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Growing seed

Editorial Board

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AL04220

AGRO-ECOSYSTEM ANALYSIS (AESA): A SUSTAINABLE APPROACH FOR CROP PEST MANAGEMENT

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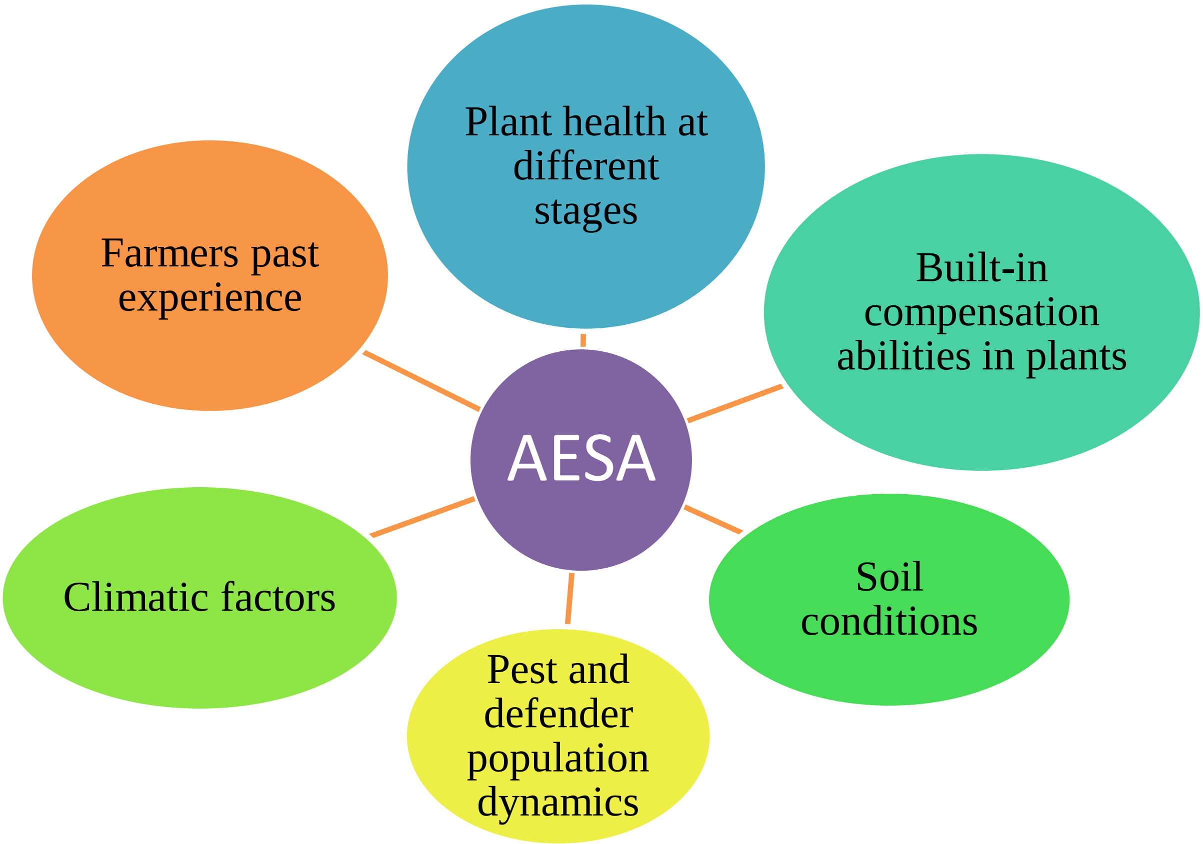
As the population is increasing at a rapid rate, the demand for food is at high. This forces the grower to depend more on inorganic pesticides to instantly control the pest. But due to over-use of these poisons, the natural enemies present in the field are getting hampered. Even the problem of bioaccumulation and bio magnification of toxicants is becoming common. So to provide a sustainable solution to these alarming problems AESA is being introduced. The health of a plant is influenced by its abiotic and biotic environment. There should be a proper balance between these two for proper functioning of the ecosystem. The population of biotic factors (insect pest, diseases an weeds) depends on the abiotic factors (Weather conditions). Hence having a good knowledge regarding both of these factors is very important for the farmer. Agro-ecosystem analysis (AESA) based IPM is an innovative method where the farmers or the extension workers examine the crop field conditions with respect to prevalent pests, plant pathogens, beneficial insects, plant health and the influence of climatic factors and their relationship for cultivating a healthy crop. In AESA, the farmer first observes his field minutely and then analyses the present condition which led to take proper decision.

Components of AESA

The various components of AESA include:



Principles of AESA

1) Healthy Crop

The basic principle of AESA is production of healthy crop. For achieving this principle, the grower need to use good quality certified seeds and planting materials brought from some authentic sources. They should better cultivate the pest resistant or tolerant varieties. The next step is seed treatment with recommended pesticide especially bio pesticides. The crops should be shown in proper spacing for preventing the building up of congenial environment for pest outbreak. The health of the soil should be looked upon by growing green manure crops and mulching. Nutrient management should be done based on the soil test data. Integrated approach of nutrient management should be taken to reduce the application of inorganic fertilizers and increase the use of manures and bio fertilizers which are not only good for plant but also beneficial to soil microbial biota. Application rate of nitrogenous fertilizers should be checked as excess nitrogen increases the succulence of crop and make it susceptible for pest attack. Potassium must be added as it makes the crop resistance to pest and diseases. Proper weed management should be followed to keep the weeds below ETL.

2) Monitoring of Field

Monitoring of the crop field is an important job of the farmers to go for preventive measures as compared to prescriptive ones. The grower should observe the field conditions properly at least once in seven days to keep good knowledge about the conditions of the soil, plant, water, climate and pest and beneficial insect of his farm. The farmer is advised to take decision based on his prevent condition of field and after calculating the pest:defender ratio. The farmer should always try to take some preventive control to keep his field out of the attack of pest and take necessary integrated measures on need.

3) Calculating the Plant's Compensation Ability

Compensation ability refers to the regrowth of the plant biomass which was eaten away by herbivores (insects, cattle, goat, etc.). The compensation ability depends upon the photosynthetic rate of the plant and its source: sink ratio i.e. mobilization of stored foods from roots and remaining leaf to newly formed leaves. Healthier the plant better is the mobilization. Interaction of plant traits and external environmental factor leads to plant tolerance to herbivores.

4) Conservation of Natural Enemies

Defenders or the natural enemies (viz. predators, parasitoids) are very important components of bio control of pest. The farmer needs to know the natural enemies present in his field and should regularly monitor their population dynamics. The broad-spectrum pesticide apart from killing the target pest kills the natural enemies too. So farmer should avoid such pesticides.

5) Insect Zoo

Insect zoo is method by virtue of which a farmer can easily differentiate between harmful and beneficial insect. Diverse group of insects are present in field. Out of them some are beneficial and referred as farmer's friend and rest cause economic loss to crop hence are pests. Bio agents like predators are difficult to observe in field as they often resemble the pests. In the method of insect zoo, the unknown predators are collected from field and taken to lab for observing the details. Each predator is then kept in a plastic bottle with some plant parts and some insect pests. If the predator (assumed) is seen to feed on the other insect, it is declared as predator or else if it feeds on plant parts it is declared as crop pest. By using this method farmer identifies the beneficial insect and conserves its population in field.

6) Calculating the Pest: Defender Ratio (P:D ratio)

The Pest:Defender ratio is very important for the farmer to have an idea regarding the population dynamics of pest and beneficial insects (predators). Visual monitoring or using of sweep nets may be done to calculate the P: D ratio. The P: D ratio depends on the type of pest and the potentiality of the predators to feed on the pest. It varies from crop to crop. Generally when the value of P: D ratio is 2:1, management should be adopted.

A Prominent Example of AESA

Suppose a farmer is going for the management of yellow stem borer in his rice field. The first step involves a through observation of the field conditions. The weather conditions (temperature, RH, rainfall) should be considered because the multiplication and spread of pests depends upon weather factors. Then the farmer should calculate the Pest:Defender ratio of his field. The Predator:YSB ratio of different predators are Mirid bug (3:1), Preying mantid (4:1), Long horned grasshopper (3:1), Carabid beetle (5:1) , Lynx spider (2:1). If this ratio changes, the farmer should go for spraying insecticide for YSB management.

AESA vs. ETL

While initiating a pest management program based on economic threshold level (ETL), the farmers mainly focuses on the population dynamics of pest which is observed by pest counts. While the important parameters like the presence of defenders, prevailing weather conditions, stage of growth of the crop are not taken into account. Hence in true sense, pest management based only on ETL is not very prominent one as the ETL keeps on changing and moreover damage caused by certain insects cannot be predicted at all. Whereas on the other hand, AESA based pest management give importance to defenders, plant compensation ability, P: D ratio etc., which makes it more precise over ETL.

Benefits of AESA

- By practicing AESA, the farmers develop their expertise in crop management.
- Farmers identify the major and minor pests of the crop and their nature of damage.
- Beside pests the farmer become aware of the natural enemies or the defenders present in his field and learns about their role in pest control.

- Farmers also gain knowledge regarding the influence of weather parameters on pest multiplication.
- The farmer becomes expert in taking proper decisions at proper time to prevent economic loss and enjoy good profit.

Conclusion

AESA is a planning tool and a practical guide which gives farmers a good overview of their field and thus helps him to take proper management at the right time. Decision making in pest management requires a thorough analysis of the ecosystem. By doing so the farmers can prevent his crops from the attack of the pest and can reduce the over use of chemical inorganic pesticide beside exploit the beneficial insects to control the pest by means of a economically and ecologically sound manner.

References

AESA based IPM, Integrated pest management , Vikaspedia.com. (https://vikaspedia.in/agriculture/crop-production/integrated-pest-managment/aesa-based-ipm#:~:text=AESA%20is%20an%20approach%2C%20which,relationship%20for%20growing%20healthy%20crop)

Chatterjee, S., Gangopadhyay, C., Bandyopadhyay, P., Bhowmick, M.K., Roy, S.K., Majumdar, A., Gathala, M.K., Tanwar, R.K., Singh, S.P., Birah, A. and Chattopadhyay, C. (2021). Input based assessment on integrated pest management for transplanted rice (*Oryza sativa*) in India. Crop protection journal; volume 141.

Gurr, G.M., Wratten, S.D., Altieri, M.A., (2004). Ecological Engineering for pest management: Habitat manipulation for arthopods. CSIRO Publishing, Collingwood, ISBN 0643 099022 3.

Samal, I., Bhattacharjee, J. and Bhattacharjee, D. (2020). Agro-Eco System Analysis (AESA) Based Plant Health Management. *Biotica Research Today*. 2,3 9Mar.2020, 32-33.

Satyagopal, K., S.N. Sushil, P. Jeyakumar, G. Shankar, O.P. Sharma, S.K. Sain, D.R. Boina, N.S. Rao, Ram Asre, R. Murali, K.S. Kapoor, Sanjay Arya, Subhash Kumar, C.S. Patni, H.P. Patnik, K.C. Sahu, S.N. Mohapatra, P.R. Patel, H.V. Pandya. (2014). AESA based IPM package for Amla.pp 32.

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ANTITRANSPIRANTS AND THEIR IMPORTANCE IN RAINFED AGRICULTURE

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Global food security is at risk due to the predicted climate change, making it imperative for agronomists to provide adaptive technologies that will sustain and improve food production. Rainfed agriculture, prone to drought, covers an estimated 80% of global cropland. Almost every part of the world evidenced its impact at different level and affected either positively or negatively. India being subtropical country is also sighting various changes in weather pattern and temperature rise that have effect on agriculture production. Water is necessary component for plant's growth and development (Rijsberman, 2008). Rainfall and irrigation are the two main sources of water in agriculture. Rain-fed crops contribute to 65% of world food production and the remaining 35% of food is produced from irrigation agriculture. Only 17% of total cultivated areas are irrigated (Rosegrant, 2002 and Hanjra, 2010). Thus, most of the land under cultivation depends on natural precipitation. Thus, shifting in global rain pattern and increase in local temperature is leading to unprecedented drought in many crop production areas of the world (FAO, 2011). One of the adaptive technologies is the use of antitranspirants – products that are applied on plants to reduce transpirational water loss and increase crop performance under drought conditions. The benefits of improving antitranspirant adoption in drought mitigation are expected to be high, especially in many drought-prone low-income countries where crop production is almost wholly dependent on rainfall. Antitranspirants are the chemical compound which results in declining the rate of transpiration from the leaves of the plants by reducing the number and size of the stomata and eventually hardening them to stress (Ahmed et al., 2014; El Khawaga, 2013).

In the field crops, the practical use of antitranspirants involves decreasing the water loss from the leaves by reducing the size and number of stomatal opening and therefore decreasing the rate of diffusion of moisture vapour. It is very important to control the loss of the water from the plant because only a very small amount of water taken up by the roots, out of which 98% is lost to the atmosphere through transpiration. Antitranspirants helps in minimising these losses to some extent. The role of antitranspirants increases in dryland agriculture where availability of water is very less and the temperature is very high which promotes the rate of transpiration. Based on the mode of their action, they are categorised into: stomatal closing type (Phenyl mercuric acetate and ABA), film forming type (Mobileaf, hexadeconol and silicon), reflectant type (Kaolin, calcium bicarbonate and China clay) and growth retardants (cycocel).

The Scope of Using Antitranspirants Includes

1. Under dryland area, to reduce water losses through transpiration
2. In costly irrigation, for extending the irrigation interval
3. In areas having poor quality of soil-water or irrigation water, to reduce the uptake of salts
4. For reducing transplanting shock of nursery plants.

There are Four Principles of Transpiration Control

1. By increasing leaf resistance to water vapour transfer by application of materials, which tend to close or cover stomata (e.g. both stomatal closing and film forming type of antitranspirants)
2. By reducing amount of energy absorbed by leaf surface (e.g. leaf reflectants).
3. By reducing top growth of plants (e.g. growth retardants)
4. By increasing air resistance to water vapour transfer by shelter belts/windbreaks

Stomata Closing Type

Most of the transpiration occurs through the stomata the leaf surface. Some fungicides like Phenyl mercuric acetate (PMA) and herbicides like atrazine in low concentration serve as antitranspirants by inducing the stomatal closing. PMA was found to decrease transpiration to greater degree than the photosynthesis in a number of plants. Stomatal opening is regulated by various sensors like, water, CO, light and hormones. The opening is strongly controlled by hydroactive mechanism, while other sensors are hydro-passive and is mediated through relative water content (RWC) of guard cell chloroplast.

