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In This Issue

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Karonda: A gift from nature with immense precious in the nutraceutical and pharmaceutical industries

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Introduction

Karonda plant (*Carissa carandas* L., 2n=22), a member of the Apocynaceae family, is a resilient, evergreen shrub native to India, characterized by its spiny nature. Among the approximately 25 species within the *Carissa* genus, five are indigenous to India (*Carissa carandas* L, *Carissa spinarum* L, *Carissa congesta*, *Carissa edulis* and *Carissa grandiflora*). It thrives particularly well in regions such as Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar, West Bengal, and Maharashtra. In the monsoon tropical climate, this plant yields plentiful berry-sized fruits with a whitish-pink hue. These fruits are uncomplicated, succulent, and globular, measuring 14-18 mm in diameter. When ripe, their thin epicarp takes on a maroon tint against the whitish-pink backdrop. The mesocarp, while not particularly juicy, is soft, moist and pleasantly acidic.

The karonda fruit is well-known for its abundant nutritional content, boasting high levels of vitamin C, vitamin A, dietary fiber, carbohydrates, lipids, proteins, essential micro-elements, and various antioxidants like phenols, DPPH scavenging activity, flavonoids, tannins and anthocyanins. Moreover, it is reputed to exhibit anti-inflammatory and antimicrobial characteristics. This plant is extensively utilized by tribes across India and is esteemed in diverse indigenous medical traditions such as Unani, Ayurveda, and Homoeopathy. Historically, it has been employed to address ailments including scabies, intestinal worms, diarrhea and intermittent fever, and is renowned for its purported aphrodisiac, antipyretic, appetizing, scurvy preventing, anthelmintic and astringent qualities.

Karonda is a delightful appetizer, often preserved by pickling before it fully ripens. Due to its significant pectin content when ripe, karonda fruit is also prized for making jelly, jam, squash, sauces, pies, syrup, tarts and chutney, all of which enjoy high demand in the international market. *Carissa carandas*, being exceptionally rare and resilient to drought, thrives well in tropical and subtropical climates. It prefers moderate rainfall and avoids waterlogged conditions. It can be cultivated in various soil types, including saline and sodic soils.

Fig. Immature, mature and ripened fruit of *C. carandas*

1. Nutraceutical Profile

The *Carissa carandas* fruits boast a wealth of fibers, lipids, proteins, carbohydrates, as well as essential macro and micro-nutrients crucial for fortifying bones and supporting the normal functioning of the heart, kidneys, muscles and nerves. These fruits are packed with beneficial compounds that not only enhance taste but also extend the shelf life of food products. When ripe, they are enjoyed fresh or utilized in the creation of high-quality cakes, ice cream, jams, squash, and jelly, imparting a flavor akin to gooseberry. Conversely, unripe fruits are employed in the preparation of chutney, pickles, and candies. Additionally, ripe *C. carandas* fruits are recognized for their utilization as a natural food colorant and nutraceutical supplement in lime sharbat, known as "Lalima".

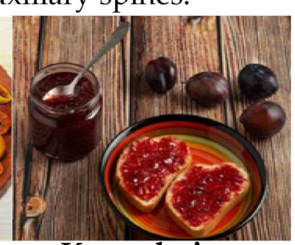
Table. Nutritional profile of karonda fruits

Components	Values	Components	Values
Energy (kcal)	42, 364	Reducing sugar (mg)	41.5
Moisture (%)	88.70	Ascorbic acid (mg/100 g)	62.93
Ash (%)	0.78	Anthocyanin content	12.18, 50.09
Total protein (%)	2.14	Calcium (mg/100 g)	1.60, 2.92
Dietary fibre (%)	1.81, 15.64	Magnesium (mg/100 g)	5.2
Crude lipids (%)	10.0	Phosphorus (mg/100 g)	24.15
Carbohydrates (%)	67.1, 2.9	Iron (mg/100 g)	39.2
Total sugar (g)	11.58, 0.04	pH	6-8
Non-reducing sugar (mg)	4.25	TSS	5.6°Brix

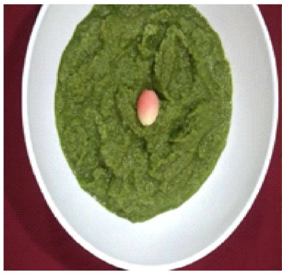
2. Traditional uses

The plant is often utilized as a seasoning or addition in Indian cuisine, spices and chilled beverages. Its leaf extract is applied externally for treating leprosy. Sweeter varieties may be consumed raw, while more acidic ones are preferable when stewed with ample sugar. The unripe fruit serves as a good appetizer and possesses astringent, antiscorbutic, cooling, acidic, stomachic, and anthelmintic properties. Decoctions of its leaves are administered in the treatment of remittent fever. Combining two drops of plant oil with half a cup of honey is recommended for controlling minor worm infestations. Karonda finds widespread use in the production of pickles, jelly, jam, squash, syrup and chutney on an industrial scale. When cooked, the ripe fruit releases a sticky latex, but upon cooling, it produces a vibrant red juice that serves as a refreshing summer beverage. It can also be used as a substitute for apples in recipes like apple tart, where it's flavored with cloves and sugar. In various regions of India, it's common to pair the fruit with green chilies for a flavorful dish eaten with chapattis. In Konkan, the fruit's root is mixed with horse urine, lime juice, and camphor to create a remedy for itchiness. In northern India, the fruit is utilized to make condiments, pickles and syrups, often pickled with hot green chilies and garlic cloves to enhance its naturally sour taste and impart health benefits. Additionally, Karonda plants can be cultivated into an effective hedge or bio-fence due to their auxiliary spines.

Karonda pickle



Karonda jam



Karonda chutney Karonda biofencing

3. Pharmacological profile.

The fruits of *Carissa carandas* contain a diverse array of phytochemicals, which contribute significantly to its medicinal properties. These bioactive compounds are present in the fruits, leaves, and roots, collectively providing valuable medicinal benefits to the plant.

4.1 Antiviral activity: The alcoholic extract derived from the fruit of *C. carandas* demonstrates potent antiviral properties, with effective inhibition observed against poliovirus at 6 µg/ml, HIV-1 at 3 µg/ml, and Sindbis virus at 12 µg/ml.

4.2 Antimicrobial activity: The ethanol-based extract derived from fruit exhibits potent antibacterial effects against various test bacteria such as *B. subtillis, S. aureus, E. coli, S. faecalis, S. typhimurium* and *P. aeruginosa*. Additionally, this extract demonstrates significant anti-candidal properties.

4.3 Anti-malarial activity: The anti-malarial potential of methanolic and aqueous extracts derived from the leaf, stem bark, and fruit of C. *carandas* was investigated against the *Plasmodium falciparum* 3D7 strain. Both extracts showed promising anti-malarial activity, with IC50 values ranging from 41.52 to 100 µg/mL for the aqueous extract and 13.57 to 69.63 µg/mL for the methanolic extract. Additionally, cytotoxicity analysis conducted on the Madin-Darby canine kidney cell line using the MTT test revealed no cytotoxic effects even at the highest tested dose.

4.4 Anti-oxidant activity: C. *carandas* has been identified as possessing remarkable antioxidant properties. Findings indicate that among the tested samples, C. *carandas* fruit extract demonstrated the highest antioxidant potency, displaying exceptional reducing power and effective scavenging activity against Nitric oxide, DPPH and peroxide radicals.

4.5 Anti-diabetic activity: The anti-diabetic potential of an aqueous extract derived from C. *carandas* leaves was assessed in both alloxan-induced diabetic and normoglycemic Wister rats. The study revealed that doses of 500 and 1000 mg/kg of the extract significantly ($P<0.05$) decreased blood glucose levels in alloxan-induced diabetic rats at 4, 8 and 24 hours post-administration. Additionally, the anti-diabetic effects of methanolic extract and its fruit fractions were investigated in alloxan-induced diabetic rats.

4.6 Anticancer activity: The anti-cancer activity of extracts from C. *carandas* fruits in chloroform, n-hexane, and methanol was investigated against lung cancer cells and human ovarian carcinoma cells, revealing promising results. Additionally, the extracts were evaluated for their anti-cancer and antioxidant properties using unconventional antioxidant enzymes such as catalase, dismutase, superoxide, glutathione-s-transferase, and glutathione on MCF-7 cancer cell lines. This research demonstrated notable antioxidant activity and enhanced cell death in MCF-7 cell lines following pretreatment with C. *carandas extracts*.

4.7 Antinociceptive Activity: The methanolic extract derived from C. *carandas* leaves, administered at doses of 50, 100, 200 and 400 mg/kg, demonstrated notable antinociceptive effects in a gastric pain model using Swiss albino mice, induced by acetic acid.

This extract led to a reduction in the number of writhings compared to aspirin, a standard antinociceptive drug, particularly at doses of 200 and 400 mg/kg.

4.8 Anti-inflammatory: The methanolic extract obtained from C. *carandas* leaves demonstrated a reduction in edema provoked by histamine, carrageenan and dextran in the hind paws of rats at a dosage of 200 mg/kg body weight. It showcased significant inflammation inhibition, achieving a maximum reduction of 72.10%, 71.80%, and 71.90% after 3 hours in histamine, carrageenan, and dextran-induced rat paw edema, respectively.

4.9 Cardiovascular activity: The roots of C. *carandas*, when extracted with ethanol, demonstrated cardiotonic effects and effectively reduced blood pressure. This cardiac influence is attributed to the presence of water-soluble glucosides called odorosides. Administering a dose of 45 mg/kg via intraperitoneal injection resulted in a notable 50.75% reduction in arterial blood pressure (significant at $P<0.001$), accompanied by a significant decrease in heart rate frequency. Additionally, it was observed that the ethanol extract of the plant exhibits strong hypotensive properties in normal rats.

4.10 Anthelmintic activity: The in vitro anthelmintic effectiveness of fruit extract C. *carandas*, dissolved in petroleum ether (60-80), ethanol and chloroform at concentrations of 50, 100, and 150 mg/ml respectively, was assessed on *Pheretimap asthma* worms by measuring the time it took for paralysis and subsequent death of the worms. Piperazine Citrate (15 mg/ml) served as the control drug. The study concluded that the C. *carandas* fruit extract induced paralysis and eventual death in the earthworms.

Conclusion

In conclusion, the karonda fruit displays substantial promise as a rich source of nutrients and antioxidants. Recognized as a valuable addition to the array of tropical fruits, it boasts diverse applications. Throughout history, the fruits of this plant have held a significant place in human diet and traditional medicine, particularly in rural and tribal communities, spanning millennia. However, its demand remains restricted primarily due to insufficient awareness regarding its nutritional value, uses, and the absence of organized supply chains. Hence, establishing large-scale cultivation facilities becomes imperative to ensure ample quantities are accessible for effective market promotion.

Reference

• Dalal, R. P., Thakur, N.A. and Singh, A. (2010). Nutritional value of Karonda (*Carissa carandas Linn*). A non-conventional fruit under semi-arid condition of Punjab. Indian J. Agrofor., 12, 102-104.

• Jain, S. K. (1991). Dictionary of Indian folk medicine and ethnobotany. *Deep publications*.

• Sarma, A., Sarmah, P., Kashyap, D., Dutta, S. and Mahanta, M. (2015). Antioxidant activity and nutraceutical property of the fruits of an ethno-medicinal plant: *Carissa carandas* L. found in Brahmaputra valley agro-climatic condition. *Journal of Pharmaceutical Sciences and Research*, 7(2), 55.

• Singh, K. K. and Singh, S. P. (2021). Karonda: A Medicinal Plant with Immense Economic Potentials. E*nergy (Calorie*), 42: 364.

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Navigating New Threats: Exploring the Impact of Climate Change on the Surge of Fungal Pathogens

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Introduction

Climate change, defined by the United Nations Framework Convention on Climate Change as human activity altering the global atmosphere, poses the biggest threat to mankind, causing nearly 0.4 million deaths annually and costing over 1.2 trillion US dollars. With a 0.74°C average global temperature increase in the last century, agriculture is severely impacted, affecting crop growth and cultivation. This leads to the emergence of new plant pathogens, threatening food security. India experiences varied warming and cooling trends regionally, impacting rainfall patterns and crop growth. Climate change fosters the evolution of pathogens, increasing their virulence and geographic range. Environmental disruptions like floods and storms disperse fungi, causing infections by previously rare species. These effects underscore the need for predictive models to assess pathogen severity in real-field conditions amidst changing climates.

Proposing the Existence of a Recently Discovered Fungal Species Linked to Climate Change

Candida auris which was initially discovered in 2009 during an ear infection case in Japan, C. *auris* has swiftly disseminated globally, documented on every continent. Despite its widespread prevalence, there is limited knowledge about the origins of C. *auris*. Its phylogenetic relatives have been found in environmental samples, suggesting a potential nonhuman reservoir, possibly dispersed by birds. While the yeast is considered the first "novel" pathogen believed to have evolved due to climate change, this assertion remains speculative, awaiting conclusive evidence. Alternative hypotheses propose its emergence through expanded farming and aquaculture, leading to heightened human contact or environmental contamination with fungicides C. *auris* poses significant challenges in healthcare settings, where it colonizes and sparks nosocomial outbreaks. Notably, the yeast exhibits remarkable resistance to antifungals and disinfectants. Fortunately, C. *auris* demonstrates relatively low virulence, primarily affecting individuals with severe comorbidities. Genomic analysis has identified four major clades associated with specific geographic regions: clade I (South Asian), clade II (East Asian, primarily infecting the ear), clade III (South African), and clade IV (South American). Understanding the complexities of C. *auris* and its various clades is crucial for effective management and mitigation strategies.

Emergence of Highly Virulent Fungal Lineages (Adaptations Indicative of Evolutionary Response to Climate Change)

Puccinia striiformis (Rust fungus)-Stripe rust, caused by the fungus *Puccinia striiformis*, stands as one of the most devastating global diseases affecting wheat. Traditionally prevalent in colder regions, wheat yellow (stripe) rust, specifically caused by *Puccinia striiformis f. sp.tritici* (Pst), has recently exhibited a notable shift towards invading warmer climates. Since the year 2000, there has been a documented adaptation of Pst to elevated temperatures. This adaptation is marked by the emergence of novel and more aggressive strains, namely Pst1, Pst2 and "Warrier," which demonstrate increased thermo tolerance. These newly evolved strains have not only supplanted older variants but have also expanded their geographical reach. The global dispersion of these strains has been widely observed, leading to significant outbreaks in regions such as the south-central United States and Australia. The prevalence of major outbreaks indicates the enhanced adaptability and aggressive nature of the Pst1 and Pst2 lineages. Microsatellite genotyping and virulence phenotyping studies have uncovered substantial variability within these lineages, underscoring the ongoing evolutionary potential of the *Puccinia striiformis* pathogen. The dynamic nature of these adaptations raises concerns about the continued impact of stripe rust on wheat crops worldwide and necessitates vigilant monitoring and research efforts for effective disease management strategies.

Fusarium Head blight- Fusarium head blight (FHB) poses a significant threat to wheat and other cereal crops, raising considerable concern within the agricultural community. This disease, caused by members of the *Fusarium graminearum* species complex (FGSC), results in diminished cereal yield and quality, with consequential adverse effects on food security. FHB outbreaks are particularly rampant during years characterized by warm and humid weather conditions, often leading to staggering yield losses, reaching up to 75%. Over the past two decades, certain temperate regions have witnessed a noteworthy transition from *Fusarium culmorum*, associated with cooler and wetter climates, to F. *graminearum*, which thrives in warmer, humid conditions. Notably, F. *graminearum* displays a higher level of aggressiveness compared to F. *culmorum*, correlating with increased yield losses. Consequently, the severity of Fusarium head blight is anticipated to escalate in future warmer climates. Adding to the complexity, F. *graminearum* is known to produce more mycotoxins and there is evidence suggesting that their production amplifies with rising temperatures and water stress. This aspect raises concerns about potential repercussions on both human and animal health. The intricate interplay between climate conditions, fungal dynamics and mycotoxin production underscores the necessity for proactive measures to address the evolving challenges posed by *Fusarium* head blight in the context of changing environmental conditions.

Impact of climate change on pathogen

Impact of increased CO_2 concentration on pathogen: While both positive and negative effects of elevated CO_2 levels on plant diseases have been reported, a noticeable trend indicates an overall increase in disease severity in the majority of cases. This observation has led to the hypothesis that the concurrent rise in CO_2 levels and climate change contributes to the proliferation of pathogenic microbes. Elevated CO_2 levels are believed to stimulate the growth of plant branches, leading to an augmentation in biomass production. Additionally, plant litter decomposition tends to slow down under elevated CO_2

conditions. The combination of increased plant biomass, delayed litter decomposition and higher temperatures creates an environment conducive to enhanced pathogen survival. This, in turn, creates microclimates that are more favourable for the growth of various pathogens such as rusts, mildews, leaf spots and blights. Notably, the rate of barley leaf infection by *Erysiphe graminis* and the expansion of the latent period after infection in *Maravalia cryptostegiae* have been observed to decline under elevated CO_2 levels. These altered microclimatic conditions are particularly conducive to the development of biotrophic fungi, increasing the likelihood of infections. Furthermore, the combination of elevated temperature and CO_2 levels has been associated with the mutation and subsequent evolution of new pathovars (pathotypes). Plants grown under such conditions exhibit increased photosynthesis and/or enhanced water and nutrient use efficiency. These findings underscore the complex interplay between environmental factors, plant health and the dynamics of pathogenic micro-organisms, highlighting the need for a comprehensive understanding of these interactions in the context of changing climatic conditions. The impact of elevated CO_2 levels extends to the modulation of stomata opening and leaf metabolism, leading to a reduction in leaf infection and disease severity caused by pathogens entering through stomata. The altered physiological responses under elevated CO_2 conditions contribute to enhanced plant resilience against certain diseases. In the case of soybean, elevated concentrations of both CO_2 and O_3 have been found to influence the expression of downy mildew and brown spot, showcasing a varied plant response. This suggests a complex interplay between atmospheric gases and the susceptibility of soybean to specific pathogens. Similarly, in barley, higher CO_2 concentrations have demonstrated an improvement in resistance to powdery mildew. This phenomenon highlights the potential for elevated CO_2 levels to confer a protective effect against certain diseases, although the specific mechanisms underlying this enhanced resistance may vary across plant species and pathogens. Understanding the intricate relationships between atmospheric conditions, plant physiology and pathogen interactions is crucial for predicting the overall impact of climate change on plant diseases. Further research is essential to unravel the specific molecular and physiological mechanisms responsible for the observed changes in disease resistance under elevated CO_2 conditions.

Impact of temperature on pathogen: The germination of *Puccinia substriata* spores exhibits an upward trend with increasing temperatures. Disease development, characterized by the initiation, germination and proliferation of fungal spores, accelerates under conditions of elevated moisture and temperature. A notable consequence of rising temperatures is the shift in leaf spot disease affecting sugar beet, attributed to an increase in the annual mean temperature by 0.8-1°C in Lower Saxony. In regions with a low productivity index, wheat crops face challenges from common bunt (*Tilletia caries*) and Karnal bunt (*Tilletia indica*) under changing climatic conditions, particularly in the absence of proper seed treatment. The disease landscape for certain pulses has undergone significant transformations over time. In India, dry root rot of chickpea caused by *Rhizoctonia bataticola* and blight of pigeon pea caused by *Phytophthora drechslerif. sp. cajani* have emerged as major threats to production in response to altered climatic conditions. Furthermore, there is an increased risk of dry root rot disease in chickpea varieties resistant to Fusarium wilt, particularly in conditions with temperatures exceeding 33°C. Different temperature regimes exert varying effects on virulence-resistance interactions in chickpea and lentil induced by *Ascochyta*. During the pea cropping seasons of 2005 and 2006, the presence of 14 days with temperatures surpassing 25°C, specifically during flower pollination and fruit ripening, significantly reduced productivity. These observations underscore the dynamic relationship between temperature fluctuations, pathogen behaviour, and crop productivity, emphasizing the need for adaptive strategies in agriculture under changing climatic scenarios.

Impact of alteration of moisture regime on pathogen: Moisture plays a pivotal role in shaping the intricate interactions between hosts and pathogens in the plant environment. Elevated temperatures, combined with ample soil moisture, create a humid environment that becomes conducive to the proliferation of pathogens. Pathogens adapted to thrive in such humid conditions exhibit enhanced disease potential. The evapo-transpiration rate rises with increasing temperatures under sufficient soil moisture, leading to the development of a humid microclimate that attracts and supports diseases. Fungal pathogens responsible for late blight and apple scab disease have been reported to cause more infections under higher moisture content. Conversely, certain pathogenic fungal species causing powdery mildew disease thrive in lower moisture conditions. The high relative humidity beneath canopies, promoting prolonged leaf wetness, significantly elevates the risk of pathogenic infections and subsequent disease incidence. For instance, late blight of solanaceous plants, affecting tomatoes and potatoes and caused by *Phytophthora infestans*, is most prevalent at high moisture levels and temperatures ranging between 7.2°C and 26.8°C. Similarly, foliar diseases and some soil-borne pathogens become more susceptible to high moisture conditions. Under climate change, certain fungal pathogens may gain significance due to dry conditions. For instance, drought conditions can favour dry root rot disease and powdery mildew disease in legume crops. Additionally, *Armillaria sp*. demonstrates increased virulence and infection potential during drought conditions, a departure from its non-pathogenic nature under normal weather conditions. These observations underscore the dynamic and multifaceted impact of moisture on the complex interplay between plants and pathogens, highlighting the need for nuanced management strategies under varying environmental conditions.

Conclusion

In the absence of significant measures to curtail carbon emissions, the trajectory of global temperature rise is expected to persist, leading to increasingly severe impacts of climate change. Fungi, as dynamic and adaptable organisms, are poised to exert continued influence on crops and native plants, expanding their ecological range and engaging in long-distance dispersal events that introduce new risks. To address these evolving challenges, there is a pressing need for the reassessment of cultivation practices, pesticide usage, and biological control strategies. This includes a critical review of stress-resistant crop varieties and the development of innovative tools and tactics. Emerging approaches, such as stress-tolerant varieties and integrated disease management programs, have demonstr-ated success in enhancing biomass and productivity within the context of climate change.

Redirecting research efforts towards areas prone to endemic disease occurrences becomes imperative. This involves a comprehensive exploration of the biology of both hosts and pathogens, along with an assessment of the economic impacts associated with escalating climatic risks. Improved disease management strategies should be a focal point and a commitment to anticipatory research is crucial for developing disease-resistant crop varieties tailored to combat emerging pathogens. This necessitates an integrated approach, involving multidiscip-linary teams working collaboratively, to forge more effective strategies in the face of evolving climatic conditions.

References

• Nnadi, N.E. and Carter, D.A. (2021). Climate change and the emergence of fungal pathogens. PLos Pathog 17(4): 1009503.

• Pathak, R., Singh S. K., Tak, A. and Gehlot, P. (2018). Impact of Climate Change on Host, Pathogen and Plant Disease Adaptation Regime: A Review. Biosci Biotech Res Asia, 15(3).

• Gautam, H. R., Bhardwaj, M. L. and Kumar, R. (2013). Climate change and its impact on plant diseases. Current Science, 105(12), 1685–1691.

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Contract Farming and Indian Agriculture: A Prospectful Horizon For Agribusiness

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Introduction

The fundamental aim of Agriculture is to get maximum output by minimum input. So the basic philosophy liesto increase the output-input ratio, or increasing the output from a particular level of input by using technology or decreasing the input cost. In the countries of the world where government is run by socialist or communist philosophy, the government tries to incur the cost and to have an amount for the post-production scenario for further cultivations, which is obtained from the profit of the previous cultivating season. But in compliance with post-LPG reforms and the capitalistic motives of the companies, it has been essential to have a higher amount of profit. For this particular reason, the concept of contract farming has been popularized in so many regions of the country. Although the concept of contract farming was first implemented in India in 1920s, but during the first few Five Years Plan (FYPs) the concept was not highly implemented for the socialist views of the then government. But in later times, in compliance with the socioeconomic condition and business motives of the sponsoring companies, contract farming has been very popular and used concepts. As in most of the cases, the task of marketing is carried out by the companies as per the agreement–hence it is also known as contract marketing.

Concept of Contract Farming

Contact farming can be defined as a pre-established agreement between the farmers and agri-business company regarding the production and marketing, where farmers are given the task of production and the marketing of the products is the responsibility of the particular company. In lieu of the production and farming practices, farmers are given the payment for the cost they have incurred and the human labour they have sacrificed. On the other side, companies take the responsibility of marketizing of all the products with proper promotion and try to secure a profit margin from the supply side.

The company helps the farmers regarding the supply of inputs, technical advises, experts suggestion, extensive activities, guidelines regarding cultivation and growing, suggestion for taking proper insecticides, pesticides with correct time scheduling, prescription of fertilizers of hormone as per crop and soil, locally available materials, soil testing labs, research and development (R&D) etc. to ensure the quality and quantity level.

Advantages for Farmers

• They get prepared suggestions regarding inputs and production services. This knowledge helps them to enhance the quality and train them for a better performance in upcoming season.

• They get to know about newer technologies an opportunity of learning new skill.

• An important approach of contract farming is the distribution of risk. At earlier times the amount of risk is to be carried by the farmer as they are the producers and marketers both. But in contact farming the farmers are the producers hence they carry the marketing risk whereas the company, which is the processor, bears the production risk.

• Better marketing opportunity for the farmers

• Insurance of price

• Higher production for better equipment, inputs and technology

• Reduction in marketing costs due to higher production.

• High quality guidance from research and development sale at free of cost.

On Agribusiness Company Side

• For working with small farmers there is no land constraint, as in most cases land are owned by the farmers.

• Due to distribution of risk, agri-business company carries only the production risk, where is the farmer counterpart carries the marketing risk only.

• In most of the land issues, political instability is a major constraint and Socio-political issues arise for it. But contract farming is both politically acceptable and socioeconomically preferable.

• Quality supply of the product at right cost

• A very good way to channelize private investment in agriculture activities.

• As Agriculture Income is not taxable, (due to nil Agriculture Income Tax law of Central Government) overhead cost is minimum and taxation burden is less.

• A very effective way of linking small farmers ecosystem with profitable business ventures, startups which result into mutual progress and development.

Disadvantage for farmers

• While growing new crops or un-experienced cropping patterns, farmers fear about market failure and production irregularities.

• If there is any inefficiency in management or operations of marketing, it is to be faced by the farmers because they are the producers.

• Contracting companies may be unreliable or can be of exploitive nature. The same practice happened in case of Indigo cultivation where British East India Company compelled farmers to cultivate and plant Indigo instead of cereal crops and forced them to sale at a fixed price considered by the company itself.

• If the company is profit centric, they can be corrupted in allocation of quota among the farmers.

• Contract farming is involved mostly in case of cash crops, not popular in case of cereals or pulses.

• Higher focus of contract farming on cash crops may lead to reduction in food security, biodiversity or normal growing seasons and their cycle

• Market making outside the country may lead to market breaking inside the country (which is already established and autonomously going on).

• There should be a good scrutiny of the contract policies and papers from government or government authorized department or officials, specially regarding legal terms and matter

From Agribusiness Company Side

• As farmers are habituated with producing particular products, they may not cope up with the customized demand of the company, [specially in case of 'make to order (MTO)', 'configure to order (CTO) 'or 'engineer to order (ETO)' level].

• Availability of land is a major problem. The same thing happened at Singur and Nandigram in West Bengal where industrial giants wanted to form business and industry over agrarian land.

• Poor management skill, improper consultation or negotiation capacity

• 'Extra-contractual marketing' is a major problem where farmers sale the products outside the contract. The company not only faces products shortage but can also face legal perils.

• Farmers may divert inputs for their own domestic usage.

Successful Implementation

The concept of contract farming in India is almost a century old. Earliest example of contract farming in India is the contract between Indian Tobacco Limited (ITC) and Andhra Pradesh for raising Virginia tobacco in 1920. Later in the recommendation of Johl committee for diversifying Indian farming, Punjab Government adopted contract farming (1990). The contract was between Pepsico company and potato farmers.

Other examples in Agriculture, Horticulture, Fishery, Dairy, Forestry, etc sectors are

Appachi - Cotton

Ugar sugar - Barley

Kerala Ayurved Pharmacy- Medicinal and Aromatic crops

Pepsi- tomato pulp by tomato growers of Punjab and Rajasthan

ITC and pulpwood growers of Punjab, Orissa, Andhra Pradesh, Uttar Pradesh.

Suguna Chicken- Broiler poultry farmers.

Organic products from merigold at Coimbatore.

NAFED and mushroom growers of Haryana

Gherkin growers of Bangalore

ITC Agrotech. for edible oil production from sunflower in Andhra Pradesh and Karnataka.

Conclusion

On a holistic scale, the future of contract farming is promising in India. Various companies are now interested to make contracts with farmers regarding agriculture and allied activities. In the recent case studies contract farming has been proved to provide a better profit margin and consistent income. In the post-covid situation agriculture has established a strong connectivity with business and industry through agro-based ventures of agribusiness companies. Also, various companies and business tycoons like Hindustan Unilever Ltd. United breweries, McQueen, Dabur, Mahindra, Tata Rallies, Mankind Agrotech etc., are organizing and developing contract farming in several corners of the country. It has also been proved as very successful in Punjab, Haryana, Maharashtra, Madhya Pradesh after various trials of crops in the terms of famous agricultural Universities business portfolios. Various post-harvest companies have been interested for cultivating their crops for production of sauce, ketchup, juice, syrup etc. In future, we can expect contract farming over basmati rice, pulse crops and oil seed crops for oil production, medicinal plants, piper, mint, flowers etc. Interestingly in 2003, the new model APMC Act, the aim for circulating and popularising contract farming was enshrined and consequently 21 States included the provision of contract farming in their schedule. Punjab was the first state to formulate their own contract farming act. In recent time, in 2018. The Union Ministry of Agriculture and Farmers Welfare has introduced a new law on Agriculture Produces and Livestock Contract Farming and Services Promotion on Facilitation Act along with special request to state governments for enactment of such laws to institutionalize contract farming. So contract farming is going to be the future of Indian agriculture along with opening of plethora of opportunities. The farmers, small farmers, Orchard owners, fruit growers, mushroom growers, dairy farm owners, fishery pond owners- all the rural as well as urban inhabitants depending on Agriculture will be benefited if they link themselves with private companies, firms aggregation, Farmer's Producer Organisations, co-operatives and other government or private bodies.

References

- Kadam M.K. (2018). A Textbook of Agribusiness Management. Kalyani Publishers.
- Acharya S.S. & Agarwal N.L. (2018). Agricultural Marketing in India. Oxford & IBH Publishing Co. Pvt. Ltd.

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Bioengineering Plant Defences: The Transformative Role of Synthetic Biology in Disease Resistance

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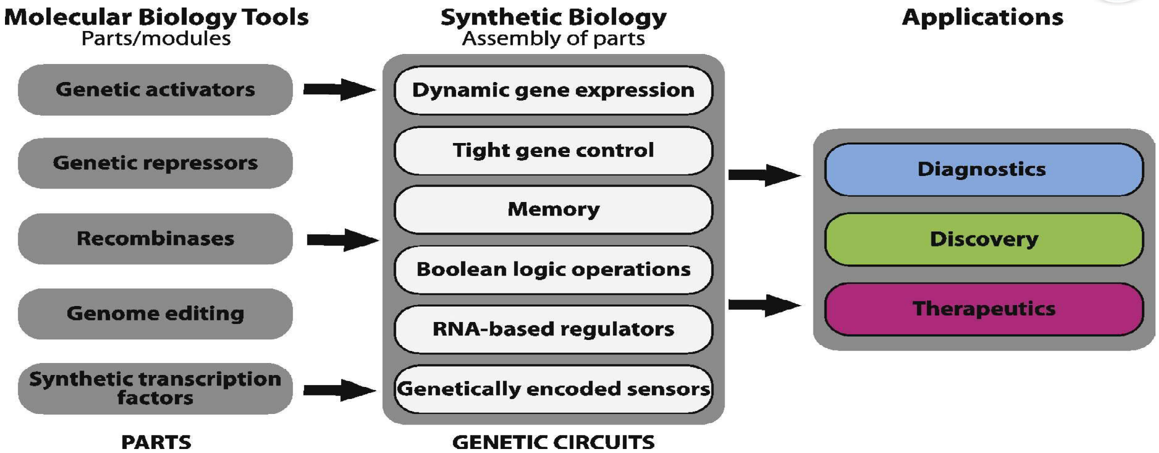
Introduction

Defining synthetic biology presents a challenge due to its broad scope, encompassing diverse methodologies aimed at manipulating living systems. At its essence, synthetic biology merges scientific and engineering principles to intricately design and fabricate novel biological components, devices and systems. Emerging in the late 2000s, it was propelled by the affordability and speed of DNA sequencing and synthesis, marking a paradigm shift in molecular sciences. This enabled the construction of complex multigene constructs and the synthesis of entire bacterial genomes, leading to initiatives like genome transplantation. Synthetic biology employs genetic engineering principles to modify natural systems or create artificial biological devices with predictable behaviors. CRISPR-mediated gene editing has enhanced crop traits, while synthetic biology often involves redesigning genetic components like promoters within constructs. Its ultimate goal is to induce transformative changes in organisms, utilizing advanced computational design to create synthetic DNA sequences and integrate them into plant genomes. Analogous to the DNA sequencing revolution, the emerging DNA synthesis revolution enables large-scale writing of DNA into genomes, expanding our capabilities significantly.

The progress in synthetic biology has paved the way for the engineering of cells equipped with genetic circuits, allowing the programming of cells to exhibit new biological behaviours, dynamic gene expression, and logic control. This evolution in cellular engineering introduces a diverse range of living sensors capable of discerning between different cell states. Moreover, these engineered cells can produce controlled doses of therapeutic biomolecules and operate across various delivery platforms.

Harnessing Genetic Engineering for *Striga spp*. Weed Control in Essential Cereal Crops

Members of the *Striga* genus, commonly known as witchweeds, pose a substantial threat to both monocot and dicot crop species, including staples like maize, sorghum, pearl millet and rice. *Striga* control remains challenging due to their dormancy until a host is present, making traditional breeding and weed management techniques inadequate. This article explores the potential of genetic engineering (GE) to address the complexities of *Striga* control, considering the diversity of crops and the non-specificity of *Striga* species. Detailing the difficulties in *Striga* control, including the dormant nature of their seeds and the initiation of germination upon detecting a host. The formation of haustoria, enabling nutrient and water acquisition, further complicates traditional control methods.



Applications of Synthetic biology and its tools in Plant Disease management

Highlighting the potential of genetic engineering for *Striga* control, acknowledging the need for diverse approaches due to the non-specificity of *Striga* species and the varying physiological responses of crops to parasitism.

Sorghum's Low-Germination Stimulant Allele (lgs)

Examining the success of the low-germination stimulant allele (lgs) in sorghum, which disrupts the strigolactone biosynthetic pathway, reducing the production of the *Striga* germination stimulant strigol. This mutation provides resistance without blocking the pathway entirely, thereby benefiting the host. Exploring successful RNAi gene silencing in other parasitic plants like *Cuscuta pentagona* and *Triphysaria versicolor*, preventing haustorial establishment and development on tobacco and lettuce, respectively. Assessing the varying outcomes of RNAi in maize and the potential of viral-induced gene silencing (VIGS) in silencing specific *Striga hermonthica* genes. Highlighting progress in producing reference genomes for parasitic species, enabling more targeted GE techniques to alter genes associated with parasitism. Discussing comparative transcriptome analyses that identified potential parasitism genes upregulated during haustoria development in Orobanchaceae species, including *Striga hermonthica*. Concluding with the ongoing determination of target genes to prevent or reduce *Striga* attachment, emphasizing promising outcomes in the quest for effective genetic solutions against these formidable parasitic weeds.

