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BIODIVERSITY- THE VARIETY OF LIFE ON EARTH: ITS CONSERVATION

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Abstract
Biodiversity is described as the distinction between living organisms and includes diversity within species, between species and ecosystems from all sources, including marine, terrestrial, aquatic ecosystems and the ecological complexes of which they are a part. Globally, biodiversity loss is observed due to habitat loss, global warming, climate change, sea level rise, sea surface temperature, excessive exploration of resources, illegal poaching of endangered animals, diseases, pollution of the environment, industrialization, urbanization, deforestation, etc. the need to take strict measures against the causes of biodiversity loss and to preserve it by preserving it through legal obligations by the government and other social organizations. WWF's 2018 Living Planet Report found an average 60% decline in global populations of mammals, fish, birds, reptiles, and amphibians between 1970 and 2014. A Freshwater Living Planet Index shows an 83% decline since 1970s.

Introduction
In India, protected areas designated under the Wildlife Protection Act, 1972, India has over 20 % of its total geographical area under biodiversity conservation, thereby exceeding the Aichi Biodiversity Target of 17%. India's 12 National Biodiversity Targets build on a range of existing activities in many areas. Biodiversity can occur in a very small particular area or in a very large area like the ocean. For example, biodiversity can occur in a very small aquarium where there are few small fish or can occur in a large ocean where whales and sharks like huge fish live with other aquatic animals. Biodiversity can be present in different ecosystems such as the desert ecosystem, the aquatic ecosystem and the terrestrial ecosystem, including the grassland ecosystem, the forest ecosystem, etc. Biodiversity is therefore present everywhere on earth.

Meaning of biodiversity: The word, "Biodiversity", is combination of two words, "Bio" means life and "diversity" means variety. The term biodiversity refers to the variety of life on Earth at all its levels, from genes to ecosystems, and can encompass the evolutionary, ecological, and cultural processes that sustain life. The term ''biodiversity'' was first used in its long version ("Biological Diversity") by Lovejoy (1980).

"Without biodiversity, there is no future for humanity," says Prof David Macdonald, at Oxford University.

E.O. Wilson, Known as 'Father of Biodiversity.

What is biodiversity? According to WWF, Biodiversity is all the different kinds of life you'll find in one area—Bacteria, fungi and other microorganisms, bryophytes and the various plants, birds, insects, fish and humans are all the fundamental part of biodiversity. Each of these species and organisms work together in ecosystems, like an intricate web, to maintain balance and support life.

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Biodiversity supports everything in nature that we need to survive: food, clean water, medicine, and shelter for many organisms.

Three-quarters of the land-based environment and roughly 66% of the ocean environment have been significantly altered. More than a third of the world's land surface and nearly 75% of freshwater resources are now devoted to crop or livestock production. Climate change worsens the impact of other stressors on nature and our wellbeing. Humans have overfished the oceans, cleared forests, polluted our water sources, and created a climate crisis. These actions are impacting biodiversity around the world, from the most remote locales to our own backyards.

Type of Biodiversity: There are three prime types of biodiversity viz, Genetic biodiversity, Species biodiversity and habitat / ecosystem biodiversity.

1. **Genetic biodiversity :** it is related to the genes of living organism and is the diversity within the specific species. Genes are responsible for transmission of certain traits from one generation to the next within the same species, so genetic biodiversity has occurred within the same specific species. It is also called as within species diversity. Genes give unique characters to each individual species.
2. **Species biodiversity :** it is occurs among different type of species (> one different species) in a particular area or location. Here, the number of species is the basic unit for classification. The diversity among the number of species and their different individual varieties that live in a particular area at a given time is called species biodiversity.
3. **Ecosystem biodiversity/ Habitat biodiversity :** The ecosystem is the interaction and interrelation between different living organisms and its non-living environment. The species can be different in different environments from geological conditions and therefore the diversity linked to different types of ecosystems such as forest, desert, and aquatic ecosystem is called ecosystem biodiversity. The term ecosystem was first coined by AG Tinsley in 1935. There are different types of ecosystems, such as the aquatic ecosystem, the terrestrial ecosystem of the desert ecosystem, the grassland ecosystem and the ecosystem forest.

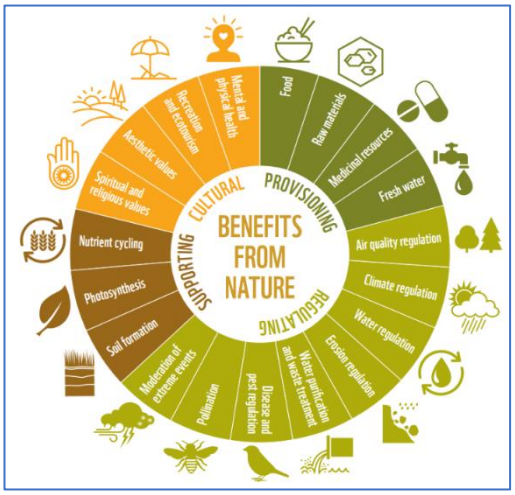

Figure 1. Benefits of Biodiversity (Source: Living Planet Report, 2018)

Importance of Biodiversity : Biodiversity is very important for balancing our terrestrial environment and our ecosystem. Below is the main importance of biodiversity.

Food chain: There are enormous living organisms living on earth and helpful for making a specific food chain which is very useful for balancing and maintaining our ecosystem.

Aesthetic value: Biodiversity is very useful for aesthetic value of our earth.

Provides varieties of food: Several varieties of food can be obtained from different kind of plants and animals.

Provides medicinal resources: Different kind of medicines can be prepared from different kind of plants and animals

Productive values: Certain daily products can be obtained from different kind of animals and plants in the form of oil, leather, etc.

The Main Threats to Biodiversity

There are certain threats to the biodiversity that is responsible for the extinction of certain species and ecosystem.

1. **High population rate:** High population rate responsible for loss of habitat for different types of animals as well as plants.
2. **Habitat loss:** Habitat loss occurs when natural environments are transformed or modified to serve human needs. Common types of habitat loss include cutting down forests for timber and opening up land for agriculture, draining wetlands to make way for new development projects, or damming rivers to make more water available for agriculture and cities.
3. **Pollution:** Pollution including air, water and soil pollution.
4. **Natural calamities**: It is related to the loss of biodiversity due to certain natural impacts such as forest fire, certain insects destroy plants and certain epidemics in animals.
5. **Deforestation:** Cutting of trees for the industrialization and urbanization.
6. **Exotic species/Invasive species:** Some species migrate from one ecosystem to another ecosystem and then dominate completely dominate over certain species, eliminating certain existing species are called as exotic species and this is also one of the reasons for the loss of biodiversity.
7. **Illegal hunting:** It is also responsible for extinction of many species of animals.
8. **Climate change:** Climate change and biodiversity loss are twin global threats with impacts felt disproportionately in the world. The cause, stemming from the rising temperature of Earth's atmosphere include rising sea levels, ecosystem collapse and more frequent and severe weather. Rising temperatures from human-caused greenhouse gas emissions affects planet-wide systems in various ways.

WWF has identified five major threats and shown each threats proportional impact, averaged across all regions:

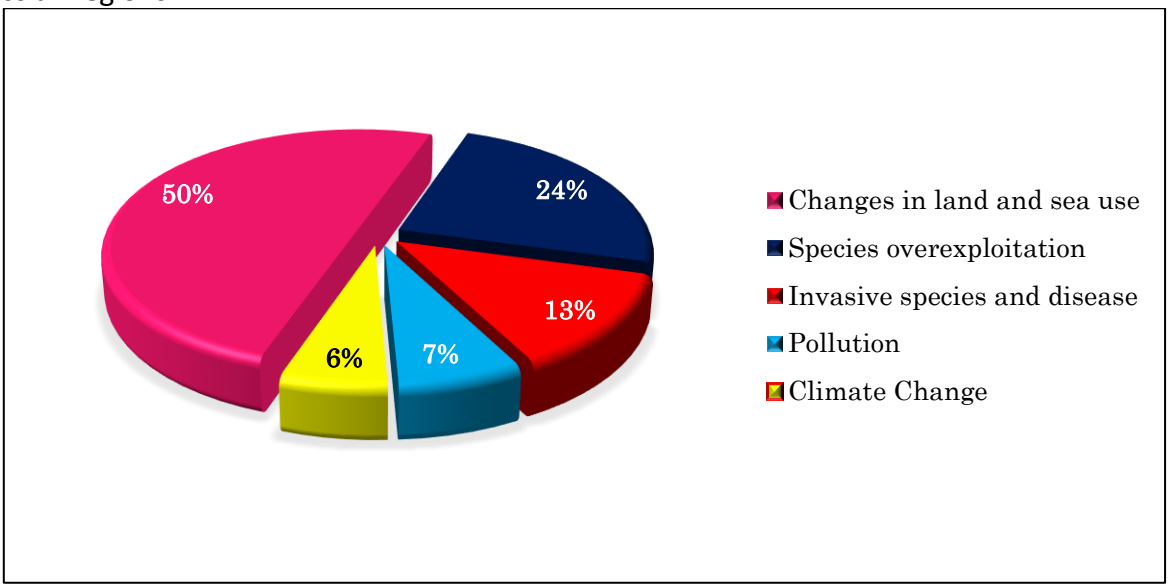

Figure 2. Proportion of threat (average across all regions)

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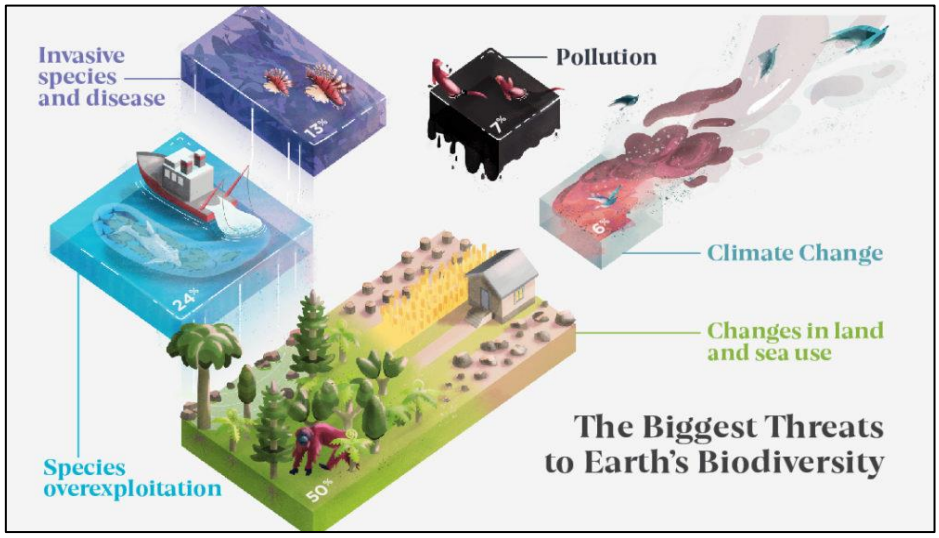

Figure 3. The biggest Threats to Earth's Biodiversity

While it's challenging to create an exhaustive list, across the board, changes in land and sea use account for the largest portion of loss, making up 50% of recorded threats to biodiversity on average. This makes sense, considering that approximately one acre of the Earth's rainforests is disappearing every two seconds. Species overexploitation is the second biggest threat at 24% on average, while invasive species takes the third spot at 13%.

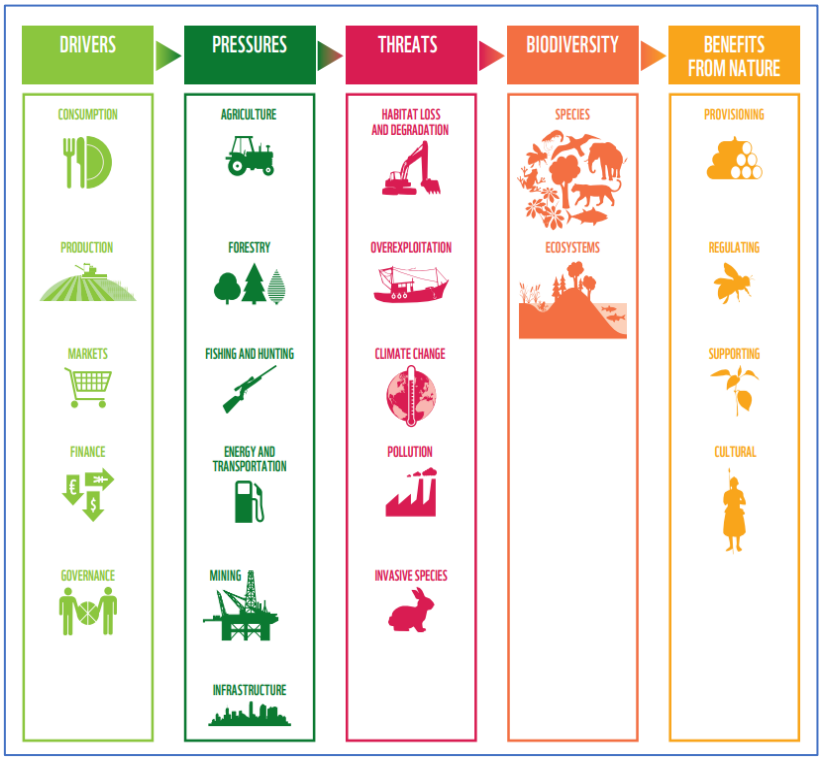

Figure 4: Threats to nature and the drivers and pressures behind them Habitat loss due to agriculture and overexploitation remain the biggest threats to biodiversity and ecosystems.

"Guns, nets and bulldozers: the threats of old are still the dominant drivers of current species loss." (Maxwell *et al.,* 2016).

Conservation of Biodiversity

The protection, management and preservation of genetic diversity, species and ecosystems are important and are also called biodiversity conservation. We must protect flora and fauna for the sustainable growth of individual species and of all types of ecosystems. The richness of species, the ecosystem, the environment and the sustainable growth of life on earth are also called Optimal Conservation of Biodiversity.