Film-forming Type

Foliar spray of waxy or plastic emulsions such as mobileaf. hexadeconol and silicone produce an external physical barrier outside the stomatal opening to retard the escape of water vapour through stomatal opening. The film so formed should have more resistance to the passage of water than to that of carbon dioxide. Film type antitranspirants, which provide selective type of permeability barriers to water vapours and carbon dioxide diffusion in the required directions, have not yet been found so far.

Disadvantages

- Affects only at low temperature but not at high temperature
- Comes in the way of gas exchange.
- From the mechanical barrier for stomatal movement

Leaf Reflectance Type

White reflecting materials such as whitewash or kaolinite % spray form a coating on the leaves and increase the leaf reflectance (albedo). Reflecting compounds do not cause blockage of stomatal pores when they are applied to the upper surfaces of leaves with stomata exclusively on the lower surfaces. Coating of reflectance type of chemical reduce the leaf temperature. Application of 5 per cent kaolin spray has been found to reduce transpiration losses markedly. Reflects radiation falling on the leaf and reduced heat load on leaf. When heat load is reduced amount of water to maintain temperature is also reduced. Therefore, water conservation occurs. Kaolinite does not come in the way of any metabolic activity.

Growth Retardants

The chemical like Cycocel (CCC), Uniconazole and Mepiquat chloride reduce shoot growth which increase root growth. The reduced shoot growth decreases transpiration loss whereas increased root enables the plant to tolerate drought by increasing water absorption from deeper layers of the soil. Other than this anti-ozone chemical like Ethylene diurea (EDU) is also becoming popular in the dryland agriculture to suppress the effects of toxic levels of ambient ozone on the several fields and forage crops.

Fig.1: Different commercial products of some antitranspirants

Good Feature of Antitranspirants

- Non-toxicity
- Non-permanent damage to stomatal mechanism.
- Specific effects on guard cells and not to other cells.
- Effect on stomata should persist at least for one week.
- Chemical or material should be cheap and readily available.

Limitations of Antitranspirants

- May reduce the rate of photosynthesis
- May increase the leaf temperature by reducing evaporative cooling
- Interaction of climatic factors with antitranspirants reduces their effectiveness for longer duration
- Marginal cost may be more than marginal returns
- May produce toxic effects on leaves.

Effect of Antitranspirants on Crop Production

1. Suppression of Transpiration

Several experiments using antitranspirants on several crops have shown that they can be used economically on higher values crops, especially in dry land/rainfed areas and for increases survival of transplants under all situations. Use of PMA with 50, 100 and 150 ppm at tillering, jointing and flowering of wheat reduce the rate of transpiration by 23.8, 40.5 and 45.5 per cent, respectively. In dry soils, PMA significantly reduced the rate of both stomatal and cuticular transpiration from sunflower leaves.

2. Water Relations

The primary objective of using antitranpirants is to improve plant performance by increasing plant water potential. This is an important effect because plant growth depends not only on the accumulation of raw materials and mineral uptake, but also on maintaining higher plant water potential. Foliar application of PMA 50, 100 and 150 ppm at tillering, jointing and flowering stages of wheat plants increased relative water content of leaves by 2.1, 5.0 and 5.6%, respectively. On barley, PMA (Stomata closing), mobileaf (Film forming) and Kaolin (Reflectant) resulted in increased relative water content.

3. Water use Efficiency

Water use efficiency is increased by use of antitranspirants, especially under moisture stress conditions. PMA/kaolin increases WUE of wheat. Foliar application of 6% kaolin or 40 ppm Chlormequat chloride (CCC) each at 800 lit/ha applied at tillering on rain fed wheat increased grain yield by 9.6 and 17.0 per cent and WUE by 21 and 26 per cent, respectively.

4. Moisture Conservation

Kaolin sprayed wheat plants grown under dry land saved 36cm water. Six per cent kaolin spray at CRI, jointing, flowering and grain formation stages of wheat as substitute for irrigation and produced similar yield. Using antitranspirants, it is possible to economize the water use by reducing number of ineffective irrigations.

5. Ionic Balance

In many arid areas, the underground water is brackish, when such water is used for sprinkling "chloride burns" appears. This effect can be reduced by spraying film forming antitranspirants.

6. Increases Survival of Transplants and Cut Flowers

When seedlings are transfer from nursery for transplanting some injury to root is caused. Thus, the water uptake rate is reduced but transpiration loss of water continues and the seedling may wilt or even die. Uprooted seedlings are either sprayed or dipped in antitranspirat solution, which increases plant water balance and increases seedling survival rate. The use of anti transpirants reduce the photosynthesis rate and slow down growth.

7. Effects on Growth and Yield

Rate of photosynthesis is slightly reduced after the use of antitranpirants, the plants water economy is improved and wilting is avoided. Plants continue to grow at a lower rate than well irrigated plants, but at a higher rate than unsprayed plants. Thus, the growth and yield of antitranspirants sprayed plant improved under rainfed/dry land conditions.

Assured benefits of transpiration suppressants and plant growth regulator to the rainfed/ dryland crops

- Optimized yield levels
- Better crop growth
- Normal sized grains
- Improved seed quality
- Reducing number of irrigations
- Monitoring crop loss with limited inputs
- Minimizing irrigation frequency and saving water through drip irrigation (eg. Cetyl alcohol and / Hexadecanol)
- Monitoring / managing drought
- Arresting fast receding soil moisture for better growth and yield of rabi crops
- Very useful for farmers with minimum irrigation facilities
- Saving large nurseries when water is scarce in summer months

Conclusion

Water stress is a relatively prevalent occurrence today and has a significant impact on production. Antitranspirants, in addition to conventionally effective irrigation technologies like drip irrigation and spray watering, reduce the rate of transpiration, preserve plant moisture, increase consumptive usage (CU) of water, improve growth and yield-attributing characteristics, and save water. Antitranspirants can be utilised in places with limited rainfall or in drought-prone areas when there is a moisture stress. By using antitranspirants, transpiration can be slowed down as needed, and comparable measures can be taken to improve soil water retention. To increase crop output, antitranspirants must be administered at the right time. As a result, antitranspirants can reduce the effects of water stress while increasing crop output in the face of global warming.

References

Ahmed, Ahmed, Y.M. (2014) Impact of spraying some antitranspirants on fruiting of williams bananas grown under Aswan region conditions. *Stem Cell*. 5(4): 34-39.

El- Khawaga, A. S. (2013) Response of grand naine banana plants grown under different soil moisture levels to antitranspirants application. *Asian journal of Crop Science*. 5: 238-250.

FAO. (2011) Climate change, water and food security, 36: ISSN 1020-1203.

Hanjra, M. A. and M. E. Qureshi .(2010) Global water crisis and future food security in era of climate change. *Food Policy*, 35: 365-377.

Rijsberman, F. R. (2006) Water scarcity: Fact or fiction? *Agricultural Water Management*, **80**: 5–22.

Rosegrant, M., C. Ximing, C. Sarah and N. Nakagawa. (2002) The Role of Rainfed Agriculture in the Future of Global Food Production. *Environment and Production Technology Division*, 90.

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GHOST FISHING - A GLOBAL PROBLEM

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Ghost nets are fishing nets that have been dumped or lost in the ocean by individual fishermen or fishing fleets. They can be left tangled on a rocky reef or drift in the open sea. If it were only a few nets it wouldn't be big deal. However, each year around 640,000 tonnes of fishing gear set adrift globally. Often almost invisible underwater, the ghost nets drift through the oceans and can continue fishing for many years. They move with the currents and tides and can travel incredibly long distances, and can be extremely long, with some nets measuring more than 6km in length. Ghost fishing gear" is abandoned, lost, or discarded fishing gear such as nets, long lines, fish traps, or any human-made contraptions designed to catch fishes or other marine creatures. As it drifts, this ghost fishing gear takes on a life of its own, trapping fish, entangling all kinds of animals from seabirds and turtles to dolphins and whales, and snagging or smothering coral reefs. Sea creatures who are caught in this gear die and in turn attract scavengers who will get caught in that same net, thus creating a vicious cycle.

Ghost gear is the greatest killers in our ocean, and not only because of their numbers. Literally hundreds of miles nets and lines get "lost" every year, and due to the nature of the materials used to produce these types of gear, they can and will keep catching and killing animals for multiple decades, possibly even for several centuries.

Different Types of Gear Causing Ghost Fishing

Gillnet

Gillnet is a passive gear mostly made of monofilament and operated at different water depths. The lost net keeps on fishing even after the net falls apart in the ocean.

Pot and Traps

It is one of the most dangerous ghost gear. It operated by using bait to trap fishes. The use of biodegradable materials for making traps and gear marking can be the best way to reduce fishery impacts.

Hooks and Line

Hooks & line are widely used to catch the big sized targeted species, but if they lost can have detrimental impacts on the ecosystem since they keep catching sea turtle, mammals.

Trawl Nets

Trawl nets get lost when they operated in the rocky substrate and coral reef areas. This gear cannot catch more fishes like other gear, but it can still entangle octopus, crabs.

Purse Seine

It mostly lost accidentally while operating. This heavy gear sink at the sea bottom. Since it does not have a large mess size, it catches small animals and can affect others' biodiversity

Potential Threats of Ghost Gear

Ghost gear may have an impact on the aquatic environment in several ways, including;

- Continued catching of target and non-target fish and shellfish species.
- Entanglement of marine mammals, sea birds, and sea turtles.
- Physical impact on the benthic environment.

- Ghost gear becomes a navigation hazard and threatening the life security of mariners.
- Ghost gear may spoil the natural beauty of aquatic habitat and affect the tourism industry.
- Ghost gear affects the sensitive habitat, including seagrass beds, coral reefs, macroalgae, and mangroves that play a vital role as a nursery ground for numerous commercially essential species
- It can interfere with fishing operation, damage fishing boats, contaminate beaches and commercial harbors
- Disturb the benthic habitat of sessile animals, builds up sediment, damages vegetation.
- Causes to Lead pollution from sink lines used in gillnets.

Causes of Fishing Gear Loss

Direct Causes

- Accidental loss of gear due to extreme environmental conditions such as low ground and extreme weather
- Deliberate disposal at sea due to spatial pressure (Misplaced gear, Gear conflict, and damage gear)

- Deliberate gear due to operational/ economic pressure (too much gear for space and time)
- Non -retrieval of gear due to enforcement pressure (IUU fishing)

Indirect causes

- Lack of gear/waste disposal facilities
- Inaccessible onshore gear/waste disposal facilities
- Expensive onshore gear/waste disposal facilities

Different Methods to Trace Ghost Gear

Scientists and fisheries authorities worldwide use the following methods to detect and remove ghost gear from the world ocean, includes

- Sonar survey
- Underwater visual survey
- Dragging or grappling survey
- Surface visual survey
- Local knowledge.

How Does Ghost Fishing Impact Marine Life?

As they drift, ghost nets capture anything in their path. This includes fish, sharks, dolphins, seals, marine turtles and seabirds. They have also been known to kill crocodiles, dugongs and other invertebrates. But it is marine turtles that are most at risk. During a recent cleanup of ghost nets on beaches in Australia's Gulf of Carpentaria, over 80% of the animals found in nets were marine turtles.

Plastic Pollution

Plastics pollution has a direct and deadly effect on wildlife. Thousands of seabirds and sea turtles, seals, and other marine mammals are killed each year after ingesting plastic or getting entangled in it.

Management and mitigation of Ghost gear

- Design and manufacture of traceable and recyclable fishing gear.

- Design and manufacture of gear with biodegradable materials that are not harmful if lost.
- Report of lost fishing gear to the respective fisheries department/ authorities.
- Retrieval of lost fishing gear, Fishers should carry well- trained crew members and retrieval equipment on board for safe retrieval.
- To avoid fishing gear loss and create awareness about ghost gear's environmental impacts to new fishers.
- Engage with government representatives to acquire more information about the ghost gear and learn the methodologies to mitigate it.
- Interact with fishing gear manufacturing industries and users to demonstrate the problem related to ghost gear

Conclusion

Ghost gear harms the marine environment and threatening marine biodiversity. We need to find the root causes of gear loss through a personal interview to develop effective strategies to prevent gear loss. Regional fisheries management organizations (RFMO) and global policies can play a crucial role in preventing and mitigating ghost gear through binding policies and voluntary measures to combat ghost fishing. Need to adopt preventive and mitigation measures, including binding measures, use of biodegradable materials, creating awareness at local, regional, and international levels. Apart from that, we need to create an International treaty with clear responsibilities and ambitions to prevent and reduce ghost gear. However, perhaps the most crucial measure to prevent ghost gear's impact would be implementing a strict code of conduct to reduce gear loss from gear interaction and theft.

References

Antonelis, K. L. (2013). *Derelict Gillnets in the Salish Sea: Causes of gillnet loss, extent of accumulation and development of a predictive transboundary model* (Doctoral dissertation).

Barnard, D. R. (2008). *Biodegradable twine report to the Alaska Board of Fisheries*. Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services.

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GOOD AGRONOMIC PRACTICES IN CORN CROP FOR ETHANOL PRODUCTION

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Total global ethanol production is 110 billion litres, in which the USA and Brazil account for 84% of global ethanol production (92 billion litres), followed by the European Union, China, India, Canada, and Thailand (2019-20) (UN Department of Energy, 2021)

- India has got all the potential to produce ethanol, as raw materials required for ethanol production is available abundantly in the country.
- Ethanol burns more completely than petrol, hence avoids carbon monoxide emission.
- National Policy on Biofuels (2018) – The Government has set the target to achieve 10% ethanol blending in petrol by the end of 2022 and increase it to 20% by 2030. And the policy further amended in June 2022. Considering the achievements in this field in the recent past, Government has decided to advance the target of 20% ethanol blending in petrol by 5 years from 2030 to 2025 (Ministry of Petroleum and Natural Gas, 2023)
- India's current production capacity of ethanol is 426 crore litres from molasses-based distilleries and 258 crore litres from grain-based distilleries. This is expected to increase to 760 crore litres and 740 crore litres, respectively and this would suffice to produce 1016 crore litres ethanol required for the ethanol blending programme and 334 crore litres for other uses. In 2025, this will require 6 million tonnes of sugar and 16.5 million tonnes of grains per year
- In 2020-21, India's net import of petroleum was 185 million tonnes worth $55 billion. Successful 20% ethanol blending in petroleum products could save the country $4 billion/annum(NITI Aayog and Ministry of Petroleum and Natural Gas, 2021).