Genetic Engineering Applications to Control Insect Vectors of Plant Disease Pathogens

Aphids, thrips, whiteflies, leafhoppers, planthoppers and treehoppers play crucial roles as vectors for plant-pathogenic bacteria and viruses. Minimizing the impact of diseases transmitted by these vectors can be accomplished through two main strategies. Firstly, plants can be equipped with resistance to the pathogens, achieved through traditional breeding methods or innovative transgenic approaches. Secondly, an alternative approach involves suppressing the pathogens by enhancing the plant's resistance to the insect vectors themselves. This dual-pronged strategy underscores the potential for developing resilient crops that resist both pathogens and their insect carriers. Traditional host plant resistance breeding efforts targeted at vectors have achieved certain successes. For instance, the Mi gene present in tomatoes imparts resistance against specific strains of aphids and whiteflies, which are vectors for plant viruses. Despite the significant resistance provided by this gene, its effectiveness can vary based on factors such as plant age and environmental conditions, with only certain aphid strains being affected. Exploring the potential of genomics and gene editing presents an opportunity to enhance the expression and performance of the Mi-gene. Various breeding programs have been implemented to select single and multiple genes conferring resistance to hemipteran vectors responsible for viral pathogens in rice. However, these pests have exhibited evolutionary adaptations, challenging the effectiveness of the resistance conferred by these genes. The widespread issue of insect vectors evolving resistance to naturally occurring resistance mechanisms underscores the need for strategic approaches in deploying conventionally bred resistant cultivars. Maintaining the effectiveness of these cultivars requires careful consideration and adaptation of strategies to counteract the evolving resistance observed in insect vectors of plant pathogens. Appropriate deployment strategies are essential for the success of recent genetic engineering (GE) approaches designed to confer resistance to insect vectors. The integration of toxins from the bacterium *Bacillus thuringiensis* (Bt) has proven successful in a diverse range of crops, effectively mitigating damage caused by major lepidopteran and coleopteran pests. However, endeavours to modify the Bt toxin-coding genes with the aim of producing proteins toxic to Hemiptera have faced challenges, experiencing limited success. Chougule *et al.* pioneered the development of a modified *Bacillus thuringiensis* (Bt) toxin with partial effectiveness against aphids. Subsequent attempts to modify another toxin-coding gene showed some improve-ments, but neither initiative led to the commerciali-zation of products. The Monsanto Company also engaged in efforts to create Hemiptera-active Bt toxins and recently tested a plant-incorporated Bt gene designed for *Lygus* plant bug control. These plants not only demonstrated efficacy against *Lygus* but also exhibited significan-tly reduced damage from *Frankliniella* species of thrips. This suggests the potential application of this toxin in controlling vectors of plant pathogens in the future.

Beyond Bt toxins, researchers have explored various effector molecules, including spider-derived toxins expressed in phloem tissues and a lectin with potential impacts on whiteflies and aphids. The utilization of plant-produced RNAi for insect pest control has been under consideration for years, and recent advance-ments have achieved robust insect control using this method. However, there is a concern that selecting for resistance to a specific RNAi transcript may lead to broad resistance to RNAi. Therefore, similar to other forms of plant resistance to insect herbivores, RNAi approaches must implement strategies to preserve their effectiveness over time.

Synthetic yeast

In what stands as the most ambitious synthetic biology initiative involving a eukaryotic organism to date, scientists are meticulously synthesizing and integrating each chromosome of baker's yeast (*Saccharomyces cerevisiae*) into the genome, one piece at a time. The ultimate objective is to craft the inaugural synthetic genome within a complex organism, ushering in a ground breaking era of comprehending the organism's intricate biology and offering unprecedented opportunities for genome rewriting. This systematic reconstruction of an entire genome represents a significant leap forward in our understanding of the organism's fundamental biology, opening vast possibilities for genome manipulation. The progress in synthetic biology holds the potential to design, construct and incorporate synthetic genomes into plants or even individual chromosomes or subgenomes. This innovative approach could be harnessed to confer pest resistance or serve other practical purposes in agriculture. The idea of inscribing substantial amounts of synthetic DNA into plants finds a natural precedent in certain viruses like caulimovirus and geminivirus. These viruses exist episomally and contribute additional genetic information to plant genomes, providing a framework for the potential implementation of synthetic genome technology in plant biology. The most conducive subgenome in plants for synthetic engineering emerges as the plastid genome and the continually expanding roster of crop plants with engineered plastids already includes soybean, lettuce and potato. Leveraging the plant kingdom's proficiency in generating a diverse array of biochemicals, the potential exists to blueprint the introduction of novel defense chemicals into crops. A testament to this capability lies in the plant kingdom's aptitude for producing over 21,000 distinct alkaloids, some of which exhibit pesticidal properties. While the current technological landscape presents challenges, the prospect of identifying key gene(s) within metabolic pathways responsible for plant production of fungicidal compounds seems feasible. Furthermore, it should be within reach to transfer these genes into crops, where they could be selectively activated upon fungal infection. This forward-looking approach holds promise for enhancing the natural defense mechanisms of crops against fungal pathogens through synthetic biology.

Synthetic Chloroplast genome for broad pest resistance

An even more futuristic and transformative concept involves the production and integration of a synthetic chloroplast genome, known as a synplastome, to confer broad pest resistance. The chloroplast, being the target of various plant viruses causing diseases, presents an intriguing opportunity. Among all plant genomes, the plastome stands out as the most straight forward to design, build and install, primarily due to its minuscule size in comparison to the nuclear genome (e.g., the tobacco plastome is a mere 156 kb and houses approximately 100 genes). While the completion of the first synplastome is on the horizon, the challenges associated with installing and maintaining a synplastome as a replacement for the native plastome remain uncertain. If successfully implemented, this innovation could unlock the potential for extensive metabolic engineering within the chloroplast itself, paving the way for large-scale advancements in plant biotechnology. The prospect of a synplastome offers a glimpse into a future where synthetic biology transforms the very core of plant genomes for enhanced pest resistance and metabolic engineering.

Resistance through recoding the genome

A particularly intriguing concept involves recoding the genome to confer resistance against viruses. Bacterial virus (bacteriophage) infection poses a significant practical challenge in various applications, including the use of bacteria as bioreactors and in laboratory cultures. In a groundbreaking experiment, Ostrov *et al*., successfully removed seven codons from the *Escherichia coli* genome to achieve virus resistance. This recoding process, involving over 62,000 mutations, remarkably resulted in very few errors in the recoded genome. Notably, the cognate tRNAs for each of the six amino acid deleted codons (along with one recoded stop codon) were also eliminated. It represents the latest endeavour to comprehensively recode the E. coli genome with the aim of enhancing virus resistance. In a previous attempt, recoding a stop codon had successfully conferred resistance to the T7 bacteriophage. Recoded genomes essentially make the codons of invading viruses untranslatable within the host. For instance, deleting a crucial viral stop codon or recoding it to another stop codon in the host genome renders the virus unable to infect the host. This innovative approach holds promise for developing virus-resistant organisms through precise genome recoding strategies. A completely recoded plastome could, theoretically, result in complete and broad resistance against all plastid-targeted viruses because the viruses would no longer be able to replicate or express genes in the plastid.

Synthetic genome biology could offer an evolutionary revolution by giving crops an advantage in the evolutionary race against much more nimbly evolving pathogens. Indeed, recoding codons may be a new integrative strategy for virus resistance. Doing so would set up viral roadblocks to multiple viruses, instead of the one-by-one resistance strategy that is currently common.

Intragenic strawberry fruit production for broad pest resistance

The enhancement of fruit quality and the development of pathogen resistance in strawberries are key objectives in breeding programs aimed at minimizing pesticide usage. Recent advancements in genome sequencing data and bioinformatics tools have furnished valuable resources, expanding the application of synthetic biology-assisted intragenesis strategies. This approach emerges as a potent tool to expedite genetic improvements in strawberries, offering innovative solutions for achieving desirable traits and ensuring the sustainability of strawberry cultivation practices. To enhance strawberry fruit quality and resistance, a strategy involves incorporating four RNAi intragenic silencing cassettes. This is achieved by combining novel strawberry promoters with candidate DNA sequences related to pathogen defense. The aim is to elevate fruit quality and bolster resistance by selectively silencing the corresponding endogenous genes. Importantly, this silencing is primarily targeted during fruit ripening stages, mitigating any undesirable effects on overall plant growth and development. This approach allows for precise genetic modifications, aligning with the goal of optimizing strawberry traits without compromising the plant's broader physiological processes.

Fungi pose significant threats to strawberries, with over 50 different genera impacting this species. Among the most devastating fungus-induced diseases are red stele disease caused by *Phytophthora fragariae*, *Verticillium* wilt associated with *Verticillium spp*., gray mold caused by *Botrytis cinerea* and anthracnose attributed to *Colletotrichum spp*. These fungal pathogens collectively contribute to the challenges faced in strawberry cultivation, necessitating robust strategies for disease management and prevention. Breeding for the enhancement of strawberries presents significant challenges due to its high cost and the time- and resource-intensive nature of the process. The cultivated strawberry, *Fragaria* × *ananassa*, is octoploid, posing a substantial hurdle for traditional breeding methods. This complexity arises because crucial traits like disease resistance, firmness, taste and aroma, among others, may be governed by multiple loci distributed across several subgenomes. The intricate genomic makeup of cultivated strawberries necessitates innovative approaches and technologies to streamline the breeding process and efficiently introduce desired traits. Genetic modificat-ion strategies offer a faster means of generating genetic variability compared to conventional breeding methods, introducing "extra traits" that may not be accessible through traditional techniques. In strawb-erries, targeted engineering of various traits, including resistance to diverse fungal pathogens, has been achieved using these approaches. Transgenic strawberries with enhanced resistance to *Sphaerotheca humuli, Verticillium dahliae, Phytophthora cactorum, Botrytis cinerea* and *Colletotrichum acutatum* have been reported. The genes introduced originate from different sour-ces, including plants, fungi and bacteria, encompassing chitinase from rice, tomato (*Solanum chilense*) and *Phaseolus vulgaris*, thaumatin II from *Thaumatococcus daniellii*, b-1, 3-glucanase gene from *Trichoderma* and RolC from *Agrobacterium rhizogenes*.

Conclusion

Disease control in agricultural crops remains crucial for addressing global issues of food security and sustainability. While genetically engineered (GE) technologies have shown positive impacts on farm productivity and profitability, they alone are not sufficient to ensure food security. Promising GE approaches have been described for managing various agricultural challenges, including cassava viruses, bacterial blight, mycotoxin-producing fungi in groundnut, parasitic weeds in cereals, and insect vectors of plant-pathogenic bacteria and viruses. However, the limited presence of genetically enginee-red crops addressing plant diseases can be attributed to regulatory hurdles favouring single-gene solutions, which are challengi-ng to find for many plant diseases, except for virus resistance. Despite this, the increasing number of regulatory approvals for pathogen-resistant crops and the robust pipeline of emerging possibilities indicate that the primary challenges ahead may be non-scientific. Institutional forces will play a significant role in determining whether and which benefits of genetically engineered crops are realized and by whom. Realizing the potential contributions of genetically engineered crops will necessitate investme-nts and policies in research, intellectual property regimes, and regulatory framewo-rks, all while addressing legitimate societal concerns about responsible stewardship, agro ecological sustainability, and equitable access to benefits. Advancements in synthetic biology, particularly in understan-ding how to program cells using gene circuits, have expanded the genetic toolbox for dynamic regulatory systems. The field of synthetic biology continues to contribute to genetic control, leveraging insights from systems biology to elucidate genetic signatures and biomarkers. As the technolo-gy evolves, understanding cellular complex-ity will be crucial for harnessing the full potential of genetically engineered crops in agriculture.

References

• Pixley, K.V., Falck-Zepeda, B.J., Giller, E.K., Glenna, L.L., Gould, Mallory-Smith, A.C.,Stelly, M.D., Jr. C. Neal Stewart, N.C.Jr.(2019). Genome Editing, Gene Drives, and Synthetic Biology: Will They Contribute to Disease-Resistant Crops, and Who Will Benefit?. Annual Review of Phytopathology, 57:1, 165-188.

• Súnico, V., Higuera, J.J., Molina-Hidalgo, F.J., Blanco-Portales, R., Moyano, E., Rodríguez-Franco, A., Muñoz-Blanco, J., and Caballero, J.L. (2022). The Intragenesis and Synthetic Biology Approach towards Accelerating Genetic Gains on Strawberry: Development of New Tools to Improve Fruit Quality and Resistance to Pathogens. Plants, 11, 57.

• Goold, H.D., Wright, P., Hailstones, D. (2018). Emerging Opportunities for Synthetic Biology in Agriculture. Genes, 9, 341.

• MacDonald, C.I., Deans, L.T. (2016). Tools and applications in synthetic biology. Advanced Drug Delivery Reviews:105.

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Adoption of ICT Innovations in the Agriculture Sector

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Introduction

The most essential issue in the world today is the food supply. The demand for food has increased by more than twice the population growth rate over the past 40 years. In fact, according to a report by the Food and Agriculture Organization (FAO), about 11% of the global population, or 815 million people, are undernourished and do not have enough food for their active and healthy lives.

The Use of Modern Technology in the Agriculture Sector

The use of modern technology in the agriculture sector is vast. It has helped farmers in various ways. The adoption of new and improved technologies has increased the production and productivity of crops. It has also helped in reducing the cost of production. The use of technology has also made the farming process easier and more efficient.

Some of the popular technologies used in the agriculture sector are:

Top 8 Modern Technology In Agriculture Industry

a. Drones: Drones are being extensively used for mapping, surveying and crop monitoring. They help in collecting data that can be used for the planning and execution of farming activities.

b. GPS Technology: GPS technology is widely used in precision farming. It helps in locating the field boundaries and applying fertilizers, pesticides and herbicides accurately. This reduces wastage and increases efficiency.

c. Satellite Imagery: Satellite imagery is used for weather forecasting, crop monitoring and yield analysis. It helps farmers take timely decisions regarding irrigation, cropping patterns, etc.

d. Automation: Automation solution has been widely adopted in agricultural processes like sowing, transplanting, harvesting, etc. This has reduced the dependence on manual labour and increased efficiency.

e. IoT Sensors: IoT sensors are being used for soil moisture monitoring, weather tracking, etc. This information helps farmers to make better decisions about irrigation, inputs application, etc.

f. Soil sensors: Soil sensors are used to measure soil moisture levels, temperature and other factors that affect crop growth. The data collected by the sensors is transmitted wirelessly to the farmer, who can then adjust his or her farming practices accordingly.

g. Weather monitoring: Farmers can now access real-time weather data that can help them make decisions about when to plant, how to irrigate, and what type of crop to grow. This information can be accessed via weather apps or websites or through dedicated weather stations on the farm.

h. Agricultural robots: Agricultural robots are being developed to carry out various tasks on farms, such as milking cows, picking fruits and vegetables and even mowing grass. These robots can work long hours without tiring, and can often do a better job than human workers.

Importance of Modern Technology In Agriculture Industry

Modern technology in agriculture has led to increased production and productivity. This has in turn led to improved food security and incomes for farmers. In addition, it has helped to create new jobs and improve the quality of life for rural communities.

Technology Boosts Agricultural Productivity

Technology has played a key role in increasing agricultural productivity. For example, the use of mechanization has reduced the need for manual labour, thus increasing efficiency and output. The introduction of irrigation systems has also helped to boost production by making it possible to grow crops in otherwise arid areas. In addition, modern technology has made it possible to develop high-yielding crop varieties that are resistant to pests and diseases.

The use of technology in agriculture has also had a positive impact on food security. Increasing production has helped to ensure that more people have access to nutritious and affordable food.

Technology can also help to create new jobs in the agricultural sector. For instance, the use of mobile phones and other digital technologies is providing new opportunities for farmers to connect with markets and sell their products directly to consumers. In addition, the development of value-added services such as agro-tourism is creating new employment opportunities in rural areas.

Impact of Agricultural Technology on Farmers

In recent years, there has been a significant impact of agricultural technology on farmers across the globe. With the help of technology, farmers are now able to increase their yields and produce more crops than ever before. In addition, they can also reduce their costs by using less labour and inputs.

However, there are also some drawbacks to using technology in agriculture. One of the main problems is that it can lead to over-dependence on machines and chemicals, which can be expensive to maintain. Moreover, if not used properly, it can also damage the environment.

Impact of Agricultural Technology on Consumers

Agricultural technology has impacted consumers in many ways. The use of modern technology has helped farmers to increase the production of crops and livestock. It has also helped to improve the quality of the products. The use of new technology has also reduced the cost of production.

The adoption of new technology has also

led to the development of new methods of marketing and distribution of agricultural products. This has helped the farmers to reach a wider market for their products. The use of technology has also helped to create new jobs in the agricultural sector.

Impact of Modern Technology on Agriculture

Modern technology has had a significant impact on agriculture, revolutionizing the industry and improving productivity, efficiency, and sustainability. Here are some key ways in which technology has influenced agriculture:

a. Precision farming: Technologies such as GPS, remote sensing, and Geographic Information Systems (GIS) enable farmers to gather precise data about their fields. This data helps them optimize the use of fertilizers, water, and pesticides, leading to improved crop yields and reduced environmental impact.

b. Automation: Agricultural machinery has become increasingly using automation solutions, reducing the need for manual labour and improving efficiency. Tractors equipped with GPS systems can navigate fields accurately and automated machinery can perform tasks like planting, harvesting, and sorting crops with precision and speed.

c. Remote monitoring: Internet of Things (IoT) devices and sensors allow farmers to remotely monitor various aspects of their operations. They can track soil moisture levels, temperature, humidity, and crop growth patterns, helping them make informed decisions about irrigation, pest control, and crop management.

d. Genetic engineering and biotechnology: Advances in biotechnology have led to the development of genetically modified (GM) crops with improved traits such as disease resistance, drought tolerance, and higher nutritional value. These crops offer increased yields and reduced pesticide usage.

e. Data analytics Solutions: The collection and analysis of large amounts of data from farm operations have become crucial in making informed decisions. Farmers can analyze data on weather patterns, crop performance, soil conditions and market trends to optimize their farming practices, minimize risks, and maximize profits.

f. Vertical farming and indoor agriculture: With the help of technology, indoor farming systems, such as hydroponics, aquaponics and vertical farming, have gained popularity. These methods allow year-round cultivation in controlled environments, conserve water and land, and reduce transportation costs.

g. Drones and satellite imagery: Drones equipped with high-resolution cameras and sensors can capture detailed images of fields. These images help identify crop health, detect pest and disease outbreaks, and assess irrigation needs. Satellite imagery provides a broader perspective, allowing farmers to monitor large areas and make data-driven decisions.

h. Farm management software: Specialized software applications assist farmers in managing their operations efficiently. These tools enable them to plan and track activities, manage inventories, analyze financials, and streamline logistics, improving overall farm management.

Overall, modern technology has transformed agriculture, making it more productive, sustainable and resilient. By leveraging these advancements, farmers can optimize their resources, reduce environmental impact and meet the growing demand for food in a rapidly changing world.

Conclusion

Agricultural productivity has increased manifold with the use of modern technology. In fact, it is one of the few sectors where labor-saving devices have been fully utilized. Today, a farmer can do the work of several men and women with the help of machines. This not only saves time but also reduces cost and increases output.

References

• https://www.drishtiias.com/daily-updates /daily-news-editorials/rise-of-agri-tech-in-India

• https://www.livemint.com/opinion/columns/farm-to-fork-let-digital-technology-lead-sustainability-11673542055829.html

• https://www.aninews.in/news/business/business/use-of-modern-technology-is-essential-in-agriculture-sector-for-enhancing-crop-yield-and-safeguarding-the-environment-kailash-choudhary20220930130700/

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Plant Defense: Related Enzymes Against Pathogens

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Introduction

In nature, plants are attacked by a diverse range of biotic agents including pathogens and herbivorous insects which can have devastating effects on host plants (Ebrahim *et al*., 2011). Application of pesticides has been the chief method of controlling plant diseases (Prasannath *et al*., 2014). However, there is a growing concern in developing alternative measures aiming to minimize the harmful impacts of pesticides on the environment and human health. Inducing systemic resistance against plant pathogens is one such environmentally-friendly approach of disease management (Prasannath and De Costa, 2015). When plants are attacked by pathogens and herbivores, these stresses can induce biochemical and physiological changes in plants, such as physical strengthening of the cell wall through lignification, suberization and callose deposition; by producing phenolic compounds, phytoalexins and pathogenesis-related (PR) proteins which subsequently prevent various pathogen invasion (Bowles, 1990). Among these, production and accumulation of PR proteins in plants in response to invading pathogen is very important. Plants enhance defense responses by inducing activity of a broad spectrum of defense enzymes which are PR proteins, namely peroxidase, β-1,3-glucanase, chitinase, polyphenol oxidase and phenylalanine ammonia lyase which can slow an herbivore's feeding and also the rate of disease spread (Deborah *et al*., 2001; Kumari and Vengadaramana, 2017).

Host plant mediated resistance against pathogens

Interactions between plants and pathogens can lead in to successful infection (compatible response) or resistance (incompatible response). In incompatible relations, viruses, bacteria or fungi which infect plants will elicit a set of localized responses in and around the infected host cells. These responses consist with an oxidative burst (Lamb and Dixon, 1997), which can lead to cell death (Kombrink and Schmelzer, 2001). The pathogen may be 'trapped' in dead cells. It can lead to prevent the spreading from the site of primary infection. There are local responses in the surrounding cells which inhibit the penetration of pathogens by changing cell wall composition and synthesis of antimicrobial compounds such as PR proteins and phytoalexins (Kuc, 1995; Hammerschmidt, 1999). Also plants respond to attacks by pathogens through various defense responses. The accumulations of several factors like defense-related enzymes and inhibitors which lead to prevent infection of pathogens are several defense responses. The enzyme activities and total phenol content were increased significantly in resistant cultivars upon pathogen inoculation (Vanitha *et al*., 2009). Plants possess a range of active defense mechanisms which respond to biotic stresses. Diseases can be reduced due to trigger of defense mechanisms in plants by a stimulus, prior to infection by a plant pathogen. Systemic acquired resistance (SAR) and induced systemic resistance (ISR) are two forms of induced resistance in plant. Combination of ISR and SAR can increase defense against pathogens that are resisted through both pathways than ISR and SAR alone (Choudhary, 2007).

Induced Systemic Resistance (ISR)

When an antagonist is present at the site of exposure, an antimicrobial substance could be synthesized by the biological control agent and transported through the plant, inhibiting the pathogen directly. The induced resistance does not necessarily need to be systemic, but a local protection can be formed as a result of the induced resistance. ISR is induced by plant growth promoting rhizobacteria which are believed to produce a translocatable signal that induces protection in tissues far from the roots where the antagonist was delivered. A systemic response of the plant to an elicitor shows that induced resistance is taking place (van Loon *et al*., 1998). ISR is independent of salicylic acid, but it is mediated by jasmonic acid and/or ethylene, which are produced following applications of some nonpathogenic rhizobacteria (He *et al*., 2004). ISR is accompanied by the expression of a set of genes distinct from the PR protein genes (Pieterse *et al*., 1998).

Systemically Acquired Resistance (SAR)

Plants can acquire resistance against the initiating of diseases through various biological agents including necrotizing pathogens, non-pathogens and soil borne rhizosphere bacteria and fungi. SAR is a mechanism of induced defense responses. In SAR a mobile signal is generated in the site of induction and translocated in the plant, bringing about an induced state in tissues, far from the site of exposure to the elicitor. It provides long-lasting protection against a broad spectrum of micro-organisms. SAR requires the signal molecule salicylic acid and it is associated with accumulation of PR proteins, which are believed to contribute to resistance. The development of SAR is associated with various cellular defense responses, such as synthesis of PR proteins and phytoalexins, rapid changes in cell wall and enhanced activity of various defense-related enzymes. SAR is induced systemically after inoculation with necrotizing pathogens or application of some chemicals such as salicylic acid. Certain plant growth promoting micro-organisms could stimulate defense activity and enhance plant resistance against soil borne pathogens (Prasannath *et al*., 2014).

Pathogenesis-related (PR) proteins

PR proteins are a structurally diverse group of plant proteins that are considered to play important roles in plant disease resistance (Mahendranathan *et al*., 2016). They are widely distributed in plants in trace amounts, but are produced in much greater concentration following pathogen attack or stress. PR proteins exist in plant cells intracellularly and also in the intercellular spaces, particularly in the cell walls of different tissues (Agrios, 2005). The several groups of PR proteins have been classified according to their function, serological relationship, amino acid sequence, molecular weight and some other properties. Currently PR proteins are categorized into 17 families according to their properties and -1,3-glucanases, β-functions, including chitinases, thaumatin-like proteins, peroxidases, ribosome-inactivating proteins, defensins, thionins, nonspecific lipid transfer proteins, oxalate oxidase, and oxalate-oxidase-like proteins. PR proteins are either extremely acidic or extremely basic and therefore are highly soluble and reactive. The signal compounds responsible for induction of PR proteins include salicylic acid, ethylene, xylanase, polypeptide systemin, jasmonic acid and probably others (Agrios, 2005).

Defense-related enzymes

Defense enzymes such as peroxidase, polyphenol oxidase, phenylalanine ammonia lyase, chitinase and β-1,3- glucanase are related to resistance inducement in plants. Peroxidases have been implicated in a range of defenserelated processes, including the hypersensitive response, lignification, cross-linking of phenolics and glycoproteins, suberization and Defense related enzymes Defense enzymes such as peroxidase, polyphenol oxidase, phenylalanine ammonia lyase, chitinase and β-1,3-glucanase are related to resistance inducement in plants. Peroxidases have been implicated in a range of defenserelated processes, including the hypersensitive response, lignification, cross-linking of phenolics and glycoproteins, suberization and phytoalexin production. Polyphenol oxidase catalyzes the phenolic compounds to quinones, thus decreasing of nutritional quality of food and reducing protein digestibility. The intensification of production of phenolic compounds, known as defense molecules of plants against pathogens and insects, is indicated by an increase in phenylalanine ammonia lyase activity in wounded plant tissues. Chitinase and β-1, 3-glucanase are responsible for the hydrolysis of cell wall components in sequence such as chitin and β-1,3-glucans (Ebrahim *et al*., 2011).

Peroxidases

Peroxidases are a distinguished class of PR proteins and induced in host plant tissues by pathogen infection. They belong to PR protein 9 sub-family and are expressed to limit cellular spreading of infection through establishment of structural barriers or generation of highly toxic environments by massively producing reactive oxygen species. Peroxidase activity or peroxidase gene expression in higher plants is, indeed, induced by fungi, bacteria, viruses and viroids. Cross-linking of the phenolic monomers in oxidative coupling of lignin subunits has been associated with peroxidase using H_2O_2 as oxidant. One significant event in plant defense reactions is oxidative burst, a general early response of host plant cells to pathogen infection and elicitor treatment. Peroxidase also participates in the production of ethylene the concentration of which increases frequently in pathogenesis process. (Passardi *et al*., 2005)

Peroxidase is a key enzyme in the biosynthesis of lignin and suberin. Peroxidases have been associated with a number of physiological functions that may contribute to resistance, through hypersensitive responses, oxidation of hydroxyl cinnamyl alcohol into free radical intermediates, phenol oxidation, polysaccharide cross linking, cross linking of extension monomers and the deposition of phenolic material in plant cell walls during resistance reactions. When peroxidase level increases due to the induced systemic resistance (Prasannath *et al*., 2014), quick synthesis of reactive oxygen derivatives by oxidative burst leads to cell death and inhibits pathogenic activities. Peroxidase oxidizes phenolics to quinines and generates hydrogen peroxide. It is antimicrobial and also releases highly reactive free radicals and further increases the rate of polymerization of phenolic compounds into lignin-like substances. These substances are then deposited in cell walls and papillae and hinder the further growth and development of the pathogen (Agrios, 2005).

β-1, 3-glucanases

They have been classified as PR-2 proteins which are β-glucanases (glucan endo-1,3-β-glucosidases) able to catalyze endo-type hydrolytic cleavage of the 1,3-β-Dglucosidic linkages in β-1, 3-glucans. β-1, 3-Glucans are the major components of the cell walls of oomycetes, a group of fungi that do not contain chitin. The induction of β-glucanase as part of the hypersensitive reaction is a stereotypic response; the pattern of induction is similar for viral, bacterial and fungal pathogens. It creates resistance against various fungi such as Aspergillus parasiticus, A. flavs, Blumeria graminis, Colletotrichum lagenarium, Fusarium culmorum, Fusarium oxysporum, fusarium udum, Macrophomina phaseolina and Treptomyces sioyaensis β-glucanases participate in the decomposition of glucans like callose which occurs in plant tissues as one of the components of wall modifications involved in resistance responses (Smart, 1991). Even though antifungal β-glucanase I appear to be tailored for defense against fungi, other studies of β-glucanase Ideficient mutants generated by antisense transformation suggest that these enzymes also play a vital role in viral pathogenesis. The endotype β-1,3-glucanase enzyme seems to be most important for the degradation of the callosic walls, while the exotype β-1,3-glucanase is involved in the further hydrolysis of released oligosaccharides. It has been proposed that these glucanohydrolases perform in at least two different ways: directly, by degrading the cell walls of the pathogen and indirectly, by promoting the release of cell wall derived materials that can act as elicitors of defense reactions (Bowles *et al*., 1990).

Chitinases

Chitinases are large and diverse group of enzymes and also one of the important plant pathogenesis related (PR) protein that degrades chitin, it improves plant defence against chitin containing plant -1,3-glucan β-pathogens (Jalil *et al*., 2015) and chitin, polymer of Nacetylglucosamine are major cell wall -1,3-β components of many fungi. Since glucanase and chitinases have been shown to be capable of attacking cell wall of fungal pathogens, these enzymes have been proposed as direct defense enzymes of plants (Abeles *et al*., 1970). In addition. reported that in -1,3-β- combination, chitinase and glucanase act synergistically to inhibit fungal growth. The mode of action of chitinase is relatively simple. They degrade the cell wall chitin polymers in situ, resulting in a weakened cell wall and rendering fungal cells osmotically sensitive. These chitinases have significant antifungal activities against plant pathogenic fungi like *Alternaria* spp. for rice grain discoloration, Rhizoctonia solani for rice sheath blight, Bipolaris oryzae for rice brown spot, Botrytis cinerea for tobacco blight, Curvularia lunata for clover leaf spot, Fusarium oxysporum, F. *udum*, Mycosphaerella arachidicola and Pestalotia theae for tea leaf spot. The level of protection observed in the plants is variable and may be influenced by the specific activity of the enzyme, its localization and concentration within the cell, the characteristics of the fungal pathogen and the nature of the host-pathogen interaction (Sakthivel, 2006).

Phenylalanine ammonia lyase (PAL)

PAL is the key enzyme that is responsible for linking primary metabolism of aromatic amino acids with secondary metabolic products. PAL catalyzes the nonoxidative deamination of phenylalanine in to trans-cinnamic acid and ammonia which is the initial step in the biosynthesis of phenolic compounds. PAL is a reliable treatment for the genetic condition phenylketonuria, due to the natural ability of the enzyme to breakdown Lphenylalanine. PAL is one of the most extensively studied enzymes in plants due to synthesis of various phenolic compounds as well as anthocyanin which are responsible for the resistance of plant pathogens. Changes in PAL activity can take place during pathological events. PAL activity can be induced by the plant hormone ethylene and plant signal molecules including salicylic acid and jasmonic acid and also it can be induced by various biotic and abiotic stresses such as pathogen invasion, wounding, chilling and ozone. When treated strawberry plants with abscisic acid, anthocyanin and PAL activity are increased. All phenylpropanoids compounds are derived from cinnamic acid, which is formed from phenylalanine by the activity of PAL. These phenylpropanoids are accountable for disease resistance, crop development and mechanical support as well as insect pest damages. PAL activity may be regulated by feedback inhibition by the pathway product, cinnamic acid, which may modify the expression of the PAL gene (Del Rio *et al*., 2004).

Polyphenol oxidase (PPO)

PPOs are a group of copper containing enzymes that catalyze oxidation of hydroxy phenols to their quinone derivatives, which have antimicrobial activity. Because of its reaction products and wound inducibility, PPO plays a role in defense against plant pathogens. Plants immediately respond to Pathogens so there is an immediate rise in PPO indicating immediate synthesis of antimicrobials to ward off the pathogens. Pathogen-induced PPO activity continues to be reported for various plant taxa, including monocots and dicots. Increase of PPO activity was reported in banana roots treated with *Fusarium oxysporum* derived elicitor by. A striking increase of PPO activity was observed in banana roots treated with *Psuedomonas fluorescens* against fusarium wilt. Similarly, studies showing correlations of high PPO levels in cultivars or lines with high pathogen resistance continue to provide support for a pathogen defense role of PPO. Several groups have also attempted to correlate the protective effects of rhizosphere bacteria with an induction of defense enzymes including PPO, with mixed success. Li and Steffens (2002) suggested several possibilities, including general toxicity of PPO-generated quinones to pathogens and plant cells, accelerating cell death, alkylation and reduced bioavailability of cellular proteins to the pathogen, crosslinking of quinones with protein or other phenolics, forming a physical barrier to pathogens in the cell wall, and quinone redox cycling leading to H2O2 and other reactive oxygen species (Jiang and Miles, 1993). While reactive oxygen species are known to be important factors in plant pathogen interactions and defense signaling, PPO is implicated in the formation of melanin-like polymers in potato black spot lesions. However, none of these hypotheses of how PPO might affect pathogens has been tested rigorously so far (Raj *et al*., 2006).

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Catalyzing Agricultural Excellence: The Pivotal Role of Krishi Vigyan Kendra in Advancing Agriculture and Allied Activities

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Introduction

Krishi Vigyan Kendra (KVK), the agricultural knowledge center, stands as the vanguard in India's agrarian landscape, a beacon illuminating the path towards sustainable and innovative agricultural practices. Rooted in the rich soil of research and nurtured by the Indian Council of Agricultural Research (ICAR), KVK emerges as an essential link in the intricate tapestry connecting scientific advancements to the furrows of farmers' fields. This dynamic institution, established to bridge the gap between theory and practice, represents the verdant synergy between cutting-edge research and the pragmatic wisdom of seasoned agriculturists.

1. Technology Assessment and Refinement

KVKs assess and refine agricultural technologies to suit local conditions. They conduct on-farm trials to validate the effectiveness of new technologies and practices.

2. Capacity Building

Organization of training programs for farmers, farmwomen, and rural youth to enhance their skills and knowledge in various aspects of agriculture, horticulture, animal husbandry and allied activities.

3. Frontline Demonstrations

Conducting frontline demonstrations to showcase improved agricultural practices and technologies directly on farmers' fields. This helps farmers witness the practical application and benefits of new methods.

4. Seed Production and Distribution

Involvement in the production and distribution of quality seeds, planting materials and other inputs to promote the adoption of improved crop varieties and hybrids.

5. Livestock Management: Health Management

KVK offers soil health testing services and promote soil health management practices to optimize nutrient use and improve soil fertility for sustainable agriculture.

6. Farm Advisory Services

Platform for disseminating timely and location-specific farm advisory services. They provide information on crop planning, pest and disease management, weather forecasting and market intelligence.

7. On-Farm Trial

KVK conducts on-farm research to address specific issues faced by farmers in their region. This research helps in generating location-specific solutions and innovations.

8. Women Empowerment

KVK, Deoghar prioritizes on empowering women in agriculture by offering training programs and promoting women-centric activities such as kitchen gardening, mushroom cultivation and dairy farming.

9. Entrepreneurship Development

KVK plays a role in fostering rural entrepreneurship by training and supporting individuals in setting up agri-business ventures, processing units and value addition activities.

10. Demonstration of Agri-Enterprises

KVK organizes demonstrations of successful agri-enterprises to inspire and guide farmers and rural youth in diversifying their sources of income.

Conclusion

In conclusion, the Krishi Vigyan Kendra stands resolute, an intellectual bulwark against the challenges that beset agriculture and allied sectors. It functions as a crucible where the alchemy of research transmutes into practical wisdom and where the tendrils of knowledge reach deep into the agricultural heartland. As India's farmers navigate the complex terrain of modern agriculture, the role of KVK becomes increasingly indispensable. The ongoing commitment to technological innovation, sustainable practices and the empowerment of farmers places KVK at the forefront of a transformative journey, sowing the seeds of progress in the fertile fields of Indian agriculture. In this collaborative endeavor between science and tradition, KVK heralds not only productivity but also prosperity, weaving a narrative of resilience and growth in the agrarian saga of the nation.

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Integrated Insect, Pest and Disease Management in Potato and Sweet Potato

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Introduction

The potato (*Solanum tuberosum L.*) and sweet potato (Ipomoea batatas) is the most important dicotyledonous source of human food. It is major food crop of the world, exceed only by the grasses such as wheat, rice, maize, and barley. It is characteristically a crop of the cool, temperate regions or of elevation of approximately 2000 m or more in the tropics. It requires cool nights and well drained soil with adequate moisture and does not produce well in low altitude, warm, tropical environment. Commercial production of most potatoes is primarily through vegetative propagation by means of lateral buds formed on the tuber, a modified stem. Trough such vegetative propagation, many diseases are transmitted from generation to generation. Suppression of such diseases and reduction of yield losses due to disease are a necessary part of increasing the food supply. Integrated pest management (IPM) may supply effective control of the potato pests including aphids (vector of some viruses), Verticillium wilt blackleg, bacterial ring rot, Rhizoctonia, Phytophthora infestans (late blight) and several weeds (night shades, pigweeds, lambs quarters, and annual grasses). It includes regular inspection for healthy seed or nursery, crop production, correct identification of the problem, cultural practices (crop rotation, sanitation etc.), biological control, soil fumigation (if necessary), seed or nursery stock treatment and disinfestations of cutting tools. In this review, pest management methods of potatoes & sweet potato included in IPM was summarized.

Pest Management Program

No single management program is suitable for all potato crops. Pest problems vary from field to field and season to season because of differences in soil type, cropping history, cultural practices, cultivar, and the nature of surrounding land. Choice of market and market conditions also affect the feasibility of management options because they determine how a crop must be handled and the value of that crop. Regardless of conditions, however, four components are essential to any IPM program:

1) Accurate pest identification
2) field monitoring
3) control action guidelines
4) effective management methods.