The main objective of conserving diversity is to save life on earth, preserve all species, maintain the ecosystem, aesthetics of the earth and a healthy environment forever so that it remains healthy for the next generation as well. Conserving biodiversity is very important for maintaining the food chain, providing a healthy environment for varieties of species, including humans, and gaining support for our sustainable development.

Types of Biodiversity Conservation

There are two types of biodiversity conservation, one is In-situ and the other is Ex-situ conservation.

1. **In-Situ conservation of biodiversity (onsite):** The conservation of species in their original ecosystem without disturbing their natural life or within their natural habitat is called as In-situ biodiversity conservation. Here, the area/ecosystem/habitat with high natural biodiversity is converted into national park or sanctuary. Sometime this reserved ecosystem is also called as biosphere reserve and a government regulating its maintenance and preservation by enforcing certain legal obligations. **E.g. - Natural Park, Sanctuary.**
2. **Ex-Situ conservation of biodiversity (off-site):** Here, the conservation of species takes place off-site i.e away from their natural habitat, these species are shifting and protected in a new ecosystem. For example, some rare species of wildlife have moved from their natural habitat to the zoo and botanical garden to aid recovery strategies for endangered species. This also includes the conservation of genetic resources. **E.g. - gene bank gamete, gene bank DNA, seed bank.**

Future Needs of Biodiversity : Saving of biodiversity

- To protect gene, species, habitat and ecosystem
- To restore lost, threatened, endangered species in their habitat
- Documenting - Composition, distribution, structure and functions of an ecosystem
- To create awareness to maintain the balance of an ecosystem
- To provide opportunities to local people for sustainable use
- To appreciate and protect the nature beauty and variety of ecosystem
- To educate people about their surroundings

Conclusion

Biodiversity is the variety of various living organisms present on earth and their interaction and interrelationship in the ecosystem. Human domination is the greatest common threat of biodiversity because it takes advantage of his power and consumes all type of resources by endangering the life of other species. Biodiversity conservation is very important for the sustainability of a healthier earth by preserving and protecting species, ecosystem, and natural resources. The rest of this guide will help inform you about issues to consider, steps you can take and examples of positive action for biodiversity. We are the first generation that has a clear picture of the value of nature and our impact on it. We may be the last that can take action to reverse this trend. From now until 2050 will be a decisive moment in history.

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WORLD BEE DAY - IMPORTANCE AND CONSERVATION OF BEES

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World Bee day is celebrated on 20th of May every year since 2018 for raising awareness in people about the survival of bees as they are at risk of extinction through unconscious human activity. Current species are 100 to 1,000 times more endangered than normal due to human influences. Bees and butterflies, in particular are 35 percent endangered worldwide. Bees have been on earth for thousands of years. Bees are the only insects that can produce food that can be eaten by humans. Bees are also good friends for our environment. They help us in reducing the pollution.

Honey bee is a eusocial insect within the genus *Apis*. Only eight surviving species of honey bees are recognized with a total of 43 subspecies, though historically 7 to 11 species are recognized. Honey bees represent only a small fraction roughly 20,000 known species of bees. Bees are a type of social insects that help humans financially with their Products. They are known for the construction of hives from wax for breeding and storing surplus honey. They collect nectar from thousands of flowers and put it in their hives and turn the nectar into honey.

Each colony of bees includes one queen bee, 20-60 thousands of male drones and millions of workers bees which collect nectar from flowers and bring to the bee hive. Each worker bee is having a sac like structure under the stomach to fill with the honey. The queen bee lives for 5 years while the other bees will live for weeks and months. Honey bees have the power to smell honey from a distance and having good eye sight able to look from many sides. Bees can smell the nectar of hundreds of varieties of flowers from any distance. Bee wings can give a strong stroke of 6-15 miles per hour. For collecting one kg of honey the bee roams the distance equals as far as they can revolve the earth 3 times. Bee honey has all the vitamins and minerals needed for good health, such as energy for the brain and immunity. Honey is used with hot milk for good sleep; it is used for increasing the immunity, weight loss, healthy skin, healing burns and cuts.

But now the honey Bees are in threat due to the mistakes of the human. In order to develop forests, pollinating the flowers, and for growing new plants, it is necessary to disperse the pollen grains of the flowers which are carried by the bees. But deforestation by humans for their needs, reducing the size of forests, discriminate use of pesticides, rising heat, declining rainfall, increasing pollution in the air leads to dying in large numbers of honey bees.

Steps to protect bees from threat of extinction

1. Plant nectar bearing flowers on balconies, terraces and gardens for decorative purposes. Setting up pollinating gardens on balcony and on terrace.
2. Planting native plants that flower at different times of the year.
3. Buying honey and other honey products from the nearest local bee keeper to express support to the local bee keepers.
4. Raising awareness on the importance of bees to children and the public.
5. Preserve old meadows - it will have more diverse flowers and sow nectar-bearing plants.

6. Cutting the grass on the lawn only after the honey-bearing plants has bloomed.
7. Use pesticides that are not harmful to the bees and do not spray pesticides when the bees visiting the plants in orchards and vineyards.
8. Providing Incentives, loans, subsidies and payments to rural people by governments for bee keeping. Arranging local community partnership trainings awareness and empowerment, knowledge sharing skills in bee keeping.

Bee keeping in Indian agriculture:

1. Bee keeping is an ancient method of collecting honey in India. It is popular due to the high demand for honey in national and international markets. It has become a lucrative industry in India as the demand for honey for its products is increasing in the market.
2. Bee keeping is on the rise in Indian agriculture. Commercial bee keeping can be done together or separately with agricultural or horticultural crops. Raising bees with crops increases crop yields and provides additional income from honey. This is not a new method in Indian farming.
3. Bee keeping in agriculture does not require huge investments, infrastructure or even fertile land. It needs a little investment, resources, time. It has a positive impact on the environment. Bees do not compete with crops for resources in fields.

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STRAWBERRY : A POTENTIAL CASH CROP IN BUNDELKHAND REGION

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Abstract

The important cash crop strawberry is cultivated throughout the world, which is successfully grows well in a cold climate but present time it can be cultivated in subtropical as well as tropical climate in India. The region Bundelkhand provide ample opportunity for the successful cultivation of strawberry due to its mild and pleasant climatic conditions and identified suitable varieties. The farmers of the region are not very conscious of the profitable production for the cultivation of strawberry. To enhancement strawberry economically production there is need to develop integrated production technology and infra-structure facilities. There is need of facilities like greenhouse-controlled environment for growing and keeping the runners before plantation. Cold chain supply system is also needed to increase shelf life. With an integrated approach of proper production and marketing, strawberry cultivation will positively become for the farmers of Bundelkhand region. Farmers of this region may be benefitted from its cultivation because it's an easy and early income generation among the fruit crops. Furthermore, strawberry is highly demandable fruit especially in this region due to the people's awareness in healthy lifestyle.

Introduction

The resent situation changing our lifestyles and an increasing population of health-conscious of middle-class population with more disposable income present new opportunities for strawberry cultivation in India. The cultivated strawberry (*Fragaria x ananassa* Duch.) is a, cross between *Fragaria chiloensis* and *Fragaria virginiana,* which is man-made hybrid fruit. The fruit has commanded a premier position in world fruit market due to its attractive shape colour and pleasant flavour. It has adapted well to highly varying climatic conditions. This crop can be a good fit for many small-scale farming operations because its high value creates the potential for significant profit. It gives quick return in a short time than any other fruit. Strawberry cultivation at present received some momentum in India with extensive business project setting up a number of horticulture-based farming system primarily focused towards at large scale production of strawberry fruits. The plants a herbaceous fruit crops which can easily grow in pots, roof-top gardens etc. Strawberry cultivation is becoming increasingly popular in non-traditional areas due to its good profit returns from as well as the availability of good markets to sell the produce.

The high nutritional value in vitamins, micronutrients and antioxidant, antimutagenic and anticarcinogenic properties make strawberry an ideal fruit for promotion towards attainment of the Sustainable Development Goals on health and nutrition security. It is regarded as a valuable food in the diet of people around the globe and is in special demand by the fruit processing industries for preparing the jams, ice cream, candy, toffee, soft drinks and other products.

The leading strawberry producing states are Haryana, Mizoram, Meghalaya, Kerala and Himachal Pradesh. However, recently strawberry cultivation started non-traditional areas in south and northern states. Bundelkhand region of U.P and M.P states, of the country also has immense scope for strawberry production as its favourable climatic condition is highly favourable for its commercial cultivation. Hence, growing strawberry is becoming an alternative source of income for the farmers.

Uses of strawberries : Strawberry leaves contain essential oil, they are utilised in a range of processed foods such as ice cream, soft drinks, candy, and chewing gum. Strawberry consumption has skyrocketed in recent years, making it one of the most popular fresh fruits available. Strawberries are an excellent source of vitamin A, B1, B2, niacin, and vitamin C, as well as one of the best natural sources of antioxidants. Chemicals like ethylebutanoate and ethylehexanoate are responsible for flavour. Strawberry may also be used to make wine, jam, ice cream, jelly, and soft beverages, among other things. Strawberry flavourings and scents are widely used in a variety of products, including lip gloss, hand sanitizers, confectionery, perfume, and many more. Moreover, strawberries have possibly high quantities of heart-healthy antioxidants including ellagic acid and flavonoids like anthocyanin, catechin, quercetin, and kaempferol, as well as flavonoids like anthocyanin, catechin, quercetin, and kaempferol. These phenolic chemicals, according studies, reduce the risk of cardiovascular disease by reducing the development of total and LDL (bad) cholesterol. Another Harvard Medical School study discovered that young and middle-aged women who ate three or more servings of a half cup of strawberries or blueberries each week had a 34 percent lower risk of heart attack. The berries' potentially high quantities of anthocyanins relax blood vessels, lowering blood pressure and reducing cardiovascular issues.

Climatic requirement : Through strawberry is a temperate fruit crop, but then some improved varieties can be successfully grown in tropical and subtropical regions in open field condition. It is a short-day plant and requires exposure to about 10 days of less than 8 hours sunshine for initiation of flowering. The varieties grown in milder subtropical climate do not require chilling and continue to make some growth during winter. It requires 22-23^{0}C temperature for better growth, development and fruiting. The maximum growth rate it was observed at 22-25^{0}C day and 7-13^{0}C night temperature. The ideal temperature required for flower bud initiation range from 15-18^{0}C. Photoperiod is effective for vegetative growth, plant morphology and yield.

Soil requirement : Strawberry can be adapted to a wide range of soil types for growing successfully. It prefers soil reasonably rich in humus because 70-90 % of its roots are found in the top 15 cm soil and the best performing is a well-drained medium loam soil. The soil pH should be preferred 5.5 to 6.5 is preferred. Besides, under high pH root formation is very poor. Strawberry cannot grow in alkaline soils due to infected with nematodes. Strawberry should not be cultivated in the same land for a number of years. It should not be grown on the soil previously devoted to potato, tomato, brinjal and pepper.

Varieties : Most suitable varieties for the Bundelkhand region are sweet sensation, winter dawn, camarosa, chandler and sweet charlie.

Propagation : Strawberry is propagated through runners that are formed after the blooming season. Runner production is the easiest and quickest method to propagate the plants. Although runner produces true to type plant, but viral diseases are quite often transmitted through runners only. Thus, for runner production, a separate bed should be used. The site and soil where the

strawberry had not been grown for at least 3 to 4 years should be selected. The planting should be done at 1.2 x 1.2 m or 1.8 x 1.8 m row to row and plant to plant distance. Rate of runner production can be enhanced by application of GA_3 (40mg/L water) spraying in last week of May. For greater survival, the runners should be lifted in September and planted in small polybags (1 Soil:1 Sand:2 FYM) for one month.

Land preparation : The land should be well prepared by deep ploughing followed by harrowing.10-12 tons FYM, 20 kg nitrogen, 20Kg phosphorous and 15 kg potash per acre should be apply at the time of land preparation. Soil fumigation with Methyl bromide (67%) or Cloropicrin (33%) or soil solarisation prior to planting can check the nematodes, verticillium wilt and even some weeds. After all cultural practices finally levelled the land and beds are prepared for planting.

Mulching : Mulching is an important component of the strawberry production system. Many synthetic and organic types of mulch are being used for strawberry cultivation in different parts of the country based on the climatic conditions and availability of raw materials. The primary use of plastic mulch is to regulate soil temperature, in addition to protecting the roots from cold injury. Other advantages of mulching include: reduced fruit decay, clean fruits, soil moisture conservation, saving irrigation water, preventing weed growth and lowering soil temperature during hot weather and protecting flower bud from low temperature or frost. The commonly used mulch materials include paddy straw and black polythene. It is ideal if mulching is carried out before plantation. Commonly black and silver, double-colored polyethylene mulching film is used. The outer surface of the film is silver colored.

Planting : In Bundelkhand region, recommended planting time is October to November. The plants can be planted on raised beds or flat beds. The planting distance should be kept 30 cm from plant to plant and 30 cm from row to row is recommended.

Special cultural practices : The significant necessary cultural practices should be adopted in strawberry cultivation for the higher yield and good quality produce are bud and shoot thinning ,deshooting, debudding. Removal of 1-2 buds/plant to improve the fruit yield and quality.

Irrigation : Frequent irrigation rather than a few heavy ones favours the crop, however avoid excess irrigation. Trickle/drip irrigation is the best method to irrigate strawberry for best produce and minimizing the amount of water required.

Nutrient management : Fertilizer requirements of strawberry differ with the type of soil, location and production system. 100:60:140kg NPK/ha in three split dose is recommended. 20:40:40 kg NPK /ha along with 20 tones FYM should be given as a basal dose and rest in two equal splits. Manures and fertilizers should not be mixed too deep since roots of strawberry go hardly 20- 30 cm deep. In addition, foliar application of Urea (2%), $ZnSO_4$ (0.5%), $CaSO_4$ (0.5%) and Boric acid (0.2%) is beneficial for higher and better yields.

