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USE OF ANTIBIOTICS IN ORNAMENTAL FISH INDUSTRY

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Abstract
In fish farms, especially in hatcheries, antibiotics may be used to prevent or cure bacterial infections. There is no record from India, although it has been documented to influence a wide variety of bacteria, may have an effect on receiving water bodies and fish diseases, and contribute to resistance to antibiotics in other regions of the world. The ornamental fish are not intended for human food, their use of antibiotics is unregulated. Although antibiotic-resistant bacteria have been reported in ornamental fish all over the world, no research has been done to examine the situation in India. Thus, the current study was carried out to look into the use of antibiotics in the ornamental fish industry. Hence, a wide variety of antibiotics are administered to aquaculture in the hopes that it will increase productivity as well as the socioeconomic profile in developing nations.

Keywords : Ornamental Fisheries, Antibiotics, Fish Health, Drug Dosage

Introduction

Antibiotics are helpful to fish-health manager's tool case, however, they're solely tools and not magic bullets. The flexibility of antibiotics to assist eliminate a fish Disease depends on a variety of factors: 1) Will the matter even have a microorganism component 2) Is the selected antibiotic responsive to the microorganism in question? 3) are the correct indefinite quantity and treatment intervals being used 4) result in additional causal stresses being eliminated or diminished. Antibiotics just manage the growth of the bacterium in an exceedingly fish long enough for its system to eliminate them. Before considering antibiotics, it is important to eliminate or lessen sources of stress such as poor feeding, heredity, handling, and poor water quality (especially sudden temperature changes).

The Best Strategy for Combating Bacterial Infections

Most fish disease-causing bacteria are long-standing members of aquatic ecosystems and, in most cases, do not create borders. Fishes, on the other hand, are susceptible to microbial infections because they are stressed by one or more conditions (such as temperature fluctuations, poor water quality, recent transport, or handling). They may also have weakened (less effective) immune systems. The terms "culture" and "sensitivity" relate to treating the infective bacterium with a variety of antibiotics to determine which one can perform best. "Culture" refers to cultivating the infective bacterium on a certain type of media (or "food"; commonly, agar or gelatin-based).

Proper Dosages and Treatment

Although choosing the right antibiotic is a very important start in dominant microorganism Disease, the correct administration of any antibiotic for the suggested range of days is equally

vital. Your fish health expert should provide you with instructions on the dosage (amount of antibiotic to use), frequency and length (how long) it should be administered (given), withdrawal time (if applicable - this is frequently the length of time needed after the last dose of antibiotic has been given, that a producer should wait before promoting the fish, and is typically additional of a priority in fish species), and other pertinent information.

Major Routes of Administration

Injection: The most direct and an efficient technique of getting antibiotics into the bloodstream is through injection. Sadly, this method is incredibly labor-intensive and impractical for a fish adult on a poster scale.

Mixed in food: In cultivation production, the foremost price-effective and normally used methodology to deliver antibiotics orally by compounding them into food. Oral administration of antibiotics requires that almost all of the fish are still ingestion, therefore each try ought to be created to catch microorganisms' diseases early, before the bulk of fish stop ingestion. It's a decent plan to coach fish to eat a ready diet (i.e., one which will be wont to incorporate antibiotics), so that, ought it becomes necessary to use antibiotics, the fish are going to be additional probably to eat the medicated food because it is acquainted with them.

Bath treatments: Though bathtub treatments are a preferred methodology for administering antibiotics, far more drug is needed to realize the specified result as compared to oral treatments or injections. Finally, bathtub treatments aren't suggested in recirculating systems or any vivarium system wherever the treated water can contact the biological filter, as a result of the antibiotics might kill or inhibit the nitrifying bacterium within the biological filters (see UF/IFAS truth Sheet FA-16 Ammonia).

Consequences of Improper Dosage and Treatment Time

If the dose is just too high or treatment Times Square measures too long, there's a danger of toxicity to the fish, oftentimes inflicting liver, kidney, or different organ harm that may or may not be reversible. On the opposite hand, if the dose of antibiotic is just too low or treatment time is just too short, the bacterium won't be killed or weakened enough for the immune system of the fish to get rid of them, and this greatly increases the risk of the bacteria developing resistance to the antibiotic. Antibiotic resistance will even occur once antibiotics unit used improperly, such as the population of fish, frequently at improper dosages, for shortened treatment times, and without the aid of correct diagnosing (i.e., without culture and sensitivity tests). Proper Handling of Antibiotics When preparing or administering any type of medication, it is always a good idea to wear gloves to avoid unnecessary exposure to the user.

Specific Antibiotics for fish disease

The following square measures some notes on specific antibiotics employed in the Ornamental fish trade. Many of them square measure strictly taboo to be used by fish producers or square measure otherwise of concern to the Food and Drug Administration (FDA). The agency has the electoral to use restrictive discretion to keep merchandise supposed for the treatment of tank fish obtainable. Officially there aren't any FDA-approved antibiotics for treating decorative fish. Erythromycin isn't FDA-approved to be used with fish. As broad-spectrum antibiotics (effective against a range of germs), oxytetracycline and related drugs work effectively when combined with meals. (See UF/IFAS truth Sheet VM-70 Use of Medicated stick in catfish.) However, bathtub

treatments might not be as effective for all species. According to one study (Nusbaum and Shotts, 1981), channel catfish absorbed 15–17% of the oxytetracycline that was introduced to water with a hardness of 20 mg/L and a pH of 6.7.

Tetracyclines are measure ineffective once used as a shower treatment for seafood. Tetracyclines square measure light-weight sensitive, and they turn brown when decomposing. This contributes to poor water quality and will be harmful to the fish. Due to years of misuse, several bacteria in many different facilities are now resistant to tetracyclines. Even today, oxytetracycline effectively treats the majority of Flavobacterium columnare (columnaris disease) cases.

Terramycin ® could be a complete antibiotic factory-made by Pfizer that's agency approved to be used within the production of salmonids, channel catfish, and lobsters (See UF/IFAS Fact Sheet VM-70).

Use of Medicated Feed-in Channel Catfish

Injections of the aminoglycosides, such as gentamicin, neomycin, kanamycin, and amikacin, are particularly successful at treating infections caused by gram-negative bacteria. Unfortunately, this group has additionally been shown to cause urinary organ harm in fish once administered by this system. Kanamycin and neomycin might be two exceptions, as they both have the potential to be helpful against external infections when used as bath treatments. Besides, the antibiotic drug is additionally believed to be effective once mixed with feed to treat duct microorganism infections (Gilmartin, Camp and Lewis, 1976).

Quinolones area unit closely associated with a class of antibacterial referred to as 'fluoroquinolones,' which are categorized as 'of high regulatory concern' by the FDA. Use of fluoroquinolones or quinolones to treat any food animal is against the law and fully loose. Nitrofurazone is specifically classified as 'of high regulative concern' by the agency and may not be a gift at any facility wherever food species area unit raised.

Name of the Antibiotics	Oral Dose with Food
Oxytetracycline or (Terramycin)	1.15 grams/lb food per day for 10 days
Oxolinic acid	140-150 mg/lb food per day for 10 days
Nitrofurazone	1.15 grams grams/food per day for 10 days
Nalidixic Acid	300 mg / lb food per day for 7-10 days
Erythromycin	1.3-1.6 grams/lb food per days
Neomycin	1.3-1.6 grams/lb food per days
Amoxicillin	3.6 grams/lb food per 10 days
Ampicillin	160 /lb food per 10 days
Gentamicin	55mg/lb food per 10 days
Note: As a rule, oral/food treatment are more effective, more efficient, less detrimental to water quality, and preferable to bath treatments; remember, bath treatment may hurt biological filtration. Also, some of these drugs are available locally in premixed medicated. Dosage references: Carpenter et al. 1996; Darwish and Hobbs 2005;Darwish and Ismaiel 2003; Noga 1996; Stoskopf 1988; and University of Florida.	

Conclusion

With good management, bacterial infections in ornamental fish can be prevented in many cases. If a population does contract an infection, it's crucial to remove or lessen all stressors that may have

contributed. It is preferable to seek the advice of a fish health professional that can help with the correct diagnosis, conduct culture and sensitivity tests, and give the best advice on dosages and treatment intervals. A facility may develop resistant germs as a result of improper use of any antibiotic. The quality of veterinary medicine sold on the market should likewise be monitored and controlled by the government. establishing efficient national disease surveillance and testing systems and ensuring access to high-quality antibiotics. To enhance biosecurity and lower ABU, promote Global Alliance on Health and Pollution (GAHP).

Reference

Carpenter, J.W., Mashima, T.Y. and Rupiper, D.J. 1996. Exotic animal formulary. First ed. Greystone Publications, Manhattan, KS. 310.

Colorni, A. and Paperna, I. 1983. Evaluation of nitrofurazone baths in the treatment of bacterial infections of Sparus aurata and Oreochromis mossambicus. Aquaculture 35: 181-186.

Darwish, A.M. and Hobbs, M.S., 2005. Laboratory efficacy of amoxicillin for the control of Streptococcus iniae infection in blue tilapia. Journal of Aquatic Animal Health, 17(2), pp.197-202.

Darwish, A.M. and Ismaiel, A.A., 2003. Laboratory efficacy of amoxicillin for the control of Streptococcus iniae infection in sunshine bass. Journal of Aquatic Animal Health, 15(3): 209-214.

Das BK (2011) Bacterial Diseases of fish. In: Fish Health management, National Training Programme. Central Institute of Freshwater Aquaculture, Bhubaneswar, India.

Noga, E.J., Khoo, L., Stevens, J.B., Fan, Z. and Burkholder, J.M., 1996. Novel toxic dinoflagellate causes epidemic disease in estuarine fish. Marine Pollution Bulletin, 32(2): 219-224.

Stoskopf, M.K., 1988. Fish chemotherapeutics. Veterinary clinics of North America: Small animal practice, 18(2), pp.331-348.

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EMBRACING DIRECT-SEEDED RICE: A MODERN REVOLUTION IN RICE CULTIVATION

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Abstract

Direct-seeded rice (DSR) has emerged as a transformative approach in rice cultivation, revolutionizing traditional farming practices and offering a sustainable and efficient alternative. DSR has numerous benefits, including water conservation, cost reduction, weed control, adaptability to climate change and its contribution to food security. The discussion begins by highlighting the water-saving potential of DSR. By flooding the fields immediately after seed sowing, DSR optimizes water management, reducing water wastage through evaporation and promoting controlled irrigation practices. The conservation of water resources and the associated environmental sustainability benefits are emphasized. DSR also provides economic advantages over transplanted rice (TR) by eliminating labor-intensive nursery preparation and transplanting, DSR reduces labor requirements, saving valuable resources and time. Furthermore, the reduction in input costs, such as seedlings, water, and fuel, contributes to improved profitability and farm viability. Weed control in DSR is thoroughly addressed, showcasing the effectiveness of strategies such as creating a dense crop canopy and employing integrated weed management approaches. These techniques minimize weed competition, enhance crop competitiveness, and promote higher yields. The adaptability of DSR to changing climate conditions is highlighted as a significant advantage. The ability to control water levels and efficiently manage resources allows farmers to mitigate the impacts of drought or excessive rainfall, reducing crop losses and ensuring more stable yields.

DSR also adds toward food security. As the global population continues to grow, sustainable agricultural practices become crucial. DSR offers a solution by maximizing productivity with fewer resources, reducing the environmental impact of agriculture, and supporting long-term food security goals. Embracing DSR and leveraging technological advancements and knowledge sharing can pave the way for a more sustainable and food-secure world.

Keywords : DSR, water conservation, weed competition and food security

Introduction

Rice, the staple food for billions of people worldwide, has traditionally been cultivated through labor-intensive methods such as nursery raising and transplanting. However, a revolutionary approach known as direct-seeded rice (DSR) is making waves in agricultural practices. DSR offers a range of benefits, including increased efficiency, water conservation, and cost reduction by bypassing the time-consuming and physically demanding transplanting process. The

representation of DSR is shown in Fig. 1 and its benefits are depicted in Fig. 2. More detailed investigation of DSR is elaborated below:

1.1 Streamlining Efficiency and Saving Time:
Gone are the days of meticulously raising seedlings in nurseries and painstakingly transplanting them into prepared paddy fields. With DSR, farmers can directly sow rice seeds into the fields, significantly reducing labor and time requirements. This efficient method allows farmers to cover larger areas within a shorter timeframe, leading to enhanced productivity and potentially higher yields.

1.2 Water Management: A Sustainable Approach
Water scarcity is a growing global concern, and agriculture is one of the primary consumers of freshwater resources. In this context, direct-seeded rice (DSR) offers a sustainable approach to water management in rice cultivation. The benefits and strategies associated with water conservation in DSR are highlighted below:

1.2.1 Controlled Water Application: DSR allows farmers to set up the water levels in fields immediately after seed sowing. This practice is known as "dry direct-seeded rice" or "controlled irrigation." By flooding the fields early in the crop growth stage, farmers can establish an optimal water level and maintain it throughout the season. This controlled water application method ensures efficient water use, as excess water is minimized, reducing the risk of water loss through evaporation and leaching.

1.2.2 Reduced Water Requirements: Compared to traditional transplanting methods, DSR typically requires less water. In transplanting, the nursery-raised seedlings need frequent irrigation before they are transplanted into the main field. However, DSR eliminates this stage, saving significant amounts of water that would otherwise be used in the nursery. Additionally, the controlled water management in DSR allows farmers to minimize water requirements by maintaining soil moisture at the appropriate level, reducing the need for excessive irrigation.

1.2.3 Enhanced Water Use Efficiency: Water use efficiency (WUE) refers to the amount of grain produced per unit of water consumed. DSR has been shown to improve WUE compared to traditional transplanting methods. With controlled irrigation, the rice plants receive the required amount of water at specific growth stages, optimizing water use and reducing wastage. This efficient water management translates into better crop productivity, as the plants can allocate resources more effectively, resulting in higher yields per unit of water consumed.

1.2.4 Potential for Alternate Wetting and Drying (AWD): In some DSR systems, farmers implement a water-saving technique known as AWD. AWD involves intermittently drying the field between irrigation events, rather than continuously maintaining a flooded condition. By allowing the soil to dry out periodically, farmers can save water without compromising crop growth. AWD has been found to reduce water usage by up to 30% compared to continuous flooding, while still achieving satisfactory yields.

1.3 Environmental Benefits: Adopting DSR can have positive environmental impacts beyond water conservation. The reduced water requirements in DSR systems contribute to lower carbon dioxide emissions. Methane emissions, a potent greenhouse gas released from flooded rice fields, are also reduced with controlled irrigation methods, further mitigating climate change impacts. By

implementing sustainable water management practices through DSR, farmers can play a vital role in preserving water resources and reducing the ecological footprint of rice cultivation.