Because most pest management tools, including pesticides, are effective only against certain pest species, one must know which pests are present and which are likely to appear. Different control methods may be needed even for closely related species. By monitoring his field, one can get the information he needs to make management decisions. Monitoring includes keeping records of weather, crop development and management practices, as well as evaluating incidence and levels of pest infestations. Control action guidelines indicate when management actions, including pesticide applications, are needed to avoid losses due to pests or other stresses.

Management Methods

1. Seed Quality and Certification

A number of pests can be transmitted in infected seed tubers, including bacterial ring rot, blackleg, common scab, late blight, potato viruses, powdery scab, Rhizoctonia, root knot nematodes, silver scurf, and wilt diseases. In order to prevent these problems, one must start with healthy stock. Stem cutting and micro-propagation techniques have been developed to obtain pest-free potato plants for propagation and production of certified seed tubers.

2. Biological Control

Any activity of a parasite, predator or pathogen that keeps a pest population lower than it would be otherwise is considered biological control. One of the first assessments that should be made in an IPM program is the potential role of natural enemies and hyperparasites in controlling pests. Control by natural enemies and hyperparasites is inexpensive, effective, self-perpetuating and not disrupt-ive of natural balances in the crop ecosyst-em. Natural enemies that affect nematodes, weeds and fungi are being studied, but as yet no practices are recommended for improving biological control of these pests. Bacteria antagonistic to Erwinia carat Vora are being developed as seed piece treatme-nts for reducing seed piece decay and blackleg.

3. Resistant Cultivars

Plant breeding is one of the most powerful tools available for both the management of pests and the production of the best crop. Pest management is one of many factors that must be taken into account when choosing cultivars. Cultivars resistant or tolerant to disease can help reduce losses caused by some soil-borne pathogens and provide long-term, economical protection from conditions that otherwise could inflict severe losses every season.

4. Chemical Control with Pesticides

Properly used, pesticides can provide economical protection from pests that otherwise would cause significant losses. In many situations, they are the only feasible means of control. Careless or excessive use of pesticides, however, can result in poor control, crop damage, higher expenses and hazards to health and environment. In an IPM program, pesticides are used only when field monitoring indicates they are needed to prevent losses.

Cultural Practices

Proper management of the potato crop, from field preparation and planting through harvesting and storage is essential for maximum yields of highquality tubers. Many cultural practices including seed selection and handling, planting, irrigation, fertilization, vine killing, careful harvesting methods have a significant impact on pest damage. Even when you cannot choose cultural methods solely for their effect on pest management, it is important to understand their impact on pests so that you will know what to expect.

1. Sanitation

Sanitation is essential to the prevention of seed piece infection during cutting and handling and prevention of spread of the pathogens in contaminated soil, water and field equipment. Strict sanitation requirem-ents must be followed in growing seed potatoes. Any potato cull piles should be destroyed or sprayed to ensure that no Phytophthora sporangia will be blown from there to the potato plants in the field later on. Cull potatoes are excellent hosts for potato diseases and can provide a safe haven for potato insects to increase in numbers. Important pests that can be harboured in waste potatoes include late blight, potato leaf roll virus (PLRV), bacterial ring rot and nematodes.

2. Crop Rotation

Proper crop rotations enhance soil fertility, maintain soil structure, reduce certain pest problems, increase soil organic matter, and conserve soil moisture. Generally, most useful rotations for potato fields are forage crops and grains, including corn. Crop rotation is useful for control of soil-inhabiting pathogens that have limited host ranges and require host plant residues for survival. Rotation is less effective for pathogens such as Verticillium spp. or Phytophthora erythristic, which can survive in the soil for a long time in the absence of host.

3. Seed Treatment

Seed piece decay frequently involves a Fusarium fungus acting synergistically with bacteria. Therefore, chemical seed treatments, which primarily act as fungicides are useful when conditions favour development of Fusarium on seed pieces.

4. Irrigation

Availability of soil water is a major factor that determines yield and quality of the potato crop. Too little water will reduce yields, induce tuber malformations, or increase severity of scab or Verticillium with symptoms. Excess or poorly timed irrigation may reduce yield or in storage or leach nutrients from root zone. Fluctuations in water availability Favor disorders such as second growth and internal necrosis. Sprinkler systems provide the most flexibility and most efficient water application and fertilizers and some pesticides can be applied through sprinklers.

5. Fertilization

Adequate nutrient availability throughout the growing season is necessary for the best yield and quality. If nutrient deficiencies occur during tuber growth, the plant shunts nutrients from the stems and leaves to the growing tubers, thereby hastening aging of the vines and yields are reduced.

6. Harvest

Before harvest, the infected vines must be killed with chemicals to destroy late blight inoculum that could be in contact with the tubers when they are dug up. Prevention of bruising is one of the most important considerations in a well managed harvest operations.

7. Storage

A large part of the crop in most growing areas is stored for fresh market or processing during the winter and spring. Design can vary but most storage facilities have controls for temperature, humidity, and ventilation. Ventilation is essential during storage. It removes heat and excess moisture that may condense on colder tubers and heat produced by respiration; at the same time it helps provide even temperature and humidity within the storage area and oxygen to support tuber respiration.

Varities	Skin Color	Flesh Color	Disease Resistance	Narative
1. Averre	Orange to light rose; fades in storage	Orange	• **Fusarium wilt** - Resistant • **Streptomyces soil rot** - Moderately resistant • **Southern root**	Averre is a high yielding, blocky variety with a length similar to Beauregard, but with straighter roots

Varities	Skin Color	Flesh Color	Disease Resistance	Narative
			knot nematode - Moderately susceptible • **Guava root knot nematode** - Susceptible	Packout of No.1 roots is high. Bedded roots produce good numbers of uniform plants. Heat stress will cause some veining.
2. Carolina Ruby	Red	Dark orange	• **Fusarium wilt:** Resistant • **Streptomyces soil rot:** Moderately resistant • **Southern root knot nematode:** Susceptible • **Guava root knot nematode:** Susceptible	Carolina Ruby is a high yielding, blocky variety with a deep red skin. Vines are trailing and thin. Bedded roots produce high numbers of uniform plants. Wet conditions near harvest will cause prominent lentices
3. Covington	Light rose skin; fades in storage	Orange	• **Fusarium wilt:** Resistant • **Streptomyces soil rot:** Resistant • **Southern root knot nematode:** Resistant • **Guava root knot nematode:** Susceptible	Covington is currently the major table stock cultivar in NC, shapes are generally blocky, yield is high with a good packout of No.1 sized roots. Roots need a long pre-sprout for optimal bedding plant production.
4. Jewel	Orange	Orange	• **Fusarium wilt:** Resistant • **Streptomyces soil rot:** Susceptible • **Southern root knot nematode:** Resistant • **Guava root knot nematode:** Resistant	Jewel was the main cultivar grown in NC in the 1970's and 80's but was replaced when Streptomyces soil rot became wide spread. It has blocky shaped roots and a high packout of No.1 roots.
5. Monaco	Rose skin; fades in storage	Dark orange flesh	• **Fusarium wilt:** Resistant • **Streptomyces soil rot:** Resistant • **Southern root knot nematode:** Resistant	Monaco was released for a combination of traits useful in both organic and conventional production systems. The

			• **Guava root knot nematode:** Susceptible	plant is upright and compact, which helps suppress weeds within a row
6. N.C. Porto Rico 198	Light orange skin	Light orange flesh	• **Fusarium wilt:** Susceptible • **Streptomyces soil rot:** Susceptible • **Southern root knot nematode:** Susceptible • **Guava root knot nematode:** Resistant	Porto Rico was the dominant variety in the US in the 1930's -1950's. This release is an improved hill selection with higher beta carotene and a more uniform orange flesh.

Conclusion

Potato and sweet potato is most important food crop in the world. Potatoes and Sweet potatoes are attacked by many insect pest in the field conditions as well in storage conditions. Major insect pest of Potato crop are Tuber moth, Phytophthora infestans and aphids which transmit a number of viruses and several weeds. Use of Integrated Pest management programs plays an important role to protect the crop. Correct identification of host is most important in Integrated management program. Most important integrated pest and disease management practices include Clutural mechanical and chemical practices which can control many insects, pests, and diseases like Deep summer ploughing, Use of resistance varieties, Regular sprays of chemical pesticides and biological control like use of botanicals are proven to be very effective against all the insect, pest and diseases in Potato and Sweet potato.

References

• Fry, W.E. (1982) Principles of disease management. Academic Press, Cambridge, 378.
• Agios, G.N. (1997) Plant Pathology. 4th Edition. Academic Press, Cambridge, 229.
• Anonymous (2008) UC IPM pest management guidelines: Potato UC. ANR Publication, New York.
• Kerry, B., Barker, A. and Evans, K. (2003) Investigation of potato cyst nematode control.
• Nematode Interaction Unit, Plant-Pathogen Interaction Division, Roth Amsted Research, Harpenden Herts, AL5 2JQ No. HH3111TPO, 87. http://programs.cphst.org/pcn/
• Larkin, R.P. (2007) Relative effects of biological amendments and crop rotations on soil microbial communities and soil-borne diseases of potato. Soil Biology and Biochemistry, 40, 1341-1351.
• Hooker, W.J. (1983) Compendium of potato diseases. The American Phyto pathological Society, St. Paul.
• Rich, A.E. (1983) Potato diseases. Academic Press, Cambridge, 1-2.
• Olsen, N., Nolte, P., Harding, G. and Ohlensehlen, B. (2001) Cull and waste potato management. University of Idaho, College of Agriculture, Cooperative Extension System CIS Bulletin # 814.
• Karekin, R.P. (2003) Characterization of soil microbial communities under different potato cropping systems by microbial population dynamics, substrate utilization, and fatty acid profiles.
• Soil Biology and Biochemistry, 35, 1451-1466.
• Amalin, D.M. and E.A. Vasquez. 1993. A handbook on Philippine sweetpotato arthropod pests and their natural enemies. International Potato Center (CIP), Los Baños, Philippines. 82 pp.

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Effect and Management of Mycotoxin Contamination

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Introduction

Many grains and sometimes other seeds and also plant products such as bread, hay, purees and rotting fruits are often infected or contaminated with one or more fungi that produce toxic compounds known as **mycotoxins**. Animals or humans consuming such products may develop severe diseases of internal organs, the nervous system and the circulatory system or may even die. Also, many pasture grasses are infected with certain endophytic fungi that grow internally in the plant and although they do not seem to seriously damage the grass plants, they produce toxic compounds that cause severe diseases in the wild and domestic animals that eat the plants. Such diseases that are caused by mycotoxins are called as **mycotoxicoses**.

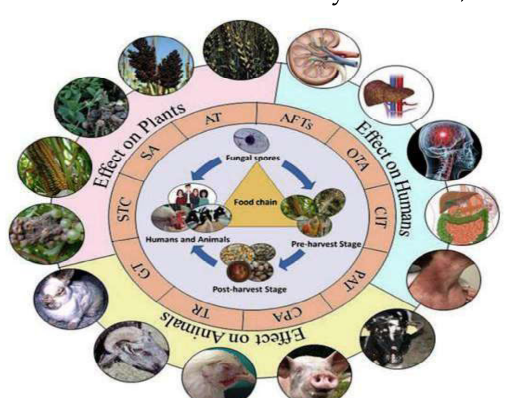
Mycotoxins are toxic fungal metabolites that are relatively few but universally present fungi growing on grains, legumes and nuts. Such produce, especially when harvested while still containing a high percentage of moisture or if it damaged and stored at relatively high humidity becomes moldy, i.e., it supports the growth of mycotoxin-producing fungi. Such moldy produce is likely to carry high concentration of mycotoxins. Several of the mycotoxins are proven carcinogens, may disrupt the immune system and may retard the growth of animals or humans that consume that consume them.

Plant fungal disease and mycotoxins cause a reduction in yield and quality of crops in the field and post-harvest processes.

Approximately 25 per cent of world's food crops are affected each year by mycotoxins. The economic effects of mycotoxins are many folds affecting all sections of production and consumption of grains, viz., grain producers, handlers, processors, consumers and society as a whole of handling and in extreme cases death problems due to consumption of contaminated products.

In this context, unravelling the genetic regulation of the pathogenesis mechanism of fungi and the interaction between pathogens and their hosts will illuminate new insight to cope with plant fungal diseases and mycotoxins. Many control strategies to prevent, delay or inhibit fungal development have been adopted to manage fungal diseases and mycotoxin production, including genetic resistance, cultural practices, irrigation management and chemical control.

To control disease and mycotoxins, it is



essential to understand the lifestyles, cycles and interactions of pathogenic fungi, their hosts, and the environment because they differ greatly among fungi genera.

Some of the major mycotoxins

Mycotoxins are secondary metabolites that are produced by many filamentous fungi belonging to *Aspergillus, Fusarium, Penicillium, Alternaria* and *Claviceps*. Mycotoxins are produced and accumulated in agricultural crops and cause contamination of feed and food resulting in harmful effects on both humans and animals consuming them. Some mycotoxins cause phytotoxicity or have antimicrobial activity too. These low molecular weight metabolites are ubiquitous and practically inevitable. Researchers have identified over 400 mycotoxins that is now well established that many mycotoxin-producing fungal species cause plant disease under field conditions.

A list of mycotoxins significantly impacting agricultural commodities would include Aflatoxin produced by *A. flavus and A.parasiticus, Zearalenone* and Trichothecenes (particularly deoxynivalenol) produced by *Fusarium* spp., Ochratoxin produced by *A.ochraceus* and Fumonisins produced by F. *moniliforme*.

Ergot Alkaloids

The most notorious mycotoxicosis in human history is ergotism, which is caused by consumption of **grains**, usually **rye**, contaminated with sclerotia of *Claviceps purpurea*. Ergotism has been known for more than 2,000 years, and was responsible for numerous epidemics of the disease called "St. Anthony's Fire", which included gangrene of the extremities, convulsions, psychoses, and death, in Europe during the Middle Ages.

Aflatoxins

The modern era of mycotoxicology began in England in 1960 with "**Turkey X disease**" and the discovery of aflatoxins. Scientists in England quickly identified the toxin-producing organism as *Aspergillus flavus* and the toxic agents as a group of related bisfuranocoumarins that were named aflatoxins B1, B2, G1, G2, etc. Subsequent studies have shown that aflatoxins are potent liver toxins and liver carcinogens in a wide variety of animals and that aflatoxins interact synergistically with hepatitis B virus.

They evade 25% of the food crops in the world mainly **cereals, maize, rice, nuts, cassava, and spices**.

Deoxynivelinol

The toxin is also known as **vomitoxin** or **DON** is produced by the fungus *Gibberella zeae* (anamorph *Fusarium graminearum*), the cause of *Gibberella* ear rot of **corn** and of head blight (scab) of **wheat**. The mycotoxin at first causes reduced feeding by the animals and thereby, slower gain or loss of weight.

Trichothecenes

For more than 100 years, both acute and chronic mycotoxicoses in farm animals and in humans have been associated with consumption of **wheat, rye, barley, oats, rice and maize** contaminated with *Fusarium* spp. that produce trichothecene toxins. Trichothecenes are produced by a number of *Fusarium* spp.

Fumonisins

Fumonisins are structurally similar metabolites to sphinganine produced by dominantly *Fusarium verticillioides* and *Fusarium proliferatum* and also by other fungal species such as *F. dlamini, F. nygamai* and *F. napiforme*. About 12 fumonisin types are identified. Among these, FB1, FB2 and FB3 are the most toxic. They occur mostly in **maize** prior to harvest or during the beginning of storage and do not increase anymore. Fumonisins are acutely toxic to the liver and kidney of a wide range of experimental animals. Fumonisins are produced by several members of the species complex, including serious pathogens of **maize, sorghum, millet** and **rice**.

Patulin

It is a polyketide, cyclic tetraketide with phytotoxic activity. Although patulin can be produced by a wide range of fungi, including numerous *Aspergillus* and *Penicillium* spp., the major source of patulin in the food supply is **juice of apples** infected with P. *expansum*.

Other Mycotoxins

In addition to the well-known mycotoxins discussed above, a number of other mycotoxins warrant closer scrutiny with respect to their role in plant pathogenesis. These include a diverse array of metabolites produced by *Fusarium, Aspergillus* and *Penicillium* spp., with few exceptions, molecular genetic analysis of these mycotoxin biosynthetic pathways is not very far advanced. *Fusarium* mycotoxins of interest include zearalenones, the strongly estrogenic polyketides produced by *F. graminearum* and related species. Consumption of feeds contaminated with zearalenones causes severe reproductive and fertility problems in animals.

Strains of G. *fujikuroi* associated with the Bakanae disease of rice produces particularly high levels of moniliformin.

Mycotoxins in Corn

Management of Mycotoxins

- To the management of mycotoxin contamination, the best strategy is to prevent plant fungal infection by avoiding drought stress.
- Removal of damaged grain and drying of grain to the minimal moisture level.
- Infestation of stored products by insect and mites is kept to a minimum through the use of fumigants. This helps keep the storage fungi from getting started and growing rapidly.
- Frequent cleaning of food/feed delivery systems and short-term storage; Use of antifungal agents such as propionic acid and acetic acid.
- Breeding resistant varieties through Restriction Fragment Length Polymorphism (RFLP).
- Physical control: hand sorting, washing, crushing and peeling off, inactivation, gamma irradiation, cooking, and steaming.
- Mycoparasites of plant pathogens, *Trichoderma* spp., has been accepted as most potent biological control agent for certain plant diseases. Its mycoparasitism involves a complimentary action of antibiosis, nutrient competition and cell-wall degradation enzyme such as α-1-3-Glucanase, proteases and chitinases.
- The usage of chemical fungicides is another management strategy of mycotoxin contamination at pre-and-post harvest stages, viz., chlorine, ozone, hydrochloric acid, benzoyl peroxide, ammonia, sodium hypochloride and ethanolamine.
- Due to the hazards of chemicals to the environment, humans, and animals, biological control has been proposed as an alternative to chemical management strategies.

Future Aspects

Mycotoxin contamination is prevalent, so future strategies must concentrate on the need to control fungal contamination and mycotoxin production along all the food chain starting from production till the food reaches the customers. The synergistic toxic effects of mycotoxins occurring simultaneously in food should be considered, as well as the probable presence of masked mycotoxins. Conventional screening methods that are reliable, convenient, rapid and cheap are needed, and the development of methods that quantify masked mycotoxins is of extreme importance.

Further research on the safety of physical, chemical, and biological decontamination methods are needed, and strategies that combine an integrated decontamination approach must be developed to maximize mycotoxin removal from food to the most possible extent. Future research should focus on discovering how mycotoxin production patterns would change and how some secondary mycotoxins could become primary ones with the emergence of climate change.

Conclusion

Mycotoxin contamination in food might not be inevitable and its presence could threaten the food security of many countries especially developing ones. However, the implementation of proper methods from the beginning of the food chain until the end including all stages of production like planting, harvest, drying, storage, processing, packaging, transport helps to decrease the level of contamination and maintain it below the tolerable levels assigned by different countries.

Complete elimination of mycotoxin contamination seems to be practically impossible. However, risks associated with mycotoxin contaminated commodities can be reduced by following an integrated mycotoxin prevention and control management. The most effective and practical procedure include good cultural practices, use of resistant crops (developed through biotechnological processes), biological control, physical removal of damaged or incomplete kernels/seeds, chemical inactivation such as ammoniation procedure and use of additional chemical agent normally used in industrial processes (nixtamalization).

References

• Agrios, G. N. (2020). Plant Pathology. (1): 39-41; 559-560.

• Arias, R. S., Dang, P. M. and Sobolev, V. S. (2015). RNAi-mediated Control of Aflatoxins in Peanut: Method to Analyse Mycotoxin Production and Transgene Expression in the Peanut/*Aspergillus* Pathosystem. *Journal of visualized experiments*: (106).

• Assefa, T. and Geremew, T. (2018). Major Mycotoxins Occurrence, Prevention and Control Approaches. *Biotechnology* and *Molecular Biology Reviews*. 12(1): 1-11.

• Beardall, J. M. and Miller, J. D. (1994). Diseases in Humans with Mycotoxins as Possible Causes. Mycotoxins in Grain: Compounds Other Than Aflatoxin. *Eagan Press*. 487-540.

• Choudhary, A. K. and Kumari, P. (2010). Management of Mycotoxin Contamination in Pre-harvest and Post-harvest Crops: Present Status and Future Prospects. *Journal of Phytology*. 2(7): 37-52.

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Black Rot of Grapes

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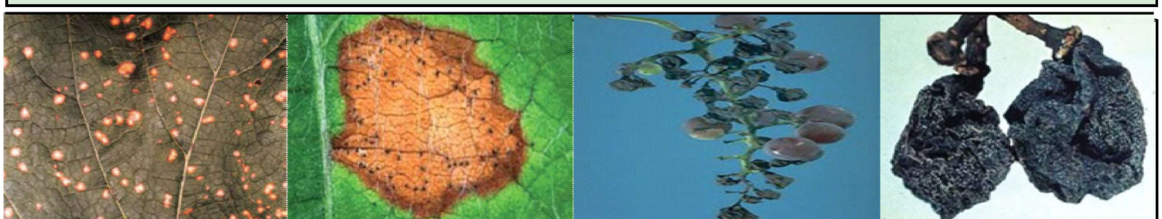
Introduction

One of the most significant grape diseases in home gardens and commercial vineyards is black rot. When it manifests itself, black rot is most likely the most dangerous grape disease. In conditions that are favorable, the crop may be totally destroyed by blasting off the blossom clusters or by the berries directly decaying. The disease affects all of the grapevine's above-ground components, including the leaves, shoots, petioles, and fruit. Fruit rot brought on by severe outbreaks of the illness can result in large yield losses. In warm, humid weather, the disease can be extremely damaging and result in total crop loss if it is not well controlled. One of the biggest obstacles to organic grape cultivation of vulnerable cultivars is black rot.



a b c d

Figs: Symptoms of black rot of grape caused by Guignardia bidwellii on grape leaf (a), single spot showing pycnidia (b), rotting and drying of infected grape berries (c) and production of fungus perithecia on rotten, shriveled berries (d). [Photographs courtesy of Plant Pathology Department, University of Florida and M. Ellis, Ohio State University.]

Symptoms

In late spring, leaves with the disease develop a lot of red necrotic patches (Figs. a & b.). Later, as the spots grow, their appearance changes from brown to grayish-tan, with black borders. Phyllosticta-type pycnidia, which resemble black dots, develop on the top side of leaf veins, tendrils, leaf and flower stems, and leaf spots. Berries start to get spots around halfway through their growth (Fig. c). These spots are initially white, but a brown ring soon surrounds them and gets wider very quickly. Dark pycnidia appear close to the center and the central part of the spot either stays flat or becomes depressed. The berry eventually shrivels and turns black as its surface is covered in many black pycnidia, causing the berry to become rotten (Fig. d).

Pathogen

Fungus Guignardia bidwellii, anamorph Phyllosticta ampelicida, in addition to conidia-bearing pycnidia, also produces ascospore-containing perithecia in rotten, mummified fruit. The perithecia supposedly develop from transformed pycnidia.

Development of Disease

The fungus Guignardia bidwellii is the cause of black rot in grapes. The quantity of overwintering inoculum and the weather patterns of the current season are the main determinants of the disease's intensity. The fungus can survive the winter on diseased canes, tendrils, and leaves, but it usually overwinters on infected mummies on the ground and within the vine. Spores are released from fungal fruiting bodies throughout the spring when the weather is rainy and damp. Raindrop splashing and wind both spread fungal spores. When the disease first appears, young leaves are quite vulnerable, but as they mature, they develop resistance. Leaf wetness at 50°F for 24 hours is necessary for spore germination and infection. Spores can germinate and infect green plant tissues in as little as 6-7 hours of wetness at the ideal temperature of 70-80°F. Thus, warm, wet weather is conducive to the development of the disease, particularly in late spring and early summer. Throughout the season, spores released from infected leaves might act as a secondary inoculum to infect additional young berries and other tissues.

Management

• In order to prevent grape leaf spot and black rot, grapevines must be sprayed with fungicides at the appropriate times.

• Spraying the disease shortly before bloom, right after bloom, and a few to fourteen days later provides effective control.

• Three to five weeks after blooming, berries develop a natural resistance against infection. Some fungicides are employed when downy mildew or powdery mildew needs to be managed since they are also efficient against other grape diseases.

• In cases where black rot has been very severe, another treatment of fungicide should be done in the early part of June, or roughly two weeks before bloom in the northern states, when shoot growth has reached a length of 25 to 30 centimeters.

• Among the fungicides available to homes are ziram, myclobutanil, ferbam, fenarimol, and mancozeb. Copper offers a modicum of control for organic farming systems. Observe all instructions and make sure you have read the label thoroughly.

Conclusion

Black rot is one of the most important grape diseases in both commercial and private vineyards. globally cultivated grape crop. It is impacted by black rot diseases, which explains why crop production is declining. Therefore, when we properly manage the grape crop, its output and nutritional value will increase.

References

• Agrios, G.N. (2005). Plant Pathology. 5th Edition.BlackRot of Grapes.Department of Plant

• Pathology University of Florida. Elsevier Academic Press, 30 Corporate Drive, Suite 400, Burlington, MA 01803,USA 525 B Street, Suite 1900, San Diego, California. Pp- 514- 515.

• Y.H.Li. (2020). Black Rot of Grapes. The Connecticut Agricultural Experiment Station (portal.ct.gov/caes).

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Income Generation through Nursery Rising by Farm women

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Introduction

The early stages of plant growth are taken care of in vegetable or fruit nurseries, which offer ideal circumstances for germination and subsequent growth until the plants are robust enough to be put out in their permanent location. A nursery can be as basic as a raised bed in a field or as complex as a greenhouse with controlled atmospheric systems and micro sprinklers. Plant propagation and nursery management are viewed as being equivalent. Despite their differences, they are connected. In truth, nursery management is a trade-oriented dynamic process, which refers to optimal resource utilization for financial gains. The core subject of nursery management is mass multiplication of high-quality planting materials. The purpose of nursery management is to achieve it as a team.

It has now been realized that to achieve higher yield production of good quality seedling is very much essential. Farm women are playing pivotal role in almost every aspect of our society from time immemorial. All phases of agricultural activities from seed sowing to harvesting and processing of crops are intimately done by farm women. They have made important contributions in creating access to human, natural, financial, physical and social capital for making their livelihood sustainable (UNIFEM, 1998). The rural farmwomen are participatory in both farming and non-farming activities directly or indirectly with men. The small farmland and homestead area is being used intensively mostly by women (ADA, Bangladesh, 2004).

Selection of the nursery site

Several factors are responsible for the selection of a suitable nursery site. Some important considerations are as follows:

• Location: A nursery must be located in a pollution-free environment. It must be ensured that the nursery site gets adequate sunlight. However, care must be taken that the plants are protected against severe heat.

• Topography of land: The topography of land at the nursery site must be even. If it is undulating, it must be leveled Soil- The soil must preferably be loam or sandy loam with large quantity of organic matter.

• pH: The pH of the soil must be near neutral (6.5-7.5). It must have adequate water retention capacity and aeration.

• Water- The quality of water used in a nursery is important for the growth of plants. Saline and polluted water must not be used. It must be ensured that there is adequate water supply ' Irrigation . Besides, the nursery must be located near a water source so that there is no water scarcity at any time in the course of raising plants.

• Drainage: The nursery site must have adequate drainage facility and be free from water logging. Water must not stagnate at any time.

• Transportation: The nursery site must be accessible by road. It must not be far from potential markets so that there is no damage to the seedlings during transportation.

• Labour: As nursery work is labour-intensive, the nursery site must have enough number of labourers. Protection from animals, the nursery area must be protected by enclosures so as to prevent damage to the plants by stray animals.

• Market needs and size: Market plays an important role in the success of nursery business. Various type of inputs like seeds, fertilizers, pesticides, fungicides, plant growth regulators, poly bags, agricultural implements, different type of spare parts and other miscellaneous items required in the nursery must be available in the nearby market. The nursery must be located near the city or an area from where people can purchase the plants. Alternatively, a mechanism to explore domestic and international markets must also be worked out for the success of nursery business.

Purpose of the Study

In Bikaner district of Rajasthan had less income is one of the major problems of farm women. The socio-economic status of rural women can be uplifted by creating more income generating activities. The onion is one of the major vegetable crop of this arid zone area. Most of the farmers face the problem of getting quality and healthy onion seedlings at the time of transplanting because they lack the technical know how of producing quality seedlings. Farm women can be made an income generating activities as well as solve the problem of farmers with nursery raising of onion. Nursery raising is one of the few significant income generating activities by which farm women can get income in less time and less expenses. So farm women can develop onion nursery and improve their socioeconomic condition by selling seedlings of onion. Farmwomen can develop the nursery from near the housing available area.

Methodology

This study was carried out by Agriculture department Rajasthan, lunkaransar for three consecutive years from 2019 to 2021 in the two villages i.e. Mahajan and Ramsara of the operational area of the Agriculture department during both season i.e., kharif and rabi. During research of these two villages, it has been observed that very less income of rural women due to unpaid agricultural practices. To solve this problem of farm women 15 front line demonstration was conducted by the Agriculture department, Bikaner to generate additional income by raising of healthy and quality seedlings of onion and seedlings these seedlings to the farmers farm women 200g seed of improved variety of Onion i.e., copper red bulb for kharif and Agri found Light Red for rabi season were distributed to 15 farmwomen (five farm women during each year). Each demonstration was conducted in an area of 250 sq.m. Under farmer practice, farm women sown the seeds by broadcasting methods, flat bed without any seed treatment, whereas in the improved practices seeds were sown in raised bed during kharif and flat bed during rabi in line sowing at 10 cm distance along with seed treatment with bavistin @ 3 g/kg seed. Under the improved practice, soil solarization (for controlling soil born pests) of beds was also done during the month of May and June every year. Seedlings were ready for selling in 45 days after sowing of kharif Onion and 60 days after sowing of rabi Onion. In this demonstration cost of seedling preparation, gross return, net return benefit cost ratio were calculated to estimate the income generated by the farm women. Other parameters like technology gap, extension gap and technology index were worked out.

Conclusion

The importance of good nursery practices cannot be over-emphasized. The nursery should be maintained at the highest standard to ensure healthy, vigorous and uniform quality seedling. There are different factors like high quality hybrid seeds, growing media with good drainage facility and water holding capacity and recommended use of fertilizer and pesticide. Seedlings are uniform germinat-ion and growth in green house condition. Hence, a full-proof planning, adequate investment, sufficient nursery infrastruct-ure, scientific production system, good nursery management practices and maintenance of quality standards of planting material in a comprehensive manner are required for sustainable and profitable nursery. With development of low cost vegetable nursery with empowe-rment of farm women and upliftment of their social and financial status can be a profitable venture. Nursery raising and its management in the village in a new interv-ention being carried out in the villagers. In both of the villages, most of the farm women are small marginal farmers and some are belong to land less family. To improve their skill to increase their socio economic status identify for nursery management training. Nursery raising is an income generating activity for sure land less people.

References

• UNIFEM. Gender consideration in sectoral planning for pacific Island planners in Agriculture, fisheries and forestry, UNIFEM ,Pacific regional office, Suva, December, 1998.

• ADA., Bangladesh: Gender poverty and the millennium development goals. ADB country gender strategy, Bangladesh resident mission and regional and sustain-able development department. Manila, Philippines: Asian development bank, 2004.

• Kadian, K S., Sharma, R. and Sharma, A.K., Evaluation of front line demonstration trials on oilseeds in KangraVally of Himanchal Pradesh. Ann. Agric. Res. 1997;18(40) :230-247.

• Sreenivasa and Ravana Reddy, R.V., Income generation activity through community based nursery raising techniques-A casestudy, International journal of Engineering science invention, 2014; 3(7):40-45.

• Hiremath, S.M., and Nagaraju, M.V., Evaluation of Fron-tline Demonstration trials on Onion In Haveri district of Karnataka". Karnataka Journal of Agricult-ural Sciences.2009;22(5): 1092-1093.

• Mukherjee, N. Participatory, learning and action. Concept, Publishing Company, New Delhi, 2003:63-65.

• Easdown, W. and Ravishankar, M. Study of tomato nursery production practices in selected districts of Maharashtra and Karnataka. World Vegetable Center; 2016; 16(807): 1-40.

• Krishnan, P.R., Kalia, R.K., Tewari, J.C., and Roy. Nursery Raising for Vegetables and Flowers in Greenhouse; 2014;95(2) Plant Nursery Management: 23-33.

• Principles and Practices, Central Arid Zone Research Institute, Jodhpur Maitra, S., Shankar, T., Sairam, M. and Pine, S. Evaluation of gerbera (Gerberajamesonii L.) cultivars for growth, yield and flower quality under protected cultivation. Indian Journal of Natural Sciences. 2020 ;10(60): 20271-20276.

• Pandiyaraj, P., Kumar, Y.R., Vijayakumar, S. and Das, A. Modern nursery raising systems in vegetables. International Journal of Agriculture Sciences. 2019; (52): 4889-4892.

• Prasad, S. and Kumar, U. Greenhouse management for horticultural crops, Agrobios, India, 2007: 476.

• Singh, R.R., Meena, L.K. and Singh, P. High Tech Nursery Management in Horticultural Crops: A Way for Enhancing Income. International Journal of Current Microbiol-ogy and Applied Sciences. 2017; 6(6): 3162-3172.

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Biofumigation for the Management of Soil Borne Plant Diseases

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Introduction

Soil borne diseases are very challenging to control, traditionally chemical soil fumigants were used to manage them but they are harmful to the environment and human health. Biofumigation is based on the incorporation of fresh plant mass into the soil, which will release several substances that would suppress soil borne diseases. Commonaly used biofumigant plants which include brown mustards, white mustards, radishes and rocket species, when these plants are finely chopped and incorporated into the soil, the glucosinolates (GSLs) are converted enzymatically into isothiocyanates (ITCs), the actual active ingredients. Biofumigants mainly target the active stages viz., fungal mycelia, mobile nematodes or germinated weeds. Relative to soil fumigation, biofumigation is economical tool that would provide additional benefits such as, helping to reduce subsequent weed problems, increase soil organic matter, improve nutrient availability and control soil erosion.

Biofumigation is the use of specialized cover crops, which are grown, mulched and incorporated into the soil prior to cropping. High biomass, especially roots, can provide the traditional benefits of green manure crops and if done right, naturally occurring compounds from the biofumigant crops can suppress soilborne pests, diseases and weeds.

The total agricultural losses of economic crops which amount to about 50-75 % are caused by soil-borne pathogenic fungi of *Rhizoctonia* spp., *Fusarium* spp., *Verticillium* spp., *Sclerotinia* spp., *Pythium* spp., and *Phytophthora* spp. The losses are due to seed rot, root rot and wilt diseases in different crop fields and green- houses.

This article summarizes the development of applicable eco-friendly formulations which use natural organic materials to disinfest soil in order to reduce plant diseases caused by soil-borne pathogens.

Common biofumigant crops

Plant such as mustard, rapeseed, sorghum horseradish, broccoli and cauliflower contain organic compounds called glucosinolates. When the tissues of these plants are damaged, biologically active chemical are produced. One of the most important compounds release is isothiocyanate (ITC).

Some commonly used biofumigant crops include

- **Mustard-oilseedcrop**
- **Sorghum-cerealcrop**

Brassica species can be utilized as late summer and early spring(mid july) cover crops. Caliente Mustard Blends can tolerate temperatures to 19.4°F (-7°C), so they can be utilized as late summer and early spring cover crops. The growing period is 8-14 weeks, with maceration and incorporation as they reach early to mid-flowering.

Managing a biofumigant crop

- It is wise to plan ahead when considering sowing biofumigant crops. Determining the sowing window (summer, autumn/ winter or spring) and the purpose of the biofumigant crop: what pest or pathogen is to be targeted, is advised. It is recommended that soil samples be taken prior to sowing the biofumigant crop to determine the population of the pest or pathogen being targeted. For example, the population of PCN eggs/g of soil, the free-living nematode population, the number of powdery scab spore balls/g of soil.

Post-biofumigation, the efficacy of the control can be assessed by taking further soil samples for the targeted pest or pathogen.

- Pick the best biofumigant crop for the time of sowing and the targeted pest or pathogen. Indian mustard, rocket or oil radish each have their favoured time of sowing as outlined above.
- Be aware that some biofumigant crops will provide a breeding ground for clubroot and exacerbate the issue, affecting future brassica vegetable crops and oilseed rape in the rotation. Request information from seed suppliers on varietal resistance to clubroot. Some oil radish varieties are resistant, but most mustards and rocket are not.
- Sourcing the seed is important in order to get the best out of your biofumigant crop. As with arable crops, not all varieties of the biofumigant crops have the same biofumigant potential.
- Seed can be sown by direct drilling or by a seeder mounted on a subsoiler, ideally to a depth of 2-3 cm.
- Seed rates do vary though and are summarised below, but check with seed supplier.