Weed management

After strawberries are planted, weeds should be managed by integrating physical, cultural, and chemical strategies. The recommended weed management strategies depend on the time in the season, the production system, and overall farm practices. If herbicides are used, care should be taken to only use labeled herbicides at appropriate times in the strawberry growth cycle as well as spot spraying when feasible to reduce herbicide injury.

Harvesting and Yield : In the Bundelkhand area, the fruit ripens from late February until the middle of April. Fruit should be gathered when completely ripe for local markets, but when still firm and before colour has formed evenly throughout the fruit for shipping to distant markets. Pick berries with the caps (or calyx) or pick special stem grade fruit by picking the stem one to two inches from the calyx. Harvesting should be done on a daily basis, if possible. Fruit is packaged in flat shallow containers of various sorts (cardboard, bamboo, paper trays, etc.) with one or two layers of fruits since it is very perishable. In dry weather, harvesting should be done first thing in the morning. The fruits should not be washed it loses its lustre. Season and location have an impact on the yield. A yield of 500 to 750 g per plants is excellent for this region, and in optimum conditions, yields of up to 1.0 kg per plants have been observed.

Packaging : As strawberry is very perishable in nature, packing should be done very carefully. The strawberries are packed in plastic punnets and are placed in the corrugated fibre trays or ventilated cardboard boxes. The punnets filled trays should be kept in shade or shelter to reduce the water loss. Strawberry should be stored at 5^0 C or below, if fruit is supposed to keep for more than one days, it should be stored at 0^0C.

Storage : The optimum storage temperature for strawberries is 0° to 2°C. The optimum humidity for storage of berries to prevent water loss and shrivelling is 90 to 95 percent. Storage should be done in the crisper drawer of refrigerator.

Marketing : Marketing is one of the most important factors in this region of which influence the success of strawberry cultivation. Strawberry fruits are highly perishable in nature, hence a great deal of care in harvesting and handling as well as it's marketing also requires to be organised carefully. Usually, the fruit is picked in the early morning and sent to the market in the afternoon of the same day or is picked in the late afternoon, stored overnight in a cool place, and sent to market the following morning.

Handling and Storage : The fruit after harvested are sold in local market as well as exported to big nearest big cities. Fruits for the fresh market is generally harvested directly into the retail container. Fresh-market strawberries must be harvested in a manner which eliminates, or keeps to a minimum, bruising, skin disruptions, and the bleeding of fruit juices. The fruits should be harvested by pinching off the stem at the cap, as clasping the fruit between the fingers and then pulling causes excessive bruising. Good commercial practice to hold harvested fruit out of the sun and protect it from warm winds and blowing dirt. It is recommended to move fruit to cold storage within 1 or 2 h of harvest.

Plant protection

Insect-pests

Red spider mite (*Tetranychus urticae*) : Most serious pest of strawberry, found in every corner where strawberry is cultivated. The mites are brick-red colour, usually with two darker spots on the back. Vertimec / Abamectin @ 0.4ml/L water used for effective controlling red spider mite.

Thrips (*Frankliniella occidentalis*) : The severe infection may result in fruit distortion, leading to down-grading and finally financial losses to farmers. Frequent sprays of Spinosad @ 0.4-0.5ml/L water, reduce thrips incidence and number of distorted fruits.

Cut Worms (*Agrotis ipsilon*): Deep ploughing and drench the soil with Chlorpyriphos @ 2ml/L water.

Diseases

Verticillium wilt : The older leaves turn brown and shrivelled and finally plants may die. The proper crop rotation should follow besides soil fumigation with formalin (5000 L/ha) or Chloropicrin (210 L/ha). Leaf spot complex: Spot of different shapes and sizes appears on the leaves during rainy season, which results in drying and defoliation Give 2-3 sprays of Hexaconazole (100 ml/200 L water) or 5 sprays of Carbendazim (100g/200 L water) at 21 days intervals.

Leaf spots (*Mycosphaerella fragaria*): Among the various foliage diseases, damage to leaves is probably greatest by the leaf-spot and it's caused by fungus. Its incidence is severe during rain when relative humidity is high. Application of Copper hydroxide @ 2gm/L water**.**

Grey mould (*Botrytis cinerea*) : It is a serious fruit disease of strawberry in the field and in storage, and is caused by a fungus. The disease appears as the light-brown soft spots on the green and ripening fruits. The berries dry out, become tough and get covered by a dusty fungal growth. Fruit loss about 40-50% may only be due to grey mould. Following control measures should be taken for reducing its incidence. (i). Don't allow berries to touch the soil. (ii). Provide suitable mulching materials. (iii). Avoid excessive application of nitrogen fertilizers. (iv). Avoid excessive irrigation. (v). Ensure proper drainage. (vi). Application of Carbendazim / Captan @ 2g/L water just after the opening of the flowers.

Powdery mildew (*Sphaerotheca macularis*) : The disease characteristics are an upward curling of leaves and a cobweb-like mould on the lower surface as the fungus destroys surface layers of the leaves. As the disease progresses, the underside of the leaves reddens, and affected leaves may be killed, and flowers and green berries may not develop. Avoid overhead irrigation, high humidity and excess use of nitrogenous fertilizers. Control with application of Azoxystrobin / Karathane @ 0.5ml/L water at 7-10 days interval.

Concluding Suggestions

To boost strawberry production there is a need to develop infra-structure facilities for transport of produce to markets as the fruit is highly perishable. Processing facilities have to be developed for value addition and increase of shelf-life of this fruit. The farmers of Bundelkhand region farmers are purchasing tissue culture plants which is putting on them large transportation cost.

As farmers are not able to distinguish much among various varieties, some of local the suppliers are mixing the runners of 2-3 varieties and charging for the best varieties. There is need of facilities like greenhouse-controlled environment for growing and keeping the runners before plantation. Cold chain supply system is also needed to increase shelf life. With an integrated approach of proper production and marketing, strawberry cultivation will positively become for the farmers of Bundelkhand region.

In future, the introduction of new cultivars with desirable characters is vital to increase strawberry production in this region. Improved postharvest facilities together with new markets and product development and diversification like processing, new packaging and organic production can be the prospective options.

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CHOLESTEROL IN FISH AND SHELLFISH

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Introduction

Fish and fish products forms important part of nutrition due to the presence of high biological value proteins and the high concentration of polyunsaturated fatty acids (PUFA), especially those of the omega-3 series, such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). However, these products also contain significant amounts of cholesterol. Though cholesterol take part in essential functions in the human body, it is unstable, especially in the presence of light, oxygen, radiation, and high temperatures and can cause the formation of cholesterol oxidation products (COPs) or cholesterol oxides, and is not good for wellbeing. Approximately half of all deaths in the United States are linked to the vascular disease atherosclerosis. Atherosclerosis is a slow progressive disease that begins with deposition of lipids in the walls of large blood vessels particularly the coronary arteries. This triggers formation of a blood clot that can prevent blood circulation to the heart causing myocardial infarction (heart attack) (Voet et al., 2008). Consequently, consumer awareness towards the nutritional quality of fish has increased with reference to cholesterol content, their health issues and other hazardous compounds. Dietary cholesterol levels are directly linked with risks of coronary heart disease (CHD) therefore; food labeling is an important parameter for displaying its regulatory and safety level of cholesterol. Many of the packaged sea foods have made mandatory for disclosure of cholesterol content of food items. The normal healthy adults synthesize cholesterol at a rate of approximately 1g/day and consume approximately 0.3 g/day. A relatively constant level of cholesterol in the blood (150-200 mg/dL) is reported for a healthy individual. Because dietary cholesterol is known to affect serum cholesterol, information about daily dietary cholesterol intake can be very important, especially for those with cardiovascular ailment (Zhang, 2005).

Chemical structure of cholesterol

Cholesterol is an organic molecule, derived from the ancient Greek words chole-(bile) and stereos (solid) followed by the chemical suffix-ol for (an alcohol). Its IUPAC name is (3β)-cholest-5-en-3-ol, molecular formula is $C_2H_{46}O$, molar mass is 386.65 g/mol, melting point is 148° C, density is 1.05 g/cm^2 and boiling point is 360° C (680° F). It is soluble in isopropyl myristate, ether, methanol, benzene, acetone, ethanol, choloroform and hexane. Cholesterol was first discovered by Francois Poulletier de la Salle in 1769 in bile and gallstone. It consists of four fused rings with an aliphatic side chain branched to the D ring at C-17, a hydroxyl group attached to the A-ring at C-3, and a double bond between C-5 and C-6 of B ring. Both the C-4 of A-ring and C-7 of B ring are on the same plane due to this double bond (Lehninger et al., 1993).

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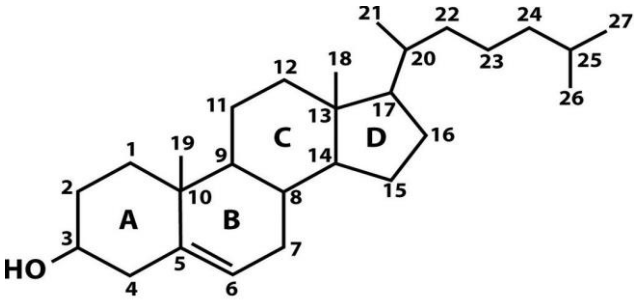

Figure 1. Chemical structure of cholesterol

Cholesterol content of fish and shellfish

The determination of sterol compounds particularly cholesterol is of growing importance to the food industry ever since the inception of Nutritional Labeling as a compulsory measure. In recent years, the incidence of cardiovascular disease has increased to such an extent that the consumer now prefers food with low cholesterol content and select processed food with nutritional labeling. Several studies have reported higher levels of cholesterol compared to other fish and shellfish especially prawns, squid and cuttle fish. It has been reported that fish fat and cholesterol content might vary with habitat and size of the fish (Kinsella, 1987).

According to Mathew et al. (1999) 55% of the fishes had cholesterol content between 45 and 65 mg % and in shellfishes like prawn the range of cholesterol was from 118 to 163 mg%, while in crabs; it was from 51.5 to 66.8 mg%. Squid (188±198 mg%) and cuttle fish (130 to 162 mg%) showed high cholesterol contents. Therefore, it can be concluded that the cholesterol content was higher in shellfish than in fish. Similarly a study has documented the cholesterol content levels of common carp (*Cyprinus carpio*), crucian carp (*Carassius carassius*), chub (*Leusiscus cephalus*) and tench (*Tinca tinca*) were determined in the range from 94.68 to 179.84 mg% respectively. Thus, the cholesterol contents of the analyzed freshwater fish species were low (Donmez, 2009).

Effects of processing on cholesterol

Cholesterol is reported to be more stable in solid form than in liquid form, and the latter is more susceptible to oxidation than the former. When heated above 200° C, cholesterol oxidised at a rapid rate. Foods rich in cholesterol such as dairy products like milk (5.6 to 11.2 mg%), eggs (361 mg%) and meat products like beef (52 to 65 mg%) and chicken (56.2 to 84 mg%) (Piironen, 2002); these products are prone to undergo autoxidation or enzymatic oxidation and form cholesterol oxidation products (COPs) like hydroxycholesterol, 5,6-epoxycholesterol and ketocholesterol. COPs can be also generated during food preparation when exposed to heat, air, light and radiation. COPs may possess biological effects such as mutagenicity, angiotoxicity, carcinogenicity, cytotoxicity, atherogenicity and cell damage and inhibition of cholesterol synthesis. The main cause of cholesterol oxidation in animal derived food is cooking, dehydration and deep frying. As a result, lowering the COPs level in daily foods is critical. Cooking oils from plants are considered as a rich source of tocopherols and tocotrienols, which are important antioxidants for preventing lipid oxidation. The antioxidants may also have capabilities of preventing cholesterol oxidation and reducing COPs production during heating (Zhang, 2005).

Biological effects of Cholesterol oxidation products (COPs)

Knowledge of the physiological and pathophysiological potential of cholesterol oxides is of great importance for biology and medicine. COPs are also involved in cardiovascular events and

physiological changes such as inflammation, apoptosis in degenerative diseases, osteoporosis, and rheumatoid arthritis. However, these oxides are capable of triggering inflammatory, cytotoxic, atherogenic, carcinogenic, and mutagenic processes. Cholesterol oxides induce a decrease in the production of prostaglandin in endothelial cells, causing platelets to adhere to these cells. Since the dietary cholesterol levels are directly linked with risks of coronary heart disease (CHD) therefore; food labeling is an important parameter for displaying its regulatory and safety level of cholesterol. Many of the packaged sea foods have made mandatory for disclosure of cholesterol content of food items (Voet et al., 2008).

Conclusion

The proteins in seafoods and the marine PUFA are known to be hypocholesterolemic, fat have cholesterol lowering effect on blood serum. However, in shellfishes the high cholesterol content also should be taken in consideration when we emphasize on effects of PUFA and fish protein on lowering the serum cholesterol. So those people who are having the heart ailments should avoid eating such products; as currently the consumption of the sea food has increased.

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BIOSENSOR : POTENTIAL AND SCOPE IN AGRICULTURE

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Introduction

To feed 9.1 billion people in 2050, a 70 percent increase in global food production is expected [1]. Emerging risks to food safety include climate change and industrial globalization. The flow of food from farm to plate is being dramatically influenced by rapid changes in the food chain as a result of environmental pollution. Biosensor technology gained popularity due to its capacity to do quick on-site detection with less expenditure, while traditional off-site investigations were constrained by time, high cost, and a lack of skilled staff. Despite being a powerful analytical tool years after its invention, the transfer of technology (TOT) to the agricultural market is still restricted. Agriculture is a rapidly developing business with a rapidly rising market. In the agricultural domain, the cost and requirement of multi-analyzers are quite high, but large capital investment and resource engagement are limited to the biomedical industry. The worldwide biosensor market for food safety is expected to grow from $17 billion in 2018 to $24.6 billion in 2023 [2]. Biosensors will need to diversify in the near future to meet agriculture and its numerous fields.