Field maize is highly suitable for ethanol production as it is rich in starch content because ethanol is made from starch. Select those varieties which are engineered strictly to produce ethanol, which have enzymes within the kernel needed to refine biofuel. The enzymes break down starch for fermentation. Ethanol plants using such corn varieties no longer need to purchase the enzyme (Alpha amylase) for the fermentation process. Example: A biotech corn named 'Enogen' from Syngenta - the first corn genetically enhanced for ethanol production

Agronomic Practices to Be Followed To Get Good Quality Corn Crop for Ethanol Production

- **Climatic and Soil Conditions:** Maize cultivation requires warm weather, deep, fertile, and well-drained loam and medium to heavy soil. Soils with good organic matter, high water holding capacity, and neutral pH (6.5-7.5) are considered ideal for higher productivity.Saline and alkaline soils are not suitable for maize cultivation. The ideal temperature for maize germination is 21°C and for growth is 32°C. It tends to thrive well where the night temperature does not go beyond 15.6°C.Maize is grown in areas receiving rainfall between 500 mm to 1000 mm. The crop is highly susceptible to frost, water-logged and moisture stress conditions, particularly during the early stages of growth.

- **Growing Season**

Season	Sowing	Harvest	States
Kharif	Last week of June to first fortnight of July	Mid-September-February	Karnataka, Andhra Pradesh, Maharashtra, Madhya Pradesh, Uttar Pradesh
Rabi	Last week of October as intercrop to first fortnight of November as sole crop	Late March-July	Bihar, Punjab, Uttar Pradesh, Coastal regions of Andhra Pradesh, Karnataka

- **Intercropping system**
    - Maize + Pulses (Pigeon pea/Cowpea, Maize/Blackgram/Greengram/Soybean)
    - Maize + High value vegetables
    - Maize + Flowers

- **Land Preparation for Sowing**

One deep ploughing immediately after rabi crop harvesting (2-3 deep ploughings in case of heavy soils) - One light ploughing - Planking

- **Sowing Method**
  - **Raised bed (Ridge) planting:** The best planting method during monsoon and winter season. For optimal germination, it is recommended to sow or plant on the southern side of the east-west ridges. This method saves around 20-30% of irrigation water with higher productivity and also the furrows act as drainage channels.
  - **Other methods of planting/sowing:** Zero-till planting, Conventional till flat planting, and Transplanting
- **Seed Treatment:** Treatment of seeds with fungicides and insecticides to protect the crop from seed and soil borne diseases and insect-pests

Disease/Insect-pest	Fungicide/Pesticide	Rate of application (g/kg of seed)
Turcicum leaf blight, Banded leaf blight and Sheath blight, Maydis leaf blight	Bavistin + Captan (1:1)	2
Brown stripe downy mildew	Apran 35 SD	4
Pythium stalk rot	Captan	2.5
Termite and Shoot fly	Imidachloprid	4

- **Seed rating:** Field corn type- 17-20 kg/ha
- **Spacing and plant population:**
  - 60 cm × 20 cm - 83,333 plants/ha
  - 75 cm × 20 cm - 66,666 plants/ha
- **Planting depth -** 5 cm to10 cm, depending on the soil type and planting date (Planting should be shallower in heavier soils thanin sandy soils)
- **Nutrient management:** Apply 10 tonnes of FYM per hectare 10-15 days prior to sowing and 158-180 kg N, 70-80 kg P_2O_5, 70-80 kg K_2O and 25 kg $ZnSO_4$ per hectare. Full P, K, and Zn should be applied at the time of sowing.N should be applied in 5 split doses as given below for higher productivity and nutrient use efficiency.

Sl. No.	Crop stage	Nitrogen (%)
1	Basal (At sowing)	20
2	V_4 (Four leaf stage)	25
3	V_8(Eight leaf stage)	30
4	V_T(Tasseling stage)	20

Sl. No.	Crop stage	Nitrogen (%)
5	GF (Grain filling)	5

(or)

Fertilizer apply period	Kharif (per ha.)	Rabi (per ha.)
1st(before sowing *Land preparation)	DAP: 50 kg/ MOP: 50 kg / Zinc Sulphate: 10 kg	DAP: 60 kg/ MOP: 60 kg / Zinc Sulphate: 10 kg
2nd (25-30 days *After germination)	Urea: 50 kg/ DAP: 25 kg/ MOP: 10 kg	Urea: 60 kg/ DAP: 35 kg/ MOP: 15 kg
3rd (45-50 days *Before flowering)	Urea: 50 kg	Urea: 60 kg

- **Water management:**
  - ✓ The irrigation should be provided in furrows up to two-third height of the ridges
  - ✓ Most critical stages of irrigation - Young seedling stage, Knee height stage (V_8), Flowering stage (V_T), and Grain filling stage (GF)
  - ✓ In raised bed planting system and limited water availability conditions - Irrigate alternate furrows to save more water
  - ✓ In rainfed areas - Tied-ridges are proves beneficial in conserving rainwater for an extended duration at the root zone
  - ✓ For winter maize - Keep soil moist (frequent and mild irrigation) between15th December to 15th February to protect the crop from potential frost damage

- **Weed management:** Weed control during first 6-8 weeks after planting is very crucial in maize. The major weeds are:Bermoda grass, Nut grass, Small burnyard grass, Crowfoot Grass, Green Foxtail (Narrow leaf weeds), Carrot Grass, Jangliimli, Common spurge, white cock's comb, Purslane, Green amaranthus, Asian yellow spider flower, Giant pig weed, White goosefoot(Broad leaf weeds)

Methods of weed control are as follows:

- ✓ **Physical methods -** Removal of weeds either mechanically or manually
- ✓ **Cultural practices -** Winter ploughing, crop rotation, planting of crop in wide rows for mechanical control
- ✓ **Chemical methods -**The herbicides listed in below are broad spectrum in nature hence effective against both narrow and broad leaf weeds in maize crop.

Herbicide	Formulations	Dose (gmai/acre)	Time of application (DAS)
Atrazine	50 % WP	300	0-2
Topramezone	33.6 % SC	12	20-30
Tembotrione	34.4% SC	50	20-30

Pest management: The major pest in maize are Maize stem borer, Pink stem borer, Shoot fly, White grub, Cut worm, Hairy caterpillar, Thrips, Aphid, Army worm, and Temites.

Integrated Pest Management

- ✓ **Cultural practices:** Deep summer ploughing, use of well decomposed farm yard manure, intercropping with legumes, proper planting spacing (75cm×18cm in Kharif and 60cm×18cm in Rabi), balanced use of fertilizers (NPK 120:60:40 kg/ha) and supplement of micronutrient, proper water manangement.
- ✓ **Genetic management:** Use of resistant varieties like HQPM 1, DHM 117, HM4, HM5, Vivek Hybrid 5, Pisa Composite 3, Amar.
- ✓ **Mechanical practices:** Removal of dead hearts, use of bird scarer, manual collection and destruction of white grub and chaffer beetle.
- ✓ **Biopesticides:** Soil application of neem cake for control of nematode and chaffer beetle.
- ✓ **Biological control:** Conservation of naturally occurring biocontrol agents such as *Trichogramma chilonis Ishii*., Carabids, Coccinellids, spiders and wasps, etc. and by reducing chemical pesticides, release of *Trichogramm achilonis* @ 1,60,000 /ha on 7 and 15 days old crop and subsequently if required.
- ✓ **Chemical control:** To control stem borer, shoot fly and thrips, apply Carbofuran 3% CG @33.3kg/ha directly into the whorls of infested plants. Spray Carbaryl 85% WP @ 1764 g/l to control borer at 15-18 days after germination. For managing shoot flies, spray Monocrotophos 36% SL @ 625 ml/ha or Dimethoate 30% EC @ 1155 ml/ha or Oxydemeton - methyl 25% EC @ 1000 ml/ha or Phorate 10% CG @ 30 kg/ha.

Disease management: The major diseases in maize are Turcicum leaf blight, Maydis leaf blight, Fusarium stalk rot, Chalk rot, Banded leaf and sheath blight, Common rust, and Brown stripe downy mildew.

Integrated Disease Management

- ✓ **Cultural practices:** Select field with good drainage, sanitation and removal of plant debris, 2-3 times deep ploughing, proper seed bed preparation, use of balanced fertilizer, avoidance of moisture stress at critical stages of plant growth.
- ✓ **Genetic management:** Use of disease resistant varieties like PEMH-5, Vivek 21, PrathapKanchan 2, PAU 352, DMH 1, NAC 6002.
- ✓ **Mechanical practices:** Stripping two lower leaves along with the leaf sheath, roguingand destroying infected plants and alternate hosts, and utilizing bird scarer to prevent seed damage.
- ✓ **Biological control:** Utilizing *Trichoderma harzianum* formulation 2.0% WP @ 10 g/kg in furrows at the time of sowing prior to mixing with FYM and incubated for 10 days in moist condition for Charcoal rot. Seed treatment with *Trichoderma harzianum* 2.0% WP @ 20 g/kg of seeds for control of banded leaf and sheath blight, combined application of mustard and tobacco dust @ 2.5q/ha (ETL-2 cyst/g of soil) for cyst nematode, on weekly interval application of *Trichogramma chilonis* @ 1,60,000/ha on 7 and 15 days old crop for various pathogens.
- ✓ **Chemical control:** Seed treatment with Thiram 75% WS @ 25 to 30 g/kg seed and Metalaxyl-M 31.8% ES @ 2.4 ml/kg of seed(Downy mildew). Foliar Spray of Mancozeb 75% WP @ 1.5 to 2 kg/l of water at first appearance of leaf blight followed by 2 to 4 applications at 10 days interval if needed.Spray Zineb 75% WP @ 1.5-2 kg/ha at firstappearance of Common rust and three sprays of fungicide at 15 days interval, if needed.

- **Harvesting:** Harvest the maize cobs mechanically when kernels are matured with 25-30% moisture

Maturity period for harvesting of maize

Varieties	Days after planting	Suitable areas
Long duration	100-120	Areas, where irrigation for early sowing is available or rainy season, starts early
Medium duration	85-95	Where late sowing is done and irrigation is available
Short duration	80-85	Where sufficient rainfall is available or grown as intercrop
Very short duration	75-80	Riverside areas where sudden floods are caused

- **Post-harvesting care:**
  - Harvested cobs should be dried before threshing and dry kernels sufficiently before storage
  - Use proper machines to avoid losses in threshing and winnowing
  - Proper follow up of sanitary measures during drying, packing, and handling
  - Adopt grading practices for proper evaluation
  - Use proper packaging material (Jute bags are ideal) for transportation and storage
  - Follow proper scientific storage techniques and maintain optimum moisture content
  - Use pest control measures like fumigation before storage
  - Provide aeration to stored grain and stir grain bulk occasionally

Feedstock Requirement for Ethanol Production: (All units in %dry basis)

Typical analysis of Maize	Moisture	Starch	Protein	Fibre	Fat	Ash	Other soluble	Total
	14.00	70.00	9.50	11.50	3.90	1.60	3.50	100.00

High starch content in maize is desirable because higher the starch content, higher the ethanol production from unit quantity of maize

- 1 MT of maize at 60% starch produces 360 litres of ethanol
- 1 MT of maize at 70% starch produces 420 litres of ethanol

Hence, 1 tonne of starch will produce around 620 litres of ethanol

Conclusion

As per the report by the Institute for Energy Economics and Financial Analysis (Worringham, 2022), India needs to allocate an additional 30,000 sq. km of land for maize cultivation in order to achieve its target of 20% ethanol blending in petrol by 2025. In India, sugarcane is the cheapest source for ethanol production. 1 ton of sugarcane yields 100 kg of sugar and 70 litres of ethanol. However, the production of sugar from sugarcane requires a significant amount of water, with 1 kg of sugar necessitating 1600-2000 litres of water, while 1 litre of ethanol from sugarcane requires approximately 2860 litres of water. Therefore, ethanol production from sugarcane places higher demands on water resources, and expanding sugarcane cultivation could potentially jeopardize the country's food security. As an alternative feedstock for ethanol production, cereals, particularly maize, offer promising prospects. The fibrous by-product after the extraction of ethanol from maize grain acts as an excellent animal feedstock called distillers grains and can be further processed for the production of corn syrup, corn flour, corn chips, and corn flakes, which can maximize profitability for producers.

References

https://agritech.tnau.ac.in/agriculture/CropProduction/Millets/millets_maize.html

NITI Aayog and Ministry of Petroleum and Natural Gas(2021).Roadmap for Ethanol Blending in India 2020-25, Government of India. Available at: https://www.niti.gov.in/sites/default/files/2021-06/EthanolBlendingInIndia_compressed.pdf

Ministry of Petroleum and Natural Gas (2023).Ethanol Growth Story: FulfillingAtmanirbar Bharat Dream, Government of India. Available at: https://mopng.gov.in/files/uploads/BPCL_Ethanol_Booklet_2023.pdf

UN Department of Energy (2021).Global Ethanol Production by Country or Region.Alternative Fuels Data Center. Available at: https://afdc.energy.gov/data/10331

Worringham, 2022). India’s Ethanol Roadmap Off Course. Institute for Energy Economics and Financial Analysis. Available at: https://ieefa.org/wp-content/uploads/2022/03/Indias-Ethanol-Roadmap-Off-Course_March-2022.pdf

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MAT SEDGE – A PRELUDE

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Cyperaceae is one of the largest genera in the sedge family. There are 650 - 750 species of it worldwide. Out of these, 80 species occur in India. Many species thrive and regarded as weeds in agricultural systems, although they have considerable economic importance because they provide food, fodder, fuel, medicine, materials for weaving, construction and ingredients for perfumery.

Sedges can now be grown in some tropical regions for use in mat and basket weaving. They are widely employed in the thatching, fencing, and rope-making purposes. Typically, sedge culms are used to make floor mats and wall hangings. More specifically, *C. articulatus, C. corymbosus, C. iria*, *C. malacensis*, and *C. pangorei* are the major resources of mat sedges. *C. pangorei*, formerly known as C. tegetum, C. dehiscens, is exclusively utilized to make the renownwd Pathamadai silk and superfine mats.