Indian mustard

- Caliente Mustard Superhot 199-8-10 kg/ ha
- Caliente Mustard Rojo-7 kg/ha
- Scala and Vitasso- 5 kg/ha
- Spudguard- 10-15 kg/ha

Oil radish

- Bento- 25-30 kg/ha
- Doublet- 20-25 kg/ha
- To maximise the biofumigation effect of Indian mustard, fertiliser inputs are needed, typically 100- 150 kg/ha of nitrogen and 25-50 kg/ha of sulphur, and irrigation may be required for establishment or to prevent early senescence of the crop.
- Oil radish inputs are nitrogen at 30-40 kg/ha and sulphur at 15-20 kg/ha.

Different ways for use of biofumigant crops for disease control

A. Intercrops and crop rotation with bio fumigants

In this case, above-ground plant material is harvested and hence, activity against plant pathogens relies on GSLs, ITCs or other compounds released through leaf washings or root exudates. Several studies have detected both GSLs and ITCs in the rhizosphere which have been implicated in the suppression of pests and pathogens and soil organisms with myrosinase activity have been shown to mediate the conversion of GSLs to ITCs. Moreover, GSLs and ITCs can affect the composition of rhizosphere communities which may also suppress soil borne plant diseases and some common beneficial microbial species such as *Trichoderma* show high tolerances to ITCs.

B. Incorporation of biofumigants

This is the most recognized use of biofumigant plants where a crop is grown specifically for incorporation with the aim of converting GSLs to ITCs. To achieve high levels of ITC release, comprehensive maceration of plant tissue is required followed by rapid incorporation into soil and addition of water if required to ensure complete hydrolysis. As some ITCs are quite volatile, sealing/smearing the soil with a roller or covering the soil with plastic mulch may be beneficial.

Steps involved in incorporation of biofumigants

- When the plants are flowering (60-80% of the stand is in blossom), the glucosinolate concentration in the biomass is at its highest. The above-ground growth must then be chaffed as finely as possible to break down all the plant cells and thereby release the maximum amount of glucosinolates. The chopped plant material should be immediately worked into the soil at a depth of 15-20 cm (e.g., by rotary cutter, disc harrow or spading machine). This can be done directly if the mass is coming from grown crop or with mass taken from other side and brought into the plot or field of interest. In the latter, the soil should be well prepared before the incorporation.
- Irrigating the soil at its field capacity.
- Covering the soil surface tightly with a transparent plastic film, this could be the same as the one used for soil solarization.
- The film is removed 3-4 weeks after and the soil slightly removed in order to permit the gases to escape from soil.
- Planting of the interested crop can be done 24 hours late.

C.Seed meals and other processed biofumigants

Seed meal produced after the processing of brassica seeds for oil (e.g., in mustard crops) also offer a convenient source of high GSL material for soil amendment as the myrosinase required for hydrolysis to ITCs remains intact. These materials have shown promise against a number of soil borne plant pathogens including Rhizoctonia spp.

D. Green manures and trap crops

As indicated earlier, use of biofumigant crops can have additional benefits in addition to ITC-based disease suppression such as potential (transient) increase in organic matter, better soil structure and nutrient release, all of which may increase plant vigour and growth, hence indirectly reducing the impact of soilborne plant pathogens. The use of green manures and cover crops to control soilborne diseases is the subject of another EIP-AGRI mini-paper and is not further addressed here. Some specific *Brassica* green manures are also used as trap crops for the control of nematodes but again this is outside the scope of this minipaper.

Biofumigant crops for control of soilborne diseases

Growing a *Brassica* as a rotational crop is not ideal for all situations. It is important to know your major disease issues as *Brassicas* can increase levels of some pathogens. *Brassicas* are a host for *Sclerotinia sclerotiorum*, causal agent of white mould and therefore, if this is a significant problem in your potato production, growing *Brassicas* as a biofumigant may not be desirable. In addition, if crucifer cash crops such as broccoli are grown, the *Brassica* cover crop should be used several years before or after these cash crops due to potential issues with club root caused by *Plasmodiophora Brassicae.* This organism causes serious malformation of the roots which will reduce yield and marketability of the cash crop. *Brassicas* have been shown to have a role in controlling *Rhizoctonia* (canker and black scurf), common scab (*Streptomyces scabies*), powdery scab (*Spongospora subterranean*) and *verticillium* wilt (*Verticillium dahliae*). Populations of other pathogen *viz., Aphanomyces* spp., *Rhizoctonia* spp., *Fusarium* spp., *Pythium* spp., *Phytophthora* spp., *Sclerotini* spp., nematodes *viz., Heterodera* (cyst), *Globodera*, *Pratylenchus* and *Tylenchus* and *Meloidogyne species* (*M. chitwoodi* and *M. hapla*) have be also reduced. The use of mustard as a biofumigant has also shown a decrease in damage caused by wireworm. Growing a *Brassica* is not a silver bullet, and having one season/year of *Brassicas* in a 3-year rotation with potato may not result in dramatic changes in disease level.

Benefits of Biofumigation

The benefits of correctly incorporating biofumigant crops include improvements in soil health and a reduction in farm inputs.

- **Soil biology:** Biofumigant crops act as break crops, disrupting the life cycle of pests and diseases. Suppression may result from direct biocidal toxicity as well as indirectly through changes in the soil fauna and microbial community. Populations of beneficial micro-organisms, including mycorrhizal fungi, have been found to increase after biofumigant crops.
- **Weed suppression:** Early vigorous growth and improved plant vigour help to outcompete weeds. When incorporated correctly, the release of isothiocyanates (ITCs) from the biofumigant crop leads to the Verticillium wilt Rhizoctonia root rot Heterodera cyst nematode Phytophthora crown rot Anthracnose crown rot biocidal burning of weed seedlings.
- **Soil organic matter:** Organic matter is replenished in the soil after incorporation of the biofumigant crop. As micro-organisms break down organic matter they produce sticky substances that bind soil particles together into soil aggregates.
- **Nutrient cycling :** Deep-rooted break crops can access nutrients stored deeper within the soil profile that are unavailable to shallow-rooted crops. Better biological activity can lead to improved nutrient cycling and crop nutrient uptake.

Conclusion

Biofumigation has good potential for management of a range of soil borne diseases but much more evidence-based research and development is needed to implement the technique more widely in order to address the main issue of variability. This concept could be used for the management of soil borne diseases under protected cultivation and may also have a future in organic agriculture sector in India. The use of biofumigation and biological disinfestation for pest and disease control should be disseminated to the farmers for proper implementation especially where solarisation and other chemical fumigation is not feasible.

References

- Srivastava, J.N. and Ghatak A. (2017). Biofumigation: A control method for the soil-borne diseases.*International Journal of Plant Protection*, 10(2) : 453-460.
- Kumar,Kiran, G.N., Jayasudha, S.M. and Kumar, Kiran, K.C. (2018). Diseases management by biofumigation in organic farming system. *Journal of Pharmacognosy and Phytochemistry*, 7(4) : 676-679.
- Biofumigation to suppress pests, weeds and diseases. *Farm Advisory Service (2020).*
- Karavana, C. (2012). Biofumigation for crop protection. *Journal of Animal & Plant Sciences*, 14(3).
- Rahman, M. (2022). Utilization of Biologicals and Biofumigation for Effective Management of Soilborne Diseases in Fruits and Vegetables. *Northeastern IPM Center.*

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Storage Condition on Qualities of Carrot

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Introduction

Carrot is a biennial herb with conical fleshy tap root and cultivated throughout India. In south and central India, it is cultivated largely in hill stations. The yield of carrot varies with the variety (20,000 to 30,000 kg/hectare). It has medicinal value and is supposed to have anti-cataract and anti-cancerous properties (Sen, 1996; Panday, 2001). Carrots are an excellent source of antioxidant compounds, and the richest vegetable source of the pro- vitamin A carotenes. The nutrients stored in fruits and vegetables are utilized by microorganisms after converting them into simpler ones (Bagwan *et al.*, 2010). Post-harvest infection of fruits and vegetables may induce a number of alterations in their physiological and biochemical processes or in the host tissues constituents, as a result of host-pathogen interactions (Bagwan, 2006; Chourasia *et al.*, 2010). The struggle between the capacity of pathogen attack and the defense capability of the host will dictate the success or the failure of the infection. In various host pathogen systems, fruit infection results in the decrease, increase or total disappearance of the biochemical content of the fruits (Barkai- Golan, 2005). In addition that out of the various environmental factors temperature and humidity plays a significant role in the host- pathogen interaction Therefore, refrigerated and cool storage rooms are used in order to control post- harvest decay during storage.

Collection and isolation of rot inducing mycoflora

Samples of rotted carrots were collected into fresh polythene bags from different local markets. Care was taken to avoid completely rotten vegetables in order to avoid secondary growth of the fungi. The disease symptoms were carefully recorded. Samples of rotted root vegetables were surface sterilized with 70% alcohol for 60 sec or 0.01 % sodium hypochlorite solution for two minutes and washed thrice with sterile distilled water and blotted dry with sterile filter paper. The infected parts were sliced into small cubes and plated onto Petri dishes having different media. Triplicates were maintained. The plates were incubated at 28±2°C for 3 days. Petri dishes were observed daily and colonies of fungi were chosen. The isolated fungi were purified using single spore technique, and then kept in a refrigerator on PDA slants in Macartney bottles (Gams *et al.*, 1998). Morphological and cultural characters of organisms were also recorded. Pure colonies of fungal isolates were identified according to Ellis (1971, 1976), Domsch *et al.*, (1980) and Moubasher (1993), Nagamani *et al.*, (2006) and confirmed their pathogenecity as per Kochs postulates.

Pathogenecity test

Pathogenicity test was conducted by following the method given by Odebode and Unalchuvu (1997). Healthy vegetables were swabbed with cotton wool soaked with 70% alcohol and washed with several changes of sterile distilled water. A hole was aseptically bored into each root using a 5 mm diameter cork borer and the core was carefully removed. One 3 mm mycelial disc of the 7 day old culture was cut from the edge of the colony and inserted into the hole in the root and the core was then replaced the wound was sealed off by means of petroleum jelly. The other technique used was to dip untreated roots into a spore/mycelia suspension of the isolates. The inoculated vegetables were arranged in sets of three in clean polythene bags, containing wet absorbent cotton wool to create a micro-humidity chamber, and were incubated at 28°±2° C for 7 days. Following this, cuts along the plane of inoculation were made using a sterile scalpel and rot was assessed by measuring the diameter of rot for each fungal isolate.

Effect of physical factors (Temperature and relative humidity) on rot enhancement.

The effect of different temperatures and humidity levels on the rate of disease advancement was studiedby using the methods of Odebode and Unalchuvu (1997) on commonly occurring pathogens such as, Rhizopus arrhizus, Sclerotium rolfsii and Fusarium solani which are causing storage rots on carrot. Carrot was artificially inoculated with above mentioned fungi individually to find the effect of different RH and temperature levels on disease advancement. Almost of same size and same age grouped of carrots were selected from the Local markets.

Apparently healthy vegetables were surfaced sterilized with 70% alcohol for 60 sec and washed in sterile distilled water and blotted dry with sterile filter paper. They were checked for internal contamination. Later they were artificially inoculated with the above pathogens, and incubated for 7 days at different temperature (10°C, 15°C, 20°C, 30°C and 35°C) and relative humidity (40%, 50%, 60%, 70%, 80% and 90%) levels. Three replicates were maintained in each case. Samples were collected at 7th day, cuts were made along the plane of inoculation using a sterile scalpel and rot was assessed by measuring the diameter of rot for each fungal isolate.

Biochemical changes during rot development

Biochemical changes in the host tissue due to pathogenesis were studied in relation to three post- harvest pathogens on carrot was inoculated with Fusarium solani, Rhizopus arrhizus and Sclerotium rolfsii. Healthy hosts were surface sterilized and artificially inoculated with the pathogens and incubated at 28°± 2° C in moist chamber for 7 days. Five replicates were maintained for each series including the control. Ethanol extract of fresh host tissue was prepared at the beginning of the experiment, while for healthy and infected tissue; the ethanol extract was prepared at every three days interval from the incubated carrots. Ethanol extract was prepared from healthy and inoculated carrots for the estimation of biochemical changes or bio deterioration.

Effect of brick wall evaporative cool chamber

In order to find out reduction in rot development and enhance shelf-life of carrots, experiment was carried out by using brick wall evaporative cool chamber which was constructed with modified method of Babarinsa *et al*., (1997) with locally available materials in rural areas in various agro climatic conditions where humidity is low and temperatures are high, materials like generated from a mixture of formaldehyde and KMnO4 crystals.

Inoculated and un-inoculated carrot samples were examined daily for decay and enhancement of shelf-life, respectively.

Temperature

At 10°C, 15°C and 40°C there was no rot development. The optimum temperature for rot development was between bricks and bamboo frame, khus-khus and gunny bags were used. This chamber can provide inside temperature and relative humidity in between 12º C - 15º C and 85- 90%, respectively. Carrots were washed 20°C- 35°C, while maximum rot appeared at 35°C. Rhizopus arrhizus and S. *rolfsii* showed maximum rot at 35°C whereas F.*solani* exhibited at 30°C. The maximum and minimum rot was observed by S. *rolfsii* at thoroughly under tap water, any vegetables with skin blemishes were removed. 35°C and 20°C respectively. In the present study, the effect of temperature on the development of rot showed that no fungal. In order to find rot development and shelf-life at both conditions, Inoculated carrots for rot and un-inoculated carrots for shelf-life were placed in ambient conditions (open laboratory) and brick wall cool chamber. Each treatment was replicated three times and each replicate contained 20 bags of three carrots. Each treatment replicate was scored in one of two systems: ambient, 17-34°C and 16-40% relative humidity (RH); in brick cooler, at 15°C-17°C and 85-98% RH.

Relative Humidity (RH)

The relative humidity had a great impact on the subsequent rot development within 7 days. The maximum rot development occurred between 70% - 90% RH. Rhizopus arrhizus and F. *solani* showed maximum rot development at 90% whereas S.*rolfsii* had significant rot at 70% RH. Minimum rot development was observed with F. solani at 40% RH. For the development of rot, R. *arrhizus* needs 35°C and 90% RH, S. rolfsii requires 35°C and 70% of RH and F. solani needs 30°C and 90%. For the development of rot, R. arrhizus, S. rolfsii and F. solani require 35°C and 90% RH, 35°C and 70% of RH and 30°C and 90%, respectively. The results showed that there is a positive and significant relationship among RH, temperature and rot development.

Storage Methods

Rot development at ambient and cool chamber carrots at both, room temperature and brick wall cool chamber. Carrots inoculated with three pathogens were placed in open (unpacked), sealed polythene bags, perforated polythene bags and stored at both Room temperature and brick wall cool chamber in order to find out rot development and to know the efficacy of cool chamber in the controlling of carrot root rots caused by three pathogens during storage. Maximum rot was observed in carrots placed in sealed polythene bags due to high moisture while minimum rot was found in carrots packed in perforated polythene bags stored at ambient temperature. No rot was found in carrots placed in open, polythene and perforated bags stored at brick wall cool chamber as well as carrots stored in open condition at ambient temperature. This could be lack of appropriate temperature for rot development at cool chamber and due to desiccation at ambient temperature. optimum temperature and Rh for R. *arrhizus*, S. rolfsii and F. solani to develop of rot in carrots were 35°C and 90% RH, 35°C and 70% of RH and 30°C & 90%, respectively. Though cool chamber provides high RH (85- 90%), pathogens could not show any rot at cool chamber. This could be due to low temperature 10 °C-17°C in cool chamber.

Shelf-life of carrot

shelf-life of carrots packed in open bunch, sealed polythene bags and perforated polythene bags stored at both, room temperature and cool chamber. Shelf- life of carrots was significantly more at cool chamber than room temperature. Among three packing systems, perforated polythene bag system showed maximum shelf-life. However, brick wall cool chamber is the best storage method for controlling root rot and enhancement of shelf-life of carrot. It is the best storage method and also affordable to the farmers and local market venders.

References

• Babarinsa, F. A. Williams, J. O. and Osanu, F. C. (1997). Storage of carrots in brick wall cooler under semi-arid condtions. Trop.Sci. 37: 21-27.

• Bagwan, N. B. (2010). Post-harvest pathogens of mango (Mangiferindica) and their effect on fruits quality. J. Mycol Pl Pathol., 40 (3): 352-55.

• Bagwan, N.B. (2006). Biochemical changes in apple fruits due to post-harvest fungal pathogens. Indian J. Plant Protection. Plant protection Association of India. CABI abstracts.

• Barkai-Golan, R. (2005). Post-harvest diseases of fruits and vegetables; Development and Control. Department of Post-harvest Science of Fresh Produce. Institute of Technology and Storage of Agricultural Products.

• Chourasia, H. K. and GyanaNandJha (2010). Fruit rot diseases of guava and physiochemical changes in fruits under pathogenesis. J. Mycol Pl Pathol.40 (3): 432-35.

• Domsch, K. H., Gams, W., Anderson, T. H. (1980). Compendium of soil Fungi, Academic press, New York, USA.

• Ellis, M.B. (1971). Dematiaceous Hyphomycetes, CMI, Kew, Surrey, UK. pp.607

• Ellis, M.B. (1976). More DematiaceousHyphomycetes CMI, Kew, Surrey, UK. pp.507

• Gams, W., Hockstora, E. S., Aptroot, A. (1998). CBS course of Mycology. 4th Ed. Central bureau voorschimmel cultures, Baan, The Netherlands.

• Klich, M.A. (2002). Identification of common Aspergillus species. CBS, Utrecht. p.116.

• Llyas, M. B., Ghazanfar, M.U., Khan, M. A., Khan, C. A. and Bhati, M. A. R. (2007). Post- harvest losses in apple and banana during transport and storage. Pak. J. Agri. Sci. 44: 534-539.

• Lowry, O. H., Rosenbrough, N. J., Farr, A. L. and Randall. R. J. (1951). Protein measurement with folinphenol reagent. J. Biol. Che. 193: 265-275.

• Moubasher, A. H. (1993). Soil Fungi in Quatar and other Arab contries. The centre for scientific and Applied Research, University of Quatar.

• Mukherjee, P. and Raghu, K. (1997). Effect of temperature on antagonistic and biocontrol potential of Trichodermaspp. On Sclerotiumrolfsii.Mycopathologia. 139: 151-155.

• Nagamani, A., Kunwar, I. K. and Manoharachary, C. (2006). Hand Book of Soil Fungi. I. K. International Pvt. Ltd.

• Odebode, A. C.,Unachulwu, N. E. (1997). Effect of storage environment on carrot root rot and biochemical changes during storage. Z LebensmUntersForschA. 205: 277-281.

• Pandey, B. P. (2001). Economic botany. S. Chand and Company Ltd. New Delhi. Patel, K. D. and Pathak, V. N. (1996).

• Temperature related humidity in relation to development of Rhizopusrat of guava fruits. Indian J. Mycol. Pl. Pathol. 26: 9-13.

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Need of Sustainable Growth for Future

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Introduction

According to the definition of sustainable development, it is "meeting the needs of the present without compromising the ability of future generations to meet their own needs." It is an efficient use of resources for economic growth while protecting the ecosystem and environment, ensuring that not only the requirements of the present but also those of future generations are met. The growth of the environment and ecosystem as well as their carrying capacity is linked by sustainable development. Sustainability preserves the environment's health and bio capacity. Individuals and communities' well-being is supported by sustainability. A more sustainable economy encourages less waste and pollution, fewer emissions, more jobs, and a more equitable distribution of wealth.

The increase in population in industrialized nations over the last 20 years has been somewhere about 28%. Numerous issues, including environmental deterioration and an over reliance on non-renewable energy sources, are being faced by these nations, which has led to a drop in living standards. With no sacrifice to the resources availability for future generations, sustainable development tries to promote growth that is in line with current demands. Sustainability focuses on the enduring protection of strength and possessions alternatively their continual use to meet next necessities. Industries are harming the environment as a result of the urbanization process by continuously using natural resources. Environmental deterioration spurred on by rising population, economic growth, and deforestation has put human survival in danger. The number of cars and factories has increased, and as a result, the earth is being polluted by greenhouse gasses like carbon dioxide and methane, which has caused the temperature to rise. The ice caps are melting as a result of the greenhouse gasses which are raising the sea level.

Causes of Unsustainable Development

The important issues is s the rate of increase of total Pollution. In this regard developed countries contribute much more than developing countries. Some people argue that raising population in the third world countries to be the crucial pollutant and it is essential to control it by all means. People should look at environment as not only reserve of man but of all living organism, so development has to sustain not only for man but also for all Living organisms.

The 3-R approach for sustainable development

Advocating minimization of resource use, using them again and again instead of passing it on to the waste stream and recycling the materials goes a long way in achieving the goals of sustainability. It reduces pressure on our resources as well as reduces waste generation and pollution.

Strategies for sustainable future

The world's carbon emissions decreased by almost 8% in 2020, the largest reduction ever observed, but the year was nevertheless full of setbacks for the global sustainability and climate goals. On the good side, a number of initiatives towards a greener future are also accelerating quickly. Some of the trends and advancements that are shaping a more sustainable future for our planet these are:

1. Renewable and Nuclear Hold Promise for Net Zero Energy

According to an info graphic based on the most recent Climate Watch statistics, 73.2% of the world's greenhouse gas emissions are attributable to energy use. In fact, the rise of renewable energy sources like solar and wind over the past year has been unprecedented, increasing by 23% and 12%, respectively. According to data from the International Energy Agency (IEA), renewable energy usage rose by 3% last year despite a fall in all other energy consumption. Also showing no signs of slowing down, the output of renewable is anticipated to increase by 2030."Green hydrogen" is a technology that is gaining popularity quickly. This type of hydrogen fuel is created using energy from renewable, low-carbon sources like sum and wind. In recent years, the price of green hydrogen has been continuously declining.

2. EVs Lead Clean Transportation Efforts

Prior to the pandemic, road transport was responsible for 73.4% of all greenhouse gasemissions from transportation or 16.2% of total emissions. In the effort to decarbonizestransportation, electric vehicles (EVs) are in the forefront. This explains why 18 of the top 20 automakers, which account for roughly 90% of worldwide auto sales, have moved or committed to transition, either totally or considerably, to electric vehicles. The government's increasing efforts to reduce carbon emissions are another major driver of the EV revolution. Through developments like the solid-state battery, which promises charging speeds of just 10 minutes to reach a full battery and a range of over 300 miles on asingle charge, manufacturers are attempting to address these issues.

3. New Methods, Materials, and Tech Transform Construction

According to data from the World Green Building Council, building and construction are responsible for almost 39% of the global carbon emissions or around 9 billion tons annually. By 2030, building's energy intensity was to be reduced by 30% per square meter, and by 2050, the entire construction sector was to be net carbon neutral. This transformation is being made possible by greener construction techniques like prefabrication, modularization and digitalization. These methods enable elements to be built separately and integrated with customization possibilities, resulting in up to 30% reduced carbon footprints than building structures on-site from scratch. The rest of the world is catching up, with Africa and Asia seeing an increase in the trend (theuse of prefinished modules is already mandatory for all government housing in Singapore. A variety of newer, less-impactful building materials including cross-laminated wood in place of steel, ethylene tetra fluoro ethylene (ETFE) in place of glass, mycdium (a type of fungus spore) in place of bricks, and cutting-edge materials like grapheme that can reduce the need for concrete, all promise to lessen our environmental impact and alter the way we construct our structures.

4. Greener Packaging unwraps a Cleaner Future

Packaging is perhaps the next most harmful part of human behavior that is hurting the health and future of the world after energy usage. The omnipresent plastic cover and its numerous packaging siblings have reached even some of themost remote regions of the globe, while millions of people may have little orno approach to energetic taxis or even common conveyance. But during the past five years, more nations than ever before have passed severe laws are prohibiting the use of single-use plastics and there are currently more than 127 nations that have outlawed their use businesses are likewise altering their procedures to comply with these regulatory trends.

Conclusion

Globally urgent action is required due to the environment's deterioration in physical, chemical, and biological aspects. Co-managing the social, economic and environmental processes in a sustainable manner should be possible with the support of concerted efforts to integrate natural and manmade systems. The gap between policy, sustainable science, and action should be obvious. In order to effectively implement national policies, the decision-making process should include science and other types of knowledge into the policies and institutionalize the means for doing so.

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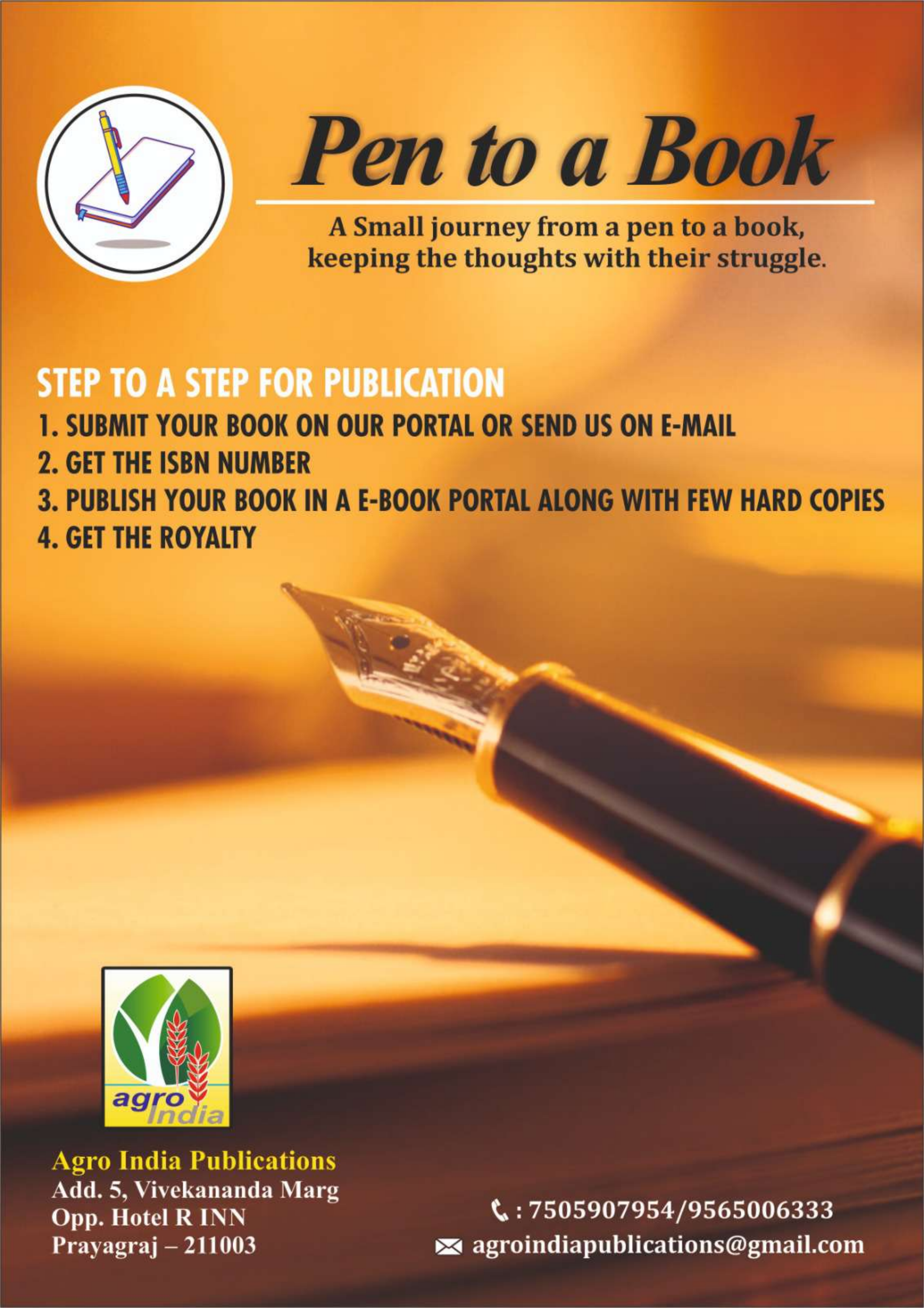
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Major Diseases of Cotton and Their Management

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Introduction

Cotton is one of the most important fiber and cash crop of India and plays a dominant role in the industrial and agricultural economy of the country. It provides the basic raw material (cotton fibre) to cotton textile industry. Cotton in India provides direct livelihood to 6 million farmers and about 40 -50 million people are employed in cotton trade and its processing. In India, there are ten major cotton growing states which are divided into three zones, viz. north zone, central zone and south zone. North zone consists of Punjab, Haryana, and Rajasthan. Central zone includes Madhya Pradesh, Maharashtra and Gujarat. South zone comprises Andhra Pradesh, Telangana, Karnataka and Tamil Nadu. Besides these ten States, cotton cultivation has gained momentum in the Eastern State of Orissa. Cotton is also cultivated in small areas of non-traditional States such as Uttar Pradesh, West Bengal & Tripura.

There are four cultivated species of cotton viz. *Gossypium arboreum*, *G. herbaceum, G. hirsutum* and *G. barbadense*. The first two species are diploid (2n=26) and are native to old world. They are also known as Asiatic cottons because they are grown in Asia. The last two species are tetraploid (2n=52) and are also referred to as New World Cottons. *G. hirsutum* is also known as American cotton or upland cotton and *G. barbadense* as Egyptian cotton or Sea Island cotton or Peruvian Cotton or Tanguish Cotton or quality cotton. *G. hirsutum* is the predominant species which alone contributes about 90% to the global production. Perhaps, India is the only country in the world where all the four cultivated species are grown on commercial scale.

Nearly 65 percent cotton area is rainfed, mainly in the Central and Southern States, Cotton crop is highly prone to pests and diseases. Wide fluctuation in cotton prices, inadequate market infrastructure and cotton export policy. Cotton, a semi-xerophyte, is grown in tropical & sub tropical conditions. A minimum temperature of 15ºC is required for better germination at field conditions. The optimum temperature for vegetative growth is 21-27ºC & it can tolerate temperature to the extent of 43ºC but temperature below 21ºC is detrimental to the crop. Warm days of cool nights with large diurnal variations during the period of fruiting are conducive to good boll & fibre development.

Fusarium wilt

It is caused by *Fusarium oxysporum* f.sp. *vasinfectum*, this is a common disease of cotton occurring at any stage of the growth. In young and grown-up plants, the first symptom is yellowing of edges of leaves and area around the veins i.e., discolouration starts from the margin and spreads towards the midrib. The leaves loose their turgidity, gradually turn brown, droop and finally drop off. Symptoms start from the older leaves at the base, followed by younger ones towards the top, finally involving the branches and the whole plant. The defoliation or wilting may be complete leaving the stem alone standing in the field. Sometimes partial wilting occurs, where in only one portion of the plant is affected, the other remaining free. Browning or blackening of vascular tissues is the other important symptom, black streaks or stripes may be seen extending upwards to the branches and downwards to lateral roots. In severe cases, discolouration may extend throughout the plant starting from roots extending to stem, leaves and even boils. In transverse section, discoloured ring is seen in the woody tissues of stem.


Management

Remove and burn the infected plant debris in the soil after deep summer ploughing. Apply farm yard manure or other organic manures @ 4t/ac. Follow mixed cropping with non-host plants to reduce the soil temperature below 200C by providing shade. Treat the acid-delinted seeds with Chlorothalonil at 4 g/kg of seed. Seed treatment with Bacillus subtilis (10g/kg) or Trichoderma asperellum @ 4 g/kg. Apply Trichoderma asperellum @ 1 kg/ acre, twice in the soil during sowing and 90 DAS. Multiply 1 kg of T. asperellum in 100 kg of Farm yard manure for 15 days before application. Spot drenching with Carbendazim 50%WP @1g/ lit of water.

Verticillium wilt

It is caused by *Verticillium dahlia,* this is a common disease of cotton occurring at any stage of the growth. The symptoms are seen when the crop is in squares and bolls. Plants infected at early stages are severely stunted. The first symptoms can be seen as bronzing of veins. It is followed by interveinal chlorosis and yellowing of leaves. Finally the leaves begin to dry, giving a scorched appearance. At this stage, the characteristic diagnostic feature is the drying of the leaf margins and areas between veins, which gives a "Tiger stripe" or "Tiger claw" appearance. The affected leaves fall off leaving the branches barren. Infected stem and roots, when split open, show a pinkish discolouration of the woody tissue which may taper off into longitudinal streaks in the upper parts and branches. The infected leaf also show brown spots at the end of the petioles. The affected plants may bear a few smaller bolls with immature lint.

Management

Remove and destroy the infected plant debris after deep ploughing in summer months (June-July). Apply heavy doses of farm and manure or compost at 100t/ha. Follow crop rotation by growing paddy or lucerne or chrysanthemum for 2-3 years. Treat the delinted seeds with Carboxin or

Carbendazim at 4 g/kg. Spot drench with 0.05 per cent Benomyl or Carbendazim. Grow disease resistant varieties like Sujatha, Suvin and CBS 156 and tolerant variety like MCU 5 WT.

Root rot

It is caused by *Rhizoctonia bataticola,* this is a common disease of cotton occurring at any stage of the growth. The fungus causes three types of symptoms *viz*., seedling disease, sore-shin and root rot. Germinating seedling and seedlings of one to two weeks old are attacked by the fungus at the hypocotyl and cause black lesions, girdling of stem and death of the seedling, causing large gappiness in the field. In sore-shin stage (4 to 6 weeks old plants), dark reddish-brown cankers are formed on the stems near the soil surface, later turning dark black and plant breaks at the collar region leading to drying of the leaves and subsequently the entire plant. Typical root rot symptom appears normally at the time of maturity of the plants. The most prominent symptom is sudden and complete wilting of plants in patches. Initially, all the leaves droop suddenly and die with in a day or two. The affected plants when pulled, reveal the rotting of entire root system except tap root and few laterals. The bank of the affected plant shreds and even extends above ground level. In badly affected plants the woody portions may become black and brittle. A large number of dark brown sclerotia are seen on the wood or on the shredded bark.

Management

Apply farm yard manure at 10t/ha or neem cake at 2.5t/ha. Adjust the sowing time, early sowing (First Week of April) or late sowing (Last week of June) so that crop escapes the high soil temperature conditions. Adopt intercropping with sorghum or moth bean (*Phaseolus aconitifolius*) to lower the soil temperature. Treat the seeds with *Trichoderma viride* @ 4g/kg or *Pseudomonas fluorescens* @ 10g/kg of seed. Treat the seeds with Carboxin or Thiram at 5 g or Carbendazim at 2g/kg. Spot drench with 0.1% Carbendazim or 0.05% Benomyl.

Alterneria leaf blight

It is caused by *Alternaria macrospora,* this is a common disease of cotton occurring at any stage of the growth. The fungus infects the seedlings and produces small reddish circular spots on the cotyledons and primary leaves. The lesions develop on the collar region, stem may be girdled, causing seedling to wilt and die. In mature plants, the fungus attacks the stem, leading to stem splitting and shredding of bark. The most common symptom is boll spotting with small water soaked, circular, reddish brown depressed spots on the bolls. The lint is stained to yellow or brown, becomes a solid brittle mass of fibre.

Management

Remove and burn the infected plant debris and bolls in the soil. Rogue out the reservoir weed hosts. Treat the acid-delinted seeds with Chlorothalonil at 4 g/kg of seed. Spray Mancozeb or Copper oxychloride @ 500 g/ acre, at boll formation stage. Four to five sprays may be given at 15 days interval.

Bacterial blight

It is caused by *Xanthomonas campestris p.v malvacearum,* this is a common disease of cotton occurring at any stage of the growth. The bacterium attacks all stages from seed to harvest. Usually five common phases of symptoms are noticed.

i) Seedling blight

Small, water-soaked, circular or irregular lesions develop on the cotyledons, Later, the infection spreads to stem through petiole and cause withering and death of seedlings.

ii) Angular leaf spot

Small, dark green, water-soaked areas develop on lower surface of leaves, enlarge gradually and become angular when restricted by veins and veinlets and spots are visible on both the surface of leaves. As the lesions become older, they turn to reddish brown colour and infection spreads to veins and veinlets.

iii) Vein blight or vein necrosis or black vein

The infection of veins cause blackening of the veins and veinlets, gives a typical 'blighting' appearance. On the lower surface of the leaf, bacterial oozes are formed as crusts or scales. The affected leaves become crinkled and twisted inward and show withering. The infection also spreads from veins to petiole and cause blighting leading to defoliation.