Biosensors are biological sensing components (bio-receptors) that are either attached to or incorporated into a transducer system. Dr. Leland C. Clark Jr., an American scientist, pioneered the creation of enzyme-based electrodes for glucose measurement in 1962. In 1956, he created the first "real" biosensor (the Clark electrode) for detecting oxygen in blood, water, and liquid. Although he is renowned as the "Father of Biosensors," Karl Cammann invented the word "Biosensor" in 1972.

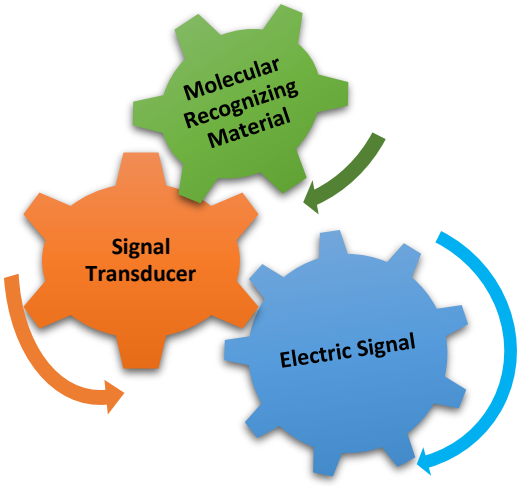

Fig: Diagrammatic representation of a typical Bio Sensor

There are different types of Bio sensors that are used in agriculture:

Electrochemical Biosensors

Electrochemical biosensors are based on the observation of electroactive substances that are either created or consumed by biological components (e.g., enzymes and cells). The resulting signal may be transduced using one of numerous ways divided into two categories: potentiometric biosensors and amperometric biosensors [3].

Potentiometric biosensors

These are based on measuring a system's potential at a working electrode in relation to an accurate reference electrode under basically zero current flow circumstances. Potentiometric values in the test sample are connected to the analyte activity (of a target species) in the process [3].

Amperometric Biosensors

Amperometric biosensors have proven to be the most extensively reported electrochemical technique in signal transduction. Commercially accessible "one-shot" (disposable) sensors and on-line (multimeasurement) devices monitor a broad variety of target analytes. The primary functioning of amperometric biosensors is characterized by a constant voltage applied between a working and a reference electrode, in contrast to potentiometric devices. Redox reactions occur as a consequence of the applied voltage, causing a net current to flow. Both cathodic (reducing) and anodic (oxidizing) reactions may be monitored amperometrically, and the amplitude of this current is proportional to the concentration of electro active species present in the test solution. The biorecognition element in the majority of the amperometric biosensors disclosed is enzymes. The most often employed catalysts for these biosensor forms have typically been oxidase and dehydrogenase enzymes [3].

Calorimetric Biosensors

The majority of biological processes involve either heat absorption or production. By using sensitive heat detection devices, sensors based on calorimetric transduction are meant to detect heat created or consumed during a biological process. Biosensors for a variety of target analytes have been developed. The application of such biosensors to detect metabolites has been discussed in the realm of food quality analysis [4].

Optical Biosensors

The reactions to illumination or light emission are measured by these sensors. Chemiluminescence, fluorescence, light absorbance, phosphoresence, photothermal approaches, surface plasmon resonance (SPR), light polarization and rotation, and total internal reflectance are some of the techniques used in optical biosensors to detect the presence of a target analyte. This approach, for example, has been used to identify the presence of allergens, particularly peanuts, during food processing [5].

Acoustic Biosensors

A change in mass at the crystal surface may impact piezoelectric quartz crystals; this phenomenon has been effectively explored and utilized to produce acoustic biosensors. The surface of the crystal may be changed with recognition elements (e.g., antibodies) that can bind selectively to a target analyte for practical applications.

Immunosensors

Immunosensors work by using antibodies' unique interactions with antigens. To detect the immunological response, immunoassays (such as the enzyme-linked immunosorbent test method) often use a label (e.g., enzyme, antibody, fluorescent marker). The use of biosensor platforms in conjunction with an immunoassay format allows for quick and precise quantification of target analytes.

Uses of Biosensors in Agriculture

Linking with nanofertilizers : an agent to promote sustainable agriculture

The use of nano-domains of plant components for effective nutrient targeting contained inside a nanoparticle has emerged as a viable nutrient delivery technology. Biosensors may be linked to nanofertilizers to allow for selective and long-term nutrient delivery dependent on agro-climatic conditions. Zeolites are crystalline aluminum silicates that occur naturally and have a high retention capacity, among other properties. The use of a zeolite-treated transducer to detect nutrient deficit in a plant or soil system and regulate the discharge of water and/or nutrients held in the zeolite [6]. That implies that for the same amount of output, less fertilizer or the same amount of fertilizer lasting longer may be utilized. Zeolite provides additional advantages since, unlike other soil additions, it does not decompose in the soil over time, allowing it to increase nutrient and water retention. The adsorption of urease enzyme on Nanozeolites by serial injections of urea (0.1 mM) was also used to illustrate a typical response of the biosensor [7].

Biosensors used for the detection of Soil Moisture

Nuclear Magnetic Resonance: Water in the soil is exposed to both a static and an oscillating magnetic field at right angles to one other using this approach. The spin echo and free induction decays are measured using a radio frequency detecting coil, rotating capacitor, and electromagnet coil as sensors. In the soil, nuclear magnetic resonance imaging may distinguish between bound and free water.

Gamma Attenuation: The gamma ray attenuation method is a radioactive technique for determining the moisture content of soil. This approach implies that the density of materials in the path of gamma rays affects their scattering and absorption, and that the specific gravity of a soil stays roughly constant when the wet density varies with variations in moisture. The moisture content is calculated from changes in wet density, which are monitored using the gamma transmission method. [8]

Diagnostic tool for soil quality and disease assessment

The Research Center for Advanced Bionics (RCAB) in Japan claims to have developed the world's first biosensor for soil diagnostics, which aims to quantify soil attributes using soil bacteria. The main premise is to quantify differential oxygen consumption in respiration or the relative activity of "good microorganisms" and "bad microbes" in the soil. When dipped in soil extract, a dual sensor system was designed that monitors microbial respiration of two separate strains concurrently, immobilized on different transducer systems, and is proportional to the reduction in dissolved oxygen (DO). Finally, a correlation matrix may be created by estimating illness symptoms using ratio response. The findings are aimed for predicting disease outbreaks quickly, with a focus on numerical databases rather than long-term trial outcomes.

Detection of bacterial phytopathogens

Pseudomonas syringae pv. tomato, Xanthomonas campestris pv. vesicatoria, and Ralstonia solanacearum are detected using a QCM (Quartz Crystaline Microbalancer) biosensor or an acoustic biosensor. The pathogens' DNA is directly employed in the QCM crystalline plate, whereas the QSM gold crystal plate includes NeutroAvidin protein molecules that are coupled to the PCR result. The gel documentation photo shows the results.

Advantages of Biosensors:

- It is a comprehensive instrument for phytopathogen identification and monitoring.
- It provides precise and accurate results.
- It is simple to use.
- Non polar molecules may also be measured.
- Continuous monitoring is unnecessary.

Disadvantages of Biosensors

- It is impossible to sterilize using heat.
- High price.
- Some biosensors, such as colorimetric tests, are not reusable.
- Strips are only used once. It focuses only on the technology's scientific foundation.

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GENETIC IMPROVEMENT OF CROPS MEDIATED BY CRISPR-CAS 9- INDIAN SCENARIO

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Crop improvement programmes are continuous to develop improved varieties by introgressing novel traits for multiple stress tolerance and quality. Among the many crop breeding technologies, biotechnology based techniques are paving their way through precision improvement. After the invention of TALENs (transcription activator-like effector nucleases, Christian et al., 2010) and ZFNs (Zinc finger nucleases, Wright et al., 2005), the next break through has been in the invention of CRISPR-Cas9 technology (Doudna and Charpentier, 2014). A major advantage of CRISPR systems over TALENs and zinc finger nucleases is the ease with which multiple sites can be targeted simultaneously using multiple sgRNAs while expressing a single Cas9 or Cpf1 protein. Multiplex editing has sophisticated applications for genome engineering. It can be used to create multigene knockouts, chromosomal deletions, translocations and gene knock-ins. The genetic diversity existing in nature has been widely harnessed and further enhancement of genetic diversity has been through CRISPR technologies. In nature, variation occurs due to mutations, unequal crossing over and replication but now gene editing is playing the role of creating desirable or targeted variations in genomes.

Genome editing is a precise molecular method of mutation unlike mutations induced by chemicals, x rays or gamma rays. There are various systems of plant genome editing namely TALENS transcription activator-like effector nucleases fused artificially to array of TALEs to FokI cleavage domain. TALENs target sites in a one-repeat variable di residue (RVD)-to-one-nucleotide manner and due to this high repeat numbers of RVDs, TALENs construction remain challenging.

Zinc finger nucleases are sequence specific nucleases that have been developed by combining specific DNA binding domain of zinc fingers and fok I cleavage domain. Each zinc finger targets a 3 basepair sequence and the Fok I acts as a dimer bound to an 18-or 24- bpseq with 5 to 7 nucleotide spacers. As ZFNs work via protein –DNA binding new ZFN is required for each edit in the DNA.High skill and cost and also off-targets have limited their usage in large scale genome editing (Chen et al., 2019).

As an improvement over the techniques of ZFNs and TALENs, the CRISPR has come into existence. The RNA –guided interference with DNA has been the basis for CRISPR based genome editing. There are different methods of genome engineering like CRISPR based double stranded break (DSB). This involves genome editing by means of homology directed repair (HDR) and non-homologous end joining (NHEJ) repair. In HDR a targeted site of DNA can be replaced, inserted or a point mutation could be induced. NHEJ based editing is more efficient and widely used for gene knockout studies but is said to be less accurate for more essential genome engineering.

Application CRISPR for the crop improvement scenario under Indian Conditions

Indian sub continent is an important agro eco zone of the world which contributed for the evolution of crops like banana, mango, rice, redgram, egg plant and many other minor crops such as millets,

sesame, medicinal plants etc. Each zone has wide variety of local land races and popular varieties characterized by poor yield, photo sensitivity, having longer durations but highly adapted to low input responses and having biotic and abiotic stress tolerances, apart from having nutritional qualities and preferential taste and cooking qualities. Indian population is ever increasing and to meet out the food requirements, high yielding and high input response varieties in crops are introduced leading to the extinction of local land races and farmer's varieties. Breeding programmes involves huge time and resources for genetic mapping and development of NILs and RILs for trait specific introgression. Major QTL/mono genetic introgression is practically not helpful to alter a trait without altering the whole genome.

In this case, CRISPR can be successfully used to alter only the gene of interest and look for genetic alterations if there are any pleiotropic effects or influencing the expression of other traits, those lines can be screened for single trait/gene modifications and successfully released as novel crop variety. These are the plant traits which can be used for genetic modification using CRISPR technology to be directly released as variety.

1. Plant Height: Rice, Tomato, chillies, papaya, cotton, Banana
2. Duration: Rice, Wheat, Redgram
3. Photo insensitivity: Redgram
4. Thermotolerance(higher /lower temperature): Rice, tomato, Capsicum, cruciferous, potato
5. Modification of PR proteins for stress tolerance: solanaceous vegetables, rice, wheat
6. Bio fortification of Iron and Zinc: Millets, Rice, and leafy vegetables

Novel varieties with improved traits viz., low input responses, tolerance to biotic and abiotic stresses and quality traits will be highly suitable for generating higher incomes. So genome modification of major crops by CRISPR-Cas 9 with additional traits will definitely bring new varieties with many advantages to the farmers of India.

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INDIAN MONSOON

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The term monsoon has been derived from the Arabic word *"mausim"* or from the Malayan word *monsin* meaning 'season'.

Monsoons are seasonal winds (Rhythmic wind movements) (Periodic Winds) which reverse their direction with the change of season. The monsoon is a double system of seasonal winds - They flow from sea to land during the summer and from land to sea during winter. Some scholars tend to treat the monsoon winds as land and sea breeze on a large scale.

Monsoons are peculiar to Indian Subcontinent, South East Asia, parts of Central Western Africa etc. In comparison to any other place, they are more pronounced on the Indian Subcontinent. The Indian Monsoons are large-scale convection cells. They are seasonal reversals in wind direction that occur on a periodic or secondary basis. Summer brings south-west monsoon winds, while winter brings north-east monsoon winds to India. The powerful low-pressure system that forms over the Tibetan plateau causes the south-west monsoons. High pressure cells over the Tibetan and Siberian plateaus are related with the north-east monsoons. The south-west monsoons bring heavy rain to most of India, while the north-east monsoons deliver rain to the country's south-eastern coast (Southern coast of Seem Andhra and the coast of Tamil Nadu.).

During the south-west monsoon season, countries like India, Indonesia, Bangladesh, Myanmar, and others receive the majority of their yearly rainfall, whereas South East China, Japan, and others receive it during the north-east monsoon season.

Factors involved in the formation of the south-west monsoon:

- During the summer months, the Tibetan plateau is extremely hot.
- South Indian Ocean's permanent high-pressure cell (east to north-east of Madagascar in summer).

Factors affecting the start of the south-west monsoon:

1. Jet Stream Subtropical (STJ).
2. Tropical Easterly Jet
3. Somalian jet Stream
4. Inter Tropical Convergence Zone. (ITCZ)
5. ENSO (EL Nino-La-Nina)

India's Monsoon Mechanism

Monsoons are mentioned in religious texts such as the Rig Veda. However, the monsoon mechanism was not mentioned in these books. Arab traders conducted the first scientific research of monsoon winds. Arab merchants exploited the sea route to trade with India. And Monsoon patterns were critical to their survival. Al Masudi, an Arab adventurer, wrote about it in the eleventh century. the reversal of ocean currents and the northerly monsoon winds, the Indian Ocean.

Sir Edmund Halley, in the seventeenth century, described the monsoon as a result of thermal differences between continents and oceans as a result of differential heating.

Modern Theories

Aside from differential heating, the monsoon's progression is controlled by the geometry of the continents, orography (mountains), and air circulation conditions in the upper troposphere (jet streams) are all factors.