1.4 Weed Control: Outsmarting Unwanted Guests:
Weeds are persistent adversaries in agriculture, posing significant challenges to crop growth and yield. In the context of DSR, innovative strategies are employed to effectively manage weeds and maximize crop productivity. The methods and benefits of weed control in DSR are highlighted below:

1.4.1 Crop Rotation and Residue Management: Implementing crop rotation practices in DSR can help break the weed life cycle and reduce weed pressure. By rotating rice cultivation with non-host crops, farmers can disrupt weed growth patterns and reduce the buildup of weed populations. Additionally, proper residue management, such as incorporating crop residues into the soil, can help suppress weed germination and growth by creating a physical barrier and altering soil conditions unfavorable for weed establishment.

1.4.2 Herbicide Application: Herbicides play a crucial role in weed management in DSR. Selective herbicides specifically target and control weeds while minimizing damage to the rice crop. Herbicide application is often done pre-emergence or early post-emergence of weeds when weed seedlings are small and susceptible. Advancements in herbicide technology have led to the development of more effective and environmentally friendly herbicides that provide targeted control, reducing the reliance on manual weeding and labor-intensive weed removal practices.

1.4.3 Integrated Weed Management (IWM) Strategies: Integrated Weed Management (IWM) strategies encompass a combination of techniques to tackle weeds comprehensively. This approach integrates cultural, mechanical, and chemical weed control methods to create a sustainable and effective weed management system. Cultural practices, such as optimal seeding rates, proper crop spacing, and timely irrigation, contribute to crop competitiveness against weeds. Mechanical weed control techniques, including inter-row cultivation, hand weeding, or the use of specialized weeders, can be employed to remove weeds that escape other control measures. By combining these approaches with judicious herbicide use, farmers can achieve effective weed control while minimizing the development of herbicide resistance.

1.4.4 Crop Competitiveness and Allelopathy: DSR promotes a dense crop canopy, which enhances crop competitiveness against weeds. A well-established and vigorous rice crop can effectively shade the soil, inhibiting weed seed germination and suppressing weed growth. Additionally, certain rice varieties possess allelopathic properties, releasing natural compounds that inhibit weed growth. This allelopathic effect can contribute to weed suppression and further enhance weed control in DSR systems.

1.4.5 Monitoring and Timely Intervention: Regular monitoring of the field is essential in DSR to detect weed infestations early. Timely intervention, such as targeted herbicide application or mechanical weed control measures, can prevent weed populations from becoming established and causing significant crop yield losses. Continuous observation and proactive weed management strategies help maintain weed control throughout the growing season.

1.5 Benefits of Effective Weed Control in DSR: Efficient weed control in DSR offers several benefits, including:

1.5.1 Increased crop yields: DSR allows rice plants to access essential resources by reducing weed competition, resulting in improved crop growth and higher yields.

1.5.2 Resource optimization: Effective weed control minimizes the need for manual labor in weeding, reducing costs and labor requirements.

1.5.3 Environmental sustainability: Integrated weed management approaches reduce reliance on herbicides and promote more sustainable agricultural practices.

1.5.4 Enhanced crop quality: Weed-free fields promote uniform crop growth, allowing for better grain quality and easier harvesting.

1.6 Maximizing economic benefits and returns in DSR by cost reduction:
DSR offers significant cost reduction and economic benefits, making it an attractive option for farmers seeking sustainable and profitable cultivation methods. DSR can help to optimize resources, minimize expenses and improve economic outcomes for rice farmers.

1.6.1 Labor Efficiency: One of the primary advantages of DSR is the reduction in labor requirements compared to traditional transplanting methods. In conventional rice cultivation, significant labor is needed for nursery raising, transplanting, and associated tasks. However, DSR eliminates the need for nursery preparation and transplanting, streamlining the process and saving valuable labor resources. This allows farmers to allocate their labor resources more efficiently, focusing on other essential farm activities, which can lead to overall cost savings.

1.6.2 Nursery-Related Costs: Transplanting rice seedlings from nurseries to the main field incurs expenses related to nursery preparation, maintenance, and seedling transportation. With DSR, these costs are significantly reduced or eliminated entirely. Farmers no longer need to invest in nursery infrastructure, purchase seeds for the nursery, or spend resources on maintaining seedling beds.

1.6.3 Water and Fuel Savings: DSR can lead to substantial water and fuel savings. Traditional rice cultivation involves puddling the fields, which requires significant amounts of water and fuel for tillage operations. However, DSR eliminates the need for puddling or reduces the intensity of soil tillage. By directly sowing seeds into the prepared fields, farmers can conserve water resources and reduce the costs associated with water supply and fuel consumption for land preparation. These savings contribute to a more economically viable cultivation method.

1.6.4 Reduced Input Costs: DSR offers opportunities for reducing input costs associated with seedlings, fertilizers, and pesticides. By eliminating or reducing nursery-raised seedlings, farmers can save on seed costs. Additionally, the controlled and precise application of fertilizers and pesticides in DSR systems optimizes resource utilization, preventing wastage and unnecessary expenses. Farmers can tailor their inputs according to specific crop requirements, resulting in efficient resource allocation and cost reduction.

1.6.5 Increased Farm Area Coverage: The efficiency and time savings provided by DSR enable farmers to cover larger farm areas within a shorter time frame. This increased coverage translates into expanded production potential and economies of scale. With DSR, farmers can cultivate more land, maximizing their return on investment and improving overall farm profitability.

1.7 Risk Management: DSR can act as a risk management strategy for farmers. By reducing the dependency on a labor-intensive transplanting process and optimizing water use, DSR offers greater resilience in the face of labor shortages or water scarcity. The flexibility and adaptability of DSR allow farmers to mitigate risks associated with unpredictable weather patterns and changing market dynamics.

Fig.1. Demonstration of Direct Seeded Rice

Challenges and Solutions related to DSR:

While DSR offers numerous benefits, it also presents certain challenges that farmers need to address for successful implementation. Some common challenges associated with DSR and the innovative solutions that can help to overcome them are discussed below:

2.1 Seed and Seedling Mortality: In DSR, the direct sowing of seeds exposes them to various environmental factors which can result in seed and seedling mortality. Factors such as adverse weather conditions, pest and disease pressure, and suboptimal seedling establishment can affect germination and plant survival rates. To address this challenge, farmers can employ seed priming techniques, which involve pre-soaking or treating seeds with specific solutions to enhance germination and seedling vigor. Seed priming helps improve seedling emergence and reduces mortality, ensuring a higher success rate in DSR.

2.2 Weed Management: Weeds pose a significant challenge in DSR, as the absence of a transplanting stage can lead to a higher weed density in the field. Weeds compete with rice plants for nutrients, water, and sunlight, potentially impacting crop yield. To tackle this challenge, farmers can adopt IWM strategies. IWM involves a combination of cultural, mechanical, and chemical weed control methods to effectively manage weed populations. Employing techniques such as crop rotation, maintaining a dense crop canopy, using mechanical weeders, and judicious herbicide application can help suppress weeds and promote successful DSR.

2.3 Pest and Disease Management: Pests and diseases can pose threats to the establishment and growth of rice plants in DSR systems. In the absence of a nursery stage, seedlings are directly exposed to potential pest infestations and disease pressures. To manage pests and diseases, farmers should focus on preventive measures such as selecting disease-resistant rice varieties, implementing proper crop rotation practices, and practicing good sanitation in the field. Regular

monitoring for pest and disease outbreaks, timely intervention with appropriate pesticides when necessary, and promotion of beneficial organisms can also help mitigate the risks associated with pests and diseases.

2.4 Nutrient Management: In DSR, efficient nutrient management is essential for optimum crop growth and yield. Without proper nutrient management, there is a risk of nutrient imbalances, which can lead to reduced productivity and crop health. To address this challenge, farmers should conduct soil testing to assess nutrient levels and adjust fertilizer applications accordingly. Adopting precision nutrient management practices, such as split application of fertilizers based on crop growth stages and using organic amendments, can help optimize nutrient utilization and minimize nutrient losses, ensuring balanced nutrition for the rice crop.

2.5 Knowledge and Skills: The successful adoption of DSR requires farmers to acquire the necessary knowledge and skills to implement the technique effectively. Familiarity with appropriate seed selection, seedling management, irrigation practices, weed control methods, and pest and disease management strategies is essential. To overcome this challenge, farmers can participate in training programs, workshops, and demonstrations conducted by agricultural extension services or research institutions. Sharing experiences and best practices within farming communities can also contribute to knowledge sharing and capacity building, empowering farmers to overcome challenges associated with DSR.

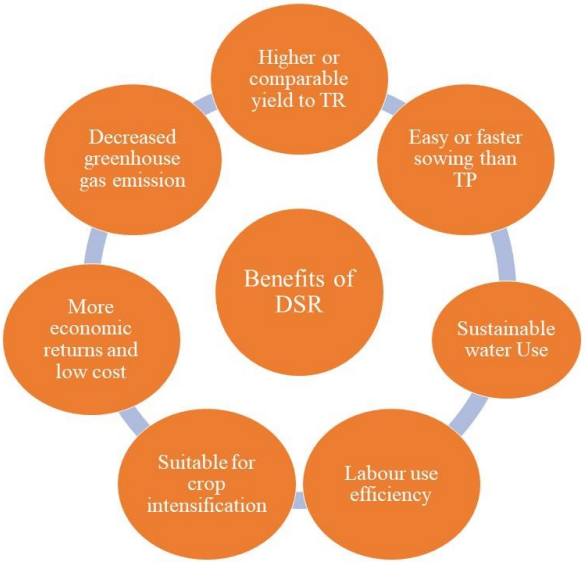

Fig. 2. Benefits of Direct Seeded Rice

Conclusion

DSR represents a significant shift in rice cultivation practices, offering a sustainable and efficient approach that addresses various challenges faced by farmers. With its water-saving potential, cost reduction benefits, weed control advantages, adaptability to climate change, and contribution to food security, DSR is poised to shape the future of rice farming. By embracing DSR, farmers can optimize their resources, reduce labor requirements, and minimize input costs while maximizing yields and profitability. The controlled irrigation practices in DSR systems conserve water, making it a vital solution in regions facing water scarcity. Additionally, DSR's effective weed control strategies improve crop competitiveness and productivity, reducing yield losses caused by weed infestations.

Furthermore, DSR provides the flexibility and adaptability needed to navigate the challenges posed by a changing climate. Its ability to withstand drought or excessive rainfall and its contribution to reducing greenhouse gas emissions make it a sustainable choice for rice cultivation. The rise of DSR has been facilitated by technological advancements, knowledge sharing, and the collaborative efforts of farmers and agricultural institutions. The dissemination of best practices, experiences, and success stories has created a vibrant community that supports and promotes DSR adoption. In conclusion, DSR stands as a testament to the power of innovation, collaboration, and the resilience of farmers in shaping a more sustainable and food-secure world.

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A REVIEW ON APPLICATION OF MACHINE VISION IN SEAFOOD INDUSTRY

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Abstract

Seafood is a rich in nutrients. Consumer acceptability of fish and its products is dependent on appearance and market pricing, and appearance is a key factor in determining market demand. Fish quality examination by manually is time-consuming, tedious, and invasive. One of the non-destructive techniques for evaluating fish quality is machine vision. Machine vision (MV) is a quick, affordable, reliable, and objective inspection and assessment technology. MV can conduct a variety of tasks concurrently in an aquatic food processing line, including automated portioning and sorting by species, size, and visual quality parameters.

Introduction

For many billions of people worldwide, fish serves as their main source of protein-rich food. The quality of fish and its products is influenced by both internal (physical and microbiological) and exterior (size, shape, color, appearance, gloss) factors. For seafood, visual qualities are crucial criteria for quality. These characteristics help decide price, eventual product forms, and consumer purchasing decisions. Automated, camera- and computer-based methods are replacing the conventional way of human subjective assessment. According to Gunasekaran (1996) and Brosnan and Sun (2004), these systems—also referred to as machine vision (MV) or computer vision (CV) systems—have been effective in the objective evaluation of a variety of food goods.

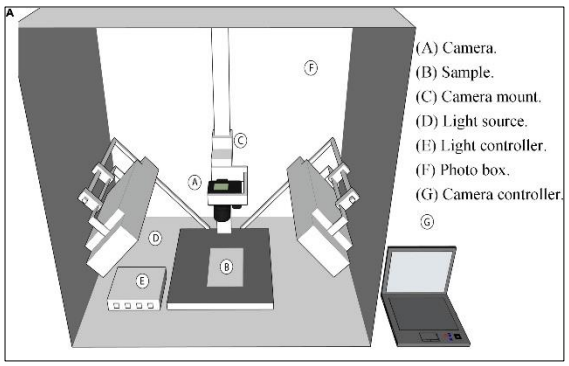

Figure 1 Components of machine vision

Components of Machine Vision

An illumination, such as a light box with fluorescent bulbs or other lighting sources, a camera, an image capturing system, computer hardware, and software are components of a MV system. The sample being evaluated is typically laid out on a flat surface with a plain background, and an image is taken using a camera. Depending on the amount of light the object is during processing, illumination may be provided. Once the image has been captured, it is ready for image analysis (using the required image processing algorithm to determine the size, shape, and composition of fishes) and image processing (image restoration, compression, segmentation techniques to process the image). Then, from the collected image, the chosen features are retrieved. Fish can be sorted based on size, shape, and species using image information integrated into the sorting unit.

Additionally, it can be used in combination with other nondestructive techniques, such as hyper spectral imaging, to determine chemical composition.

Application of Machine vision

1. Determination of seafood composition

Based on the internal composition of features like fat content, color, texture, and flavor, fish and its products are evaluated according to quality. When it comes to consumer acceptance, these characteristics are quite important. The texture of the fish meat changed significantly as a consequence of oxidation. Rapid image analysis is an improved method for identifying color changes, estimating fat content, and determining fillet quality. The primary indicator for determining the quality of fish fillets is fat content.According to Fjellanger et al. (2001), the average fat content of fillets ranges from 11% to 19%. Additionally, other quality factors including color and gaping gaps are affected by lipid content. Automated image processing makes it possible to estimate fat quickly and with high accuracy. Analysis of the total area of fat stripes using total area. The shrimp dehydration level is analysed by notifying the colour change and it evaluated using Machine vision techniques (Mohebbi, et al., 2009).

2. Determination of weight of fish

Based on fish length, an important objective for determining fish weight is used. But with the development of machine vision, it is now possible to estimate fish weights based on the length-weight relationship (Gerami et al., 2013). The method for determining weight based on the area computation from the obtained images was developed by Gerami et al. (2014). The region includes the caudal, annual, dorsal, and ventral fins, which contribute to fish weight and predicts various fish sample ranges.