Special Features of Matsedge

Cyperus pangorei is a perennial, grass-like plant with short, creeping rhizomes. The plant can thrive a wide range of agro-climatic conditions and is found in marshy areas, particularly in Eastern and Southern parts of India. The plant is able to withstand extreme conditions like prolonged submergence in water and chronic drought conditions. *Cyperus pangorei* is a widely distributed species without any known threats. The plant is commonly used to produce high quality mats in India, where it is especially famous for producing 'Pathamadai' mats in southern India.

Need and Importance

In this species culms are more edible part and used to weave screen and sleeping mats. It forms a clump of stout culms that are 50 – 90 cm tall. The culms are harvested and split into two or three species and then woven into mats. The mat manufacturing industry still exists in a few districts of Tamil Nadu, West Bengal and Kerala, but it needs to be expanded to other regions of India, especially for the benefit of rural residents who lack resources through income generation schemes. The aged members of a farmer's family, regardless of sex, typically weave mats and can earn a net income.

Cultivation Practices

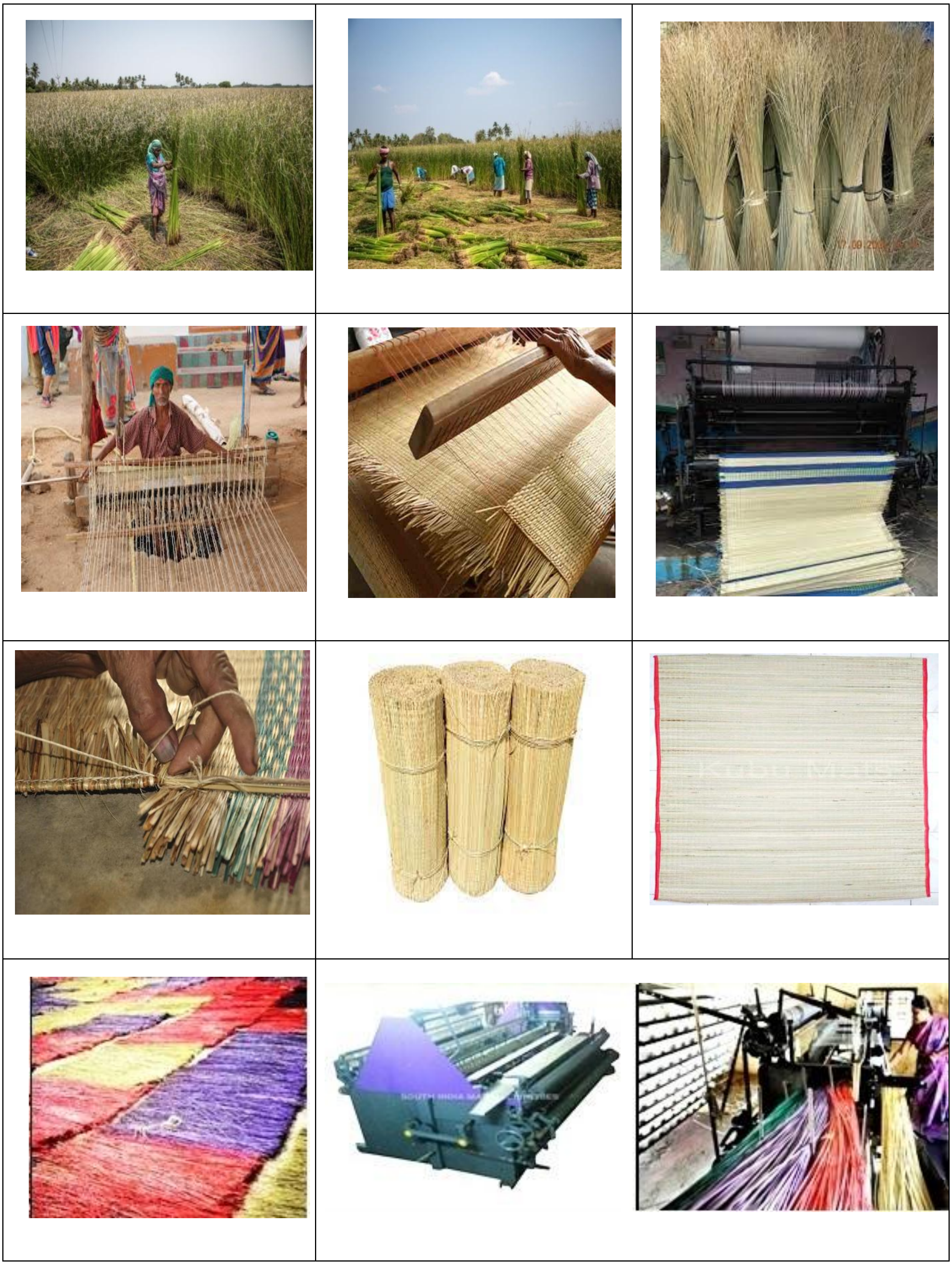
The best soil types for growing this species are heavy clay soil and canal irrigated areas. Rhizomes are the propagating material for cultivation of this *Cyperus* species. The field is ploughed and puddled like it would be for rice cultivation, and then rhizomes are sown in the field under submerged condition. For this crop, weed control is crucial upto 1 month and no particular fertilizer is advised. For obtaining good yield, the field should be irrigated at 10 days once with stagnated condition (15 cm water level). Even though it has a unique trait that allows it to tolerate a month of constant drought, still it needs additional water. It will mature within six month of sowing and attain 5 to 6 feet height. Flower initiation serves as an index of crop maturity.

This crop grows as a ratoon crop for 5-10 years based on the soil fertility status and good agricultural practices. The major advantages of this crop cultivation are less management concern than others. There are no pest issues, only root rot disease might develop under extreme conditions. The continuous ratoon crop will thereafter experience stunted growth and linear stem growth in the absence of any nutrient supply. These are a few shortcomings of this crop.

After Cultivation

When the crop reached maturity, it will be harvested by sickle, leaving 5 cm of the plant above ground portion for next crop. After harvest, the stem/clum splits into 2 parts in the field, with the top portion being trimmed along with leaves. The culms are dried in the field itself for 3 days to ensure complete drying without moisture. The dried culms are then bundled according to equal height. These bundles are exported for mat industry. The bundles are graded by length/ height of the culms and used for weaving in the mat industry. The culms are stained with appropriate colours and dried under shade to create multicoloured mats. Nowadays, weaving operations are carried out by machines, mat edges are rectified by scissors and the mat is stitched with cloth to make a suitable mat for use.

Fig 1: Mat Manufactiring from Sedge (Korai)



Conclusion

It may conclude that, *Cyperus* species are regarded as weeds in agricultural systems, although they have beneficial and economic importance for cultivation.

References

www.eFloras.org. (Flora of China, vol. 23, P: 223-231)

India biodiversity portal (https://indiabiodiversity.org/species/show/243479)

https://tropical.theferns.info/viewtropical.php?id=Cyperus+pangorei

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MEDICINAL PLANT FARMING TO IMPROVE FARMERS' ECONOMY

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Agriculture has always played a vital role in the economic growth of nations, and the well-being of farmers is crucial for the overall development of rural communities. In recent years, there has been a growing interest in the cultivation of medicinal plants as a means to enhance the economic stability of farmers. Medicinal plant farming not only offers an opportunity to diversify agricultural practices but also provides a sustainable source of income for farmers. This article explores the benefits of medicinal plant farming and its potential to improve the economy of farmers. Medicinal plants have been used for centuries in traditional medicine systems to treat various ailments. With the increasing global demand for herbal products, there is a rising need for a sustainable supply of medicinal plants. This demand presents an excellent opportunity for farmers to explore the cultivation of these valuable plants. Unlike traditional crops, medicinal plants can be grown on smaller plots of land, making it accessible for small-scale farmers.

One of the significant advantages of medicinal plant farming is its potential for high profitability. Medicinal plants fetch a higher price in the market compared to conventional crops, mainly due to their medicinal properties and limited availability. By growing medicinal plants, farmers can tap into a niche market, catering to the increasing demand for herbal medicines, natural remedies, and botanical extracts. This not only ensures a higher income for farmers but also reduces their dependency on traditional crops that are often subject to price fluctuations and market uncertainties.

Furthermore, medicinal plant farming offers numerous environmental benefits. Many medicinal plants have deep root systems, which improve soil structure and prevent soil erosion. By cultivating these plants, farmers can contribute to soil conservation and sustainable agriculture practices. Additionally, medicinal plants are often grown without the use of synthetic pesticides and fertilizers, making them a more eco-friendly option. The cultivation of medicinal plants promotes biodiversity and can even act as a natural habitat for beneficial insects and wildlife, enhancing the overall ecological balance.

Benefits of Medicinal Plant Farming

A. Economic benefits

Medicinal plant farming offers a range of economic benefits that can significantly improve the financial stability and prosperity of farmers. Compared to traditional crops, cultivating medicinal plants presents unique opportunities for higher profitability, market niche, and reduced vulnerability to market fluctuations. Let's explore the economic advantages of medicinal plant farming in more detail:

1. **Higher Profitability:** Medicinal plants have a higher market value compared to many conventional crops. This is primarily due to their medicinal properties and the increasing demand for herbal medicines, natural remedies, and botanical extracts. The limited availability of certain medicinal plants further drives up their prices in the market. By growing medicinal plants, farmers can tap into this lucrative market, commanding premium prices for their produce. This translates into higher profit margins and increased income for farmers.

2. **Niche Market Opportunities:** Medicinal plant farming allows farmers to target specific niche markets. As consumers increasingly seek natural and plant-based remedies, the demand for medicinal plants continues to rise. By cultivating and supplying these plants, farmers can cater to the growing demand from herbal product manufacturers, pharmaceutical companies, and the health-conscious consumer

segment. This niche market positioning enables farmers to differentiate their products and capture higher-value market segments.

3. **Reduced Vulnerability to Market Fluctuations:** Traditional crop farming often faces challenges related to price volatility, changing weather patterns, and market uncertainties. In contrast, medicinal plant farming offers a degree of stability due to its specialized market. The demand for medicinal plants remains relatively consistent, as their usage is not solely dependent on external factors like weather or seasonal changes. This stability provides farmers with a more predictable income stream, reducing their exposure to market risks.

4. **Diversification of Income Sources:** Medicinal plant farming allows farmers to diversify their income sources. Instead of relying solely on a single crop, farmers can allocate a portion of their land and resources to cultivate medicinal plants. This diversification reduces the financial reliance on a single crop and spreads the risk across different revenue streams. It also provides farmers with the flexibility to adapt to changing market conditions and consumer preferences.

5. **Employment Generation and Rural Development:** Medicinal plant farming can contribute to rural development by generating employment opportunities. Processing and value addition of medicinal plants, such as extracting essential oils or manufacturing herbal products, require additional labor. This creates jobs not only for farmers but also for the local community, enhancing income and livelihoods. Furthermore, the establishment of processing units and marketing infrastructure stimulates the local economy, fostering rural development and prosperity.

6. **Export Potential:** Medicinal plants and their derived products have a significant export potential. Many countries are importing medicinal plants and herbal products due to increasing global demand. By cultivating high-quality medicinal plants, farmers can tap into international markets and benefit from export opportunities. Export earnings can provide a boost to the local economy and contribute to the overall economic growth of the region.

7. **Sustainable Income and Long-Term Viability:** Medicinal plant farming offers the potential for sustainable income and long-term viability. As the demand for herbal products and natural remedies continues to grow, the market for medicinal plants is

expected to expand. By establishing themselves in this sector, farmers can secure a stable income source that has a strong long-term outlook. Additionally, the cultivation of medicinal plants encourages sustainable agricultural practices, promoting ecological balance and long-term land productivity.

B. Environmental Benefits

Medicinal plant farming not only brings economic benefits to farmers but also offers significant advantages for the environment. Here are some key environmental benefits associated with the cultivation of medicinal plants:

1. **Soil Conservation:** Medicinal plants often have deep root systems that help improve soil structure and prevent soil erosion. Their extensive root networks bind the soil particles together, reducing the risk of soil erosion caused by wind and water. By cultivating medicinal plants, farmers can contribute to soil conservation and maintain the fertility of their land for future cultivation.

2. **Reduced Chemical Inputs:** Medicinal plants are often grown using organic farming practices, minimizing or eliminating the use of synthetic pesticides, herbicides, and fertilizers. By avoiding the excessive use of chemicals, medicinal plant farming reduces the risk of soil and water pollution. It promotes a healthier ecosystem and minimizes the negative impact on beneficial insects, pollinators, and other wildlife.

3. **Biodiversity Promotion:** Many medicinal plants are native species or have adapted well to local ecosystems. By cultivating these plants, farmers contribute to the preservation of biodiversity. Medicinal plant farming can act as a buffer against the loss of natural habitats and provide a sanctuary for native flora and fauna. It helps maintain ecological balance and supports the survival of various species, including beneficial insects and birds that assist in pest control.

4. **Medicinal Plant Conservation:** The cultivation of medicinal plants can have a positive impact on the conservation of endangered or threatened species. By growing these plants in controlled environments, farmers can help reduce the pressure on wild populations. Sustainable cultivation practices can ensure a steady supply of medicinal plants without contributing to their overexploitation and endangerment.

5. **Carbon Sequestration:** Like other plants, medicinal plants play a role in carbon sequestration. Through the process of photosynthesis, they absorb carbon dioxide from the atmosphere and convert it into oxygen, helping to mitigate climate change. By incorporating medicinal plant farming into agricultural practices, farmers can contribute to reducing greenhouse gas emissions and promoting a healthier environment.

6. **Water Conservation:** Medicinal plants often have specific water requirements and can be grown with efficient irrigation techniques. By implementing water conservation practices such as drip irrigation or mulching, farmers can minimize water usage and reduce the strain on local water resources. This sustainable water management approach benefits the environment by preserving water availability for other ecosystems and reducing the risk of water scarcity.

7. **Ecotourism Potential:**Medicinal plant farming can create opportunities for ecotourism and nature-based activities. Farms that cultivate medicinal plants can attract visitors interested in herbal medicine, traditional healing practices, and nature exploration. Ecotourism can contribute to local economies and raise awareness about the importance of biodiversity conservation and sustainable agriculture.

