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CLIMATE SMART AGRICULTURE

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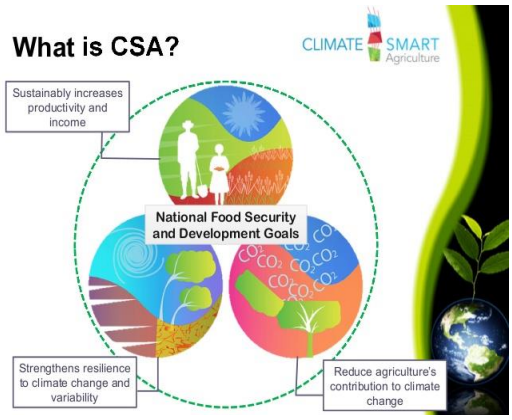


Climate change is today's major concern as it mainly affects the agriculture sector resulting growing food insecurity across the world. Agriculture is the most vulnerable and sensitive sector affected by climate change because of its dependency on local climate parameters like rainfall, temperature, soil health, etc. Impact of climate change on agriculture will be one of the major deciding factors influencing the future food security of mankind on the earth. The increased frequency of extreme weather events such as floods, cyclones and droughts are the most challenging issues of current age. The developing countries due to their dependency on agriculture and allied sectors and limited infrastructure suffer the most. The extreme weather events cause tremendous loss in agriculture and allied sector (crop, livestock, fisheries, etc.) leaving farmers in distressed condition. At present around 570 millions farms are facing the threat of climate change across the world. The estimated impacts of both historical and future climate change on cereal crop yields in different regions indicate that the yield loss can be up to -35% for rice, -20% for wheat, -50% for sorghum, -13% for barley and -60% for maize depending on the location, future climate scenarios and projected year.

In Asia, agricultural crop yields are expected to decline by 5-30% by 2050s due to rising temperature in the Himalayas and this decline in agricultural yield will lead to food insecurity, which becomes a serious future problem for human beings. Higher temperature eventually reduces yields of desirable crops while encouraging weed and pest proliferation. Here, climate smart agriculture can be a better solution to address the issues of changing climate as well as to enhance global food security. To alleviate the challenges posed by climate change, agriculture has to become "climate smart".

The term CSA is coined by FAO in the background document prepared for the 2010 Hague Conference on Food Security, Agriculture and Climate Change. The CSA concept was developed with a strong focus on food security including adaptation to climate change. Climate Smart Agriculture is an approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate. The Food and Agricultural Organization (FAO) defines CSA as "agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces GHGs (mitigation) where possible and enhances achievement of national food security and development goals".

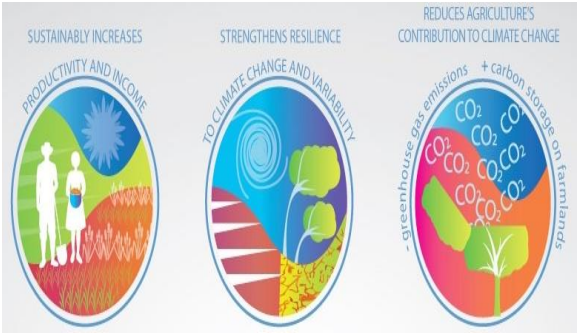
Despite the recognized importance of Climate Smart Agriculture (CSA), the dissemination and uptake of climate smart technologies, tools and practices is still largely an ongoing and challenging process. The adaptation of climate related knowledge, technologies and practices to local

conditions, promoting joint learning by farmers, researchers, extension personnel and widely disseminating Climate Smart Agriculture (CSA) practices, is critical. CSA approach deals with these interlinked challenges in a holistic and effective manner.

The Three Pillars of CSA

Productivity

CSA aims to sustainably increase agricultural productivity and incomes from crops, livestock and fish, without having a negative impact on the environment. This, in turn, will raise food and nutritional security. A key concept related to raising productivity is sustainable intensification. As per report by FAO, to achieve food security and agricultural development goals by 2030, adapting to climate change and lowering emissions will be necessary.



Adaptation

CSA aims to reduce the exposure of farmers to short- term risks, while also strengthening their resilience by building their capacity to adapt and prosper in the face of shocks and longer-term stresses. Particular attention is given to protecting the ecosystem; services which ecosystems provide to farmers and others. These services are essential for maintaining productivity and our ability to adapt to climate changes.

Mitigation

Wherever and whenever possible, CSA should help to reduce and/or remove greenhouse gas (GHG) emissions. This implies that emissions from production of each calorie or kilo of food, fibre and fuel should be reduced; deforestation from agriculture should be avoided and manage soils and trees in ways that maximizes their potential to act as carbon sinks and absorb CO2 from the atmosphere.

Key Elements of Climate Smart Agriculture

Climate smart agriculture is an approach that involves different elements embedded in local contexts. CSA relates to actions both on-farm and beyond the farm and incorporates technologies, policies, institutions and investment. The different elements which can be integrated in climate smart agricultural approaches include:

1. Management of crops, livestock, aquaculture and capture fisheries to manage resources better, produce more with less while increasing resilience.
2. Ecosystem and landscape management to conserve ecosystem services that are key to increase at the time resource efficiency and resilience
3. Services for farmers and land managers to enable them to implement the necessary changes.

How CSA is different?

Climate smart agriculture explicitly considers climate risks that are happening more frequently with greater intensity than in the past. We need to change our existing agricultural technologies and should adopt improved technologies and approaches to deal with the new climatic risks. CSA approaches need greater investment in managing climatic risks, understanding and planning for adaptive transitions that may be needed. For example, new farming systems or livelihoods, utilizing opportunities for reducing or removing greenhouse gas emissions where feasible.

Examples of CSA Interventions

Examples of specific CSA interventions include soil management, drought- tolerant maize, dairy development, farming catfish intensively and carbon finance to restore crop fields, waste-reducing rice thresher, rainfall forecasts and incentive system for low carbon agriculture.

Actions needed to implement climate smart agriculture

A range of actions can be undertaken by government and other agencies for successful implementation of climate-smart agriculture in agriculture systems. CSA approaches include four major types of actions.

1. Expanding the evidence base and assessment tools to identify agricultural growth strategies for food security that integrate necessary adaptation and potential mitigation.
2. Building policy frameworks and consensus to support implementation at scale.
3. Strengthening national and local institutions to enable farmer management to climate risks and adoption context-suitable agricultural practices, technologies and systems.
4. Enhancing financing options to support implementation, linking climate and agricultural finance.

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HILL AQUACULTURE IN UTTARAKHAND

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Uttarakhand, one of the Hilly states of India has enormous freshwater fisheries resources that comprised of 2,700 km of rivers, 24,200 hectares of reservoirs, 297 hectares of lakes and about 2000 hectares of ponds. The state comprises two major regions namely Kumaon and Garhwal and both the regions are blessed with an abundance of aquatic resources. Among the available resources, a number of natural lakes in the Kumaon region constitute a valuable water resource even for development of aquaculture fisheries in the region. The principal lakes are Bhimtal, Garudtal, Hanumantal, Khurpatal, Nainital, Naukuchiatal, Sattal and Shyamlatal. In addition to these lake resources, the low and mid Himalayan Kumaon region has small aquatic ponds and great potential for creating more water areas for aquaculture development.

Since, water temperature in the hills falls below 20°C, the exotic carps (common, grass and silver carps), mahseers and other such coldwater fishes that can grow and survive at lesser temperature than IMCs are more suitable for use in hill aquaculture. Among all the cultured species; Silver carp, Grass carp and Common carp are reported to perform better in composite culture system in the mid altitude conditions. Common carp plays an important role in augmenting fish production especially in the hill states of the region. Since the size of fish ponds in the hill areas are small and principally rain fed and seasonal, the small-scale integrated aquaculture utilizing available on-farm resources has great potential.

Uttarakhand climate diversification for aquaculture

Trout Zone	Areas above 4000 feet where temperature is below 20°C
Mahseer Zone	Areas below 4000 feet located in central Himalayan
Plain Zone	Hilly areas after Trout & Mahseer Zones
Major Carp Zone	Plain areas of state i.e., Udham Singh Nagar, Haridwar& Dehradun

Best practises in hilly areas of Uttarakhand

1. Angling with conservation
2. Cluster based trout farming

1. Angling with Conservation

- The rivers are an important natural resource available in the state in abundance that can be exploited for fish production and sport fishery.
- Due to various natural and man-made reasons the natural fishery is depleting in rivers.
- Development of rivers without participation by local residents and active groups was a challenge.

- Department has identified major river systems which are divided in beats of 5 to 8 km sand are being allotted to local groups /SHGs/ female groups for conservation & employment generations.
- Allocation of beat shave ensured check on illegal fishing, conservation of fish in natural rivers and a source of employment to locals.
- A beat is generating direct employment for a cooperative (min.11people) with an income of roughly Rs.1.60 lakh.
- Further development of beats as ANGLING VILLAGES for supporting recreational fisheries will enhance income manifold by attracting tourists and anglers worldwide.

Sport fishing

2. Cluster Based Trout Farming

- Upland area of the state, six districts have been identified for trout farming.
- Trout farming has observed slow pace of growth in past as trout growers were demotivated owing to various factors like capital intensive nature of trout farming, limited number of farmers, low momentum of production, absence of marketing linkages, etc.
- For development and establishment of trout farming as a primary occupation in uphills, department is now focusing on cluster-based trout farming through cooperatives where minimum of 20 farming units are established at one place.
- To achieve this, fisheries cooperatives have been formed in identified areas at mission mode resulting in existence of 39 fisheries cooperatives.
- For financial support to cooperatives and thereby enhancing trout fisheries in the state an integrated model has been developed which is funded through NCDC (National Cooperative Development Corporation).
- In proposed model FARM TO TABLE approach has been emphasized where 1000 trout raceways, hatcheries, retail outlets, OASIS (One Stop Aquaculture Shop & Information System) and Market are proposed to be developed.

Raceways for trout farming

Action Taken / Targets

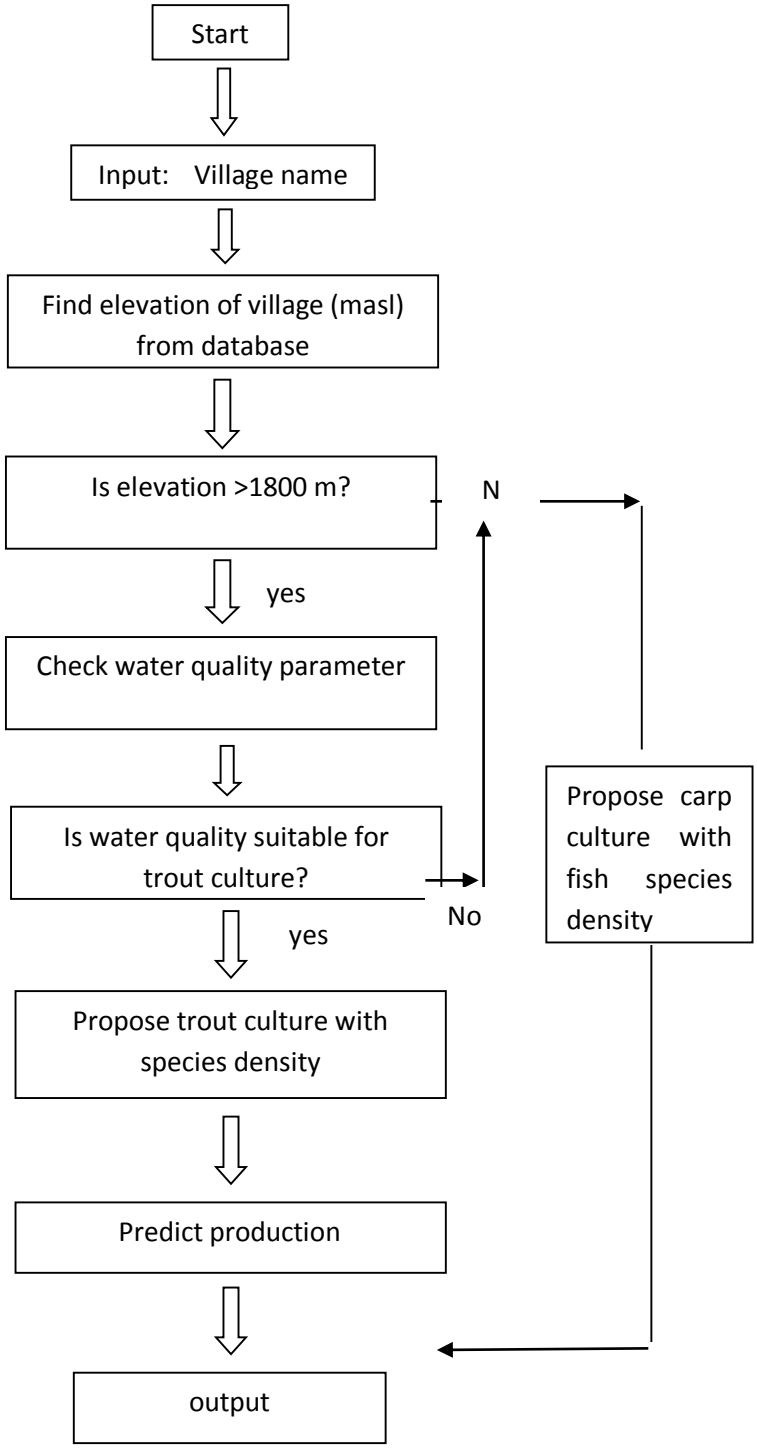
Number of Trout Raceways developed in last three years	305
Trout Raceways to be developed under NCDC	1000
Trout Hatcheries	02 (Established) 01 (Under Construction)
Additional Trout Hatcheries to be Established	08
Trout Brood Bank to be established	01 (Under Construction)
Number of Retail Shops to be established	04