3. Sorting of fish by species

Fish are manually sorted into different species on fishing boats. However, the procedure takes a long period and more manpower than usual. The ideal method for reducing labor and improving sorting accuracy is machine vision. Species-based fish sorting is accomplished using an optical sensor. Calibration, locating regions of interest, and image rotation at various angles are among the create shape descriptors that serve as a basis for species identification.

4. Determination of quality of fish

In India, food quality inspection is done manually, which includes inaccurate human judgement in classifying quality aspects including appearance, texture, and nutrition. It is slow and consistently subjective. Machine vision techniques' inspection approach has a wide range of applications in the food industry. The density differential between the meat and bone is employed by X-ray vision systems to identify bones in fish fillets. The created technology can produce 10,000 fillets per hour with a 99% accuracy rate (Jamieson, 2002). Shrinkage and length contraction in rainbow trout fillets (Stien et al., 2006a), quantification of shrinkage in pink salmon fillets (Kong et al., 2008), and ridge detection method in fillets are just a few of the factors that can affect the quality(Sivertsen et al., 2009).

Advantages of Machine vision:

It involves producing accurate descriptive data, quickly operating and retrieving data, automating processes, consistency, efficiency, and cost effectiveness. All of the information has been recorded and examined.

Disadvantages of Machine Vision

It requires a clearly defined light source, calibration of the vital equipment, multiple image acquisition, overlap of photos, and object-specific speed (Brosan and Sun, 2004). It might be difficult to find and train workers for machine vision systems. It is quite expensive.

Conclusion

With improved computer capabilities, processing speeds, and real-world algorithms for determining shape, size, species, and composition of fishes, machine vision technology is increasingly important in the fish processing industry. This machine vision system has been developed to fulfill the needs of practical applications. Because of automation in machine vision method, it includes quicker recognition. Additionally, automatic hygienic examination of aquatic items is required; this can be accomplished well using machine vision technology.

References

Brosnan, T. and Sun, D-W. 2004. Improving quality inspection of food products by computer vision-a review. *Journal of Food Engineering,* 61:3-16.

Gunasekaran, S. 1996. Computer vision technology for food quality assurance. Trends in Food Science and Technology, 7(8): 245-256.

Fjellanger, K., Obach, A. and Rosenlund, G. 2001. Proximate analysis of fish with special emphasis on fat. *Farmed fish quality*: 307-317.

Mohebbi, M., Akbarzadeh-T, M-R., Shahidi, F., Moussavi, M. and Ghoddusi, H-B. 2009. Computer vision systems (CVS) for moisture content estimation in dehydrated shrimp. Computers and Electronics in Agriculture, 69: 128-134.

Gerami, M. H., Abdollahi, D. and Patimar, R. 2013. Length-weight, length-length relationship and condition factor of Garra rufa in Cholvar River of Iran. *World Journal of Fish and Marine Sciences*, 5(4):358-361.

Gerami, M. H., Abdollahi, D., Patimar, R. and Abdolhahi, M. 2014. Length–weight relationship of two fish species from Cholvar River, western Iran: Mastacembelus mastacembelus (Banks & Solander, 1794) and Glyptothorax silviae Coad, 1981. *Journal of Applied Ichthyology*, 30(1): 214-215.

Jamieson, V. 2002. Physics raises food standards. *Physics World*, 1:21-22.

Kong, F., Tang, J., Lin, M. and Rasco, B. 2008. Thermal effects on chicken and salmon muscles: Tenderness, cook loss, area shrinkage, collagen solubility and microstructure. *LWT-Food Science and Technology*, 41:1210-1222.

Stien, L.H., Suontama, J. and Kiessling, A. 2006a. Image analysis as a tool to quantify rigor contraction in pre-rigor-filleted fillets. *Computer Electronic Agriculture*, 50:109-120.

Sivertsen, A.H., Chu, C-K., Wang, L-C., Godtliebsen, F., Heia, K. and Nilsen, H. 2009. Ridge detection with application to automatic fish fillet inspection. *Journal of Food Engineering*, 90: 317-324.

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BEYOND THE CLASSROOM: ENGAGING PARENTS IN NUTRITION EDUCATION FOR RURAL SCHOOL CHILDREN

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ABSTRACT

This article examines the importance of involving parents in nutrition education for rural school children, aiming to promote healthy eating habits and overall well-being. In rural areas, limited access to proper nutrition and healthcare facilities often leaves children vulnerable to malnutrition and related health issues. While schools play a critical role in imparting nutritional knowledge, engaging parents in the process can significantly enhance the impact of nutrition education. It suggests practical methods to engage parents, such as workshops, cooking classes, community gardens, nutrition challenges, and online resources. The benefits of parental involvement are highlighted, including improved health outcomes, reinforced classroom lessons, the cultivation of lifelong habits, and strengthened parent-child bonds. By fostering collaboration between schools, parents, and the community, this article advocates for a comprehensive approach to nutrition education that extends beyond the classroom, creating a healthier and more empowered generation.

INTRODUCTION

In rural regions worldwide, where access to proper nutrition and healthcare facilities can be scarce, children attending school often confront significant nutritional challenges that can impede their growth and overall well-being. Addressing this issue requires more than just classroom-based efforts. While schools play a crucial role in promoting healthy eating habits, engaging parents in the process can have a transformative impact on the long-term health and well-being of their children. This article delves into the significance of involving parents in nutrition education for rural school children and how it can positively influence their dietary habits and overall health. In rural areas, limited access to diverse food options and a lack of nutrition knowledge render children particularly vulnerable to malnutrition. In such communities, nutrition education in schools becomes imperative to instil healthy eating habits and raise awareness about the importance of a balanced diet. By educating students about proper nutrition, schools can empower children to make informed food choices and adopt healthier lifestyles, reducing the risk of chronic illnesses like obesity, diabetes, and heart diseases in the long run.

This article aims to explore various strategies for effectively engaging parents in promoting healthy eating habits for their children in rural areas. By fostering collaboration between schools, parents, and the community, we can empower the next generation to lead healthier, happier lives. Through concerted efforts that extend beyond the classroom, we have the potential to create a positive

and lasting impact on the nutritional well-being of rural school children. The following sections will delve into the benefits of parental involvement, effective approaches to engage parents, and the broader implications of this collaborative approach on the overall health of rural communities.

Key Words: Nutrition education, Rural Children, Parents

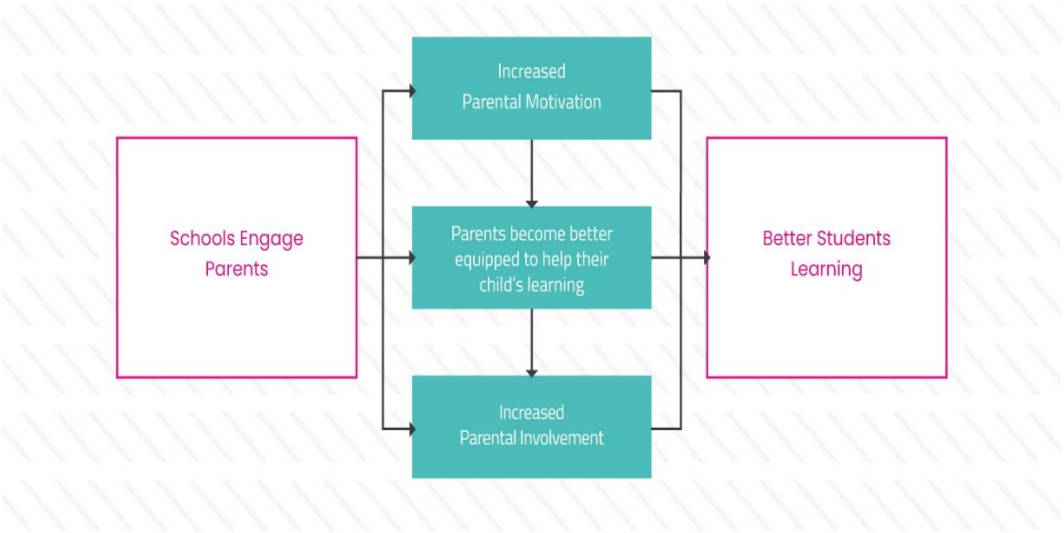
THE IMPORTANCE OF NUTRITION EDUCATION IN RURAL SCHOOLS

- **Combat Malnutrition**: Nutrition education helps address malnutrition issues prevalent in rural areas by promoting healthier eating habits and balanced diets.
- **Prevent Chronic Diseases:** Educating children about proper nutrition early on can reduce the risk of chronic diseases, such as obesity, diabetes, and heart diseases, later in life.
- **Enhance Cognitive Development:** Proper nutrition positively impacts cognitive development, leading to better academic performance and improved learning outcomes.
- **Boost Immune Systems:** A well-balanced diet strengthens children's immune systems, making them more resilient to common illnesses.
- **Increase Productivity:** Well-nourished children are more energetic and attentive, leading to increased productivity in the classroom.

INVOLVING PARENTS IN NUTRITION EDUCATION

Parents are powerful influencers when it comes to their children's dietary choices. By engaging parents in nutrition education, schools can create a more supportive environment that reinforces the lessons taught in the classroom. Here are some effective ways to involve parents in promoting healthy eating habits for their children:

1. **Workshops and Seminars:** Schools can organize workshops and seminars where nutritionists and healthcare professionals share valuable insights on balanced diets, portion control, and the nutritional needs of growing children. These events can encourage parents to make informed food choices for their families.
2. **Cooking Classes:** Practical knowledge goes a long way in influencing eating habits. Organizing cooking classes that involve parents and children together can be an enjoyable way to learn new recipes and cooking techniques that promote health and nutrition.
3. **Community Gardens:** Schools can collaborate with local communities to establish community gardens, where parents and children can actively participate in growing fruits and vegetables. This hands-on experience not only fosters a connection with nutritious foods but also enhances the understanding of where food comes from.
4. **Parent-Child Nutrition Challenges:** Encourage friendly nutrition challenges where parents and children work together to plan and prepare balanced meals. This interactive approach can make nutrition education fun and engaging for both parties.
5. **Mobile Apps and Online Resources:** Utilize technology to provide parents with easy access to nutrition-related resources, including mobile apps, websites, and social media platforms. These platforms can offer recipes, meal planning tips, and dietary guidelines, making it convenient for parents to access information on-the-go.



BENEFITS OF PARENTAL INVOLVEMENT

Engaging parents in nutrition education has numerous benefits for both children and their families:

1. **Improved Health Outcomes:** When parents and children develop healthier eating habits together, the whole family benefits from improved health outcomes, reducing the risk of malnutrition and related health issues.
2. **Reinforcement of Classroom Lessons:** Parental involvement reinforces the nutrition lessons taught in school, ensuring that children receive consistent messages about healthy eating habits.
3. **Cultivation of Lifelong Habits**: Children who learn about nutrition with their parents are more likely to carry these habits into adulthood, setting the foundation for a healthier future.
4. **Strengthening Parent-Child Bonds:** Nutrition education provides an opportunity for parents and children to bond over shared experiences, fostering a supportive and nurturing relationship.

CONCLUSION

In conclusion, engaging parents in nutrition education for rural school children is a pivotal strategy that can bring about positive, long-lasting changes in the health and well-being of the younger generation. By recognizing the significant influence parents have on their children's dietary choices and involving them actively in the process, schools can create a collaborative and supportive environment that extends beyond the classroom. Through workshops, seminars, cooking classes, community gardens, and technological resources, parents can be equipped with the knowledge and tools they need to make informed decisions about their family's nutrition. When parents and children learn about nutrition together, it fosters a sense of unity and shared responsibility, strengthening the parent-child bond and promoting a healthy lifestyle within the household.

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MARKET-LED EXTENSION FOR FISHERIES DEVELOPMENT

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Abstract

Production led extension has contributed significantly to increase the fish production. However, in order to increase the producer's share in consumer's rupee, we need to focus on market-oriented extension delivery mechanism. Market led extension enables farmers to overcome marketing related problems by using efficient and effective methods of extension. It will guide the fishers/ fish farmers towards efficient and need based marketing system. The market led extension can bring high market price thereby higher incomes to the farmers which will eventually leads to overall development of fisheries sector.

Introduction

Market-led fisheries extension refers to render market orientated extension services where fisheries coupled with economics act as perfect blend to reach out farming community with appropriate technology. The market-led extension considers farmers as aquapreneur and enable them to get high returns (money to money) out of farm enterprise. It will also enable farmers with diverse basket of package of practices suitable to local conditions/ farming systems. In nutshell, market led extension means "educating farmers to bring about desirable change in their knowledge, skills and attitude in relation to marketing activities such as market intelligence, value addition, standardization, processing etc."

Why market led extension?

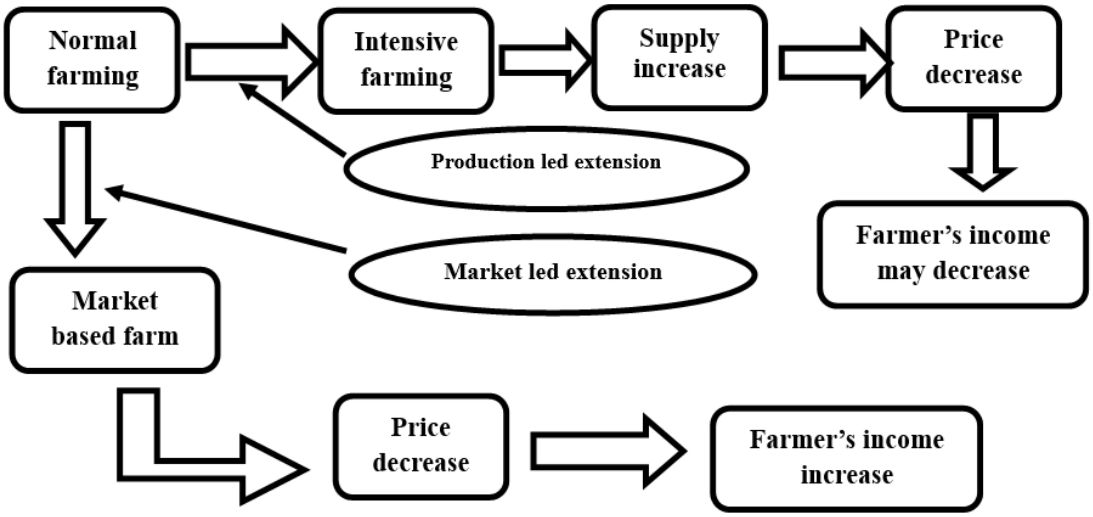

Fig1: Production- led extension vs Market- led extension

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From the beginning of farm mechanization, our extension delivery mechanism has always been production oriented. The primary objective of production-oriented extension is to increase the farm production. Yet, increase in production does not imply increase in farmers income as increase in supply of a farm product sometimes brings about a decrease in price. Therefore, we need to focus on market-oriented extension delivery mechanism rather production oriented, with which farmers could get market information on what to produce, where/when to sell their produce.