Value-Added Opportunities and Market Potential of Medicinal Plants

a. Processing and value addition of medicinal plants
b. Production of herbal products, essential oils, and extracts
c. Local and international market potential
d. Establishing partnerships with herbal product manufacturers

Training and Support for Medicinal Plant Farmers

a. Government initiatives and policies
b. Training programs and workshops
c. Access to quality planting material
d. Technical guidance and extension services

Conclusion

In conclusion, medicinal plant farming offers a promising pathway to improve the economic conditions of farmers. Its profitability, environmental benefits, and value-added opportunities make it an attractive alternative to conventional agriculture. By embracing medicinal plant farming, farmers can diversify their income sources, reduce their vulnerability to market fluctuations, and contribute to sustainable agricultural practices. To fully realize the potential of medicinal plant farming, it is crucial for governments, agricultural institutions, and stakeholders to provide the necessary support and resources. This includes offering training programs and workshops to educate farmers on cultivation techniques and post-harvest processing, ensuring access to quality planting material, and establishing marketing channels and linkages with potential buyers. By doing so, policymakers can empower farmers to tap into the growing demand for medicinal plants and create a sustainable livelihood for themselves and their communities. Medicinal plant farming not only benefits farmers individually but also contributes to the overall development of rural areas. It stimulates economic growth, generates employment opportunities, and promotes sustainable agricultural practices. Moreover, the cultivation of medicinal plants can help preserve biodiversity, enhance soil health, and support ecological balance. As we move towards a more holistic and sustainable approach to agriculture, medicinal plant farming stands out as a viable and lucrative option. By recognizing its potential and taking proactive steps to support and promote this sector, we can improve the economic well-being of farmers and foster rural development. Let us embrace medicinal plant farming as a means to create a brighter and more prosperous future for our farming communities.

References

Sher, H., Aldosari, A., Ali, A., & de Boer, H. J. (2014). Economic benefits of high value medicinal plants to Pakistani communities: an analysis of current practice and potential. *Journal of Ethnobiology and Ethnomedicine*, *10*, 1-16.

Ghorbani, A. (2005). Studies on pharmaceutical ethnobotany in the region of Turkmen Sahra, north of Iran:(Part 1): General results. *Journal of ethnopharmacology*, *102*(1), 58-68.

Lawal, I. O., Grierson, D. S., &Afolayan, A. J. (2014). Phytotherapeutic information on plants used for the treatment of tuberculosis in Eastern Cape Province, South Africa. *Evidence-Based Complementary and Alternative Medicine*, *2014*.

Nwafor, I., Nwafor, C., &Manduna, I. (2021). Constraints to cultivation of medicinal plants by smallholder farmers in South Africa. *Horticulturae*, *7*(12), 531.

Zahra, W., Rai, S. N., Birla, H., Singh, S. S., Rathore, A. S., Dilnashin, H.. & Singh, S. P. (2020). Economic importance of medicinal plants in Asian countries. *Bioeconomy for sustainable development*, 359-377.

Phondani, P. C., Bhatt, I. D., Negi, V. S., Kothyari, B. P., Bhatt, A., & Maikhuri, R. K. (2016). Promoting medicinal plants cultivation as a tool for biodiversity conservation and livelihood enhancement in Indian Himalaya. *Journal of Asia-Pacific Biodiversity*, *9*(1), 39-46.

Golmohammadi, F. (2014). Saffron and its farming, economic importance, export, medicinal characteristics and various uses in South Khorasan Province-East of Iran. *International Journal of Farming and Allied Sciences*, *3*(5), 566-596.

Van Wyk, B. E. (2019). The diversity and multiple uses of southern African legumes. *Australian Systematic Botany*, *32*(6), 519-546.

Wangchuk, P., Pyne, S. G., & Keller, P. A. (2011). Ethnobotanical authentication and identification of Khrog-sman (lower elevation medicinal plants) of Bhutan. *Journal of ethnopharmacology*, *134*(3), 813-823.

Yadav, R. N. S., & Agarwala, M. (2011). Phytochemical analysis of some medicinal plants. *Journal of phytology*, *3*(12).

Sumardjo, A. F. (2021). Organic medical plants urban farming based on family empowerment on Bekasi, West Java. *Journal of Hunan University Natural Sciences*, *47*(12).

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ROLE OF NANOTECHNOLOGY IN HORTICULTURE

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The development of nanotechnology creates an excellent opportunity to address complex technical issues in the food supply chain. Failure to embrace nanotechnology will deny the horticultural sector an opportunity to capitalize on improved product visibility, food safety, quality and security, and associated economic benefits. Agricultural and food supply chain management is complex due to the diverse characteristics of agricultural products. There are numerous types of horticultural crops and products, many of which are perishable. In addition, the degree of standardization of some kinds of fruit products and their management is still low. In this regard, the potential application of nanotechnology to horticulture is reviewed. Investigation confirms that in credential application of nanotechnology in horticulture, first in fruit packaging and later in other areas such as tracking, tracing, storage, and distribution, is occurring. Currently, most nanotechnology applications in the agricultural supply chain are concentrated in packaging, mainly in the improvement of packaging materials for product security, quality, and safety. From the point of view of the supply chain, the logical extension is the application of intelligent packaging based on nano-sensors with a view to promoting information and management across all elements of an agricultural supply chain. Compared with traditional sensors and their shortcomings, nano-sensors have several advantageous properties, such as high sensitivity and selectivity, near real-time detection, low cost, and portability. However, the economics of nanotechnology application in the agricultural supply chain is no more different from the application of other new technologies.

- Agriculture has always been the backbone of most of the developing countries.

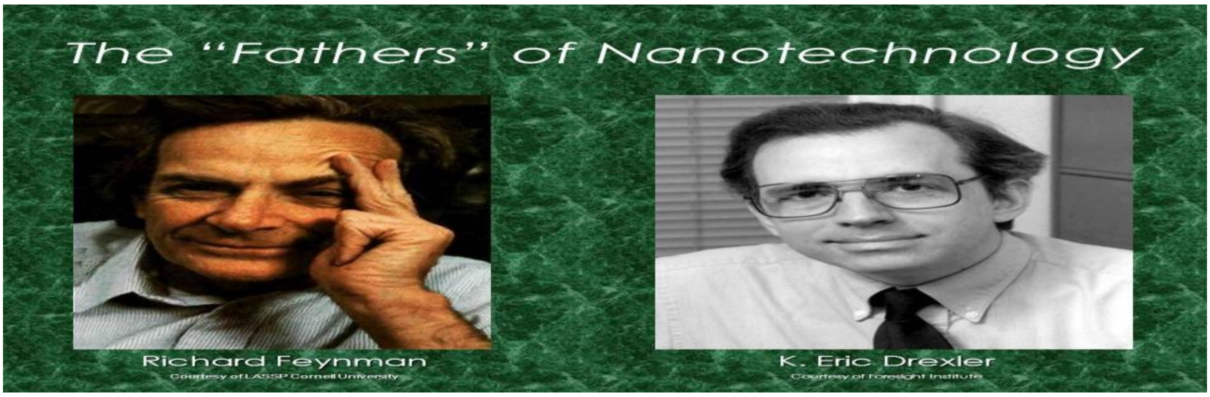
- In recent decades the agricultural scenario has witnessed several challenges like burgeoning population, shrinking farm land, depletion of natural resources, resurgence of new pests and diseases and global warming.
- With increasing population there is further pressure on this sector to meet the growing food demand.
- To address all these challenges, there is a need for an alternate technology such as nanotechnology that promotes productivity while ensuring environmental safety.

Current Scenario of Nanotechnology in India

- ✓ Apart from raising crop yield, it may also help the country cut import of urea, estimated to be about 9 million tonnes in 2019-20.
- ✓ Farmers use 30-32 million tone of urea per year to grow their crops. E.g- For instance, if farmers are using 2 bags of urea in 1 acre, instead of this they may use 1 bag and 1 bottle of nano urea. By this cost reduced.

History

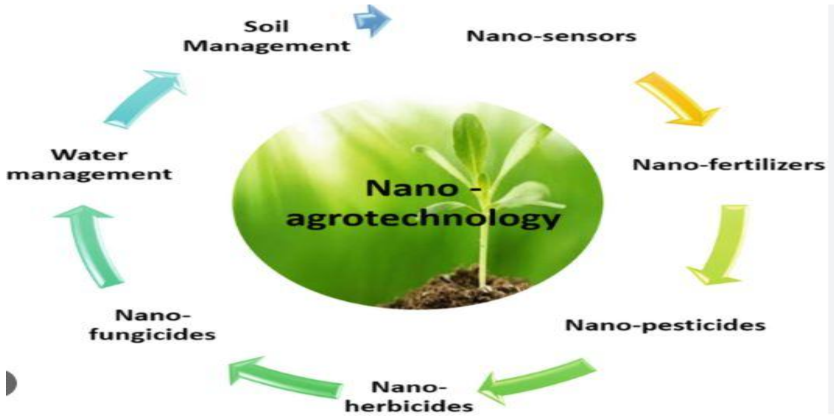
- 2000 Years Ago - Sulfide nano crystals used by Greeks and Romans to dye hair.
- 1000 Years Ago - Gold nano particles of different sizes used to produce different colors in stained glass windows.
- 1959 - The first concept discussed by renowned physicist Richard Feynman in his talk There's Plenty of Room at the Bottom.
- 1974 -,, Nanotechnology" - Norio Taniguchi uses the term nanotechnology for the first time.
- 1981 - IBM develops Scanning Tunneling Microscope.
- 1985 -Bucky ball" - Scientists at Rice university and University of Sussex discover C60.
- 1986 - K. Eric Drexler independently used the term "nanotechnology" in his 1986 book Engines of Creation: The Coming Era of Nanotechnology.
- 1991 - Carbon nanotube discovered by SumioLijima.
- Richard Feynman Tiny Machines, BUCKY BALL" The Feynmean Lecture on Nanotechnology 10,10 nanotube.



List of Nano Organizations in India

- Centre for Nanoscience and Nanotechnology, JMI, New Delhi.
- International Institute for Nanotechnology (IIN) was established by Northwestern University in 2000, United states.
- Center for Nano Technology, UAS Raichur.
- Department of Nano Science and Technology (TNAU), Coimbatore.
- Department of Nanotechnology (University of Kashmir).
- Indian Association for the Cultivation of Science (IACS)
- Centre for nano science and technology, Pondicherry university

Scope of Nanoparticles in Agriculture As Well As In Productivity and Quality of Horticultural Crops



What is Nanotechnology?

❖ Nanotechnology is a field of research and innovation concerned with building 'things' – generally, materials and devices – on the scale of atoms and molecules.

❖ Attempts to apply nanotechnology in agriculture began with the growing realization that conventional farming technologies would neither be able to increase productivity any further or restore ecosystems damaged by existing technologies back to their pristine.

- ❖ Nanotechnology is emerging as the sixth revolutionary technology in the current era.
- ❖ Nanotechnology interventions for vegetable production and protection can assure improved productivity with low inputs, enhanced input use efficiency, precision application through quick diagnosis of the pest/pathogen attack and by curbing non-target losses that may lead to environmental contamination and hazards (Kalia & Sharma, 2019).
- ❖ Nano particles is defined as the small object that acts as a whole unit in terms of transport and properties. (Natural or synthetic particle)
- ❖ Nano particles are characterized by unique physical and chemical feature like surface area, pore size, particle morphology and reactivity.
- ❖ Another name of NPs is "magic bullet" due to their intensive application in agricultural field.
- ❖ Nano particles can be used as nano-fertilizer, nano-pesticide and herbicides which are useful to increase crop productivity, to control excessive use of chemical fertilizer and also increase survivability against biotic stress.

Quantification of Nano Particals

- ➢ Nanotechnology is the study and control of phenomena and materials at length scale 1 to 100 nm.
- ➢ 1 nm = 10-9 m or 1 billionth of a meter.
- ➢ 1/50,00,000 the size of an ant.
- ➢ 1/80,000 of the diameter of a human hair.
- ➢ 1/90th size of HIV virus.
- ➢ 1/10 diameter of hydrogen atom Nano particles of various shapes and forms Uniform/irregular shape. Dispersed particles/agglomerates.

Tools of Nano Technology

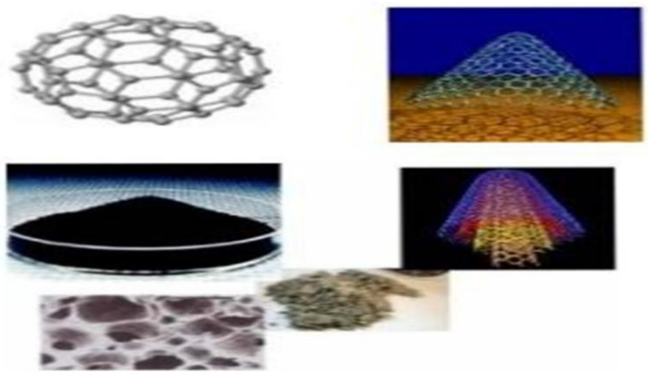
Why Nano Technology?

- High surface area and high reactivity
- Effective catalyst of plant/microbial metabolism
- Better penetration into the cell
- Increased both plant and microbial.
- Nano materials can be either:

a) Natural: Materials having one or more dimensions in the nano scale. e.g., Soil colloids
b) Incidental: Materials formed as a result of man-made or natural processes. e.g., Welding, milling, grinding or combustion.

Nanocarbon

- Fullerene
- Tubes
- Cones
- Carbon block
- Horns
- Rods
- Foams
- Nano diamonds



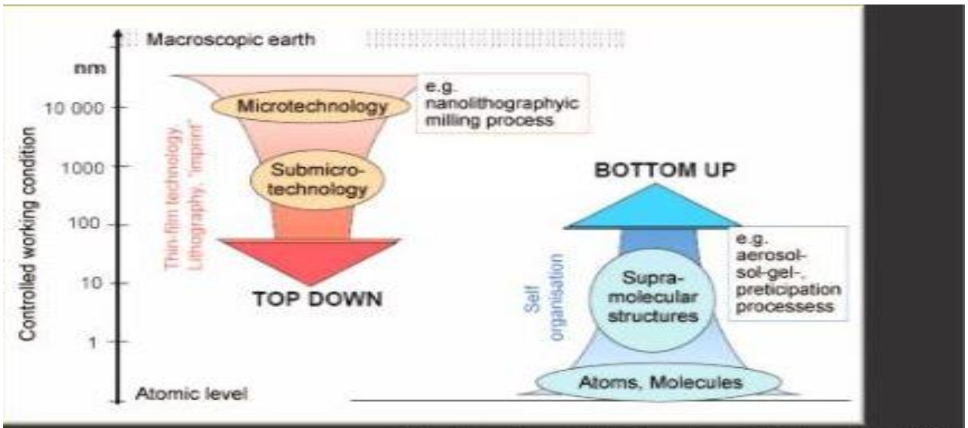
Advantages of Nano Technology

- Increase Productivity – Nano technology helps to improve horticultural production by increasing the efficiency of inputs and minimizing relevant losses.
- Improve soil quality – Nano fertilizers are used to increase vegetative growth, Pollination and fertility of flowers, resulting in increased yield and improved product quality for fruit trees.
- Provide smart monitoring – Nano sensors facilitate up to date monitoring of growth, plant disease, and pest attack in crop plants under field conditions.
- Plant protection and disease scouting – Nano sensors used to measure toxicity, nutrient deficiency, Pest attack.
- Minimal tillage practices.
- Nano filtration – reduce impurity.
- Weed management – slow-release complex.