As a result, Halley's hypothesis has lost a lot of its relevance, and modern ideas based on air masses and the jet stream are becoming more important.

Sir Edmund Halley's or Classical Theory

Summer Monsoon

In the summer, the sun's apparent path crosses the Tropic of Cancer vertically, causing high temperatures and low pressure in Central America.

Asia Over the Arabian Sea and Bay of Bengal, the pressure is relatively high.

In the summer, winds blew from the oceans towards the continent. This air flow from the sea to the land brings significant rain to the Indian subcontinent.

Winter Monsoon

The apparent path of the sun in winter is vertically over the Tropic of Capricorn.

Classical theory's basic concept is analogous to land and water. except in the case of monsoons, where the day and night Summer and winter take the place of night.

Drawbacks

Monsoons do not develop evenly around the globe, and Halley's thermal theory fails to explain the monsoon's complexities, such as abrupt bursts of rain, delays in one batch of rain, and so on.

Air Mass or Modern theory

- The monsoon, according to this hypothesis, is just a variation of the tropics' planetary winds.
- The notion is based on the seasonal migration of ITCZ.
- The Inter-Tropical Convergence Zone (ITCZ) and the Indian Monsoons.

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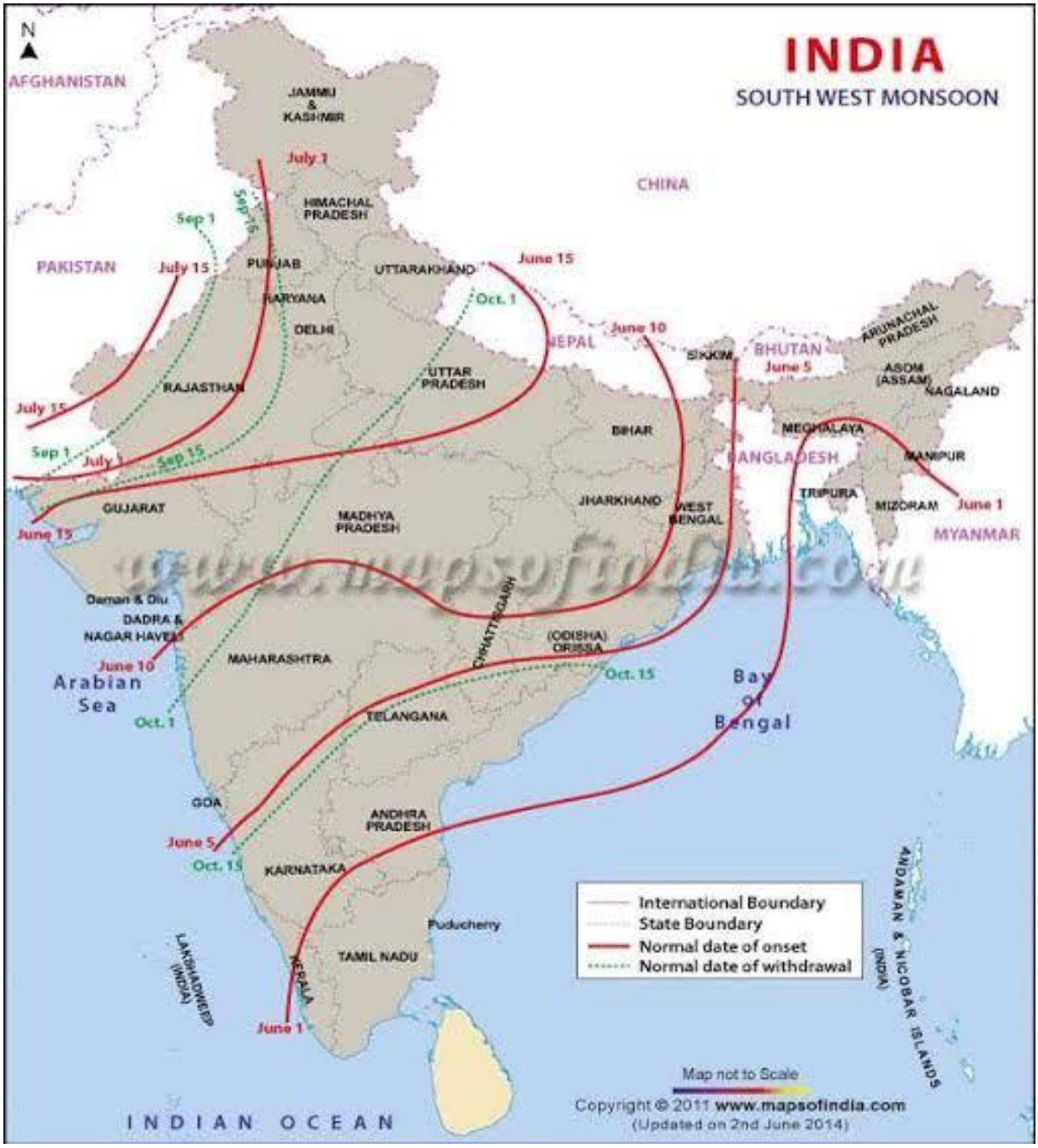

Normal Onset and Withdrawal of Indian Monsoon

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INTEGRATED FLOATING CAGE AQUAGEOPONICS SYSTEM (IFCAS) : A SUSTAINABLE WAY TO CULTURE VEGETABLES WITH FISH

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Lembucherra, Tripura (W)

Introduction

Fisheries, a promising sector playing an important role for development of economic ambience in the country. The sector has exhibited strong growth of 8 % per year on the average with aquaculture growing at an annual average of more than 10 %. The sector showing a steady growth in the total gross value-added accounts for about 7.28% share of agriculture GDP. Percentage contributions of fisheries sector in Indian economy 2018-19 was 1.24%. Total production of India during 2019-20 was 14.1 MMT in which 10.43 MMT contributed by inland sector and 3.72 MMT contributed by marine sector. The value of fisheries export during the 2019-20 was Rs. 46,662.85 crore (Handbook on Fisheries Statistics, 2020). Sunlight is the major factor that affects the water quality of the water body. Trees on the pond dyke create shadow, which reduces sunlight penetration to the edges of the pond and the dykes. Moreover, these kinds of ponds are often deep and irregular in shape, making it is difficult to harvest carp from deeper ponds during the peak monsoon season (June–September). All of these aspects negatively impact potential for fish and vegetable production. However, the sunlight exposed areas of the pond water have the potential for growing vegetables (Haque *et. al*., 2015). For that reason integrated floating cage aquageoponics system could be the effective way to utilize the maximum available area of the water body.

What is IFCAS ?

Integrated floating cage aquageoponics system (IFCAS) originated from Bangladesh (Haque *et. al*., 2015). We are well known about the aquaphonics technology in which plants are grown in water medium (Konig *et al.,* 2016). Aquageoponics is a new version of traditional aquaponics where soil is used as a medium to grow plants within the cage surface instead of conventional media such as pebbles and sponges in aquaponic systems. Basically the word aquageoponics is the Combination of the three words aqua, geo and ponics which means water, mud/soil and cultivation, respectively. This method can be very effective in rural areas where land is a major constraint. In this farming technique water of culture system is used for growing crops in the cage and/or pond. Crops and fishes benefit each other to grow. Crops growing in the culture system purify and stabilize the water for fish in the culture system. In return the waste products produced by fish supply nutrients for the growing crops and/or vegetables. This approach can extend the growing capabilities of rural communities where land would be unavailable.

Concept of IFCAS model

In integrated farming systems, an output and/or waste produces from one system used as an input to other sub-system. This is the effective way towards sustainable aquaculture. In this farming technique water of culture system is used for growing crops in the cage and/or pond. Crops and fishes benefit each other to grow. Crops growing in the culture system purify and stabilize the water

for fish in the culture system. In return the waste products produced by fish supply nutrients for the growing crops and/or vegetables.

- Cages is enclosed on all sides with mesh netting made from synthetic material that can resist decomposition in water for a long period of time and utilize existing water resources to raise fish. The advantage of cages is that free circulation of water is take places.
- In aquaponics systems, plants grown hydroponically get nutrients from the waste produced by farmed fishes.
- As we know pond mud have the good amount of nutrients that's why in the IFCAS, dried pond mud collected from the same pond was used as a holding medium for plants.

Design of the IFCAS

Integrated floating cage aquageoponics system design was developed by **(Haque *et al*., 2015)**. Firstly a rectangular shape cage was prepared with the help of iron-bars with four bowl-shaped grooves in the four corners to hold floats made from plastic drums. Nylon net cage was used to cover the structure. The dimensions of the nylon net cage were 3.66 m length × 2.44 m width × 1.25 m depth. This cage system also held bed of pond bottom soil with cow dung for growing vegetables.

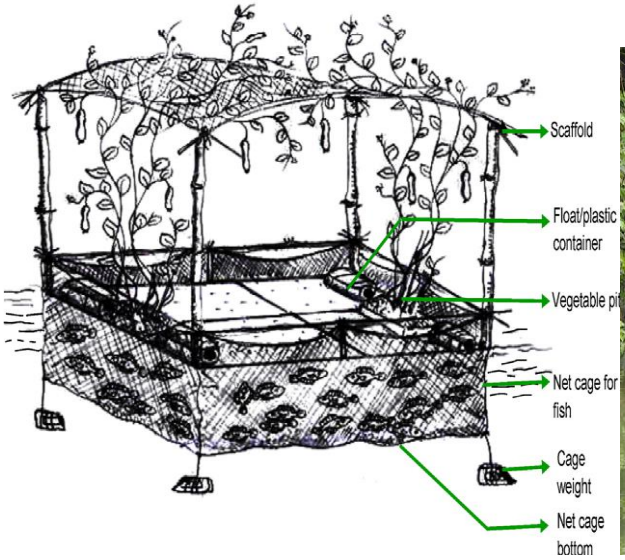

Figure 1 Sketch of IFCAS (Haque et al., 2015)

Figure 2 IFCAS model

Species of fish and vegetables suitable for IFCAS

Fish Species	Vegetables
Monosex tilapia, Vietnamese perch, Stinging cat fishes, Carps	Bitter gourd (*Momordica charantia*), Snake gourd (*Trichosanthes cucumerina*), cucumber (*Cucumis sativus*), Bottle gourd (*Lagenaria siceraria*), tomato (Solanumlycopersicum) and flat beans (*Phaseolus vulgaris*) Asian spinach etc.

Benefits of IFCAS

- It is cheap and sustainable.
- It's suitable for very deeper ponds which is not suitable for fish culture.
- Harvesting of fish and vegetables from IFCAS is very easy for both men and women.

- IFCAS is not only useful in the small shaded ponds but also in natural water bodies (beel), rivers, canals, and the waterlogged areas affected by climate change.
- Maintain water quality by reduce the waste in water body.

Conclusion

In rural areas where small and large water bodies located in such type of water bodies this technology could be very effective. Farmers get benefited by generating two or more vegetable crop with the fish farming. IFCAS could be very affective in improving socio-economic status of the farmers and/or can double their income.

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A NOVEL APPROACH OF PULSED ELECTRIC FIELDS IN FISH PROCESSING INDUSTRIES: FUTURE PERSPECTIVE

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Abstract
The food sector was interested in novel meat and fish products with improved physicochemical and nutritional qualities due to market demand. PEF is a new method that involves passing electrical currents between two electrodes, causing electroporation and allowing non-invasive tissue alteration. PEF treatment could improve several preservations, tenderization, and aging processes. The PEF treatment could be a valuable strategy to increase the water-holding properties of fish products and fish drying. Because of its ability to improve the extraction of high added-value compounds, PEF could be used to increase the value of by-products in meat and fish foods. This review gives an overview of the current state of knowledge regarding pulsed electrical field processing in meat and fish to improve the nutritional changes as a preservation method and the extraction of high added-value compounds.

Introduction
Among the electrical-based processing techniques is the pulsed electric field (PEF) is a short electrical pulses at high voltages allow control of thermal effects from thermal electrical-based techniques such as ohmic heating and moderate electrical field. These properties make PEF a promising technique for destroying biological cells in the food matrix while having no negative impact on food product attributes. Even though the concepts of this technique were first introduced to the food industry about 50 years ago, PEF has still been considered an emerging technology due to recent developments in its industrial applications.

The use of PEF for the treatment of food commodities is extensively reported as a unique preservation approach capable of producing foods with high nutritional and organoleptic quality and long shelf life. Currently, research is focusing on two critical uses of this technique: non-thermal microbial inactivation and improved mass transfer via cell rupture. These applications are carried out totally different processing because microbial inactivation affects small cells, whereas mass transfer events usually require the breakdown of larger structures. The capacity of PEF to achieve the aims above efficiently is determined by a variety of parameters, including the quantity and length of electric pulses and cell characteristics.

PEF is acquiring a reputation in the food sector as a novel food processing technology suitable for the pre-treatment of liquid and semi-solid edible items. However, it is limited to entities with minimal electrical conductivity and no air bubbles to minimize dielectric breakdown. Despite the notion that PEF is a non-thermal food production method, there is a significant temperature increase during high-intensity treatment, which must be considered with sensitive chemicals such as proteins. PEF side effects such as temperature rise or the presence of electrochemical reactions must be considered depending on the processing parameters and treatment circumstances to

protect food quality. As a result, minor damage to pigments, taste chemicals, or vitamins may occur, resulting in the deterioration of some meals sensory traits and nutritional value. Identifying and understanding undesirable side effects can help enhance the procedure, such as the treatment chamber design. Despite several studies on the idea of the PEF and its applications to various goods such as alcoholic drinks, avian eggs, and dairy products. There is still a need to understand better the relevance of this developing technology in the meat and fish sectors.

Mechanism

The application of high voltage pulses for brief duration durations to meals put between two electrodes is known as PEF processing. The capacitor stores energy from the power supply and discharges it via the treatment chamber to produce an electric field in the food material. While designing a PEF process, numerous process parameters must be established in addition to the setup of the complete device and the EFS.

