failures.

Conclusion:

As urban populations continue to rise and resources become scarcer, soilless cultivation holds great potential in reshaping our urban landscapes, creating a more resilient and self-sufficient food system for the future. So, soilless cultivation represents a new hope for urban food supply. It has to overcome the availability of year-round production, supply chain in urban areas, presents a sustainable and efficient solution formitigate the growing demand of fresh and locally sourced food in cities. Soilless cultivation offers a sustainable and resilient solution to meet the rising demand for fresh food in urban areas, while promoting environmental sustainability and community engagement. By integrating technology and efficient resource utilization, urban farming can create a healthier and more self-sufficient food system for the future

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AGRICULTURAL SOIL COMPACTION- EFFETS, CAUSES AND MANAGEMENT

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Dr.P.K.Padmanathan

Associate Professor

Department of Farm Machinery and Power Engineering,Agricultural Engineering College and Research Institute,Tamil Nadu Agricultural University, Coimbatore -3

*Corresponding Author Email ID: padmanathanpk@tnau.ac.in

Introduction

Soil compaction is the physical consolidation of the soil by an applied force that destroys structure, reduces porosity, limits water and air infiltration, increases resistance to root penetration and often results in reduced crop yield. Most farmers are aware of compactionproblems, but the significance is often underestimated. Compaction effects on crop yield can be a significant factor in today's farm economy. Recent changes in agricultural practices*viz.*,such as increased number of operations and larger equipment have made soil compaction more common.Most yieldlimiting compaction is caused by wheel traffic from heavy equipment, often when operations are conducted on wet soils. Significant compaction can also be caused by tillage and livestock.This bulletin describes the causesand effects of soil compaction, explains how to recognize the symptoms of compactionin soils and crops, discusses effects of soil compaction, causes of compaction, management for reducing soil compactionand providesmethodsto minimize compaction problems.

Effects of soil compaction

1. Soil water contents, soil texture and structure and soil organic matter are the threemainfactors which determine the degree of compactness in the soil.
2. Soil physical properties such as bulk density, strength and porosity can be used todirectly quantify the soil compactness.

3. Modified soil physical properties due to soil compaction can alter elements mobilityand change nitrogen and carbon cycles in favour of more emissions of greenhousegases under wet conditions.
4. Severe soil compaction induces root deformation, stunted shoot growth, lategermination, low germination rate and high mortality rate.
5. It decreases soil biodiversity by decreasing microbial biomass, enzymatic activity, soilfauna and ground flora.
6. It is restricted to elastic domain and do not consider existence of preferential paths of stress propagation and localization of deformation in compacted soils.

Causes of compaction

A typical silt loam soil contains about 50% pore space portioned at 25% water and 25% air by volume at field moisturecapacity. Soil particles and organic matter occupy the remaining 50%. Soil compaction is a process that first occurs whenthe force from wheel traffic pushes aggregates together. If the applied force is great enough the aggregates are destroyed.Theresult is a dense soil with few large pores that has poor internal drainage and limited aeration. The problem of soil compaction is increasing for several reasons. Earlier planting schedules, larger equipment, and increaseduse of duals or flotation tires that encourage field operations on wetter soils are all responsible.Wheel traffic from heavy farm equipment is recognized as the majorcause of soil compaction, although somecompaction occurs from normal crop productionpractices.Heavy machines with axle loads thatexceed 10 tons increase the risk of compactionextending into the subsoil, compactingsoils to a depth that cannot beremoved by conventional tillage. Loadedcombines and manure tankers commonlyweigh 20 to 30 tons.These machinesproduce more compaction to greaterdepths as these loads overwhelm thebearing strength of the soil. Producer soften feel that large loads can be offset bywider tires.While some reduction inpressure from a heavy load can be realizedfrom larger tires, compensation for theincreased load will not be realized and the compaction effect will be distributed overa greater soil volume.

The type and condition of a soil affects thepotential for compaction. Soils with loworganic matter content tend to be moresusceptible to compaction because theydo not form strong aggregates (soil particlesthat are bound together). Clay soils,when wet, are highly compactible becausethe clay minerals have bound wateraround them, which act as a lubricant, thusmaking it easier for the soil particles tomove against each other. Sandy soils,which do not form aggregates, can also becompacted.Many sandy soils are used forvegetable crop production and are subjectedto heavy loads and aggressivetillage and harvesting practices. Any soiltype is most easily compacted when thesoil water content is at or above field capacity, although at saturation the soil is not easily compacted since all pores arefilled with water, which is not compressible. While operations on a saturated soil may not compact at depth, the surface soil is easily puddled as it squashes outside the tire path. Under drier conditions, the soilbearing strength increases, reducing thecompactibility of the soil.

The trend toward continuous row crops, instead of crop rotations that include solidseeded/deep-rooted crops such as alfalfa, increases the potential for soil compaction. Perennial alfalfa/grass mixture crops,because of their dense canopies and taproot systems, provide greater support at the soil surface than row crops andcreate channels deep into the soil that subsequent crops can use. Perennial crops also tend to favour aggregation, whereasrow crops have been shown to have lower aggregate stability. Aggressive tillage also increases the susceptibilityof a soil to compaction because tillage reduces aggregate stability and reduces soil strength. Soils managed underno-till systems tend to have a somewhat denser surface, with greater bearing strength that develops over time as thesoil consolidates.Moldboardplowing typically forms a dense layer of soil immediately below the tilled zone.During moldboardplowing, one tractor wheel usually operates in the furrow on soil which is never tilled. It is still possible to detect the plow layer in many soils even though a moldboardplow has not been used for years. Secondary tillage tools operations,especially disking, decrease aggregate stability and create a soil condition more susceptible to compaction by subsequenttraffic.

Management for Reducing Soil Compaction

Where soil compaction is a persistentproblem, economical methods of alleviatingit are needed. First consider surfaceand subsurface drainage improvementsfor poorly drained fields or portions offields that contain problem areas. Addingorganic material such as manure ororganic byproducts will improve soil structure.Other management practices that willhelp offset compaction include plantingcover crops or rotating with a forage crop.Tillage is the common response foraddressing soil compaction and is oftennecessary to remove furrows caused by operationsduring wet conditions. Surface compactioncan be removed with a chisel plowrun in the top 8 to 10 inches of soil.Deeperplowing with this tool is generally notefficient.If compaction is found 11 to 18 inchesdeep, many producers consider subsoiling.

Subsoiling is an expensive practice andrequires a substantial return in crop yieldto be justified.Typically 30 to 50 horsepowerper shank is required to pull a subsoiler.Subsoiling should not be considereda permanent solution for compaction ifthe practices that caused the compactionare not modified.When a field is subsoiled,be sure to leave at least three untreated“check strips” that can be evaluated thesucceeding year.This will allow the farmerto determine if subsoiling produced theexpected results.Subsoiling is generally conducted in thefall when soil conditions are somewhatdrier compared to those in the spring. Anexception would be on sandy soils wheremost subsoiling is conducted in the spring.There are two major types of subsoilers:(1) tools with parabolic shanks, oftenequipped with wings on the shanks andmultiple disk gangs, and (2) tools withstraight shanks and a single coulterdesigned to cut through residue.The firstexample is more aggressive and disrupts aconsiderable portion of the soil volume.Such shattering removes much of thebearing strength of the soil. It also buriesmost of the crop residue and requires asecondary tillage pass to create the seedbed. Straight-shanked tools are betteradapted to conservation tillage systemsand do not invert soil.Therefore a secondarytillage pass is often not required.

Farmers are becomingmore interested in strip-tillage as a compromisebetween no-till and full-widthtillage.No-till row crop production systemshave been shown to have cooler andwetter soil conditions and higher bulkdensity in the surface that contribute toslower emergence and in some casesreduced yield. A strip-tillage systemcontrols traffic and loosens the soil in thefuture seed zone.The residue-free zoneensures early-season warming and conditionsthat are similar to those found withfull-width tillage.The residue coverage inthe field is typically only 10 to 15% lessthan that found in no-till systems.Strip-tillage is generally conducted in thefall with a tool that creates an 8-inch wideresidue-free zone. Strip-tillage tools areequipped with coulters that first movesresidue to the row center, followed by asoil loosening knife that runs 8 to 12inches deep, and then coulters that form asmall ridge 2 to 4 inches high. All tillage isconducted on the desired row cropspacing.

Minimizingcompaction

The best way to minimize compaction is toavoid field activities that have the potentialto damage the soil.Whenever possible,do not conduct field operations on wetsoils. Even delaying

an operation a portionof a day to allow for some drying maymake a big difference.There is always atemptation to operate on wet soils,because of the concern that timely fieldoperations are needed to avoid large yieldreductions from delayed planting or
inferior crop quality if harvest is delayed.Modern agricultural equipment isequipped with options such as four-wheeldrive, tracks, and duals or triples whichallow working in wet soils.

Equipment maintenance andmanagement tips to reduce compaction:

- When performing tillage, ensure thetractor is properly balanced. A correctlyweighted two-wheel drive tractorshould weigh 125 to 140 lb/PTO hp formost field operations. Proper weightingis especially important in tillageoperations.
- Avoid using oversized equipment.
- Vary tillage depth from year to year toreduce the development of a plow panlayer.
- A moldboardplow large enough topermit on-land operation where alltractor wheels operate on theunplowed or untilled soil surfaceshould be considered to eliminatewheel-induced soil compaction at thebottom of the plow furrow.
- Keep all tillage equipment in peakoperating condition and be sure thesoil-engaging tools are sharp.

While it may be considered impractical, aneffort should be made to limit load when operating under wet soil conditions.Thiscould mean only filling the grain tank orchopper box partially full, or only carryinga partial load of manure to the field.Excessive weight creates high soil loadsthat may exceed the soil-bearing strengthdepending upon soil water content. Suchoperations also use more fuel, but considerationwould have to be given to the
additional fuel used for multiple trips.

Tips for minimizing and avoiding soil compaction

Proper tractor and machine setup and operation can minimize the effect ofcompaction, but improved managementis the best solution for addressing compaction.

Manage field operations

- Avoid performing field operations on wet soils.
- Limit vehicle load and ensure proper weighting in tillage operations.
- Manage vehicle traffic within fields. Controlled-traffic farming systems, especially those that maintain surface crop residue, will serve to limit compaction and reduce soil erosion.

Address drainage problems

- ✓ Add organic materials to help build soil structure and increase soil strength.
- ✓ Rotate to tap-rooted forages to create channels in the soil that subsequent crops can use.

Remove existing compaction

- ➢ Use conventional tillage to remove compaction in the plow layer.
- ➢ Subsoiling may be required to alleviate deep compaction. Deep tillage should not be an annual practice due to its potential to destroy soil structure, bring infertile soil and stones to the surface, and may not be cost effective.

A number of management options can be implemented tominimize the risk of soil compaction:

- Keep a protective residue cover on the soil surface toreduce the negative effects of rain or irrigation watercausing soil crusting.
- Minimize or eliminate soil tillage to prevent soilaggregate breakdown and induce the development of atillage "hardpan" – this goal can be achieved by directseeding and the elimination of soil cultivation.
- As far as possible, avoid field traffic when soils are wet;this is more easily said than done, for example, whenharvest schedules dictate the crop must come offdespite wet field conditions.
- Reduce the wheel traffic load on the soil, which can bedone by keeping axel loads to a minimum. Use radialtires at low inflation pressures to create a largerfootprint.
- Minimize the field traffic areas on fields. Load wagonsor trucks on a road (if it can be done safely) or onheadlands.
- Improve soil organic matter and soil structure andincrease biological activity in soil by using bestagronomic management practices.

Conclusion

Your soil is you're most important resource when growing a healthy and profitable crop.Preventing soil compaction will increase water infiltration and storage capacity, timeliness of field operations, decrease the stress on plant roots, and decrease disease potential.

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CENTENNIAL TAMARIND TREES OF NALLUR SACRED GROVE: CHARACTERIZATION AND CONSERVATION

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Kanupriya, C[1]*; Karunakaran G[1]; Pritee Singh[1]; Deepa Samant[2]and Tripathi, P.C[1]

[1]ICAR-Indian Institute of Horticultural Research, Hesarghatta Lake Post, Bengaluru-560089

[2]ICAR-IIHR-Central Horticultural Experiment Station, Bhubaneswar- 751 019, Odisha, India

*Corresponding Author Email ID: Kanupriya@icar.gov.in

Abstract

In this paper, we have profiled and conserved some of the heritage tamarind trees of the Nallur sacred grove. This is one of India's oldest man-made groves and the first Biodiversity Heritage site. The trees are thought to have been planted several hundred years ago during the reign of the Chola dynasty (8th century AD to 12 century AD). Carbon dating has revealed that the oldest tree on the property is over 400 years old. The old trees have distinct characteristics, some of which have been described in this paper. Unfortunately, the grove is now somewhat neglected, with weeds overgrowth, unregulated grazing, and weekend revelers who dump garbage in the grove. By collecting scion wood and grafting, eleven old trees were attempted to be conserved. Nine trees were successfully established in the Indian Institute of Horticultural Research field bank, Hesarghatta, Bengaluru. To the best of our knowledge, this is the first attempt to conserve the heritage trees of this grove.

Keywords: Heritage trees, sacred grove, tamarind, Nallur, conservation, ex situ, field genebank

INTRODUCTION

Agricultural Biodiversity is the diversity of crops and their wild relatives, trees, animals, microbes and other species that contribute to agricultural production resulting from the interactions among people and environment over thousands of years. The recent increase in exploitative use of nature threatens this connection that has allowed humans to survive. There is a global agreement in the form of Sustainable Development Goals to conserve biological diversity and use it sustainably. The Indian Biological Diversity Act of 2002 is a national step towardsprotecting India's bioresources and ensuring that local communities can actively participate in biological resource management. This law includes a provision for designating biodiversity-rich areas as Biodiversity Heritage Sites (BHS). This is a broad provision designed to ensure an inclusive model of biodiversity conservation rather than the exclusionary models used by previous laws (Watve and Chavan, 2020).