Decision support system (DSS)

The decision support system (DSS) is an interactive computer-based system or subsystem intended to help decision makers by using communications technologies, data, documents, knowledge and/or models to identify and solve problems and decision-makings. The DSS development approach is based on the assumption that the information requirement of a system can be predetermined. The decision support system database was developed in Microsoft Visual Basic 6.0 software as front-end tool and Microsoft Access 2000 as back-end tool. Various forms, menus, text fields and command buttons were created in visual basic software and it was linked with the

backend tool of Microsoft Access **(Siler and Spotts, 2002).** The village information like name of the village, msal, latitude, longitude, population density, nearest market, nearest hatchery etc. were stored in the back end which was accessed on the system for taking appropriate decision.

Fig: Flowchart diagram of decision support system for aquaculture in Kumaon hills



Schemes related to promote hill aquaculture in Uttarakhand

S. No.	Name of project	Details of project
1.	**Schedule Cast Sub Plan (SCSP)**	For SC: 70 % subsidy (INR 42000) for hill areas on fishery pond of INR 6000/-per 0.01 hectare (unit).
2.	**Tribe Sub Plan (TSP)**	For Tribe: 70 % subsidy (INR 42000) for hill areas on fishery pond of INR 6000/-per 0.01 hectare (unit).
3.	**Fishery pond manufacture in hilly areas**	Small pond manufacture of 0.005-hectare area. pond manufacture of 0.005-hectare/ 50-meter area with 50% subsidy of total cost i.e., INR 25000/- of INR 50000/-. One candidate can have 3 units only. Training, field visit and holding public seminar for person in fish cultivation
4.	**Adrash fishery pond manufacture in hilly areas**	Manufacture and making Adrash fishery pond in state Manufacture of concrete pond of minimum 20 sq. meter/ 0.02-hectare size (20×10×1.5 mtr. / 01 unit) area. 1st year subsidy INR 150000 (of total investment INR (300000). One candidate can have maximum 3 units.
5.	**Development of cold-water fishes (75% centre funded)**	Promoting Fisheries in hilly areas. Constructing running water ponds in hilly areas and providing total investment of 60,000/- Rs in which 20 % is payable at 0.001 hecatre (unit) i.e., Rs. 12000/- Rs. per 0.001 hectare.

Constraints : Important constraints to sustainable aquaculture development in the hill region are:

- Difficult terrain
- Non- availability of quality fish seeds of appropriate fish species in time
- Non-availability of specific technology
- Non-availability of suitable fish food organisms/feeds
- Diseases
- Non-availability of trained technical manpower
- Urgent need to find alternate fish species which can grow in lower water temperature or grow to marketable size within short period of time (7-8 months)
- Lack of private entrepreneurship
- Poor extension machinery in transfer of appropriate technologies
- Inadequacy in generation of appropriate culture technologies to suit the local demand
- Under-utilization of aquatic resources and potential low-lying areas for fish farming
- Unscientific management and inadequate infrastructure facilities and financial assistance are some of the important bottlenecks in expansion of mid hill aquaculture

Conclusion

In general, the coldwater fish farming has been largely overlooked due to appropriate fish species, lack of suitable technology, poor growth of fish and inadequate infrastructures most tribal farmers of the region are resource poor and possess small to medium sized fish ponds for aquaculture. Therefore, there is tremendous scope for increasing productivity through introduction of suitable fast growing fish species appropriate to the region. The Government should take a policy decision to establish brood bank of suitable fish species for quality fish seed production in order to provide quality brood stocks to the selected farmer fish seed producers of the mid hill region. With large population of domestic animals and huge resources of green foliage in the region, there is ample scope for vertical expansion of aquaculture through use of on-farm resources to meet the demand. Development of site-specific farming systems suitable for the terrain based on the elevation and climatic conditions is therefore required for the region.

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IMPORTANCE OF SMALL FISH IN HUMAN NUTRITION

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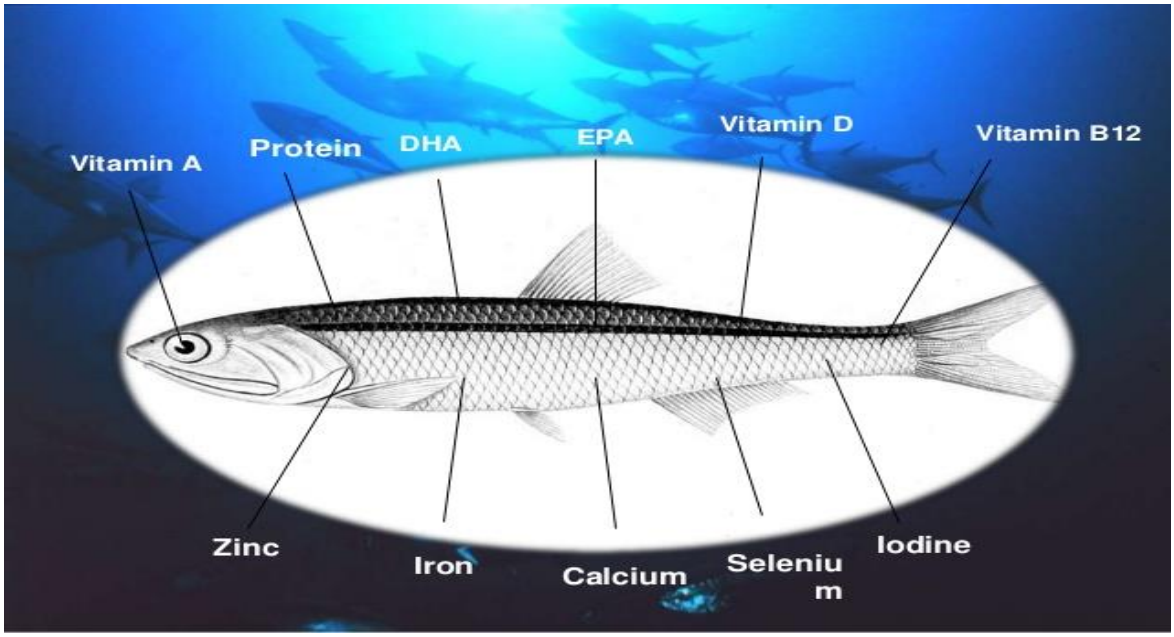
Introduction

It is a tragic irony that during a world where nearly 30 percent of the population suffers from malnutrion, the same numbers of individuals suffer from a plague of excess caloric intake and obesity. Nutritious food products are in high demand and aquatic food products represent an important component of the worldwide food basket. An often ignored resource is little pelagic fish, a highly abundant and productive renewable protein which today is usually wont to feed other fish or as an ingredient to feed livestock. Today, tons of this nutritious protein that would be available for human consumption particularly in developing countries is actually getting used for other purposes, *i.e.* fish meal as an ingredient in feed for livestock. Small-sized marine pelagic fish could provide a reasonable and far needed source of top quality animal protein and essential amino acids, omega-3 fatty acids, vitamins, minerals, and trace elements. Small fish are a standard food and an integral a part of the everyday carbohydrate rich diets of the many population groups in poor countries. These populations also suffer from under nutrition, including micronutrient deficiencies – the hidden hunger. Small fish are an upscale source of animal protein, essential fatty acids, vitamins and minerals.



Small fish are Good source of protein, essential fatty acids, vitamins and minerals

To make full use of this potential, further data on nutrient bioavailability, intra-household seasonal consumption, nutrient analyses, cleaning, processing and cooking methods of small fish species are needed. Advocacy, awareness and nutrition education on the role small fish can play in increasing diet diversity and micronutrient intakes must be strengthened. Measures to develop and implement sustainable, low cost technologies for the management, conservation, production, preservation, availability and accessibility of small fish must be undertaken. Also, an analysis of the

cost-effectiveness of micronutrient-rich small fish species in combating micronutrient deficiencies using the Disability-Adjusted Life Years (DALYs) framework should be administered. Fish is great way to keep your family healthy, because it is a rich source of different types of nutrient.

- Omega –3 fatty acid
- Vitamin A
- Polyunsaturated fatty acid
- Vitamin B12
- Vitamin D
- Zinc
- Iron
- Calcium

Omega-3 fatty acid : Omega –3 fatty acid is improving the brain functions and decreases the mental illnesses, heart disease etc. the inclusion of omega 3 fatty acid are show the batter result.

Vitamin A : Vitamin A is improving the eye sight, immunity and reproductive functions.

Polyunsaturated fatty acid : Polyunsaturated fatty acids are beneficial for heart disease and heart condition.

Vitamin B 12 : Vitamin B 12 is a vital source of formation of RBC and also responsible of metabolism of cells.

Vitamin D : Vitamin D are responsible for calcium absorptions for strong healthy teeth and bones, it is also preventing to rickets in children.

Zinc : Zinc is promotes the healthy immune system, healthy growth during childhood and also reduce the severity of diarrhea.

Iron : Iron is important for production of Reed Blood Cell and the prevention of anemia.

Calcium : Calcium is essential for strong the bone and teeth. Human heart and nerves system also need to calcium.

The studies in rural Bangladesh and Cambodia showed that tiny fish made up 50–80 percent of total fish intake within the peak fish production season. Although consumed in small quantities, the frequency of small fish intake was high. As many small fish species are eaten whole; with head, viscera and bones, they're particularly rich in bioavailable calcium, and a few also are rich in vitamin A, iron and zinc. A traditional daily meal of rice and sour soup, made with the iron-rich fish, “trey changwa plieng” (Mekong flying barb, *Esomus longimanus*), with the top intact can meet 45 percent of the daily iron requirement of a Cambodian woman. Small fish are a preferred food, supplying multiple essential nutrients and with positive perceptions for nutrition, health and well-being. Thus, in areas with fisheries resources and habitual fish intake, there's good scope to incorporate micronutrient-rich small fish in agricultural policy and programmers, thereby increasing intakes which may lead to improved nutrition and health. The results of the many studies and field trials conducted in Bangladesh with carps and little fish species have shown that the presence of native fish in pond polyculture and the stocking of the vitamin A-rich small fish, “mola” (*Amblypharyngodon mola*), didn't decrease the entire production of carps; however, the nutritional quality of the entire fish production improved greatly. In addition, mola breeds within the pond, and partial, frequent harvesting of small quantities is practiced, favoring home consumption. A production of only 10 kg/pond/year of mola within the estimated four million small, seasonal ponds in Bangladesh can meet the annual recommended intake of six million children. Successful

aquaculture trials with polyculture of small and enormous fish species have also been conducted in rice fields and wetlands. Thus, aquaculture features a large, untapped potential to combat hidden hunger.