The variables mentioned above and the duration of the PEF treatment should be considered for evaluating the efficiency and economic impacts of PEF treatment, especially for up-scaled applications. The specific energy input of the process (which expresses as kJ/kg and depends on the input voltage, the ohmic resistance of the treated products and the processing time) is closely associated with the economic cost and environmental footprint of a PEF process. Hence, researchers use this parameter to compare the price and sustainability of PEF processes with those of conventional methods.

Advantages

PEF technology offers several benefits, including process continuity, good nutrition and vitamin retention and high organoleptic quality of the product. PEF technology can be more successful when combined with other approaches such as high hydrostatic pressure, ultrasound and promising temperature control technologies upstream and downstream. Nonetheless, the combination of multiple procedures and the optimization of the relevant parameters will be dependent on the material and the treatment target. As a result, further research is required. Furthermore, PEF technology can efficiently and inexpensively optimize energy consumption, manage the presence of microbes in foods in a rapid and homogenous manner, and retain nutritional characteristics.

Limitations

On the other hand, Electrolysis products may have a bad effect on foods and the presence of bubbles might result in non-uniform treatments and safety and operational issues. Furthermore, because the high EFS necessary for microbial inactivation generally means minimal spacing gaps between the electrodes (in the scale of millimeters). This approach for pasteurization is relatively confined to liquid food items, which is not the case for conventional meat products. Other drawbacks include microbial spore resistance to inactivation and its upscaling is still in the works. Following the PEF treatment, the material is chilled its necessary to aseptically packaged and kept at refrigerated or ambient temperatures depending on the kind of food and its intended uses. The initial capital investment is the primary problem for industrializing the use of PEF in food processing.

Applications of PEF in the fish industry

1. Impact on product quality

The PEF is gaining popularity in the food business since it is a non-thermal option that may have a more significant influence on the microstructure of muscle food than new heat-based technologies

such as ohmic and microwave heating. Furthermore, various writers have demonstrated the usefulness of this procedure in preserving the physical, organoleptic, and functional properties of the end product, i.e., introducing minimal changes in the tastes, vitamins, and other nutrients. The authors proposed PEF treatment as a possible method for increasing water retaining qualities in fish and a suitable pre-treatment for fish drying.

2. Valorization of fish by-products

The PEF approach may be used to valorize by-products from fish processing businesses and researchers developed an improved way to extract calcium from fish bone using high-intensity PEF. Compared to the ultrasonic approach, it is correct to say that PEF enabled better extraction efficiency in a shorter amount of time. This study emphasized the advantages of this technology, such as reduced process time, increased efficiency, and eco-friendliness. The suggested extraction process yielded a high yield of abalone viscera protein with potential emulsifying capabilities compared to current enzymatic extraction methods. When PEF was added, the extracted product's viscosity and foaming qualities were reduced. The idea of integrating other techniques with PEF to increase process efficiency was emphasized in this study.

Conclusions

The PEF is a cutting-edge processing technique that cannot only preserve but also transform the structure of food items. Furthermore, it is an energy-efficient and ecologically beneficial food processing option. These benefits will be effectively employed in the industry soon, either as a stand-alone treatment or in conjunction with other treatments that increase product quality and process yields synergistically. Developing equipment capable of producing high-strength electric field pulses on an industrial scale remains a difficult job. The creation of user-friendly and low-cost PEF systems is a critical requirement for its full implementation in the meat and fish sectors. The effect of processing parameters including temperature, pH, moisture and fat content on the safety and quality of novel products is still a mystery to food scientists. Finally, despite various papers on the benefits of PEF technology for meat and fish processing on laboratory scales, its use in industry is restricted. The minimal energy usage and short processing periods required by PEF technology would make it an excellent fit for the fish and meat industries.

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BREEDING VEGETABLES FOR PARTHENOCARPY

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Abstract
The vegetables are the inevitable sources of minerals, nutrients and dietary fiber. The vegetable production has many phenomenonal limitations and one such is the problem in pollination and fertilization under adverse climatic conditions. Under changing climate, the temperature appears to be rising drastically. This increase in temperature affects the pollination, particularly pollen production. During winter, the pollen production as well as the insect tripping are reduced. Under greenhouse conditions, the natural insect tripping is not possible, therefore release of insect pollinators or artificial/manual pollination has to be made. Artificial pollination incurs the cost of pollinating equipment and labors, to ensure pollination. Parthenocarpy is an useful trait that addresses the above problems under changing climate and greenhouse. This article discusses about various aspects of parthenocarpy in vegetable crops.

Introduction

The parthenocarpy is defined as the development of fruits without fertilization. The significance of parthenocarpic fruits is the absence of seeds except for rudimentary seeds, which is of consumers' appreciation. The seedlessness is desirable in both fresh consumption (watermelon) and processed products (frozen eggplant, tomato sauce). The pollen production is an important phenomenon for the successful fertilization and consequent fruit set. This pollen production is highly sensitive to the climatic vagaries, mainly temperature.

Each vegetable crop has its own optimal regime for normal pollen production and successful pollination and fertilization. Under the changing climate, pollen production and fruit set become a question. Breeding for parthenocarpy enables undisturbed pollination and fruit set, despite the adverse effects of changing climate. Besides, there is a usual decrease in pollen production of vegetable crops during the winter periods (Rao *et al*., 2018). Parthenocarpy can address this shortage of pollen as well.

The greenhouse production of cross-pollinated crops depends upon the insect pollinators and other artificial instruments for pollination. Involvement of parthenocarpic trait enables the fruit set inside the greenhouse environment. Breeding for parthenocarpic trait in gynoecious lines of cucumber is gaining momentum in Indian vegetable research scenario.

Climate specificity to pollination in vegetable crops

Each vegetable has its own optimal regime for successful pollination and fruit set. The pollen production is the major phenomenon that is affected by climate vagaries, especially temperature. Tomato has a narrow range of temperatures for pollination (30-35^{o}C/15-21^{o}C as day/night temperatures). In bell pepper, blossom drop is a problem if the temperature exceeds 33^{o}C and falls below 10^{o}C (Hassan *et al*., 1987).

Brinjal needs a long and warm temperature (17-25°C) for better growth and yield. However, if the temperature falls below 17°C, pollen deformity at the bud stage takes place. In common beans, high temperature during anthesis (above 35°C) reduces pollen germination, pollen tube growth, fertilization and seed set. In cucurbits, pollination and fruit set occurs in 13-18°C. However, bottle gourd has good pollination at higher temperature (above 25°C). Hence, parthenocarpy can be employed for the uninterrupted production of vegetable crops, under adverse pollination conditions (Tomes, 1997).

Advantages of parthenocarpy

The following are the ideotype of parthenocarpy.

a. Production of marketable fruits without pollination
b. Normal percentage of fruit setting under adverse conditions
c. Non-relatedness of parthenocarpic expression with negative traits of intrinsic and extrinsic fruit quality.
d. Multi-pistillate production of fruits

The advantages of parthenocarpy are discussed hereunder.

i. Stability in production and productivity
ii. Increased consumer acceptance (seedless water melon, seedless pickled gherkin)
iii. Novelty
iv. Improved quality and shelf-life (absence of seeds eliminates bitterness in eggplant)
v. Improved taste, high TSS (seedless tomato)
vi. Increased profitability for processing units (seedless tomato for processing)
vii. Continuous fruit set (no crown set inhibition effect)
viii. Elimination of cost incurred in artificial pollination
ix. Early yielders (parthenocarpic cucumber)
x. Avoidance of horizontal gene transfer (gene transfer is a major problem in transgenic approval)
xi. Protection of genetically modified crops (prevention of contamination of transgene)

Genetics and inheritance of parthenocarpy in different vegetable crops

Table 1 discusses about the genetics and inheritance of parthenocarpy in various vegetable crops.

Table 1. Genetics and inheritance of parthenocarpy in various vegetable crops

Sl. No.	Crop	Gene	Reference
1	Tomato	*pat, pat-2, pat-3, pat-4,* *pat-2* gene plays a major role	Philouze, 1983; Vardy *et al*., 1989
2	Eggplant	Oligogenic, dominant	Daunay *et al*., 2001
3	Chilli	Single recessive gene	Tiwari *et al*., 2011
4	Cucumber	Pc, a single incompletely dominant gene	Pike and Peterson, 1969
5	Summer squash	A single gene, incomplete dominance	De Menezes *et al*., 2005
6	Muskmelon	Recessive genes	Yoshioka *et al*., 2018

Artificial induction of parthenocarpy

Table 2 discusses about various approaches in induction of parthenocarpy

Table 2. Approaches to induce parthenocarpy

Sl. No.	Approaches	Details
1	Use of plant growth regulators	Exogenous application of auxins, cytokinins and GAs.
2	Distant hybridization	Altered ploidy through interspecific hybridization is the mechanism of seedlessness
		E.g. Severianin - *S. Lycopersicon x S. hirsutum*
3	Mutation breeding	E.g. Sha-pat mutants of tomato from line Montfavet 191
4	Use of irradiated pollen	E.g. soft X-ray irradiated bottle gourd pollen produces seedless watermelon. Bottle gourd pollen tubes did not reach the ovules of watermelon - stimulative parthenocarpy
5	Alteration in chromosome number	E.g. breeding seedless watermelon under unbalanced triploid background, only residual integuments are seen
6	Gene silencing	Parallel switch to hormone independent parthenocarpy
7	Genetic modification	Transgenic approach, gene silencing by RNA interference
		E.g. In eggplant, DefH9-iaaM transgene construct produces parthenocarpic fruits
8	Genome editing tools	TALENs, ZFNs, and CRISPR/Cas9 techniques are used to induce parthenocarpy in vegetable crops

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MARINE FISH DIVERSITY IN INDIA

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Introduction

India is one among 12 mega-biodiversity countries and 25 hotspots of the richest and highly endangered eco-regions of the world. In terms of marine environment, India has a coastline of about 8000 km, an Exclusive Economic Zone of 2.02 million km2 (Venkataraman, and Raghunathan, 2015). Diversity in the species complex, typical of tropical waters and co-existence of different fish and shellfish species in the same ground are important features of Indian Marine Biodiversity (Joshi, 2015). The fisheries sector plays an important role in Indian economy and its contribution to the GDP is about one percent (Sathianandan, 2013). World total marine catch was 81.2 million tones in 2015 and 79.3 million tonnes in 2016, representing a decrease of almost 2 million tones. In india 3.59 million tones of total marine (FAO sofia 2018). The basic facts of diversity through species discovery and description are mostly complete for some areas of the world and for many families of fishes. Fishes constitute more than half of all vertebrates, with over 31,000 valid species, and of these over half are marine fishes4. Biodiversity is the life sustaining system and the biosphere has intrinsic value and its components have ecological, social economic, scientific education culture and aesthetic value (Verma, 2015).

Biodiversity is also essential for stabilization of ecosystems, protection of overall environmental quality, for understanding intrinsic worth of all species on the earth. Positive correlations between biomass production and species abundance have been recorded in various earlier studies (Kar, 2006). India is one of the 12-mega biodiversity countries having two biodiversity hotspots, namely the Western Ghats and the Eastern Himalayas that are included amongst the top eight most important hotspots in the world (Chaudhuri, 2004). The marine and coastal areas play an even more important role today, since they provide protein from fish and other seafoods. The current problems of environment destruction in tropical coastal seas, and the effects on the productivity of fish and other seafood from these areas are therefore are of primary importance (Nammalwar, 2013).

SOME MARINE ORGANISMS ASSOCIATED IN INDIAN WATER

1. Marine fish diversity

The seawater surrounding east west coasts of the country with salinity more than 30 ppt is designated as marine water. Mariner fisheries resources of the Bay of Bengal, Arabian Sea and Indian Ocean. 1,370 taxa including the commercially important species like sharks, rays, Bombay Malabare sole, parrot fish, perches, white fish, silver bellies seer fish, mackerel, tuna, carangids, polynemids, pomfrets, basracuds, red mullet, ribbon fishes, anchovies shellfishes1 comprise slightly extra than one-half of total number of approximately 54,711 recognized existing vertebrate species; there are metaphors of an estimated 27,977 valid species of fishes3. Fishes constitute more than half of all vertebrates, with over 31,000 valid species, and of these overhalf are marine fishes (Verma, 2015).

Fish constitutes almost half of the total number of vertebrates in the world. They live in almost all conceivable aquatic habitats; *c.* 21,723 living species of fish have been recorded out of 39,900 species of vertebrates (Jayaram, 1999). Of these, 8,411 are freshwater species and 11,650 are marine. India is one of the megabiodiversity countries in the world and occupies the ninth position in terms of freshwater megabiodiversity (Mittermeier and Mittermeier, 1997). In India, there are 2,500 species of fishes; of which, 930 live in freshwater and 1570 are marine (Kar, 2003). This bewildering ichthyodiversity of this region has been attracting many ichthyologists both from India and abroad (Kar, 2006).

2. Marine shellfish diversity

Species richness among the vast phylum Crustacea varies considerably with taxonomic class, as does the level of knowledge on each taxonomic group. In general, the smaller the size of the organisms, the less known is the taxon. For example, ostracods, tanaids, mysids, cumaceans and amphipods, most usually less than a centimetre in length, are very poorly known from the western Indian Ocean region as well as other tropical areas. Decapod groups such as those including the lobsters, shrimps and crabs by comparison are well known. The meagre information on the former groups in part reflects the absence of specialists, while the former taxa, which include many species of commercial interest, have attracted greater attention of taxonomists.

The preliminary mollusc species checklist for the region provided by Richmond (1999) includes a minimum of 2550 species of gastropod prosobranchs from 75 familes, 39 species of polyplacophorans representing 6 families and a minimum of 667 species of bivalves from 49 families. Among the gastropod prosobranchs, the most species-rich families were the Mitridae with 210 species, Conidae (198), Muricidae (187), Turridae (180) and Cypraeidae (97). Of the remainder, several families included in the checklist are considered little known. These tend to include members which are smaller than 10 mm, from deep water or from cryptic or parasitic habitats (e.g. living in sponges, or on echinoderms). The chitons, though few in number, are relatively well known, thus the diversity reported can be considered to be a reliable measure of the true diversity of this group. The bivalve fauna has been less documented for the western Indian Ocean than the prosobranch fauna. Few detailed studies of bivalves exist and the checklist was compiled from only 30 sources compared to 72 used in preparing the prosobranch checklist (Richmond, 2001).