Sacred groves and socio-cultural aspect

Nature conservation traditions such as tree worship has been a widespread and popular form of religious practice in India and the Far East since ancient times. Trees are thought to have souls like men, and they feel injuries done to them. Sometimes the souls of the dead animate them. Trees are the abode of spirits who bring rain and sunshine, cause crops to grow, herds to multiply, and bless women with offspring. Thus, all over India, we find grooves and clumps of trees that are firmly believed to be the home of spirits and that no villager will harm or cut down. Further, trees like the neem, Bengal quince (bilva) and Indian laburnum (kontrai) are considered associated to a particular deity whose idol is installed beneath them. Later, when temples are erected for the deities who had originally occupied places under the trees, devotees take special care not to remove or disturb those trees. In fact, these trees formed the centre of the temple (sthala vriksha) near the sanctum sanctorum, and they were provided enough space for future growth (Subramaniya Pillai, 1961). The tamarind tree of the Vishnu temple at Alvar Tirunagari (between Tirunelvelli and Tiruchendur) is illustrative of this practice(Amirthalingam, 2013). The presence of a particularly bountiful tree may have given rise to the belief that a deity is present in the tree who offers her blessings in the form of fruits. This is so in the case of the tamarind tree where Puliyidaivalaiyamman is worshipped and a kadamba tree that is linked to a Goddess called Kadambariyamman. These sacred trees are symbolic of prolific genetic resource and play a pivotal role in the conservation of local floral wealth and biodiversity. In another example, the deity associated with a particular tamarind tree in Chandipur village in Bankura, West Bengal is Maa Manasa, the Hindu goddess of snakes and poison. Worship is done by the local people on a special day during the rainy season. Thus, these 'sacred' tree species have socio-religious importance which intertwines with various socio - cultural and religious beliefs, and taboos, and ecological services of sacred groves (Fig. 1). There are sacred groves in 19 of India's 28 states, and it is estimated that there are between 100 000 and 150 000 throughout the country (Malhotra et al. 2001). Despite the fact that the majority of these groves are less than 1 ha in size and cover only 0.01% of the country's total geographic area, their number and spatial distribution make them so important for biodiversity conservation(Table 1).

Nallur tamarind grove

Humans have always been drawn to trees with exceptional qualities. Various criteria, including size, tree form, historical-cultural associations, and sacred-mythical connotations have been used to formally designate them as heritage trees. Old trees with seasoned characteristics provide a variety of microhabitats to support an unexpected assemblage of companion organisms. Other large trees provide the foundation for key ecologically significant structures. Scientific data and inventory can boost public awareness and enhance management. Engaging the public and business community could foster ownership and rally support for their conservation. The Nallur Amarai grove in Devanhalli taluk, a few kilometres from Bengaluru International Airport in Karnataka, is well-known throughout the country. It is India’s first biodiversity heritage site, with over 300 tamarind trees spread across 53 acres (Nagendra and Mundoli, 2019). While some claim the trees in the groove are over 800 years old, carbon dating by the University of Agricultural Sciences in 2008 revealed that the oldest trees are about 400 years old (the site could be older).

A typical tamarind tree has life span of 200 years. Many experts who have visited the location have been captivated by the distinctive characteristics of the trees in the grove. According to the Karnataka Biodiversity Board publication: Research Finding into The Peculiar Features and The Complex Biodiversity in The Tamarind Grove (Heritage Site) At Nallur Village,peculiar structures were seen in the hollows of the trunks where some living cells, though livid, underwent meristematic development and produced fleshy peg-like stem/root primordia. They ranged from one to many, short or long, twisted or intertwined among one another, or produced calli, which later evolved into various strange structures. Some primordially produced roots continued to grow down to the ground and creep a short distance away from the main trunk (Tree nos. 118,1), and produced shoots and later developed into mini tamarind trees extending the life and useful years of mature trees. Such mini trees can be single or multiple (1-7) in number per tree (Tree nos. 1, 118). This phenomenon is similar to plant rejuvenation via stolons or runners, which is common in creeping herbs such as asparagus, pepper, betel vines, and so on, but not in tree species, particularly *Tamarindus* species (Karnataka Biodiversity Board report).These features emphasize the location's ecological importance. These trees, along with the dilapidated temple dedicated to Chennakeshava, are the only remaining remnants of the 800-year-old Nallur fort (Figure2).

The village panchayat managed the grove until 2007, when it was designated a biodiversity heritage site. In a 2009 report, the National Biodiversity Authority mentioned the construction of a barbed wire fence to protect the grove and putting a display board at the site. In 2008, the Nallur Biodiversity Heritage Management Committee numbered each tree to keep track of them. The Board also issued the following publications: Bird diversity in Nallur village, Devanahalli taluk, Bangalore, and the Nallur Tamarind Grove Research Report. There are 18 old, 234 middle aged and 26 clonal trees in the grove.The largest tree has a circumference of 20 feet and a height of about 30 feet. All the old trees have artistic warty markings on the stem. The forest department auctions off the harvest from these tamarind trees every year. Wood Apple (*Ferronia elephantum*), Banyan (*Ficus benghalensis*), Neem (*Azadirachta indica*), Jagalganti (*Diospyrus montana*), Uppigida (*Balanitis roxburghii*), Taggigida (*Gmelina asiatica*), and Bore hannu (*Zizyphus jujube*) are some of the plants commonly found in this area. Jackals, porcupines, black-naped hares, pangolins, and slender loris have been spotted, as have snakes such as Russell's Viper, Cobra, Saw Scaled Viper, and Rat Snake.The grove is also rich in avifauna particularly raptors such as owls and kites, which prefer tall, old trees for roosting and breeding necessitating proper protection of their roosting areas (Karnataka Biodiversity Board report).

Tamarind taxonomy

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Fabales, Family: Fabaceae, subfamily Caesalpinioideae, Genus: Tamarindus, Species: indica, Vernacular name: Imli (Hindi). The genus is monotypic with single species. It is dicotyledonous diploid species, having chromosome number 2n=24.

Nomenclature and origin

The name derives from Arabic: *Tamar-e-hind*, "Indian date". It is an evergreen multipurpose tree species with a wide geographical distribution in the subtropical and semi-arid tropical regions of the world. It is believed to have originated in Africa, from where it spread to Asia, America and Australia (Van den Bilcke et al. 2014). The dates of these introductions are unknown, and the exact origin of this species is still a point of contention (El-Siddig et al. 1999).

Grollier et al. (1998) claimed that it originated in Africa and was introduced into India at an early date, whereas Wunderlin (1998) and Poupon and Chauvin (1983) assumed that it originated in Asia, specifically India because of its title "*Tamar-e- hind*" which when translated means "Indian date" and owing to the fact that Marco Polo in his writings quotes its presence (1298 AD) and it is mentioned in Amarsimha's *Amarkosha* (600 AD) as *tintidi*, *cinca*, and *amlik*a. Another theory proposes that Ethiopian merchants had close contacts with India during the ancient Axumite Empire (1st century AD), long before the Arabians (600 AD) came, and that they were the ones who introduced tamarind to this country. The climate in India was ideal for the tree, and it took 200 to 500 years for the species to naturalize. The tree was favorably received by the locals, and it became an important element of their cultural life as well as their traditional cuisine (Shah, 2014). Being a tropical tree tamarind grows well in humid areas where mean annual rainfall is higher than 1500 mm but cannot tolerate continuous frost. The tree can grow up to 20 meters (66 ft) in height, and stays evergreen in regions without a dry season. It prefers to some extent acidic well-drained loamy soil (pH 5–6), but can also grow in a huge range of soil types, from alluvial to limestone (rocky) soil. It can withstand rather dry soils and climates. The tree has pinnate leaves with opposite leaflets giving a billowing effect in the wind. Tamarind timber consists of hard, dark red heartwood and softer, yellowish sapwood. The leaves consist of 10–40 leaflets. The flowers are mainly yellow in colour and produced in racemes. The fruit is a brown pod-like legume, which contains a soft acidic pulp and many hard-coated seeds.

Uses

Tamarind trees are used as ornamentals to provide shade on the country roads and highways. The pulp has laxative properties; its infusion in water makes a refreshing drink which is a coolant and useful in fevers. It is extensively used in the cuisine of southern India. The tree has recently become popular in bonsai culture, frequently used in Asian countries like Indonesia, Taiwan and the Philippines. In India, Tamil Nadu, Kerala, Maharashtra, and Madhya Pradesh are the major states contributing more than 90 percent of production (APEDA, 2021). Virtually every component of the tree (fruit pulp, seeds, flowers, leaves, wood, bark) has its specific applications, ranging from human and animal consumption to fuel wood, traditional medicine, construction, trading and industrial processing (El-Siddig et al. 2006). Tamarind is primarily valued for its fruits, especially the pulp which is used for a wide variety of domestic and industrial purposes such as tamarind juice concentrate, pulp powder, tartaric acid, and pectin (El-

Siddig et al. 2006). Tamarind pulp has laxative properties; its infusion in water is a very refreshing drink; it is useful in fevers. As a laxative it is taken singly or in mixture with other purgative drugs. When mixed with other purgative drugs it reduces their laxative property. The high nutritive value of fruit (100g pulp provides good amount of energy (239 kcal), dietary fiber (5g), minerals such asCa (74 mg $100g^{-1}$), Mg (92 mg $100g^{-1}$), P (113 mg $100g^{-1}$), K (628 mg $100g^{-1}$), Fe (2.8 mg $100g^{-1}$) and vitamins Thiamin (0.428 mg $100g^{-1}$), Riboflavin (0.152 mg $100g^{-1}$) and Niacin (1.94 mg $100g^{-1}$) making it one of the cheapest sources of multivitamins and minerals for the poor (Food Data Central, 2022).

Location	Number of sacred groves	Districts	Area (ha)	Local name
Andhra Pradesh	800	-	-	Pavitraskhetralu
Andhra Pradesh	750	23	-	
Arunachal Pradesh	58	2	-	Gumpa forests
Arunachal Pradesh	101	4	-	
Assam	40	1	-	Than, Madaico
Chhattisgarh	600			Sarna, Devlas, Mandar, Budhadev
Gujarat	29	1	0.42	
Haryana	248	18	-	Beed or Bid, Bani, Bann, Janglat, Shamlat
Himachal Pradesh	329	-	-	Dev Kothi, Devban, Bakhu Devban
Jharkhand	21			Sarna
Karnataka	1424	-	2407	Devarakadu
Kerala	2000	-	500	Kavu, Sarpa Kavu

Madhya Pradesh	275	-	-	
Maharashtra	1600	-	-	Deorai/Devrai
Maharashtra	483	10	3570	
Maharashtra	250	1	-	
Manipur	365	-	-	Umang Lai, Gamkhap, Mauhak
Manipur	166	4	756.42	
Meghalaya	79	-	26,326	Law Kyntang, Law Lyngdoh
Orissa	322	-	50	Jahera, Thakuramma
Puducherry	108			Kovil Kadu
Rajasthan	1	-	83	Oran (Jaiselmer, Jodhpur, Bikaner), Kenkri (Ajmer)
Rajasthan	9	-	158	
Sikkim	56	4	-	Gumpa forests
Tamil Nadu	10	-	127	Kovil Kadu
Tamil Nadu	3	-	-	
Tamil Nadu	1	-	-	
Tamil Nadu	448	28	-	
Uttarakhand	18	-	5500	Devbhumi, Baun, Bugyal
West Bengal	7	-	2	Garamthan, Harithan, Jahera, Sabitrithan,
West Bengal	190	-	15	
West Bengal	670	5	-	

Table 1. Distribution of sacred groves in different parts of India along with the area covered by them (Adopted from Malhotra et al. 2001 and Khan et al. 2008)

Tamarind seeds are used to make tamarind kernel powder (TKP) and tamarind seed gum or flour which are used as a thickener, gelling agent, and stabilizer in a variety of processed foods (Glicksman M, 1996).

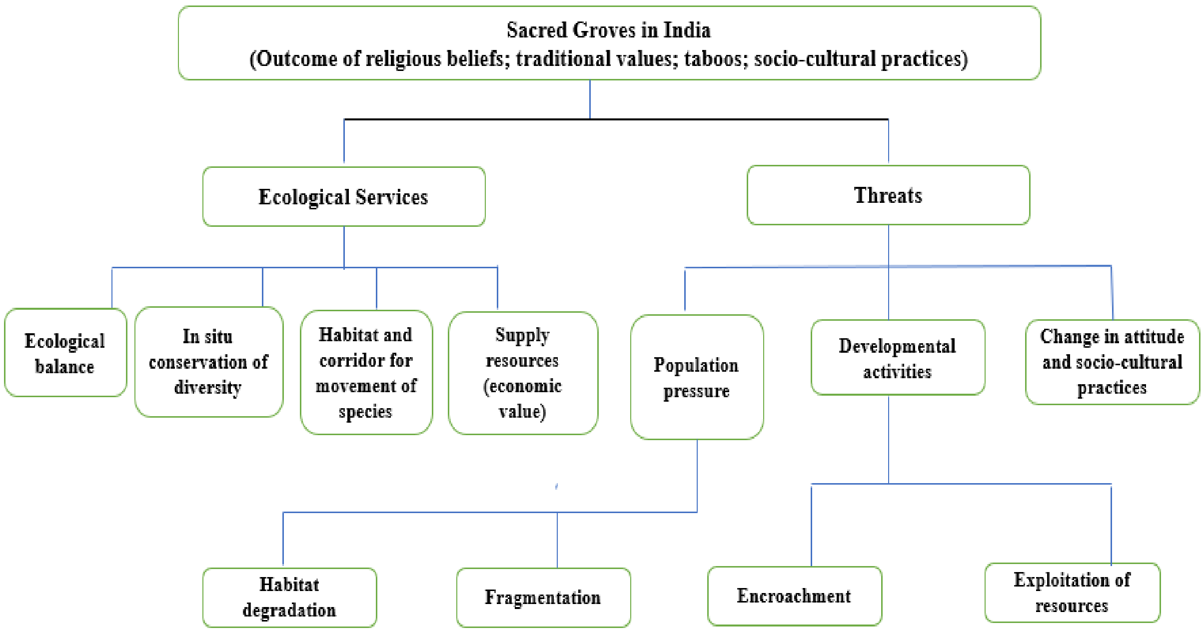

Figure 2.Relationshipsbetweenecologicalservices,and threats to sacred groves (modified from Khan et al. 2008)

MATERIAL AND METHODS

Exploration of the Nallur sacred grove area and documentation of the historic tamarind trees was conducted in Devanhalli taluk, having passport data : Latitude 13.19 ° N, Longitude: 77.76 ° E and Altitude: 891.3 m MSL. As a first step, necessary permissions for the survey and collection of scion wood were obtained from the Karnataka Forest Department. The assistance of the forest guard was used to identify the old trees in the groove since the number plates on some trees were damaged. Eleven old trees' distinctive characteristics were noted (Table 1). The scion was taken from the ends of branches with dormant buds. Five cuttings were taken from each tree and immediately wrapped in a thick layer of wet paper towels for transport to the ICAR-Indian Institute of Horticultural Research nursery, Hessarghatta, Bengaluru where softwood grafting was performed the same day. After three months, successful grafted trees were planted in the ICAR-IIHR field gene bank, where they will be evaluated in the coming years