Benefit of small fish eating:

- Small fish are easily available on cheap price.
- Small fish are good dietary sources of vitamin A and D
- Its may boost brain health.
- It is also good source of Omega-3 fatty acids are essential for growth and development.
- It is also reduce the risk of heart attacks and stroke.
- It is also may decrease the risk of depression, Alzheimer's disease, dementia, and diabetes.

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FISH DISEASES AND THEIR MANAGEMENT

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Factors of Disease

Most of disease outbreak is observed during fluctuation of temperature or changes in the environment. The common factors of diseases are as followings:

- Changes in water quality such as: Temperature, Dissolved Oxygen, CO_2, pH, Transparency, Turbidity etc.
- Waste products make water polluted so that gills, skin, and mouth cavity become infected.
- Excess use of organic matters and food produce harmful gases such as H_2S, Ammonia, Methane, CO_2, which are responsible for fish disease.
- Mixing of polluted water from sewage, factory, town or city makes pollution in water.
- Runoff water from agricultural field, flooded area and other ponds make polluted water.
- Fluctuation in temperature and high stocking density may cause stress in fishes.
- Over feeding may cause water pollution.

Symptoms of Disease : Common symptoms of disease are following:

- Isolation from group, differences in behavior and swimming.
- Abnormal position, stop feeding or reject food intake.
- Changes in body physique, shape, colour i.e., discoloration of body.
- Edges of fins become whitish, reddish, removal of scales.
- Accumulation of water or reddish fluid in the body and roots of fins.
- Stomach swollen, necrosis of gills, secretion more mucous.
- Body swelling followed by spots, abrasions, furunculous, ulcer or wound with fungal infection.
- Sudden movement and jumping off the water, rubbing the body against rough surface, pond dykes, aquatic plants etc., improper respiration and movement.
- Movement on own axis, backward or forward, tail down or head down, oblong, vertical or horizontal, imbalanced body.
- Exopthalmous or endopthalmous with swelling or bulging eyes, improper vision.

Precautions and Treatment

Precautions and Treatments to prevent fish from disease are based upon mode of application of practices, chemicals, medicines etc. as per requirement:

i. Disinfection of ponds and tanks: Pond management is based on the application of 50-100kg bleaching powder per hectare during pond preparation. Quick lime is used @ 400-600kg / h in new ponds and 500-800kg/ h in old ponds to eradicate microbes and pathogens. Fish stock can be treated with 5ppm formalin or 0.5-2.0% salt solution prior to stocking in the pond. 5kg KMnO4 and 5-liter formalin can be used in new ponds. 10kg KMnO4, 10kg CuSO4 and 10liter formalin can be used in old ponds.

ii. Disinfection of instruments: The instruments related to fish culture should be disinfected with 5-25ppm formalin or 250 ppm KMnO4 after proper washing and complete sun drying before using in the pond. Never use instruments from others pond.

iii. Proper diet: Fresh and healthy feed having 24% protein and sufficient fat, lipids, vitamins and minerals should be used 2-3 times in a day. Poor quality food may cause slow growth and weaken the fish.

iv. Grading of fish: Fish should be stocked in separate ponds according to the size, species and stages to prevent the mortality due to competition of food and space. There should be separate tanks and ponds for brooders, fries, fingerlings, yearlings and juveniles.

v. Eradication of diseased and dead fishes: diseased fish can be eradicated and treated till healthy condition. Dead fishes should be taken out from the pond and buried away from ponds and hatchery.

vi. Primary treatment: This treatment is done with the help of KMnO4, common salt solution, formalin and CuSO4. Generally, 2-3% salt solution is used as bath treatment for 1-2 minutes. KMnO4 is @ 100- 250ppm for 2-3 minutes as bath treatment. KMnO4 is applied @ 2.5kg/h in each month. Slacked lime is used @ 100-200kg/h every month. Netting is required twice a month or after 20 days. Water exchanges up to 30cm should be done per month. In severe infection different medicine or chemicals could be used according to the diagnosis of disease. Oxytetracyclin antibiotic antibiotics can be mixed with fish feed @50-60mg /100kg fish up to 15 days. Also, an injection of streptomycin 25mg and Penicillin 20,000IU can be given to valuable and costly fish more than 1kg body weight.

Viral Disease

Disease	Causative agent	Symptoms	Treatment
Viral hemorrhagic septicemia (VHS) or Egtved disease	*Viral hemorrhagic septicemia virus* (VHSV, or VHSv)	Bulging eyes, bloated abdomens, bruised-looking reddish tints to the eyes, skin, gills and fins.	Chlorine bleach kills the VHS virus
Infectious hematopoietic necrosis virus	A negative-sense single-stranded, bullet-shaped RNA virus	Abdominal distension, bulging of the eyes, skin darkening, abnormal behavior, anemia, and fading of the gills.	No treatment had yet proven to be effective. To prevent the disease, strict isolation, hygiene, and testing procedures should be in place.
Spring viremia of carp	Rhabdovirus	External hemorrhaging, pale gills, and ascites.	Currently efforts have been made to prevent infection by the virus through the development of DNA vaccines and immunostimulatory therapeutics.

Bacterial Diseases

Disease	Causative agent	Symptoms	Treatment
Columnaris Disease or "Cotton wool" disease	*Flexibacter columnaris*	Grey whitish spots appear on the head and fins, gills and lateral sides of body. These spots become ulcerated with reddish colored periphery around the lesion.	Use $KMnO_4$ @ 2-3ppm in the fish pond. Bath the fish in 1-2ppm $KMnO_4$ solution. For bigger fish more than 1kg give injection of 25mg streptomycin and 20000 IU penicillin per kg body weight of fish. Provide Nitrofurazone in fish feed @ 6.5 g /100 kg fish/day.
Bacterial Hemorrhagic Septicemia (BHS)	*Aeromonas hydrophila*, *Pseudomonas flurescense, A. liquefaciens typus* (or *forma*) *ascitae.*	Accumulation of red fluid in body cavity; other symptoms include destruction of lever cells, green or yellow coloration of liver, necrosis of skin and inflammation of the blood vessels. Exophthalmia (bulging eyes).	Use 2-3ppm $KMnO_4$ in the fish pond; use Terramycin @ 65-80mg /kg fish body weight up to 10 days. Give injection of streptomycin 25mg and Penicillin 20000 IU per kg body weight of fish, only for bigger fish more than 1 kg.
Edwardsiellosis	*Edwardsiella tarda*	Removal of scales, causing skin lesions and damage of muscle tissues. Many gaseous wounds appear on the skin, causing bad smell.	Use tetracycline or sulphonamide @ 8-12 mg/kg fish with fish feed. Provide bath treatment in 1:20,000 copper sulfates solution for 15 minutes. Put the fish is 0.04ppm iodine solution for 2 hrs. Improve the water quality hygiene food and stocking density.
Vibrosis, pike pest, or pike vibriosis	*Vibrio anguillarum*	Dark skin oozing bloody exudates; accumulation of fluid in body cavity; Exophthalmia with white spots.	Use vaccination in proper way. Provide the Oxytetracycline and sulphonamide or nitrofurazone @ 8-12 mg/kg feed. Disinfect the pond with slacked lime.
Furunculosis	*Aeromonas salmonicida*	Hemorrhagic septicemia, ulcerative appearance from blood capillaries to skin releasing of blood-stained fluid into water.	Provide rational vitamin rich food to fish. Foreign material should not be allowed in the fish ponds and hatcheries. Use sulfonamide @ 5g/100 kg fish per day and also use Chloramphenicol and Oxytetracycline @ 5-8 g/ 100 kg of fish per day with feed.
Fin Rot or tail Rot	*Aeromonas fluorescence* and *Pseudomonas putrifaciens*	Outer edges of fins become slightly cloudiness, and at advance stage of disease the tissues of fins and tail get necrosed and finally the tail and fins disappear.	Use long bath in acriflavine @ 10gm/100-liter water or sulfonamide @ 10gm/100-liter water; use dip treatment with emequil @ 10 ml/100 lit for 24-48 hrs. For bigger fish more than 1kg weight give injection of antibiotic Kanamycin @ 20mg/kg body weight fish, disinfect the tanks, raceways with chlorine and copper sulfate (1:2000).

Disease	Causative agent	Symptoms	Treatment
Dropsy	*A. hydrophila*	Gills become pale in colour, exophthalmia, anus becomes swelling with red coloration, bulging eyes and heavy tummy; fish swim near the surface of pond.	Disinfect the pond with slacked lime @100kg per hectare. Use Oxytetracyclin or Chloromycin @ 5mg per kg fish.
Epizootic Ulcerative Syndrome	*A. hydrophila, A. salmonicida, Pseudomonas fluerescens, Saprolegnia ferox, Aspergillus* sp. *Aphanomyces invadans* etc.	Mouth of fish becomes deformed as cauliflower disease. Several red ulcers are formed on the skin of fish.	Provide bath treatment of fish with copper sulfate @ 100-200g/100litre water. Spray 1-2kg copper sulfate per hectare. Apply slacked lime @ 400-600kg per hectare pond. Apply Potassium permanganate @1-2kg per hectare. Apply Cifax or Tinchlor Iodine@ 1-2liter per hectare.
Bacterial Kidney Disease	*Renibacterium salmoninarum*	Kidney becomes swollen; cysts are formed in posterior kidney. A bloody turbid or yellow brown fluid often accumulates in the abdominal cavity and around the heart. The intestinal tract may contain a white or yellow viscous fluid.	Use erythromycin phosphate @1.0mg per kg body weight of fish. Provide bath treatment in 2ppm erythromycin phosphate solution up to 1hr.

Fungal Diseases

Disease	Causative agent	Symptoms	Treatment
Saprolegniasis and Achlyasis	*Saprolegnia ferox, S. parasitica, Achlya hoferi*	Fins become frayed and provide the place for bacterial infection. The fungi penetrate into the muscle tissues.	Provide Bath treatment of potassium permanganate @ 100g/100-liter water for 10 minutes. Provide dip treatment with Copper Sulfate @ 100g/100liter water for 1minute.
Ichthyosporidiosis	*Ichthyosporidium hoferi*	The destruction of the epidermis in these points results in desquamation and the formation of tiny white colored necrotic areas, produced by the growth of the fungus.	Bath treatment in 3% salt solution is effective. Add copper sulfate @ 1-2ppm in fish pond. Add formation @ 15-25ppm in the pond. Bath the fish with 20ppm formalin up to 2-5 minutes.
Branchiomycosis	*Branchiomysis sanguinis* and *B. demigrans*	Necrotic patches on the gills, together with false membrane formation; made up of proliferation and adhesions of the gill epithelium.	Disinfect the tanks and ponds with quick lime or calcium cyanamide @ 2ppm, after complete drying the pond or tank. Treat the fish with 3% salt solution and add copper sulfate @ 1-2ppm in the fish pond.

Other Prasitic Diseases

Disease	Causative agent	Symptoms	Treatment
Costiasis	*Costia necatrix*	Soft grayish-white film or sheet is observed on the surface of the fish body and the more intensely affected parts are reddened and hemorrhagic. Fishes scrape themselves against stones and other solid objects.	Infected fish should be removed from the tanks and ponds. Leeches should be destroyed, since these are vectors of the disease.
Whirling disease, Myxosporidiosis, Microsporidiosis, or lentosporidiosis	*Myxosoma cerebralis*, *Ceratomyxa shasta* and *Microsporidium* sp. *Myxosoma cartilaginis, Glugea hertwigi*	First symptom rotatory movements and black coloration in the caudal region of the body; moving on the surface of the water, the fish start this whirling movement when they swim.	Contaminated tanks must be disinfected with grease free calcium cyanamide @ 1 kg /m^2. Apply slaked lime @ 80 Kg/ha in the pond before stocking the fish and use bleaching powder for pretreatment.
Chilodonellasis	*Chilodonella cyprini*	The skin of infected fish shows bluish-white opaqueness. Small pox like pimples appear in the neck region and near dorsal fins. Infected fish scrape their body against the bottom side of tank/pond and swim listlessly with improper respiration.	Methylene blue @ 3ppm and Acriflavine @ 10ppm were used successfully to control of this disease. Copper sulfates bath @ 8ppm for 15 mm are most effective method. Lysol @ 200 ppm bath treatment up to 30 seconds is also effective.
Dactylogyrosis	*Dactylogyrus vastator, D. Formosus*	The edges of gills turn grayish in colour. Initially these worms attack on gill filaments but when they are present in large numbers, they become distributed in all over the body.	Provide short bath in 40% formalin in 100-liter water for 30 minutes. Bath the fish in 3-4% salt solution for 2-3 minutes.
Gyrodaclylosis	*Gyrodactylus elegans, G. medius*	These parasite attacks on skin causing inflamed and radish areas. Flashing in common symptom. In severe condition the	Formalin bath treatment @ 25ppm; NaCl salt solution bath treatment @ 2-5%

Disease	Causative agent	Symptoms	Treatment
		cornea of eyes become turbid due to blindness.	
Argulosis or fish louse	*Argulus foliaceus*, *A. pellucidus* and *A. coregoni*	These parasite attacks on skin causing inflamed and reddish areas. Secondary infection may be of bacterial hemorrhagic septicemia.	Provide short bath in 40% formalin in 100-liter water for 30 minutes. Bath the fish in 3-4% salt solution for 2-3 minutes. Apply cleaner @ 1-1.5 liter per hectare pond.
Lernaea (Anchorworm)	Anchor worms	Lernaea frequently attack almost all the species of major carps and sometimes cause large scale damage in nursery and rearing ponds.	Provide short bath in 40% formalin in 100-liter water for 30 minutes. Bath the fish in 3-4% salt solution for 2-3 minutes. Apply cleaner @ 1-1.5 liter per hectare pond.