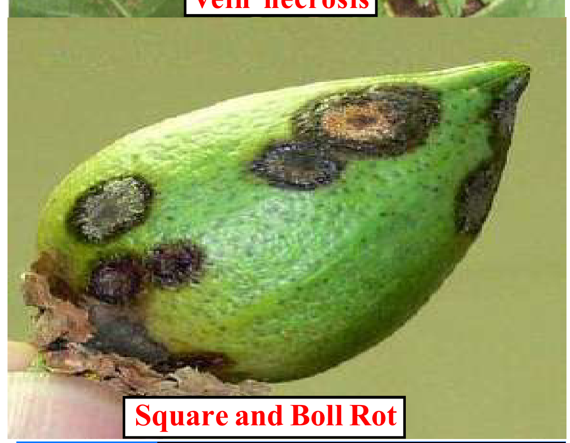
iv) Black arm

On the stem and fruiting branches, dark brown to black lesions are formed, which may girdle the stem and branches to cause premature drooping off of the leaves, cracking of stem and gummosis, resulting in breaking of the stem and hang typically as dry black twig to give a characteristic "black arm" symptom.

v) Square rot / Boll rot

On the bolls, water-soaked lesions appear and turn into dark black and sunken irregular spots. The infection slowly spreads to entire boll and shedding occurs. The infection on mature bolls lead to premature bursting. The bacterium spreads inside the boll and lint gets stained yellow because of bacterial ooze and looses its appearance and market value. The pathogen also infects the seed and causes reduction in size and viability of the seeds.

Vein necrosis



Square and Boll Rot

Management

Delint the cotton seeds with Concentrated sulphuric acid at 100ml/kg of seed. Treat the delinted seeds with Carboxin or Oxycarboxin at 2 g/kg or soak the seeds in 1000 ppm Streptomycin sulphate overnight. Remove and destroy the infected plant debris. Rogue out the volunteer cotton plants and weed hosts. Follow crop rotation with non-host crops. Early thinning and early earthing up with potash. Grow resistant varieties like Sujatha, 1412 and CRH 71. Spray with Streptomycin sulphate +tetra-cycline mixture 100g along with copper oxychloride at 2kg/ha or spray Copper oxychloride alone at 2.5kg/ha.

Conclusion

These diseases remain a persistent challenge in cotton cultivation, threatening both crop yields and quality. Vigilance, preventative measures, and integrated disease management approaches are vital to combat these fungal and bacterial infections effectively. Researchers and farmers must continue to work together to develop resilient cotton varieties and sustainable practices to minimize the impact of these diseases on cotton production.

References

- Kalpana, P., Chellamuthu, V. and Jeyalakshmi, C. (2004). Screening of cotton hybrids against bacterial blight incited by Xanthomonas campestris pv. malvacearum (Smith) Dye, *Paper presented in Inter. Symp. Strat. Sust. Cotton Prod*.-A Global Vision 3, Crop Production, 23-25 November 2004, Univ. Agric. Sci., Dharwad (India), pp. 373-374.
- Mishra, S. P. and Krishna, A. (2001). Assessment of yield potential losses due to bacterial blight of cotton. *Journal of Mycology and Plant Pathology*. 31: 232- 233.
- Sekhon, P. S., Singh, D. and Singh, G. (2008). Cotton pathology research achievements and targets in Punjab. All India Coordinated Cotton Improvement Project Report. PAU, Ludhiana.
- Sandipan, P.B., Patel, R. K., Faldu, G. O. and Patel, D. M. (2019). Status of Different Diseases of Cotton under South Gujarat Region of India. *International Journal of Current Microbiology and Applied Sciences*. 8(10): 2651-2657.
- https://agritech.tnau.ac.in/crop_protection/cotton_diseases/cotton_d9.html
- https://aiccip.cicr.org.in/NZ-RJ-Snagar.html
- https://circot.icar.gov.in/en/sirsa/

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Role of Vegetable in Nutrition and Medicine

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Introduction

Vegetables are annual or perennial horticultural crops, with certain sections (roots, stalks, flowers, fruits, leaves, etc.) that can be consumed wholly or partially, cooked or raw.

Vegetables are important for human nutrition in terms of bioactive nutrient molecules? such as dietary fiber, vitamins and minerals and non-nutritive phytochemicals (phenolic compounds, flavonoids, bioactive peptides, etc.). These nutrient and non-nutrient molecules reduce the risk of chronic diseases such as cardiovascular diseases, diabetes, certain cancers, and obesity.

Classification of vegetables

There are approximately 10,000 plant species used as vegetables in the world. Classification of these species can be done by considering a common set of features. It is important for food researchers, dietitians and nutrition educators to subcategorize vegetables by taking into account health and nutrition. This subcategorization will be more useful if it is based on similarities in food composition. Vegetables can be classified according to the part of the plant used for nutrition and the specific nutritional value.

Green vegetables, Leaf vegetables, Stalk vegetables, Fruit and flower vegetables, Root, bulb and tuber vegetable

Leaf vegetables

- This group includes spinach, lettuce, curly lettuce, etc.
- These are sources of important minerals like iron and calcium, vitamin A, C and fiber.
- Young fresh leaves contain more vitamin C than mature plants.
- Recommended daily intake of green leafy vegetables is 40g for an adult

Stalk vegetables

- The best examples to be given to stalk vegetables are vegetables are celery and asparagus.
- They contain minerals and vitamins in proportion to the green colour.
- Asparagus is a particularly rich sources of folic acid.

Flower vegetables

- Broccoli and cauliflower are frequently consumed flowering vegetables.
- Broccoli is good source of iron, phosphorous, vitamin A and C and riboflavin.
- Cauliflower is also a good source of vitamin C. The nutritional value of the outer leaves of cauliflower and broccoli is much higher than the flower buds. They can be consumed raw in salads or cooked.
- Tomatoes and peppers are most common fruit vegetables. Both are rich in vitamin C.
- A dark green or yellow color, the higher the content of β-carotene content. The darker the yellow color, the higher the content of β-carotene.

Root vegetables

- Root, bulb and tuber vegetables

• Carrot, beetroot, turnip, onion, radish and potato are examples of this group of vegetables.

• Yellow and orange varieties are rich in β-carotene, which is the precursor of vitamin A. Carrots are exceptionally high in beta carotene.

• Onion is an extraordinary example of root vegetables and contain moderate levels of vitamin C.

• Recommended daily intake of root vegetables is 50-60 g for an adult

Colour classification and health benefits

Colors	Vegetables	Photochemical vitamins & minerals
Green	**Vegetables** Asparagus, Broccoli, Brussels, celery, Greens, Collard greens	Glucosinolates, Floate, Isothiocyanates, Vitamin K, folic acid, Vitamin C
Red Blue Purple	**Vegetables** Beets, radish, tomatoes, red peppers, red onion	Lycopene, anthocyanins, flavonoids, resveratr, vitamin C, floates

• **Data Sources:** Six electronic databases (BioMed Central, MEDLINE, Web of Science, CINAHL, Scopus, PsycINFO) were searched from database inception to December 2015.

• **Study Selection:** The search strategy used the following sets of descriptors: adolescents; fruits and vegetables; cardiovascular risk indicators; cross-sectional and cohort studies.

Traditional Leafy Vegetables: A Future Herbal Medicine

• **Scientist: Vaishali S. Kamble *et al.***

Traditional medicine system plays an important role in rural areas. It is based on knowledge, skills and information about the plants or plant parts to be used for different purposes. Ethnobotanical investigation has renewed interest in traditional medicine, particularly the herbal medicines.

The present paper focus on ethnomedicinal properties of some non cultivated green leafy vegetables from various regions of Kolhapur district of Maharashtra. On the basis of collected ethnobotanical information through field survey and literature studies, it is observed that they are used as tonics, antioxidants, cooling, digestive, laxative, diuretic etc. by rural people.

Conclusion

• On the basis of this preliminary data it is noted that the plants noted are used as vegetables as well as to cure various disorders. So that it is believed that these species must contain some potentially important bioactive components.

• By quantifying the important active ingredients of the potentially important plants they were introduced as future medicinal plants.

• To avoid the side effects of synthetic drugs these herbal drugs used traditionally are initiated as a future medicines as they didn't have any side effects.

• To conserve this traditional knowledge there is an urgent need of public awareness about these nature's doctors.

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Breeding Program of Okra (*Abelmoschus esculentus*)

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Introduction

Okra is generally known as "Lady's finger", 'Gumbo' or 'Bhindi', is a popular crop of the world grown for vegetable purpose. It is one of ancient and economically important crops cultivated throughout the tropical and sub-tropical zones for its fibrous edible pods. Enriched with various vitamins, minerals, calcium, carbohydrates, proteins and dietary fibre. Seed proteins of okra have balanced proportion of amino acids like tryptophan and lysine comparable to that of other sourceof proteins present in legumes. Seeds of okra (*Abelmoschus esculentus*) are a potential source for extracting edible oil (20-40%), with high constitute of linoleic acid (48%) which have health benefits for patient suffering from cardiovascular problems **(Gemede *et al.,* 2015)**. Conventional breeding practices have always been an answer to enhance that desired qualitative and quantitative traits in crop species, where as genetic diversitystrengthens the identification process of diverse genotypes **(Nagesh *et al.*,2014)** suggested the exploitation of heterosis as a widely accepted approach for commercial production in okra. It is also a known fact that high divergence between parental germplasm revealed high level of heterosis within the cross combinations **(Patel and Patel, 2016)**. More authors suggested extensively utilization of conventional breeding techniques for examining genetic diversity and exploitation of hybrid vigour in okra germplasms in terms of yield, nutritional quality and adaptability **(Nagesh *et al.*, 2014)**. Heterosis analysis using conventional approaches is mainly based on identification and phenotypic screening of desirable traits, although it has always been an effective technique to study the magnitude of heterosis. However, the major constraints of conventional breeding practices are dependency of desirable morphological characters on environment, labour intensive as well as time consuming process for evaluation of these characters.

Materials and Methods

The following materials were used in the proximate analysis: Dessicator, muffle furnace, spectrometer, silica dish, Kjeldahl flask, funnel, Soxhlet apparatus, filter paper, thimble, electric oven, grinder, retort stand, test tube and test tube rack, crucible, weighing balance, petri dish. The chemicals used include: Tetrahydrosulphate (vi) acid, Boric acid indicator solution, Sodium hydroxide, Hydrochloric acid, Petroleum ether, Potassium hydroxide, Acetone, Phenolphthaline indicator, Ammonia, Dithezone solution, Carbon tetrachloride, *Hydroquinoline*, *Phenonthroline*, *Vanado Molybidic acid*, *Selenium oxide*. **(Chiafor 2017).**

(Alam 2021) conducted the experiment for the best quality parental line selection of okra (*Abelmoschus esculentus*) varieties based on morpho-physiological and nutritional attributes. Significant variations were observed for the measured morpho-physiological and nutritional attributes among those varieties. Among the major traits; highest fresh and dry weight of fruit was recorded in variety 3 (Ok1-MKB1) and 7 (Ok7-GGS). Days to 50% flowering and days to mature fruit harvest showed that varieties 2 (Ok2-0366) and 4 (Ok4-LG) were the earliest. Variety 4 possessed the highest level of P while variety 6 (Ok6-ABM) of okra fruits contained the highest concentration of K. Zinc content was the highest in variety 4 and the lowest was in variety 1. Next, Variety 7 had the highest concentration of Mg and the lowest was in variety 6. Variety 5 (Ok5-SS103) contained the highest concentration of Fe while variety 3 had the lowest. Lastly, variety 3 possessed the highest content of Ca while the lowest was in variety 1, respectively. Pearson's correlation analysis revealed the strongest correlation (P = 0.001) in between days to 50% flowering and days to harvest, while fruit fresh weight and fruit dry weight as well. Cluster analysis grouped those 7 okra varieties into five different clusters; where V2, V3 and V6 were solely different from others, indicating the highest diversity compared to other accessions. So, for varietal improvement program, the most judicious crossing combination can be made with V2, V3 and V6 with V1 or V5 and V4 or V7, which would bring about the greater genetic diversity.

Breeding Methods

Local okra cultivar (cv. Balady) by accessing superior earliness **purelines** using an individual plant selection breeding program. Six cycles of individual plant selection were carried out at the Agricultural Experimental Station Farm at Abies region, Faculty of Agriculture, Alexandria University, Egypt, which resulted in ten pure lines with distinct horticultural traits. The selected pure lines were evaluated in the summer season of 2020 with the original population. The results showed that the pure lines L5 and L1 recorded significantly the lowest mean values compared to all the genotypes for the earliness traits, viz., days number to first flower and pod, as well as days number to 50% flowering, and days number to first harvest. Moreover, the selected pure lines significantly exceeded the original population in the characteristics of early and total yield per plant, and the three pure lines L4, L8 and L9 were the most distinguished for these traits. Concerning correlation estimates, the characteristics of earliness reflected positive and significant correlations between one another, as well as, with the characteristics plant height and early yield as the number of pods. The results of cluster analysis illustrated that the first group (I) was distinguished as being the earliest, while the third (III) and fourth (IV) clusters were the best for the producti-vity traits. So, it is recommended to use the pure lines L4, L8 and L9 to improve total and early yield as well as the earliness traits (**Helmy *et al.*, 2022**)

The investigation was carried out with the purpose of selecting new economic okra strains through **pedigree method**. In this respect, four original cultivars were previously crossed. The resulting F1's of them were self pollinated. Having the dessendant F2's in 2004, self pollination and selection based on economic traits was done subsequently for five successive generat-ions. The complete phenotype and genot-ype homozygosity was then reached having 9 selected strains ansested from 5 F2's. In the summer season of 2009, a large scale field experiment was designed and applica-ted to evaluate these promising nine selected strains side by side with their original 4 cultivars (**Elgendy 2012**).

Seeds of two okra varieties, Annie and Okura, were irradiated with Gamma rays at doses of 400 and 600Gy. Screening of YVMD resistant plants was conducted for M3 and M4 plants under field conditions in Petchaburi and

Phichit provinces and greenhouse conditions using whitefly transmission in Bangkok. One M4 plant of Okura (B-21) irradiated at 400Gy was found to be highly resistant, but none of Annie. M5 plants of B-21 were screened further for YVMD resistance under both greenhouse and field conditions. Ten resistant lines obtained by screening for YVMD resistance up to the M7 generation were selected for yield trial observations at Phichit Horticultural Research Center (PHRC) and Chiengmai Horticultural Research Station (CHRS), both located in the northern Thailand. Three of the **mutant lines** were further tested at Kanchanaburi Horticultural Research Center (KHRC) in Kanchanaburi province, an okra growing area in the west of central Thailand where YVMD was seriously widespread. At the KHRC, all tested mutant lines showed resistance up to a month, when the susceptible check variety already showed symptoms of the disease. However, only a small portion of the plants of the mutant lines appeared to be resistant throughout the whole growth duration; others eventually exhibited the yellow vein symptom. Plants were further screened in two growers' fields. Growers were satisfied with the plant stature and fruit shape of the mutants and their delayed disease development, and further screening is underway to select uniformly YVMD resistant lines for okra production in Kanchanaburi **(Phadvibulya 2009).**

Conclusion

The conclusion of an okra breeding program could include summarizing the achieved objectives, such as increased yield, disease resistance, or improved quality traits. It may also discuss any challenges encountered during the breeding process and potential future directions for further improvement. Additionally, the conclusion should highlight the significance of the breeding program's results for farmers, consumers and the agricultural industry as a whole, emphasizing the importance of sustainable crop improvement efforts.

References

- **Chowdhury, S., & Kumar, S. (2019).** Okra breeding: recent approaches and constraints. Annals of Biology, 35(1), 55-60.
- **Düzyaman, E. (2005).** Phenotypic diversity withina collection of distinct okra (Abelmoschusesculentus) cultivars derived from Turkishland races. Genet. Resour. Crop Evol. 52 :1019-1030
- **Elgendy, S. E. (2012).** Selection of some promising lines through pedigree method in okra. Journal of Agricultural Chemistry and Biotechnology, 3(2), 41-48.
- **Gemede, F., Ratta, N., Haki, D., Woldegiorgis, A. Z.and Beyene, F. (2015**). Nutritional qualityand health benefits of okra (Abelmoschusesculentus) : A review. J. Food Sci. Technol.6 : 1-6.
- **Nagesh, G. C., Mulge, R., Rathod, V., Basavaraj, L.B. and Mahaveer, S. M. (2014).** Heterosisand combining ability studies in okra[Abelmoschus esculentus (L.) Moench] foryield and quality parameters. Bioscan(Ranchi) 9 : 1717-1723
- **Patel, B. G. and Patel, A. I. (2016).** Heterosis studiesin okra [Abelmoschus esculentus (L.)Moench]. Ann. Agric. Environ. Sci. 1 : 15-20
- **Phadvibulya, V., Boonsirichai, K., Adthalungrong, A., & Srithongchai, W. (2009).** Selection for resistance to yellow vein mosaic virus disease of okra by induced mutation. Induced plant mutat-ions in the genomics era. Food and agriculture organization of the United Nations, Rome, 349-351.
- **Ragheb, E., & Helmy, E. (2022).** Improving Earliness-Related Traits of Egyptian Local Okra Cultivar (Abelmos-chus esculentus L. Moench). Scientific Journal of Agricultural Sciences, 4(1), 1-11

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Selfing and Crossing Techniques in Leguminous Vegetable Crop

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Introduction

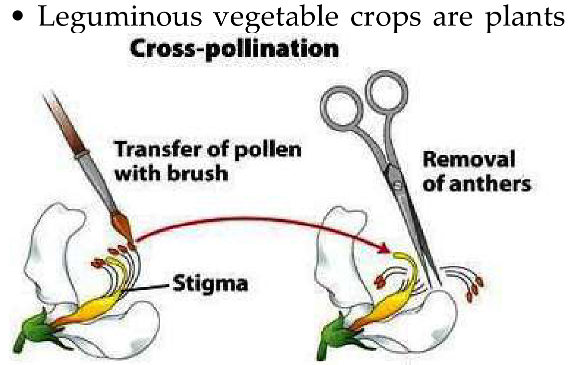
Selfing and crossing are essential reproductive mechanisms in leguminous vegetable crops, influencing genetic diversity and trait expression. Selfing, or self-pollination, occurs when a plant fertilizes itself, promoting genetic uniformity within a population. In contrast, crossing involves the transfer of pollen between different plants, fostering genetic variability. Leguminous vegetables, such as peas and beans, exhibit both selfing and crossing behaviors. Selfing ensures stable traits are maintained, but it may limit genetic diversity. Cross-pollination introduces variability, potentially enhancing adaptability and resilience. Understanding the balance between selfing and crossing is crucial for plant breeders seeking to optimize desirable traits in leguminous crops for improved yield, disease resistance and nutritional quality.

Selfing

- Selfing refers to the process of self-pollination, where a plant fertilizes itself with its own pollen.
- This can lead to the production of genetically similar offspring, which can be useful for maintaining specific traits in a crop.

Crossing

- The transfer of pollen from one plant to another, leading to the creation of genetically diverse offspring.
- Crossbreeding leguminous vegetable crops can introduce genetic variability, potentially leading to improved traits such as disease resistance, higher yield, or better nutritional content.
- Both selfing and crossing are essential techniques in plant breeding to develop new varieties with desired characteristics in leguminous vegetables, ensuring sustainable and improved crop production.
- Leguminous vegetable crops are plants that belong to the family Fabaceae.



- Legumes include
  1. Beans
  2. Soybeans
  3. Chickpeas
  4. Peanuts
  5. Lentils
  6. Lupins
  7. Grass peas

Selfing techniques

Self-pollination techniques are used to ensure that plants are able to reproduce even without external agents like wind, insects or animals.

Some Common Self-pollination Techniques

1. Hand self-pollination
2. Bagging
3. Isolation
4. Time-Controlled Pollination
5. Genetic Selection
6. Manipulating Environmental Conditions

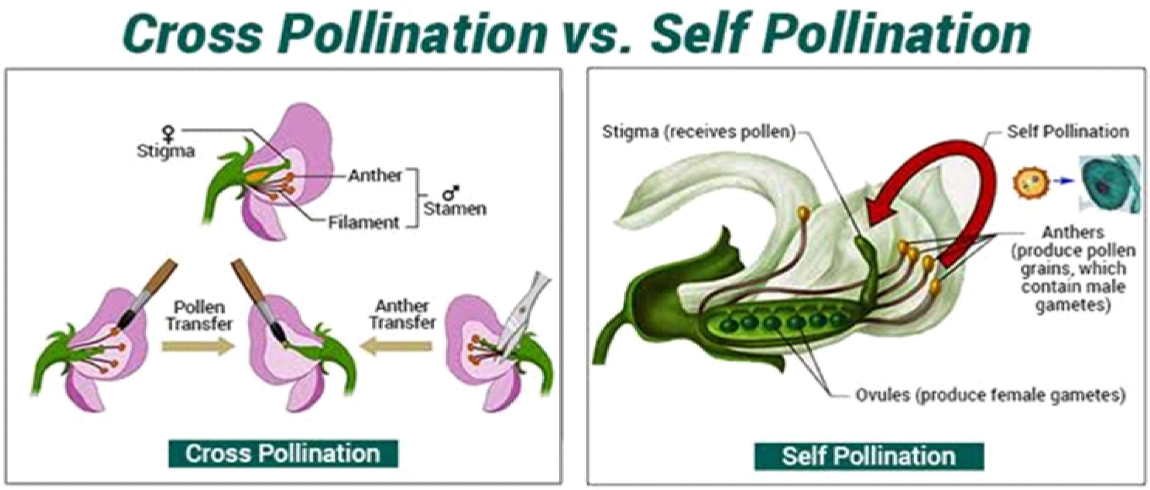
• These techniques can be used in plant breeding to maintain specific traits or to ensure genetic purity in the offspring.

Crossing techniques

• Cross-pollination techniques are used to facilitate the controlled transfer of pollen from one plant to another.

• Some common cross-pollination techniques include

1. Hand pollination
2. Emasculation
3. Bagging or Caging
4. Isolation Distance
5. Time-Controlled Cross-Pollination
6. Insect Pollination Management
7. Genetic Markers



Advantages of Selfing

• Only one parent is required.

• Offspring inherits its genes from parent plant. Hence beneficial qualities are more likely to be passed down to the offspring.

• It does not depend on external factors e.g., insects or wind for pollination.

• Anthers are close to the stigmas of the same flower hence there is a high possibility that self pollination will occur.

Less pollen and energy is wasted is self-pollination compared to cross pollination

Disadvantages of Selfing

• Less varieties of offspring are produced as the offspring's genes are similar to those of the parent plant, therefore the species is less adapted to changes in the environment. Continued self-pollination may lead to offspring becoming weaker, smaller and less resistant to diseases

Advantages of Crossing

• Offspring may have inherited beneficial qualities from both parents.

• Abundant and more viable seeds tend to be produced (i.e., seeds are capable of surviving longer before germination).

• More varieties of offspring can be produced (greater genetic variation).

Increases chance of survival of species to changes in the environment.

Disadvantages of Crossing

• Two parent plants are required.

• Depends on external factors e.g. insects or wind for pollination.

• Lower probability that cross pollination will occur compared to self-pollination (because it involves transfer of pollen grains from the anther of one plant to the stigma of another plant).

More energy and pollen is wasted as compared to self- pollination

Agents of Crossing

• Entomophilous (entomon: insect, phile: affinity)

Insect pollinated flowers (Example: Pea)

• Insect pollinators

1. Bees
2. Wasps
3. Flies
4. Butterflies
5. Some beetles

• The aim of a case study on selfing and crossing techniques in leguminous vegetable crops is to explore and underst-and the impact of these breeding methods on traits such as yield, disease resistance and overall plant performance.

• By analyzing specific cases, researchers can gain insights into the effectiveness of selfing and crossing in enhancing desired characteristics, ultimately contributing to the improvement of leguminous crops for agricultural purposes.

Conclusion

• Selfing and crossing techniques play a crucial role in leguminous vegetable crop breeding.

• Selfing, or self-pollination, involves allowing a plant to fertilize itself, maintaining genetic purity.

• This is advantageous for fixing desirable traits.

• On the other hand, crossing, or cross-pollination, facilitates the introduction of genetic diversity, promoting the development of hybrids with improved characteristics

• In conclusion, a balanced approach combining selfing for trait fixation and controlled crossing for genetic diversity is essential in leguminous vegetable crop breeding programs.

This strategy helps achieve a desirable balance between maintaining specific traits and introducing genetic variability for enhanced adaptability and performance in varying environmental conditions

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Soil Carbon Sequestration

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Introduction

Carbon sequestration or carbon dioxide removal (CDR) is the long-term removal, capture, or sequestration of carbon dioxide from the atmosphere in order to delay or reverse atmospheric CO_2pollution or to moderate or reverse global warming. Carbon sequestration is the long-term storing of carbon dioxide or other forms of carbon in order to minimize or defer global warming and prevent disastrous climate change. It has been proposed as a method for slowing the atmospheric and marine accumulation of greenhouse gases produced by the combustion of fossil fuels. Carbon sequestration varies by climate, soil type, land use, and management strategies, ranging from 100 to 1000 kg C/ha/year. For nearly two decades, experts in the soil science community have researched and calculated the potential for carbon sequestration in soil organic matter. The premise is essentially rational: nearly 10,000 years of cultivated agriculture have lowered global soil carbon by 116 Gt, which is equivalent to more than a decade of current industrial emissions rates. Through altered farming techniques, it is proposed that most of this carbon can be restored to domesticated soils and so serve as a substantial instrument to counteract climate change, offering a longer timeline for society to decarbonize.

Objectives

Soil carbon sequestration aims to following objectives.

- Offset anthropogenic emissions from fossil fuel combustion, cement production, and deforestation.
- Reduce the net increase in atmospheric CO_2 concentration (which reached 400 ppmv in 2013) and pool (~800 PgC)
- Improve soil organic Carbon (SOC) concentration and pool to above the threshold level of 1.5-2.0%.
- Restore soil quality and ecosystem functions and services increasing water and nutrient retention capacity.
- Improving input use efficiency in managed ecosystem soils.
- Reducing risks of accelerated erosion and non-point source pollution (NPSP). Developing climate-smart soils and agro-ecosystems.
- Improving input use efficiency and strengthening soil disease-suppressive characteristics
- Increasing and sustaining agronomic productivity and advancing food and nutritional security.

Soil Carbon Pool

It is a component of the climate system that has the ability to store, collect, and release carbon. The soil carbon pool is one of the most important pools in the terrestrial ecosystem, storing approximately 1200 to 1800 Gt (1 Gt = 1 Gigaton = 10^9 ton) of carbon, which is 3.3 times larger than atmospheric carbon pools (760 Gt) and 4.5 times larger than biotic carbon pools (560 Gt). Soil carbon pools are made up of soil inorganic carbon and soil organic carbon. Soil inorganic carbon is made up of primary and secondary carbonates, while soil organic carbon is made up of living and dead organisms.

To increase the soil carbon pool included

- Soil restoration
- No till farming
- Wood land regeneration
- Cover crops
- Nutrient management
- Manuring and sludge application
- Agroforestry practices

Challenges for Carbon Sequestration

1. Mismatched scale of operations

CCS (CARBON CAPTURE STORAGE) projects require a considerable upfront investment, particularly in transmission and storage infrastructure.

Even with a minimalist strategy, the capacity of carbon dioxide transportation and storage infrastructure frequently surpasses the needs of a single emitter.

The upfront costs are also generally prohibitively expensive for a single emitter to cover; amortized over each tonne of CO_2 they intend to capture, transport, and store, the cost is frequently higher than alternative abatement solutions.

2. Social license to capture

CCS does not capture all emissions.

For some industries, such as steel and cement, that is still far superior to the alternative.

However, in industries where there are or will be cleaner alternatives, such as power generation and ammonia manufacture, choosing the CCS approach may be problematic.

It remains to be seen if investors, customers, and other stakeholders will accept enterprises who had the option of fully decarbonizing but chose not to

3. Ongoing storage liabilities

CCS projects typically entail storing carbon dioxide deep below.

Because of the risk of leakage, these storage facilities must be monitored and maintained for potentially hundreds of years.

The danger of leakage is modest, but it is nonetheless a risk that must be controlled if the integrity of carbon accounting and targets is to be maintained.

Some Best Management Practices for Soil Organic Carbon Sequestration

a. Soil fertility management

Increasing soil carbon can be accomplished in a variety of ways, including reducing soil disturbance by switching to low-till or no-till practices or planting perennial crops; changing planting schedules or rotations, such as planting cover crops or double crops instead of leaving fields fallow; managed grazing of livestock; and applying compost or crop residues to fields. In addition to offering local environmental and economic benefits, these methods can collect carbon dioxide (CO2) from the atmosphere and store it in soils, making them a type of carbon removal.

b. Forestry, agroforestry and perennial culture

The available estimations of C-sequestration potential of agroforestry systems are generated by combining information on aboveground, time-averaged C stocks and soil C values; however, they are often not rigorous. Methodological problems in measuring biomass C stock and soil C storage under varied conditions are exacerbated by a lack of trustworthy estimations of agroforestry area. We estimate that the present global agroforestry area is 1,023 million ha.

c. Viable alternative to jhum and shifting cultivation

Deforestation of natural forests and subsequent burning for shifting agriculture resulted in a considerable loss in soil organic carbon (SOC) at depths ranging from 0 to 30 centimeters. The forest had the highest SOC concentration due to its higher net primary output and abundant litterfall on the soil surface. This litterfall functions as mulch, helping to increase soil organic matter. As a result, the SOC of the natural forest is high. When this area is converted to shifting cultivation, such as jhum, the SOC drops dramatically due to forest fires and organic matter oxidation. The highest quantity of SOM (13.2 g kg-1) was discovered in grassland in the topsoil layer (0-15 cm), followed by forest land.

d. Conservation agriculture

A increases SOC stocks by adding more C inputs through increased biomass production, reducing SOC losses due to surface soil cover, and trapping SOC in soil aggregates. This results in the net sequestration of atmospheric carbon into the soil, which helps to mitigate climate change. Conservation agriculture's effects on SOC are variable around the world, with both increases and decreases observed. However, in regions where soil and climatic conditions are favourable for biomass production and the system does not have a negative impact on yield, conservation agriculture can result in higher amounts of SOC than conventionally managed systems, particularly at the soil's surface.

e. The rice-wheat system

Rice crop straw absorption into soil through ploughing and tilling resulted in negative carbon sequestration due to increased methane emission. A mixed NPK treatment with only rice stubble inclusion may be sustainable for increased rice production, however this strategy results in a lower rate of negative carbon sequestration in the paddy field. Straw covering with no tillage was the best measure to achieve high yield and low carbon emission for rice crop straw integration into the soil.

Recent Scheme

NITI AAYOG will launch a carbon capture, utilization, and storage (CCUS) regulatory framework and deployment mechanism in India in November 2022.

AIM: CCUS plays a vital part in decarbonizing the Indian sector, which contributes 70% of emissions, and achieving net-zero by 2070. The use of CCUS in the power sector will give India with long-term prospects to meet more than 70% of its electricity needs with coal, enabling the sunrise sectors of coal gasification and the low-carbon hydrogen economy.

Conclusion

There is a need for research, education, outreach, and policy interventions to restore the SOC pool and improve soil quality in agro-ecosystems. The development of non-destructive and in-situ measurements of SOC pools at landscape scale (Mg C/ha to 1-m depth) is a top goal. Nutrient management (N,P,S) must be determined to conserve biomass-C in humus. There is an urgent need to update undergraduate and graduate curricular to include courses that explain the importance of topics such as soil in the global C-cycle, soil degradation and human nutrition and health and soil restoration to improve environmental quality. Research and education must be strongly related to outreach and extension. The social and economic values of SOC must be objectively determined.

References

• Bauhus, J. ,Khanna, P.K., Hopmas, P. and Weston, C. (2002) Is soil carbon is useful indicator of sustainable forest soil management? Forest Ecology and Management 171,59-74.

• Bruce, J.P., Frome, M. and Haites, E. (1999) Carbon sequestration in soils. Journal of soil and water conservation 54,382-389.

• Falkowski , P. , Scholes, R.J. ,Boyle ,E., Canadell, J. and Canfield ,D. (2000) The global C cycle :the test of our knowledge of earth as a system. Science 289, 270-277.

• Fan, C. (1998) Humus Chemistry-Genesis, Composition and Reaction 88,471-480.

• Goyal ,V. (2021) Synthesis Report : The Physical Science Basis, Working Group L. Fifth Assessment Report, WMO, Geneva, Switzerland ,24 -56.

• Khanna , J.K. (2002) ,Plant and soil 202,91-101.

• Khanna, P.K. (2015) Forest ecology and management 171,121-132.

• Nieder and Benbi(2008) Carbon and Nitrogen in the Terrestrial Environment , Springer , 442.

• Trans, W. (1990) Soil Organic Carbon, Geoderma 81,153-225.

• Wofsy (2001) Agronomy for sustainable development 29,257-265.

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Tips for Paprika Cultivation and Storage

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Introduction

Paprika is one of the most popular spice crops grown in India. It is principally used to season and colour rices, stews, and soups such as goulash and in the preparation of sausages as an ingredient that is mixed with meats and other spices. It is also used as condiment in several Spanish stews. The rich colouring of paprika not only enhances the visual appeal of foods, but it can also be used as a major flavoring as in goulash or chicken paprikash. Paprika is unusually rich in vitamin C (Aleksandra *et. al*., 2008). As an antibacterial agent and stimulant, paprika can help normalize blood pressure, improve circulation and increase the production of saliva and stomach acids to aid digestion. Paprika is rumoured to have been named in India after a religious figure named "Rysh Paprike". It is grown successfully in Himachal Pradesh, J&K and Nilgiri hills during summers. However, it can also be grown as an autumn crop in states like Maharashtra, Karnataka, Kerala and Tamilnadu, where temperature remains mild. Therefore, it is necessary for the paprika growers of the country to have preliminary knowledge about the cultivation and storage practices.

- Crop should be grown in warm season and frost free (4-6) months.
- Planting times in Hills; April-May; and plains; May-June & Sept. - Nov.
- Optimum temperature for good plant growth is 24-27 0 C.
- Well drained sandy loam or clay soil having pH 8.5-7.0 is preferable.
- Three to four ploughings are necessary for good tilth.
- FYM (20-25 tonns/ha) is mixed at the time of last ploughing.
- Avoid growing the crop in poorly drained areas.
- Obtain certified seed from reliable source.
- Use a raised seed bed and avoid thick sowing.
- Avoid nursery sowing in same bed year after year and frequent heavy irrigation.
- Prepare nursery beds of 2 m length 0.75 m width and 15 cm height and sow the seeds in rows 6 cm apart and 0.5 cm deep.
- Optimum seed rate is 600 g/ha.
- Improved varieties should be grown such as Kt Pl-19, Arka Abir, SB-106,104,101 and Byadagi.
- After sowing the seeds beds are coverd with dry paddy straw or with dry leaves to give warmth, retain moisture, avoid dislocation of seeds at the time of watering by rose can and cracking of soil layer on drying.
- Keep the seed beds moist but not too wet.
- Need based nursery soil drenching @ 6 litres /m 2 of Captan 50 WP (0.3%).
- Remove the mulch when the seedlings start just emerging.
- Use of UV stabilized polytunnel for

successful nursery growing.

• The seedlings are ready for transplanting at 4-6 true leaf stage.

• Healthy seedlings should be transplanted in the evening hours at a distance of 45 x 45 cm.

• Fertilizer should be applied in three split doses i.e., basal (60:100:60 kg/ha), 3 weeks after transplanting (20:0:20 kg/ha) and 6 weeks after transplanting (40:0:40 kg/ha).

• If the growth of the plants is poor give urea spray @ 2 g/liter of water after 30 days of plantings.

• Spray Dithane M-45 (0.25 %) or Copper oxychloride-50 WP (0.25 %), if the diseases like anthracnose, fruit rot, cercospora leaf spot and powdery mildew are observed.

• Crop should be kept weed-free.

• Maintain optimum soil moisture.

• It is always beneficial to remove the first flower bud from the first dichotomous branching followed by pinching of two or more buds.

• Biological matured red fruits are ready for harvest after 70-80 days.

• Average yield is 250-350 q/ha.

• Ripened fruits should be stored in open, preferably in shade to avoid direct sun light.

• The dried fruits after removing the seeds and pedicels are ground into paprika powder.

• The quality of ground paprika also depends on whether or not the seeds and stems are ground in with the dried peppers.

• Once harvested, the fruit is completely dried and then ground into the rich, red paprika powder.

• Paprika should be evenly and finely ground, with a shiny uniform colour. The redder the colour, the milder the paprika. Conversely, the more yellow the colour, the stronger the flavour.

• Paprika should be stored in an airtight container in a cold, dark place, preferably in a refrigerator.

• Rather than storing paprika in a glass bottle, choose a tin container which will protect the contents from damaging light. As with most ground spices, paprika will lose its flavour and potency with age. Use it or replace it within six months for best results.

Conclusions

Paprika is a colorful spice derived from ground peppers. It offers a variety of beneficial compounds, including capsaicin, vitamin C, vitamin A and carotenoid antioxidants. These substances may help prevent inflammation and improve your cholesterol, eye health, and blood sugar levels, among other benefits. Therefore, it is necessary for the paprika growers of the country to have preliminary knowledge about the cultivation and storage practices.

Reference

• Aleksandra N., Tepic, G.R., Dimic, B.L., Vujicic, Z.S., Kevresan,M.V. and Zdravko M. S. (2008). Quality of Commercial Ground Paprika and its Oleoresins. APTEFF, 39, 77-83.