With the changing scenario, fish farmers would be provided up to date information ranging from production technology to market oriented knowledge which includes the following

- What species of fish to produce?
- When to produce?
- How much to produce?
- When and where to sell?
- At what price to sell and
- What form to sell?

Objectives of market-led extension:

- ***Identifying possible areas of intervention of extension in Fisheries marketing:***

In market led extension, potential areas in fish marketing in specific region can be identified where intervention of extension services is required. It may bring some positive changes in fish marketing and fish producers will be benefited with the higher market price.

- ***Building up and use effective extension methodologies for providing need-based support to farming community in marketing:***

Marketing has become one of the major problems in fisheries sector due to bulk production. Market led extension enables farmers to overcome marketing related problems by using efficient and effective methods of extension. It will guide the fishers/ fish farmers towards efficient and need based marketing system and to make decisions about: -

What to produce?
When to produce?
Where to market?

- **The present linkage among Research-Extension-Farmers is extended by market linkage.**

In production led extension system (Fig. 2) an innovative and productive idea is discovered by the research process. The idea is then taken by extension personnel and delivered to farmers. With the aid of extension service, farmers are able to produce more but may encounter problems in marketing.

Fig-2: Production-led extension linkage system

Such problem may be eliminated through market led extension where Research-Extension- Farmers linkage is extended by market systems as depicted in Fig 3.

Fig-3: Market-led extension linkage system

- **To identify possible areas of intervention of extension in fish marketing.**

The market led extension identify possible areas where intervention in existing marketing system is required and based on identified problems, suggestions will be given to farmers.

Role of extension personals in light of market-led extension:

- SWOT analysis of market for creating awareness among fish farmers/ fishers for proper planning of production and marketing.
- Organization of farmers' interest groups (FIGs) on commodity basis and building their capabilities.
- Establishing marketing and fish-processing linkages between farmers' groups, markets and private processors.
- Enhancing the interactive and communication skill of the farmers to exchange their views with customers and other market forces (middlemen) for getting feedback and gain the bargaining during direct marketing.

Conclusion

Market-led extension enable the fish farmers or fishers to realize high returns for their produce, minimize production costs, improve the product value (value addition) and marketability. Indian farmers have moved from subsistence to self-sufficiency due to advent of production technologies. In order to be successful in the liberalized market scenario, focus needs to be shifted from 'supply driven' to market driven' and farmers have to produce according to the market needs to earn high returns. Therefore, the concept of market led extension is essential for Indian fish farmers, as they acquire marketing strategies and adjust their production systems according to market needs. By doing so, famers could get higher market price thereby higher incomes which will ultimately leads to development of fisheries sector as a whole.

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AGRI-ENTREPRENEURSHIP AND FARM DIVERSIFICATION: ENCOURAGING FARMERS TO EXPLORE ALTERNATIVE INCOME SOURCES BY VENTURING INTO ACTIVITIES THROUGH AGRI-TOURISM, AGRI-PROCESSING SECTORS

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Abstract
Agri-entrepreneurship and farm diversification involve encouraging farmers to explore new income sources beyond traditional farming practices. Agri-entrepreneurship refers to the entrepreneurial activities and initiatives within the agricultural sector. It involves the application of business principles and innovative approaches to create and manage agricultural enterprises. Agro-tourism, also known as agricultural tourism or farm tourism, refers to a form of tourism that involves visiting and experiencing agricultural operations, rural areas, and farm-based activities. agri-entrepreneurship and farm diversification are essential for farmers to explore alternative income sources beyond traditional farming practices. Activities such as agri-tourism and agri-processing provide farmers with new opportunities to enhance their economic viability.

Keywords: Entrepreneurship, Eco-tourism, Agro-processing, Sustainability, Farm diversification

Introduction

Agri-entrepreneurship and farm diversification involve encouraging farmers to explore new income sources beyond traditional farming practices. It focuses on promoting entrepreneurship in agriculture and expanding farmers' business opportunities. Several key aspects and considerations are involved in this process:

Identifying opportunities: Farmers should assess local market demand, consumer preferences, and potential niches. Factors like geographical location, climate, available resources, and infrastructure should be considered to identify viable diversification options.

Market research and analysis: Conducting thorough market research helps understand the target audience, competition, pricing trends, and distribution channels for chosen diversification options. Identifying potential buyers, retailers, restaurants, or value-added processing units that can support the new ventures is important.

Entrepreneurial skills and training: Equipping farmers with entrepreneurial skills is crucial. Training programs should cover business planning, financial management, marketing strategies,

and risk assessment. Farmers should understand market dynamics, customer engagement, and value proposition.

Access to finance and resources: Farmers need assistance in accessing financial resources like loans, grants, subsidies, or venture capital for their ventures. Facilitating linkages with relevant financial institutions, government schemes, and agricultural support agencies is essential.

Technical knowledge and innovation: Farmers should be encouraged to adopt new farming techniques, value addition processes, packaging, and quality control measures. Collaboration with research institutions, agricultural extension services, and industry experts can provide access to up-to-date knowledge and technological advancements.

Networking and collaboration: Farmers should engage in networking activities and join agricultural associations, cooperatives, or producer groups to share knowledge, experiences, and resources. Collaborating with stakeholders like processors, retailers, and others can help build strong value chains and access larger markets.

Risk management and resilience: Developing risk management strategies and diversifying income sources is important. Farmers should enhance resilience against market fluctuations, climate variability, and other challenges. Guidance on insurance options, crop diversification, and sustainable farming practices can be provided.

Regulatory compliance and certifications: Farmers need to be educated about legal and regulatory requirements associated with their ventures. Assistance should be provided in obtaining necessary certifications, licenses, permits, and adhering to food safety and quality standards.

Knowledge sharing and learning platforms: Creating platforms for farmers to share success stories, lessons learned, and best practices is beneficial. Workshops, seminars, field visits, and online forums foster knowledge exchange and create a supportive community.

Monitoring and evaluation: Continuous monitoring of agri-entrepreneurship and farm diversification initiatives is essential. Evaluating economic, social, and environmental outcomes helps refine strategies, learn from experiences, and adapt interventions as needed.

Agri-entrepreneurship and farm diversification contribute to the economic growth of rural communities, create employment opportunities, improve food security, and foster sustainable agricultural practices. Supporting farmers in exploring alternative income sources enhances their livelihoods and contributes to the overall development of the agricultural sector.

Objective of Studying Agri-entrepreneurship and Farm Diversification

Agri-entrepreneurship refers to the entrepreneurial activities and initiatives within the agricultural sector. It involves the application of business principles and innovative approaches to create and manage agricultural enterprises. Agri-entrepreneurs identify opportunities, take risks, and create value by leveraging their skills, resources, and market knowledge. Farm diversification refers to the practice of expanding the activities and income streams of a farm beyond traditional agricultural production. It involves exploring alternative ventures and activities that complement or supplement existing farming operations. Some basic objectives are-

1. To create income generation

2. To understand risk management activities
3. To identify market opportunities
4. To understand proper utilization of resources
5. To implement agro-tourism and recreational activities

Agro-tourism

Agro-tourism, also known as agricultural tourism or farm tourism, refers to a form of tourism that involves visiting and experiencing agricultural operations, rural areas, and farm-based activities. Agrotourism is an economic strategy aimed at assisting villagers in establishing alternative sources of income and preserving their cultures (Chandra Shekhar, 2022). It offers tourists the opportunity to learn about and engage in various aspects of farming, rural lifestyle, and agricultural heritage. Agro-tourism has gained popularity as a niche tourism segment, offering unique experiences and promoting sustainable agricultural practices. Modern rural development trends underline that the rational and organized utilization of agricultural resources, along with the enhancement of rural cultural and naturalistic heritage, is the right leverage to ensure sustainable growth (Hemani Kothari *et al.,*2021). Agro-tourism is a form of tourism that involves organized visits to farms, allowing tourists to observe and learn about agricultural activities. It offers hands-on experiences where tourists can participate in farm activities like harvesting crops or feeding animals. Agro-tourism often provides rural accommodation options, allowing tourists to experience the rural lifestyle firsthand. It promotes cultural immersion by providing insights into local culture, traditions, and rural communities. Educational programs are offered to enhance tourists' understanding of agriculture, sustainable farming practices, and environmental conservation. Farm-to-table experiences enable tourists to sample fresh, locally produced food directly from the farm. Nature and outdoor activities are provided for tourists to explore the natural surroundings. Agro-tourism emphasizes environmental conservation and sustainability by promoting sustainable farming practices and raising awareness among tourists. It facilitates direct interaction between farmers and consumers, fostering a deeper appreciation for farming and the food consumed. Agro-tourism benefits farmers and rural communities by providing additional income streams, supporting local businesses, generating employment opportunities, and preserving agricultural practices and rural heritage. Overall, agro-tourism offers a unique and immersive experience that connects tourists with agriculture, promotes sustainability, and contributes to the economic development and preservation of rural areas.

Importance of Agro-tourism

Agro-tourism offers farmers the chance to diversify their income streams beyond traditional farming, reducing their reliance on fluctuating commodity prices. Agritourism is an incredible educational tool with varied expected effects on the educational plan. Pupils, students, teenagers and adults understand better: the rural traditional culture, the production and the distribution processes of the agricultural products, the importance of healthy food in people's lives, the preservation of the environment (Ioan Petroman *et al.,* 2016). This form of tourism stimulates economic activity in rural areas, creating employment opportunities and supporting local businesses. It also plays a crucial role in preserving agricultural heritage and cultural traditions, raising awareness about traditional farming knowledge. Agro-tourism promotes sustainable agriculture by educating tourists about sustainable farming practices, organic methods, and biodiversity conservation. It serves as an educational platform, providing interactive learning

experiences about food production, rural life, and farming challenges. By bridging the gap between rural and urban communities, agro-tourism fosters connections between consumers and producers, enhancing trust and transparency in the food system. For tourists, it offers unique and authentic experiences in rural landscapes, diversifying the tourism sector. Agro-tourism contributes to the local economy through visitor expenditures, benefiting various local businesses. Additionally, it encourages the conservation of rural landscapes, reducing land conversion and preserving the scenic beauty of rural areas. Agro-tourism empowers local communities by involving them in tourism activities, allowing them to showcase their culture and traditions. Overall, agro-tourism brings numerous benefits, including economic diversification, rural development, cultural preservation, sustainability promotion, education, community engagement, and conservation of rural landscapes.

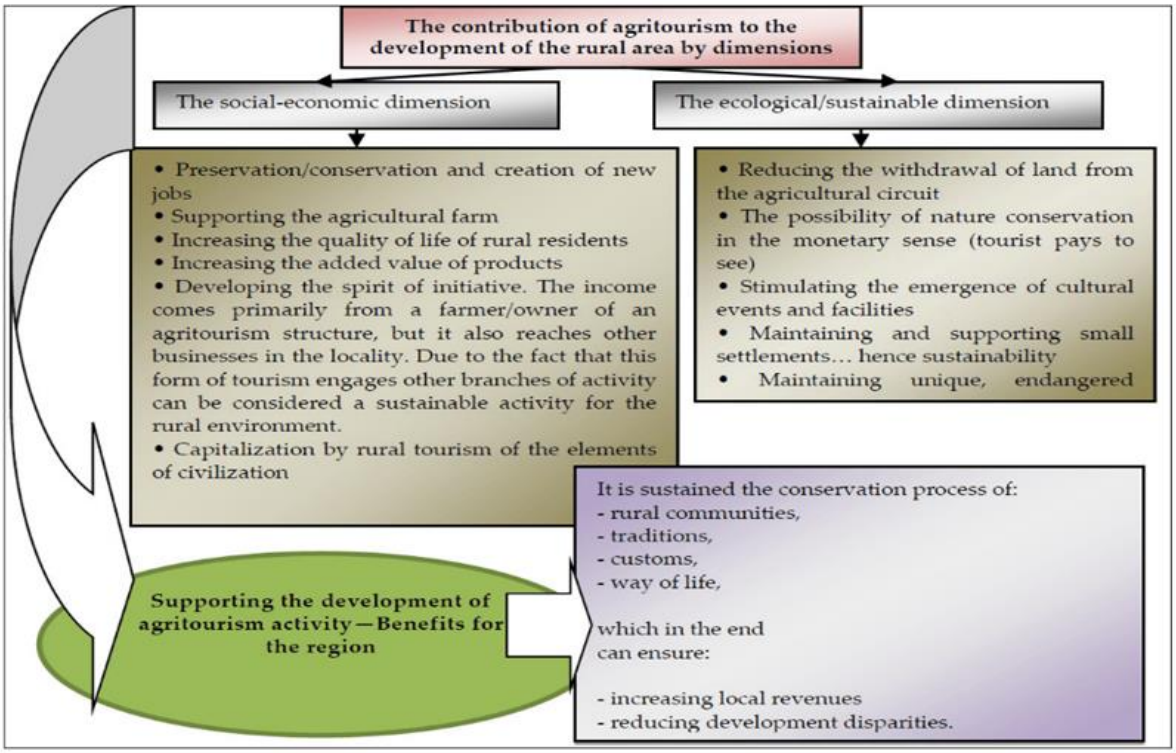

Fig1. Contribution of Agro-tourism for rural Area

Some Success stories of Agro-tourism

Joydhak, Shantiniketan: Joydhak is an agro-tourism initiative located in the vicinity of Shantiniketan, West Bengal. It offers tourists a unique rural experience where they can engage in various farm activities, such as paddy cultivation, vegetable farming, and dairy farming. Tourists can also participate in traditional handicraft workshops and cultural programs. Joydhak has successfully promoted sustainable farming practices, provided employment opportunities to the local community, and offered tourists an immersive rural experience.

Samsing and Suntalekhola, Darjeeling: Samsing and Suntalekhola, located in the Darjeeling district of West Bengal, have emerged as popular agro-tourism destinations. These serene hamlets offer visitors a chance to experience tea gardens, orange orchards, and cardamom plantations. Tourists can participate in guided nature walks, visit nearby villages, interact with farmers, and

enjoy local cuisine. The success of agro-tourism in Samsing and Suntalekhola has contributed to the local economy, supported sustainable agricultural practices, and preserved the region's natural beauty.

Purulia Eco Tourism, Purulia: Purulia, a district in West Bengal, has embraced agro-tourism as a means of rural development. The district administration, in collaboration with local farmers, has developed agro-tourism destinations that offer activities such as organic farming, cattle rearing, beekeeping, and pottery workshops. Tourists visiting Purulia can explore the scenic beauty of the region, learn about traditional farming practices, and enjoy local hospitality. The success of Purulia's agro-tourism initiatives has provided farmers with additional income sources and helped showcase the region's rich cultural heritage.