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BIOFLOC TECHNOLOGY : AN EMERGING AVENUE IN AQUACULTURE

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Introduction

Biofloc Technology (BFT) is considered as new "blue revolution" since nutrients can be continuously recycled and reused in the culture medium, benefited by the minimum or zero-water exchange. BFT is an environment friendly aquaculture technique based on in-situ microorganism production. Biofloc is the suspended growth in ponds/tanks which is the aggregates of living and dead particulate organic matter, phytoplankton, bacteria and grazers of the bacteria. It is the utilization of microbial processes within the pond/tank itself to provide food resources for cultured organism while at the same time acts as a water treatment remedy. Thus, this system is also called as active suspension ponds or heterotrophic ponds or even green soup ponds.

How Biofloc Floc Technology works?

- Biofloc system is a wastewater treatment which has gained vital importance as an approach in aquaculture.
- The principle of the technique is to maintain the higher C-N ratio by adding carbohydrate source and the water quality is improved through the production of high-quality single cell microbial protein.
- In such condition, heterotrophic microbial growth occurs which assimilates the nitrogenous waste that can be exploited by the cultured species as a feed and also works as bioreactor controlling of water quality.
- Immobilization of toxic nitrogen species occurs more rapidly in biofloc because of the growth rate and microbial production per unit substrate of heterotrophs are ten-times greater than that of the autotrophic nitrifying bacteria.
- This technology is based on the principle of flocculation within the system.

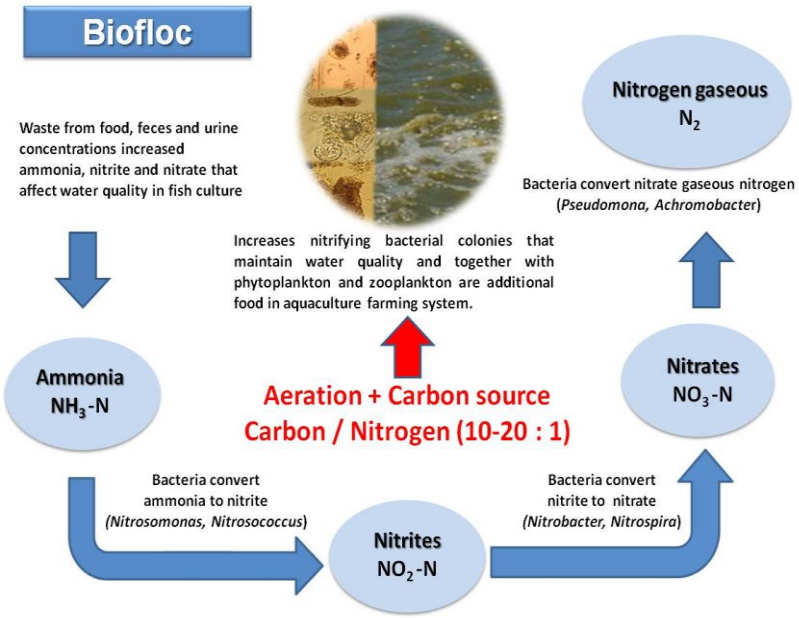

Fig 1: Biofloc system design

Composition and Nutritional Value of Biofloc

Biofloc is a heterogeneous aggregate of suspended particles and variety of microorganisms associated with extracellular polymeric substances. It is composed of microorganisms such as bacteria, algae, fungi, invertebrates and detritus, etc. It is a protein rich live feed formed as a result of conversion of unused feed and excreta into a natural food in a culture system on exposure to sunlight and vigorous aeration. Each floc is held together in a loose matrix of mucus that is secreted by bacteria and bound by filamentous microorganisms or electrostatic attraction. Large flocs can be seen with the naked eye, but most of them are microscopic. Floc size range from 50 – 200 microns. A good nutritional value is found in Biofloc. The dry weight protein ranges from 25 – 50%, fat ranges 0.5 – 15%. It is a good source of vitamins and minerals, particularly phosphorous. It has an effect similar to probiotics. The dried biofloc is proposed as an ingredient to replace the fishmeal or soybean in the feed.

Fig 2: Talwar Biofloc fish farm Khatima, Uttarakhand

Advantage of Biofloc Floc Technology

- Eco-friendly culture system
- It reduces environmental impact
- Judicial use of land and water
- Limited or zero water exchange system
- Higher productivity (It enhances survival rate, growth performance, better feed conversion in the culture systems of fish)
- Higher biosecurity
- Reduces water pollution and mitigate the risk of introduction and spread of pathogens
- It reduces utilization of protein rich feed and cost of standard feed
- It reduces the pressure on capture fisheries i.e., use of cheaper food fish and trash fish for fish feed formulation

Species suitable for Biofloc Culture

Major cultivable fish species in Biofloc Floc Technology

Biofloc system is most suitable for species that can tolerate high solids concentration in water and are generally tolerant of poor water quality. Some of the species that are suitable for BFT are:

- Air breathing fish like Singhi (*Heteropneustes fossilis*), Magur (*Clarias batrachus*), Pabda (*Ompok pabda*), Anabas/Koi (*Anabas testudineus*), Pangasius (*Pangasianodan hypophthalmus*)

- Non-air-breathing fishes like Common Carp (*Cyprinus carpio*), Rohu (*Labeo rohita*), Tilapia (*Oreochromis niloticus*), Milkfish (*Chanos chanos*)
- Shellfishes like Vannamei (*Litopenaeus vannamei*) and Tiger Shrimp (Penaeus monodon)

Singhi (*Heteropneustes fossilis*)

Tilapia (*Oreochromis niloticus*)

Technical Specifications- 100 m^3 (7 Tanks)

S.No.	Component	Details
1	Area for 7 tanks	200 m^2
2	Biofloc Tank size	4 metre diameter and 1.5-meter height (1.20 m water depth)
3	Water holding capacity of each tank	15,000 Litres capacity
4	Water quality parameters	Dissolved Oxygen-5mg/L, Temparature-26-34°C, pH-7.5 to 8, TDS-600ppm, Floc density-25-40 mg/l, Ammonia-0.5 ppm, Nitrite-0.3 ppm, Nitrate-150 ppm, Alkalinity-120-280 ppm
5	Tanks Made-up of	Tarpaulin/Fibre/HDPE
6	Stocking density	100 no. /m^3 (1000 no. per 15,000 litres tank - depending on species)
7	Species cultured	GIFT Tilapia (Oreochromis niloticus)
8	Survival (%)	80
9	Type of feed to be used	floating pellet feed
10	% of feed	2-3% per Average Body weight
11	Feeding frequency	4 times early stage, later 2 times per day
12	FCR	1:1.2
13	Duration of culture	6 months
14	Size/weight of the species(gm)	500 gm average weight
15	No. of crops per year	2
16	Production	4.2 Tonnes per crop (600kg per tank per crop)
17	Fish price (Rs.)	130/- kg fish
18	Capital cost	6.00 Lakhs
19	Input cost	1.5 lakhs per one crop
20	Total project cost	7.5 lakh

Cost Estimates of Biofloc Unit with 7 Tanks

S. No.	Component	Nos	Cost (Rs)	Total (Rs in lakhs)
Capital cost				
1	Setup of Tarpaulin/Fibre tanks (15,000 Litres capacity)	7	25,000	1.75
2	Shed material and accessories fixing charges	200 m^2	120000	1.20
3	Water supply borewell(3HP)	1	100000	1.00
4	PVC pipe fittings for air, water flow	LS	75000	0.75
5	Nets and accessories	5	3000	0.15
6	One Blower (1 HP), Air stones and other accessories	1	30000	0.30
7	Electrification	LS	10000	0.10
8	Power generator (2 KVA)	1	45000	0.45
9	Weighing balance	1	5000	0.10
10	Miscellaneous expenses			0.20
			Total Capital Cost	**6.00**
Input cost for one crop				
11	Seed cost, Feed cost, Probiotics, Test kits etc.			1.50
Total Input cost (per one crop)				**1.50**
			Grand total	**7.50**

input cost may vary depending on stocking density

Economic feasibility (one crop) from 7 Tanks

S. No.	Components	Amount (Rs in lakhs)
1	Capital Cost	6.00
2	Operational Cost	1.50
3	Total project Cost	7.50
4	Gross income per crop	5.46
5	Gross income at the end of one crop after deducting the recurring cost for the 2nd crop	3.96
6	Gross income from the 2nd crop	5.46
7	Gross income at the end of 2nd crop	9.42
8	Depreciation/maintenance @ 15% of capital cost	0.975
9	Interest @ 12% of TPC	0.90
10	Repayment @ 1/7th of the TPC	1.07
11	Recurring cost for the next crop	1.50
12	Net profit at the end of 2nd crop 9.42-(0.975+0.9+1.07+1.50)	4.975

Conclusion

Biofloc technology application offers benefits in improving aquaculture production that could contribute to the achievement of sustainable development goals. This technology could result in higher productivity with lesser impact on the environment. Furthermore, biofloc systems may be developed and performed in integration with other food production, thus promoting productive integrated systems, aiming to produce more food and feed from the same area of land with minimum input. The biofloc technology is still in its initial stage. A lot more research is needed to optimize the system (in relation to operational parameters) e.g., in relation to nutrient recycling, MAMP production and immunological effects. In addition, research findings will need to be

communicated to farmers as the implementation of biofloc technology will require upgrading their skills.

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WETLAND CONSERVATION AND MANAGEMENT

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Introduction

A wetland is a land area which is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem. It is considered as the most biologically diverse of all ecosystems, serving as home to variety of plant and animal life. Wetlands constitute a vital component of our ecosystem. They are low lying area and can be called as ecotone. Wetlands are the ecosystem in which sand is hydric because soil is totally saturated with water. Wetlands that are situated along the floodplains of rivers are called floodplain wetlands. Roughly 12% of the earth's surface is covered by wetlands: of this 5% is under floodplain wetlands. It is totally chocked with organic matter. Wetlands found in both inland and marine area. They help in reducing the impact from storm, attenuate flood, recharge ground water, maintain water quality, store carbon; keeps stabilize climatic conditions, control pests and works as kidneys of the landscape.

Types of Wetland

Coastal Wetlands

- They are found in the areas between open sea and land that are not influenced by rivers i.e., Beaches, mangroves coral reefs and shoreline etc.

Shallow lakes and ponds

- These wetlands are areas of permanent or semi-permanent water with little flow. They include spring pools, vernal pools, salt lakes and volcanic crater lakes.
- They are shallow, small, intermittently flooded depressions in grasslands or forests,and are often only wet in winter and early spring.

Bogs

- Bogs are waterlogged peat lands in old lake basins or depressions in the landscape. Almost all water in bogs comes from rainfall.
- Bogs have specialized and unique flora that have evolved in their nutrient-poor and acidic conditions, including for example the carnivorous pitcher plant.
- Water source is rain water. Typical vegetation dominated by insectivorous plant like venus fly trap and pitcher plant other plants like sphagnum (acidic moss) also present.
- pH ranges from 3.2 to 4.7 and base fully devoid of oxygen.