RESULTS AND DISCUSSION

Close integration of in situ and ex situ approaches to plant species conservation is required in germplasm banking of wild species (Cai, 2015). This ex-situ effort, however, is intended to supplement rather than replace in situ conservation. The conservation programs' top priority is to protect target species in their native habitats as part of ecological communities that are as intact as possible and can continue to provide diverse ecosystem services.It is unclear exactly how these plant species interact with a variety of other living things, including microbes, insects, birds, and mammals. Everything must therefore be done to ensure the survival of plant species with extremely small populations in the wild. Simultaneously, the establishment of ex situ collections is critical in order to bring living specimens into cultivated safe havens, most commonly botanical gardens and germplasm banks, where their future can be ensured and where they can be used for research, public outreach, and educational programs at all levels. Creating catalogues of ancient monumental trees could be a good first step toward protecting them. This is important because, in recent years, the patrimony of ancient fruit trees has suffered serious spoliation, with cases of trees being removed from their original locations, or as a result of the gradual transformation of traditional groves into modern, intensive orchards. Inventorying, characterizing, and conserving ancient fruit trees in situ should be prioritized in this regard. This is especially important given the discovery that many ancient fruit trees represent previously uncatalogued varieties, constituting a previously untapped reservoir of genetic diversity (Diaz et al. 2011). The current study was therefore conducted in the Devanhalli region as part of a national project with the primary goalto preserve the genetic heritage of old tamarind trees and to encourage local farmers to utilize them. Thus, exploration of the area and documentation of the historic tamarind trees (Fig. 3), followed by ex situ preservation of these trees through the transport of scion wood and grafting on tamarind rootstocks were undertaken(Figure 4). Five number of softwood grafting in the oldest tree was attempted while in remaining three grafts each were performed totaling to thirty-five grafts. The final successful establishment could be achieved for nine grafts (Table2)

S.No	Tree Plate No	Characteristic feature	Fruiting	Grafting success
1	1	8 clonal trees around the main	Sparce	1 grafted plant

		trunk.The base of trunk is forked out and moved out slightly away creating wide space between two trunks.Crown is spreading type (Fig.2 a)	fruiting on some branches	successfully established in FGB
2	118	2 clonal trees around the main trunk.Roots creep above the ground at some distance, slightly away from the main trunk and produced shoots which have developed into mini tamarind trees. Crown is irregular in shape.(Fig.2 b)	No	1 grafted plant successfully established in FGB
3	-	3 clonal trees around the main trunk showing numerous warts. Crown is spreading type.(Fig.2 c)	No	Not successful
4	-	4 clonal trees around the main trunk. Crown is spreading type (Fig.2 d)	Sparse, small pods on terminal ends of branches	2 grafted plants successfully established in FGB
5	81	2 clonal trees around the main trunk. The main trunk is hollow with several stem/ root like structures inside. Crown is spreading type (Fig.2 e)	No	1 grafted plant successfully established in FGB
6	-	Trunk is triple trunk type. 3 clonal trees observed around the main tree. Crown is spreading type (Fig.2 f)	Sparse, small pods on terminal ends of branches	1 grafted plant successfully established in FGB
7	-	Multiple trunked with rugged or freckled surfaces with dirty grey- brown colour. Hollowed trunk with stem like structures inside. Crown is spreading type	Sparse, small pods on terminal ends of branches	Not successful

		(Fig.2 g)		
8	-	Trunk is big with rugged or freckled surfaces with dirty brown colour. Hollowed trunk with stem like structure inside. Crown is semi-circle type (Fig.2 h)	No	1 grafted plant successfully established in FGB
9	155	Oldest tree in the grove, Carbon dating revealed it to be 410-year-old. Double trunked, hollow and thick. Crown is dome type (Fig.2 i)	Sparse, small pods on terminal ends of branches	1 grafted plant successfully established in FGB
10	156	Trunk is solid, surface is rough and rugged, twisted into knots of various shapes and sizes. One of the branches has hollowed. Crown is dome type (Fig.2 j)	Sparse, small pods on terminal ends of branches	Not successful
11	-	Multiple trunks. Several root-like structures inside the main trunk. Crown is dome shape type (Fig.2 k)	Sparse, small pods on terminal ends of branches	1 grafted plant successfully established in FGB

Table 2 List of centennial trees of tamarind from Nallur sacred grove for collection of scions for conservation at field gene bank of ICAR-IIHR, Bangalore

Figure 2. The display board put up at the site of Nallur Tamarind Grove describing the unique features and ecological importance of the place and temple dedicated to Chennakeshava.

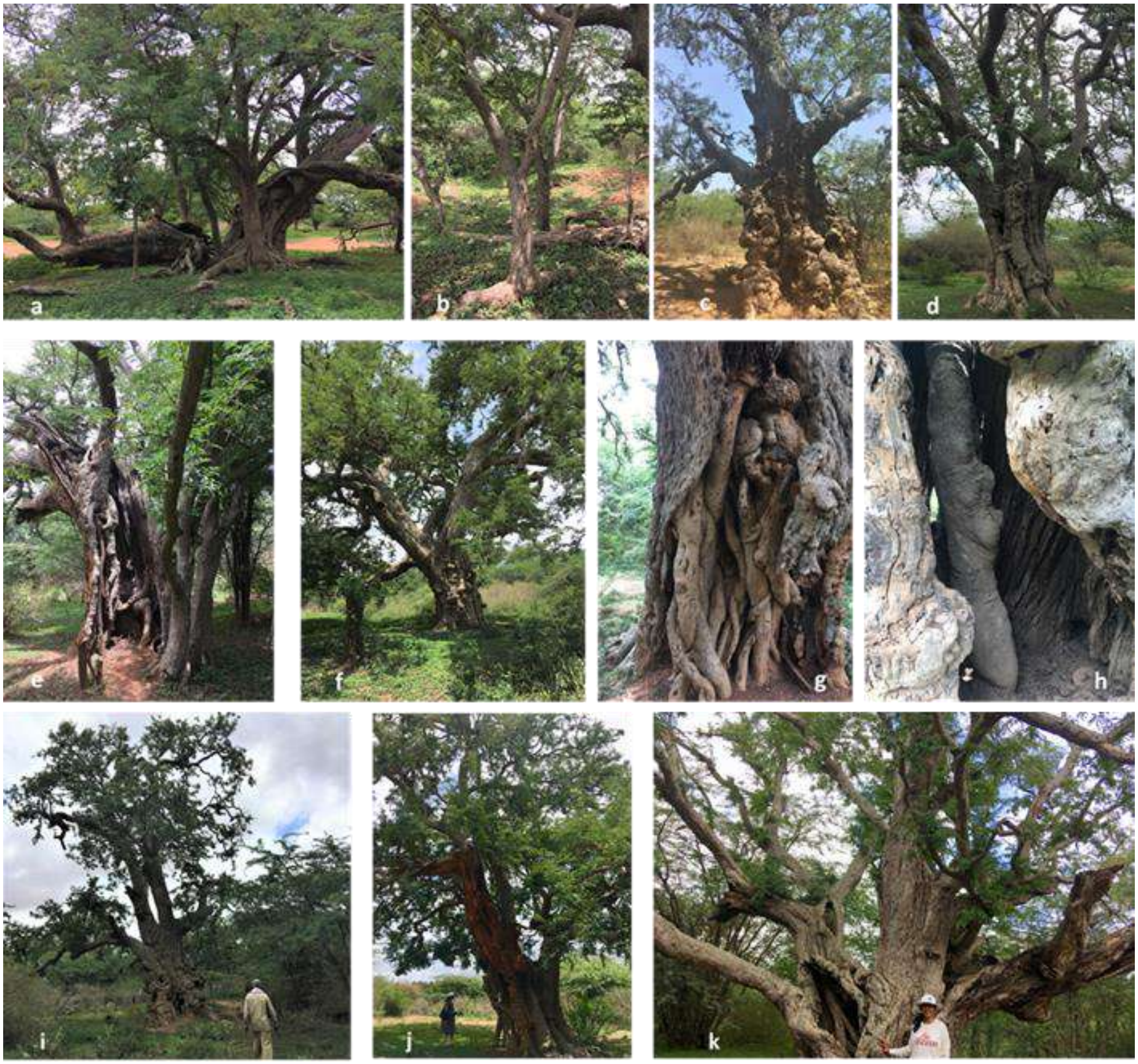

Figure 3. Picture depicting unique characters of 11 old tamarind trees at Nallur tamarind grove

Figure 4. Softwood grafting of the collected scions and field view of tamarind ex situ germplasm site at ICAR-IIHR

CONCLUSION

These heritage trees of Nallur sacred grove are a part of our history, a legacy that connects the influence of humans on the natural landscapes around them. As biodiversity declines, these living structures provide a safe haven for thousands of species. Their transpiration helps to keep a hot climate cool. They also preserve history and memory, giving us the ability to dream and imagine. They make a strong case for formal adoption as biodiversity and heritage indicators for the health of our cities and rural areas. To sustain the lineage, the ageing tree-population structure necessitates proactive nurturing of younger successors. Inventory and scientific data can help to increase community awareness and management. By involving citizens and the business sector, we can foster ownership and garner support for their conservation.To fully comprehend and realise the potential of sacred natural sites for biodiversity conservation, more research on the ecological values and sociocultural mechanisms underlying them is required.

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MILLETS- A SECRET INGREDIENT TO A HEALTHIER LIFE

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Miss Urmi Chawra, Dr. H.L. Kacha*, Shri. N. D. Makwana, Dr. G. K. Bhabhor, Dr. R. Radha Rani

Scientists, Krishi Vigyan Kendra, Anand Agricultural University, Dahod, Gujarat

*Corresponding Author Email ID: kvkdahod@aau.in

Introduction

Millets are traditional grains, grown and consumed in the Indian subcontinent from the past more than 5000 years. Millets are small - grained, annual, warm - weather cereals belonging to grass family are known for their high nutritional value. Being an excellent source of essential nutrients to the millions, millets have renowned themselves as **'Nutri-cereals'**. Millets are hardy and resilient crops, capable of thriving in harsh environmental conditions such as drought, high temperatures, and low soil fertility. Millets are nutri cereals comprising of sorghum, pearl millet, finger millet (major millets) foxtail, little, kodo, proso and barnyard millet (minor millets). These are one of the oldest food known to humanity. They assume to have significance for food and nutritional security in most of the Asian and African countries because of their hard nature and ability to grow in rainfed lands with very little agricultural inputs as compared to most of the cereals. The annual production of millets worldwide is about 32 million tonnes, of which a little more than half the quantity is produced in India. These are cultivated in almost all the states of India but majorly in states like Karnataka, Rajasthan, Gujarat, Haryana and Maharashtra.

Millets are predominantly used for food purposes in India as well as in other major developing countries but mainly used as feed ingredients in developed countries. Absence of appropriate primary processing technologies to prepare ready-to-use or ready-to-cook products and also secondary as well as tertiary processing to prepare ready-to-eat value added products have been the major limiting factors for their diversifies food use and better economic status. Millets are considered a need in today's society as they provide sustainable nutrition, contribute to environmental resilience, support food security, and promote culinary diversity. Incorporating millets into our diets can help improve overall health and well-being while addressing global challenges such as climate change and food insecurity. Therefore, United Nations General Assembly designated**Year 2023** as **International Year of Millets**.

Millets are high in nutrition and dietary fiber. They serve as good source of protein, micro-nutrients and phytochemicals. The millets contain 7-12 % protein, 2-5 % fat, 65-75 % carbohydrates and 15-20 % dietary fibers, treasuring themselves in basket of **super food**. Pearl millet, for instance, is an excellent source of magnesium, iron and zinc, which are essential for the immune system and brain functioning. It is commonly used to make porridge, flat breads etc. in Africa and India. Finger millet, a staple food in parts of Southern India and East Africa is rich in calcium and antioxidants, can prevent osteoporosis and cardiovascular disorders. It is used to make porridge, bread, and snacks.

On another hand, sorghum is rich in antioxidants such as flavonoids, phenolic acids, and tannins. It also contains the goodness of iron that is important for immunity, energy, and overall vitality. It is also packed with protein and fiber. It is widely consumed in Africa, Asia, and Latin America, where it is used to make porridge and beer. Foxtail millet and Proso millet, being excellent sources of vitamin B12 is essential for the heart and nervous system. They are popular in China, Japan, Korea, and other parts of Asia, where they are considered as a healthful alternative to refined grains.A variety of foods from the millets are traditionally prepared and consumed, over the centuries in Indian subcontinent, Africa and Central America. Majority of conventional products are made from flour prepared either from the whole grain or from partially decorticated grains. These include unleavened pancakes from fermented or unfermented dough, stiff porridge or muddle, snack foods, deep fried products, non-alcoholic beverages and decorticated grains, boiled similar to rice.

In India millets are mainly consumed in the form of khichdi, pulao, flatbreads, multigrain rotis, ladoo, kheer, upma, jowar pops, biscuits, chaklis, cookies, dosa, porridge etc. Below are some recipes of millets crops generally prepared by rural population of the District Dahod in the State Gujarat.

DISH NAME : Sorghum Flat bread (Juwar no rotlo)

S. No.	Ingredients	Measure (in cups and spoons or in grams)
01	*Sorghum Flour*	1 cup
02	Hot Water	1/2 cup

PREPARATION

Take a cup of sorghum flour in a bowl. By adding hot water knead it in a dough. Knead until it becomes soft. Put it aside for 5 minutes. Make small balls of dough and roll it out by help of roller or put the ball between two plastic sheets and press it with palm. Pre heat the pan and get the flat bread cooked properly from both the side. Serve it hot with Kadhi or Dal.

DISH NAME : Pearl millet's Dhokla (Bajarina dhokla)

S. No.	Ingredients	Measure (in cups and spoons or in grams)
01	*Peral millet Flour*	2 cup
02	Water	1 cup
03	Chopped Onion	50 gms
04	Turmeric Powder	1 tea spoon
05	Red Chilli Powder	1 tea spoon
06	Coriander Powder	1 tea spoon
07	Cumin	1 tea spoon
08	Mustard seeds	½ table spoon
09	Ginger chilli Paste	½ table spoon
10	Baking Soda	½ table spoon
11	Oil	3 table spoon
12	Salt	Add to taste
13	Green leafy coriander	To garnish

PREPARATION

Take 2 cups of pearl millet flour in a bowl. Add chopped onions to it. Add all the mentioned spices and mix it well. Add salt to taste and half table spoon of baking soda at last. Knead it in a semi soft dough by help of water. Make two cylindrical shapes out of the mix. Keep it aside. Steam it for 25 minutes. Check by putting a knife into the cylindrical shapes. If knife sticks keep it in low flame for another 5-7 minutes. Put the flame off and keep it aside for cooling. Cut it in circular pieces. Further, take a non-stick pan and put 3 table spoon of oil, add cumin and mustard seed, when seeds pops out add the pieces. Get it grilled/roast till a golden brown color is seen. Garnish it with leafy coriander. Serve hot with green chutney.

DISH NAME: <u>Pearl millet's Flat bread (Bajari no rotlo)</u>

S. No.	Ingredients	Measure (in cups and spoons or in grams)
01	*Pearl millet Flour*	1 cup
02	Hot Water	1/2 cup

PREPARATION

Take a cup of pearl millet flour in a bowl. By adding hot water knead it into a semi soft dough. Make small balls of dough. Put the ball between two plastic sheets and press it with palm in round shape. Pre heat the pan and get the flat bread cooked properly from both the side. Serve it hot with Kadhi or Dal.