NABARD-supported projects: The National Bank for Agriculture and Rural Development (NABARD) has played a significant role in promoting agro-tourism in West Bengal. Through its financial and technical support, NABARD has helped establish and strengthen agro-tourism ventures across the state. These projects have included farm stays, organic farming initiatives, rural crafts, and cultural experiences. NABARD's initiatives have facilitated the growth of agro-tourism, empowered local communities, and contributed to rural development.

Agro-processing Sectors

The agro-processing sector involves transforming and adding value to agricultural produce through activities like cleaning, grading, packaging, and preservation. It adds value to raw materials, extends shelf life, and creates marketable products. The combined pressures of civil society social movements and advances in corporate social responsibility standards may well counter the "trading down" effects of cheap wages and slack environmental regulation (John Wilkinson *et al.,* 2008). Agriculture and industry have traditionally been viewed as two separate sectors both in terms of their characteristics and their role in economic growth, however over as few decades Agro and food process has rapidly expanded as an Organized industry with a bright role to be played in Socio-economic development of a country (Ajay Shukla *et al.,* 2015). Key aspects and benefits of agro-processing include:

Value addition: Agro-processing converts agricultural commodities into processed products, increasing their market worth, profitability, and consumer appeal.
Preservation and shelf-life extension: Techniques like canning, freezing, and drying help preserve produce, reducing post-harvest losses and ensuring a continuous supply to consumers.
Market diversification: Agro-processing enables farmers and processors to target new markets and consumer segments, reducing reliance on volatile commodity markets.
Employment generation: The sector creates jobs for machine operators, technicians, quality control personnel, packaging workers, and marketing professionals, contributing to rural and urban employment.
Income generation: Agro-processing increases farmers' income by selling processed products at higher prices, capturing a greater share of the value chain.
Food security and nutrition: Agro-processing reduces food waste, makes surplus produce available year-round, and offers a variety of nutritious and convenient food products.
Technology adoption and innovation: Processors invest in machinery, quality control, and research to improve product quality, efficiency, and safety standards.

Export potential: Agro-processing produces high-quality products that meet international standards, contributing to foreign exchange earnings and economic growth.

Linkages with farmers: Processors collaborate with farmers, providing training, technical assistance, and market linkages to improve practices and ensure a consistent supply of quality raw materials.

Sustainable agriculture: Agro-processing promotes sustainable practices by utilizing surplus produce, reducing food waste, and adopting environmentally friendly sourcing, processing, and packaging methods.

The agro-processing sector is essential for value addition, economic growth, job creation, food security, and sustainable agriculture. It strengthens the agricultural sector and contributes to its overall development and sustainability.

Fig2. Agro-based Industries in India

Conclusion

In conclusion, agri-entrepreneurship and farm diversification are essential for farmers to explore alternative income sources beyond traditional farming practices. Activities such as agri-tourism and agri-processing provide farmers with new opportunities to enhance their economic viability. Agri-tourism enables farmers to showcase their agricultural operations, offering unique experiences, educational programs, and farm-to-table interactions for tourists. Agri-processing involves value addition and transformation of agricultural produce, leading to the creation of marketable products with increased value and shelf life. Both agri-tourism and agri-processing contribute to rural development by generating employment opportunities, promoting sustainable agriculture practices, preserving agricultural heritage, and diversifying the local economy. These activities also facilitate direct interaction between farmers and consumers, fostering understanding, trust, and support in the food system. Through training, capacity-building programs, access to finance, and technological advancements, agri-entrepreneurship and farm diversification empower farmers to expand their business horizons, improve their livelihoods, and contribute to the overall development of the agricultural sector. By encouraging farmers to explore these alternative income sources, agri-entrepreneurship and farm diversification strengthen the

resilience of farming communities, ensure food security, and foster sustainable agricultural practices. They serve as pathways towards economic growth, rural development, and the preservation of agricultural heritage for present and future generations.

References

Hemani Kothari and Dr. Asif Perwej. 2021. Agro Tourism: A Way of Sustainable Development. Wesleyan Journal of Research. **13**(68):93-100.

Chandra Shekhar. 2022. Agro -Tourism. 29-35. DOI:10.13140/RG.2.2.27005.03045.

Ioan Petroman, Melania Varga, Elena Claudia Constantin, Cornelia Petroman. 2016. Agritourism: An Educational Tool for the Students with Agro-food Profile. Procedia Economics and Finance 39:83-87.

Ajay Shukla, Vandana Sharma, Hetal Bhinde. 2015. Agro and Food Processing Industry in India: Status, Opportunities & Challenges. International Journal of Social & Scientific Research. 2(1):1-8.

John Wilkinson, Rudi Rocha. 2008. The Agro-Processing Sector: Empirical Overview, Recent Trends and Development Impacts. Plenary paper: Global Agro-industries Forum. 1-59.

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STATUS OF THE DRY FISH MARKET AND PROCESSOR AT VERAVAL REGION: SURVEY, OBSERVATION, PROBLEM AND FUTURE PROSPECT

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Abstract
The marketing of dried fish holds a vital role in both the economy of Veraval and India. It contributes to increased food production, economic diversification, and the creation of employment opportunities. Prices and demand for dried fish are influenced by factors like quality and species. Notably, it serves as a significant income source for the fisherman community. Day by day population is increasing so that increasing the demand for dried fish therefore increasing the production. During off season demand of dried fish is increasing and fishermen get good prices. The future of dried fish will make good quality as well as invention of new technology through production increased. Make it good marketing channel and online marketing stage to prepare for future prospects.

Key words: Dried Fish, Market Survey, Fishermen, Future Prospect

1. Introduction

Drying is regarded as a traditional and primitive method of preservation of fish. India lacks adequate post-harvest infrastructure facilities to process and store dry fish. There is a huge landing of undersized and low market value fish as by catch, which is mostly discarded at sea during peak fishing seasons. During lean fishing seasons, these fishes are brought to the fish landing centers by the fishermen, due to demand from the dry fish enterprise. Dry fish can be transported to areas where these fishes have good market potential. Dry fish attracts greater demand during fishing ban period when availability of fresh fish in the market is low (Das et al., 2013).

Dry fish has higher concentration of protein (in terms of weight) as compared to the wet weight of fish and therefore is a cheap source of animal protein. Hence, dry fish production provides employment opportunity especially to women and generate income to the fishers (Kallon et al., 2017) Artisanal fisheries provide approximately 25% of the global fish catch and about 40% of the fish used for human consumption (Watson et al., 1996). Fish is an important part of the regular diet and is a cheap source of protein for the peoples. About 78% of total fish catch is consumed in fresh condition, 6% is used as dry fish and rest is used as frozen fish. Indian dry fish export contributes 8% of all form of fish exports and earned 754 crores during 2012-2013 (MPEDA, 2013).

In India, dry fish are widely sold at local markets and commercially important species are also

exported to other countries (Immaculate et al., 2013). Dry fish is a low cost dietary protein food, with the growing importance of dry fish, studies on various aspects such as traditional method of dry fish production and their problems (Payra et al., 2016).

Though dry fish enterprise has a significant role in the improvement of livelihood of the fishers and nutritional security of the society, not much attention has been paid to documenting the different avenues on the dry fish products. Hence, the present study was attempted to address the economics of dry fish production, its financial feasibility and how the dry fish reached consumer.

2. Veraval Market survey

The fish market structure varies from area to area here we were surveyed major two places which is major markets in veraval.

2.1 Fish Market Survey at Kharakuva

The Kharakuva fish market in Veraval is located nearby the State Highway, which is well-connected to all the coastal areas of Gujarat. The market offers various fishing activities, including the sale of fresh and dried fish, filleting, and preparing chunks of different fish. However, our main focus was on dried products. During our visit, we observed a significant presence of both women and men involved in the fishery field, as fishing is the primary source of income in this area. The market boasted a wide variety of fish cutting styles and sizes, with different species being processed, such as whole fish, headless, butterfly, chunks, fillets, and more. Notably, there is a global demand for products derived from sharks and rays (fofandi durga et al. 2019).

2.2 Fish Market Survey at Bhidiya

Bhidiya is situated between Somnath and Veraval and is primarily known as a fresh fish market. The local fishermen predominantly purchase fish here for their daily food needs. The market offers a variety of fresh materials obtained directly from local boat fishing. Occasionally, the good quality dried fish production can be attributed to the availability of excellent raw materials from this area.

2.3 Survey at Jose & Bros, Veraval

Jose and Bros hold a prominent position as one of the largest dried fish companies in Veraval. They employ various technologies for the drying process, including semi-drying, brining, rack drying, and mat drying. The brining process usually takes two days. Once the fish are dried, they are transported to regions like Kerala, Tamilnadu, and Odisha for distribution and sale.

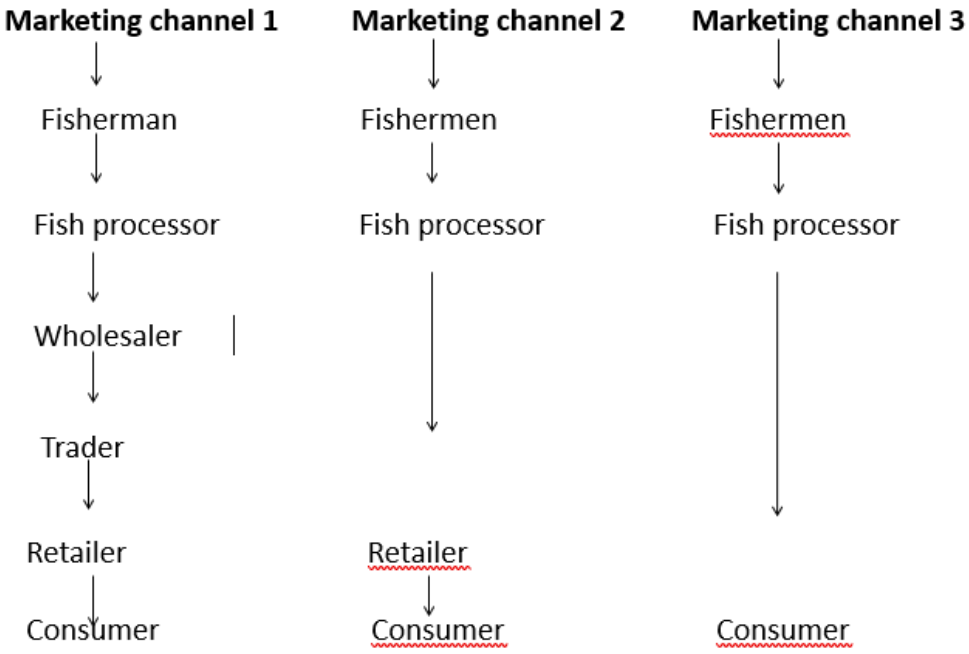
2.4 Dhanjibhai's danga and other dried fish danga

In Veraval, Dhanjibhai and several other dried fish wholesalers are actively involved in preparing dried fish and distributing them to various locations. The process of drying fish includes rack drying, mat drying, brining, semi-drying, and pole drying, all of which are commonly observed there. A wide variety of fish species are dried, such as shrimp, jawala, crocker, ribbon fish, Jeebh, Bombay duck, eel, and lizard fish. These dried fish spices are then transported to different places for sale and distribution.

3 Market structure channel and supply

The market in Veraval operates based on the interplay between demand and the availability of materials. Being the largest landing center among all fish centers, Veraval benefits from a steady supply of materials, ensuring the availability of a wide range of fish products. As the awareness of

the health benefits and nutritional value of fish continues to grow, the demand for fish products in Veraval has been steadily increasing day by day. Fish is increasingly recognized as a health promoter, containing valuable nutrients that are beneficial for human consumption. This rising awareness and appreciation for the nutritional properties of fish have contributed to the sustained growth in demand for fish products in the region.



Marketing channels of dry fish production in veraval Gujarat Girsomnath district of India.

4. Transportation Methods

Mode of transportation after landing purchased fish through fisherman. Transport is either in mechanized van or small truck and Chakada for local transportation. Wholesaler collect fresh fish from market. Long distance transportation track and railway are used.

5. Hygiene Condition

Maintaining the hygienic condition of the fish market is of utmost importance as there is a higher risk of faecal contamination. These conditions can create a suitable environment for the growth of blowflies, especially during the rainy season. To address this issue, fish processors utilize insecticides to control fleas and prevent infestations in the market. Furthermore, to ensure a hygienic environment, bleaching powder is commonly used both in fish landing areas and within the markets. This practice helps in disinfecting and sanitizing the surroundings, reducing the risk of contamination and promoting a safe and clean space for handling and selling fish (Khileri R .A et all 2014).

6. Problem originated in dried fish

Various problems associated with the quality of the dried fish like spoilage, discoloration, microbiological problems, etc. Quality of water and ice used in fish processing is very important in maintaining overall quality. Unsuitable drying method, storage problem, bacterial attack, dun spoilage. Major problem related to dry fish marketing in this region are poor hygienic condition,

poor road facility, improper market infrastructure, less modern techniques are used and less government support for credit facilities (Bharda *et all* 2017).

7. Future Prospect

The Indian fish trade is export oriented, almost 100%. No processing factory is there in the country to cater exclusively the local population. Appropriate quality standards are also not available species-wise. There is an urgent need to set up standards for fish and fishery products sold within the country. Future of Indian fish trade depends on this as purchasing capacity of the people is going to enhance in the years to come, and market prices are going to be high for dried fish in India (Datta, S., 2015.).

Table 1. Price of raw and dried fish.

Species	Price of raw Fish/kg (In Rs.)	Selling price of dry Fish/kg (In Rs.)
Saurida tumbil	32	225
Harpodon nehereus	18	225
Sphyraena obtuata	15	170
Epinephelus Diacanthus	15	170
Colia dussumieri	15	90
Acetes indicus	8	90
Solenocera Crassicornis	70	350
Zebrias quagga	25	175
Congresox Talabonoides	28	120
Otolithes cuvieri	15	170
Scoliodon Laticaudus	40	130
Arius thalassinus	17	100

(Source from Bharda et all 2017)

References

Bharada, S.; Desai, A. Y.; Tandel, R. P. and Tandel, J. T. (2017). Production of different type of dry fish and its yield measurement at Veraval, Gujarat, India. Res. J. Recent Sci. **6(7):** 28 - 32.

Das, M., Rohit, P., Maheswarudu, G., Dash, B. and Ramana, P. V. (2013). Overview of dry fish landings and trade at Visakhapatnam Fishing Harbour. Mar. Fish. Infor. Ser. T&E Ser., 215: 3-7.

Datta, S., (2015). Prospects of value added products and it's future in Indian market.

Fofandi Durga C, Tanna Poojaben D, Motivarash Yagnesh B, Agiya Akash and Dabhi Rajkumar (2019). Dry fish market survey of veraval Journal of Entomology and Zoology Studies 2020; 8(1): 686-688.