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Soil Health Management with Organic Farming Practices

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Introduction

Organic farming is a sustainable agricultural technique that includes environmentally friendly insect treatments and biological fertilizers obtained mostly from animal and plant wastes, as well as nitrogen-fixing cover crops. Modern organic farming was established in reaction to the environmental harm caused by conventional agriculture's use of chemical pesticides and synthetic fertilizers, and it offers significant ecological benefits.

Organic farming, when compared to conventional agriculture, utilizes less pesticides, lowers soil erosion, reduces nitrate leaching into groundwater and surface water, and recycles animal feces back into the farm. These advantages are offset by increased consumer food costs and overall reduced yields. Indeed, organic agricultural yields have been found to be roughly 25% lower overall than conventionally grown crops, however this varies greatly depending on the type of crop. The challenge for future organic agriculture will be to retain environmental benefits, boost yields, and lower prices while dealing with climate change and a growing global population. Organic farming' is defined as an agricultural technique that uses ecologically based bio-fertilizers and pest controls derived primarily from plant and animal waste and organic manure.

Need of organic farming

Organic farming desires to have a good impact on both human health and the environment. Focus on the importance of organic farming in avoiding chemical based pesticides and fertilizers. Organic farming is suitable for environmental protection. The larger global issue of climate change reflects the damage looming on our ecosystem, requiring measures such as organic farming in the agricultural sector to ensure nature remains abundant and clean. Demand for organic foods means that farmers that produce organic foods may supply the market and profit from it.

Soil Fertility Preservation: Organic farming stresses the use of natural practices such as composting, cover cropping and crop rotation. These methods increase soil fertility by encouraging the presence of helpful microorganisms, which break down organic matter and release critical nutrients for plant growth.

Reduced Soil Erosion: Organic farming practices such as mulching and the use of cover crops support in reducing soil erosion by shielding the soil from the effects of heavy rains and wind. This preserves soil structure and avoids the loss of important topsoil.

Improved Soil Structure: Organic farming promotes soil-building methods. Organic matter increases soil aeration, water retention, and drainage. This improves the soil's ability to maintain nutrients and promotes healthy root growth.

Chemical Contamination is Reduced: Organic farming avoids the use of synthetic pesticides and fertilizers, which can build up in the soil and cause contamination. Using natural alternatives contributes to a better soil ecology and the preservation of soil organism diversity.

Long-Term Sustainability: Organic farming encourages a comprehensive strategy that benefits the soil's long-term health. It supports sustainable farming practices for future generations by enhancing soil biodiversity and fertility without depleting natural resources.

Principal of organic farming

a. The health principle: Organic farming should sustain and improve soil health, plant, animal, human and global health.

b. The ecological principle: Organic farming should maintain ecological balance and natural cycles in order to be sustainable. This principle promotes environmental sustainability through organic agriculture.

c. The fairness principle: States that connection between organic farming and nature should be just enough to maintain it viable.

d. The caring principle: Organic farming responsibly protects the health of current and future generations while also saving the environment and protecting biodiversity.

Common organic farming practices

1.Crop rotation and intercropping

Because organic agriculture is dependent on soil health and biology, methods such as crop rotation, intercropping, and mixed cropping may be beneficial for maintaining soil life by increasing soil characteristics and associated bioactivities.

Crop rotation is the practice of farming crops in distinct farm regions so that no single crop is sown continually in the same location. It is an excellent method for conserving and improving soil structure and nitrogen levels while also reducing soil-borne pests.

2. Integrated Pest Management (IPM)

The aim of integrated pest management is to keep pest populations below the level that could cause economic downfall.It combines the use of biological andcultural practices to control insect pest in agriculture.

3. Bio-Fertilizers

Biofertilizers, as the word means, are "preparations constituting latent cells or living cells of efficient strains of microorganisms that assist crops' uptake of nutrients by their interactions in the rhizosphere when applied through soil or seed. Such as Rhizobium, Azospirillum, Azotobacter.

4. Organic Manure

Organic manures are natural materials used by farmers to provide nutrients to agricultural plants . Organic manure comes in a variety of forms, including but not limited to green manures, farmyard manures, vermicompost, biological wastes, compost manures, and oil cakes. Organic manures are essential for increasing soil organic matter, increasing soil water-holding capacity, and improving drainage.

5. Vermicomposting

Vermicomposting is an important process that can improve soil fertility physically, physiologically, and chemicallythe process by which earthworms convert organic materials into humus-like material.Several studies have found that vermicompost has a greater nutrient profile than typical compost, making it a feasible strategy for enriching soil nutrient composition, increasing productivity, and improving soil structure.

6. Bio-Pesticide

Biopesticides are biological agents that cause poisons that are harmful to pests that attack plant crops. For instance, secondary metabolites such as alkaloids, terpenoids, phenolics, etc., help fight, repel and kill fungi, insects, nematodes and other pests. Nicotine, pyrethrum, margosa and neem are some examples of biopesticides.

7. Waste Management

Waste management practices such as organic waste recycling and composting are critical in a variety of soil qualities. Organic farming allows for the effective management of home and agricultural waste, often through anaerobic digestion, composting, and thermos-chemical treatments, while lowering the usage of conventional chemical pesticides, fertilizers and other energy sources. Organic waste management promotes biological activity and pore structure, which has a favorable impact on the environment.

Limitations in Organic Farming

While yield variability can be a limitation organic farming emphasis on natural fertilizers and pest control methods promote environmental sustainability by reducing chemical inputs, preserving biodiversity and promoting healthier ecosystem. Despite the time consuming nature of organic farming practices, these methods contribute to enhancing the soil health over the time by promoting better soil structure, increased microbial diversity, ensuring sustainable agriculture for future generation.

Organic farming's limited use of synthetic pesticides helps mitigate environmental and health risks associated with chemical exposure. Crop rotation and biodiversity promoted in organic farming enhance the resilience of agricultural systems, making them more adaptable to changing environmental conditions. While nutrient limitations can occurs, organic farming practices focus on building soil organic matter, which enhancenutrient retention and promotes a more balanced ecosystem, reducing the risk of nutrient runoff and water pollution.

Future Prospects

Environmental Sustainability: Organic farming promotes soil health by minimizing chemical inputs, preserving biodiversity and reducing soil erosion. This sustains ecosystems, making it an attractive solution in the face of climate change.

Consumer Demand: There's a growing consumer preference for organic produce due to health concerns and environmental consciousness. This demand is expected to rise, creating market opportunities for organic farmers.

Government Support: Many governments are incentivizing and subsidizing organic farming practices. Policies promoting sustainable agriculture indicate a favorable future for organic methods.

Improved Technology: Ongoing research is enhancing organic farming techniques. Advancements in organic pest control, crop rotation and soil management are making these methods more efficient and economically viable.

Health Benefits: With increasing awareness about the harmful effects of chemical residues in food, organic produce is seen as a healthier alternative. This perception will likely continue to drive demand.

Global Awareness: The global movement towards sustainable living and ethical consumption favors organic farming.

Conclusion

Organic farming is agriculture that makes the healthy soil, healthy plant, food and healthy environment. Use of organic manures has beneficial effect on yields.

Sustainable Soil Fertility: Organic farming encourages soil health by promoting natural processes like nutrient recycling and microbial diversity, ensuring long-term fertility.

Reduced Environmental Impact: Highlight the environmental benefits, such as minimized soil degradation and lowered greenhouse gas emissions compared to conventional farming.

Biodiversity and Ecosystem: Emphasize how organic farming encourages biodiversity, supporting beneficial insects, microorganisms and wildlife, which contribute to a more resilient ecosystem.

Human Health and Nutrient-Rich Food: Organic farming leads to healthier produce by avoiding synthetic pesticides and fostering higher levels of essential nutrients, contributing to improved human health.

Reference

• Das, S., Chatterjee, A., & Pal, T. K. (2020). Organic Farming in India: A Vision Towards a Healthy Nation. Food Quality and Safety. 4(2), 69-76.

• Dey, S., Achar, S., & Dey, A., (2021). Organic Farming: Concept, Principles, Benefits and Prospects in India. Agriculture Letters. 2(5), 24-26.

• Elayaraja, M., & Vijai, C. (2020). "Organic Farming in India: Benefits and Challenges. European Journal ofMolecular & Clinical Medicine. 7(1), 3021-3029.

• Kumari, S. V., Raj, S., (2020). Organic Farming: Path for Sustainable Ecosystem, Discussion Paper 17," National Institute of Agricultural Extension Management (MANAGE), pp. 1-102.

• Olle, M. (2019). Review: Vermicompost, its Importance and Benefit in Agriculture. Journal of Agricultural Science. 2, pp. 93-98.

• Soni, R., Gupta, R., Agarwal, P., & Mishra, R. (2022). Organic Farming: A Sustainable Agricultural Practice. Vantage: Journal of Thematic Analysis. 3(1). 21-44.

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Foliar application of Micronutrients and its Impact on Tomatoes in Greenhouses

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Introduction

Tomato, botanically known as Solanum lycopersicum L., Tomatoes are horticulture crop belongs to the family Solanaceae bearing chromosome number 2n=2X=24.It originated from South America. It is one of the most popular and widely grown vegetable crops throughout the world and treated as "protective food" universally. It is rich source of vitamins, vegetable protein and minerals and holds a glorious position among vegetable after the potato and sweet potato. Tomato known as poor man's apple (orange) in India & love of apple in England. Tomato is used as soup, salad, pickles, ketchup, puree, sauces, tomato paste, tomato juice and other products. The pulp and juice of tomato fruit are digestible and a mild aperients, a promoter of gastric secretion and a blood purifier.

Foliar application refers to the practice of spraying nutrient solutions directly onto the leaves of plants. This method is particularly effective for delivering micronutrients, which are essential for plant growth and development but required in very small quantities. In the context of greenhouse tomatoes, foliar application of micronutrients can have a significant positive impact on several aspects.

1. Enzyme Activation

Micronutrients act as cofactors for many enzymes, which are like biological catalysts that accelerate vital chemical reactions within plants. They help activate these enzymes, ensuring efficient processes like

- **Photosynthesis**: Converting sunlight, water, and carbon dioxide into sugars for energy production.
- **Respiration:** Breaking down complex molecules to release energy for plant functions.
- **Nitrogen fixation:** Converting atmospheric nitrogen into a usable form for plant growth.

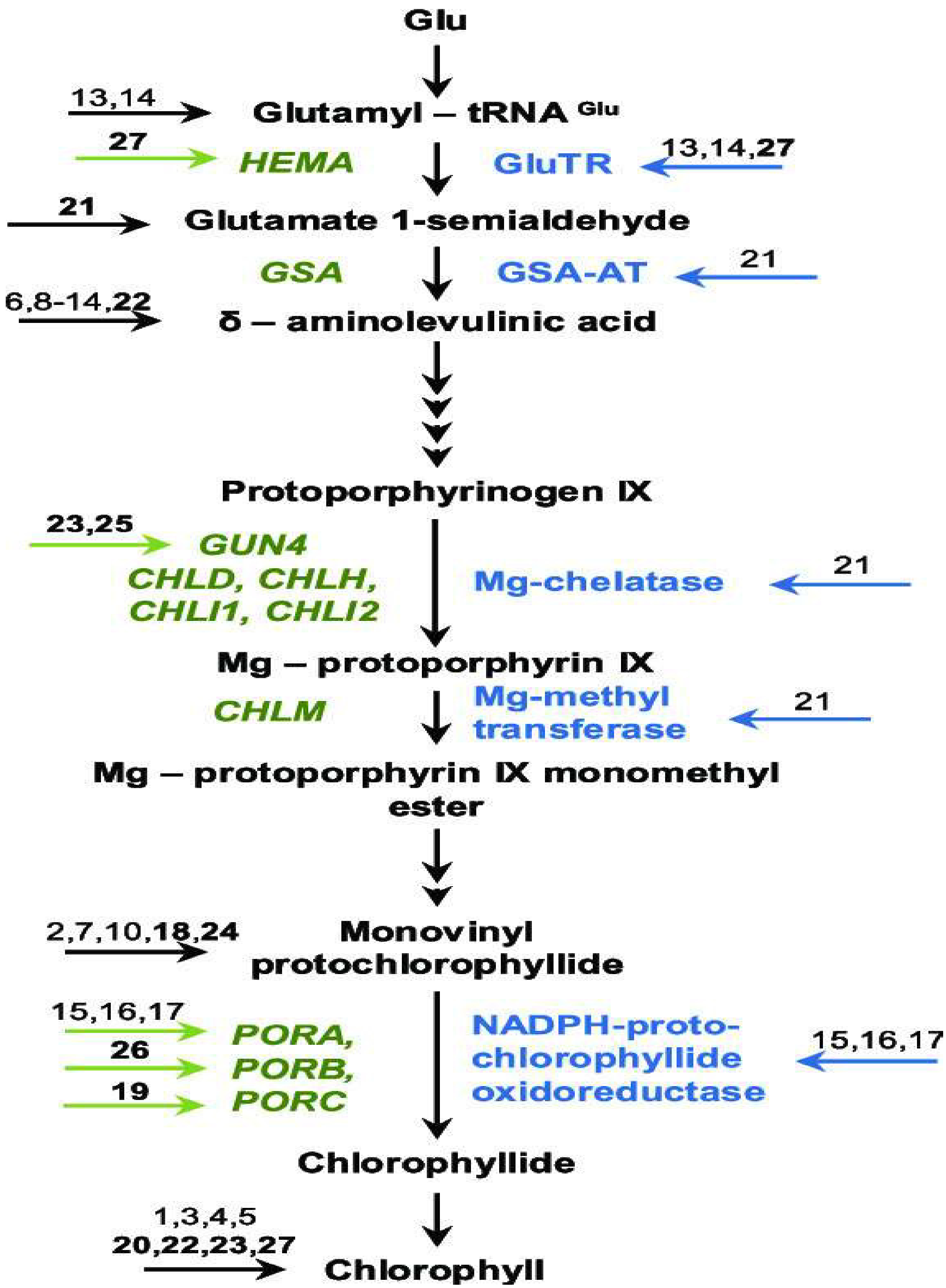
2. Structural Components

Some micronutrients are incorporated into the building blocks of plant structures, providing strength and stability. For example:

- Boron is essential for cell wall formation, influencing the integrity of stems, leaves and fruits.
- Calcium is a component of cell walls and membranes, contributing to overall plant structure and function.

3. Chlorophyll Synthesis

Micronutrients like iron and magnesium are crucial for the production of chlorophyll, the green pigment responsible for capturing sunlight during photosynthesis. Adequate levels of these elements ensure efficient light absorption and energy conversion for plant growth.


Glu
13,14
Glutamyl – tRNA Glu
27
HEMA
GluTR
13,14,27
21
Glutamate 1-semialdehyde
GSA
GSA-AT
21
6,8-14,22
δ – aminolevulinic acid
Protoporphyrinogen IX
23,25
GUN4
CHLD, CHLH,
CHLI1, CHLI2
Mg-chelatase
21
Mg – protoporphyrin IX
CHLM
Mg-methyl
transferase
21
Mg – protoporphyrin IX monomethyl
ester
2,7,10,18,24
Monovinyl
protochlorophyllide
15,16,17
26
19
PORA,
PORB,
PORC
NADPH-proto-
chlorophyllide
oxidoreductase
15,16,17
Chlorophyllide
1,3,4,5
20,22,23,27
Chlorophyll

4. Stress Tolerance

Micronutrients can enhance a plant's resilience against various environmental stresses, such as:

- Drought: Micronutrients like potassium can help regulate water balance and improve drought tolerance.
- Pests and diseases: Adequate micronutrient levels can contribute to a plant's defense mechanisms against pests and diseases.

5. Improved Fruit Quality

- Micronutrients play a role in determining the quality of fruits and vegetables. For instance, boron deficiency can lead to misshapen fruits, while calcium is crucial for maintaining firmness and preventing post-harvest storage disorders. Additionally, micronutrients can influence the nutritional value and shelf life of tomatoes.

6. Improved Growth and Yield

- Micronutrients like boron, copper, molybdenum, manganese and zinc play crucial roles in various plant processes. Their application through foliage can enhance vegetative growth, leading to stronger plants with better branching and more leaves.
- This improved plant health can translate to increased fruit set, resulting in higher yield of tomatoes.

Addressing Deficiencies

- Greenhouses often face limitations in soil volume and nutrient availability. This can lead to micronutrient deficiencies in the plants, even if the soil is adequately fertilized with macronutrients.
- Foliar application provides a targeted approach to address these deficiencies, ensuring that the tomato plants receive the specific micronutrients they need for optimal growth and fruit development.

Benefits over Soil Application

- Compared to traditional soil application, foliar feeding offers several advantages:

♦ **Faster uptake:** Micronutrients are absorbed directly through the leaves, bypassing the slower process of root uptake and transport.

♦ **Targeted delivery:** This method ensures that the nutrients reach the specific plant parts that need them most.

♦ **Reduced risk of leaching:** Foliar application minimizes the risk of nutrients being lost through leaching in the soil, which can be a concern in greenhouse environments with frequent irrigation.

Examples of Micronutrients and their Roles in Plants

- **Boron (B)**: Cell wall formation, pollen germination, seed development.
- **Copper (Cu):** Photosynthesis, respiration, disease resistance.
- **Iron (Fe):** Chlorophyll synthesis, enzyme activation.
- **Manganese (Mn):** Photosynthesis, nitrogen metabolism, disease resistance.
- **Molybdenum (Mo):** Nitrogen fixation, enzyme activation.
- **Zinc (Zn):** Seed production, enzyme activation, growth regulation.

Conclusion

Foliar application of micronutrients is a valuable technique for enhancing the growth, yield, and quality of tomatoes grown in greenhouses. Proper implementation requires careful planning and attention to detail to ensure optimal results and avoid potential drawbacks. In conclusion, micronutrients, despite their minute quantities, play indispensable roles in plant growth, development and stress tolerance. Their proper availability ensures efficient physiological processes, improved fruit quality, and overall plant health.

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Seaweed as a Booster: Enhancing Tomato Performance

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Introduction

Tomato (*Solanum lycopersicum* L., formerly *Lycopersicum esculentum* Mill.) belongs to the nightshade family Solanaceae with the chromosome number 2n=24. It is one of the most popular vegetables grown in India as well as all over the world. The first known record of tomato is in the year 1554 in South America and it spread to Europe from Peru in 1935. However, in India its cultivation started during the end of 19^{th}century. It is an important and most widely grown vegetable crop of tropical and sub-tropical part of the world. It is a warm season vegetable crop but grown commercially in winter season. It is a day neutral plant which is not affected by the day length. Tomatoes grow best under temperature range of 20-27^{o}C. Fruit setting is poor when average temperatures exceeds 30^{o}C or falls below 10^{o}C. It prefers a well-drained sandy loam soil as the plants are sensitive to water logging and optimum soil pH for tomato is 6.0-7.0.

The Nutrition value of tomato per 100g fruit weight is Energy (18 Kcal), Carbohydrates-3.9g, Protein (0.9g), Total Fat (0.2g), Folates (15µl), Niacin (0.594mg), Vitamin A (833 IU), Vitamin C (13mg), Vitamin E (0.54mg), Calcium (10mg), Iron (0.3mg), Magnesium (11mg), Carotene β (449µg), Carotene a (101µg) and Lycopene (2573µg, 20-50mg).

Seaweed, often mistaken for a simple plant, is a diverse group of marine algae that play a crucial role in the ocean ecosystem and hold immense potential for various applications. Let's delve into the fascinating world of seaweed, exploring its diverse forms, ecological significance and promis-ing future. Seaweed, a marine plant rich in various nutrients and bioactive compou-nds, has emerged as a promising tool in improving tomato performance. Studies have shown that incorporating seaweed, often in the form of seaweed extract (SWE), can positively impact various aspects of tomato growth and quality.

A Spectrum of Sizes and Colors

Seaweed encompasses a vast array of life forms, ranging from microscopic phytopla-nkton that drift freely in the water column to giant kelp forests towering underwater like majestic trees. They come in a vibrant spectrum of colors, including green, brown, and red, thanks to the unique pigments they possess.

1. Brown algae (*Ascophyllum nodosum, Kelp*): These extracts are rich in cytokinins, which are plant hormones known to promote cell division and growth. They also contain alginic acid, which can improve soil

structure and nutrient retention. They may be beneficial for enhancing overall plant growth and stress tolerance.

2. Red algae (*Lithophyllum* spp., *Eucheuma* spp.): These extracts are known for their high concentration of carrageenans, polysaccharides with various benefits. They can improve water retention in plants, enhance nutrient uptake, and stimulate the growth of beneficial soil microbes. They may be beneficial for improving drought

tolerance and soil health.

3. Green algae (*Ulva lactuca, Caulerpa* spp.): These extracts are typically rich in amino acids and other micronutrients readily available for plant uptake. They may be beneficial for providing a quick boost of nutrients during critical growth stages, such as seedling development and fruit set.

Ecological Powerhouse

These remarkable organisms play a vital role in the health of our oceans. They form the base of the marine food web, providing sustenance for countless creatures, from tiny fish to majestic whales. Additionally, seaweeds act as carbon sinks, absorbing significant amounts of atmospheric carbon dioxide and mitigating climate change.

Beyond the Ocean

Seaweed isn't just limited to the ocean realm. Its potential extends far beyond, offering numerous benefits for human endeavours. Here is some of its example-

- **Food Source:** Seaweed, particularly varieties like nori and wakame, are a staple food in many Asian cultures, prized for their rich nutrient content, including vitamins, minerals, and dietary fiber.
- **Biofuel Production:** Seaweed holds promise as a sustainable source of biofuel, offering an alternative to fossil fuels and contributing to a greener future.
- **Agriculture:** Seaweed extracts can be used as fertilizers and biostimulants, promoting plant growth and improving crop yields in a sustainable manner.
- **Cosmetics and Pharmaceuticals:** Seaweed's unique properties make it valuable in the cosmetics and pharmaceutical industries, with applications ranging from skincare products to potential treatments for various medical conditions.

Seaweed extract (SWE) is a natural product derived from various marine algae species. It's rich in biostimulants, which are compounds that promote plant growth and development. These can include:

- **Plant hormones:** Auxins, cytokinins and gibberellins, which help regulate various aspects of plant growth, like root development and cell division.
- **Micronutrients:** Essential elements like boron, zinc, and manganese, which are crucial for plant health and metabolism.
- **Antioxidants:** Compounds that protect plants from stress and damage caused by environmental factors.

Mode of application

• **Foliar sprays:** This method involves directly spraying a diluted solution of seaweed extract onto the leaves of tomato plants. This allows for rapid uptake of nutrients and biostimulants by the plant through its stomata (tiny pores on the leaves). Foliar sprays are particularly effective for addressing immediate nutrient deficiencies and stimulating specific physiological processes in the plant.

• **Soil amendments:** In this approach, the seaweed extract is incorporated directly into the soil, either by drenching or mixing it with compost or other organic matter. This method takes longer for the plant to benefit as the nutrients and biostimulants need to be broken down and released by soil microbes before being taken up by the roots. However, soil amendments offer a long-lasting and more sustainable approach to improving soil health and fertility, which indirectly benefits tomato growth over time.

The Benefits of Using Seaweed Extract on Tomatoes

• **Increased yield:** Research indicates that seaweed application can significantly boost the number of fruits produced by tomato plants. This improvement is attributed to various factors, including enhanced flower and fruit set, as well as overall plant growth.

• **Improved plant health:** Seaweed extracts are rich in biostimulants, which are natural compounds that can stimulate various physiological processes in plants. These processes include improved nutrient uptake, enhanced stress tolerance, and increased chlorophyll production, all of which contribute to a healthier and more resilient tomato plant.

• **Enhanced soil health:** Studies suggest that seaweed application can positively impact the soil microbiome, promoting the growth of beneficial bacteria that can improve nutrient availability and soil health. This, in turn, can create a more favorable environment for tomato plants to thrive.

• **Provides essential nutrien:** Seaweed is a rich source of various essential plant nutrients, including potassium, magnesium and calcium. These nutrients can help to improve plant growth and development, ultimately leading to higher yields.

• **Enhances beneficial microbes:** Studies suggest that seaweed extracts can also promote the growth of beneficial soil microbes, which can further improve plant health and productivity.

• **Improved nutrient uptake:** Seaweed contains various minerals and micronutrients, including potassium, magnesium, and calcium, which can enhance the plant's ability to absorb essential nutrients from the soil.

• **Enhanced root development:** Seaweed's polysaccharides can improve soil structure and drainage, promoting healthy root growth for better water and nutrient uptake.

Enhanced Stress Tolerance

Salinity Resistance: Seaweed extracts can help tomato plants better cope with salt stress, a major challenge in agriculture. Studies have shown increased tolerance and productivity in tomatoes treated with SWE under saline conditions .

Improved Fruit Quality

- **Increased Shelf Life:** SWE application can enhance fruit firmness, potentially reducing post-harvest losses and extending shelf life.
- **Potentially Higher Antioxidant Content:** Some studies suggest that seaweed extracts may contribute to increased antioxidant levels in tomatoes, although further research is needed.

Conclusion

The use of seaweed as a natural biostimulant holds promise for improving tomato performance in several ways, including increased yield, stress tolerance and potentially enhanced fruit qualityand the growing body of research suggests that seaweed has the potential to be a valuable tool for sustainable and productive tomato cultivation

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Cultivation of Oyster Mushrooms: A Profitable Business

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Introduction

Oyster mushrooms, formally known as *Pleurotus* spp., are a popular and commercially valuable kind of edible mushroom. Oyster mushrooms are becoming more and more well-liked in culinary circles all over the world because of their distinctive look and delicate flavor. Oyster mushrooms are a popular choice for both small-scale and commercial mushroom farming due to their culinary appeal as well as their nutritional value and ease of production. These days, Oyster mushroom is grown widely in several of our nation's states, including Karnataka, Maharashtra, Tamil Nadu, Kerala, Orissa, West Bengal and the North Eastern States. The Oyster mushroom has certain characteristics that are making it more and more popular to cultivate, not just in India but globally as well. Oyster mushroom has a 45-60-day crop cycle, is quickly dried, and may be produced on any kind of agricultural leftovers. Like other mushrooms, Oyster mushroom includes a variety of vitamin salts and therapeutic components. By selecting the appropriate species in the winter or summer, Oyster mushroom may be produced all year round. Its commercial cultivation currently occurs in the Western, Southern and North Eastern States of our nation. However, our nation's environment is ideal for its cultivation, and there is great potential to boost its output here in the near future.

Nutritional properties of mushrooms

Mushrooms have long been utilized as a vegetable by our ancestors and as a medicinal by our sages. However, study has shown that it actually includes a high-grade protein, vitamins, salts, and a variety of minerals, indicating its genuine nutritional worth. A high-quality protein is one that has every type of necessary amino acid. It has been shown that mushrooms contain between 30 and 35 percent protein. Specifically, the digestibility of protein can reach 60-70%, which is higher than that of protein derived from plants. It is crucial for mushroom producers to understand that in order to boost per capita consumption, information must be disseminated to the public through appropriate channels.

Nutritional properties of oyster mushrooms

Oyster mushrooms are low in calories and rich in minerals and vitamins. A 100-gram serving of oyster mushrooms contains

Calories: 33

Protein: 3 grams

Fat: 0.4 grams

Carbohydrate: 6 grams

Dietary fiber: 2.3 grams

Potassium: 420 milligrams

Folate: 38 micrograms

Niacin (vitamin B3): 5 milligrams

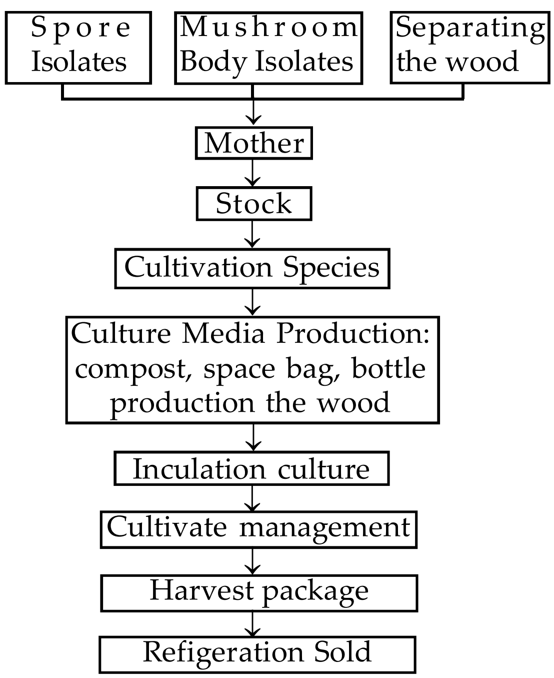
Pantothenic acid (vitamin B5): 1.3

milligrams
Riboflavin (vitamin B2): 0.3 milligrams

Method of producing Oyster mushroom

We need a manufacturing facility to make Oyster mushroom and materials like straw, raw bricks, bamboo and polythene may be used to build it. Mesh should be used on the doors and windows of these manufacturing facilities. They may be produced in any size, for example, 300 bags in a 20-foot-by-20-foot space or 15 feet by 15 feet (10 feet). Remember that there should be one window in front of the door and two huge windows for effective air management. If it were possible to add an air chiller, that would be preferable in order to keep the production room damp.

Mushroom Cultivation Process



1. Preparation of Nutrition: Any of the above-described agricultural leftover types can be used to make Oyster mushroom. It is essential that the straw or straws not be old and rotted for this to work. Tall, hard plant wastes can be machine-treated at a depth of two to three centimeters. One subtracts the size. Agricultural leftovers include a wide variety of dangerous bacteria, fungus and other microbes. Consequently, agricultural leftovers can be handled using any of the following techniques after they have first been sterilized.

2. Hot water treatment method: Using this technique, agricultural waste is put into a porous jute bag or sack and left to soak overnight. The following day, the water is heated to 60-65°C and treated for 20-30 minutes. The prepared straw is cooled before the seeds are introduced.

3. Chemical method: Using specialized agricultural chemicals or medications, agricultural leftovers are sterilized in this manner. Using this procedure, a 200-liter drum or tub is filled with 90 liters of water and 12-14 kg of dried straw. Subsequently, a plastic bucket containing 10 liters of water, 5 grams of Bavestein and Formalin (125 ml) is filled with the solution and applied to the straw drum. The drum is then securely sealed with a polythene cover or lid. The treated straw is kept in the drum for two to four hours, covered with a plastic sheet or iron mesh, after roughly twelve to fourteen hours. This will get rid of extra water as well as the formalin odour.

4. Sowing: Oyster mushroom seeds are to be utilized as soon as possible; they should not be older than 30 days. To make one quintal of dry straw, 10 kg of seeds must be acquired before the straw is prepared. *Pleurotussajor cashews, plu. Phlebiletus, plu. Sepidus, plu. Jamor* or *plu. Cytotrophiatus* are the predominant species throughout the summer. Must be developed. The room should be coated with 2% formalin two days prior to planting. After thoroughly combining around 100 grams of seeds with 4 kg of damp straw, form 40-45 centimetres polythene bags need to be completed. To preserve the moisture content of the straw, either fold and seal the polythene or cover it with newspaper. Polythene has around 5 mm if it has to be closed. Make 10-12 holes both inside and outside of the pans to prevent the bag's temperature from rising beyond 30°C.

5. Crop Management: To disperse the seeds after planting, the bags are put inside a production chamber. Once a week, the bags need to be examined to determine whether the seeds are spreading or not. A bag should be removed from the manufacturing area and thrown away if it exhibits green, black or blue mold. Seeds do not require light, air or water to spread. Turn on the air chiller or spritz two or three times on the room's walls and ceiling if the temperature of the bag and the space starts to rise beyond thirty degrees Celsius. It is important to ensure that water does not build up on the bags.

The straw will be covered with a mushroom fungal web in around 15 to 25 days, at which point the bags will begin to take on a white appearance. In this instance, polythene needs to be eliminated. During the warmer months of April through June, polythene shouldn't be totally removed since the bags could become dry. Water should be sprayed on the bags and in the chamber two or three times a day for fruiting after the polythene has been removed. The windows in the room should be mirrored or the tube lights should be controlled, so that the space is lit for around six to eight hours. To reduce the amount of carbon dioxide in production rooms, windows should be left open two to three times a day or exhaust fans can be used. Excess carbon dioxide causes the Oyster mushroom's stem to grow while the umbrella stays smaller. Within a week or so of opening the bags, little mushroom buds will begin to grow and in four to five days, the mushrooms will reach their full size.

6. Plucking mushrooms: The Oyster mushroom becomes breakable once it has completely grown and its edges begin to bend upward, which takes around 7 to 8 days. Water should never be sprayed without first plucking. Using a knife, cut and remove the straw that is connected to the stem after breaking the mushroom. Eight to ten days will pass between the first and second crops. Roughly half or more of the total yield is produced in the first harvest. This results in a high yield of up to three harvests. The bags should then be placed in a deep hole to break down into compost that may be applied to the fields. For every commercial species, 700-800 grams of dry straw are produced.

7. Precautions: In the production chamber in the morning, Oyster mushroom's pod releases a lot of tiny spores or spores that resemble smoke. Individuals who work a lot could be allergic to these spores. As a result, two hours before you plan to clear the dirt in the production area, you should open the windows, doors and other windows. You should also enter the rooms wearing a mask or a towel over your nose.

8. Storage use: Once the shimmer has been broken, it should be stretched out on the fabric for around two hours to remove any remaining moisture before being packed in polythene. You may store fresh Oyster mushroom in the refrigerator for two to four days by packing it in a porous plastic container. You may dry Oyster mushroom in the sun or in an oven. Oyster mushroom may be used to make a variety of foods, including pakora, biryani, omelettes and peas. Vegetables can also be cooked with dried ghee. It may therefore be utilized simply immersing it in hot water for a short period of time. Soups and fresh Oyster mushroom pickles can also be prepared to perfection.

9. Income: Oyster mushroom's company is successful and appears to have very little overhead. This may be accomplished by building production rooms at a reasonable cost and the crop cycle takes 40-50 days. Oyster mushroom may be easily sold in the market for the same price as white button mushrooms, with a kilogram costing between 10 and 15 rupees.

Future thrust

The cultivation of oyster mushrooms is a lucrative enterprise with a bright future. Demand for oyster mushrooms and other specialized kinds is increasing as people become more health aware and interested in sustainable and organic cuisine. Oyster mushrooms are popular with health-conscious customers due to their nutritional value and adaptability in a variety of cuisines. Advances in mushroom growing methods, such as controlled environment agriculture (CEA), automation and precision farming, may improve productivity, quality and consistency in mushroom output. Investing in cutting-edge cultivation techniques and technology may help producers improve their operations and fulfill the rising demand for oyster mushrooms. Oyster mushroom production is not only lucrative, but also eco-friendly. Use agricultural waste as a substrate, and you'll be successful in your endeavor. Remember, this is just the start of your mushroom adventure. As you acquire expertise, try new mushroom kinds and develop your company.

Overall, oyster mushroom production has enormous economic potential, driven by changing customer tastes, environmental efforts, technical developments, and novel product development techniques. Entrepreneurs and producers that capitalize on these trends and possibilities may set themselves up for success in the mushroom business.

References

- Mandeel QA, Al-Laith AA and Mohamed SA. Cultivation of oyster mushrooms (*Pleurotus* spp.) on various lignocellulosic wastes. *World Journal of Microbioa Biotechnology*, 2005; 4: 601-607.
- Rajak S, Mahapatra SC and Basu M. Yield, fruitbody diameter and cropping duration of oyster mushroom (*Pleurotus sajor-caju*) grown on different grasses and paddy straw as substrate. *European Journal of Medicinal Plants*, 2011; 1(1): 10-17.
- Jongman M, Khonga EB, Khare KB and Mubyana-John T. Effect of seasonal variation and supplementation on yield of oyster mushrooms cultivated on indigenous grasses in Botswana. *Mushroom Research*, 2010; 19(2): 54-61.
- Rühl M, Fischer CH and Kües U. Ligninolytic enzyme activities alternate with mushrooms production during industrial cultivation of Pleurotus ostreatus on wheat-straw-based substrate. *Current Trends Biotechnol Pharm*, 2008; 4: 478-492.
- Belewu MA and Belewu KY. Cultivation of mushroom (*Volvariella volvacea*) on banana leaves. *African Journal of Biotechnology*, 2005; 4: 1401-1403.

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Safe Processing of Fruits and Vegetables for Quality Enhancement

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Introduction

Consumers have been increasingly demanding in recent years, wanting high-quality and convenient food items with natural fragrances and flavors that are devoid of chemicals and preservatives (Tylewicz *et al.,* 2017). As a result, the challenge for the fruit and vegetable sector is to create such commodities while considering quality and safety as well as customer approval (Tylewicz *et al.,* 2019). Emerging, novel fruit and vegetable processing is being investigated more and more in order to generate goods rich in bioactive compounds while also paying attention to waste and by-product valorization (Barba *et al.,* 2015; Deng *et al.,* 2019).