Limitations of Nano Technology

- Whole plant can obviously be used to produce metal nano particles, however there exist some limitations.
- The heterogeneity of the size and morphology of nano particles produced in whole plant may hinder their use in application where specific, finely tuned sizes and shapes are required; illustrating the inability to tailor the whole plant synthesized nano particles to market requirement.
- Moreover, efficient extraction, isolation and purification of nano particles from plant materials is a difficult and problematic procedure, with a low recovery.

Methods of Nanoparticals Production



(Royal Society and Royal Academy of Engineering, 2004)

Preparation of Nanoparticles

- Sol-gel synthesis
- Colloidal precipitation
- Co-precipitation
- Combustion technique
- Hydrothermal technique
- High energy ball milling
- Sono chemistry

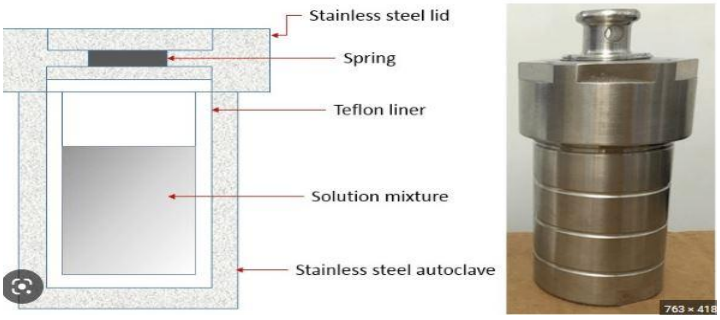
Sol –Gel Synthesis

- Wet chemical technique
- Chemical solution deposition

- For gel like properties particle density should be increased by removing significant amount of solvent.

Hydro Thermal Technique

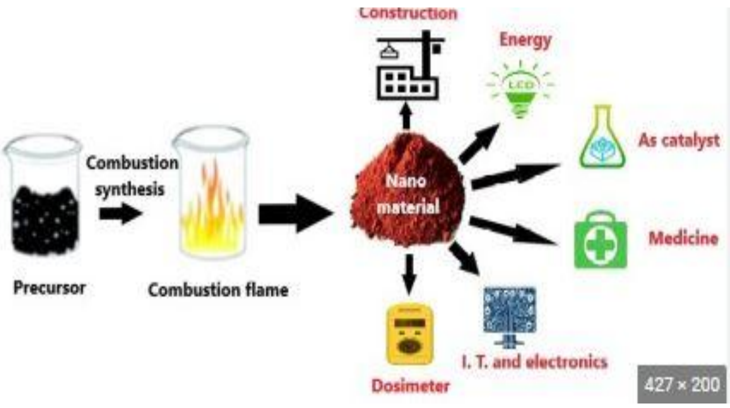
- Conducted in steel pressure vessels called auto claves with or without Teflon liners.
- Under controlled temperature and/or pressure with their action in aqueous solution.



- Widely used for the production of small particles in ceramics industry.
- Used to prepare nano particles of Ti02.

Combustion Technique

- Used for the preparation of nano particle sized LiBi02.
- Requirements
- Lithium Nitrate
- Bismuth Nitrate
- Urea(igniter-fuel)
- Glycerol(binding material)

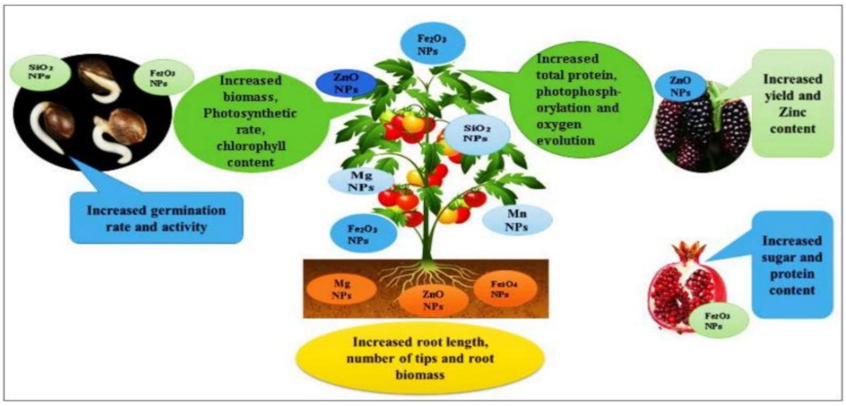


Synthesis of Nano Particles

The nano particles may be synthesized by physical, chemical, biological and aerosol technique. Physical synthesis method includes sedimentation process, rotor speed mill, high energy ball mill and pot mill. In general, phosphorus (P) nanoparticles are prepared by purifying rock phosphate and grinding with high energy ball mill or pot mill.

Crop Growth

- Nano materials have the potential to penetrate the seed coat and enhance the ability of absorption and utilization of water, which improves germination and seedling growth Nano materials, such as ZnO2, TIO2, FeO2, Zn, Fe, Cu-oxide and hydroxyl fullerenes



are reported to increase crop growth and development with quality enhancement in many crop species including, onion, spinach, tomato and potato.

- The growth and development is increased due to long term availability of nutrients to the plant over the full crop period of cultivation is crucial for promoting germination, growth, flowering and fruiting.

Application of Nanotechnology in Vegetable Crops

✓ Nanotechnology helps to revolutionize horticulture and food industry. Nano materials commonly used in vegetables include silver nano particles, zinc oxide nano particles, titanium dioxide nano particles. The benefits of nanotechnology in vegetable production are enormous.

✓ These include control of insect pests using nano pesticides and nano insecticides, increase in vegetable production and productivity using nano particles encapsulated fertilizers and bio fertilizers.

Frontline of Nano Technology in India


In the presence of the Union Minister of Chemicals & Fertilizers and Health & Family Welfare Mansukh Mandaviya, a practical field trial of drone spraying of Nano Liquid Urea was conducted by IFFCO in Bhavnagar, Gujarat, on October 1. India has become the first country in the world to start commercial production of Nano Urea.

Chemicals Used in Nano Technology

- All of the chemicals used in the study were at their highest integrity.
- Calcium hydroxide ($Ca(OH)_2$)
- Orthophosphoric acid (H_3PO_4)
- sodium hydroxide ($NaOH$)
- Trisodium citrate ($Na_3C_6H_5O_7$)
- Urea molecules ($CO(NH_2)_2$)
- Other chemicals including zinc chloride ($ZnCl_2$), copper chloride ($CuCl_2$), and ferrous chloride ($FeCl_2$)

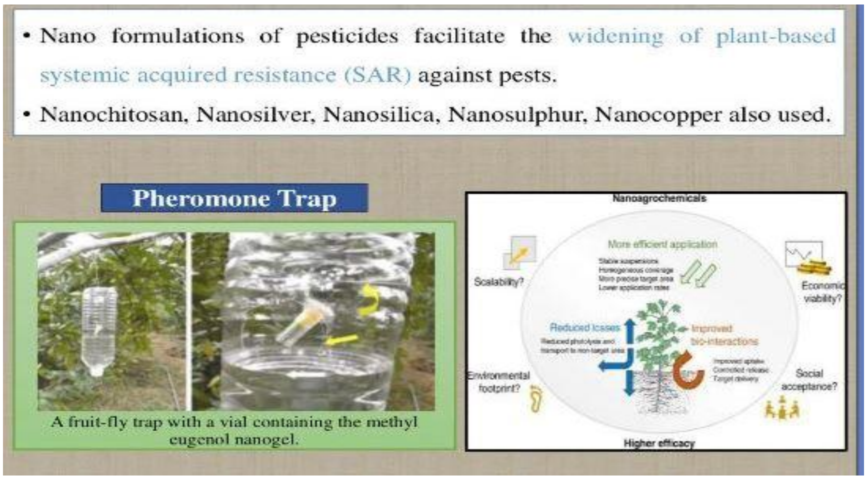
Nano Fertilizer Products

Plant Protection

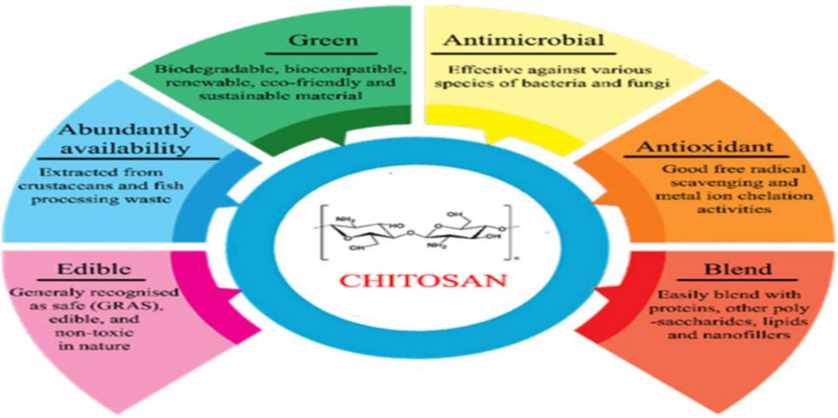
- Among the applied pesticides, much amount lost in the environment or unable to reach the target sites. This not only increases the expenses of crop.

➢ Production, but also causes the depletion of environmental systems. Nano formulation of pesticide facilitate the persistence or controlled release of active ingredients in root zones or inside plants without compromising effectiveness. Conventional formulations having limited water solubility of pesticides.

➢ Also injure other organisms, leading to increased resistance to target organisms. More importantly, the timely and controlled release of active ingredients.



Nano Chitosan



Nano Partlcles in Post-Harvest Disease Management

- Different nano materials showed important potential in post- harvest. Technology management by controlling growth and development of microorganisms.
- Several investigations support that Nano-packing material had quite beneficial effects on physicochemical and physiological quality compared with normal packing material.

- Therefore, the Nano-packing may provide an attractive alternative to improve the preservation qualities of fruits, vegetables and other valuable horticultural crops during extended storage.

Comparison of Packing with Nano Packing and Conventional Packing and Their Effect on Reduction in Decay Rate, Anthocyanin and Malondialdehyde Contents

Nanotechnology has the potential to generate new fruit packaging. The new technology of nano-packing materials with lower relative humidity, oxygen transmission rate, and high strength was synthesized by blending polyethylene with nano-powder (nano-Ag, kaolin, anatase TiO_2, mineral TiO_2), and it enhanced the preservation quality of fruits throughout storage at 40°C.

Concluding Remarks and Prospects of Nano Technology

- ❖ Nanotechnology is advancing as a state-of-the-art tool in modern agriculture to facilitate sustainable crop production.
- ❖ It also has a great promise in horticulture, where different kinds of nano materials are used to increase productivity and quality of produce and reduce post-harvest spoilage of fruit and vegetables.
- ❖ Nanotechnology takes advantage of the power of nano materials and their distribution methods for improvement of the productivity of horticultural crops. They reduce the over-use of chemical fertilizer and pesticides. Nano materials are simple, cost-effective, and eco-friendly, allowing them to be produced in a minimum time and with less effort and without causing any harm to the environment.

Future Prospects

- ✓ "More studies are needed to explore the mode of action of NPs, their Interaction with bio molecules, and their impact on the regulation or gene expressions In plants.
- ✓ "Research on nano particles with respect to crop protections should be geared towards introduction of faster and ecofriendly nano formulations in future**.**

References

Feynman, R.P. There's plenty of room at the bottom. Eng. Sci. 1960, 23, 22–36.

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Advanced Materials Engineering (NAME), Jashore University of Science and Technology, Jashore 7408, Bangladesh;

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Zhao et al. Applications of Nanotechnology in Plant Growth and Crop Protection,2019 Jul; 24(14): 2558.Published online 2019 Jul 13.

Cynthia R.et al. Influence of Reaction Mixture Porosity on the Effective Kinetics of Gasless Combustion Synthesis. *Eng. Chem. Res.* 1998, 37, 6, 2246–2249Publication Date: April 17, 1998

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SOCIO-ECONOMIC IMPACTS OF CLIMATE CHANGE

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Climate change, a global phenomenon primarily driven by human activities, has emerged as one of the most pressing challenges of our time. Its socio-economic impacts are far-reaching and affect various aspects of human society, including health, agriculture, water resources, infrastructure, and economic development. This article explores the socio-economic impacts of climate change, highlighting the challenges it poses and the potential strategies to mitigate its effects.

Agriculture productivity is significantly influenced by soil fertility, air pollution, and water availability. Due to both direct and indirect effects of abiotic stressors, harsh repercussions on plant productivity are intensifying with sudden changes in environmental circumstances. The atmospheric CO_2 concentration has increased from 280 mol^{-1} to 400 mol^{-1} as a result of ongoing deforestation and unsustainable fossil fuel use. At the end of this century, the CO_2 concentration is expected to increase by two, or up to 800 mol^{-1}. The primary causes of the greenhouse effect and rising world average temperatures are the emissions of hazardous gases, particularly CO_2.

The number of stress seasons, their influence on daily living, and damage to agricultural crops are the key metrics used to quantify the effects of climate change and environmental variation. Agricultural yield is primarily harmed by unfavourable environmental circumstances in developing nations; therefore, high temperatures and excessive CO_2 build-up forced scientists to discover new approaches to deal with unpredictable obstacles. New climate-smart crop cultivars must be produced in order to overcome these obstacles and ensure food security.

Health Impacts

Climate change has a profound impact on human health, both directly and indirectly. Rising temperatures and extreme weather events contribute to increased heat-related illnesses and deaths, particularly among vulnerable populations. Heatwaves, exacerbated by climate change, can lead to heatstroke, dehydration, and cardiovascular problems. Additionally, changing weather patterns and increased precipitation can create favorable conditions for the spread of vector-borne diseases such as malaria and dengue fever.