DISH NAME: <u>Finger millet's Flat bread (Nagli no rotlo)</u>

S. No.	Ingredients	Measure (in cups and spoons or in grams)
01	*Finger millet Flour*	1 cup
02	Hot Water	1/2 cup
03	Salt	As per taste
04	Onion rings	2 small onion

05	Green chilly	2 in number
06	Curd	1 cup

PREPARATION

Take a cup of finger millet flour in a bowl. Add salt to taste. By adding hot water knead it into a semi soft dough. Make small balls of dough. Apply oil in your palm. Pressing the kneaded ball with palm giving them a round shape. Pre heat the pan and get the flat bread cooked properly from both the side. Serve it with any pickle or curd. And sides with salads, onion rings and green chilly.

DISH NAME : <u>Finger millet's Laddoo (Naglinaladu)</u>

S. No.	Ingredients	Measure (in cups and spoons or in grams)
01	*Finger millet Flour*	2 cup
02	Gur	1 cup
03	Ghee	6 table spoon
04	Milk	1/2 cup
05	Cardamom powder	2 tea spoon
06	Graded coconut	1 table spoon
07	Dry fruits	As per required

PREPARATION

Take a non-stick pan and roast the flour with ghee in low flame until it smells of roasting. Cut small pieces of dry fruits and roast it well along with graded coconut. Boil the milk and get the gur melted. Take every ingredient in the bowl and mix it well. Prepare lemon size laddoo out of the mixture. And serve it well.

DISH NAME : <u>Finger millet's Kheer (Naglini Kheer)</u>

S. No.	Ingredients	Measure (in cups and spoons or in grams)
01	*Finger millet's Vermicelli*	1 cup
02	Sugar	½ cup
03	Ghee	3 table spoon
04	Milk	2 litre
05	Cardamom powder	2 tea spoon
06	Dry fruits	As per required

PREPARATION

Take a non-stick pan and roast the vermicelli of finger millet with ghee in low flame until it smells of roasting. Cut small pieces of dry fruits and roast it well. Alongside, boil milk in a thick bottomed pan. Boil it till milk becomes half of initial quantity. Add vermicelli and let it further cook for 4-5 minutes. Then add sugar. Add dry fruits and cardamom powder at last when crystals of sugar got dispersed in milk fully. Let it cool down and serve.

DISH NAME : <u>Finger millet's Papadi (Naglinapapad)</u>

S. No.	Ingredients	Measure (in cups and spoons or in grams)
01	*Finger millets Flour*	1 cup
02	White sesame	½ table spoon
03	Papad Khar	¼ table spoon
04	Baking soda	1 pinch
05	Asafetida	1pinch
06	Cumin	1/4th table spoon

PREPARATION

Boil 2 cups of water for 4 minutes. Add cumin, asafetida and salt. After 2 minutes add Papad Khar, and baking soda. Slowly add the finger millet's flour and stir with the help of a whisk to prevent lumps. Cover the pan with the lid for 2 min and turn off the gas. Keep the prepared flour in the pot for 5-7 minutes to steam.Take it out in a plastic bag and knead it well for 5 minutes. Apply a small amount of oil in your hands and roll out a round papali on the plate. Keep in heat to dry for 2-3 days until you hear a crackling sound when crushed. Deep fry it and serve. Used it as side dish or light snack in the evening.

DISH NAME : Kodo's Upma

S. No.	Ingredients	Measure (in cups and spoons or in grams)
01	*Kodo seeds*	1 cup
02	Chopped onions	150 gams
03	Chopped green chilly	3 in number
04	Graded ginger	1 tea spoon
05	Green curry leaves	10-12 leaves
06	Urad dal	½ table spoon
07	Chana dal	½ table spoon
08	Mustard seeds	½ tea spoon
09	Water	1 and 1/2 cup
10	Oil	2 table spoon
11	Chopped vegetables	Peas, carrot, beans, potato

PREPARATION

Wash kodo seeds 2-3 times in a bowl. Completely drain the water and keep it aside. Then finely chop the onions, green chillies and vegetables. Also, grate the ginger by side. Put a pressure cooker on flame and heat oil. Add mustard seeds, urad dal, chana dal, curry leaves and green chillies.

When the dal starts to turn golden brown, add onion and ginger and saute till the onions turn golden brown.Add chopped carrots, beans and potatoes and saute for another 2 to 3 minutes. Then add kodo, saute for 1 minute until everything is mixed properly. Add water and salt as per taste. When water starts to boil, close the lid and cook on medium flame until it whistles 3 times. Serve hot with any kind of chutney or sambar.

DISH NAME : Kodo's Kheer

S. No.	Ingredients	Measure (in cups and spoons or in grams)
01	*Kodo*	150 grams
02	Sugar	250 grams
03	Ghee	50 grams
04	Milk	250 ml
05	Kesar	4-5 threads
06	Dry fruits	Cashew nut, Almond, Pistachio (50 gms)

PREPARATION

Take a thick bottom end pan and cook kodo, saffron and milk altogether on low flame till it becomes a mash.Add sugar and stir gently to cook. Heat ghee in a pan and add all the dry fruits and roast until it turns to golden. Served hot with sprinkled dry fruits over top.

DISH NAME: Barnyard millet's Pizza (Bunty na Pizza)

S. No.	Ingredients	Measure (in cups and spoons or in grams)
01	*Barnyard millet*	½ cup
02	Maida flour	½ cup
03	Baking soda	½ tea spoon
04	Salt	Add as per taste

05	Oil	2-4 table spoon
06	Water	If necessary
07	Veggies	Onion, Green capsicum, tomato chopped
08	Sweet corn	1/3 cup
09	Tomato Chutney	1/3 cup
10	Mozzarella cheese	As per need

PREPARATION

Take barnyard seed in a bowl, wash it properly and keep it aside for an hour with water filled till brim. Rinse the seed after an hour and make smooth paste by help of mixture grinder. Take the mixture in a bowl and add baking powder, fenugreek with salt and mix well. (You can keep the batter in a warm place for 6 hours or leave it to ferment).

Heat a flat pan and pour prepared batter, do not spread it. Apply a few drops of oil around the crust, let it cook for some time. Then pre-heat the oven to 180 degrees Celsius for about 5-7 minutes. Meanwhile, line a baking tray with aluminum foil. Place those prepared pizza crusts on a baking tray. Spread tomato sauce and mozzarella cheese on the pizza base. Place chopped onion, capsicum and sweetcorn on the pizza base. Bake/grill at 180°C for about 7-10 minutes until the cheese melts and the vegetables are toasted. Serve hot topped with red chili flakes and mixed Italian herbs.

Note: The pizza base may have some cracks on the edges as it is gluten free.

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FROM ORCHARD TO INNOVATION: APPLE PROCESSING AND VALUE ADDED PRODUCTS

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Mir Muskan Un Nisa, Talib Bashir Bhat and Naveed Hamid

Sher-e-Kashmir University of Agricultural Sciences and Technology Shalimar, Srinagar, Jammu and Kashmir, India.

*Corresponding Author Email ID: naveedbhat@skuastkashmir.ac.in

Introduction

Apples have been a staple fruit for centuries, beloved for their crisp texture, refreshing taste, and numerous health benefits. However, the journey of an apple does not end once it is plucked from the tree. In fact, the true potential of apples is unlocked through various processing techniques and the creation of value-added products. This article explores the fascinating world of apple processing and the diverse range of value-added products that can be derived from this versatile fruit. From traditional methods to cutting-edge technologies, we delve into the steps involved in transforming apples into a plethora of innovative and marketable goods.

1. Selecting and Harvesting the Finest Apples

The process of apple processing and the creation of value-added products begins with the careful selection and harvesting of the finest apples from orchards. This initial stage is crucial in determining the quality and characteristics of the fruit that will eventually make its way into various products (Wani and Mishra, 2022)

- **Orchard Selection:**

Different varieties of apples are grown in various orchards, each with its own unique flavour profile and characteristics.Factors such as climate, soil conditions, and geographical location influence the growth and quality of apples.Orchards are chosen based on their ability to produce apples that meet specific criteria for taste, texture, colour, and size.

- **Appropriate Harvesting Time:**

Apples are harvested when they have reached the optimal level of ripeness, ensuring the best flavour and texture. The timing of the harvest is essential, as picking apples too early or too late can impact their taste and overall quality.

- **Quality Assessment:**

Skilled workers or farmers carefully assess each apple to ensure it meets the required standards. Factors such as appearance, size, colour, absence of blemishes or bruises, and firmness are considered in the quality assessment process.

- **Harvesting Techniques:**

Apples are typically hand-picked using ladders or mechanical aids, depending on the size and layout of the orchard.

Care is taken to handle the apples gently to avoid damage and maintain their freshness.

- **Sorting and Grading:**

After harvesting, apples go through a sorting and grading process to separate them based on their size, colour, and quality.Sorting ensures that only the best apples move forward in the processing chain, while those with imperfections are set aside for alternative uses.

2. Transforming Apples through Juicing, Drying, Canning, and Freezing

Apples, once cleaned, sorted, and graded, are ready to undergo various traditional processing techniques. These methods have been utilized for generations and play a fundamental role in transforming apples into a wide array of value-added products that can be enjoyed throughout the year.

- **Juicing:**

Juicing is a popular method of apple processing that involves extracting the liquid content from the fruit.Apples are crushed or pressed to release their juices, which are then filtered to remove any solids or impurities. The resulting apple juice can be consumed as a refreshing beverage on its own or used as a base for other beverages and products.

- **Drying:**

Drying is a preservation technique that removes the moisture from apples, extending their shelf life and intensifying their flavour.Sliced or chopped apples are dehydrated using methods such as air drying, sun drying, or using specialized drying equipment.The dried apple slices or pieces can be consumed as a healthy and convenient snack or used as an ingredient in various food products.

- **Canning:**

Canning involves preserving apples by sealing them in airtight containers, typically glass jars, with the addition of sugar syrup or other preservation solutions.Apples can be canned as slices, chunks, or even as applesauce or pie filling.Canned apples retain their flavour, texture, and nutritional value, making them suitable for use in a variety of culinary applications.

- **Freezing:**

Freezing is a widely used method for preserving apples and maintaining their freshness and quality.Apples are peeled, sliced, or diced and then quickly frozen to prevent the formation of ice crystals that can degrade their texture.Frozen apples can be stored for extended periods and used in recipes such as pies, cobblers, smoothies, or as toppings for breakfast dishes.

3. Unlocking Flavour and Nutrition: Value-Added Products Derived from Apple Juice

Apple juice serves as a versatile base for a multitude of value-added products that offer enhanced flavours and nutritional benefits. Through various processes and creative formulations, apple juice becomes a key ingredient in a range of innovative and marketable goods.

- **Apple Cider:**

Apple juice can undergo fermentation, resulting in apple cider—a popular beverage known for its rich, tangy flavour.Apple cider can be enjoyed as a non-alcoholic beverage or undergo further processing to produce hard cider, a fermented alcoholic beverage.

- **Sparkling Apple Beverages:**

By carbonating apple juice, sparkling apple beverages are created, providing a bubbly and refreshing alternative to traditional soft drinks.These effervescent beverages can be enjoyed as standalone refreshments or combined with other flavours for a delightful twist.

- **Apple Flavored Mixers:**

Apple juice serves as an excellent base for crafting flavorful mixers used in cocktails and mocktails.Mixers infused with apple juice can add a crisp and fruity note to a wide variety of alcoholic and non-alcoholic drinks, enhancing their taste and appeal.

- **Apple Vinegar:**

Fermenting apple juice further transforms it into apple vinegar, a tangy and versatile ingredient used in cooking, salad dressings, and even as a natural cleaning agent.Apple vinegar offers a unique blend of acidity and sweetness, adding depth of flavour to a variety of dishes.

- **Apple Syrup and Sauces:**

Concentrating apple juice can yield apple syrup—a thick, sweet liquid that can be drizzled over pancakes, waffles, and desserts, or used as a flavouring agent.Apple syrup can also be utilized as a base for producing apple sauces and toppings that complement a range of dishes.

- **Apple-Infused Products:**

Apple juice can be used as an infusion in various food and beverage products to impart its distinctive flavour profile.It serves as a key component in apple-flavouredyoghurts, ice creams, jellies, jams, and bakery items, offering consumers a taste of apples in different culinary experiences.

4. Crisp and Crunchy Delights: Exploring the World of Dried Apple Snacks

Dried apple snacks offer a delightful combination of natural sweetness and a satisfying crunch, making them a popular choice for health-conscious consumers seeking convenient and nutritious treats. Through a careful drying process, apples are transformed into crispy and flavorful snacks that can be enjoyed on their own or incorporated into a variety of culinary creations.

- **Drying Techniques:**

Dried apple snacks are created through dehydration, where the moisture content of the apples is significantly reduced, leading to a concentrated flavour.Apples are sliced or cut into thin pieces to expedite the drying process, or they may be dried whole, creating apple rings or chips.

Traditional methods involve air drying or sun drying, while modern technologies, such as freeze-drying and hot-air drying, offer efficient and consistent results.

- **Natural Sweetness and Nutrients:**

The drying process intensifies the natural sweetness of apples, creating a satisfyingly sweet and flavorful snack without the need for added sugars.

Dried apples retain much of their original nutritional content, including dietary fibre, vitamins (such as vitamin C and B-complex vitamins), and minerals (such as potassium).

- **Healthy Snacking:**

Dried apple snacks are a wholesome alternative to sugary and calorie-dense treats, providing a guilt-free option for those seeking a balanced diet.They offer a convenient on-the-go snack that can be enjoyed anytime, anywhere, providing an energy boost and satisfying hunger pangs between meals.

- **Culinary Uses:**

Dried apple snacks are versatile ingredients that can enhance a range of dishes, both sweet and savoury.They can be added to oatmeal, cereals, or yoghurt for extra texture and natural sweetness.In baked goods, such as muffins, cookies, or granola bars, dried apple pieces impart a chewy and fruity element.In savoury dishes, dried apples can be incorporated into salads, stuffings, or trail mix, adding a delightful contrast to other ingredients.

- **Innovative Culinary Explorations:**

Canned apples can inspire culinary creativity by being incorporated into new and innovative recipes.They can be used in savoury-sweet combinations like apple and cheese pairings or as toppings for pizzas and flatbreads.Canned apple slices can be caramelized or used as a filling in turnovers or empanadas, creating a delightful treat.

- **Novel Apple Varieties and Hybridization:**

The development of new apple varieties through selective breeding and hybridization techniques provides opportunities for unique flavour profiles, improved disease resistance, and enhanced storage capabilities.Innovation in apple breeding has led to the introduction of apples with attributes such as increased crispness, juiciness, and novel taste experiences.These new varieties contribute to the diversity of apple processing and value-added products, offering consumers exciting choices and experiences.