Marshes and Swamps

- Also known as palustrine wetlands, marshes, swamps, and fens account for almost half of all wetlands throughout the world.
- Marshes form in depressions in the landscape, as fringes around lakes, and alongslow-flowing streams and rivers.
- Trees and shrubs are absent in marsh and swamps are dominated by trees.

Estuaries

- Area where rivers meet the sea and water changes from fresh to salt can gives an extremely rich mix of biodiversity.
- It includes deltas, and salt marshes. Mudflats and Seagrass beds in particular provides better food for many species of insects, fish, birds, turtles and other species. They provide nutritive condition to different type of fish species.

Factors Affecting Wetland

- Urbanization
- Impervious surface
- Construction of bridges and highways
- Sanitary landfills
- Industries effluents (PAH's & radioactive metals)
- Untreated runoff
- Alien species
- Peat mining

Why conserve wetlands?

Wetlands are among the world's most productive environments. They are wellsprings of biological diversity, providing the water and primary productivity upon which countless species of plants and animals depend for survival. They support diversity of birds, mammals, reptiles, amphibians, fish and invertebrate species. Wetlands are also store houses of plant genetic material. For example, Rice is a common wetland plant. It is the important diet of more than half of humanity. Our over-exploitation of water resources puts at risk human well-being and the environment. Access to safe water, human health, food production, economic development and geopolitical stability are made less secure by the degradation of wetlands driven by the rapidly widening gap between water demand and supply. Even with current attempts to maintain minimum water flows for ecosystems, the capacity of wetlands to continue to deliver benefits to people and biodiversity, including clean and reliable water supplies, is declining. This has led to large expenditures to restorelost or degraded hydrological and biological functions of wetlands.

Types of Approaches for Wetland Management

1. Passive approach : Renewing wetland functions is to remove the factors causing wetland degradation or loss and let nature do the work of re-establishing the wetland. Natural regeneration ofwetland plant communities, natural decolonization by animals, and re-establishment of wetland hydrology and soils. Most appropriate when the degraded site still retains basic wetland characteristics and the source of the degradation is an action that can be stopped. The benefits are low cost and a high degree of certainty.

2. Active approach : Physical intervention in which humans directly control site processes to restore,create, or enhance wetland systems. Methods include re-contouring a site to the desired topography, changing the water flow with water control structures (i.e., weirs or culverts), intensive planting and seeding, intensive non-native species control, and bringing soils to the site to provide the proper substrate for native species. Most appropriate when a wetland is severely degraded or when goals cannot be achieved in any other way, as is the case with wetland creation and most enhancements.

The Ramsar Convention in Wetlands

The Convention on Wetlands of International Importance holds the unique distinction of being the first modern treaty between nations aimed at conserving natural resources. The signing of the Convention on Wetlands took place in 1971 at the small Iranian town of Ramsar. Since then, the Convention on Wetlands has been known as the Ramsar Convention. The Ramsar Convention's broad aims are to halt the worldwide loss of wetlands and to conserve, through wise use and management, those that remain. This requires international cooperation, policy making, capacity building and technology transfer.

Ramsar Wetland Sites in India

Sl. No.	Name of Site	State Location	Date of Declaration	Area (in Sq. km.)
1	Asan Conservation Reserve	Uttarakhand	21.7.2020	4.444
2	Asthamudi Wetland	Kerala	19.8.2002	614
3	Beas Conservation Reserve	Punjab	26.9.2019	64.289
4	Bhitarkanika Mangroves	Orissa	19.8.2002	650
5	Bhoj Wetlands	Madhya Pradesh	19.8.2002	32.01
6	Chandertal Wetland	Himachal Pradesh	8.11.2005	0.49
7	Chilka Lake	Orissa	1.10.1981	1165
8	Deepor Beel	Assam	19.8.2002	40
9	East Kolkata Wetlands	West Bengal	19.8.2002	125
10	Harike Lake	Punjab	23.3.1990	41
11	Hokera Wetland	Jammu and Kashmir	8.11.2005	13.75
12	Kabartal Wetland	Bihar	21.07.2020	26.20
13	Kanjli Lake	Punjab	22.1.2002	1.83
14	Keoladeo Ghana NP	Rajasthan	1.10.1981	28.73
15	Keshopur-Miani Community Reserve	Punjab	26.9.2019	3.439
16	Kolleru Lake	Andhra Pradesh	19.8.2002	901
17	Loktak Lake	Manipur	23.3.1990	266
18	Lonar Lake	Maharashtra	22.7.2020	4.27
19	Nalsarovar Bird Sanctuary	Gujarat	24.09.2012	120
20	Nandur Madhameshwar	Maharashtra	21.6.2019	14.37
21	Nangal Wildlife Sanctuary	Punjab	26.9.2019	1.16
22	Nawabganj Bird Sanctuary	Uttar Pradesh	19.9.2019	2.246
23	Parvati Agra Bird Sanctuary	Uttar Pradesh	2.12.2019	7.22
24	Point Calimere Wildlife and Bird Sanctuary	Tamil Nadu	19.8.2002	385
25	Pong Dam Lake	Himachal Pradesh	19.8.2002	156.62
26	Renuka Wetland	Himachal Pradesh	8.11.2005	0.2
27	Ropar Lake	Punjab	22.1.2002	13.65
28	Rudrasagar Lake	Tripura	8.11.2005	2.4
29	Saman Bird Sanctuary	Uttar Pradesh	2.12.2019	52.63
30	Samaspur Bird Sanctuary	Uttar Pradesh	3.10.2019	79.94

Sl. No.	Name of Site	State Location	Date of Declaration	Area (in Sq. km.)
31	Sambhar Lake	Rajasthan	23.3.1990	240
32	Sandi Bird Sanctuary	Uttar Pradesh	26.9.2019	30.85
33	Sarsai Nawar Jheel	Uttar Pradesh	19.9.2019	16.13
34	Sasthamkotta Lake	Kerala	19.8.2002	3.73
35	Sunderbans Wetland	West Bengal	30.1.2019	4230
36	Surinsar-Mansar Lakes	Jammu and Kashmir	8.11.2005	3.5
37	Sur Sarovar	Uttar Pradesh	21.8.2020	4.31
38	Tso Kar Wetland Complex	Ladakh	17.11.2020	95.77
39	Tsomoriri Lake	Jammu and Kashmir	19.8.2002	120
40	Upper Ganga River (Brijghat to Narora Stretch)	Uttar Pradesh	8.11.2005	265.9
41	Vembanad Kol Wetland	Kerala	19.8.2002	1512.5
42	Wular Lake	Jammu & Kashmir	23.3.1990	189

Three Pillars of the Convention

1. Wise Use

- Maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development".

2. Wetlands of International Importance

- "Promote the conservation" of all of those listed sites, and this system forms the world's largest network of protected areas.

3. International Cooperation

- Trans-boundary wetlands, shared water systems and shared or migratory species, andto share expertise and resources with Parties less able to meet their commitments.

How to Reduce Wetland Loss

- Identified and understand ecosystem
- Use different technology like remote sensing, GPS, GIS etc. all these aids can help informing map and data.
- We should learn about our natural ecosystem
- Mapping tools can help us.
- Reduction of pollution
- Laws and legislation should apply on these types of issue
- Stop invade of invasive species
- By raising awareness through various initiatives and projects aimed at students, teachers, media and the general public, as well as through more technical tools, including consultations, workshops, books and research focusing on international policy and communication.
- By fencing.

Fisheries Management

- **Capture fishery for open wetlands** : allow natural fish recruitment where optimum ecological conditions, protection of breeding ground.
- **Culture-based fishery for closed wetlands :** cage culture, pen culture, stocking and recapture
- **Capture and culture-based fisheries :** wild stock capture for maintenance of genetic diversity, stocking of high genetic profile fish species
- **Integrated management :** habitat restoration, paddy cum fish culture, macrophytesused as aquifers
- **Species options :** introduction of high genetic profile fish species, restocking ofnative species
- **Restoration, enhancement and preservation** : ranching, active approachmanagement, passive approach management.

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ICE APPLE - THE MYSTERIOUS FRUIT

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Introduction

Ice apple (palm fruit) is a seasonal fruit of the sugar palm tree and is widely available during the sizzling summer. The fleshy fruit loaded with translucent, juicy fluid has excellent cooling properties. Ice apple (palm fruit) or nature's halwa is a famous juicy translucent fruit of India, native to the eastern and southern parts of the country. It goes by different names like Thati Munjalu in Telugu, Taal Patali in Bengali, Tari or Tadgola in Marathi, Pananungu in Malayalam, Tala in Oriya, Taati Nungu in Tamil and many others.

Ice apple is very similar to litchi fruit in texture and tastes like a slightly sweet tender coconut. Due to its cooling effect and translucent jelly-like appearance, it is known as ice apple.

Ice Apple Nutrition

Ice apple is a low-calorie fruit providing 43 calories per 100 grams, it is powerhouse of carbohydrates and rich in calcium and phytonutrients. It also contains a minimal amount of fibre, protein, vitamin C, A, E, K, B7 and iron which confers you with a host of healing health benefits.

Nutrient Value per 100g	
Nutrients	**Content**
Water	86.5g
Carbohydrates	11.1g
Protein	0.8g
Fat	0.1g
Fiber	0.9g
Calcium	28mg
Phosphorous	30mg
Iron	1mg
Vitamin C	5mg
Thiamin	0.04mg

Major Benefits of Ice Apple

- **Natural Hydrator and Prevent Heat Stroke :** Being hydrated is one of the most prominent issues in summers. Ice apple contains a good amount of sodium and potassium, therefore, it helps in maintaining the fluid and electrolyte balance in the body making it best to prevent dehydration. It contains lot of water and thus keep our body hydrated and prevents heat stoke

- **Strong Immune System :** Ice apple is loaded with tons of minerals and vitamins, which assist to strengthen our immune system. For instance, due to the presence of potassium, it aids in cleansing the toxins out of the body and promotes the health of the liver. Moreover, doctors too recommend this fruit to people.

- **Reduces Prickly Heat Pimples :** Ice apple aids in cooling the body during summer season and provides relief from the prickly heat pimples
- **Enhance Energy :** The best benefit of Ice apple is that it keeps the glucose level high and provides right balance of minerals and nutrients to the body.
- **Weight Loss :** A low-calorie watery fruit ice apple is an ideal deal to lose weight. The presence of water keeps you satiated for a long time and help in losing the weight naturally.
- **Helpful With Rashes :** It helps to prevent heat rashes and prickly heat that are very common in summer. Applying the flesh of ice apple on the affected areas helps relieve itchiness during summer, therefore providing a soothing effect.
- **Solve Digestive Issues :** Digestive problems another one of the issues faced by people nowadays. However, ice apple is itself an effective natural remedy for people suffering from these issues, including constipation and acidity. It relieves several stomach ailments including acidity and ulcers. Ice apple also helps to get rid of heat boils, which are common during summers.
- **Natural Coolant :** Ice apple acts as an excellent natural coolant and naturally cools the body in the summer regulating the body temperature. It quenches the thirst and provides energy to stay active throughout the day.
- **Phytochemicals Storehouse :** Ice apple is considered to possess several strong phytochemicals that have antioxidant and anti-inflammatory properties, which not only help slow down ageing and reduce the risk of developing incurable diseases such as heart disease and cancer.
- **God's Gift for Pregnant Women :** Pregnant women are strongly advised to eat ice apple because it not only aids the digestion process directly but also reduces the feeling of nausea and vomiting, which are common during pregnancy. Furthermore, the consumption of palm fruit is also known to improve the quality of breast milk in the feeding mother. It adds to the nutritional value that the baby receives from the milk, and acts as a good supplement, too. It also acts as a natural energy supplement and regulator. With the combination of minerals and salts within, it helps maintain the right glucose level in your body and keeps you fresh. Also Ice apple designate the existence of the phytochemical anthocyanin which may inhibit the growth of tumors and breast cancer cells.

Important Note

The fruit is highly perishable and should be consumed within a day. Don't eat overripe Ice apples it may cause stomach aches.