3. Major influencing factors/ phenomenon

1. Physical process (upwelling, currents and eddies)
2. Biogeochemistry (Anoxia)
3. Algal Blooms
4. Benthic production
5. Fishery (Demersal trawling)
6. Biodiversity (particularly Endemic fauna and flora)

4. Conservation and management strategies: Action taken

For the purpose of conservation and management of the coral biodiversity many steps have been undertaken in India.

1. Identification of marine protected areas and their demarcation and protection.
2. Coral Reef Monitoring Action Plans prepared and launched. Other significant international activities such as the Coral Reef Degradation in the Indian Ocean (CORDIP), India–Australia Training and capacity building programme (IATCB), initiated.

3. National wide mapping of coastal areas by remote sensing techniques combined with land surveys to assess the rate of degradation initiated.
4. Amendment and enactment of National policies (National Biodiversity strategy and Action Plan and National Biodiversity Bill) with relevance to the protection of respective ecosystem.
5. Export trade control order.

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MULCHING – A SOIL AND MOISTURE CONSERVATION PRACTICES

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Introduction

The word mulch has been derived from the German word "molsch" which means soft to decay, which apparently referred to the gardner's use of straw and leaves as a spread over the ground as mulch. The process of covering the open surface of the ground by a layer of some external material is called mulching & the material used for covering is called as 'Mulch.' Reasons for applying mulch include conservation of soil moisture, improving fertility and health of the soil, reducing weed growth and enhancing the visual appeal of the area.

In India, out of the total cultivated area 70 per cent is dryland agriculture. Crop production in dryland agriculture limited by soil constraints, climatic constraints, lack of production technology and socio-economic status of the farmer. Crop production in dryland agriculture is solely depends on rainfall of the region. Most of the rainfed area of the country, severe loss of soil and water erosion is the major problem. Soil and moisture conservation practices is very important in rainfed areas of the country to reduce the runoff losses as well as improving the moisture retention in the soil. Conserving soil moisture in the rainfed region is a challenging task as it plays a significant role in crop productivity and livelihood security of rainfed farmers.

Based on the slope of the land soil and moisture conservation practices are classified:

1. Agronomic or cultural practices.
2. Mechanical or engineering practices.
3. Agrostological practices.
4. Forestry approaches.

Among the soil and moisture conservation practices agronomic or cultural practices are commonly followed when the land slope is <2%. Among the agronomic practices, mulching is the commonly followed cheapest *in-situ* soil and moisture conservation practices.

Types of Mulch for Soil and Moisture Conservation

1. Straw / stubble mulch: Straw / stubble mulch is covering of soil with paddy straw or any crop residues like stubbles, groundnut shells, cotton stalks etc; for soil and moisture conservation. Applied straw / crop residues will decompose and improves the soil organic matter.

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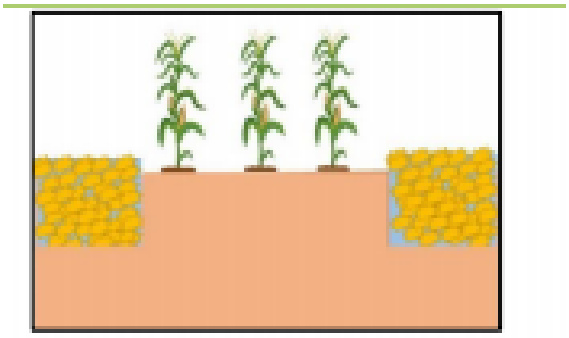
2. Vertical mulching: It is a technique wherein trenches of 40 cm wide, 15 cm deep are dug at 2 to 4 m interval across slope and filled with stubbles or organic wastes to a height of 10 cm above soil surface. Runoff is checked, collected in the shallow trenches and redistributed to adjoining soil layers and infiltration is increased in black soils.



3. Plastic mulching: Plastic mulches are very effective. The plastic mulches may be either white or black. Black plastic mulches will absorb the solar radiation and enhance the soil temperature for hastening the germination of winter crops like wheat, barley etc., White plastic mulches will reflect the incident radiation and reduce evaporation of soil moisture.

4. Pebble mulching: Pebble mulching means placing small pebbles like stone on the soil surface. This mulching will be successful in dryland fruit tree culture. The pebbles placed on the basis of trees not only reduce evaporation but also facilitate infiltration of rain water into the basin.

5. Soil/dust mulching: Soil mulch is a thin layer of loose soil surface that can be created by frequently stirring the soil with surface tillage implements like danthis, guntakas (blade harrows) etc.. Soil mulch of surface 5-8 cm dry soil effectively reduces the evaporation losses by obstructing the raise of soil moisture through capillary action. The soil mulch also prevents deep cracks in soils

(especially black soils) by reducing the direct action of atmosphere and hence evaporation is also reduced. Among the different mulches, soil mulch is the cheapest.

6. Live mulch: Live mulch is the covering of soil surface through the plant canopy in intercropping system. E.g., Sorghum + forage cowpea.

Advantages of Mulch on Soil and Moisture Conservation

1. Mulching helps to retain soil moisture, so less amount of water is required during irrigation. Mulch directly conserves water.
2. It traps surface water of the soil that would otherwise get evaporated quickly.
3. Mulching also protects soil from erosion, heavy winds, intense sunlight & overall weathering.
4. Improves the soil structure
5. Mulching helps to regulate soil temperature, which is beneficial for proper root growth.
6. Mulching arrests the growth of harmful weeds by not allowing their seeds to germinate. Therefore the biggest problem of weeds is resolved.
7. Due to the absence of weeds, main crops are less likely to get infected by pests & diseases.
8. If mulch is organic, such as decaying leaves, bark, or compost; it adds to the overall humus content of soil & enriches the soil with the steady supply of nutrients.
9. Improves the soil organic matter
10. In dryland area soil salinization avoided
11. Overall yield is sometimes doubled when mulching is done on vegetable, flower or fruiting crops.
12. Due to mulching, soil micro-flora is activated & beneficial micro-organisms start growing in the soil.

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COMMERCIALLY IMPORTANT FISH ROHU: IMPROVING GROWTH & HEALTH STATUS THROUGH ECO-FRIENDLY APPROACH

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Abstract
The disease and immunostimulatory properties of *Achyranthes aspera* were evaluated in *Labeo rohita* in the pond. Rohu (1.9±0.08 g) were introduced into the hapas (25 fish/hapa). Experimental diets containing 0.5% seeds (D1) and leaves (D2) and control diet (D3) were fed for 60 days. The rohu were immunized with c-RBC and various samples were collected on days-7, 14 and 21 after immunization. The weight and SGR were significantly higher in D1, whereas FCR was lower in D1 diet fed fish. Lysozyme, myeloperoxidase and NOS levels were significantly higher in D1, whereas TBARS and carbonyl protein levels were significantly lower in D1 fed rohu compared to others. Significantly up-regulation of *lysozyme-C*, *lysozyme-G* and *TNF-α* in D1, whereas *IL-10* was significantly higher in D3 diet fed rohu. The *TLR-4* was significantly higher in D1 and D2 diets fed rohu compared to other feeding regimes on day-7 and day-21 after immunization, respectively.

Keywords : *Labeo rohita*, *Achyranthes aspera,* c-RBC, Serum lysozyme, Pond study.

Introduction

Food security is the current major problem in the world. Fisheries and aquaculture continue to be an important source of food, nutrition, income and livelihood to millions of people and fisheries sector has also shown impressive growth in recent years. India is one of the largest fish producing country in the world and shares 7.58% to the global fish production. India is the second largest country in aquaculture production after china whereas third in fisheries. The target of agricultural sector is to double the production by the year 2025 and triple it by 2050, in a limited farming land with under challenging environmental conditions. This target may help to achieves by the fast growing and healthy fish species production in the fisheries sector. Various major freshwater and marine water finfish and shellfish species have been cultured in the country. These cultured major fish and shellfish species increasing production every year to fulfill the increasing population demand.

Fish farming is one of the major source of livelihood of people for living, can be increased by the various culture techniques using in the water bodies *viz*. cage culture near sea, inside reservoir, inside lake & pen culture in oxbow lakes and interrupted between river flow *via* monoculture, polyculture, mixed culture of various uncompetitive species of fishes.

The production of fisheries may be suffered due to the diseases. The various bacterial, viral and parasitic infections were found in the water bodies. *Aeromonas hydrophila* is a causative agent of major bacterial diseases, may have different clinical signs in fishes are range from sudden death of healthy fish, inap-petence, swimming abnormalities, pale gills, bloat and skin ulcerations.

Moreover, small-sized fishes are more allowing to such infections due to pre-developed immune system. Fish farmers are using antibiotics for improving fish health, however, these antibiotics adversely affect direct/indirect to humans who consume fish or fish by-products for their protein requirements. Consequently, fisheries experts they may scientists or senior researchers are exploring various eco-friendly and sustainable approaches that can be enhance the fish immunity, improve fish yield and profits for farmers.

Medicinal plant *Achyranthes aspera*

Achyranthes aspera (Chirchita) is an indigenous medicinal plant (herb) belongs to the family Amaranthaceae, distributed throughout the country. The leaves and seeds of this plant show immunostimulatory and disease resistance properties in carp fishes. *A. aspera* addition in the fish diets may one of the alternatives to replace the hazardous antibiotics in aquaculture sector. The positive effects of this plant on different fishes have been observed, but field trials of this plant on the various major fishes like *Catla catla*, *Cirrhinus mrigala* and *Heteropneustes fossilis* etc. are still missing. Trials on these fishes are important to validate the efficacy of enriched feed; these fishes are the major contributors to the fish production of the country. The current pond study was aim to explore the effect of enriched feed into boosting fish immunity.

Experimental methods

A. aspera were grown in the outdoor culture facility. Both parts of the plant i.e. leaves and seeds were collected, cleaned, ground into powder then checked all biochemical compositions. After that, powders were used as ingredients for formulation of fish diet. The major components of enriched and control feed were fishmeal, wheat flour, cod fish liver oil, Supradyn multivitamins tablets and *A. aspera* (Sharma *et al*., 2019).

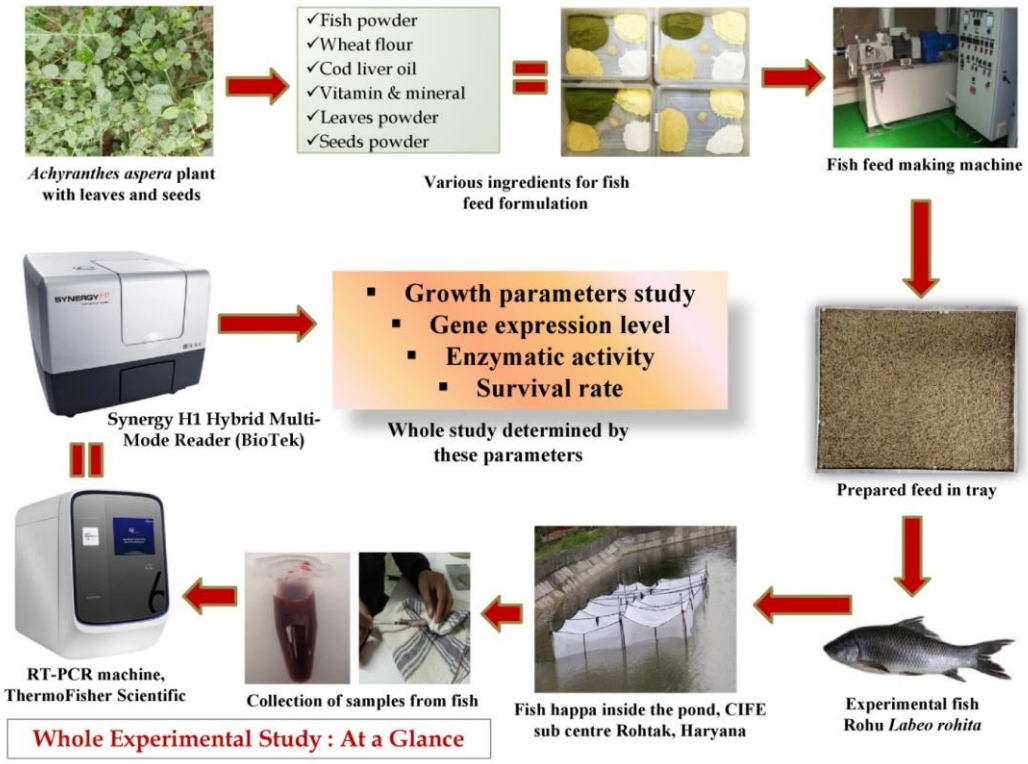

Figure 1. Whole experiment in a graphical view

Based on these ingredients, plant leaves & seeds dry powder (5g each in 1 Kg of feed) were added in experimental feed while these were absent in control feed.

These two experimental diets selected based on previously observed best positive results in fishes fed with previously doses (Kumar *et al*., 2019). All the ingredients were mixed properly with required amount of double distilled water and processed through the feed making machine for final pelleted feed formulation.

Rohu fry (1.9 ± 0.08 g) were cultured in pond conditions, in nine hapas (size- 2.0 m × 1.5 m × 1.5 m) set inside a pond (size- 54.5 m × 30.5 m × 2.25 m) of ICAR-CIFE Sub-Centre, Rohtak, Haryana. Each hapa was made of nylon net and set-in pond with bamboo sticks. Hapas also covered with net upper side for avoid escaping of fishes (Figure 1). Rohu fishes were fed with two experimental doses (having leaves and seeds of plant) and one control dose (without any plant). The chicken blood (c-RBC) was collected in Alsever's solution (1:3). After 90 days of feeding, taken weight and immunized with c-RBC (60 µl/fish). Some fishes were injected with phosphate buffer saline (PBS) solution as a same control to eliminate variations in observed results due to injection trauma. The samples were taken on days 7, 14 and 21 after immunization after mild anesthesia with MS-222 (Sigma). The blood samples were drawn from the caudal vein of individual fish for further enzymatic analysis. Tissue samples were collected of individual fish for the immune and stress parameters. The tissue sample was taken into the 100 ml TRIzol reagent (Ambion, ThermoFisher Scientific, USA) for various mRNA expressions analysis.