5.**Apple By-products and Waste Utilization:**

Apple processing generates by-products and waste materials that can be utilized in various ways, reducing waste and maximizing resource efficiency.Apple pomace, peels, and cores can be converted into value-added products like apple pectin, apple fibre supplements, animal feed, or bioactive compounds for pharmaceutical applications.Utilizing these by-products creates a circular economy approach, minimizing waste and increasing the overall sustainability of apple processing operations (Duan*et al*., 2021)

6.A Slice of Beauty: Apple Extracts and Essences in Cosmetic and Personal Care Items

Apples, with their rich nutritional profile and beneficial compounds, have found their way into the world of cosmetics and personal care products. The extracts and essences derived from apples offer a range of skincare and haircare benefits, adding a touch of natural beauty to a variety of beauty and grooming items.

- **Nourishing Skin Care:**

Apple extracts are known for their antioxidant properties, which help protect the skin against environmental damage caused by free radicals.
They can help rejuvenate the skin, improve elasticity, and promote a more youthful appearance.
Apple extracts are often used in moisturizers, serums, masks, and lotions, providing hydration and nourishment for a healthier complexion.

- **Brightening and Toning Effects:**

Apple extracts contain natural acids, such as malic acid, which help exfoliate the skin gently and promote a more even skin tone.They can aid in reducing the appearance of dark spots, hyperpigmentation, and blemishes, resulting in a brighter and more radiant complexion.
Facial cleansers, toners, and brightening treatments often incorporate apple extracts to promote a balanced and vibrant complexion.

- **Scalp and Hair Health:**

Apple essences and extracts offer benefits for scalp and hair health, promoting strong and lustrous locks.They can help cleanse the scalp, balance oil production, and soothe irritation or dryness.Apple-infused shampoos, conditioners, hair masks, and scalp treatments provide a refreshing and revitalizing experience, enhancing the overall health and appearance of the hair.

- **Anti-Aging Properties:**

Apples contain natural compounds that can help reduce the signs of ageing, such as wrinkles and fine lines.The antioxidants and polyphenols present in apple extracts can combat oxidative stress and promote collagen production, improving skin elasticity and firmness.
Anti-ageing creams, serums, and eye treatments often incorporate apple extracts to help diminish the visible signs of ageing and promote a more youthful complexion.

- **Aromatherapy and Fragrance:**

The delightful scent of apples is also harnessed in personal care items to create a pleasant and refreshing aroma.Apple essences can be found in perfumes, body mists, shower gels, and soaps, providing a crisp and uplifting fragrance experience.

Conclusion

By meticulously selecting and harvesting the finest apples from carefully chosen orchards, the apple processing industry ensures the availability of high-quality fruit for the subsequent stages of processing. This attention to detail sets the foundation for creating exceptional apple-based products that satisfy consumer expectations for taste, texture, and overall enjoyment.The incorporation of apple extracts and essences in cosmetic and personal care items brings the natural goodness of apples to the realm of beauty and grooming. With their skin-nourishing properties, brightening effects, scalp and hair benefits, anti-ageing properties, and aromatic qualities, apple-based ingredients offer a slice of natural beauty and enhance the overall sensory experience of these products. With their preserved texture, natural sweetness, and easy accessibility, canned apples offer culinary versatility and allow for the creation of both familiar and inventive dishes. From classic apple pies to unexpected flavour pairings, these pantry staples continue to delight chefs and home cooks alike, offering an opportunity to infuse meals with the comforting and delicious taste of apples throughout the year. These value-added products derived from apple juice demonstrate the versatility and wide range of applications for this natural and flavorful ingredient. By harnessing the unique qualities of apple juice, manufacturers can create a diverse portfolio of products that cater to consumers seeking delicious, nutritious, and innovative options. Furthermore, apple juice-derived products often retain the nutritional benefits of apples, including vitamins, minerals, and antioxidants. This allows consumers to enjoy the taste of apples while also incorporating valuable nutrients into their diets. Through the transformation of apple juice into an array of value-added products, the apple processing industry continues to satisfy evolving consumer preferences and provide opportunities for culinary exploration and enjoyment.

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THE ROLE OF FRUIT CROPS IN AGRITOURISM: EMPOWERING FARMERS AND ENHANCING INCOME

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Dharmendra Kumar Gautam[1],Om Prakash[2], Vikash Kumar[3] and Sidharth Kumar[3]

PG Research Scholar[1], Assistant Professor[2], Ph.D. Research Scholar[3]

Department of Fruit Sciences, College of Horticulture.

Banda University of Agriculture and Technology, Banda, U.P.-210001

*Corresponding Author Email ID: gautam1998dharmendra@gmail.com

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Abstract

Agritourism refers to the practice of attracting visitors to agricultural areas or farms for recreational, educational, or entertainment purposes. It involves activities and experiences that allow tourists to engage with various aspects of farming and rural life. Agrotourism is often recommended as a practical method to advance the agricultural sector and raise farmers' income and living standards. However, the role of agri-tourism is to develop the potential by increasing the income of farmers by deceiving the potential so that it attracts tourists to visit. This step determines the base area of fruits by determining the location quotient method and through the result of this study the best location has been selected which has the potential to develop fruit agro-tourism. While potential items for fruit agro-tourism are dragon fruit, serikaya fruit, watermelon fruit, watermelon fruit, orange fruit, water guava fruit, jackfruit and guava fruit. The perfect fruit is a community based on the agro-tourism model. By selling flowers to regional government organizations for use in displays at the annual flower festival, which attracts a lot of tourists to the area, the flower farms get extra money. So that it can utilize the labour in the village and the families living on the farms can also supplement their income with the money earned by family members working for tourism businesses.

Introduction

Agricultural tourism as a sector of the tourism industry refers to "tourism products that are directly linked to the agricultural environment, agricultural products or agricultural migration". Such a definition means that this type of tourism is related to hospitality services (such as bed and breakfasts, food services, hosting farmers' markets, weddings and private parties, and overnight stays on farms, accommodations, farm-based recreational activities (such as fishing, horseback riding, recreational self-harvest, and u-pick fruits or vegetables), agricultural education and training workshops with an emphasis on personal field experiences, and a variety of foraging (e.g., hunting) and non- Conclusion (e.g., nature observation)) Agri-recreational activities. Agro-tourism development has been recognized as an alternative to diversified agricultural activities as a source of employment generation and economic growth. This type of tourism can benefit the farmers by attracting tourists. Provides additional income. For agricultural sectors, it also provides efficient use of available assets and helps preserve cultural heritage and traditions. Along with increasing urbanization and industrialization, this type of tourism has created psychological problems in rural areas. And it has also created a form of mental relaxation, leading to both recreational and experiential tourism. In the context of agritourism, taking into account the potential of rural areas for a variety of activities, this type of tourism can be used to improve agricultural productivity and plant fruit trees, as well as reduce rural migration, increase social participation and can be done. To promote agricultural products.

Visitor Engagement: Fruit crops provide an opportunity for visitors to actively engage in farm activities such as picking fruits, which enhances their overall experience. This hands-on experience allows visitors to connect with the land, learn about farming practices, and appreciate the effort involved in producing fresh, high-quality fruits.

Attractive and Engaging Experiences: Fruit crops provide visually appealing and interactive experiences for visitors. The vibrant colors, enticing aromas, and the opportunity to pick fresh fruits directly from the trees or vines create an engaging and memorable experience. Visitors are drawn to the beauty of fruit orchards and vineyards, making them popular destinations for agritourism.

Seasonal Activities: Fruit crops have distinct growing seasons and harvesting periods, which can be a major draw for tourists. Agritourism destinations can organize seasonal activities such as fruit picking, fruit festivals, or harvest celebrations. These events create a sense of anticipation and excitement, attracting visitors who want to experience the specific seasonal activities related to fruit crops.

Educational Opportunities: Fruit crops offer valuable educational opportunities for visitors. Agritourism destinations can provide guided tours, workshops, and demonstrations that educate visitors about various aspects of fruit cultivation, including planting, pruning, pest management, irrigation techniques, and harvesting methods. Visitors gain insights into the agricultural processes, learn about sustainable farming practices, and develop a deeper understanding of where their food comes from.

Culinary Experiences: Fruits are integral to culinary experiences, and agritourism destinations centered around fruit crops can capitalize on this. They can offer activities such as fruit tastings, cooking classes featuring fruit-based recipes, or opportunities to sample and purchase homemade fruit products like jams, jellies, wines, and pies. These culinary experiences showcase the diverse flavors and culinary potential of fruit crops, enhancing the overall agritourism experience.

Health and Wellness: Fruits are associated with health and wellness, and agritourism destinations can leverage this aspect to attract visitors seeking wellness-related experiences. They can offer activities such as yoga or meditation sessions in fruit orchards, wellness retreats in serene natural surroundings, or health-focused workshops and programs that highlight the nutritional benefits of fruits. Such initiatives create a unique and rejuvenating experience for health-conscious tourists.

Unique Market Opportunities: Agritourism destinations centered around fruit crops can provide unique market opportunities for farmers. They can sell fresh fruits directly to visitors through U-pick experiences or farmers' markets, bypassing traditional distribution channels. This direct-to-consumer approach enables farmers to establish a closer connection with customers, generate additional income, and strengthen their brand.

Environmental Awareness and Sustainability: Fruit crops offer an opportunity to showcase sustainable farming practices and raise awareness about environmental conservation. Agritourism destinations can educate visitors about organic farming methods, integrated pest management, water conservation, and other sustainable approaches used in fruit cultivation. By promoting environmentally friendly practices, these destinations encourage visitors to make more informed and sustainable choices in their daily lives.

Economic Benefits: Agritourism centered around fruit crops can contribute to the localeconomy by generating income for farmers and creating employment opportunities in rural areas. It can also support other local businesses such as food vendors, souvenir shops, and accommodations, thereby boosting the overall tourism industry.

Conclusion:

Fruit crops have a wide scope in agritourism, which provides many benefits and opportunities for both visitors and farmers. The unique characteristics of fruit crops, such as their visual appeal, seasonal nature and culinary versatility, make them highly attractive to tourists seeking an engaging and educational experience. Agritourism destinations focused on fruit crops provide visitors with opportunities to pick their own fruit, participate in farm activities, learn about sustainable agricultural practices, and enjoy fresh and healthy culinary experiences. Furthermore, even in areas where local conditions are suitable for the development of agritourism, only a few mountain farmers have the necessary knowledge, skills and resources to take advantage of the opportunities offered by such development. Nevertheless, our study suggests that under suitable conditions, agritourism development can be beneficial to mountain farmers.

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INTEGRATED MULTI- TROPHIC AQUACULTURE (IMTA)

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***Gowhar Iqbal [1], Rida Reyaz[1], Showkat Ahmad Dar[2],**
[1]ICAR - Central Institute of Fisheries Education, Mumbai – 400061
[2]College of Fisheries Kishanganj Bihar Animal Science University, Patna- India
*Corresponding Author Email ID: drgowhariqbal@gmail.com

Abstract

IMTAsystemsplayamajorroleworldwideinsustainableaquaculture operations expansions with a balanced ecosystem approach to respond to a worldwideincreasing seafood demand with a new paradigm in designing the most efficient foodproductionsystem.TheIMTAisstillin itsinfancybutpresentsgreatprospectstowardsbecomingthefuture of aquaculture, with increased production and product diversity and quality, promoting environmental, economic and social sustainability. Much of the research was initially focused on finding a suitablecombination of species for integration and the production potential in the system.

Keywords: ITMA, Aquaculture, Social sustainability, Disease control.

Introduction

Integrated multitrophic aquaculture can thus be defined as "a practice in which by-products from one species are recycled to become inputs for another". Integratedmulti-trophic aquaculture (IMTA) involves cultivating fed species with extractive species thatutilize the inorganic and organic wastes from aquaculture for their growth.IMTA is the practice which combines, in the appropriate proportions, thecultivation of fed aquaculture species (e.g. finfish/shrimp) with organic extractive aquaculture species(e.g. shellfish/herbivorous fish) andinorganic extractive aquaculture species (e.g.seaweed)to create balanced systems for environmental sustainability (bio mitigation), economic stability (product diversification and risk reduction)and social acceptability (better management practices). IMTA farming is now increasingly gaining popularity among farmersadopting seaweed cultivation.

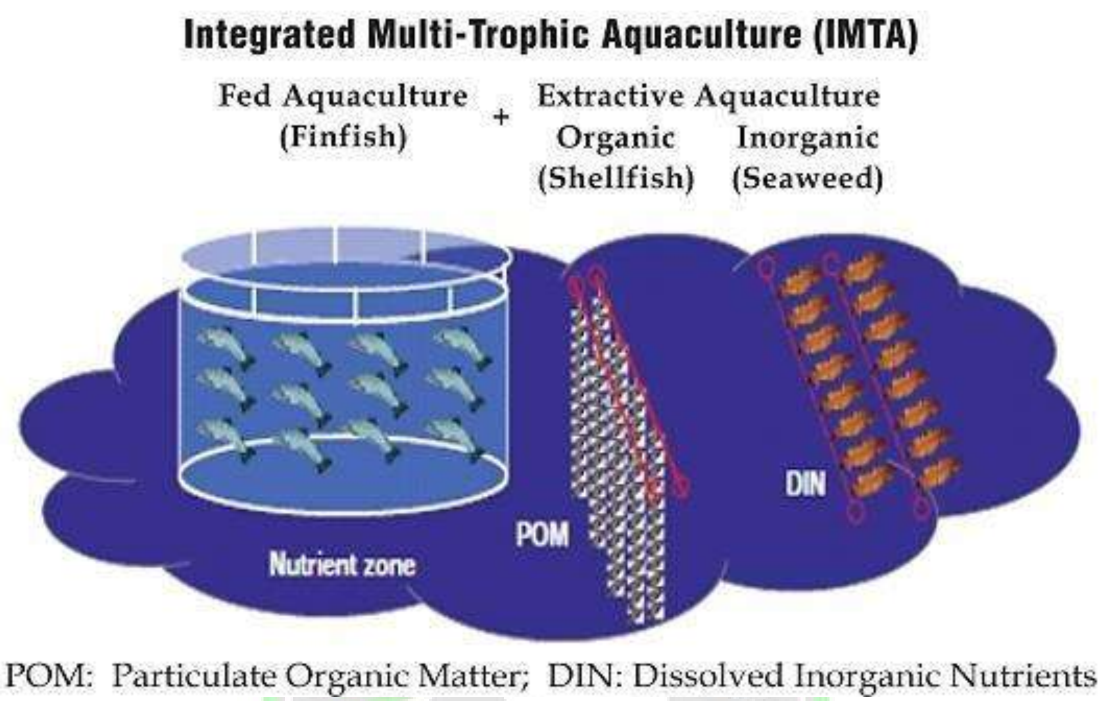

Figure 1. Representation of a possible IMTA system, with fed species and both organicandinorganicextractivespecies

The crucial aspect is that the appropriateorganisms are chosen based on their functions in the ecosystem, and the idea behind IMTAs is that,besides environmental sustainability, these systems can provide economic diversification.Each species actsas a natural biofilter andhas its commercial value,increasing the overall aquaculture value.