Conclusion

Besides being a natural coolant, the translucent fruit is known to be a perfect mix of minerals and sugars that are needed by the body. It provides the perfect blend of minerals and sugars for the body during the summer season. Ice apple has a lot of health benefits, therefore making it a precious fruit that Mother Nature has provided to Indians.

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FOOD IRRADIATION- CONCEPT OF PRESERVATION

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Introduction

Food irradiation (the application of ionizing radiation to food) is a technology that improves the safety and extends the shelf life of foods by reducing or eliminating microorganisms and insects. Like pasteurizing milk and canning fruits and vegetables, irradiation can make food safer for the consumer. The Food and Drug Administration (FDA) is responsible for regulating the sources of radiation that are used to irradiate food. The FDA approves a source of radiation for use on foods only after it has determined that irradiating the food is safe. Technology of irradiation was appropriate technology that can be used for preserving food. Nuclear irradiation technology in the field of food, besides being able to preserve food, can also sterilize certain foodstuffs in an effort to create food security. The advantages of this technology are efficient energy and materials, easily controlled, no residues and its' environmentally friendly.

Technology

Irradiation does not make foods radioactive, compromise nutritional quality, or noticeably change the taste, texture, or appearance of food. In fact, any changes made by irradiation are so minimal that it is not easy to tell if a food has been irradiated. The technology of preserving foodstuffs has been widely developed and practiced as with warm-up, freezing, evaporation, the use of synthetic chemicals and fogging. Technology is evaluated less effective in preserve foodstuffs due to not being able to kill microbial pathogens and tend to produce residues in spite the small concentrations. Microbial pathogens that originate from the air has good resistance when it was in a State of frozen or hot, smoky. Another dangerous thing is when adding synthetic preservatives that are obviously harmful towards health. It is therefore necessary that appropriate technology innovation can preserve food ingredients and retaining the quality of foodstuffs.

Insights

Ionizing radiation will break the bonds of phosphodiester and hydrogen bonding on the DNA strand of a Microbe that will lead to obstruct the growth of microbes. Based on the capability of resistance, there are several types of microbial pathogens having the ability to fix the strands of DNA which ties cut off. Other treatments such as fogging or frosting are necessary for the effectiveness of irradiation technology. Technology is the combination of irradiation with other treatments such as freezing is able to inhibit the growth of microbes. This is due to the low temperature, can stop enzyme activity as well as damaging the protoplasm of colloidal systems further will cause denaturation of cell growth so that it becomes obstructed.

How is food irradiated?

There are three sources of radiation approved for use on foods.

- Gamma rays are emitted from radioactive forms of the element cobalt (Cobalt 60) or of the element cesium (Cesium 137). Gamma radiation is used routinely to sterilize medical, dental, and household products and is also used for the radiation treatment of cancer.

- X-rays are produced by reflecting a high-energy stream of electrons off a target substance (usually one of the heavy metals) into food. X-rays are also widely used in medicine and industry to produce images of internal structures.
- Electron beam (or e-beam) is similar to X-rays and is a stream of high-energy electrons propelled from an electron accelerator into food.

Safety of Irradiation Technology on Food Products

World Health Organization (WHO) States that the technology of irradiation is a safe way to extend the power save food. The WHO also stated that the recommended doses of irradiation do not damage the nutrient content and toxic hazards [14]. The Sources of ionizing radiation that is the recommended gamma ray has a maximum of 5 MeV. These limits are based on the radioactive impact will be incurred if the energy source of radiation used exceeds 5 MeV for gamma radiation. At the stage of high energy ionizing radiation that exceeded the recommended threshold will cause a dangerous radioactive material. The material contains high radioactive elements capable of altering the genetic order permanently.

Conclusions

Technology of irradiation is a very appropriate technology applied to the prospects for the process of preserving food. These technologies are environmentally friendly because it does not leave residue, easily controlled and energy efficient as well as materials. Gamma irradiation technology with the recommended dose may be extend the power save and do not cause radioactive materials as well as capable of creating security food products without changing the quality of the ingredients such as the chemical and nutritional content. This technology is also still need to be developed such as the necessity of the combination of irradiation Technology with existing Technologies to improve the effectiveness and efficacy in prolonging the power save, kill microbes without the slightest change the quality of the food.

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REMEDIATION OF RADIOISOTOPIC WASTE USING MICROORGANISMS

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Introduction

Isotopes are atoms of an element with the same number of protons but different numbers of neutrons. Some of these isotopes are unstable, making these atoms radioactive that decay spontaneously, emitting energy in the form of electromagnetic waves or particles. Radioactive decay involves the emission of alpha particles, beta particles, or gamma rays. Gamma rays are the most energetic and therefore most likely to ionize whatever they strike, they can damage DNA, protein, and various human tissues. These wastes can affect human health and the environment, so their safe management has received considerable attention worldwide.

Technetium, Cesium (Cs), Plutonium (Pu), Strontium (Sr), Uranium are some of the commonly used radioactive elements. Of the naturally occurring radionuclides, only uranium and radium are found in substantial amounts. Most radionuclides are produced artificially in nuclear reactors or in particle accelerators, others are produced during radioactive decay of other radionuclides. A large quantity of radioactive waste is being generated and dumped into the environment, and if the general population is exposed to it, may cause serious life-threatening disorders and acute health effects that begin with nausea, vomiting and headaches. With increased exposure a person may also experience fatigue, weakness, fever, hair loss, dizziness disorientation, diarrhoea, blood in stool, low blood pressure and ultimately death. Therefore, treatment of radioactive wastes is receiving considerable attention worldwide for the protection of human health and the environment from the adverse effect of radiation associated with these wastes.

There exists no reservations that microbes, specifically bacteria and archaea, possess tremendous knack to not only withstand extreme conditions but also carry out important biotechnological processes. Contrary to their microscopic size, they have relentlessly shown to carry out certain vital and unique processes without which other life might not be able to sustain or even exist. Using microorganisms for radioactive waste remediation is an important area of interest gaining attention among scientists and research groups.

Uses/Importance in various sectors

Radioisotopes are useful in various sectors **(Figure 1).** They are used in carbon dating, as tracers within living organisms for diagnostic purposes, radiation in radioisotopes is useful in treating certain types of illnesses, particularly cancerous tumors. Radiolabelled pesticides are used to monitor the persistence of their residues in food items, soil, ground water and environment. These studies have helped to trace and minimize the side effects of pesticides and insecticides. Besides, different types of radiation can be used to induce mutations to develop desired mutants line that are resistant to disease, are of higher quality, allow earlier ripening, and produce a higher yield. This technique of utilizing radiation energy for inducing mutation in plants has been widely used to obtain desired or improved characters in number of plant varieties.

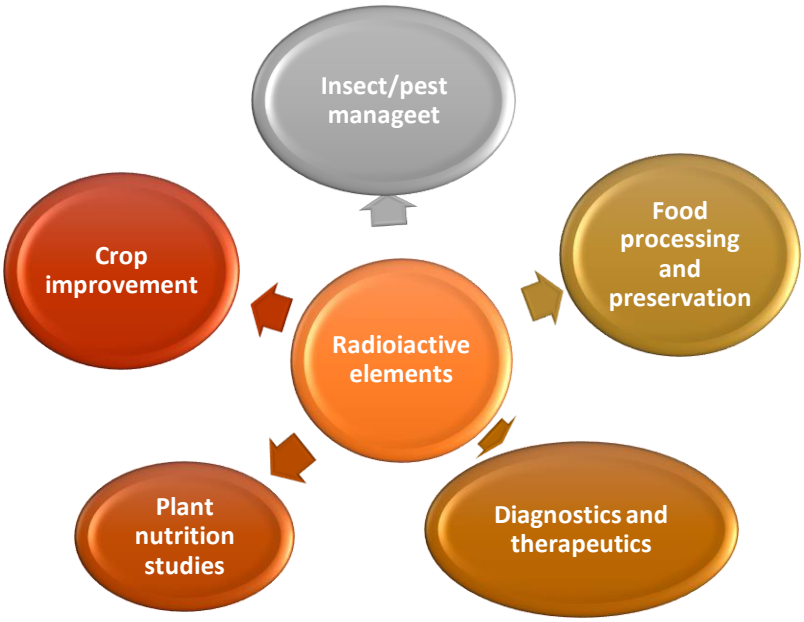

Figure 1 : Uses of radionucleotides in any sectors

Treatment of radioactive waste

Treatment is an important phase in the management of radioactive wastes, it aims to reduce the volume of generated wastes to enhance the safety and/or reduce the costs of further management phases. After the treatment phase, the wastes split to two portions, the first is a small volume of concentrate that contain the bulk of radionuclides is kept in the management system and the second is a large volume portion that have low radioactivity that allow its discharge to the environment after meeting the regulatory requirements.

Radionuclides form complexes with natural organic ligands such as humic substances. The solubility of these complexes varies with the pH of the natural aquifers in which they occur. Radionuclides also can form complexes with inorganic materials such as carbonate and sulfate. Natural organic matter (NOM) constitutes an important pool of ligands for complexing radionuclides and metal ions, and can play a role in their migration in subsurface environments.

Bioremediation has been viewed as the ecologically responsible alternative to environmentally destructive physical remediation. Microorganisms carry endogenous genetic, biochemical and physiological properties to reduce, eliminate, contain, or transform to benign products contaminants present in soils, sediments, water, or air, it has become widely accepted that microorganisms, and to a lesser extent plants, can transform and degrade many types of contaminants. Attempts have been made to develop native or genetically engineered (GE) microbes for the remediation of environmental contaminants including radionuclides. Microorganism-mediated bioremediation can affect the solubility, bioavailability and mobility of radionuclides. Therefore, we aim to unveil the microbial-mediated mechanisms for biotransformation of radionuclides under various environmental conditions as developing strategies for waste management of radionuclides.

This technology includes intrinsic bioremediation, which relies on naturally occurring processes, and accelerated bioremediation, which enhances microbial degradation or transformation through the addition of nutrients (biostimulation) or inoculation with microorganisms (bioaugmentation). Certain organic compounds, however, can play a central role in metal and radionuclide bioremediation strategies. The synthetic chelators (EDTA) and nitrilotriacetic acid (NTA) were

commonly used as cleaning agents during industrial processing of nuclear fuels at DOE and have formed stable, soluble complexes with certain metals and radionuclides in the subsurface. These chelators may be inherently toxic, and when combined with radionuclides. The increased solubility of the radionuclides to move much farther in the subsurface than normal, thereby increasing their probability of reaching risk receptors (drinking water wells and surface waters, e.g., rivers). Bioremediation is an alternative to traditional remediation technologies such as landfilling or incineration. Although prokaryotes, Bacteria and Archaea are usually the agents responsible for most bioremediation strategies, eukaryotes such as fungi and algae also can transform and degrade contaminants. Microorganisms already living in contaminated environments are often well-adapted to survival in the presence of existing contaminants and to the temperature, pH, and oxidation–reduction potential of the site. These indigenous microbes tend to utilize the nutrients and electron acceptors that are available in situ, provided liquid water is present. The bulk of subsurface microbial populations are associated with the solid phase. Water acts as a vehicle to transport both microorganisms and dissolved substances, including contaminants and their breakdown products. biodegraded. However, microorganisms can interact with these contaminants and transform them from one chemical form to another by changing their oxidation state through the adding of (reduction) or removing of (oxidation) electrons. In some bioremediation strategies, the solubility of the transformed metal or radionuclide increases, thus increasing the mobility of the contaminant and allowing it to more easily be flushed from the environment. In other strategies, the opposite will occur, and the transformed metal or radionuclide may precipitate out of solution, leading to immobilization.

For bioremediation of metals and radionuclides, first step may be to increase contaminant mobility for extraction or the choice may be to immobilize the metal through sequestration, complexation, or changes in speciation that reduce solubility. **Figure 2** represents some of the strategies aoted by microorganisms for radionucleotide bioremediation which involve, the enzymatic bioreduction of radionuclides through direct or indirect reduction of soluble contaminants in sedimentary and subsurface environments by metal reducing or sulfate-reducing microorganisms.