Wayumba *et al.,* (2019) highlighted the importance of high quality standards for the potato to be used in processing industries. This particular study was carried out to evaluate the clonal potatoes having acceptable quality which could be utilized for chips production matching to the quality standards of the potato for references *viz.,* superior and Dubaek. After the study, it was concluded that for the high-quality processing of potato chips the clone needs to have a low level of glyco-alkaloids and reducing sugars accompanied by high dry matter content and acceptable chip color. Potato starch is a vital component that adds to its nutritional and technical qualities. Different food processing procedures, such as boiling, chilling, reheating, classic frying, and air frying, have been reported to modify starch digestibility (Abduh *et al.,* 2019). The effect of emerging processing using pulsed electric field (PEF)-typically used for structure modification in fruit and vegetables-on the properties of starch in potatoes was investigated in the paper by Abduh *et al.,* (2019) revealing that PEF did not change the properties of starch within the potatoes, but it narrowed the temperature range of gelatinization and reduced the digestibility of starch collected from the processing medium. As a consequence, this research demonstrates that when employed as a potato processing aid, PEF has no negative impacts on the characteristics of potato starch. PEF has been proven to be beneficial in improving the extraction yield of bioactive components (mostly betalains) from beetroot (Nowacka *et al.,* 2019). When an electric field of 4.38 kV/cm was applied, the concentration of betalain compounds in the red beet extract increased the most. The use of high-voltage electrical discharges (HVED) as a green technology increased the extraction rate of polyphenols from olive leaves (Zuntar *et al.,* 2019). Different green solvents (water, ethanol), treatment periods (3 and 9 minutes), gases (nitrogen, argon) and voltages were used in the HVED (15, 20, 25 kV). The sample treated with argon/9 min/20 kV/50 percent yielded the largest yield of phenolic chemicals (3.2 times greater than conventional extraction (CE). In general, HVED has a high potential for phenolic chemical extraction for subsequent use in functional food manufacture.

The work by Lvdal *et al.*, (2019) discusses the valorization of waste and byproducts. It includes an overview of tomato production in Europe as well as the tactics used for processing and valorizing tomato byproducts and waste fractions. The four tomato-producing nations of Norway, Belgium, Poland and Turkey received special attention. These nations represent the extremes among European tomato-producing countries in terms of meteorological conditions for tomato cultivation and volume produced.

The goal of research by Nowacka *et. al.*, (2019) and Stamenkovi'c *et al.*, (2019) was osmotic dehydration and drying of berries. Nowacka *et. al.*, (2019) coupled cranberry osmotic dehydration with blanching, ultrasound, and vacuum application in their work. Unusual cranberry pretreatment resulted in a considerable boost in osmotic dehydration efficacy. Cranberries exposed to a combination of treatments, particularly ultrasounds, showed equivalent or greater polyphenolic, anthocyanin, and flavonoid content than blanched tissue exposed to osmotic dehydration alone. Taking into consideration the examined physical and chemical features of dehydrated cranberries as well as the osmotic dehydration process, it was determined that a 20-minute sonication followed by a 10-minute decreased pressure treatment was the optimal combination pretreatment approach. Stamenkovi'c *et.al.*, (2019) compared the efficacy of convective drying of Polana raspberries to freeze-drying, which enables producers to generate high-quality but expensive goods. The authors found that convective drying of Polana raspberry with an air temperature of 60ºC and an air velocity of 1.5 ms-1 is a viable alternative to freeze-drying (Stamenkovi'c *et al.*, 2019).

High-pressure processing is another developing non-thermal method being investigated on fruits and vegetables with the goal of better maintaining nutritional and organoleptic qualities. Indeed, the findings provided in the research by Paciulli *et al.*, (2019) demonstrated a minor effect of high-pressure treatments on the organoleptic qualities of blueberries, as well as improved texture and color retention. The effects of ultra-high pressure (UHP) and thermo-sonication (TS) on mango juice quality were also investigated. Both treatments had little influence on mango juice's total soluble solids, pH and titratable acidity (Dars *et al.*, 2019). The residual activities of three enzymes (polyphenol oxidase, peroxidase and pectin methylesterase), antioxidant compounds (vitamin C, total phenolics, mangiferin derivatives, gallotannins and quercetin derivatives) and antioxidant activity decreased sharply as the TS treatment temperature increased. Despite this, the UHP therapy maintained a high amount of antioxidants and antioxidant activity. In terms of bioactive chemical and antioxidant activity preservation, the UHP procedure seems to be better than TS. As a result, mango juice products created by ultra-high-pressure processing may be more health-beneficial. Instead, Wiktor *et al.*, (2019) analyzed the role of pulsed light therapy with altering irradiance on a gallic acid aqueous solution-as a laboratory experiment on phenolic-rich liquid food compositions. It was established that pulsed light may modify the optical features of gallic acid and activate reactions and degradation of gallic acid. However, at low fluence levels, the introduction of pulsed light had no noticeable influence on the quality of the model gallic acid solution. Cluster analyses revealed that gallic acidvariations conferred to 3.82 Jcm-2, which can be exploited to reduce the nutritional losses and may be employed as the critical threshold for food process design aiming to decrease nutritional loss. Tomas-Egea *et al.,* (2019) investigated the significance of process control in the sector, which necessitates quick, safe and simple approaches. In this regard, the application of dielectric spectroscopy in the microwave region might be a fantastic chance to monitor operations where the mobility and amount of water is the key attribute to generate a high-quality and safe product, such as fruit candying. They proved that using dielectric characteristics in-dispersion at relaxation frequency enabled us to not only monitor the osmotic drying and hot-air-drying processes of apple candying but also anticipate the liquid phase supersaturation condition till vitrification.

References

• Abduh S, Leong SY, AgyeiD and Oey I. (2019). Understanding the properties of starch in potatoes (*Solanum tuberosum* var. Agria) after being treated with pulsed electric field processing. Foods, 8(5), 159.

• Barba FJ, Parniakov O, Pereira SA, Wiktor A, Grimi N, Boussetta N and Vorobiev E. (2015). Current applications and new opportunities for the use of pulsed electric fields in food science and industry. *Food Research International*, 77, 773-798.

• Dars AG, Hu K, Liu Q, Abbas A, Xie B and Sun Z. (2019). Effect of thermo-sonication and ultra-high pressure on the quality and phenolic profile of mango juice. Foods, 8(8), 298.

• Deng LZ, Mujumdar AS, Zhang Q, Yang XH, Wang J, Zheng ZA and Xiao HW. (2019). Chemical and physical pretreatments of fruits and vegetables: Effects on drying characteristics and quality attributes a comprehensive review. Critical reviews in food science and nutrition, 59(9), 1408-1432.

• Løvdal T, Van Droogenbroeck B, Eroglu EC, Kaniszewski S, Agati G, Verheul M and Skipnes D. (2019). Valorization of tomato surplus and waste fractions: A case study using Norway, Belgium, Poland and Turkey as examples. Foods, 8(7), 229.

• Nowacka M, Tappi S, Wiktor A, Rybak K, Miszczykowska A, Czyzewski J, and Tylewicz U. (2019). The impact of pulsed electric field on the extraction of bioactive compounds from beetroot. Foods, 8(7), 244.

• Nowacka M, Wiktor A, Dadan M, Rybak K, Anuszewska A, Materek L and Witrowa-Rajchert D. (2019). The application of combined pre-treatment with utilization of sonication and reduced pressure to accelerate the osmotic dehydration process and modify the selected properties of cranberries. Foods, 8(8), 283.

• Paciulli M, Medina Meza IG, Rinaldi M, Ganino T, Pugliese A, Rodolfi M and Chiavaro E. (2019). Improved physicochemical and structural properties of blueberries by high hydrostatic pressure processing. Foods, 8(7), 272.

• Putnik P, Lorenzo JM, Barba FJ, Roohinejad S, RežekJambrak A, Granato D and Bursac Kovacevic, D. (2018). Novel food processing and extraction technologies of high-added value compounds from plant materials. Foods, 7(7), 106.

• Stamenkovic Z, Pavkov I, Radojcin M, TepicHorecki A, Kešelj K, Bursac Kovacevic D and Putnik P. (2019). Convective drying of fresh and frozen raspberries and change of their physical and nutritive properties. Foods, 8(7), 251.

- Tomas-Egea JA, Fito PJ and Castro-Giraldez M. (2019). Analysis of Apple Candying by Microwave Spectroscopy. Foods, 8(8), 316.
- Tylewicz U, Tappi S, Mannozzi C, Romani S, Dellarosa N, Laghi L and Dalla Rosa, M. (2017). Effect of pulsed electric field (PEF) pre-treatment coupled with osmotic dehydration on physico-chemical characteristics of organic strawberries. Journal of Food Engineering, 213, 2-9.
- Tylewicz U, Tappi S, Nowacka M and Wiktor, A. (2019). Safety, quality, and processing of fruits and vegetables. Foods, 8(11), 569.
- Wayumba BO, Choi HS, and Seok LY. (2019). Selection and evaluation of 21 potato (*Solanumtuberosum*) breeding clones for cold chip processing. Foods, 8(3), 98.
- Wiktor A, Mandal R, Singh A, and Pratap Singh A. (2019). Pulsed Light treatment below a Critical Fluence (3.82 J/cm2) minimizes photo-degradation and browning of a model Phenolic (Gallic Acid) Solution. Foods, 8(9), 380.
- Žuntar I, Putnik P, Bursa´cKovacevi´c D, Nutrizio M, Šupljika F, Poljanec A, Dubrovi´c I, Barba FJ, RežekJambrak A. (2019) Phenolic and Antioxidant Analysis of Olive Leaves Extracts (*Olea europaea* L.) Obtained by High Voltage Electrical Discharges (HVED). Foods 8, 248.

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Dragon fruit Cultivation: A Tropical Fruits with Nutritional Benefits

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Dragon fruit is a newly introduced fruit crop in India, this fruit crop is gaining popularity in terms of growing area and popularity within the members of edible cactus. It is a highly remunerative crop with high nutraceutical value. The article discusses the in-depth cultivation aspects of dragon fruit based on literature and research findings.

Introduction

Dragon Fruit (Hylocereus sp) ranks first in terms of growing area and popularity within the members of edible cactus. Another important edible cactus is prickly pear (*Opuntia ficusindica* L.) (Shetty *et.,a*l 2012). The most extensively grown Hylocereus species throughout the world are *Hylocereus undatus* (White fleshed), *Hylocereus polyrhizus* (Red fleshed) *Hylocereus costaricencis* violet red flesh and pink skin and *Hylocereus megalanthus* (Yellow peeled). All these species are collectively called as dragon fruit. The first two species have red skin colour while last one has yellow skin colour. Dragon fruit is a semi epiphytic vine plant which can climb naturally to any natural or artificial support they meet (trees, wood or cement posts, stonewalls, etc.) Each fruit is covered with bracts or scales hence the name dragon fruit was given (Nerdand Mizrahi 1997). While in Central and Latin America, this scaly fruit is popularly known as Pitayaor Pitahaya (Wybraniec and Mizrahi 2002).

Composition and nutritive value: 100g of edible part

Contents	*Hylocereus undatus*	*Hylocereus polyrhizus*	*Hylocereus megalanthus*
Moisture (%)	89.00	87.30	85.40
Ash (g)	0.50	0.70	0.40
Protein (g)	0.50	0.16	0.40
Fiber (g)	--	10.10	0.50
CHO (g)	--	1.48	--
Fat (g)	--	0.24	0.10
Vit C (mg)	25.00	8-9	4.00
Fe (mg)	0.40	3.40	0.30
Ca (mg)	6.00	5.90	10.00
P (mg)	18.50	23.00	15.50

Jaffer *et., al* (2009).

Origin and Distribution

Dragon fruit is native to Tropical regions of Mexico and central to South America (Mizrahi *et., al* 1997). All three commercial *Hylocerous* sp. widely grown in South East Asian countries like Malaysia, Vietnam, Thailand, Philippines and Taiwan.

Area and Production

It was first introduced to Thailand in 1991 and successfully produced in 1994 with good quality and high production. *Hylocereus costaricensis*, red fleshed pitaya and *Hylocerou sundatus*, a white fleshed pitaya is two major species growing under Indian condition especially in West Bengal. Cultivation of dragon fruit already started in different part of west Bengal with many success stories of farmer from different regions (Perween *et., al* 2018). However, it was first successfully grown in Gujarat state. Many nursery men started propagation for raising planting material of dragon fruit.

Varieties

Red Dragon Fruit: It has pink skin with dark red flesh inside. Fruit varieties that fall under this type are Orejona, Costa Rican Sunset, Lisa, Rosa and San Ignacio-very sweet taste self-fertile, Red Jaina, Zamorano and Natural Mystic.

Pink Dragon Fruit: It has pink-red flesh. Varieties like Delight, Dark Star, Purple Haze, Makisupa and American Beauty come in this type.

White Dragon Fruit: This cultivar produces pinks kin and white flesh. David Bowie, LA woman, Alice, Zihong long White fleshed and Neitzel are the popular varieties.

Yellow Dragon Fruit: This type includes just one variety that has yellow skin a companied by white and firm flesh that is a lot tastier as well as sweeter.

Soil and Climate

Dragon fruit prefers warm, moist climate with rich, organic soil. Dragon fruit is a semi-epiphytic plant which prefers a dry tropical or sub-tropical climate with an average temperature of 21-29°C, but can withstand temperatures of 38-40°C and freezing temperature (as low as 0°C) for short periods. This crop requires sunshine and rainfall of 600-1300mm with alternating wet and dry seasons.

Propagation

Dragon fruit can be propagated successfully by cutting off the stem as soon as it touches the ground. Cuttings at least (50-70cm) in length are watered regularly in order to ensures at is factory rooting by making a slanted cut on the stem end to be inserted into the soil is said to improve rooting. Cuttings may be planted directly in the field or in pots using a well-drained potting medium.

Spacing

Dragon fruits are creepy vine it needs support to grow. The distance between plants depends upon the type of support used.

Planting at a distance of 2.5 m each row to row between the plants with 4 cuttings/ support can accommodate 6400 plants/ha and also gives good yield and quality of fruits. The height of the different type of support should be betw-een 1.4-1.6 m for vertical sup-ports and between 1-1.2 m for horizontal and inclined sup-ports to facilitate management of the crop.

Fig1: Dragon fruiting support column with iron rings in KVK, Kalimpong.

Manuring and fertilization

Mineral and organic nutrition is particularly advantageous and when they are combined. Anexperiment conducted in Bidhan Chandra Krishi Viswavidyalaya for different combination of N,P, K fertilizer doses revealed the dose of N: P_2O_5: K_2O 450:350: 300 perform best result for yield and quality (Perween *et., al* 2018).

Irrigation

Its annual rainfall requirement is 25-50 inches; excessive rain may lead to flower drop and fruit rot. Even if Dragon fruit can survive with very low rainfall, many months of drought, when good quality fruits are required, a regular water supply is needed.

Harvesting

The fruit skin colors very late in the maturation stage, changing from green to red or rosy-pink (25 or 27) days (depending on the species) after a thesis (Nerd *et.,al* 1999). In case of *Hcostariensis* it takes 30 days. Four to five days later the fruit reach their minimal colouration and leads to splitting and cause economical loss. The fruits are harvested by simply moving the fruit in clockwise direction and twisting the fruit cause less injury to the fruits. The absence of peduncle makes the picking difficult.

Yield

The yield depends on planting density and is around (10to30) t/ha (Barbeau 1990).

Pests

Ants belonging to the genera Atta (Barbeau 1990) and Solenopsis are very notorious pest and can cause major damage to the plants as well as to the flowers and fruits. Rats and birds can also cause serious damage mainly to flowers and fruits as well as ripe fruits.

Disease

Fungal (*Gleosporeumagaves, Macssonina-agaves Dothiorella* sp, *Bothryophaeria dothidea Collectrotrichum gleosporoides* and *Bipolaris cactivora*). Hot-water treatment, vapor heat, forced hot air and irradiation), modified atmosphere and 1-MCP are among alternative management of postharvest anthracnose *Collectrotrichum gleosporoides* in dragon fruits (Bordoh *et., al* 2020) Virus (Cactusvirus X) Bacteria (*Xanthon onas campestris* and *Erwinia* sp)

Conclusion

The above article presents brief cultivation aspects of dragon fruit, which is an attractive fruit with high nutritive content. The crop needs to be grown in different areas of India as it is a hardy crop with good market demand and high export value.

References

- Barbeau G. La pitahaya rouge, un nouveau fruit exotique. Fruits.1990; 45:141-174.
- Bordoh P, Ali A, Dickinson M, Siddiqui Y, Romanazzi G (2020) A review on the management of postharvest anthracnose in dragon fruits caused by Colletotrichum sp. Science Direct
- Jaffer R A, Rahman A R B A, Mahmod N Z C and Vasudevan R (2009) Proximate analysis of Dragon Fruit (Hylo cerous polyrhizus). American Journal Applied Science 6(7): 1341-1346.
- Mizrahi Y, Nerd A and Nobel P S (1997) Cactias crops. Horticulture Review 18:291-319.
- Nerd A and Mizrahi Y (1997) Reproductive biology of cactus fruit crop. Horticulture Review 18:321-346.
- NerdA, Guatman F and Mizrahi Y (1999) Ripening and Postharvest behavior of fruits of two Hylocerous sp. (Cactaceae). Postharvest Biological Technology 17:39-45.
- Perween T, Mandal K K and Hasan M A (2018) Dragon fruit: Anexotic super future fruit of India. Journal of Pharmacognosy and Phytochemistry,7(2):1022-1026.

• Shetty A, Rana A and Preetham S P (2012) Cactus: a medicinal fruit. Journal of food Science Technology 49 (5): 530-536.

• Wybraniec S and Mizrahi, Y (2002) Fruit flesh betacyanin pigments in hylocereus cactus. JAgric Food Chem. 9; 50 (21):6086-89.

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Production Technology of Asiatic Lily under Protected Cultivation

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Introduction

Lilium sp. is cultivated worldwide and is one of the most important generator cut flower and pot plant. The genus lilium belongs to the family Liliaceae comprising of around 100 species and more than 9,400 cultivars, which are divided into seven sections. Northern hemisphere, mainly Asia, North America and Europe, especially China, Nepal, Korea and Japan, constitute the gene centres of this genus around the world. It is a genus of great economic significance for production and commercialization of its cut flower in the international cut flower market. In the language of flowers, lily symbolizes purity and innocence.

Today, it is one of the most significant flowers grown by the cut flower industry. Due to its size, beauty and longevity, lilium is among the top ten cut flowers in the world. As a cut flower, lily is the fourth most important crop in the Netherlands. Species of genus lilium, originated from Asia, Europe, and North America, are mostly vegetatively propagated monocot perennials and are one of the economically most important flower bulbs. Lilies produce big attractive flowers with a wide range of colours and shapes; therefore, they make excellent cut flowers, wonderful flowering potted plants and have a great ornamental value for landscape purposes. Worldwide commercially important lily cultivars, viz. Asiatic hybrids, Oriental hybrids and cultivars of *Lilium longiflorum*, originated from only three of the seven sections. Asiatic hybrids were obtained after complex interspecific hybridization between at least 12 species of the Sino martagon section. Hybridisation between five species of the section Archelirion resulted in the oriental hybrids, whereas *Lilium longiflorum* belongs to the section Leucocidin. Crosses between L. *longiflorum* and 'Asiatic' lilies lead to development of 'LA' hybrids while crosses between L. *longiflorum* and 'Oriental' produced the 'LO' hybrids, specially the difficult hybridisation between Asiatic hybrids and Oriental hybrids ('OA' hybrids), a combination of the two most commercially important lily clusters, are a break-through in lily breeding and hybridisation.

Intersectional crosses have considerably increased the availability of genetic variation in lilium for important traits. Out of total acreage of lily bulb production in The Netherlands, Asiatic hybrids account for about 45% of this area, Oriental hybrids for about 40% and the cultivars of L. *longiflorum* for about 5%. The relatively new L. *longiflorum* x Asiatic ('LA') hybrids are already responsible for about 7% of the acreage of lily production.

These different groups of lilies have many things in common but with few differences among them, some related to their morphological & anatomical structures and developmental patterns, while others related to their growing and environmental conditions. However, for cut flower production, Asiatic and Oriental lilies are promising having gained admiration in recent years.

The lily flower contains two alternating whorls of perianth segments (tepals). The individual flowers are usually arranged in an inflorescence, which contains several flowers in different developmental stages. Flower development proceeds acropetally. The number of flowers and inflorescences depends on the bulb size. At the commercial level, many forced cultivars having bulb size of 12 to 14 cm inches in circumference produce 38 flowers per inflorescence. Large and attractive flowers with the capacity to rehydrate after a long-distance transportation have made lilium gain popularity fast in our country.

Suitable Varieties

1) EREMO: Easterx Asiatic lily, Flowers are huge and bright melon- orange, do not fade and last a long time in polyhouse. Deep orange colour gives a wide range of beautification for the flower. Great to cut for arrangements and used in back of the border due to its large flowers and taller stance. Mainly it is popular because of its colour that shows up well during rainy weather. Little amount of fragrances is also there.

2) NASHVILLE: These are large, pure old-gold yellow flowers. It has a combination of both the Asiatic and longiflorum. The stunning golden yellow colour gives beauty to the flower.

3) RELOAD: flowers are white in color. Growing period up to 90-95 days. Height up to 90-100 cm. flowers are up facing.

4) MASAI: flowers are deep orange in color. Growing period up to 90 days. Flowers have a good fragrance.

5) RODENGO: flowers are creamy white in colour, mild fragrances are there. Plant attains a height up to 70-75 cm. More than 4 buds can be seen in this hybrid.

6) ARABTAX: Flowers are light pink in color and it attains a height of 100-105 cm. Bud size are large comparative to other hybrids.

7) FANGIO: Flowers are dark pink to hot pink in color. 3-5 buds are there in many spikes. Plant height up to 70-80 cm.

8) YERSEKE: Flowers are light pink in color. Flowers are facing up ward and it attains the height up to 75-80 cm.

9) BEAU SOLEIL: Flowers are dark yellow in color. Most commonly many of them are cultivating this hybrid. It needs very low sunlight and can be grown in indoors. It attains a height up to 80 cm.

10) CAESARS PALACE: Flowers are dark orange in color, it also have a mild fragrance and it attains height up to 90 cm.5-6 buds can be seen in this hybrid.

Climate

Temperature

Lilies require a night temperature of 13-17°C and higher than 21°C Day temperature and day temperature should be ideally around 29°C. In general, Asiatic lilies took 30-35 day to flower. When seasonally warm temperatures occur, keeping the soil and air temperatures below 20°C is recommended. Temperature below 15°C can result in bud drop and yellowing of foliage in oriental type of hybrids.

Light

Light influences flowering both, photo periodically and photosynthetically. Long photoperiods enhance floral initiation, making lilies a quantitative long day plant. Long photoperiods can substitute for cold on weekly basis. Lilies require a medium to high light intensity (>2500-foot candles) in greenhouse cultivation, especially during the short days of the winter. In location where the day length is shorter than 12 hours, lilies respond to assimilation lighting during the winter. This aids in reducing flower abortion and flower abscission with sensitive varieties. For quality flower production in lilium, 2000-3000-foot candles of light are essential.

Humidity

Humidity is the amount of moisture present in the air. If the temperature is higher, air can contain more humidity as compared low temperature. Plants require humidity of 75 to 85% when grown in polyhouse/greenhouse/tunnels. If the humidity reaches 100%, the plants can become wet and it generally occurs when the temperature drops too much during the night.

Carbon dioxide

CO_2 has a positive effect on the growth and flowering of lilies. An optimum concentration of 800 to 1,000 ppm is recommended for commercial cultivation. The use of 1,000 ppm CO_2 in conjunction with supplemental lighting improve quality, reduced flower bud abortion and reduce the number of days to flower.

Ventilation

It has been observed that, a lot of heat build-up underneath polyfilm inside a polyhouse. Sometimes, temperature can rise to record high if no provision is made for proper ventilation. To have proper ventilation inside the greenhouse, it is advisable to build a structure with a top ventilation gap of minimum 3 feet. Depending on design and size of the greenhouse, one can have a provision for side ventilation as well, If the distance from side to centre of the greenhouse is less than 30 feet, side ventilation in combination with top ventilation is recommended.

Soil

Lilies can be forced into flower in almost any type of soil. The soil used for cultivation of lilies should have good structure, particularly the top layers and should also be kept well drained during the entire growing period. Heavy soils is also essential for good healthy root system and thus for plant development. Maintaining the optimum pH of soil plays a major role in root development and uptake of nutrients. It is advisable to maintain a pH of 6 to 7 for the Asiatic and Longiflorum hybrid groups.

Propagation

Lilium is propagation by bulblets, axillary bulbils, separation of scales, division of bulbs, leaf cutting and through micro-propagation. A 6-week cold storage period at 2-5 degree is needed to make dormancy. Bulbs can be stored up to-20 degree for one year.

Spacing

30 x 45 cm is mainly suitable and it depends on bulb size.

Planting

Before planting the bulbs treated with fungicide solution of Bavistin @2g/l for 1 hr. immediately light irrigation was given after planting. At the time of planting vermicompost applied along with the bulbs.

Planting Depth

Lilium bulbs should initially be planted at a depth of 15 cm. After planting and irrigation, the soil will settle down about an 3-4 cm leaving 10 cm of soil on top of the bulb. This is sufficient for the stem roots to develop properly. Shallow planting will result in poor stem-root development and hence compromise on the quality of the flower. Planting depth varies according to the size of the bulb. Bulbs planted at 5cm deep delays the flowering time, while bulbs planted by kept nose at soil line and ½ bulb exposed resulted earlier flowering. Generally, bulb should be planted to the depth of three times more than the diameter of the bulb.

Irrigation

The amount of irrigation water depends on type of soil, greenhouse climate and the variety Too much or too little watering will result in uneven, delayed emergence and growth; reduction in stem length; and even flower bud desiccation among certain susceptible cultivars. First two weeks, irrigation only by using water can or shower is advised. Third week onwards, it is recommended to use drip for irrigation. Lilies are sensitive to salt content will also reduce the roots capacity to absorb water, and this will lead to a reduction in the height of the crop.

Nutrients

Lilium is a bulbous crop; most of its nutrients are already present in the bulb itself. Basal application of Farm yard manure at 100 kg for 250 m^2 was applied before planting. Lilium is a very salt sensitive crop and therefore one should take care while applying fertilizers. After planting, NPK 19:19:19 @ 2 g/litre was applied twice a week.

Intercultural Operations

1. Weeding/ hoeing: Regular hand weeding and hoeing was done at intervals of 15-20 days from the day of transplanting and the last weeding was done after the completion of blooming period. Total 5 weeding and hoeing were done. And soil loosening operation was done at weekly interval.

2. Earthing up: Intercultural operations like earthing up was done 15 days after planting to cover up the exposed bulbs and nodes.

3. Staking: When the plants attain a height of 70-80 cm, because the Eremo will rise up to the height of around 65-70 cm, wooden stakes of at least 6 feet tall are tied around the stem in order to give mechanical support to the plants as well as its oversized flowers. These small investments at the start of the growing season will ensure us to enjoy a bumper crop of beautiful blooms.

Plant Protection

Pests

(1) Aphids: The upper leaves are curled and deformed, green spots can be seen in young buds, and then the flower should be deformed and remain partially green.By the application of imidachloropid 17.8 % SL@ 1ml/l or by using chloropyriphos 2ml/l can be sprayed.

(2) Mites: Mites feed the small buds and causes damage, Spray wettable sulphur @1.5 g/l

Diseases

(1) Bulb and scale rot: The underground brown spots on top and side of bulb, laterly it starts to rot and growth becomes retarded. By maintaining the lowest possible soil and to maintain the greenhouse temperature. Destroy the infected scales and bulbs. Drench the soil by using carbendazim @ 1g/l

(2) Root rot: Drenching the soil by using metalaxyl @0.1%

Harvesting

Harvesting is done when lower most bud showed color but is not open. Harvesting of flowers was done early morning or in the evening before bud opening. The cut flowers were immediately kept in bucket containing fresh water to remove field heat.

Crop Duration

Duration up to 75- 80 days

Yield

The average yield is 7500 stalks for 250 m^2

Economics

1. Cost of cultivation (Rs/250 m^2)

S. No.	Particulars	Quantity	Units	Rate	Cost
	Land Preparation				
1.	Ploughing and leveling	2	Hours	300	600
2.	Layout of the field	1	Labour	400	400
	Planting				
1.	Cost of bulbs	1851	Per bulb	30	55,530
2.	Planting	2	Labour	150	300
	Fertilizers And Manures				
1.	Farm yard manure	100	kg	02	200
2.	NPK 19:19:19	10	kg	150	1500
3.	Bavistin	0.35	kg	2857	999.95
	Intercultural Operations				
1.	Weeding	3	Labours	250	750
2.	Staking	1	Labour	250	250
	Irrigation				
1.	Tube well charges	8	Hours	300	2400
2.	Labour for irrigation	1	Labour	250	250
	Harvesting				
1.	Harvesting of flowers	1	Labour	250	250
2.	Transportation	-	-	-	1000
			Total cost of cultivation		**64,429.95**

2. Gross Return, Net Return, Benefit Cost Ratio (Rs/250 m^2)

Total Yield	7500 Stalks / 250 m^2
Market price of product	Rs. 300 / 100 stalks
Total cost of cultivation	Rs. 64,429.95
Gross Return	Rs.225,000
Net Return	Rs.160,570.05
Benefit Cost Ratio	3.49

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Zero Budget Natural Farming in Vegetables: Boon for Farmers

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Introduction

Zero Budget Natural Farming (ZNBF), Zero budget natural farming means raising crops without using any fertilizers and pesticides or any other external materials. The word Zero Budget refers to the zero cost of production of all crops. The phrase "Zero Budget" refers to all crops with zero production costs. The farmers' reve-nue is increased as a result of ZBNF's guidance towards sustainable farming methods that help to maintain soil fertility, assure chemical-free agriculture, and ensure a cheap cost of production (zero cost). Simply said, ZBNF is a farming technique that emphasises cultivating crops in harmony with the environment. Under the specific programme known as Parampa gat Krishi Vikas Yojana (PKVY), the government has been encouraging organic farming. This programme supports all different types of chemical-free agricultural methods, including Zero Budget Natural Farming.

Subash Palekar (Indian Agriculturist and Padma Shri Recipient) is the father of Zero Budget Natural Farming. He developed it in the mid 1990's as an alternative to the Green Revolution methods.

The points put forward by Subash Palekar in support of Zero Budget Natural Farming are:

- Lakhs of farmers are using the technique of Zero Budget Natural Farming in different agroclimatic zones and soil types.
- To grow a plant, whatever is needed is present in nature. No chemicals are required to grow a plant. An example. Earthworm excreta has seven times more nitrogen than the soil.

A large number of small farmers are using this technique as they see Zero Budget Natural Farming as a tool that can free them from debts and defaults. It makes farming both profitable and sustainable.

The topic, 'Zero Budget Natural Farming,' gained prominence when Finance Minister Nirmala Sitharaman mentioned it in her 2019 budget speech, speaking of it as a source of doubling farmer's income.

Principles of zero budget natural farming

- Zero external inputs
- Crops to cover the soil for 365 days (Living Root)
- Soil disturbance at a minimum
- Biostimulants as essential catalysts
- Utilize native seed for mixed farming
- Mixed cropping
- The incorporation of trees onto the farm
- Conservation of moisture and water
- Bring animals into farming
- More organic debris in the soil
- Using plant extracts to control pests
- No artificial pesticides, herbicides or fertilisers

Components of Zero Budget Natural Farming

There are four primary ZNBF components and models:

1) Bijamrita

As native cow species are more adapted to our region's climatic circumstances and easier for small and marginal farmers to maintain, the seeds are treated with formulations made using their dung and urine. While neem leaves and pulp, tobacco, as well as green chilli extracts are used to manage insects and pests, bijamrita is utilised to treat seeds.

2) Jiwamrita/Jeevamrutha

A natural resource utilised to restore the fertility and nutritional value of soil is cow dung. A gramme of cow dung may contain 300-500 billion helpful microorganisms. These bacteria help decompose the soil's biomass and transform it into readily usable nutrients for crops. Cow dung and cow urine are used to make Jiwamrita. It is a component of the plants' diet. It is a fermented microbial culture made from uncontaminated soil, jaggery, cow dung, urine and pulse flour.

3) Acchadana/Mulching

The process of mulching involves adding cover crops, organic debris, or agricultural residue to the topsoil.

Benefits: Decomposing the materials used for mulching results in humus, which not only im-proves soil nutritional status but also conserves topsoil, boosts soil water retention, reduces evaporation loss and promotes soil fauna. It also inhibits weed growth.

4) Waaphasa/Moisture (Soil Aeration)

For plants to grow and thrive, the soil must have adequate aeration.

Benefits: Applying Jiwamrita and mulching promotes soil aeration, humus content, availability of water, water retention capacity, and soil structure, all of which are essential for crop growth, particularly during dry spells.

Sample	pH	N	P	K	Mg(ppm)	Cu(ppm)
cow dung	8.08	0.7	0.285	0.231	9.33	3.6
Gomutra (cow urine)	8.16	1.67	0.112	2.544	6.3	20
Gram Flour	6.7	1.47	0.622	0.91	12.6	12.4
Jeevamrut	4.92	1.96	0.173	0.28	46	51
Beejamrut	8.02	2.38	0.127	0.485	16	36

The Nutrient Composition Beejamrut, Jeevamrut and Their Constituents Revels That Beejam-rut are Alkaline and Jeevamrut are Acidic in Nature. They are Good Source of Macro and Mi-cro Nutrients

Table 1: Advantages and Dis-advantages Of ZBNF

S.No	Advantages	Dis- advantages
1)	Inefficient or obsolete operations can be identified and discontinued	It emphasises short-term benefits to the detriment of long term goals.
2)	ZBB leads to increased staff involve-ment at all levels since a lot more information and work is required to complete the budget	The budgeting process may become too rigid and the organisation may not be able to react to unforeseen opportunities or threats
3)	It responds to changes in the business en-vironment	The management skills required may not be present
4)	Knowledge and understanding of the	Managers may feel demotivated due to the

S.No	Advantages	Dis- advantages
5)	cost behaviour patterns of the organisation will be enhanced Resources should be allocated efficiently and economically	large amount of time spent on the budgeting process Ranking can be difficult for different types of activities or where the benefits are qualitative in nature

Conclusion

Zero Budget Natural Farming (ZBNF) represents a holistic approach to agriculture that em-phasizes sustainability, environmental stewardship and farmer livelihoods. Through the utili-zation of natural inputs, minimal external resources and the promotion of biodiversity, ZBNF aims to reduce farmer's dependency on costly inputs while enhancing soil health, conserving water and preserving ecosystems.

This farming method not only offers economic benefits by lowering production costs and in-creasing resilience to climate change but also contributes to food security and rural develop-ment. By empowering farmers with knowledge of traditional practices and agroecological principles, ZBNF fosters self-sufficiency, promotes community resilience and fosters a healthier relationship between humans and nature.

Overall, ZBNF presents a promising paradigm shift in agriculture, demonstr-ating that it is possible to achieve sustainable and profitable farming practices while respecting the envi-ronment and promoting social equity. As the global agricultural community continues to grapple with the challenges of feeding a growing population while mitigating environmental degradation, ZBNF stands as a beacon of hope for a more sustainable and regenerative future.

References

- Bishnoi, R., & Bhati, A. (2017). An overview: Zero budget natural farming. Trends in Bios-ciences, 10(46), 9314-9316.
- Bharucha, Z. P., Mitjans, S. B., & Pretty, J. (2020). Towards redesign at scale through zero budget natural farming in Andhra Pradesh, India. International Journal of Agricultural Sus-tainability, 18(1), 1-20.
- Khadse, A., & Rosset, P. M. (2019). Zero Budget Natural Farming in India from inception to institutionalization. Agroeco-logy and Sustainable Food Systems, 43(7-8), 848-871
- Khadse, A., & Rosset, P. M. (2019). Zero Budget Natural Farming in India from inception to institutionalization. Agroeco-logy and Sustainable Food Systems, 43(7-8), 848-871.

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Breeding Program in Onion (*Allium cepa*) and Garlic (*Allium sativum*)

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Introduction

Onion is one of the most important commercial vegetable crops in India. India is the second largest onion growing country in the world. Indian onions are famous for their pungency and are available round the year. Indian onions have two crop cycles, first harvesting starts in Nov. to Jan. and the second harvesting from Jan. to May.

The onion is a hardy cool-season biennial but usually grown as annual crop. The onion has narrow, hollow leaves and a base which enlarges to form a bulb. The bulb can be white, yellow or red and require 80 to 150 days to reach harvest.

Maharastra, Gujarat, Uttra Pradesh, Orissa and Andhra Pradesh are the major onion growing states. The total annual area is estimated to be about 3 lakhs hectare and production is about 35.37 lakh tonnes. It is grown mainly in rabi season. Three crops viz., Kharif, late Kharif and rabi are taken in Nasik division of Maharashtra whereas Gujarat, Andhra Pradesh, Rajasthan, Punjab, Harayana, Madhya Pradesh, Karnataka and Tamil Nadu take up two crops that is Kharif and rabi. Kharif onion is a recent introduction in Northern, Eastern and Central India.