Criteria for selection of species

Environmental sustainability is the major consideration in IMTA. Therefore, the criteriaguidingspeciesselectionincludeunderstandingthelimitationsofthenaturalecosystem.Whenestablishingwhichspeciestouseinan IMTAsystem,onemustcarefullyconsiderthesuitabilityofthespeciesinaparticularhabitat/cultureunit.Farmers should understand its compatibility and future impact on the ecosystem to ensure successful growth and economic value—the risk of invasive species causing harm to the local environment and potentially harmingother economic activities.

Species Cultured In ITMA

IMTA is considered more sustainable than the common monoculture systems – that is,a system of aquaculture where only one species is cultured – in that fed monoculture tends tohave an impact on their local environments due to their dependence on supplementation withan exogenous source of food and energy without mitigation. IMTA systems can be land-based or open-water systems, marine orfreshwatersystems,and may comprise several species combinations. Some IMTA systems have included such combinations as shellfish/shrimp, fish/seaweed/shellfish,fish/shrimp,and seaweed/shrimp. Theex tractive species used in IMTA include organic (bivalves/shell fishor her bivorous fishes) and inorganic (seaweeds or aquatic plants) extractive species,which tog ether sustain the ecological balance.The first trial started under participatory modewith a fishermen group at Munaikadu (Palk Bay), Ramanathapuram district, Tamil Nadu by integrating seaweed *Kappaphycusalvarezii* with cage farming of Cobia (*Rachycentroncanadum*). The inclusion of deposit feeders in IMTA is particularly seen in Japan and many parts of Asia,where these species are found to have high demand, while disregarded in Europe, the United States,India, etc.

BENEFITS OF ITMA

1. **Effluent bio-mitigation:** Mitigation of effluents through bio-filterssuited to the ecological niche of the aquaculture site. This can solve a number of the environmental challenges posed by monoculture aquaculture

2. **Improving local economy:** Economic growth through employment (both direct and indirect) and product processing and distribution

3. **Disease control:** Prevention or reduction of disease among farmed fish can be provided by certain seaweeds due to their antibacterial activity against fish pathogenic bacteria

4. **Increasedprofitsthroughdiversification:** The increased overall economic value of an operation from the commercial by-products that are cultivated and sold. The complexity of any bio-filtration come satasignificant financial cost.

FUTURERESEARCHPROSPECTS

The IMTA is stillin its infancy but presents great prospects towards becoming the future of aquaculture, with increased production and product diversity and quality, promoting environmental, economic and social sustainability. Furtherresearchfor the developmentof IMTA must focus onthe following:

1. Great opportunities come along with great challenges, and pinpointing the most suitablespecies to be combined in IMTA systems, together with the need to create models to assess the densities and conditions for co-culture better to generate optimum revenue,will require considerable research

2. The extractive species may take up various contaminants and chemicals administeredduring production and from the surrounding environment- Food safety and human health concerns of IMTA-raised products mustbe tackled.

3. Optimization of stocking densities of various extractive and fed species in IMTA.

4. The suitable integration of aquatic plant aand medicinal herbs with high market demand in IMTA.

5. Suitability of high-valued marine and brackishwater fishes and halophytes in open water IMTA.

Conclusion

IMTA systems play a major role worldwide in sustainable expansions of quaculture operations with in a balanced ecosystem approach to respond to a worldwide increasing seafood demand with a new paradigm in designing the most efficient food production system. IMTA provides the advantage of incremental carrying capacity,bioremediation diversified products and prevention of diseases. However, despite their enormous potential, IMTAs are still under development in most countries, at least at full commercial scales. To date, a few promising open-ocean IMTA demonstration facilities existin different parts of the world, which may be used as protocols for future development Hence, this eco-friendly and sustainable option must be further promoted to ensureas teadyincome for the coastal fishes as well as one of the significant mitigating measures for the adverse impact of climate change and earn valuable carbon credit for ourcountry.

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PRECISION AGRICULTURE: ENHANCING CROP FARMING WITH TECHNOLOGY

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Noureen Khurshid & Naveed Hamid

Sher e Kashmir University of Agricultural Sciences and Technology of Kashmir J&K UT

*Corresponding Author Email ID: noureenkhurshid@gmail.com

Introduction

For the Indian economy to continue to expand steadily, agriculture is a vital sector. Most economies around the world are based on agriculture because it produces a large portion of the GDP and ensures food security (World Bank, 2020). Contrarily, due to its use of 70% of the world's freshwater resources to irrigate 25% of its cropland, agriculture has been recognized asa key water user industry. Approximately 70% of rural households and 8% of urban households still rely mostly on agriculture for livelihoods. Since over 75 % of people reside in rural regions, this industry is the main income source for most of the income for the majority of individuals. Although the industrialization of the Indian economy has negatively impacted the GDP share of the agricultural sector, the fact that India has experienced a series of successful agricultural revolutions, starting with the "green" revolution in wheat and rice in the 1960s and 1970s, the "white" revolution in milk, and the "yellow" revolution in oilseeds in the 1980s, cannot be ignored. India now has a self-sufficient agricultural sector. A consistent application of agricultural inputs throughout the field without taking into account local differences in soil fertility and crop conditions does not provide the desired crop yield. The core of precision farming is the control of in-field variability in crop conditions, soil fertility, and influence on the environment. Since India is geographically dispersed over numerous agro-climatic zones, the knowledge required for the agricultural methods in each of these regions is completely different. A holistic approach to farming is necessary to integrate the use of existing technology to achieve farmers' aims. Up until just over a year ago, the idea of completely automated towns was still a pipe dream. However, the rapid advancement of information and communication technology has made this reality possible.

Precision agriculture

Precision agriculture is a farming approach that has the potential to revolutionize agriculture in the 21st century. Precision farming, also known as precision agriculture, is a farm management system that uses information and technology to identify, analyze, and manage spatial and temporal variability within fields for maximum productivity and profitability sustainability, and protection of land resources while minimizing production costs. Precision farming is at the center of shaping itself to offer solutions to the industry's major issues. Precision agriculture is the "use of technologies that integrate sensors, information systems, improved machinery, and informed management to improve production by accounting for dynamics within sustainable agricultural systems," according to Yin *et al.* (2021). Over the last several decades, productivity gains in the global food supply have increasingly relied on the growth of irrigation systems, with more than a third of the world's food currently requiring irrigation for production. Rapid socioeconomic developments in several emerging nations, especially India, are opening up new avenues for precision agriculture (PA) application. Overall, global market rivalry in agricultural goods is threatening the economic viability of existing agricultural systems, necessitating the creation of new and dynamic production methods. Precision agriculture conjures up thoughts of farmers overcoming the elements with computerized machinery that is precisely controlled via satellites and local sensors, as well as employing crop growth planning correct software. This illustration has been dubbed "agriculture's future."

Need for Precision Farming

The 'Green Revolution' of the 1960s enabled our country to become self-sufficient in food production. Food grain output has expanded more than treble during the past 50 years, while yields have increased more than twice as much. High input utilization, including more fertilizer, irrigation, pesticides, higher use of High Yielding Varieties (HYV), increased cropping intensity, and increased mechanization of agriculture, has made all of this possible. It is unavoidable that contemporary technology would be introduced and used in Indian agriculture to fulfill the country's enormous food grain demand, which is expected to reach 480 million tonnes (Mt) by the year 2050. Over the next 40 years, the tremendous difficulties facing the world food system will only become worse. To deal with anticipated challenges and solutions, the food system has to undergo more drastic changes, and research funding is needed. Major issues in agricultural growth and development now include the decline in total productivity, diminishing and depleting natural resources, stagnating farm incomes, lack of an eco-regional approach, decreasing and splintered land holdings, trade liberalization on agriculture, limiting employment opportunities in the non-farm sector, and global climatic variation. The use of balanced soft and hard precision agriculture (PA) technologies depending on the requirements of a country's unique socioeconomic situation is anticipated to make precision agriculture (PA) appropriate for emerging countries as well. Instead of relying on statistical and scientific data, "soft" precision agriculture (PA) mostly relies on visual observation of the crop and soil as well as management decisions based on experience and intuition. All contemporary technology, including GPS, RS, and VRT, is used in "Hard" PA. Three elements have been recognized as parts of PA adoption strategies in developing nations like India: "single PA technology," "PA technology package" (allowing the user to pick one ora mix), and "integrated PA technology."

Basic Steps in Precision Farming

The basic steps in precision farming are:

I. Assessing variation II. Managing variation and III. Evaluation.

I. Assessing variation

The assessment of variability is a vital initial step in precision farming. Factors and mechanisms that regulate or affect crop yield performance vary in space and time. Precision agriculture has difficulty quantifying the variability of these elements and processes and establishing when and where different combinations are responsible for spatial and temporal variation in crop production. Techniques for measuring spatial variability are widely available and have been widely employed in precision agriculture. The majority of precision agriculture is concerned with measuring geographical variability. Techniques for assessing temporal variability exist as well, however reporting both spatial and temporal variance at the same time is uncommon.

II. Managing variation

After assessing variance, one must match agronomic inputs to known conditions using management advice. These are site-specific and employ precise application control devices. Precision soil fertility management is an enticing, but largely unproven, alternative to uniform field management due to the possibility of better precision in soil fertility management combined with higher precision in application control. Precision soil fertility management demands that within-field variability exists and is precisely identified and reliably interpreted, and that variability affects crop yield, crop quality, and the environment for successful implementation. As a result, inputs can be applied precisely. A manageable soil attribute has a larger potential value and better possibility for precise management.

III. Evaluation

Regarding the evaluation of precision agriculture, there are three crucial considerations.

Economy, environment, and technology transfer are the first three.

a). Economics: The value is created by applying the data, not by using the technology, which is the most crucial truth when analyzing the profitability of precision agriculture.

b). Environment: Using precision agriculture is frequently justified by the potential benefits of environmental quality. Environmental advantages are commonly mentioned, including decreased usage of agrochemicals, higher nutrient use efficiencies, increased efficiency of regulated inputs, and increased production of soils from degradation. Precision agriculture may be made possible by enabling technology, applicable by agronomic principles and decision rules, and lucrative by increased production efficiency or other types of value.

c). Technology transfer: The phrase "technology transfer" may suggest that the adoption of precision agriculture happens when people or businesses merely purchase and employ the enabling technologies. The essential word here is managed because precision agriculture does include the use of enabling technologies and agronomic principles to control spatial and temporal variability. How to interact with the farmer has received a lot of interest in what is known as technology transfer. As precision agriculture advances, these difficulties relating to the operator's managerial skills, the infrastructure's spatial distribution, and the technology's suitability for specific farms will drastically change.

Precision Agriculture Technologies

Precision farming requires special equipment and software to collect and analyze all the information. The three types of precision farming technologies are ground, aerial, and satellite. The former is appropriate for machine control, scouting, mapping, and production planning. The latter two are important for addressing larger-scale issues, such as real-time yield state analyses from anywhere.

I. **Global Positioning System (GPS)**

GPS is a ground-based technology that enables growers to collect data in real time with precise location information. The use of pseudo-range errors acquired at a known location to improve measurements taken by other GPS receivers within the same approximate geographic area is a strategy for improving GPS accuracy. The following tasks are suitable for using GPS:

- Mapping of irrigation systems, fields, and roads;
- Detection of areas with problem plants;
- Soil testing in specific field areas;
- Tractor driving with a parallel steering system;
- VRA for precise seed and fertilizer application.

II. **GIS Technology**

Geographic Information Systems construct maps, including digital ones, by combining item information and location data. Remote sensing is required to segment the farm into distinct zones. These zones are typically classified based on the soil type, available nutrients, soil moisture content, pH level, and pest infestation. GIS in precision agriculture enables farmers to see records, such as soil survey maps and plant features traditionally grown in the area. Aerial shots and satellite images add to the information. GIS's ability to compare and manipulate data layers to compare and contrast various farm management approaches is another useful capability.

III. **UAVs And Dusters**

Unmanned aerial vehicles (UAVs) are the foundation of aerial technology for crop management. As a result, farmers can keep an eye on the state of the yield without physically inspecting every field. Crop dusters appear to be the simplest option because farmers already use them for seeding and watering. Any agricultural aircraft can be equipped with a hyperspectral camera to capture the necessary data. However, it will result in an increased workload for crop dusters, who will be required in addition to the primary crop management chores. It will result in increased environmental contamination and quicker gadget wear. Precision agriculture might benefit greatly from the use of UAVs or drones. They require less fuel and can be managed remotely. Furthermore, precision agricultural drones can undertake in-depth multispectral, thermal, and hyperspectral soil investigations on the field.

IV. Remote Sensing

Remote sensing technology is a useful tool for collecting lots of data at once. It is the gathering of information remotely. Data sensors might be simple hand-held gadgets, aircraft mounts, or satellite-based systems. The use of remotely sensed data can be used to assess the health of crops. In aerial photographs, plant stress resulting from moisture, nutrients, compaction, crop diseases, and other issues with plant health are frequently visible. When used promptly, remote sensing can identify in-season variability that influences agricultural output and help managers make adjustments that will increase the profitability of the currently harvested crop. Although remote sensing technology collects a lot of data, it is difficult to pinpoint the key management factor because each field has different conditions, such as the timing and duration of midseason drainage, the amount and timing of nitrogen fertilizer application, and the timing of harvest. Geographic information systems (GIS) are ideal for this type of research.

Precision Farming's Scope and Adoption

Precision Agriculture for small farms can employ small farm equipment and robots that do not compress the soil and can run on ecologically friendly fuels such as bio-oil, compressed biogas, and electricity generated on farms from agricultural leftovers. Precision agriculture may involve sub-surface drip irrigation for targeted fertilizer and water application, weed control, harvesting, and other agricultural operations on small farms. Some of these robots are currently in use on small farms in the US and Europe, and they may soon be utilized extensively.

Precision agriculture may benefit small farms by utilizing robots for weed control, crop harvesting, and other tasks, as well as sub-surface drip irrigation for targeted water and fertilizer application. In a similar vein, drones have been made available in Japan and the US for mapping farms, spotting diseases, and other purposes. The majority of robotic devices and drones are portable, making them ideal for small farms. Therefore, India's tiny farms are perfect for the widespread adoption of precision agriculture.

The way forward

The creation of a large pool of engineers, scientists, and agriculturalists to create different components of the technology will be the most crucial step in moving precision agriculture forward. Precision Agriculture (PA) won't be successful without outstanding human resources and subsequently, good R & D. To create equipment like robots and drones for Precision Agriculture (PA), top engineers from universities like the IIT, NIT, etc. are also required. This can be aided by the development of a new field of engineering called agricultural Mechatronics or robotics, in which academics and students from ICAR institutes, IITs, businesses, and farmers combine to create intelligent PA systems.