Agriculture and Food Security

Agriculture, a critical sector for global food security, is highly susceptible to the impacts of climate change. Rising temperatures, changing precipitation patterns, and extreme weather events pose significant challenges to crop production and livestock farming. Heat stress, prolonged droughts, floods, and pest infestations can reduce crop yields, degrade soil quality, and affect livestock productivity. These disruptions in the agricultural sector can lead to food shortages, increased food prices, and food insecurity, particularly in developing countries.

Water Resources

Climate change impacts the availability, quality, and distribution of water resources, which are essential for human well-being, agriculture, and industrial activities. Changes in precipitation patterns can result in more frequent and severe droughts or heavy rainfall events, leading to water scarcity or flooding, respectively. Decreased water availability can affect irrigation systems, hydropower generation, and freshwater supply for domestic use. Water scarcity can also contribute to conflicts over resources and exacerbate social and economic inequalities.

Infrastructure and Human Settlements

The increasing frequency and intensity of extreme weather events associated with climate change pose significant risks to infrastructure and human settlements. Coastal areas are particularly vulnerable to sea-level rise, storm surges, and erosion. Low-lying islands and coastal cities face the threat of inundation, displacement of populations, and loss of infrastructure and cultural heritage. Inland regions are also at risk from flooding, landslides, and damage to critical infrastructure, including roads, bridges, and power grids. Rebuilding and adapting infrastructure to withstand climate-related risks require substantial investments and long-term planning.

Economic Development

Climate change poses substantial challenges to economic development, particularly in developing countries that heavily rely on climate-sensitive sectors such as agriculture, forestry, and tourism. The costs associated with climate-related damages, adaptation measures, and the loss of productivity can undermine economic growth and exacerbate poverty. Small-scale farmers, marginalized communities, and indigenous populations are disproportionately affected by the socio-economic impacts of climate change, further widening existing inequalities.

Migration and Displacement

Climate change can also trigger migration and displacement, as communities are forced to leave their homes due to the adverse effects of climate-related events. Rising sea levels, prolonged droughts, and increased frequency of extreme weather events can render certain areas uninhabitable. This leads to population movements, both within and across borders, which can strain resources and infrastructure in receiving areas and create social tensions. Climate-induced migration and displacement pose complex challenges for governments and communities, requiring adequate planning, support, and policy frameworks.

Biodiversity and Ecosystems

Climate change poses a significant threat to biodiversity and ecosystems, with cascading impacts on socio-economic systems. Changes in temperature, precipitation patterns, and extreme weather events disrupt ecosystems, leading to shifts in species distribution, reduced productivity, and increased vulnerability to invasive species and diseases. Loss of biodiversity can harm ecosystem services vital for human well-being, such as pollination, water purification, and climate regulation. Furthermore, industries such as fisheries and tourism that rely on healthy ecosystems are at risk, impacting livelihoods and local economies.

Social and Political Stability

The socio-economic impacts of climate change can have far-reaching consequences for social and political stability. Increased competition for scarce resources, such as water and arable land, can exacerbate social inequalities and heighten tensions within and between communities. Disruptions in food production and availability can trigger social unrest and political instability. Additionally, climate-induced migration and displacement can strain social systems and lead to conflicts over resources. It is essential to address these challenges through effective governance, inclusive policies, and international cooperation to ensure social cohesion and stability.

International Cooperation and Climate Diplomacy

Addressing the global challenge of climate change requires international cooperation and collective action. International agreements, such as the Paris Agreement, play a crucial role in coordinating efforts to reduce greenhouse gas emissions and provide support for vulnerable countries. Climate diplomacy aims to foster collaboration among nations, facilitate technology transfer, and ensure financial assistance for developing countries to implement climate mitigation and adaptation measures.

Public Awareness and Education

Raising public awareness about the socio-economic impacts of climate change is essential for fostering sustainable behaviors and mobilizing support for climate action. Education plays a vital role in equipping individuals and communities with knowledge and skills to mitigate and adapt to climate change. By promoting environmental education and integrating climate change topics into curricula, societies can foster a culture of sustainability and empower citizens to make informed choices.

Mitigation and Adaptation Strategies

To address the socio-economic impacts of climate change, a comprehensive approach is required, encompassing both mitigation and adaptation strategies:

Mitigation focuses on reducing greenhouse gas emissions to limit the magnitude of climate change. Transitioning to clean and renewable energy sources, improving energy efficiency, and promoting sustainable transportation are crucial steps in mitigating climate change. Additionally, afforestation and forest conservation efforts help sequester carbon dioxide, mitigating climate change while providing additional ecological and socio-economic benefits.

Adaptation strategies aim to enhance societies' resilience and capacity to cope with climate change impacts. This involves implementing measures such as climate-informed land-use planning, building resilient infrastructure, strengthening early warning systems, improving water management practices, and promoting sustainable agricultural practices. Investing in research and development for climate-resilient technologies and supporting vulnerable communities through social safety nets are also vital components of effective adaptation strategies.

Conclusion

Climate change's socio-economic impacts are wide-ranging and pose significant challenges to human societies worldwide. From health risks to agriculture, water resources, infrastructure, and economic development, climate change affects multiple sectors and exacerbates social and economic inequalities. However, through a combination of mitigation and adaptation strategies, international cooperation, and public awareness, it is possible to mitigate these impacts and build a more resilient and sustainable future. By addressing climate change holistically and prioritizing the needs of vulnerable populations, we can create a society that is better prepared to face the challenges of a changing climate.

References

Adger, W. N.(2007). Assessment of Adaptation Practices, Options, Constraints and Capacity. In M. L. Parry, *et al.* (Eds.), Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC. Cambridge University Press.

Falkenmark, M. andRockström, J. (2008). The New Blue and Green Water Paradigm: Breaking New Ground for Water Resources Planning and Management. *Journal of Water Resources Planning and Management*, 134(6), 428-429.

FAO. UNICEF. WFP. WHO.(2018).*The State of Food Security and Nutrition in the World 2017*: Building Resilience for Peace and Food Security. Food and Agriculture Organization of the United Nations (FAO); Rome, Italy.

Foresight. (2011). Migration and Global Environmental Change: Future Challenges and Opportunities. Retrievedfrom https://www.gov.uk/government/publications/migration-and-global-environmental-change

Intergovernmental Panel on Climate Change (IPCC). (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the IPCC. Cambridge University Press.

Lobell, D. B. and Burke, M. B. (2010). On the Use of Statistical Models to Predict Crop Yield Responses to Climate Change. *Agricultural and Forest Meteorology*, 150(11), 1443-1452.

Raza, A., Razzaq, A., Mehmood, S.S., Zou, X., Zhang, X., Lv, Y. and Xu, J., (2019). Impact of climate change on crops adaptation and strategies to tackle its outcome: A review. *Plants*, 8(2),34.

Rosenzweig C., Elliott J., Deryng D., Ruane A.C., Müller C., Arneth A., Boote K.J., Folberth C., Glotter M., Khabarov N.(2014). Assessing agricultural risks of climate change in the 21st century in a global gridded crop model intercomparison. *Proc. Natl. Acad. Sci. USA.* 111, 3268–3273. doi: 10.1073/pnas.1222463110.

Stern, N. (2007). The Economics of Climate Change: The Stern Review. Cambridge University Press.

United Nations Framework Convention on Climate Change (UNFCCC). (2013). The 2013–2015 Review: Addressing the Adequacy of the Long-term Global Goal. Retrieved from https://unfccc.int/resource/docs/2013/cop19/eng/10a01.pdf

UNWTO. (2018). Tourism and Climate Change. Retrieved from https://www.unwto.org/tourism-and-climate-change.

Vaughan M.M., Block A., Christensen S.A., Allen L.H., Schmelz E.A.(2018). The effects of climate change associated abiotic stresses on maize phytochemical defenses. *Phytochem. Rev*, 17, 37–49. doi: 10.1007/s11101-017-9508-2.

Wheeler T. and Von Braun J.(2013). Climate change impacts on global food security. *Science.* 341:508–513. doi: 10.1126/science.1239402.

World Bank. (2012). Inclusive Green Growth: The Pathway to Sustainable Development. Retrieved from https://openknowledge.worldbank.org/handle/10986/6058.

World Health Organization (WHO). (2018). Climate Change and Health. Retrieved from https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

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BASIC CONSIDERATION AND CONSTRUCTION OF WATER GARDEN

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Water garden is a type or feature or part of a landscape where any type of water feature is a basic or dominant component along with aquatic, water-loving, bog or marsh plants and occasionally ornamental fishes. Water gardening is the process of simulating a natural environment with a body of water via careful design and the use of various plants and other features which aids in breaking up the monotony of a vast landscape. An ornamental pond has decorative fish, but a water garden solely contains plants, thus the name garden which is the main difference. It provides a calming aesthetic effect and appears to re-establish a connection with the natural aquatic environment. It might be built in a pond, a natural land depression, a man-made pool or a lily poll, rivers and lakes. A bog garden for plants that prefer soggy soil could be included in a water garden.

History of Water Gardening in India

The Buddhist era has the earliest mention of a water garden where Lotus ponds were typically seen in stupas and temples. Lord Buddha reportedly observed lotuses and blossoming trees at *Nandanavana*, according to the poet Asvaghosa (100 A.D.) (Roy, 2013). In some literature it is written that first creation of water garden was done by the Egyptians who channelled water from the Nile into their royal gardens and planted lotuses, a holy plant and a main source of healing. Lotus petals were found surrounding Ramses II's coffin during an excavation of his tomb in 1881, indicating that they were utilized 5,000 years ago. Next came the Persians, where water gardens and other water elements have been a common component of both public and private gardens. Statuary was first used in water gardens by the Greeks. Japanese and Chinese water gardens were intended to be spaces for introspection and thought and these were modernized, stone-built structures that may be found in cities during the Italian Renaissance (Randhawa and Mukhopadhyay, 1986). Running water was one of the most crucial elements of Mughal gardens since it gave the plants life. For instance, growing

Chinese spinach on floating gardens is mentioned in the (about 304 CE) Nanfang Caomu Zhuang.

Consideration for Establishment of Water Garden

Site selection: Consider the plants that will grow in the pond, the soils on the site, how level the grade is, surface drainage on the site, the view of the pond site from the house, the overall fit of the pond in the existing landscape, and anticipated maintenance needs when choosing the location for the water garden.

Location: A water garden should be situated where it can be well visible from the home that's why the owner will be better able to notice predators (Kleinholz, 2000c), in full sun, or as much as is possible, close to water and power, and where the water may reflect the beauty of the nearby scenery. A water garden placed within sight of the home enables enjoyment, pet and child monitoring, predator observation, and decreased costs for pipes, electrical equipment, and pumping. Never construct an ornamental pond over gas, water, sewage or electrical wires. All water garden plants should receive at least 5 to 6 hours of direct sunshine each day for the optimal development and establishment (Sink *et al*, 2014). The positioning of a water garden shouldn't obstruct pond upkeep or surface water drainage from storm runoff. A water garden shouldn't be placed in an area where trees drop leaves which may have the ability to contaminate water, release harmful compounds into ponds, and block filters.

Design consideration:

Size of pond: A healthy, balanced pond is said to have a minimum surface area of 50 square feet. The pond's depth should be between 18 and 24 inches and should contain a part that is 3 to 5 feet deep to withstand winter freezes and offer fish a cool retreat in the summer. At least two-thirds below ground level water gardens retain heat in cold weather and cool down in hot weather (Masser and Anderson, 2010).

Shape: A geometrically structured pond would be great for a formal setting. A pond with a less formal or geometric design might be more suited to a casual environment.

Edging: The use of edging materials enables the water feature to blend in with the garden's general design. The pond can be framed with bricks, pebbles, steel edging, wood, or any combination of these materials.

Construction: When choosing materials, factors like as price, availability, installation requirements, and compatibility with other materials in the landscape should be taken into consideration. Pools with an earthen or plastic lining can be built with minimal expertise. Rain-related run-off water may result in muddiness, oxygen issues, chemical contamination, fish escape, and other issues. A berm may be needed to deflect run-off water away from the garden if the surrounding topography is higher than the water garden (Kleinholz, 2000a). Another issue that might arise is precipitation saturation of the soil under the water garden, which could lead to overflow or cause it to float out of the ground. Build unique drainage systems under the pool to prevent this issue. In order to convey debris towards the deepest section of the pool where it can be cleaned out, sides should be tiered and/or sloping rather than vertical to prevent detritus (such as dirt, leaves, etc.) from accumulating along the edge of the pool bottom. Cutting pool sides into two or three levels, each around 12 inches wide, is a frequent construction technique. Tiers provide ledges for plants and other aesthetic things in addition to aiding in the retention of liners. Different construction materials are earthen materials, flexible liners, fiberglass or plastic and concrete (Masser, 2010).

Components of Water Garden

Water: City water, well water, subterranean water, and occasionally rainwater collecting are the most common sources. Dissolved oxygen, nutrients, algae, ammonia, nitrite, pH, alkalinity, hardness, and contaminants or pollutants, such as pesticides, are some frequent elements affecting water quality. The pH fluctuates daily due to the activities of photosynthesis and respiration and should normally cycle from 6.5 to 9 without harming the fish; if the pH is outside of this range, buffers should be added to increase the alkalinity. The amount of oxygen in the ornamental pond is determined by the amount of dissolved oxygen (D.O.). Water has extremely little dissolved oxygen, thus it is measured in parts per million (ppm), which can range from 0 to 20 ppm, though 4 to 7 ppm is more normal. Water hardness is often determined by the amounts of calcium and magnesium present, however ferrous iron may have a substantial impact on the hardness of groundwater. For decorative ponds and water gardens, the recommended range for hardness is greater than 5 ppm, but it should be 20 ppm or above to preserve fish health and reproduction.

Water Feature, Water Follies, Stream Gardens

A water feature is any one or more objects from a variety of fountains, rills, artificial waterfalls, and streams in landscape architecture and garden design. Modern water features are often self-contained, which means they don't need water pipes; instead, they recycle water from a pond or a secret reservoir called a sump.