Immaculate, K., Sinduja, P., Velammal, A. and Patterson, J. (2013). Quality and shelf life status of salted and sun dried fishes of Tuticorin fishing villages in different seasons. Int. Food Res. J., 20(4): 1855-1859.

Kallon, A., Lebbie, A., Sturm, B., Garnett, T. and Wadsworth, R. (2017). Comparative studies of fish smoking and solar drying in the Sierra Leone artisanal fishing industry. J. Stored Prod. Post-harvest Res., 8(3): 40-48.

Khileri, R.A., Lende, S.R. and Deshmukh, P.G., (2014). Analyzing Potential of Kharakuva Fish Market

on the Coastal Region of Saurashtra, Gujarat. Adv. Econ. Bus. Manag, 1(3), pp.259-264.

MPEDA (2013) 19th India International Seafood Show at Chennai Trade Centre, Chennai press release - 24 June 2013.

Payra, P., Maity, R., Maity, S. and Mandal, B. (2016). Production and marketing of dry fish through the traditional practices in West Bengal coast: Problems and prospects. Int. J. Fish. Aqua. 4(6): 118-123.

Watson, R. T., V. H. Heywood, I> Baste, B. Dias, R. Gamez, T. Janetos, W. Reid and G. Ruark (1996), Global Biodiversity Assessment, for the United National Environment Programmed, Cambridge University Press.

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ROLE OF NANO-FERTILIZERS IN ALLEVIATING BIOTIC AND ABIOTIC STRESSES IN AGRICULTURE

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Abstract

The direct and indirect effects of climate change are causing intense droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms and declining natural resources, soil fertility and productivity and in turn negatively impacting the growth, development, yield and quality of crops and the environment. The current paper highlights the potential impact of Nano-fertilizers in alleviating biotic and abiotic stresses in agricultural crops.

Introduction

To reduce the detrimental impact of disease and pest infestations, farmers are applying millions of metric tonnes of pesticides every year. This increases environmental pollution, ecosystem disruption, residual toxicity in food and feed, decline in soil health and also creates resistance to such pests. Therefore, clear identification and appropriate use of novel technologies or approaches to overcome the current yield limiting factors and to increase resource use efficiency are essentially important. Researchers are striving to mitigate detrimental effects of abiotic and biotic stresses by reducing negative impact of environmental stress on crop plants, and achieve agriculture sustainability and food security. Now novel technologies, such as nanotechnology has emerged and use of Nano-fertilizers (NFs) and Nano-pesticides is recently gaining increasing interest as potential plant-enhancing technologies mainly being utilized to improve nutrient use efficiency (NUE), optimize water usage, reduce environmental pollution, prevent biotic and abiotic stresses, ensure food security, and enhance sustainability through stimulating the activity of certain enzymes, increasing the contents of chlorophyll, enhancing efficiency of photosynthesis, initiating early germination, better root growth, better and early nodulation in pulses, early flowering and prolonged fruiting, controlling plant biotic and abiotic stresses which in turn ensure high yield with quality produce and better profits to the farmers (Kumar et al, 2020a, 2020b}. The current paper highlights the potential impact of Nano-fertilizers in alleviating biotic and abiotic stresses in agricultural crops.

Importance of NFs in Agriculture

Nanoparticles (NPs) are tiny materials 1–100 nm in size (Kumar et al., 2021). In contrast to their larger sized equivalents, NFs possess certain unique and diverse physicochemical properties due to large surface area-to-volume ratio which ensures high absorption efficacy, and increased connecting and working efficiencies owing to their extremely small size increase stomatal penetration with a diameter higher than 10 nm (Perez-de-Luque, 2017) and ensure excess sorption capacity and controlled release kinetics with intelligent delivery mechanisms. NFs may release their nutrients in 6-7 weeks, while synthetic fertilizers do the same within a week. Now,

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NFs can be used on the plants or in the soil to boost nutrient uptake and utilization to upgrade plant performance. NFs by providing balanced nutrition combat various environmental variables with significant advantages for physiological fitness and performance of plants/crops as well being delivered at slow rates to extend soil health and fertility with nutrient balance by lowering runoff into groundwater and reducing the risk of toxicity. General benefits of NFs are depicted in **Figure 1**.

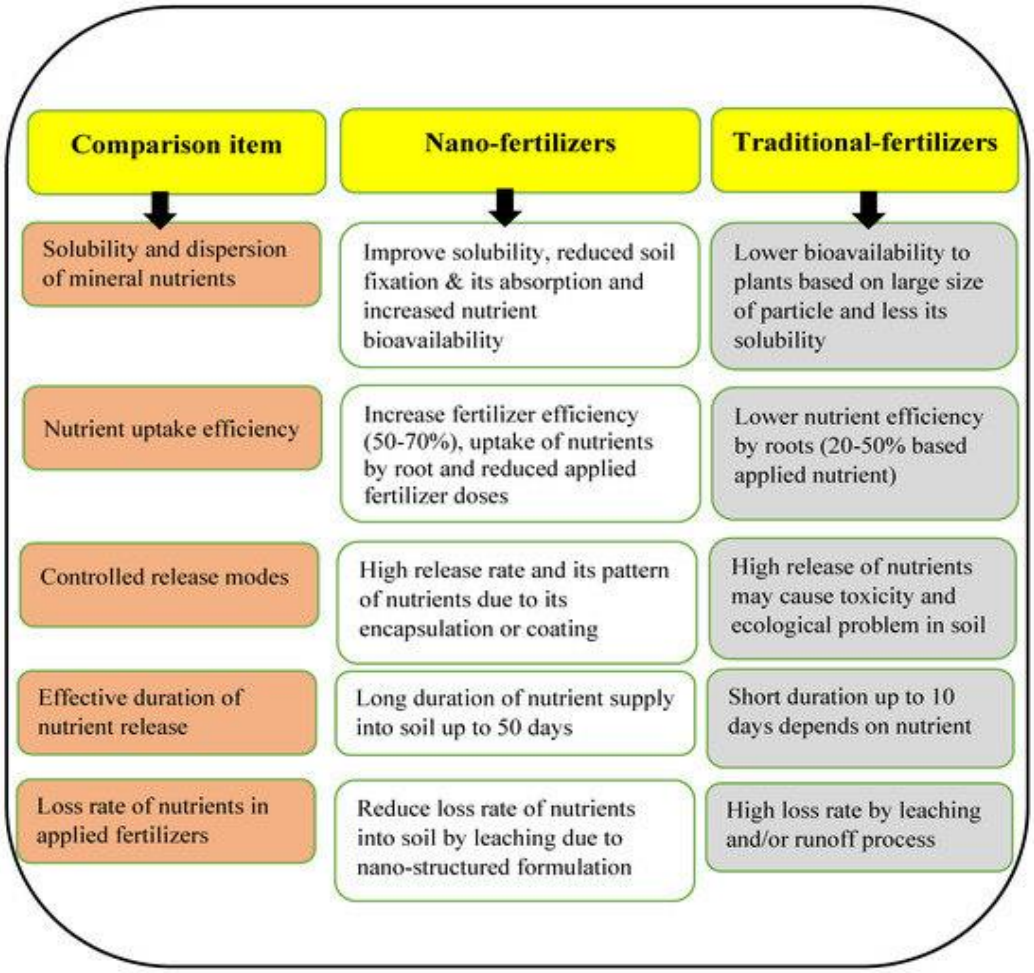

Figure 1. A comparison between traditional fertilizers and Nano-fertilizers (Sources: Seleiman et al., 2021; Kalwani et al., 2022; Belal and El-Ramady, 2016; Rizwan et al., 2018)

In contrast, excessive application of fertilizers contributes to soil pollution due to leaching or being not fully utilized by plants; thus, non-utilization of nutrients gets converted into insoluble salts in the soil. The synthetic urea fertilizer after field application rapidly loses 70% of its N content through leaching and volatilization, leaving < 30% available for plants (Seleiman et al., 2021). NFs are currently getting selected as an alternative over the conventional ones and have been integrated into abiotic and biotic stress management strategies to enhance plant health.

Plant Abiotic and Biotic Stresses

Stress in plants refers to external conditions that adversely affect growth, development or productivity of plants. Two types of environmental stresses are encountered to plants which can be categorized as (i) Abiotic stress and (ii) Biotic stress (**Figure 2**).

Figure 2. Stresses/problems in plants, and benefits, applications and limits of Nano-fertilizers (Source: Tarek et al. 2022)

Among abiotic stresses, radiation, heat, hail, salinity, floods, drought, extremes in temperature, heavy metals and mineral deficiencies are considered to be the main stresses that affect the growth, yield, and quality of crops. On the other hand, attacks by various pathogens such as fungi, bacteria, actinomycetes, nematodes and herbivores are included in biotic stresses that also decrease plant yield. As plants are sessile in nature, they have no choice to escape from these environmental cues. Abiotic and biotic stresses are major limitations to crop production that have negative impacts on both plant growth and productivity, and they are main threats to global food security.

Role of NFs in Combating Plant Biotic and Abiotic Stresses

Nano-fertilizers have a great ability to mitigate the abiotic/biotic stresses on cultivated plants through many mechanisms because of their vast surface areas and their nanoscale size. NFs can improve the morphological, biochemical, and physiological indices of cultivated plants, such as photosynthetic rate and its efficiency, nutrient uptake efficiency, regulation of phytohormones, and enhancement of plant defense system (**Figure 3**).

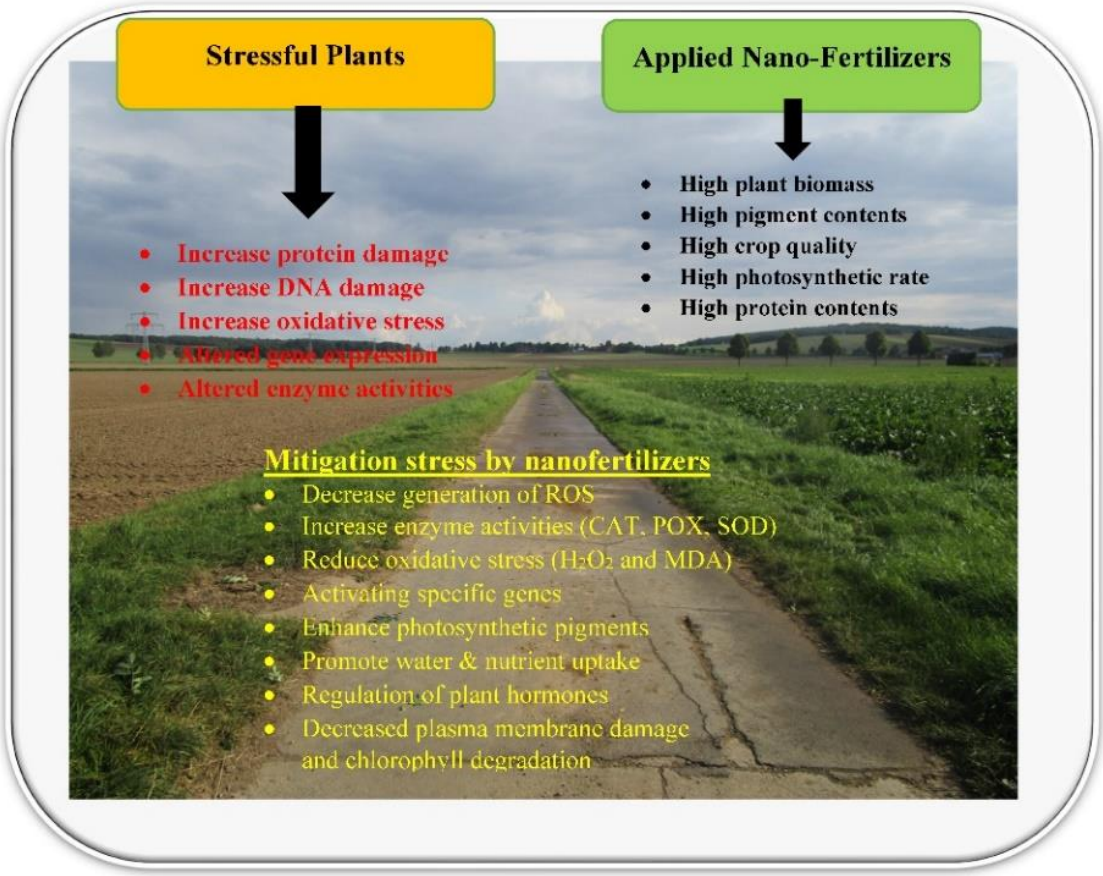

Figure 3. Main problems in stressful plants and mitigation stress by NFs (Source: Verma et al., 2022)

Note : ROS - Reactive oxygen species; CAT - Catalase; POX - Peroxidase; SOD - Superoxide dismutase; MDA - Malondialdehyde

Studies have shown that NFs can help enhancing crop productivity by improving stress tolerance as well as promoting plant germination, growth, and physiological processes. Plants exposed to NFs show a variety of morphological and physiological alterations, such as germination frequency, lengths of the shoot-root, biomass, chlorophyll fluorescence yield (Fv/Fm), photosynthetic efficiency, biomolecules, and cellular injuries, *i.e*., lipid peroxidation, protein, and cell membrane damage. Several variations have been observed in the plant cell ultra-structures, *i.e*., disruption of the cell wall, cell membrane, chloroplasts, thylakoids, irregular shape/size of plasto-globules and starch granules, destructive variation in peroxisomes, swollen and damaged mitochondrial cristae, irregular nucleus, rough and thin mesophyll cells, and epidermal, cortical, and stellar cells (Rajput et al., 2018). At present, numerous studies have shown that the use of NFs or NPs can effectively decrease the adverse effects resulting from different environmental stresses by increasing the levels of plant antioxidant compounds. The plant breeders should develop stress tolerant cultivars in order to secure food security and to ensure safety to the farmers.

Crop Plants and Biotic Stress

Plants struggle with many kinds of biotic stresses caused by different living organisms especially viruses, bacteria, fungi, nematodes, insects, arachnids and weeds. These biotic stress agents cause various types of diseases, infections and damage to crop plants and ultimately affect the crop

productivity. The agents causing biotic stresses directly deprive their host of its nutrients and in turn can lead to death of plants. Biotic stress can become major because of pre-and post-harvest losses. Despite lacking the adaptive immune system, plants can counteract biotic stresses by evolving themselves to certain sophisticated strategies. The defence mechanisms which act against these stresses are controlled genetically by plant's genetic code stored in them. The resistant genes against these biotic stresses present in plant genome are encoded in hundreds. The biotic stress is totally different from abiotic stress. Different studies have shown that the application of NPs or NFs has the potential to decimate the population of different noxious soil and plant microorganisms, as they can easily enter and disrupt bacterial or fungal cells. Application of NPs or/and NFs onto infected plants has a high potential to reduce the population of different noxious soil and plant microorganisms because they can easily enter and disrupt bacterial or fungal cells.