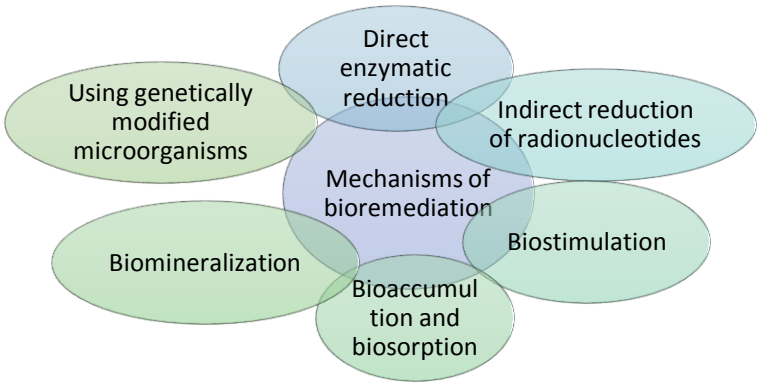

Figure 2 : Mechanisms used by microorganisms for radionucleotide remediation

Biosorption is the sequestration of positively charged metal ions to the negatively charged cell membranes and polysaccharides secreted on the outer surfaces of bacteria through slime and capsule formation. Biostimulation using specific communities of microorganisms is another mechanism to enhance the bioremediation of radionuclides. Microorganisms can interact with metal ions and immobilize them to transformation.

Genetic engineering (GE) and recombinant DNA technology have been employed to generate character-specific microorganisms for efficient removal of radionuclides by sorption. Different protein constructs have been generated in which the bacterial cell surface is equipped with metal

binding polypeptides by fusion-binding domains to outer-membrane-anchored proteins that include metallothioneins.

Challenges and future prospects

The microbes have shown their ability to undergo genetic manipulations and carry out their recombinant phenotypic traits. It is also interesting to note that the interaction mechanisms with radionuclides, as discussed above, are akin to those of metals. Recently, the biotechnological applications of recombinant bacteria have shown encouraging results in remediation of radio waste. It seems only prudent to make use of those microbes that are indigenous to radionuclide containing natural samples, such as soil, air or water, and subject them to extreme scrutiny for exploring their capabilities. True potential of these microbial processes can be unlocked by frequent and sustaining collaborations with various fields of science and technology and, once characterized completely, these microscopic beings can be used, in isolation or as a consortia, for removal of high concentrations of radiowaste. The removed radionuclide can be further used as substrate for other commercial applications. The beauty of using microbes for the job lies in their reusability. Such an approach could lead to the development of an eco-friendly way for treatment as well as extraction and/or recovery of precious radionuclides.

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NATURALLY COLOURED COTTON : AN ALTERNATIVE FOR TEXTILE INDUSTRY

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Introduction

Cotton is an ancient fibre known for its versatility, natural comfort and performance. But the process of cultivation of cotton involves the application of pesticides, and chemical fertilizers, much of which are causing devastating health hazards. Textile industry is also condemned for is usage of chemicals in the dying process. Approximately 10-15% dyes are released into environment during the dyeing process making the effluent highly colored and aesthetically unpleasant.Growing cotton without chemicals and harmful pesticides is now considered environment friendly and biodynamic. It is a positive solution to all the health hazards caused by conventional cotton cultivation, and dyeing process. Naturally pigmented cotton eliminates all the issues regarding processing and dyeing. Naturally colored cotton dates back to more than 5000 years. Historical evidences exist regarding the usage of naturally colored cotton with pink and brown tint. They are naturally pigmented fibres. The color of the cotton comes due to the plants inherent genetic properties. Based on climate and soil variations, the shades may vary.

What is dyeing?

Dyeing is the process of applying the coloring matter directly on fiber, yarn or fabric without any additives. Natural dyes were used only for coloring of textiles from ancient times till the nineteenth century. As the name suggests, natural dyes are derived from natural resources. Coloring materials obtained from natural resources of plant, animal, mineral, and microbial origins were used for coloration of various textile materials. Today is world of most scientific and advance level of dyeing. There are huge number of processes to do coloration. Natural and manmade colours are also used. In this paper, the natural dyes are extracted and fabric dyeing is analyzed by applying dye on 100% pure cotton.

Scenario in India

Cotton with naturally coloured lint, other than white, is commonly referred as coloured cotton. In nature, coloured and white linted cottons are found from time immemorial. Coloured cotton is being grown and used by mankind since 2500 B.C. The Old World Asiatic diploid cottons are presumed to originate earlier than New World allotetraploid cottons. Coloured varieties were known in diploid cottons and were under cultivation in Asia, particularly Indian subcontinent, China and Central Asian Republics of former Soviet Union since long.

In India, brown linted varieties of tree cotton (G.arboreum L.) namely Cocanada 1, Cocanada 2 and Red Northerns were under commercial cultivation mainly on black soils under rainfed condition in parts of Andhra Pradesh. Red linted types were predominant and high in demand for their better dyeing qualities and colour fastness. However, the situation has changed with the advancement and standardization of dyeing techniques. Cultivation of coloured cotton was discouraged and almost abandoned in the latter half of this century. Coloured linted varieties could not remain popular with growers, mainly because of low productivity per unit area, poor fibre characteristics and non-uniformity of colours. Need of the hour was to increase cotton production in order to meet

the basic requirements of ever increasing population for clothing. With the advancement of spinning and processing technologies, ease in imparting varied treatments of shades and colours during processing specially with the advent of synthetic dyes, greater emphasis was given in production of high yielding cotton with superior fibre quality, which resulted in the replacement of coloured cotton by white linted types. Yet, cultivation of coloured cottons continued in isolated pockets as novelty niche cotton and for aesthetic purpose.

Types of Lint Colour

The lint colour of cotton under commercial cultivation is often white. In the cultivated species, brown and green colours are most common. Some of the genotypes in germplasm collection of USA and Russian Republics are reported to have coloured lint with shades of pink, red, blue, green and also black. However, genotypes with multi coloured lint have not yet been made available to the researches nor produced on large scale. The two commonly occurring lint colours, i.e. brown and green are briefly discussed below:

Brown colour

Among the coloured cottons, brown is the most common colour. The brown colour is found in different shades which ranges from light brown to intense mahogany red. Depending on the intensity of colour, it is named as light brown, khaki / camel colour, brown, dark brown / chocolate colour, dirty grey, tan and red. Brown colour is found in all the four cultivated as well as many of the wild species. Brown colour is more stable than green colour. On continuous exposure to sunlight, brown colour also fades but gradually at a very slow rate. In India, brown linted varieties of *G.arboreum*, namely, Cocanada-1, Cocanada-2 and red Northern were under commercial cultivation during first half of the 20th century.

Green colour

Green is the second important commonly occurring lint colour in cotton. Green colour is less common than brown and occurs mainly in two shades i.e. light green and green. Green colour is more prone to fading, fades faster than the brown colour. Prolonged exposure to sunlight during boll opening leads to rapid fading of green colour and the colour turns to white, off-white or brownish. Portion of lint which is not directly exposed to sunlight retains its original lint colour. Green colour is mostly observed in *G.hirsutum* and probably varieties possessing green lint have not yet been released for commercial cultivation.

Source of Lint Colour

Germplasm collection : Genetic resources are most vital for improvement of any crop. In India, about 40 coloured genotypes of upland cotton (*G.hirsutum*), mostly of various shades of brown and green colour are available in the National Gene Bank of Cotton maintained at the Central Institute for Cotton Research, Nagpur.

Wild species : Wild species are important sources of coloured lint. Many of the wild species of genus Gossypium, including putative donors of present day tetraploid cotton i.e. G.herbaceum race africanum and G.raimondii have coloured lint. The brown colour in different shades is most common.

Development of Lint Colour

Lint colour is a genetically controlled character. Accumulation of pigments in the lumen of lint starts before boll bursting. In upland cotton (G.hirsutum), pigmentation starts appearing in the developing lint 32 days after fertilization and it takes nearly six days to develop colour. In Asiatic cotton (G.arboreum) colour pigments observed 46-47 days after fertilization which take 5-6 days for colour development. However, complete expression of lint colour takes place only when the boll bursts open and the lint is exposed to sunlight. It takes about a week for the lint to develop a complete natural colour. The intensity and the time taken for complete development of colour varies with the genetic background of the genotypes.

Advantages of Coloured Cotton

Effect on Human Health : Cotton fabrics with artificial dyes have been reported to have adverse effects on the skin and human health. Artificial dyes cause allergy and itching on the skin and sometimes may cause skin cancer. The fabric prepared from naturally coloured cotton lint is free from such adverse effects. There is no need of using artificial dyes, when the fabric is manufactured from naturally coloured cotton. Such fabric manufactured from coloured cotton has been found to be the best for human health.

Effect on Environment : Various artificial dyes are being used for dyeing of cloth manufactured from the white lint. After dyeing, the chemical residues in the form of dyeing or finishing affluents are thrown in nearby river contaminating water and soil. This form a major source of environmental pollution. When the fabric is manufactured from naturally coloured lint, there is no need of artificial dyes. Thus use of naturally coloured cotton helps in reducing environmental pollution caused by artificial dyes.

Effect on cost of Fabric Production : The dyeing process adds to the cost of production of fabric. The dyeing process is omitted when naturally coloured lint is used for manufacturing of the fabric.

Thus the cost of production of fabric can be reduced to some extent through the use of naturally coloured cotton. If the coloured cotton is paid higher price than white cotton, then the reduction in the cost of production of fabric caused by omitting dyeing process is compensated by high price of coloured cotton fabric.

Limitations of Coloured Cotton

- Low Yield Potential.
- Poor Fibre properties.
- Limited Colours.
- Instability of colours.
- Low Market Demand

Conclusion

The future of naturally coloured cotton will eventually depend on how strong the market demand grows. Currently there is a limited niche market from special consumer groups who may prefer organically grown naturally coloured cotton. While naturally coloured cotton is a precious natural resource that needs to be conserved, the future would depend on how preciously and collectively we treat this precious resource.

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GROWING CITRUS AS A BONSAI

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Abstract

Growing of fruit plants apart from ornamentals in pots for aesthetic purpose has been gaining momentum. Growing citrus plants in shallow containers as bonsai is on demand in market nowadays. Bonsai is an ancient Japanese technique that takes normal tree seedlings and turns them into miniature pieces of natural art. By training and regularly pruning the branches and roots, the trees can be kept at a miniature size for decades (Castilo, 2019). Citrus plants produce fragrant white flowers and decorative yellow or orange fruit. The size of the fruit depends on the cultivar. The species and cultivars with small fruit and small leaves are preferred for bonsai. Especially popular are the bonsai orange tree and the bonsai lemon tree. Flowering bonsai trees are beautiful but fruiting ones like bonsai orange tree is one of the prettiest.

Introduction

Bonsai is an art which expresses in miniature the beauty of natural tree forms. The word 'Bonsai' is comprised of two words *'Bon'* means a tray or shallow container and *'Sai'* means to grow; thus bonsai means something growing in a shallow container or tree in a pot. The art of bonsai is only achieved by constantly bending, hold down, and cutting the branches. These miniature bonsai trees can maintain their sizes for years and years. Growing ornamental plants as bonsai is common but growing fruiting trees as bonsai is also gaining popularity. Among fruit trees, citrus plants are also suitable for bonsai. Among citrus, lemon, kumquat and calamondin orange are popular. The lemon tree is a popular citrus that can easily grow as a bonsai. This citrus fruit is sensitive to cold that thrives in full sunlight tree. Produce a rich dark green foliage and fragrant spring flowers. When pruned properly, lemon bonsai produces edible fruit, of a size proportional to the tree, which has the same qualities as their equal-size. Another citrus suitable for bonsai is orange tree. The miniature version of this citrus fruit is called the **calamondin orange** and it is very popular in the bonsai art form because of its evergreen leaves, its capability to flower in almost all parts of the year, and its beautiful little orange fruits which **are edible** as well. Specific guidelines and cares must be followed while growing citrus as bonsai like temperature, training & pruning, fertilization or nutrition, watering, insects, diseases and weeds. They should be watched with constant attention and affection like children.