Conclusions

With the use of Precision Agriculture (PA) systems, farmers in many developing nations, like India, have many opportunities to find better, higher-yielding crops that are specific to a given place. This results in the farmer becoming a breeder and creating better, higher-yielding kinds. The general adoption tactics of PA in developing nations have three components that have been identified: "single PA technology," "PA technology package," and "integrated PA technology." These strategic components' appropriate application industries have been identified. By assisting the rural poor to better their standard of living through high-tech farming, PA may offer a platform for industrial corporate social responsibility (CSR) action. Therefore, high-tech PA can contribute to the next green revolution in India and can generate enormous rural riches in a sustainable and environmentally responsible manner. A concerted effort should be made to harness new technical advancements to transform the "Green Revolution" into an "Evergreen Revolution" in light of the pressing need of the day.

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A CLOSER LOOK AT ONCIDIUM ORCHIDS: THE DANCING BEAUTIES IN THE GARDEN

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Aswini M S*

Ph.D scholar, Department of Plant Breeding and Genetics,

College of Agriculture, Vellayani,Thiruvananthapuram, Kerala

*Corresponding Author Email ID: aswinims89@gmail.com

Introduction

Oncidium orchids, an epiphytic sympodial orchid, also known as 'dancing lady' orchids, are a fascinating and visually stunning group of plants. It is called so because of their blooms resembles a lady dancing. With their vibrant colours, intricate patterns, and unique shapes, these orchids have captivated the attention of botanists and horticulturist's alike.It has an oddly lovely floral shape, and its hue is deep. Its decorative era is extensive. It is a crucial species for both cut flowers and terra cotta pots. Both its economic and ornamental value are exceedingly great. They have openly interbred. There are actually several hundred oncidium species that have been identified, but because the names are not stable, there is a lot of flux as scientists redefines plants.

Habitat and Distribution

Oncidium genus belongs to the family Orchidaceae is native to Central and South America. *Oncidium* are native to tropical and subtropical climates, making them easy to grow indoors or in a greenhouse. In addition to their captivating appearance, *Oncidium* orchids have specific requirements for their natural habitat and cultivation. Understanding the physical characteristics, natural habitat, and care of these orchids is essential for successfully growing and enjoying these remarkable plants(De, 2014). It is an important species of potted and cut flowers in the world. It has extremely high ornamental value and economic value. In the Oncidium subfamily, there are about 100 species of Chinese Orchids. Among them, Spider Orchids and Orchids are mainly used for breeding of *Oncidium*s.

The *Oncidium* family is very large and includes many flower varieties. They are familiar indoor and florist orchids for a very good reason, their large sprays of flowers often sag with dozens of blooms. They have been freely hybridized. There are actually several hundred recognized *Oncidium* species, but the naming is not stable, so there is considerable flux as experts reclassify plants.

One of the world's most diversified groups of orchids is the *Oncidium* genus, *Oncidium kramerianum*, which originated in Colombia and Ecuador, is one of the most well-known varieties. Due to its golden-yellow blossoms with brown flecks, this plant is known as the "butterfly orchid." *Oncidium* is yet another well-liked cultivar.



Figure 1, 2 &3. Various *Oncidium* varieties

The "Sharry Baby" variety of *Oncidium* is a different well-liked cultivar. From tropical sea level to the high Andean mountains, they can come from anyplace. Because of this, generalisations about cultures are challenging. They are frequently characterised as temperamental and challenging to cultivate. However, they may be grown very simply with the right care.

Propagation

They can be multiplied through division or by employing cuttings, and both methods are rather simple. Divide the clump into smaller pieces and transplant them in different pots when reproducing via division. Cut a stem just below a node and plant it in a pot with moist potting soil when propagating via cuttings. They are a fantastic option for both seasoned and inexperienced gardeners because they require little maintenance and are simple to spread. With the basal root, it is desirable to plant a plant that has at least two or three pseudobulbs. On benches, they are raised or elevated from the ground. Placing little particles of partially burned charcoal or dried coconut husk will help plants flourish.

Planting is done using a support for proper anchorage and is done above the medium.Another option for planting is to use pots or other containers. For planting, mud pots with a diameter of 10 to 20 cm that have multiple huge holes on the bottom and side and are filled with tile fragments, chopped coconut husk, or charcoal are utilised. For a few days, irrigation can be done using a clear solution of fresh cow-dung.

Light Requirements

Oncidium orchids are specific when it comes to light requirements. It depends on their growth stage as well as the time of day and season. When they are first starting to grow and blossom, they need direct sunlight for several hours per day. Once they start to blossom and give flowers, it's important to move your orchid to a cooler place without direct sunlight. Too much direct sunlight can actually burn blossoms. Generally, it's best to keep it in a semi-shady to semi-sunny environment.

At home, east or west windows are ideal. South windows will work but one should be careful of the brilliant sun that will come in during the fall through spring months. If we have miniblinds or sheer curtains, you can break the light so that it is more diffused. Many types of *Oncidium* will grow under artificial light, four fluorescent tubes supplemented with incandescent bulbs and placed 6 to 12 inches over the plants are necessary for proper growth. Metalhalide and sodium- vapour bulbs also provide sufficient light without needing to be so close to the plants. One of the best types of artificial light we can provide for theplants by using LED grow lights. If the leaves are turning much darker, check whether your plant is getting enough sunlight.

Temperature requirements

Oncidium can be found in many habitats, from semiarid subtropical lowlands to cool and misty cloud forests. Generally, the most popular which feature small yellow flowers, large pseudobulbs, and strappy leaves, are intermediate to warm orchids.Thus, ideal requirement are, Day temperature at 26-30° C and Night temperature at 13-16° C. We should not expose them to cold drafts or temperatures below about 10° C as that may cause the plant to slow its growth if exposed long.


Figure 4 &5. Different potting media for *Oncidium* orchids

A regular supply of *Oncidium* flowers to the market all year round has been constrained by lack of effective means for flowering modulation in Taiwan flower markets. Red *Oncidium* flowers and perfect flower shape with a pleasant fragrance are the atmostexpections of consumers. In addition, poor quality of planting materials due to somaclonal variations generated by micropropagation constrains the full expansion of the orchid industry (Hsiao *et al.*, 2011). Usually, *Oncidium* orchids flower twice per year from March to May, and from September to November. Cool nights are not required for *Oncidium* to produce flowers.

Water requirements

Overwatering as well as underwatering are common mistakes we do while gardening. Oncidium generally have different water requirements during different stages of their growth, but a rule of thumb is that they should generally differently water requirements during different stages of their growth, but a rule of thumb is that they should never be overwatered. *Oncidium*store water in their pseudobulbs, making them more tolerant of dry media than wet.

Generally, *Oncidium* orchids require the most water when they are starting to grow and beginning to blossom. This is the only stage in which they require relatively lots of water that should be provided. Once actually love water, but the trick is to provide adequate drainage. If not, the roots will drown, lose oxygen and rot. This will make the orchid die. For this reason, overwatering is not a good idea for these orchids. On the other hand, if noticed that the top compost is completely dry, it's usually a sign of watering again. The frequency of watering varies with respect to the media used, surrounding temperature and the ventilation provided. A way heck the mix for moisture is by sticking a wooden pencil into the mix about 3-4 inch. When we pull the pencil out, check the wooden end. If it has turned dark in colour, the mix is still wet and should wait a day or two. They prefer clean water without a lot of mineral content.

In the winter, reduce watering to bimonthly or less. They can withstand considerable drought because of their large pseudobulbs. Wrinkled pseudobulbs generally indicate lack of water. They need specific humidity levels, at least between 40% and 50%. However, these plants love humidity, so the ideal is actually between 55% and 75%. If we can't provide that, make sure that humidity levels never drop below 40%. The higher temperature rises, the higher must be humidity of the air, and the higher the humidity of the air, the more often and longer it is necessary to ventilate the room where the orchids are kept, otherwise there is a high probability of day and appearance on the leaves of various fungal diseases.

Blooming

Oncidium are magnificent in bloom. A large, well-grown plant might yield six or seven-branched sprays of yellow flowers. The effect is very much like a cloud of buttery butterflies. Although they are known for their yellow flowers, other varieties available. The *O*. Sharry Baby is sometimes called the chocolate orchid for its sprays of brownish flowers with a rich cocoa scent.Depending on the variety the flowering season can be at any time of year, but is generally heaviest in the fall and spring. Many hybrids can bloom 2-3 times per year. In order to initiate the flower spikes, it is important to grow the plant in an area where the night temperatures fall below 18° C. Usually plants growing by a window are a couple of degrees cooler branched sprays of yellow flowers. Usually, plants growing by a window are a couple of degrees cooler the rest of the house. The flower spikes generally grow to a medium or tall length and branch in several directions.

Fertilizer requirements

These types of orchids need enough food to thrive. It's therefore important to fertilize them regularly or they will be unhealthy. However, over fertilization is bad for your plant. If skies are cloudy, applications once a month are sufficient. Make sure to clean any salt deposits on monthly basis in order to avoid burning the *Oncidium* orchid's roots. On its growing phase, avoid excess usage of high phosphorous based fertilizers.

Recommended fertilizers:

Balanced fertilizer for growth: 20-20-20 (NPK) or 19:19:19(NPK)- 2 grams per litre of water is adequate for vegetative growth. Spray once in every alternative week. When the the plant overgrows its container or potting material deteriorates repotting must be done.They should be planted in bright but controlled sunlight because they need a lot of light to blossom. Throughout the growing season, they should be fertilised every two weeks and properly watered. They should never be allowed to dry out because they love to be kept slightly damp. $N:P_2O_5:K_2O$ 3:1:1 fertiliser can be applied during the vegetative phase, while 1:2:2 fertiliser can be applied during the flowering phase.On blooming periods (once in a month),high phosphorousfertilizer is adequate. Two times a week, a typical dose of this mixture is 2-3 g per litre of water.

Potting, media and propagation

These plants like to be slightly underpotted in a very free-draining bark-based potting media. Many they will form large clumps of pseudobulbs and develop into rather large plants. They can be easily divided into clumps when repotting. In general, only repot when necessary. Aggressive repotting can kill the orchids. *Oncidium* orchids have thin roots so repotting is a very delicate job. They repotted about once in every two years. Many *Oncidium* will form large clumps of pseudobulbs and develop into rather large plants. They can be easily divided into clumps when repotting.

Pests and Other *Oncidium* Related Problems

Aphids, orchid weevil, orchid bulb borer, orchid fly, mealy bug, scales, thrips and mites are the most common pests. Snail is the major threat and can be eradicated by hand picking them or by spraying salt solution around the garden premises.Fungal and bacterial diseases are common because of the levels of humidity and substrate they need to survive. Fungal agents cause problems like root leaf blights and spots on flowers.

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SWEET BITTER GOURD AND *M. cymbalaria*– NUTRITIONALLY IMPORTANT UNDEREXPLOITED ETHNIC CUCURBIT VEGETABLES

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Dr. P. Syam Sundar Reddy*, Dr. B. Hari Mallikarjuna Reddy and P. Sudheer Kumar Reddy (Ph.D. Scholar)

Department of Vegetable Science, College of Horticulture,

Dr.YSR Horticultural University, Anantharajupeta, Annamayya Dist. 516105

*Corresponding Author Email ID: syamhort@yahoo.in

Introduction

Cucurbits are vegetable crops belonging to family Cucurbitaceae, which primarily comprises 118 genera and 825 species. In India, 37 genera and about 100 species of cucurbits, including wild and cultivated, have been reported. About 60 cucurbit crops are grown in India and half of these are indigenous to India or Indian subcontinent. As a result, only 33 crops (10 main and 23 minor) of this enormous family are consumed as vegetable or salad crops globally or regionally. Cucurbits share 5% of the total vegetable production in India which includes indigenous cucurbits. Being the largest group of vegetables, cucurbits provide better scope to enhance overall productivity and production of vegetable to meet the challenges. The important indigenous cucurbit crops grown in India are cucumber, bitter gourd, ridge gourd, sponge gourd, pointed gourd, ash gourd, snake gourd, ivy gourd, long melon, round melon, snap melon and spine gourd. Though cucurbits are occupying a major place in vegetable crops and rich source of dietary fibre, vitamins and minerals, but proportionally very few crops of this family are known for medicinal properties in ethnic uses like *Cyclanthera pedata*and *Momordica cymbalaria*

1. Sweet bitter gourd or Methakarela (*Cyclanthera pedata*)

Sweet bitter gourd or Metha karela or (*Cyclanthera pedata)* also known as slipper gourd and more frequently used as stuffed cucumber, is a cucurbitaceous vegetable crop growing in the hills of West Bengal and Sikkim. It is an annual, monoecious, viny vegetable crop related to bitter gourd and cucumber. This crop is reputed to be bitter-free and sweeter. Crop also has various therapeutic characteristics that can be used to cure significant health concerns. Metha karela is a staple in practically everyone's kitchen garden in the region, and it's eaten in a variety of ways, including some unique traditional meals. Young sweet bitter gourd fruits are cooked as vegetables or eaten raw as salad. It has a cucumber flavour. Fruits are frequently filled with materials similar to stuffed peppers after the seeds and pulp have been removed. It has anti-inflammatory, hypocholesterolemic and hypoglycemic effects.

Nutritive value

It contains 94.1 g of water, 4.0 g carbohydrates, 14 mg Vit C, 0.6 g proteins, 0.1 g fats, 0.7 g fibre, 0.7 g ash, and 0.04 mg Vit B_1 per 100 g edible portion. Sweet bitter gourd provides17 Kcal of total energy.

Medicinal Significance

Cyclanthera pedata extract can be beneficial in decreasing the effect of LOX activity (tumour production and cancer spread). Because of its low in calories content in fruits, metha karela has also been discovered to be effective in lowering blood cholesterol, regulating fat metabolism, and weight reduction (Sukorno *et al*., 2019). *Cyclanthera pedata* is utilised in South America for its anti-inflammatory, hypoglycaemic, and hypocholesterolaemia effects (Montoro *et al*., 2005).

Origin & Distribution

Sweet bitter gourd is thought to have originated in the Caribbean area. It is now grown from Mexico to Peru and Ecuador, as well as in the old world tropics (India, Nepal, Malaysia, and Taiwan). Its cultivation in India is restricted to the highlands of the Western Himalayan areas of Himachal Pradesh and Uttaranchal.

Botany

Cyclanthera pedata shares a genus with *Cyclanthera brachystachia*. It is also edible and neutralised in the same locations as sweet bitter gourd. Plant is a robust annual vine up to 4-5 m tall, branching at the lower nodes, with leaves 8-18 cm wide and generally 5 lobed. For support, vines have forked tendrils. It is a monoecious perennial with a climbing habit that may also be cultivated as an annual. Fruit is pepo in shape, tapering flattened, obliquely oval, 10-15 cm long, 5-10 cm wide, and 2-3 cm thick.

Fruit skin can have scant spines at times. The fruit cavity is hollow, the fleshy peel is 3-4mm thick, and the interior tissue is a white spongy pulp with black-brown seeds.