Plants:

- Submerged plants, also known as oxygenators, are those that spend practically their entire lives beneath water. Ex: *Ceratophyllum demersum*, *Hottonia palustris*, *Myriophyllum spicatum*, *Potamogeton lucens*, *Vallisneria americana*, *Sagittaria natans*, *Elodea Canadensis*, *Cabomba caroliniana*, *Myriophyllus* sp.
- Marginal or bog plants are those that live above the surface of the water with their roots submerged. Ex: *Iris* sp., *Ranunculus fluitans*, *Scirpus lacustris*, *Typha latifolia*, *Colocasia esculenta*, *Sagittaria latifolia*, *Pontederia cordata*.
- Floating plants are ones that aren't at all attached to the soil but instead float freely on the top (Anonymous, 2012). Ex: *Azolla* sp., *Salvinia* spp., *Marsilea vestita*, *Pistia stratiotes*, *Eichhornia crassipes*, *Lemna* sp., *Wolffia* sp.
- Deep aquatic: *Nymphaea* sp., *Nelumbo* sp., *Nuphar luteum*
- Marsh plants: *Calla polustris*, *Primula japonica*, *Saxifraga pellata* can be selected.
- Moisture loving plants: *Alocasia isp.*, *Hedychium sp.*, *Cyperus alternie folius*, bamboo and grasses can be selected.
- Creeping aquatic plants: *Jussica repens*

Filters: Water circulation is necessary for ornamental ponds and water gardens in order to prevent stagnation, remove solids, and biologically decompose and detoxify dissolved pollutants. Mechanical and biological filters are the two primary categories. Biological filters are more challenging to install but may only require maintenance once a month, for example. Water filters such as *Nitrosomonos* sp., *Nitrospira* sp., etc. work well. Mechanical filters that aid to catch or remove dirt and organic debris include leaf skimmers, foam filters, and settling basins.

Liner: There are several types of liners utilized, including PVC, butyl or rubber, fibreglass, and concrete, each of which has a lifespan of 7 to 15, 30, or lifetime. Sand, gravel, or boulders may be used to adorn the water garden's interior. However, compared to flexible liner materials like PVC, polyethylene, or EPDM rubber, stiff liners are often more costly, may need heavy machinery, and are more difficult to create. Flexible liners are often less costly than rigid liners, have a wide range of durability and longevity, and may be UV-resistant. Because of its flexibility, adaptability to uneven surfaces, chemical inertness, and resistance to puncturing and UV radiation, EPDM sheeting is the most popular liner material for ornamental ponds (Kleinholz, 2000b). To cover the liner and equipment holes, it could be more visually pleasing to let the pond's boundaries protrude 1-2 inches above the water.

Pumps: The pond's pump should have the capacity to circulate all of the water through a filter in one to two hours.

Fish: Common pond fish examples include: Ricefish (Himedaka), Mosquitofish, Rosy Red minnows, White Cloud Mountain minnows, Common minnows, Goldfish (*Carassius auratus*), Crucian carp, Koior *Cyprinus carpio* (Nishikigoi, Butterfly Koi and Ghost Koi to obtain their unique color, scale, and fin characteristics), Mirror carp, Common carp, Grass carp, Weather loach, Stone loach, Golden orfe, Golden tench, Golden rudd, Gudgeon, Red shiner, Three-spined sticklebacks, Channel catfish, Bluegill, Pumpkinseed, Black bass, Sturgeon, Snakehead and Goby etc. Regardless of the variety of fish used in the ornamental pond, it's critical to understand the environmental needs of each species and which fish will thrive there (Masser, 1999).

Media for plants: All pond plants should be potted in fertile heavy clay loam. Fertilizers, herbicides, and other pesticides should not be present in this soil. To keep the clay from mixing with the pond water, all media must be coated with a 1 to 2 inch layer of coarse gravel or pebbles (not sand).

Maintenance tools: For removing leaves and other debris that has fallen, a long poled net comes in useful. Water plant trimming is made easier by garden shears. To measure the pH of the water, a pH meter or testing kit is helpful.

Construction of an Artificial Water Garden

In the absence of a natural pond, an artificial pond may be constructed using cement or concrete with a geometric pattern in the form of a simple circle, rectangle, or other shape. Pond dimensions can be 15 sq m (5 x 3) or 20 sq m (5 x 4), with a depth of 1 to 1.5 m. However, pigmy or very little fish up to 40 cm, medium fish up to 90 cm, and huge fish up to 2 m deep may be preserved.

After excavating and making drainage and supply pipe arrangements, 15.0–22 cm thick concrete layers made up of 3 parts aggregate–not more than 2 cm–1 part sand and 2 parts cement are poured at the bottom. Make the concrete airtight by coating it with cement when it has dried. However, the optimum mortar consists of one part cement, three parts fine sand, and a water-proofing substance. Mortar should be applied in two coats, preferably when the first coat is still wet yet solid, and should be around 1.5 to 2.0 cm deep. In order to remove toxicity from the water, potassium permanganate crystals can be added in precisely the right amount to turn the water a bright pink tint. Add 40g of washing soda to the 5 litres of water used to prepare the mixture in order to make it waterproof for use in mending fissure surfaces. If repairs are made without emptying the pond, mix ash and water and let this seep out. Normal water depth is kept at 60 cm, whereas lotus requires 1 m.

Beginning of the monsoon season is the ideal time to plant. The bottom of the pond is covered with a layer of dirt and compost that is 25–35 cm thick. The planning may be done either directly in the soil or in soil mixture-filled baskets that are 40 cm in diameter and 25–30 cm deep; the soil layer at the base of the garden may be as deep as 10 cm. The roots of plants that are first planted in baskets will eventually escape the baskets and wander in the soil. Plants that have fully developed roots that can quickly assimilate nutrients are pulled from the ground. One to two baskets of cow dung and a tablespoon of bonemeal or other similarly slow-acting fertilizer may be applied annually for water plants.

Conclusion

A water garden can provides a unique and soothing environment that combines the tranquility of water with the beauty of aquatic plants and fish. Whether it's a small container water garden or a large pond, there are several benefits and considerations to keep in mind. It can serve as a focal point in a garden and provide a sense of relaxation and tranquility and can also attract wildlife, such as birds, butterflies, and dragonflies, adding an element of nature and biodiversity to your surroundings. It can create a mini-ecosystem that supports various organisms, contributing to the overall balance and health of garden. It can help improve air quality by releasing moisture into the atmosphere, which can be beneficial in dry climates or during hot summers. The evaporation of water from the surface of the pond can also help cool the surrounding area, making it more comfortable.

References

Anonymous (2012) Water Garden. Ornamental Horticulture, Indian Agricultural Statistics Research Institute, e-courses, http://ecoursesonline. iasri.res.in/mod/page/view.php?id= 103346.

Kleinholz, C. (2000) Pond Design. Langston University Agricultural Research and Extension Programs. http://www.luresext.edu/aquaculture/ pond%20design.htm

Kleinholz, C. (2000) Pond Types and Liners. Langston University Agricultural Research and Extension Programs. http://www.luresext.edu/aquaculture/ pond%20type%20and%20liners.htm

Kleinholz, C. (2000) Site Location for Ornamental Ponds. Langston University Agricultural Research and Extension Programs. http://www.luresext.edu/aquaculture/ site%20location.htm

Masser, M. and E. Anderson. (2010) *Ornamental Garden Pools*. Publication No. CIRCULAR ANR-789. Alabama Cooperative Extension Service. Auburn University.

Masser, M. P. (2010) *Water gardens*. Oklahoma Cooperative Extension Service. Division of Agricultural Sciences and Natural Resources , Oklahoma State University, SRAC-435:1-8.

Masser, M.P. (1999) Water Gardens. Southern Regional Aquaculture Center Publication No. 435. https://srac.tamu.edu/index. cfm/getFactSheet/whichfactsheet/95/

Randhawa, G.S. and Mukhopadhyay, A., (1986) *Floriculture in India*. Allied Publishers.

Roy, R. K. (2013) *Fundamentals of Garden Designing: A Colour Encyclopedia*. New India Publishing Agency.

Sink, T., Gwinn, J., and Gerke, H. (2014) Ornamental Ponds & Water Gardens in Texas. *Texas A&M AgriLife Extension Service: College Station, TX, USA.*

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DECONTAMINATION TECHNIQUES IN PROTECTED CULTIVATION

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In India greenhouse technology is still in its budding stage. The crops cultivated in protected structures are having high productivity due to less competition and optimum growing conditions. Several climatic parameters like humidity, temperature and CO_2 can be adjusted according to the plant optimum growing conditions. Depending upon the type of cladding materials used the light transparency into the greenhouse influences and the light that was entrapped in the greenhouse and maintains the temperature in the greenhouse (Nimje and Shyam, 1991). The ideal and optimum climatic factors that were maintained in the greenhouse are not only favourable to plant growth and development but also favourable to diseases that infect the growing crops. There are different ways through which a number of pathogens may enter in the greenhouse and cause the disease incidence. Airborne pathogens enters through main doors and air space and zoospores may enter by means of irrigation water and can be easily grown in growing medium and hence necessary actions has to be taken in order to remove these harmful pathogens.

Sterilization before Planting

Sterilization of soil and soil-less culture Soil Sterilization is an important process of destroying pathogens, pests and weeds. Soil sterilization method may be physical, chemical or ionic in nature.

Methods of Sterilization

There are two methods of sterilization one is physical and the other is chemical method of sterilization.

i. Physical Agents

Steam sterilization:

The process of steam sterilization involves application of steam for 30 minutes i.e till the coldest spot in the patch reaches 180°F (Warncke and Krauskopf. 1983).

Methodology: The root media should be pasteurizing and should not loosed before be dry but should be at capacity (vapsa) field condition. Steam generator or main steam Tine in the greenhouse through low-pressure hosepipe used for steam application. It is distributed in beds buried perforated through buried for I.2m pipes. For 0.9m wide bed one row is boiler tubes, beds, two rows are used. Old rain gutter, holes (3-6 mm) irrigation pipes etc can be used with pair of in every 15 cm diameter drilled on opposite sides at to pipe. distribute steam, with plugged end of the pipe. Covers are placed over media during pasteurization to each steam in close contact to raise the temperature. Three types of covers viz. polyethylene, vinly and neopropene-coated nylon fabric are available. Depending on soil temperature, 6 to 8 hours are required for steam sterilization.

Limitations:

Two types of toxicity problems can occur as a result of steam pasteurization. One is manganese toxicity and other is ammonium toxicity. It is very expensive method

ii. Chemical methods:

Various chemical agents are used for soil sterilization as given below:

Formaldehyde (Formalin)

Formalin, is an aqueous solution, containing 37-40% formaldehyde, which has a poor penetration and diffusion ability. It should be mixed with water in 1:10 proportion. It is used at the rate of 7.5 lit for 100 sq m i.e.v 37.5 lit of Formalin is required for 500-sq.m area. Planting is done after two weeks of drenching, this method is not effective against nematodes and it should not to be used in a standing crop (O'Neill, and Green, 2010).

Methyl bromide

Liquid formulations contain about 25 % methyl bromide by weight in a solvent. It is a liquid under pressure and turns into gas when released. It is extremely hazardous to humans.

The gaseous methyl bromide Contains 2% chloropicrin as a warning agent. It is available in 454-680(1-112- pound) cans or cylinder and is used at the rate of 0.6kg/m (Pizano, M., 2002).

Chloropicrin

This fumigant, also known as tear gas, is a popular choice for carnation crops because of its sensitivity to methyl bromide. It is used at the rate 3-5 cc (cubic centimetre per cubic feet chloropicrin is injected in greenhouse soil by hand injector. Chloropicrin should not be used at media temperature below 15 °C and the exposure time of one to three days is required. Media should be aerated for at planting least seven to ten days before (McSorley *et al.*, 2004).

Dazomet (Basamid granules)

Microgranular soil fumigant contains 98% Dazomet, which releases biologically active gases mainly methyl isocyanate, which penetrates between soil particles. It is a micro granular soil fumigant containing 98% Dazomet leaves no degraded and harmful residues as the gases are mineralized after treatment. It is rate of 40 applied at gms/ m² (Gassauer, E., 1980).

Easy Method of Application

Prepare-the soil to fine tilth in the usual manner. Irrigate and leave for one week to activate the soil organisms (e.g. nematode, fungi, bacteria, and weed deeds) Prepare seedbeds with friable crumb structure after one week.

a) Spread basamid uniformly on the surface of the seedbeds at rate of 40gms/sqm. Incorporate basamid immediately in to soil to depth of 45 cm. by using spade or rotavator or any suitable implements. Ensure that's basamid mixes thoroughly and uniformly.

b) Press the seeds bed by rolling over with heavy loaded drum or wooden plank or use, a roller, if available. Irrigation with water can, rolling, followed by irrigation, would seal the soil and prevent the active gases from escaping. Keep the soil under moist condition. After 5 days looses the soil to 45cm depth with the implements, which is used for incorporation of basamid. Leave the seedbed for 2-3 days to allow the escape to toxic gases. Conduct a germination test and if found is normal, sowing should be undertaken.

Conclusion

To get expected yields along with the climatic factors and nutritional factors the decontamination techniques also to be followed. Pathogens have great potentiality to decrease the growth and yield of the crops and can adversely affect the returns causing a great loss to the farmer. Hence the above discussed methods had to be followed. Chemicals like formalin, methyl bromide and dazomet have great use in the decontamination and thereby eradicates the harmful pathogens that can affect the plant growth.

References

Gassauer, E., (1980). Soil fumigation in intensive crops with Basamid-Granular: Italy. *BASF Agricultural News (Germany FR)*, 1: 11-14.

Nimje, P. M., and Shyam, M. (1991). Greenhouse as an alternative technology for commercial vegetable crop production. *Indian journal of Agriculture Sciences*, 61(3): 85 -89.

O'Neill, T. M., and Green, K. R. (2010). Evaluation of some pre-plant soil treatments and chemical disinfectants for control of fusarium wilt diseases in protected cut flowers. *Acta Horticulturae*, 883: 215-222.

Warncke, D. D., and Krauskopf, D. M. (1983). Greenhouse growth media: Testing and nutrition guidelines. Mich. State Univ. Ext. Bul. E-1736.

Pizano, M., (2002). March. Alternatives to methyl bromide for use in cut–flower production. In *Proc. International Conference on Alternatives to Methyl Bromide*, 5-8.

McSorley, R., Wang, K. H., and Church, G. (2004). Comparison of alternative fumigants in cut flower production. In *Proc. Annual Int. Research Conf. on Methyl Bromide Alternative Reductions and Emissions Reductions*, MBAO,10-1.