Requirements including Tools and Equipments

- Plants
- Pots – square, round, oval, rectangular, heart, hexagonal or octagonal shape with a drainage hole at the bottom.
- Potting mixture

- Potting sticks
- Sieves
- Copper wire of 10-22 gauge
- Wire cutter
- Pruning knife
- Secateur
- Watering can
- Tub
- Turntable

Styles of Bonsai Suitable for Citrus

- Formal upright
- Informal upright
- Semi-cascade
- Slanting
- Windswept
- Forest
- Twin Trunk
- Multiple trunk
- Rock grown

Specific Bonsai Care Guidelines

Suitable citrus plants : Kumquat (*Citrus japonica*), Lemon (*Citrus limon*), Orange (*Citrus sinensis*), Lime (*Citrus aurantiifolia*) (Casandra, 2018). Meyer lemons, mandarin oranges and limes are smaller trees and easy to grow indoors (Castilo, 2019). Calamondin (*Citrus microcarpa*) is very popular in the bonsai art form because of its evergreen leaves, its capability to flower in almost all parts of the year, and its beautiful little orange fruits which are edible as well (Stockton, 2017).

Propagation : Seeds, cuttings, air Layering and grafting are the methods which can be adopted (Raj, 2006). But air layering and grafting are the best methods as they are faster.

Characteristics of ideal growing medium : Coarse, well drained medium which provide basic needs like water, oxygen and nutrition is desirable. Equal portion of soil, leaf mould and crushed bricks or sand is ideal medium. Top layer must have sufficient humus.

Placement : Citrus trees love heat and sun. In a warm climate, Citrus plants can be kept outside all the year round. In temperate climates, it should be placed in full sun from May to September. From autumn until spring the tree must be placed in the house or in a greenhouse. If it is kept in a warm room in winter, extra grow lights might be necessary.

Watering : The Citrus needs regular watering in summer, but tolerates temporary dryness. It does not tolerate constantly wet soil. If the soil is well-draining, the Citrus tree must be watered thoroughly as soon as the soil surface becomes dry. In winter it needs less water. Citrus plants prefer lime-free water. Best time for watering is morning or evening.

Nutrition : A special liquid fertilizer can be used for Citrus plants for fertilizing at least once a month except for winter months (Stockton, 2017). Sludge or well rotten cow dung slurry. Groundnut and cotton or neem cake one kg each is mixed in five litres of water which is allowed to rotten or ferment for about a month before diluting another five times. A mug of this is given twice in a month. A pinch of bonemeal and single super phosphate is also very beneficial (Raj, 2006).

Pruning and Training : New shoots are cut back leaving two leaves after four leaves have developed. Regular pruning is important in order to achieve some ramification. Training is done using wire which is possible throughout the year. Good care must be taken so that the wires don't cut into the bark. Copper wire is the best for shaping the trees. Thinning the branches and stems to increase indoor air circulation and light penetration in the tree, and sprouts & suckers that grow vigorously should be removed using sharp and sterilized pruning shears (Anonymous, 2014).The purpose of training and pruning is to develop a good attractive shape. Regular trimming and pruning also restrict growth and maintain proper balance between roots and shoots. In one trimming not more than one third portion of roots or shoots are cut.

Repotting : Repotting needs to be done every two or three years in spring with root-pruning. Citrus prefers a slightly acid soil mix, so some peat can be added.

Pests and diseases : Citrus trees are often attacked by spider mites, scale, mealy bugs, leaf-miner fly, weevils and borer, especially if they are placed in a warm place with insufficient light. Specific pesticide can be used and growing conditions should be improved.

Conclusion

Making bonsai can be a hobby and also a means to make money as they cost thousands of rupees. But we must remember that this is not an easy venture and needs time and tireless efforts. This is an art without end. Growing citrus as a bonsai requires a lot of knowledge, perseverance and experience and should be taken care like pets. Choosing the right method of propagation, style, proper nutrition, regular watering, shaping or training, pruning, trimming & pinching, repotting, insects and disease management need to be done with utmost care for a healthy and beautiful plant.

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CROP INSURANCE: NEED, ADVANTAGES AND NATURE

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What is Insurance?

Insurance is a tool to protect you against a small probability of a large unexpected loss. It is a technique of providing people a means to transfer and share risk where losses suffered by few are met from the funds accumulated through small contributions made by many who are exposed to similar risks. Insurance is not a tool to make money but a tool to help compensate an individual or business for unexpected losses that might otherwise cause a financial disaster.

What is Crop Insurance?

Crop insurance is a means of protecting the agriculturist against financial losses due to uncertainties that may arise from crop failures/losses arising from named or all unforeseen perils beyond their control.

Objectives

Need of Crop Insurance

Every year, in one part of India or the other food crops are affected by natural calamities, “Crop yield instability is the normal condition and agriculture continues still to be which the farmer’s fortunes are exposed, is practically the same as before. In fact, good years and bad years, wet weather and drought or floods and frost, low yields and bumper crops are to be expected in mixed succession.

The total loss due to natural calamities (like flood, drought and plant diseases) is estimated as high as Rs. 1,000 crores every year.

The man behind the plough has to be assured that he will be compensated for such loss in crops.

Otherwise, he cannot be drawn into the campaign to increase productivity of land under his plough.

Advantages of Crop Insurance

Farmers

- Can avoid the loose incurred due to vagaries of weather
- Pest and Diseases
- Fire
- Market Prices
- Other unprevenable losses.

Banks

- Increasing the repayments capacity of debtor
- Avoiding the risk of non-payment in events of crop damage or failure

Governments

- Reducing the payment of relief package.
- A prosperous, stable and happy nation.

It provides protection to farmers against losses caused by crop failure and thereby ensures stability in farm income. It also strengthens the position of co-operatives and other institutions that finance, agriculture to the extent it enables the farmer members to repay their loans in years of crop failure. By protecting the economic interest of the farmers against possible risk or loss, it accelerates adoption of new agricultural practices. It minimizes the problem of rural indebtedness, which is traceable to the frequent failure of crops. It also reduces, to some extent, government expenditure incurred on relief measures extended to meet the havoc caused by natural calamities. It may act as anti-inflationary measure, by locking up part of the resources in rural areas.

Nature of Crop Insurance

Crop insurance makes up the loss or damage to growing crops resulting from a variety of causes such as hail or drought frost, flood and disease. The cultivators pay a premium and protection is given to them on the same basis as in other insurance. When the production from an insured acreage falls below the insured coverage, the tiller is entitled to an indemnity.

Coverage and premium rates are settled on the basis of productivity and susceptibility to risk of the lands under cultivation in the same, area. Besides an all-risk crop insurance, there are three other main types of insurance to cover the risk from fire, hail and flood.

Conclusion

To conclude, it may be said that one of the basic objectives of our economic planning is to step up farm production. This can be achieved by adopting crop insurance schemes. Crop insurance schemes will assure the farmers that they will be compensated for losses against natural calamities.

These schemes will not only spread the losses geographically but also spread them over the time. The raison d'être of crop insurance is the stability it imparts to the agricultural produce. Therefore, the earlier the scheme is put into operation, the better it will be for the farmers and for the nation.

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RODENT AND FUNGUS INFESTATION ON LOW COST HYDROPONIC SEED GERMINATION TECHNIQUE FOR CITRUS CV. RANGPUR LIME (*CITRUS LIMONIA*)

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Abstract

Citrus seed being recalcitrant in nature 100% germination are difficult under the field condition. Under low cost hydroponic technique of seed germination, Rangpur Lime seed germination started after 13 days with the germination percentage of 98.9% as compared to 21.4% in the field condition which germinate after 32 days of seed sowing. This experiment proved to be cheap and better seed germination for the citrus seed, for raising rootstock. However, precautions of rodent and fungus infestation are necessary before the germination of the seed under hydroponic technique.

Key words : Rangpur Lime, hydroponics, rodent, fungus, seed germination

Introduction

Rangpur lime (*Citrus limonia*) is most likely a lemon (*Citrus limon*) × mandarin (*Citrus reticulata*) hybrid originating in India. The fruit whose peel is reddish-orange, with large oil glands, thin and easily removed resembles mandarin orange. It is a prolific variety of citrus with well flavoured and highly acidic fruits. The variety has worldwide usage as a rootstock on account of its high resistance to tristiza virus and more tolerant to salts as well as drought than others rootstock. It is an important rootstock for mandarin and sweet orange which are commercially propagated by seed (Parmarch, 2018).

Arunachal Pradesh, which is known for its unique organic khasi mandarin quality and GI (Geographical indication) tag, is facing problems of citrus decline problem due to tristiza virus (quick decline in citrus) in the recent years. Inorder to control such problems rootstock viz. Rangpur Lime play an important role since Rangpur lime is resistant to citrus tristiza virus (CTV) and tolerant to drought condition (Ray, 2006). However, seed of such rootstock are recalcitrant in nature and germination in the field condition is poor. Therefore, in order to evaluate a better seed germination of the seedling of such rootstock this experiment was done *in-situ* (hydrophonic) and *ex-situ* (field) condition for the evaluation.

Materials and methods

The present investigations were carried out at the Department of Fruit science, College of Horticulture & Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh to evaluate the better seed germination percentage under the field and hydroponic condition. To investigate the experiment, the seeds of Rangpur Lime were collected from the ripe fruit. Fruits were cut into two halves with a sterile knife and seeds were collected over sieves. Extracted seeds were washed in running tap water several times to remove the mucilage. Seeds were dried over filter paper. Extracted seeds were treated with Captan fungicide @ 1g/litre of water for about 1 hour to protect against fungal infestation. Fungicide treated seeds are kept inside the BOD for 25^0C in the plastic tray (30x30cm size) which have the capacity around 2200 seeds per tray in which blotting paper are kept in between the thin bamboo stick. In case for the field condition, seeds are sown in the raised

bed with 1 m width and conventional length spacing of 2 x 2 cm at a depth of 2 cm. After sowing seeds are irrigated regularly. Oliveira and Walkyria (2007) also reported that 1-2 cm depth for the trifoliate seed sowing give better seed germination. The seeds which are germinated in hydroponic method in the tray are frequently treated with fungicide (Captan @1g/litre of water) in order to avoid fungus infection. After the complete germination hardening is necessary in the ambient room temperature in order to develop the chlorophyll to the plants. Development of chlorophyll completed within one week and are transplanted to the polythene bag which are mixed with 2:1:1 (Soil: Sand: FYM) and kept under the insect proof net house for budding purpose.

Results of the experiments

Low cost hydroponic seed germination technique observed significant seed germination as compared to field condition. Seeds which are sown under the hydroponic method provide moisture through the wet blotting paper which is in contact with the water. Such technique of seed germination starts germination from 13 days and completed within 22 days with the germination percentage of 98.9% whereas under the field condition showed 21.4 % success.

The better success for germination of this method is might be due the continuous moisture supply to the seeds through the absorption by the blotting paper. Further, fungicide is poured over the seed at 2-3 days intervals and it also absorbed by it from the root zone through blotting paper preventing the fungus growth which and maintain at continuously moderate temperature of 25^0C provide quick germination and better % of germination as compared with the normal seed sowing in the open field condition. Angel and Maria (2005) also reported that the storage of seeds with 14.7% of moisture content with fungicide treatment resulted higher percentages of germination 59.3% while in seeds without chemical treatment with lower seed germination 33.3% in the field condition.

Advantages of low cost hydroponic seed germination technique

- Better seed germination
- Early seed germination as compared to filed condition
- Weed free and easy for maintenance

Disadvantages of low cost hydroponic seed germination technique

- Low seed germination
- Fungus and rodent infestation before the sprouting of the seed
- Weed infestation and difficult for maintenance during rainy season

Table 1 : Performance of seeds germination of in hydroponic method

No. of seeds/row in the bamboo strip	No. of bamboo strip in 1 tray (30x30cm)	Total number of seed / tray (30x30cm)	Total germinated seeds	Germinated seeds (%)
50	44	2200	2177	98.9%

Table 2 : Performance of seeds germination in field condition (*Ex-situ* condition)

No. of seeds/row (Spacing 2x2cm)	No. of replication	Total number of seeds	No. of seeds germinated/row (out of 50 seeds)	Total germinated seeds	Germinated seeds (%)
50	10	500	32, 17, 23, 18, 16,12,17,14,16,11	176	21.4%

Conclusion

Therefore, low cost hydroponic using water as a media under BOD at 25°C is cheap and better seed germination of citrus seeds for raising rootstock. However, precautions are necessary for fungus and rodent infestation before the sprouting of the seeds.

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