Fig 1: Flowering and fruiting in Metha Karela (*Cyclanthera pedata*)

Cultivation Aspects

Metha karela is primarily propagated by seeds. Seeds can be grown in the hills of West Bengal from March to April, and the fruits can be harvested beginning in September and continuing until November. Metha karela requires warm, sunny weather and sandy-loamy soil to grow and flourish well. Because the crop belongs to the cucurbitaceous vegetable group, it has a viny growth pattern for which trellises made of bamboos are used to offer support to the vines in order to produce a decent yield. In general, in the hills of West Bengal and Sikkim, the topmost sections of bamboos are employed to offer support to vines, which replaces trellises and their building costs, which are fairly costly in that location.

Importance

Metha karela is consumed in many kinds of ways in the hills of West Bengal and Sikkim, including cooked, fried, pickled, and so on. Metha karela's traditional use as a vegetable cooked with dried meat or fish has its own significance in the local region's social structure. Fruits are also sun dried after being sliced into pieces, allowing for further crop utilisation during the off season. Crop is very important in meeting the local people's veggie demands. It has also been noticed that production of such crop is advantageous in enhancing the income of certain local producers since the immature fruits are traded at a decent price in local marketplaces. Due to its nutritional and medicinal properties most of the local people prefers to consume it as a healthy vegetable once or twice in a week during its time in a year.

2. Kasarakaya (*Momordica cymbalaria*)

In India, *M. cymbalaria* is known by the vernacular names Karchikai and Madagalikai in Kannada in Karnataka, Athalakkai in Tamil in Tamil Nadu, and Kasarakaya in Telugu in Andhra Pradesh and Telangana. *Momordica cymbalaria* is a small and underutilised tuber-forming cucurbit member of the Cucurbitaceae family native to India's Western and Eastern Ghats. Tribal farmers utilised the fruits and tubers in traditional medicine as well as vegetable food. Farmers in the home province are preserving this species for ethnic use as traditional knowledge.

Medicinal properties of *Momordica cymbalaria*

Due to its lack of popularity, the nutritional and economic relevance of this species has gone neglected. Potential hepatoprotective, cardioprotective, nephroprotective, and antioxidant capabilities (Jeyadevi *et al*. 2012). Tribal practitioners in Asia and Africa have employed the Momordica species in indigenous systems of medicine. Several studies have found that Momordica reduces the incidence of lymphoid leukaemia, lymphoma, choriocarcinoma, melanoma, breast cancer, skin cancer, prostate cancer, human bladder carcinoma, and Hodgkin's disease in those who exercise frequently (Basch *et al*. 2003).

Momordica cymbalaria fruit is utilised as a tonic with stomachic, stimulant, and laxative qualities. Diabetes, malaria, colic, sores and wounds, infections, worms and parasites, measles, hepatitis, and fevers are all treated with fruit juice and leaf tea. The anthelmintic characteristics of the fruit pulp, leaf juice, and seeds were discovered, and the root is used to cure constipation, indigestion, diabetes, diarrhoea, and rheumatism, as well as being astringent, abortifacient, and aphrodisiac (Fernandes *et al*. 2007). Furthermore, *M. cymbalaria* fruits have long been used in

Asian traditional medicine due to their wide range of bioactive compounds, including flavonoids, carotenoids, cucurbitacins triterpenoids, phenolic acids, and phytosterols, and tuber is used as an abortifacient medicinal property noted in ancient ethnic treatments(Jeyadevi *et al*. 2012).

Botany

Momordica cymbalaria is a thin, scandent, branching, and striated climbing annual or perennial plant. Behera *et al.* (2010) describe the fruits as 20-25 mm long, pyriform, with strong ridges reduced at the apex and the base narrowing into the curving peduncle. The plants were monoecious sex form, bears white flowers, and anthesis is between 11 and 12 AM, had symmetrical anthers, the plant generates tuberous roots, and ribbed fruits are the economically important parts, plants were propagated by round oval seeds with hypogeal germination process and tubers were also used for plant multiplication. *M. cymbalaria* earns a competitive price in the local market, resulting in a significant monetary advantage without any inputs. August and September are the peak harvest times.Harvesting does not necessitate any special abilities.While fruits that are 10–12 days old are best, olderfruits would be used through deseeding. Tendergreenfruits have a decent consistency and shelf life (Josephand Antony, 2008).

M. cymbalaria is on the verge of extinction due to anthropogenic-assisted habitat degradation, overexploitation without protection, and a lack of scientific understanding or record of development, propagation, and reproduction. In light of this, a preliminary field study was carried out to identify plant morphological properties for future breeding and genetic advancement programmes, as well as chemical and nutritious features of vegetable fruit for human consumption.

Fig 2: *M. Cymabalaria* plant

Nutritional properties of *M. Cymbalaria*

Minerals found in *M. cymbalaria* include potassium (505.92 mg/100 g), calcium (73.57 mg/100 g), sodium (41.58 mg/100 g), zinc (2.76 mg/100 g), and iron (1.71 mg/100 g), as well as ascorbic acid (299.12 mg/100 g), total carotenoids (2.81 mg/100 g), and lycopene (1.86 mg/100 g).

 

Fig 3: Flowering and fruits of *Momordica cymbalaria*

Propagation of *M. cymbalaria*

It is primarily propagated by tuberous roots and its method of propagation is asexual. The tubers emerge once the monsoon begins and go dormant throughout the summer dry times. Because seeds are black in colour, glossy, and hard, they are normally not utilised for propagation because the rate of germination is very low or insignificant. Tissue culture methods, when combined with various explants, can be beneficial for bulk multiplication. Studies for this aim have also been carried out with success. (Aileniaet *et al*., 2009).

Micro propagation

An overcoming the invitro propagation of *Momordica cymbalaria*. Leaf tips, stems, and nodal segments are utilised as explants in in vitro propagation. The use of nodal explants resulted in success. Leaf explants on MS media produced the greatest number of indirect regeneration of numerous shoots (9.0 +-0.5). Repeated subculturing of leaf callus on shoot regeneration media resulted in large scale shoot development (35+-3.4) shoots/explants. On hormone-free half-strength MS media, root induction was accomplished. Even while invitro propagation was successful, there was a poor proliferation rate in previous findings.

Future thrust

Indigenous and minor vegetables show very substantive biodiversity, are adapted to specific marginal soil and climatic conditions, and often can be grown with minimal external inputs. Diversifying current production systems with traditional vegetables will increase their heterogeneity and will subsequently lead to better resilience to abiotic and biotic stresses.

Research is needed to understand the potential opportunities and perceived constraints faced by poor smallholder farmers in cultivating indigenous vegetables to be able to devise adoption and dissemination strategies to best meet their needs. Relatively nutrient-dense indigenous vegetables have a potential role in improving human nutrition and addressing malnutrition problems and maintaining biodiversity and ensuring incomes for poor farmers.

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FOODBORNE POISONING IN ANIMALS: CAUSES AND DIAGNOSIS

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Anita Kumari Meena[1] and Deepak Kumar[2*]

1- PhD Research Scholar, Department of Animal production, MPUAT, Udaipur, Rajasthan

2-PhD Research Scholar, Department of Animal Husbandry & Dairying, ChanderShekhar Azad University of Ag. & Tech., Kanpur, Uttar Pradesh.

*Corresponding Author Email ID: dippymushal@gmail.com

INTRODUCTION

A balanced diet is very important in the animal husbandry industry due to the high food expense. Green fodder has been regarded the greatest animal feed owing to the lowest rate of nutrient supply, but due to the current terrible famine scenario, their availability has become highly limited. Due to a lack of water, the growth of the crops slows and the fodder begins to dry up, causing harmful substances to be created in the underdeveloped and withered fodder, resulting in food poisoning in the animals. In the lack of green fodder during famine, urea treatment is used to offer nutrients and other dry fibrous fodders. Inadvertently or unintentionally, by ingesting more urea-treated fodder when processing dry fodder treated with distance. Food poisoning can occur for a variety of causes that animal owners have no control over, however for some poisonings that occur often owing to a lack of understanding of animal husbandry, animal owners can take some measures and keep their animals away from their effects.

Types of Foodborne Poisoning

1. **Cyanide poisoning,**
2. **Nitrate poisoning**
3. **Urea poisoning**

1. Cyanide poisoning

Cyanogenic glucosides are found in plants. These glucosides are broken down by enzymes found in feed or rumen. When an animal is poisoned by cyanide, oxygen-carrying enzymes are disrupted, resulting in a shortage of oxygen to the body's tissues and death by asphyxia. Although there are several plants/fodders that might cause cyanide poisoning, the amount of cyanide in them varies depending on the season and the section of the plant consumed. Tides, Bajra, Chari, and other particular have sodium nitrite 3 g and cyanogenic glucoside in sodium circumstances owing to high thiosulfate 15 g, 200 ml of water, animals die as a result of their eating.

The farmer is prohibited from eating the sorghum and chari crops at the time of sowing due to the quantity of poison in the fodder, its condition, and the presence of nitrogen in the soil. Water shortage, among other things, affects how much urea or other fertilizer is used to grow feed. The amount of cyanide in such feed rises, especially in plants whose growth and development have halted owing to a lack of water, causing the leaves to dry out and become yellow. Animals that lack access to green fodder notice this food and consume it out of greed. Lacking knowledge, livestock owners begin feeding their animals withered and undeveloped jowar, millet, and chari in place of green fodder, which causes the animal to pass away.Animals that lack access to green fodder notice this food and consume it out of greed. Lacking knowledge, livestock owners begin feeding their animals withered and undeveloped jowar, millet and chari in place of green fodder, which causes the animal to pass away.

Within 10 to 15 minutes of a rapid overdose of cyanide-containing feed, an animal experiences poisoning symptoms. The animal becomes agitated, and saliva starts to flow from its mouth.Because of the consumption of such four, it appears that the animal has trouble breathing and must breathe through its lips.Due to excessive weakness, the animal's muscles spasm and hurt, causing it to tumble to the ground in a lethal cloud of hydrocyanic acid.The mouth has a bitter almond odour. The blood turns a vivid crimson color.At the moment of death, there is moaning and suffering that seems like suffocation.

Treatment:

1. Give 200 ml of water mixed with 3 grammes of sodium nitrite and 15 grammes of sodium thiosulphate intravenously as soon as symptoms of cyanide poisoning appear.

2. The farmer is prohibited from eating the sorghum and chari crops at the time of sowing due to the quantity of poison in the fodder, its condition, and the presence of nitrogen in the soil. Water shortage, among other things, affects how much urea or other fertilizer is used to grow feed.
3. In particular, plants whose growth and development have halted owing to a lack of water, whose leaves have dried out and become yellow, have more cyanide in them. Animals that lack access to green fodder notice this food and consume it out of greed. Lacking knowledge, livestock owners begin feeding their animals withered and undeveloped jowar, millet, and chari in place of green fodder, which causes the animal to pass away.
4. Only provide the animals with well-irrigated jowar and chari as green food. Feed the animals the standing crop after two to four showers. 'Hey' can be made from feed that has been contaminated with cyanide.
5. After allowing the cyanide-affected feed to dry for a while, adding molasses to it and giving it to animals as silage also lessens the poison's effects. Useless, yellow, and dried-up tiny plants should not be used as feed.

2.Nitrate toxicity:

Consuming feed that has a lot of nitrates might result in nitrate toxicity. The amount of nitrate in fodder is often rather low, but when nitrogen-containing fertilizers are applied to the soil in excess, the amount of nitrate in the green fodder—especially maize, oats, Sudan grass, etc.—that is grown there rises.

Nitrates are transformed into the very lethal nitrites as a result of a sudden excess of feed or water containing high levels of nitrates. Haemoglobin is changed to Methaemoglobin by the enzyme 5, which prevents oxygen from reaching the body's tissues. On a dry basis, nitrogen is the only one of the four that is safe up to 0.15 percent, whereas nitrogen over 0.45 percent is exceedingly poisonous.

Symptom:

1. The respiratory and heart rates of the animal rise in nitrate poisoning cases.
2. The animal maintains its mouth open while turning its head towards the stomach.
3. The blood turns chocolate dark during the acute stage of poisoning, and the animal passes away within one to four hours.

Treatment:

1. 50–100 ml of a methylene blue solution at 1%.
2. The medication needs to be injected right into a vein.
3. Depending on body weight, ascorbic acid 5 mg should be administered intravenously.

3. Urea poisoning:

Urea poisoning is one of the most typical forms of toxicity seen in ruminants, notably cattle and buffaloes. Ruminants have been fed urea and other non-protein nitrogen compounds for more than a century as a less expensive option to animal and vegetable proteins. The rumen's microbes can use the nitrogen released from urea as ammonia to aid ruminants in synthesizing protein. The animal may then acquire this protein thanks to routine digestion and absorption processes.

Ammonia is absorbed into the circulation from the rumen when an excessive amount of urea is consumed. Ammonia is changed in the liver into urea, which is then eliminated by the kidneys. This pathway is easily overwhelmed and leads to poisoning when there is an excess of ammonia and urea circulating in the blood. Intentional urea usage in cow feed might be fatal and lead to severe losses in agricultural animals. Farmers should thus be knowledgeable about the quantity and method of urea addition in cattle feed and exercise caution in this situation.

Causes of urea poisoning:

1. excessive consumption of urea in a supplemented diet.
2. exposing animals that have never been exposed to urea in big doses.
3. Diets that are low in calories, poor in protein, and heavy in roughage have an unbalanced or excessive urea content.
4. a liquid supplement made of urea.
5. Urea separates from the supplement after transit.

Doses of urea supplement:

It is recommended that NPN make up no more than one-third of total nitrogen intake and that urea make up no more than 3% of the concentrate ration, or 1% of the total feed intake.

For cattle, toxic dosages range from 0.3 to 0.5 g/kg/day, whereas lethal doses range from 1 to 1.5 g/kg/day.

Signs of urea poisoning:

Clinical indicators of urea poisoning included agitation, withdrawal from food and liquids, suspension of ruminating, subnormal rectal temperature (98.5°F), teeth grinding, frothy salivation, nasal discharge, increased respiratory rate (60 per minute), dyspnea, coughing, increased heart rate (95 per minute), arrhythmia, muscle tremors, tympany, atony of rumen, and fluid-filled rumen felt on percussion. Near the urea supplement source, dead animals are commonly found.

Diagnosis of urea poisoning:

The most accurate diagnostic indicators are the history of urea access and the symptoms shown by living, ill animals. Lab blood tests aren't very helpful, and post-mortem investigations don't show any distinguishable changes.

Treatment of urea poisoning:

1. As a remedy, acetic acid was taken orally. A mature cow with ammonia poisoning should take 4 L of vinegar orally; this procedure may need to be repeated every 20 to 30 minutes until the symptoms go away.
2. After giving urea for 90 minutes, adding acetic acid doesn't seem to make much of a difference.
3. Fluid therapy was administered in order to dilute the blood's toxins.
4. Diuretics were used to treat oedema. Stomachic and live yeast extracts were given to stimulate appetite and digestion.
5. Cold water can be applied as a remedy.

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