Onion (*Allium cepa*)

- **2n:16**
- **Family: Amaryllidaceae**
- **Centre of Origin:Central Asia**
- **Mode of pollination: Cross pollination**

Botany

Onion is the biennial crop and takes two full seasons to produce seeds. In the first year bulbs are formed and in the second year stalks develop and seed are produced. It is a long-day plant. The day length influences bulb onion, but has little effect on induction of seeding. It appears to be day-neutral for seed production. It requires cool conditions during early development of the bulb crop and again prior to and during early growth of seed stalk. Varieties bolt readily at 10 to 15°C. In the early stages of growth, a good supply of moisture is required and temperatures should be fairly cool. During bulbing, harvesting and curing of seed, fairly high temperatures and low humidity is desirable. Seed production is widely adapted to temperate and sub-tropical regions.

Importance

Onion also known as the bulb onion or common onion is widely used as salad or cooked in various ways in all curries, fried, boiled or baked. Onion is also used in processed forms e.g., flakes, powder paste, pickles etc. It has very good medicinal value. Onions are high in vitamin C, a good source of fibre and with only 45 calories per serving, add abundant flavor to a wide variety of food. Onions are sodium, fat and cholesterol free and provide a number of other key nutrients. It is rich in quercetin, a flavonoid that has antioxidant properties and chromium which plays an important role in insulin action.

Onion Classification

Onions vary in colour, size, the time of year harvested and flavor. These differences make onions very versatile.

a. Yellow Onions: are full-flavored and are a reliable standby for cooking almost anything. Yellow onions turn a rich, dark brown when cooked and give French Onion soup its tangy sweet flavor.

b. Red Onions: with their wonderful colour are a good choice for lots of fresh uses or for grilling & roasting.

c. White onions: often used in prepared salads, white sauces and is the traditional onion for classic Mexican cuisine. They have a golden colour and sweet flavor when sautéed.

Breeding Objectives

- High yield
- Longer bulb storage life
- Resistance to diseases (purple blotch, basal rot, stem phyllium blight, bacterial storage rot)
- Resistance to pests (Thrips)
- Resistance to abiotic stresses (moisture stress, high temperature, salinity & alkalinity)
- Bulb quality (size, shape, color, pungency, firmness, dormancy, amount of soluble solids)
- Dormancy (for long time storage)
- High TSS (for dehydration industry)

Varieties

White Skinned	Yellow Skinned	Red Skinned
Pusa White Flat	Early Grano	Arka Kalyan
Pusa White Round	Brown Spanish	Pusa Red
Punjab-48	Bermuda Yellow	Punjab Red
Udaipur-102	Arka Pitamber	Arka Nidhi
Phule Safed	Phule Suvarna	Arka Niketan
		Arka Bindu

Some important varieties in India and their characters

Varieties	Characteristics
Pusa Red	Red coloured bulbs, good storage
Pusa Ratnar	Deep red, round, yield 30-40t/ha
Arka Nikethan	Good for storage
Arka Kalyan	Moderately resistant to purple blotch
Arka Bindu	Suitable for export
Arka Lalima	Resistant to purple blotch
Pusa White Flat	Suitable for dehydration

Resistance breeding for biotic and abiotic stress

Insect	Resistant varieties or species
Onion Thrips	Pusa Ratnar, Kalyanpur Red Round, Udaipur 103
Onion Thrips	Allium fistulosum
Diseases	Resistant varieties or species
Purple Blotch	Pusa Red, Pusa Ratnar, Pb. Sel-5, Arka Kalyan
Downy Mildew	A. Praemixtum, A. odoratum
Basal Rot	White Large, Poona Red, Ratna Red
Salinity	Hisar-2 and Early Grano

Garlic (*Allium sativum* L.)

- **2n=16**
- **Family: Amaryllidaceae**
- **Other names: Lehsun and wonder food**
- **Centre of origin: Central Asia**
- **Mode of pollination: Cross Pollination**

The garlic bulb is a compound bulb consisting of small bulblets or segments called cloves. Since garlic is propagated exclusively by vegetative methods clonal selection of local existing types in various regions is the important method of improvement. In the hill districts of U.P., cv., chauballci was found to be a very promising clonal selection in respect of bulb size and yield. In different regions of India good numbers of local strains are available. They vary in number of cloves, ranging from 16-50/bulb and the size of bulb. Despite the importance of crop, very limited breeding work has been done so far. As a first step of systemic breeding programme, collection and evaluation of germplasm is required. The adequacy of germplasm collection is determined by the amount of genetic variability Present in the germplasm. Assessment of variability present in these genotypes is helpful in selection of suitable genotype. Correlation estimates between bulb yield and its components are useful in developing suitable selection criteria for selecting desired plant type or developing high yielding varieties. Path analysis is helpful in choosing the character(s) that has direct effect on yield. Improvement techniques like polyploidy, mutation breeding and tissue culture have proved beneficial in increasing yield of garlic: These techniques have helped in improving major genetic and physiological traits. They have been also used for incorporating resistance to fatal diseases. The recent literature pertaining to the breeding of garlic is briefly reviewed.

Importance

Garlic is frost hardy bulbous erect herb. The bulb consists of 6-35 smaller bulblet is called 'cloves' which is used as spice. Garlic is good source of amino acids and protein. Garlic contains amino acid called allin. The enzyme allinase converts allin into allicin. Allicin is the anti-bacterial substances of garlic and has the typical odour of fresh garlic. It has been used for medicinal purpose since ancient times. It has antibiotic action. It reduces cholesterol and blood pressure. It also prevents stomach cancer. It has wound healing potential. Feasibility as pesticide i.e., garlic extract with mineral oil. It has also the antibacterial effect.

History

Garlic is among the oldest known horticultural crops. In the Old World, Egyptian and Indian cultures referred to garlic 5000 years ago and there is clear historical evidence for its use by the Babylonians 4500 years ago and by the Chinese 2000 years ago. Some writings suggest that garlic was grown in China as far back as 4000 years ago.

Garlic grows wild only in Central Asia (centered in Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) today. Earlier in history garlic grew wild over a much larger region and, in fact, wild garlic may have occurred in an area from China to India to Egypt to the Ukraine.

This region where garlic has grown in the wild is referred to as its "center of origin" since this is the geographic region where the crop originated and the only place where it flourished in the wild. In fact, although we sometimes hear about "wild garlic" elsewhere in the world, this is the only region where true garlic routinely grows in the wild without the assistance of human propagation. There are other plants locally referred to as "wild garlic", but these are invariably other species of the garlic genus

(Allium), not garlic itself (Allium sativum). For ex., Allium vineale is a wild relative of garlic that occurs in North America and is commonly called "wild garlic".

The "center of origin" for a plant or animal species is also referred to as its "center of diversity" since it is here that the broadest range of genetic variation can be expected. That is why those of us who have sought to find new genetic variation in garlic have collected wild garlic in Central Asia.

Once cultivated by the first garlic farmers outside of its "center of origin", what types of garlic did early afficianados grow? In fact, we know almost nothing about the early types of garlic produced. No designation of garlic varieties was made in the early writings discovered to date, be it hardneck or softneck, red or white, early or late, local or exotic. Throughout its earlier history some have speculated that softneck garlic was the predominant type cultivated although evidence of what would be interpreted as a hardneck type was found interred in Egyptian tombs. It was not until garlic was cultivated in southern Europe within the last 1000 years that the distinction between hardneck and softneck was routinely noted. Until more ancient writings which describe garlic are found, or old, well-preserved samples are unearthed, we can only speculate about the early types of garlic grown.

Garlic producers and consumers have come through 5000 years of history growing and eating their crop with little need to specify type or variety. In fact it is a rather modern habit of only the last few hundred years whereby more detailed descriptions of varieties have come to be developed for any crop plant.

Breeding Objectives

- High yield
- Larger bulb size
- Bulb quality: white colour, high pungency and compact cloves
- Resistance to diseases (Mosaic purple blotch and stemphylium blight)
- Resistance to insect-pest (Mite, aphid and Thrips)

Breeding Methods & Developed varieties

S.No.	Breeding Methods	Varieties
1.	Mass Selection	Agrifound White, Yamuna Safed, Yamuna Safed-2, Yamuna Safed-3, Yamuna Safed-4
2.	Clonal Selection	Gujarat Garlic-2, Gujarat Garlic-3

Resistant Breeding for Tolerant Stress

Diseases	Tolerant
Purple Blotch	Yamuna Safed, Agrifound Parvati
Stemphylum Blight	Yamuna Safed, Agrifound Parvati
Insect	------------
Onion Thrips	Yamuna Safed

Important Varieties and Varietal characterization

Varieties	Source	Characteristics
Agrifound White	NHRDF, Nasik	Bulb diameter 3.5-4.5cm, 20-25 cloves/bulb, susceptible to purple blotch and stemphylium blight, TSS=41%
Yamuna Safed	NHRDF, Nasik	25-30 sickle shaped cloves, diameter 4.0-4.5 cm, tolerant to thrips, purple blotch and stemphylium blight, TSS=38%

Varieties	Source	Characteristics
G-282	NHRDF, Nasik	Bulbs are creamy white and big size (5-6cm diameter), having 15-16 cloves/bulb, TSS=38-42%, suitable for export puposes.
Bhima Omkar	DOGR, Rajguru Nagar, Pune	Average yield of the variety is 107 q/ha.
Bhima Purple	DOGR, Rajguru Nagar, Pune	The bulbs are purple in colour with TSS 33.6% and allicin @ 2.9mg/g (fresh wt. basis) and 9.6 mg/g (dry wt. basis)

References

- https://jhs.iihr.res.in/index.php/jhs/article/view/527
- https://link.springer.com/chapter/10.1007/978-3-319-97415-6_8
- https://indianspicessociety.com/uploads/syl_document/SYMSAC-VI-383.pdf#page=17
- https://www.indianjournals.com/ijor.aspx?target=ijor:vgt&volume=48&issue=2&article=001
- https://www.slideshare.net/vlnreddy/onion-and-garlic
- https://dogr.icar.gov.in/images/ebook/ebookdogr.pdf

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The World of E-Farming

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Introduction

E-farming, also known as electronic farming or e-agriculture, denotes the utilization of information and communication technologies (ICTs) within the agricultural sector. This encompasses the use of mobile phones, the internet, and other digital tools to enhance agricultural production, marketing, and distribution. The goal of e-farming is to improve efficiency, productivity, and sustainability in farming practices through the integration of technology.

In the world of e-farming, where technology converges with the fertile soil of agriculture, the seeds of innovation grow into a myriad of opportunities. Envision a future where the traditional plow is replaced by the digital plow, and fields transform into landscapes of endless possibilities.

Understanding E-Farming: Definition and Scope

E-farming is characterized by the intertwining of technology with the soil, where data flows like a steady irrigation stream, and farmers harness the power of digital innovation to cultivate their fields. This transformative approach redefines traditional agriculture through the integration of digital tools and technologies.

Digital Tools and Technologies: Harnessing the Technological Harvest

In the vast digital landscape of e-farming, an array of tools and technologies awaits the ambitious farmer, akin to stepping into a high-tech toolbox. Each gadget serves a specific purpose to make farming more efficient and effective. Let's explore some of these digital marvels and how they revolutionize farming operations.

a. Smart Sensors: Similar to a skilled farmer reading the signs from the land, smart sensors act as vigilant eyes and ears. These intelligent devices monitor environmental parameters such as soil moisture, temperature and humidity, providing real-time data for informed decisions on irrigation, nutrient application and pest control.

b. Unmanned Aerial Vehicles (UAVs): Drones offer a bird's-eye view for e-farmers. Equipped with high-resolution cameras, drones survey vast land areas, identify crop stress, and assist in crop health assessments.

c. Farm Management Software: Acting as the digital command center, farm management software streamlines record-keeping, inventory management, crop planning, and financial tracking, providing farmers with crucial data for decision-making.

d. Internet of Things (IoT) Devices: These devices create an interconnected ecosystem, allowing farmers to monitor and control critical aspects of farming remotely, from automated irrigation systems to livestock tracking.

e. Blockchain Technology: Like an unbroken chain of trust, blockchain ensures transparency and traceability in the agricultural supply chain, enhancing the credibility and value of farm produce.

As e-farmers adopt these digital tools, they gain a resource arsenal that revolutionizes their farming practices. The synergy between traditional agricultural knowledge and modern technology paves the way for a bountiful harvest and a prosperous farming future.

Implementing E-Farming Practices

A) Crop Monitoring and Management

In the fields of e-farming, digital tools act as vigilant guardians, monitoring crops' health, growth, and pest control. Sensors, drones, and smart devices serve as personalized caretakers, providing valuable insights for optimized farming practices.

Digital tools offer insights into crop health, with sensors measuring moisture levels for optimal irrigation schedules and drones scanning fields for potential stress points. Precision agriculture techniques, leveraging satellite imagery and remote sensing, enable targeted interventions for tailored crop care.

B) Data-Driven Decision Making

Data-driven decision making is pivotal for successful e-farming. Collecting, analyzing, and interpreting data unlocks valuable insights, transforming farming practices for optimal results.

a. Collecting and Analyzing Data: Gathering information from sensors, weather stations and IoT devices provides a comprehensive dataset, forming the foundation for decision-making.

b. Extracting Insights: Advanced analytics techniques identify patterns and trends within the data, allowing farmers to make informed choices such as optimizing irrigation schedules and predicting pest outbreaks.

c. Implementing Data-Driven Strategies: Aligned with real-time data, farmers optimize crop rotation, adjust fertilization schedules, and fine-tune irrigation techniques, enhancing productivity, reducing costs and promoting sustainable practices.

d. Data-driven decision making amplifies farmers' expertise, empowering them to maximize yields, reduce costs, and practice sustainable farming.

Market Access and Sales

In the digital age, e-farmers are not limited to traditional channels but have a world of online opportunities at their fingertips. Digital platforms and e-commerce solutions redefine market access and sales for e-farming.

a. Explore Digital Platforms: Platforms like Farm-to-Table and LocalHarvest connect farmers directly with consumers, bypassing intermediaries and reaching conscious consumers seeking locally sourced products.

b. Embrace Direct-to-Consumer Models: Adopting direct-to-consumer models, such as community-supported agriculture (CSA) programs and online farm stores, fosters direct connections with consumers, cultivating loyalty based on authenticity and quality.

c. Leverage Online Marketplaces: Platforms like Etsy, Amazon Fresh, and Shopify enable farmers to showcase products globally, transcending geographical boundaries and expanding market reach.

d. Build Your Brand and Tell Your Story: Authenticity and storytelling on social media platforms like Instagram and Facebook strengthen connections with consumers, fostering a community of loyal followers.

E-farming opens doors to a vast marketplace, and success lies in cultivating relationships and providing value beyond transactions. Trust, loyalty, and customer advocacy drive sales and transform customers into advocates for the farm.s

Overcoming Challenges in E-Farming

a) Training and Education: As the digital revolution reshapes agriculture, farmers must equip themselves with digital skills and knowledge. Continuous learning and education are essential for thriving in the digital era.

Resources and training programs are available to support farmers in acquiring digital literacy. Understanding the difference between a tractor and a smartphone is crucial and various resources help farmers embrace continuous learning.

b) Fiancial Considerations: Implementing e-farming practices requires careful financial planning. Farmers must evaluate costs for hardware, software, connectivity, and training.

Government programs, grants and subsidies support the adoption of digital technologies in agriculture. Collaboration and partnerships distribute costs, foster knowledge-sharing, and drive innovation. Incentives such as tax breaks and preferential market access encourage farmers to embrace e-farming practices. Governments recognize the value of digital transformation in agriculture and provide support for those venturing into this domain.

Future Trends and Innovations in E-Farming

a) Artificial Intelligence

Artificial Intelligence (AI) transforms e-farming by analyzing data, offering predictive insights, and optimizing farming practices. AI-powered systems monitor soil conditions, predict weather patterns, and identify pest infestations, enabling data-driven decisions for maximizing yields.

b) Block chain

Block chain technology revolutionizes the traceability and authenticity of agricultural products. By recording every transaction in an immutable ledger, blockchain ensures transparency, reduces fraud and builds trust among consumers.

c) Automation

Automation technologies, such as drones and robotic systems, streamline labor-intensive tasks in e-farming. Drones survey fields, detect crop health issues, and optimize irrigation strategies. Robotic harvesters minimize wastage and labor costs, allowing farmers to focus on decision-making and innovation.

These emerging technologies, while transformative, require a harmonious integration with traditional farming wisdom. Combining technological innovations with expertise is key to unlocking the full potential of e-farming.

As farmers sow the seeds of the future, adapting and staying informed about emerging technologies is essential.

Exploring new technologies, attending conferences, and collaborating with fellow farmers fosters collective growth and innovation.

Embracing the future of e-farming enhances traditional practices rather than replacing them. Technology, woven into the fabric of farming, amplifies efforts, provides insights, and optimizes operations.

Benefits and Potential of E-Farming for Farmers

E-farming offers numerous benefits, unlocking untapped potential for farmers:

a. Increased Productivity: Digital tools enhance crop monitoring and decision-making, leading to higher yields.

b. Enhanced Efficiency: E-farming streamlines operations, saving time, effort and resources.

c. Market Expansion: Online platforms and e-commerce solutions open doors to a broader customer base.

d. Sustainability: E-farming promotes sustainable practices, contributing to environmental preservation.

As farmers embark on their e-farming journey, every step forward brings them closer to unlocking their farm's full potential. Adaptation, learning and embracing new opportunities define success in this new era of agriculture.

Conclusion

As the world bids farewell to this exploration of the future, it is crucial to remember that the power of e-farming lies not only in technology but also in passion, resilience, and connection to the land.

Recapping the e-farming journey, it is essential to embrace the opportunities presented by this digital revolution. Continuous learning, curiosity, and community engagement contribute to collective growth in the ever-evolving landscape of agriculture.

Though challenges may arise, each step forward in e-farming is a step closer to unlocking the full potential of the farm. With a blend of expertise, innovation, and technology, the e-farming journey promises abundance and sustainability to fields.

So, don your digital overalls, equip yourself with technological tools, and sow the seeds of innovation. The e-farming journey begins now, promising a flourishing farm in the dynamic landscape of agriculture.

Reference

- https://www.google.com/search?q=ADOPTION+OF+ICT+INNOVATIONS+IN+THE+AGRICULTURE
- https://isdsnet.com/ijds-v1n3-22.pdf.

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Grafting in Cucumber (*Cucumis sativus L.*): Importance and Practical Implications

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Introduction

Cucumber (***Cucumis sativus***)

- X 2n=14
- X Family- Cucurbitaceae
- X Centre of Origin- India
- X Mode of pollination- Self pollination

Uniting is the mix of two indistinguishable detailing plants which develop as one plant. Vegetable uniting is a cutting edge strategy used to control soil microbes in which vegetative development of frail root mix is joined on chosen rootstocks of sickness and nuisance opposition and versatile to ecological changes. Joined vegetable plants are 'actual half breeds' coming about because of consolidating no less than two assortments, a rootstock and no less than one scion; the first used to give significant characteristics and the second used to deliver natural product. The cycle is practically equivalent to organ transplantation in that rootstock and scion assortments and seedlings should be viable, the working room and patients clean and sickness free, the grafter utilizing suitable strategies, what's more, the recently united plants permitted to recuperate under unambiguous circumstances. This cooperatively evolved manual depicts significant parts of making joined vegetable plants, stressing research-based data and approaches demonstrated by experience to be solid. In any case, regardless of much headway in joining approach, there are not many outright insights in vegetable uniting and continuous exploration and experimentation keep on improving locally-significant strategies, devices, and information. Consequently, the manual is organized and presented as a "living record" that will be refreshed as new data and upgrades become accessible. Perusers are urged to get back to this page occasionally to check for new manual parts.

History

Grafting of vegetable seedlings is a remarkable green innovation that is utilized overall to conquer soil-borne sicknesses and vermin as well as to increment plant energy under different natural pressure conditions. Today, uniting is utilized particularly when there are restricted revolutions or soil fumigation choices. For instance, practically all watermelon created in Japan, Korea, southern Spain, southern Italy, Turkey, and Greece are united, and there are expanding quantities of joined tomato, eggplant, pepper, cucumber, and melons around the world. In tank-farming nurseries, uniting has turned into a standard practice to increment plant life and yield. In high passages, legacy cultivars are joined onto current rootstocks to beat soil-borne sickness. Grafting is likewise used to relieve ecological pressure like saltiness, dry spell, flooding and low temperature. This article sums up the historical backdrop of the advancement of vegetable uniting and its utilization around the world.

Objectives

- To eliminate soil borne pests
- To tackle with problems of salinity and soil acidity
- To increase productivity
- To increase the plant tolerance to different temperature

Vegetable	Objective of grafting
Cucumber	Tolerance to Fusarium wilt, Phytophthora melonis, cold hardiness, favourable sex ratio.
Melon	Tolerance to Fusarium wilt, wilting due to physiological disorders, Phytophthora disease, cold hardiness, enhanced growth.
Watermelon	Tolerance to Fusarium wilt, wilting due to physiological disorders, cold hardiness and drought tolerance.
Tomato	Tolerance to Fusarium oxysporum f.sp. radicis-lycopersici, corky root (Pyrenochaeta lycopersici), better colour, greater lycopene content and tolerance to nematode.
Brinjal	Tolerance to bacterial wilt (Pseudomonas solanacearum), Verticillium albo-atrum, Fusarium oxysporum, low temperature, nematodes, induced vigour and enhanced yield.

Introduction to Cucumber Grafting

Grafting the highest points of more delicate cucumber assortments onto a rootstock assortment with a stronger, vivacious root foundation is a reasonable technique for cultivators to expand their creation potential, especially in the early season. Grafting can work for any of the cucumbers we offer, however we normally see the most advantage in involving this strategy for nursery assortments. Since the plants of cucumbers reproduced explicitly for nursery creation can be more delicate than those of field-reared assortments. While there are a wide range of sorts of rootstock to browse, research has shown that generally, between unambiguous cross breed squash are the most encouraging rootstock for early-season nursery/high passage cucumber creation. When done effectively, grafting can assist with beating the difficulties of cold soil, take into account prior harvests, further develop general plant wellbeing and ecological pressure resilience and possibly increment the cultivator's net gain.

Why in Cucumber?

- Tolerance to Fusarium wilt
- Tolerance to Phytophthora melonis
- Cold hardiness
- Favorable Sex Ratio
- Bloomless fruits

Required materials for Grafting

- Scion seed (top or fruiting variety)
- Rootstock seed (bottom or base variety)
- Your preferred growing medium
- Plug trays of your desired cell size
- Shallow leakproof trays
- A disinfectant, such as Virkon® or a 1:10 bleach solution
- An old-fashioned, double-edged razorblade
- Grafting clips
- Narrow plastic straws, or similar, for supporting the grafted seedling
- A spray bottle or hose mister
- 7" Humidity domes or a healing chamber

Seeding Cucumber Scion & Rootstock

Plant seed for your picked assortments around 4-5 weeks before your ideal transfer date, contingent upon the temperature and measure of light in your developing regions. The recuperating system adds 1 fourteen days to the seedling proliferation stage, contrasted with non-united cucumbers. Legitimate germination conditions (85-95°F/29-35°C, high RH; and dim area) can go quite far toward advancing germination rate. The whole interaction from planting of rootstock and scion assortments to conclusive relocating of united plants into nursery soil or soilless medium typically requires 4-5 weeks.

1. Top Grafting

The principal challenge of top-joining cucumbers is to try not to have the recently grafted plants run out of energy before they have gotten done with recuperating, significantly reducing the post-unite endurance rate. Leaving the single cotyledon builds the grafted plant's store of carbs, giving it enough put away energy to consider further developed grafting outcome in a more limited timeframe. Since leaving a solitary cotyledon is a typical practice, top-grafting of cucumbers is in some cases alluded to as One-cotyledon grafting.

Step 1

Select a plant of your rootstock with a stem width that matches that of your scion. Cautiously make a cut just between the developing point and one cotyledon: cut down at a point with the goal that you eliminate all of the meristematic and genuine true leaf tissues. The cut is regularly made at a point between 45-60°, yet a decent guideline is to attempt to make a cut surface around 1/4" long. On the off chance that the cut is excessively shallow and not the apical meristem is all eliminated, the meristematic tissues will regrow, rivaling the grafted scion.

Step 2

Take the scion with a comparable stem breadth to the rootstock and cut off the scion's top underneath the cotyledons, at a matching point to the rootstock. Dispose of the root ball from the scion.

Step 3

Place the foundation of the cut scion onto the highest point of the cut rootstock stem so the cuts impeccably coordinate, guaranteeing greatest surface region contact between the two plants' tissues. Air or soil caught between the cut surfaces will keep the graft from recuperating. Tenderly spot a joining cut around the two parts to seal them together, taking consideration to guarantee the scion doesn't get awkward. Be certain the uniting cut handle is opposite to the stem, with the goal that the scion is held firmly set up. Slide a limited plastic straw through the ring at the rear of the uniting clasp and down into the developing media, to offer extra help to the recuperating plant. Without added help, mending plants might fall. The cut surfaces of the rootstock and scion plants ought to be grafted together not long after the cuts are made.

Healing

As expressed over, the recuperating system is basically as significant as the grafting methodology itself, and basic to grafting achievement. Recently grafted cucumber plants ought to be recuperated in a climate with 100 percent relative humidity at first, at temperatures between 77-89°F/25-32°C. Temperature inside the healing chamber ought to be firmly checked to try not to surpass 95°F/35°C. The most basic time frame for unite recuperating is the initial 3-4 days in the wake of grafting. For the initial 24-48 hours in the wake of grafting, keep up with 100 percent relative humidity and almost complete murkiness. It is genuinely simple to arrive at this humidity necessity by tenderly clouding the inside of the healing chamber and the plants with water. The objective is for the plants to rest and keep away from photosynthesizing or unfolding while the graft association starts to heal. After this underlying rest period, it is essential to gradually wean plants once more into the light-totally dull circumstances defer the unite healing process. Utilizing lights with a light force of 200-400 μmol/m2/s is adequate during the healing process. During days 3-7, steadily adapt the plants back to full light and lower moistness by making little, gradual changes consistently or two. Steadily decrease temperatures and relative moistness throughout the next days until they arrive at regular nursery conditions. The whole healing process requires around 6-7 days. If moving the plants from inside to a nursery setting, additional consideration during acclimation might be important to minimise shock; the plants can likewise be moved out during a stretch of overcast climate or put under fractional shade. When the plants have reacclimated to nursery conditions for a couple of days they will be prepared for typical dealing with and watering. Grafting clasps will normally extend with the development of the plant.

Transplanting

During the time of transplantation, we have to make sure the plant's graft association lies over the soil, or the scion assortment might root into the ground, which would refute a portion of the grafting benefits. Prune off any suckers that create at or underneath the unite association, as these get from the rootstock and will rapidly overpower the scion. Likewise, consider planting at more extensive dispersing than you could use with non-grafted plants, allowing more pioneers to develop per plant, and different adjustments in fruitfulness and yield care to boost the advantages and financial aspects of your grafted cucumbers. Given the additional time, exertion, and cost of grafting, we suggest trellising and pruning the plants utilizing the lower-and-lean creation framework. Crop care for grafted plants contrasts little from that of non-grafted plants; however you might find that the more enthusiastic plant development will require more brief bringing down of the plants.

2. Hole Insertion

This generally happens between 8 to 12 days of after planting. Eliminate the true leaf including the developing reason behind the squash utilizing a disposable cutter with a checking movement. Make an opening at a skewed point at the midriff of the cut squash, utilizing a slim bamboo stick. Incline cut the hypocotyls/stem part of the cucumber to a tightened end and supplement it into the opening that has been made in the squash rootstock. Keep the cucumber scion and squash rootstock intact at the joint utilizing a clasp. Move the grafted plants into a Biodome Seed Starter. Cover Biodome Seed Starter with its top. The lid keeps a 95% RH in the healing plate, and temperature of 28-29°C to increase callus development at the association. Place the Biodome Seed Starter containing the plants in a dark space for 24hrs to start the healing process. Roughly fourteen days post grafting the plants would be healed, solidified and prepared for transplanting.

3. Tongue Approach

The benefit of the tongue approach, which is once in a while called approach graft (TAG), is that it is simple and requires a low RH microclimate subsequent to grafting. Albeit this technique requires more space and work contrasted with different strategies, high seedling endurance rate can be achieved even by fledglings. Nonetheless, the grafting position is near the ground making it simple for extrinsic roots from the scion to arrive at the soil. The rootstock is sliced through the hypocotyls at a 35° to 45° point. The developing point might stay by just slicing lower part of the way through the hypocotyls, or it could be taken out with a grafting blade or razorblade. The scion is additionally cut at a point (up in the event that the developing tips of the rootstock stays appended) and joined to the rootstock with the cut surfaces adjusted. Grafting cuts are utilized to keep grafts intact. Nonetheless, the grafting cuts should be eliminated once the association is recuperated. United plants are kept up with in the nursery until prepared for relocating. This is somewhere around two days subsequent to eliminating the scion roots. A humidity chamber isn't needed.

Importance & its Implications

The grafting system ha s a critical job in enhancing vegetative development under saltiness and intensity stress. For instance, saltiness stress limits cucumber developm-ent by diminishing the photosynthetic rate and lessening the stomatal conductance, the two of which are improved by grafting. Grafting likewise joins beneficial roots and shoots to create delusions that are fierier, more microbes' safe and more abiotic stress safe. Subsequently, it presents an exquisite and effective method for further developing plant efficiency in vegetables and trees utilizing customary procedures.

Conclusion

Grafting is climate agreeable which advances natural vegetable creation. In India, grafting can likewise help in the decrease of the issues made by vegetables industry and furthermore diminished the utilization of composts and pesticides prompts expansion in yield and nature of created additionally moved along. Grafting application helps in decreasing in the event of soil borne diseases prompts decrease in harmfulness level vegetables and ecological contamination. From this it is presumed that utilization of present day and native methods helps in the decrease of information utilized by grafting in cultivation of future.

References

- https://www.johnnyseeds.com/growers-library/methods-tools-supplies/grafting/cucumber-grafting-advantages-materials-technique.html
- https://www.researchgate.net//315614895 EFFECT OF GRAFTING ON THE CUCUMBER YIELD AND QUALITY UNDER HIGH AND LOW TEMPERATURES #:~:text= The% 20 results % 20indicated% 20that%20 Ferro, compared %20 with% 20non%2 Dgrafted% 20control.
- https://www.pvamu.edu/cafnr/wp-content/uploads/sites/27/grafted-cucumber-factsheet-optimized.pdf
- https://www.extension.purdue.edu/extmedia/ho/ho-328-w.pdf
- https://www.frontiersin.org/journals/plant-science/articles/10.3389/fpls.2019.01290/full
- https://www.researchgate.net/public ation / 43270902_Cucurbit_Grafting

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Screening Techniques for Insect, Pest, Disease and Environmental Stress Resistant for Vegetable crop

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Introduction

All the crop species are attacked by insects, but the degree of damage to as well as the number of insect species attacking different crop species vary considerably. Therefore, an effective pest management is the basic requirement for reaping good crop. It was hoped that chemical control measures will effectively control or even eliminate the insect pests. Extensive pesticide application leads to increase in cost of production of crops, reduces the population a natural enemies of insect pests, leads to the development of pesticide resistant races of insects, pollutes the environment. Pest Management involves several divergent measures to minimize the losses due to insect pests. Insect resistant varieties form an important component of pest management schedule.

Procedure in screening program

Development of screening methods, Sources of seeds for screening, Selection of seeds to begin the screening program, Multiplication of seeds for screening, Selecting a screening site, Sources of insects for screening, Sowing seed and maintaining plants, Management of field plots, Screening techniques.

Screening Techniques for insect pest Resistance

The first step in a resistance breeding programme is to rapidly screen all the available genetic stocks, including the local land races, improved cuttings and exotic germplasm using empirical techniques in glass houses or by field tests. An escape from disease is a hazard of breeding for resistant varieties.

1. Field screening

Using field populations: used in early stage of a plant resistance program.

Problems: Populations may be either too low or too high or unevenly distributed in space or time.Year-to-year variation in population levels.

Solutions

• Trap crop.
• Selective insecticides to eliminate the insect pest's predators and parasites.
• Higher dose of nitrogenous fertilizer, closer spacing.
• Placing light traps, pheromone traps.
• Mass collection and release of indigenous insect population

2. Field cage screening

• Limits emigration of the test insect
• Protection from predation and parasitism.

Disadvantages

- May cause abnormal environmental conditions.
- Can alter plant growth, insect behaviour.
- Can cause foliar disease outbreak.

3. Greenhouse screening

Standard seed box screening test

- Test cultivars are sown in wooden or metal flats filled with soil.
- Test insects are uniformly distributed on to the seedlings.

Modified seed box screening test

- Plants are older at the time of infestation and the infestation rate is lowered.

4. Laboratory Screening

- Field and greenhouse tests are affected by a number of environmental factors that cannot always be controlled.
- Laboratory screening methods reliable and rapid method.
- Leaf discs or plant tissues are commonly used in insect feeding bioassays of chewing insects.
- Plant damage by insects is measured based on the basis of area fed, dry weight of control and damaged tissue etc. reduced leaf area, loss in dry weight index, and poor chlorophyll concentration.

Screening techniques for insects pest

(Based on insect responses to plants)

- Orientation
- Contact
- Settling
- Feeding
- Metabolism of ingested food, growth.

Brinjal (*Solanum melongena*) Shoot and fruit borer: *Leucinodes orbonalis*

It is a destructive pest of brinjal and other solanaceous plants and the incidence is more during rainy season. Many of the screening trials revealed non preference and antibiosis as the major mechanisms of resistance. Antibiosis is the association of two or more than two organisms where the association is harmful for minimum one of the partners.

Resistant Varieties: Natural field infestation has been largely relied upon for screening against this pest. Several wild species of Solanum have been reported resistant to fruit borer. Recently Punjab Agricultural University has released "Punjab Barsati" variety possessing moderate resistance to fruit borer. Solanumgilo was found to be most resistant to borer and crossable with S. melongena. Pusa Purple Long, Pusa Purple Cluster, Junagadh Long, and PusaKrante were reported to have resistance.

- **Hadda beetle and Lady bird beetle** is another commonly occurring pest on brinjal and *Solanum mammosum* and S. *viarum* were found to be resistant. This has been recorded on wide range of hosts like solanaceous, cucurbitaceous, wild Amaranthus and some medicinal plants.

Resistant Varieties: No cultivated variety has been found to be resistant while most of the wild accessions were resistant. Pusa Purple Round and Apple Green Flesh were reported to have moderate resistance to this pest.

Okra (Solanum mammosum)

Leafhopper: Amrasca biguttula biguttula It is one of the serious pests on okra. Downward curling and reddening of leaves.Under severe infestation turn brick red colour. Growth retardation and death of plants.

Resistant Varieties: Sandhu *et al*., [5] evaluated wild species of okra for resistance to leafhoppers. They identified Abelmoschus manihot sub sp. manihot, A. moschatus (IW-1502) and A. tuberculatus (IW 495) as resistant also found A. moschatus to be Resistant.

Screening techniques for disease resistance

Depending on mode of spread of disease the screening technique may differ. The screening can be done both at screen or glass house level and field level. The different screening techniques are as follows.

Soil borne diseases: Wilt, root rot are produced by soil borne fungi. In this case sick plot technique is followed. Susceptible varieties can be grown and infected plants can be ploughed insitu to maintain optimum condition for infection.

Air borne diseases: E.g. Rust, Smut, mildews, blights. For ground nut rust, infestor rows can be sown 15 days earlier as border rows and the disease will infest the susceptible infestor rows. After 15 days the varieties tested to be are to be sown. Spraying the spore suspension from affected leaves will also increase the load.

Seed borne disease: Smut, bunt etc. Artificial inoculation can be done by soaking the seeds in solution of pathogen under vaccum condition.

Conclusion

Insect resistance screening techniques vary with crop, insect and site of the experiments. However, selection of an efficient, simple and accurate screening method is extremely important in identifying a resistant / tolerant variety. Resistant crop varieties can be an ideal component in any IPM system since they are cost effective and easily acceptable to farmers for adoption. The screening against other pests of brinjal viz., stemborer, tingid bug etc., has been done mainly on the basis of mean infestation or means number of individuals harboured by plants or leaves (mainly season's average) and the cultivars or genotypes supporting minimum population or with minimum infestation level is subsequently categorized into resistant grade.

References-

• Mukhopadhyay A, Mandal A. Screening of brinjal (Solanummelongena) for resistance to major insect pests. Indian J. Agric. Sci. 1994;64:798-803.

• Mote UN. Studies on the varietal resistance of brinjal, Solanummelongena to jassid, Amrascabiguttulabiguttula under field conditions. J. Veg. Sci. 1978;5(2):107-110.

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