Results

The growth of fish was checked by calculating final weight minus initial weight, specific growth rate (SGR) and feed conversion ratio (FCR) which is calculated by dividing the total amount of feed consumed by fish in a period (days) by the weight gain at the same period. The non-specific immune system related enzymes like nitric oxide synthase (NOS), myeloperoxidase, lysozyme and immune related genes were notably higher in rohu fishes that consumed enriched feed as compare to the control diet feed rohu. The highest activity found in the seeds formulated feed fed rohu compare to the control diet feed rohu. The TBARS and carbonyl protein levels were significantly lower in D1 fed rohu compared to others. Significantly up-regulation of *lysozyme-C*, *lysozyme-G* and *TNF-α* in D1, whereas *IL-10* was significantly higher in D3 diet fed rohu. The *TLR-4* was significantly higher in D1 and D2 diets fed rohu compared to other feeding regimes on day-7 and day-21 after immunization, respectively.

Conclusions

The results of these tests indicate that enriched feed can be improve the immunity of fish and help to fight against constant challenge of waterborne pathogens or outer antigen in the body. The enriched feed also has potential to increase the growth of fish. Thus, high yield may provide profit to fish farmers. Seeds and leaves enhanced the growth, induced the immune system of rohu and gave protection against oxidative stress in pond conditions. Seeds are more efficient compared to the leaves. The information generated from the field study has practical utility.

This plant (Chirchita plant) can be grown on large scale, and therefore, is commercially useful for fisheries and aquaculture industry. Currently, Government of India is also promoting the small and medium enterprises (MSME) and providing training to unskilled youth and thus facilitating skilled labour through small start-up. Additionally, small and marginal farmers can also grow this plant in

small enclosed plots to maintain the quality of plant and subsequently can sell it to the aquaculture industries. This study is significant and useful to fish farmers. The findings of this study establish eco-friendly and supportable approach as a remarkable method to improve fish health and fish production.

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VERMIWASH

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Vermiwash is a watery extract of compost, the wash of earthworms present in the medium and honey-brown in colour. Vermiwash is the organic fertilizer obtained from units of Vermiculture or vermicompost as drainage. It is the liquid extract collected from the passage of water through the different layer of worm culture unit. Vermiwash contains beneficial microbes which help to plat growth and prevent infections. It improves soil aeration, texture and tilth, thereby reducing soil compaction.

Chemical composition of vermiwash

pH	7.48
Electrical conductivity ds/m	0.25
Organic carbon %	0.0008
Total kjeldhal nitrogen %	0.01
Available phosphate %	1.69
Potassium (ppm)	25
Sodium (ppm)	8
Calcium (ppm)	3
Copper (ppm)	0.01
Ferrous (ppm)	0.06
Magnesium (ppm)	158.44
Manganese (ppm)	0.58
Zinc (ppm)	0.02
Total heterotroph (CFU/ml)s	1.79
Nitrosomonas (CFU/ml)	1.01
Nitrobacter (CFU/ml)	1.12
Total fungi (CFU/ml)	1.46

Procedure

Earthworm eats its food while making tunnels in the soil. These tunnels contain micro-organisms. The water passing through this tunnel comes down carrying the nutrients from it in a soluble form and is easily absorbed by the plants. For this, we are given a slight (8-10 cm) slope outwards to the bottom surface of the vermicompost bed. A pipe is inserted into the outer wall by making a hole (5-10cm in diameter) at the bottom. Keep the mouth of the exit pipe in an earthen pot or any vessel. During making earthworm compost, a liquid starts to accumulate at the bottom, which starts falling into the pot with the help of a pipe. This is vermiwash.

Integrated Vermiwash Unit

Vermiwash can also be prepared from vermicompost by allowing water to pass through vermicompost container and collecting it. Sprinkle water two times a day on vermicompost unit in morning & evening. Vermiwash unit may be established with vermi-composting beds for large scale production. Vermiwash can also be prepared from vermicompost by allowing water to pass through vermicompost container along with earthworms, put it on a sac. Now take 10 litres of water in a tube will be ready, and put the earthworms back on the bed.

How to use of vermiwash

Dilute with water (10%) before spraying effectively on the plant. Vermiwash must be diluted 5 to 10 times with water and then applied. Vermiwash can also be mixed with cow's urine and diluted for use as foliar spray and pesticide as follows;

1 liter of Vermiwash
1 liter of cow's urine
8 liters of water

Cost of vermiwash

The price of the Vermiwash varies from farmer to farmer. However, the farmer can sell Vermiwash at the rate of Rs. 10 per liter.

Benefits

- Vermiwash acts as a plant tonic and helps to reduce several plant diseases.
- A mixture of 1 litre Vermiwash with 1litre cow urine in 10 liters of water acts as biopesticide and liquid manure.
- It helps to develop resistance against various diseases and pests in plants
- It helps in initiating good flowering and produce good yield in some vegetable crops. Vermiwash is a liquid fertilizer and reported that at 20-30% dilution inhibits the mycelia growth of pathogenic fungi.
- Act as a bio-pesticide when diluted with 10% cow urine or neem extract or garlic extract.
- It does not have any adverse effect on soil, plant and environment.
- Vermiwash can be used a potent biofertilizer to develop the germination and seedling survival rates in crop plants growing on nutrition depleted soils.
- It could be utilised efficiently for sustainable plant production at low input basis green farming.
- It is a natural growth supplement for tea, coconut, horticultural crops.

Precautions

- The tap should be always kept open to collect the washing .
- The vermiwash should be stored in cool dry place.
- Water should be poured slowly.
- Do not mix un-decomposed material, while watering.
- Do not add any green material.
- Do not allow to compact the contents.

Effect of Vermiwash on Yield and Quality of Crops

1. Kebatake (1954) reported that the coelomic fluid from earthworm body had antibacterial properties. Studies on the effect of spraying of vermiwash on vegetables indicated that the

quality and quantity of yield were improved markedly. It was also observed that the foliage turned dense green in two to three days when spray was used on plants other than vegetables.

2. (Anonymous, 1993). Ismail (1997) reported that vermiwash can be sprayed on plants as a foliar sprayfor improving quality and yields of okra crop.
3. Foliar application of vermisol special to winter wheat in field studies at Sladkovicovo in 1994-96 gave a mean yield of 7.62 ha in combination with 30 kg N/ha compared with 7.28 t from N alone and 6.71 t in unfertilized controls.

Dosage for use

Root dip/stem dip : The seedling before transplanting are dipped in vermiwash solution which is diluted 5 times with water for 15 to 20 minutes and then transplanted.

Foliar spray : Vermiwash is diluted in water 5 times and sprayed on the foliage of crops. It provides the plant with vital nutrients which also helps to control plant disease. The vermiwash is diluted with water for 5-10 times and after that sprayed on the crops. It enriches the soil with nutrients and this help in controlling plant disease. One litre of vermiwash can also be mixed with 1 litre of cow's urine and diluted in 10 litres of waters for use as foliar spray.

Soil drench : Vermiwash is diluted 10 times with water and the soil is drenched the solution to prevent some of the soil borne pathogens.

Drip irrigation applications : Drip applications enhances the nutrient uptake by the plants and thereby, it acts as natural fertilizers for the crop.

Effect of vermiwash on insect pest and diseases

- Vermiwash proves to have excellent bio pesticidal activities.
- The plants treated with vermiwash were disease resistant and no any worms like leaf eaters were seen on the leaves and other parts of plants.
- It is also reported that vermiwash obtained from animal dung with gram bran and neem oil was also highly effective in controlling pod borer (Helicoverpa armigera).
- Plants treated with vermiwash are green having vigorous growth and much more resistant to pests and disease and management of *Lucinodes orbanalis* infestation on brinjal crop.
- Combinations of vermiwash and biopesticides is a superior alternative of the chemjcal
- fertilizer and pesticides.
- Increasing concentration of vermiwash suppressed insect-pest population of tomato.
- Using the vermiwash on cowpea for mildew disease and the study revealed that usage of 20-30 % vermiwash will cause suppression of mycelia growth of fungi.

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AGRICULTURAL DRONE – APPLICATIONS AND CHALLENGES

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Abstract
Agricultural drones have made significant technological progress in recent years. Drones deliver high-resolution crop images as well as several indices that are useful in making farm management decisions. Drones have revolutionised farming methods by allowing farmers to save money, improve operational efficiency and increase profitability. Agricultural drones have gained popularity over time, attracting the interest of researchers, manufacturers, and the government. However, there are a number of challenges with drone technology that must be addressed in order to successfully deploy it in agriculture.

Introduction

The main source of food for the population of the world is agriculture but it has been facing challenges because of increasing demand for food products, food safety and problems such as environmental protection, water conservation, and sustainability. The world's population is estimated to be 9.7 billion by 2050 (Rajeb *et al*., 2022). The solution for these problems of agriculture and increase in agricultural production is the use of technology. Drone technology with advanced image data analytics has the potential to fill the gap between current agricultural production and the needs of the future.

Drone also known as Unmanned Aerial vehicle (UAV) is a vehicle/aircraft that can be operated remotely without a pilot on board or autonomously. The drone can be programmed to travel the predefined path using navigation algorithms. Drones consists of a propulsion system, a programmable controller with or without the satellite navigation system, automated flight planning features and capable of carrying payload such as cameras, spraying systems, etc. for accomplishing a given task. Drones have sensors that can provide real-time information about the crop status or livestock movement. A drone may have different sensor systems for digital imaging such as multi spectral, high-resolution camera systems and actuators which help in field survey, crop scouting, spraying and surveillance in livestock and fisheries. The data captured through cameras mounted on drone farmers can be used for calculation of precise land sizes, classification of crop types and verities, development of soil maps along with pest management, proper planning of harvesting of crops and scheduling of farm machineries using data analytics. Drones have been frequently classified using some of the performance characters such as weight, maximum altitude, wing load, engine type, power source and flight range. According to ministry of civil aviation, drones are classified based upon the maximum all-up weight including payload as under-

1) Nano drone: Less than or equal to 250 gram
2) Micro drone: Greater than 250 gram and less than or equal to 2 kilogram
3) Small drone: Greater than 2 kilogram and less than or equal to 25 kilogram
4) Medium drone: Greater than 25 kilogram and less than or equal to 150 kilogram
5) Large drone: Greater than 150 kilogram.

Application of drones in agriculture

i. **Assessment of crop health:** Drone with infrared cameras is used for development of Normalized Difference Vegetation Index (NDVI). The NDVI view of an area is used for the analysis of the intensity of solar radiation absorbed and therefore the condition of the monitored plants and its specific parts. This information helps in early identification of pests and diseases.
ii. **Crop surveillance:** Drones based agriculture mapping keeps farmers updated on the plants status and point out which field areas require attention. Based on these inputs, farmers can take measures to improve the state of plants in any spot of the field.
iii. **Crop Insurance:** Advanced geospatial NDVI products can also be used in case of natural disasters or destruction of crops to precisely estimate the level of losses by comparing the pre-disaster state of vegetation with the damages that occurred. Precise documentation of damages followed by precise estimation of reduction in estimated yields can be used in insurance procedures.
iv. **Livestock management:** Drones equipped with high resolution cameras used for counting animals using their heat marks. It also used for identification and treatment of ill animals based on a temperature comparison.
v. **Spraying:** Drones with suitably sized reservoirs can be filled with fertilizers, herbicides, or pesticides for crop spraying on large areas in less time. For efficient use of chemicals, the spraying needs to be synchronized with the imaging, processing and automated analytics.
vi. **Assessment of soil condition:** Drone technology can be utilised to analyse soil condition and consequently predict yields before the vegetation cycle begins. Actual 3D mapping of the terrain with precise soil colour coverage is the most important application in analysing soil condition. This helps in the exact assessment of soil quality, moisture, and water movement.
vii. **Irrigation management:** Drones equipped with hyper-spectral, multi-spectral or thermal sensors can detect moisture deficient regions using the vegetative index. This aids in the precise planning of irrigation to the designated regions.

Challenges of drones in agriculture

i. **Initial cost:** Agricultural drones are expensive as it includes cost of sensors, software, hardware and tools. The initial cost also depends on the payload and flight time capacities.
ii. **Data management:** As the drones have accuracy and precision of information, the size of datasets is large. So, it becomes difficult to manage all data.
iii. **Quality software:** Software plays a crucial role in the applicability of drone technology from flight path planning to process the image data. So, drone technology needs quality software for better results.
iv. **Weather dependency:** Drones activities are intensely subject to climatic circumstances, accordingly restricting their utilization. Flying drones is difficult under rainy or stormy circumstances.
v. **Poor connectivity:** In most cases farmlands does not have sufficient connectivity, under such circumstance the farmer needs to invest in connectivity or purchase a drone capable of collecting data locally for later processing.
vi. **Knowledge, Skill and acceptability by the farmers:** Farmers don't have the technical knowledge to analyse the drone images and other data. Due to this lack of technical knowledge, it is difficult for farmers to accept it.

Conclusions

Drone technology is a tool for increasing agricultural output, and it has a lot of potential for efficiently carrying out a variety of agricultural tasks. It can save labour and advanced technology attracts young people to farming. However, high initial cost and technology gap are some of the challenging aspects of making it farmer-friendly which can be overcome by involving of custom hiring centers, training centers and emerging start-ups. There is also a need to perform research in order to improve operation protocols as well as calibrate and validate drone use. With the improvement of drone technology, the cost of drones will decrease. Furthermore, advances in technology such as battery capacity and payload weight reduction are projected to boost flying time and range. These developments will ensure that farmers get more benefits from the use of drones in agriculture.

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