Crop Plants and Abiotic Stress

Plants are subjected to a wide range of abiotic stresses, such as high or low temperature (heat and cold), waterlogging, drought, salinity, flooding, heavy metals (HMs), and ultraviolet (UV) radiation causing alterations in various morphological, physiological, and biochemical processes depending on the crop and stress types, and time of exposure. During stress, physiological and biochemical changes occur in plant cells that can adversely affect plant growth, development, and productivity. Species and varieties bred to tolerate these challenges along with nanotechnology and other climate-sensitive agricultural technologies could be the most efficient adaptation strategy to cope with climate and abiotic stress factors, thereby achieving sustainable production (Kumari et al., 2022).

These abiotic stresses are interconnected with each other and may occur in the form of osmotic stress, malfunction of ion distribution and plant cell homeostasis. With the increasing world population, abiotic stress conditions are increasingly affecting crop production. Generally, abiotic stresses have adverse impacts on plant growth and development which affects agricultural productivity and agriculture sustainability causing food security problems, and resulting in economic losses. Sustainable agriculture and yield productivity can improve the quality of soil, water, and other resources required by plants (Saxena et al., 2016; Desoky et al., 2020b). Abiotic stress factors and their negative effects on plants are elucidated in **Figure 4.**

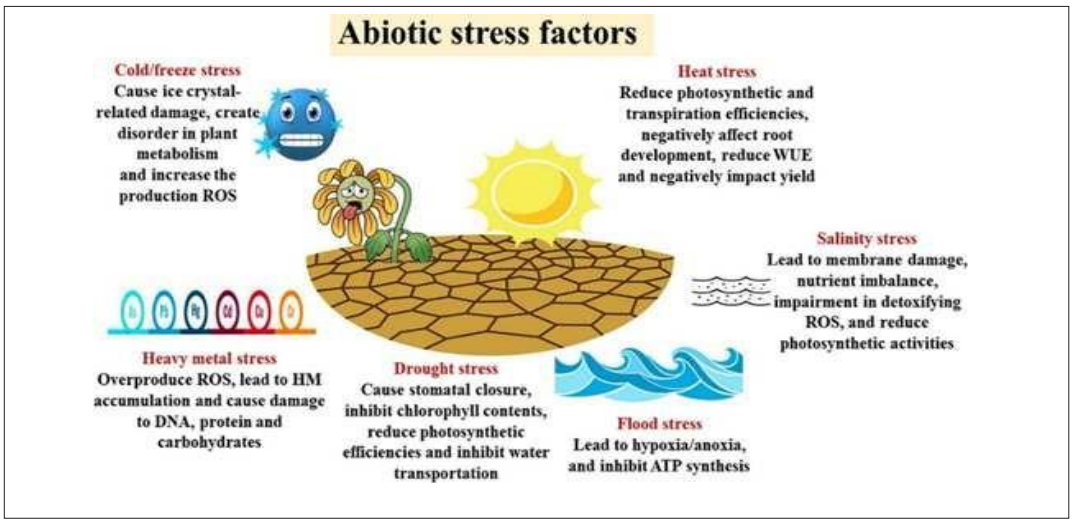

Figure 4. Abiotic stress factors and their negative effects on plants (Source: El-Saadony et al., 2022)

Drought Stress: Nowadays, climate has changed all around the globe by continuous increase in temperature and atmospheric CO_2 levels. The distribution of rainfall is uneven due to the change in climate which acts as an important stress as drought. Soil water available to plants has been steadily decreasing due to severe drought conditions and causing death of plants prematurely. Limited water availability resulted in a significant loss in overall plant biomass, including yield. In addition to cultivation of drought-resilient crops, use of stress-ameliorative materials such as NFs has the significant potential to decrease the negative effects of drought stress on plants by increasing the water-holding capacity of soils. NPs can increase the contents of antioxidants and proline, thus decreasing the production of H_2O_2 and malondialdehyde.

Salinity Stress: Soil salinity poses a global threat to world agriculture by reducing the yield of crops and ultimately the crop productivity. Two primary effects are imposed on crop plants by salt stress; osmotic stress and ion toxicity. The osmotic pressure under salinity stress in the soil solution exceeds the osmotic pressure in plant cells due to the presence of more salt, and thus, limits the ability of plants to take up water and minerals like N, P, K, Na and Ca, thereby crop yields are adversely affected. Adverse effects of soil salinity on soil properties, plant growth and its metabolism, and crop yields have been reported in the literatures by the experts in the field.

In this context, use of NFs could be a positive approach to overcome the increasing problems of soil salinity. NFs/NPs help in alleviating the harmful effects of various stresses including salinity. Application of NPs extends better growth and development (El-Saadony et al., 2021) with enzymatic activities of peroxidase, superoxide dismutase, and catalase which scavenge reactive oxygen species (El-Saadony et al., 2021). Nanomaterials may mimic the role of antioxidative enzymes like peroxidase, superoxide dismutase and catalase. These antioxidants and enzymes are continuously scavenging the reactive oxygen species (Upadhyaya et al., 2015). Because of larger specific surface area and more reactive areas, NPs helped in enhanced enzyme activity related to salt tolerance.

The NPs simplify the absorption of nutrients which are involved in the salt tolerance mechanism.

Waterlogging/Flooding: The lack of oxygen in the rhizosphere during flooding stress induces hypoxia, which may experience energy deficiency and increased ethylene production-related genes with reduced respiration with impaired vegetative and reproductive development. NPs may play a key role in lowering hypoxic conditions during waterlogging by modifying metabolism and expression of genes, thus improving plant performance.

High Temperature: When plants encounter heat stress, percentage of seed germination, photosynthetic efficiency and yield declines. Under heat stress, during the reproductive growth period, function of tapetal cells which provide nutrition to the microsporocytes (the pollen mother cells) is lost, and the anther is dysplastic. Heat stress causes changes in plant characteristics, lipid structure, and protein–lipid interactions (Younis et al., 2020). Plants maintain their photosynthetic efficiency and homeostasis as part of their adaptation strategies when subjected to excess light intensities. Foliar spraying of NPs decrease oxidant content, protecting plants from the harmful impacts of oxidative damage caused by high-temperature stress. Significant role of NPs has been reported on photosynthesis, stomatal conductance, and transpiration rate in tomato leaves during excess light intensities.

Cold/ Freezing Stress: Cold stress as abiotic stress has proved to be the main abiotic stresses that decrease productivity of agricultural crops by affecting the quality of crops and their post-harvest life. In temperate conditions, plants are encountered by chilling and freezing conditions that are very harmful to plants as stress. Chilling stress may damage plant cell organelles and tissues due to enhancement in distorted permeability of the cell wall, which induces ion leakage across the membranes and negatively affects germination plant development. Chilling stress threatens photosynthesis, a unique and crucial plant carbon assimilation metabolism. It impairs photosystems in a variety of ways, including reduced photosynthetic pigments, transpiration, CO_2 absorption, and RuBisCO (photosystem enzyme) breakdown. Plants exposed to chilling stress have higher levels of ROS-scavenging enzymes, such as dehydroascorbate reductase (DHAR), glutathione reductase (GR), and monodehydroascorbate reductase (MDAR). NPs boost the synthesis of the RuBisCO enzyme, the capacity of chloroplasts to absorb light and decrease ROS formation in the plant photosystem.

Heavy Metal Toxicity: There are many contributing factors responsible for build-up of heavy metals in agriculture soils causing harmful effects on soil-plant environment system. The heavy metal contamination may affect via the food chain as Cd, Hg, As, and Pb are among the top 20 toxic heavy metals according to the Agency for Toxic Substances and Disease Registry and the US Environmental Protection Agency. Heavy metals endanger food production, while NPs may boost seed germination, photosynthetic rate, antioxidant defence system, yield, and plant vigour Experts agreed using NPs to combat the varied effects of toxic ions on plants. NPs help to minimize metal phytotoxicity. Several workers established the role of NPs in reducing Cd stress and improving soybean plant development and of NPs, in general, to minimize metal phytotoxicity. Application of Nano-fertilizers scan also help reduce soil toxicity caused by an accumulation of chemical substances applied to the soil, while also acting as an alternative means of enhancing resource-use efficiency.

The Road Ahead

It is expected that earth's temperature will increase by 3–5 °C in the coming 50–100 years. As there is continuous increase in temperature and uneven rainfall, the changes of flood and drought is always in consideration. Under these circumstances, plants will probably encounter more frequently, concurrently both biotic and abiotic stresses. To achieve sustainable agriculture, we have to identify appropriate eco-friendly solutions that address biotic and abiotic stress–induced loss of crop yield. Nanotechnology is an innovative and effective means of promoting crop yield and quality, enhancing the farming sector, and managing global food demand. Nano-fertilizers are regarded to reduce the negative effects of abiotic stress by activating plant defence mechanisms *via* the induction of ROS production and phytotoxicity. The role of Nano-fertilizers under stress needs much effort on the part of researchers for novel approaches, especially under multiple stresses, which represent the typical environmental conditions under which we seek global food security.

Conclusion

Extreme climates, pests and diseases, and environmental pollution pose a huge threat to agricultural food production. In the face of the increasing problems of environmental pollution and hunger dilemma of the growing population, NFs which have proven benefits in promoting plant growth and enhancing plant resistance against biotic and abiotic stresses assume great

importance. It seems that the use of NFs can not only reduce environmental pollution, eutrophication, pollution of groundwater and diseases, but also with more penetration into the roots and leaves of plants can improve the physiological traits and yield of crops due to smaller particle diameters.

References

Belal, E. and El-Ramady, H. 2016. Nanoparticles in water, soils and agriculture. In *Nanoscience in Food and Agriculture 2*. S. Ranjan et al. (eds.), Sustainable Agriculture Reviews, Volume, **21**, 311. Springer International Publishing Switzerland. DOI 10.1007/978-3-319-39306-3_10.

Desoky, E.S.M., Saad, A.M., El-Saadony, M.T., Merwad, A.R. M. and Rady, M. M. 2020b. Plant growth-promoting rhizobacteria: potential improvement in antioxidant defense system and suppression of oxidative stress for alleviating salinity stress in *Triticum aestivum* (L.) plants. *Biocatalysis and Agricultural Biotechnology* **30**, 101878.

El-Saadony, M.T., Saad, A.M., Soliman, S.M., Salem, H.M. et al. 2022. Role of nanoparticles in enhancing crop tolerance to abiotic stress: A comprehensive review. *Frontiers of plant science* **13**, 946717.

El-Saadony, M.T., ALmoshadak, A.S., Shafi, M.E., Albaqami, N.M. et al. 2021. Vital roles of sustainable nano-fertilizers in improving plant quality and quantity-an updated review. *Saudi Journal of Biological Sciences* **28**, 7349–7359.

Kalwani, M., Chakdar, H., Srivastava, A., Pabbi, S. and Shukla, P. 2022. Effects of nanofertilizers on soil and plant-associated microbial communities: Emerging trends and perspectives. *Chemosphere* **287**, 132107.

Kumar, Yogendra, Tiwari, K.N. Singh, Tarunendu, Sain, N. K., Laxmi S., Verma, R., Sharma, G. C. and Raliya, R. 2020a. Nanofertilisersfor enhancing nutrient use efficiency, crop productivity and economic returns in winter season crops of Rajasthan. *Annals of Plant and Soil Research* **22**(4):324-335.

Kumar, Yogendra, Tiwari, K.N. Nayak, R.K. Abhimanyu Rai, Singh, S.P. Singh, A.N., Yatendra Kumar, Harish Tomar, Tarunendu Singh and Raliya, Ramesh (2020b). Nano fertilisers for enhancing nutrient use efficiency, crop productivity and economic returns in winter season crops of Uttar Pradesh. *Indian Journal of Fertilisers* **16 (8)** : 772-786.

Kumar, Yogendra, Tiwari, K.N. Singh, Tarunendu and Raliya, Ramesh (2021). Nanofertilisrs and their role in sustainable agriculture. *Annals of Soil and Plant Research* **23 (3):** 238-255.

Kumari, S., Khanna, R. R., Nazir, F., Albaqami, M., Chhillar, H., Wahid, I. 2022. Bio-synthesized nanoparticles in developing plant abiotic stress resilience: a new boon for sustainable approach. *International Journal of Molecular Sciences* **23**:4452.

Perez-de-Luque, A. 2017. Interaction of nanomaterials with plants: what Do we need for real applications in agriculture*? Frontiers in environmental science* **5**, 12. doi: 10.3389/fenvs.2017.00012.

Rajput, V. D., Minkina, T., Sushkova, S. V., Mandzhieva, S., Fedorenko, A. and Lysenko, V. 2018. "Structural and ultrastructural changes in nanoparticles exposed plants," In *Nanoscience for Sustainable Agriculture*. eds R. Pudake, N. Chauhan, and C. Kole (Cham: Springer).

Rizwan, M., Ali, S., Ali, B., et al. 2018. Zinc and iron oxide nanoparticles improved the plant growth and reduced the oxidative stress and cadmium concentration in wheat. *Chemosphere* **214**, 269–277.

Saxena, R., Tomar, R. S., and Kumar, M. 2016. Exploring nanobiotechnology to mitigate abiotic stress in crop plants. *International journal of pharmaceutical sciences research* **8,** 974–980.

Seleiman, M. F., Almutairi, K. F., Alotaibi, M., Shami, A., Alhammad, B. A., and Battaglia, M. L.2021. Nano-fertilization as an emerging fertilization technique: why can modern agriculture benefit from its use ?. *Plants.* **10**, 2.

Tarek, A. Shalaby, Yousry Bayoumi, Yahya Eid, Heba Elbasiouny, Fathy Elbehiry, József Prokisch, Hassan El-Ramady and Wanting Ling 2022. Can Nanofertilizers Mitigate Multiple Environmental Stresses for Higher Crop Productivity? *Sustainability **14*****(6),** 3480. https://doi.org/10.3390/su14063480

Upadhyaya, H., Shome, S., Tewari, S., Bhattacharya, M. K. and Panda, S. K. 2015. Effect of Zn nano-particles on growth responses of rice. In *Nanotechnology: Novel Perspectives and Prospects* (Eds. Singh, B. Kaushik, A. Mehta, S. K. Tripathi, S. K. New Delhi, India: McGraw Hill Education, *pp.* 508-512.

Verma, K. K., Song, X.-P., Joshi, A., Tian, D.-D., Rajput, V. D. and Singh, M. 2022. Recent trends in nano-fertilizers for sustainable agriculture under climate change for global good security. *Nanomaterials* **12**, 173.

Younis, A. A., Khattab, H. and Emam, M. M. 2020. Impacts of silicon and silicon nanoparticles on leaf ultrastructure and *TaPIP1* and *TaNIP2* gene expressions in heat stressed wheat seedlings. *Biologia plantarum* **64**, 343–352.

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ROLE OF MELATONIN FOR ABIOTIC STRESS TOLERANCE IN PLANTS

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Abstract

Plants are sessile organisms permanently restricted to the site and cannot easily cope with adverse environmental conditions. Rapid climate change resulted in many biotic and abiotic stresses such as drought, salinity, heat and cold stress, which negatively affect a plant's normal growth and eventually prevent it from reaching its genetic potential. To feed the ever-growing human population, farmers are compelled to use different chemical fertilizers and herbicides, which cause land degradation and pollution and, in many cases, deteriorate human health. An alternative to this is the need of the hour and one such method is the use of bio-stimulants in agriculture which are required in minute amounts, reduce fertilizer need of the crop and are eco-friendly. Melatonin is also a bio-stimulant that induces growth and tolerance in plants under abiotic stress by improving the photosynthetic rate and improving antioxidant defense activity in stressed plants and hence can effectively be used to ameliorate the adverse and ill effects of biotic and abiotic responses in plants.

Introduction

Global climate change seriously threatens growing agriculture by causing several abiotic stresses. A growing worldwide population and deteriorating environmental conditions present agriculture with both current and future challenges. Abiotic stresses, such as temperature extremes, drought, salinity, etc., significantly affect plant development and yield. Around 90% of the arable land is susceptible to one of the aforementioned stresses, which significantly reduces the yield of economically important crops such as rice, wheat, maize and barley. If the current pattern holds, crop losses might soar at an unprecedented rate very shortly, significantly reducing production, driving up food costs, and making it more challenging to meet the expanding demands of a growing population. Increasing food demands resulted in increased intensive agricultural practices, including the use of agrochemicals such as insecticides and pesticides and deforestation which causes land and water resource exploitation, causing severe environmental pollution. Under such conditions, use of alternative methods for crop improvement under stressed conditions which are effective and eco-friendly is important. One such potential and novel approach is use of bio-stimulants such as melatonin, salicylic acid, gibberellic acids, sea weed extract, jasmonic acid, etc. whose application make the crop tolerant to abiotic stress by causing many physiological and biochemical changes in them and thereby, increasing seed or grain yield and quality and also decreasing the fertilizer need of the crop. Bio-stimulants can be natural or synthetic and are required in very minute quantity compared to fertilizers, increasing nutrient efficiency, stress tolerance and crop quality traits. Therefore, are also economically feasible to the small margin farmers, contributing a major portion to our agricultural sector.

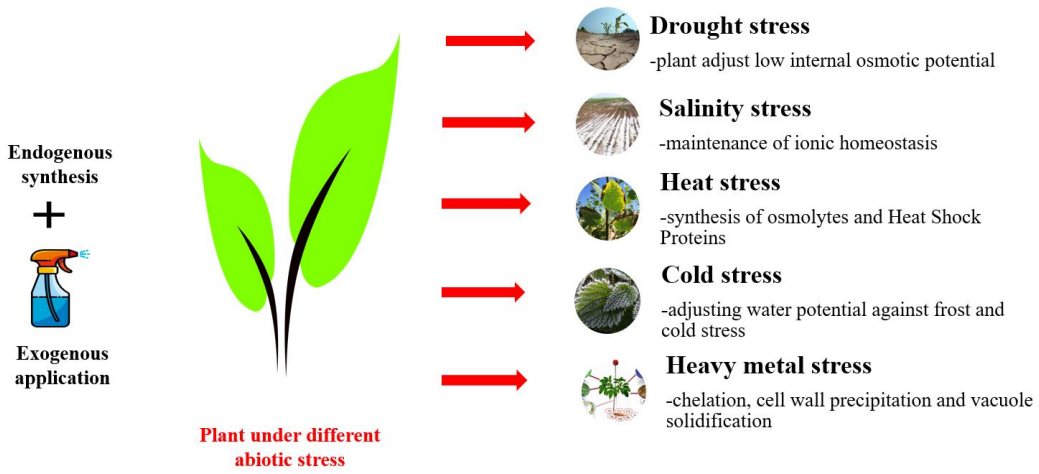
Melatonin is a plant growth regulator, besides providing tolerance to biotic and abiotic stress. The exogenous application of melatonin is very effective under many stresses and positively affects the growth and yield of plants. Stressed plants accumulate melatonin to survive adverse conditions, e.g., under high-intensity light conditions, salinity and drought, etc. Melatonin improves plant growth by improving thermotolerance, improved antioxidative enzymatic activity, osmoregulation, scavenging of Reactive Oxygen species (ROS) and expression of stress tolerance genes on transcriptional level. This article discusses the different roles of melatonin application on crops under various abiotic stress.

Melatonin under salinity and ionic stress

It has recently been discovered that melatonin (MT) has a regulatory role in enhancing plant tolerance to several types of abiotic stress, including salinity stress by improving the antioxidant system in different crops such as tomato (Martinez *et. al.,* 2018), cucumber (Wang *et. al.,* 2016) and watermelon (Li *et. al.,* 2017). MT helps the plant alleviate salinity stress by accumulating organic osmolytes, protecting chlorophyll, improving light absorption, CO2 fixation and photosynthetic activity, hence maintaining ion homeostasis and preventing dehydration into the cells.

Melatonin under drought and heat stress

High environmental temperature causes heat stress in plants, generally followed by drought stress. Water is considered a crucial environmental component whose deficiency causes drought stress that limits plant development, production, and quality due to various physiological and biochemical responses. Excessive water deficient conditions result in the formation of ROS, which causes oxidative damage to plant cellular machinery, lipid peroxidation in chloroplast and mitochondria and inactivates the enzymatic activity, ultimately affecting the photosynthetic machinery of the plant. Melatonin act as a growth regulator by enhancing carbon assimilation, preventing chlorophyll degradation and improving antioxidative enzymatic activity. Melatonin is also known to regulate several processes including morphogenesis, rhizogenesis and caulogenesis. Exogenous application of melatonin enhances drought and heat tolerance in number of crops such as wheat (Cui *et. al.,* 2017), brassica (Li *et. al.,* 2018), and maize (Ye *et. al.,* 2016).



Ameliorative effect of melatonin under different abiotic stresses

Melatonin under cold stress

Low-temperature stress is a major challenge to warm-climate plants as it induces molecular, physiological and metabolic disruptions. Cold stress disrupts cell membrane, decreases membrane fluidity and ultimately disrupts ion homeostasis in plant cells. Cold-induced formation of excessive ROS causes damage to DNA, proteins and lipids, photosynthesis, and carbon fixation. Foliar application of melatonin induces growth and development by directly scavenging ROS, hence mitigating oxidative stress in plants in many plants such as *Arabidopsis* (Li *et. al.,* 2015), and wheat (Sun *et. al.,* 2018).

Melatonin under heavy metal stress

Heavy metals cause serious problems to plant growth and productivity. Heavy metals *viz*, Fe, Mn, Zn, Cu, Mo, Ni, and Co are required by the plants in lower amounts and hence when present in higher amounts (more than required) cause heavy metal toxicity whereas heavy metals such as Pb, Cd, Hg, and As are not required by the plant therefore merely their presence in the soil causes heavy metal toxicity. Heavy metals induce oxidative stress by accumulating ROS in different cell organelles, lipid peroxidation, interrupt antioxidant systems, favour stomatal closure, and increase plant photorespiration rates. Melatonin is effective in many plants such as *Melissa Officinalis* (Hodzic *et. al.,* 2021) and radish (Xu *et. al.,* 2020).

Conclusion

Abiotic stresses challenge crop growth and prevent them from reaching their genetic potential by altering different physiological and genetic responses, resulting in reduced productivity worldwide. Exogenous application of melatonin improved plant growth under stressed environment. Based on the result presented in the article, it is possible to conclude that melatonin plays a role in reducing the effect of environmental stress by regulating antioxidant metabolism and shielding the photosynthetic apparatus. Enhancing agricultural output and addressing the major problem of global food insecurity is made more accessible by increased photosynthesis. Exogenous melatonin application at the field level can be beneficial from an agronomic standpoint as abiotic stress lowers the quality and yield of the crops.

References

Martinez, V.; Nieves-Cordones, M.; Lopez-Delacalle, M.; Rodenas, R.; Mestre, T.C.; Garcia-Sanchez, F.; Rubio, F.; Nortes, P.A.; Mittler, R.; Rivero, R.M. Tolerance to stress combination in tomato plants: New insights in the protective role of melatonin. *Molecules* **2018**, 23, 535.

Wang, L.Y.; Liu, J.L.; Wang, W.X.; Sun, Y. Exogenous melatonin improves growth and photosynthetic capacity of cucumber under salinity-induced stress. *Photosynthetica* 2016, 54, 19–27.

Li, H.; Chang, J.; Chen, H.; Wang, Z.; Gu, X.; Wei, C.; Zhang, Y.; Ma, J.; Yang, J.; Zhang, X. Exogenous melatonin confers salt stress tolerance to watermelon by improving photosynthesis and redox homeostasis. *Front. Plant Sci.* 2017, 8, 295.

Cui, G.; Zhao, X.; Liu, S.; Sun, F.; Zhang, C.; Xi, Y. Beneficial effects of melatonin in overcoming drought stress in wheat seedlings. Plant Physiol. *Biochem*. 2017, 118, 138–149.

Li, J.; Zeng, L.; Cheng, Y.; Lu, G.; Fu, G.; Ma, H.; Liu, Q.; Zhang, X.; Zou, X.; Li, C. Exogenous melatonin alleviates damage from drought stress in Brassica napus L. (rapeseed) seedlings. *Acta Physiol. Plant.* 2018, 40, 43.

Ye, J.; Wang, S.; Deng, X.; Yin, L.; Xiong, B.; Wang, X. Melatonin increased maize (Zea mays L.) seedling drought tolerance by alleviating drought-induced photosynthetic inhibition and oxidative damage. *Acta Physiol. Plant.* 2016, 38, 48.

Shi, H., Reiter, R. J., Tan, D. X., and Chan, Z. (2015). Indole-3-acetic acid inducible 17 positively modulates natural leaf senescence through melatonin-mediated pathway in Arabidopsis. *J. Pineal Res.* 58, 26–33. doi: 10.1111/jpi.12188

Sun, L., Li, X., Wang, Z., Sun, Z., Zhu, X., Liu, S., ... & Wang, Y. (2018). Cold priming induced tolerance to subsequent low temperature stress is enhanced by melatonin application during recovery in wheat. *Molecules*, *23*(5), 1091.

Hodzic, E., Galijasevic, S., Balaban, M., Rekanovic, S., Makic, H., Kukavica, B., & Mihajlovic, D. (2021). The protective role of melatonin under heavy metal-induced stress in Melissa Officinalis L. *Turkish Journal of Chemistry*, *45*(3), 737-748.

Xu, L., Zhang, F., Tang, M., Wang, Y., Dong, J., Ying, J., ... & Liu, L. (2020). Melatonin confers cadmium tolerance by modulating critical heavy metal chelators and transporters in radish plants. *Journal of Pineal Research*, *69*(1), e12659.

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BIRDS AND AGRICULTURE: AN UNBREAKABLE BOND

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Introduction

Birds, the most conspicuous forms of animal life across the globe, with an estimated 10,000 species worldwide, are economically significant in agriculture, but the presence of birds in agroecosystems is often seen as an economically significant threat to crops. The field of agricultural ornithology examines the interplay between birds, agroecosystems, and their management, with a particular focus on the impact of avian behaviour on agricultural productivity. This area of study is distinct from economic ornithology, which takes a broader view of the relationship between birds and economic systems. Avian species hold a crucial position in agroecosystems, serving a twofold function in the realm of agriculture (Ali, 1971). Agro-ecosystems are characterised by their capacity to provide diverse and reliable food resources, such as seeds, fruits, grains, green vegetation in the form of grasses or crop plants, arthropods, particularly insects and rodents, found in the soil, and crops, in addition to serving as breeding grounds for birds. Birds also serve as natural crop predators, insect pest controllers, seed dispersers, pollinators, etc. However, the net effects of birds in agroecosystems are neutral; the more damage they cause, the more they gain. The purpose of this article is to describe the significance of birds in nature and our agroecosystem and how crucial they are to maintain our agroecosystem by emphasizing the services rendered by birds and any potential impact on agricultural landscapes, assisting the public and policymakers in planning, designing, and implementing biofriendly strategies for conservation of birds and their habitats to draw attention to this issue to maintain balance in our ecosystem, and educating people about the consequences of the extinction of birds.

Services of birds in agriculture

In the context of Indian agriculture, it is observed that areas with intensive cultivation of fields exhibit a significant presence of dispersed fish, dairy, honey bee, and poultry farms within the farmlands. These farms offer supplementary food resources for avian species, including piscine organisms, livestock feed, pollinators such as bees, floral nectar, and orchards bearing fruits. Avian species have gained prominence due to their utilisation by humans in various activities such as sustenance, propagation, pollination, ornamental purposes, among others. The avian population in specific ecosystems is significantly influenced by the accessibility of nourishment, breeding, and resting locations, and the variety of bird species is correlated with the nature of the available habitat. Avian species play a significant role in the realm of biological control for certain fauna. The avian population provides a range of valuable services within agricultural systems, as outlined below:

Role in Seed Dispersion and Plant Distribution

Birds, as significant and effective browsers of forest vegetation, act as good seed disperser agents because when they eat fruits or other vegetables, they dispose of their waste along with the

seeds. Feces provide good fertilization for the seeds with which they are dropped, giving seeds very good conditions to grow. A large proportion of tree and shrub species have fleshy fruits, which are attractive to birds acting as dispersal agents for these trees. The physical structure of the environment is typically determined by plant communities in most of the habitats, and as a result, these communities have a significant impact on the distributions and interactions of animal species.

Role as Pollinators

Birds pollinate a variety of significant crops, including horticultural crops and other plant species with economic, social, and commercial significance. They perform this crucial service where birds consume the nectar of various plant species and, in turn, help to pollinate the plant while receiving its food. They are the most significant flower pollinators in the entire world. Ornithophilly, is the term for this process of bird pollination of the plant, and mutualism, the term for food consumption from the plant, both of which benefit from one another. Ornithophily, the study of bird pollination, has recently received more attention in the scientific community due to the fact that birds are important pollinators in places with low insect populations, such as dry regions, areas with a lot of rain, and low temperatures because they can function in a wide range of temperatures. Beyond food production and agriculture, pollinator birds are very important for the environment because they increase genetic diversity by about 80% by improving plant reproduction efficiency. A significant number of agricultural crops grown around the world are said to benefit greatly from wild pollinators. It is unlikely that specific plant species have evolved adaptations to browsing by specific birds due to the extensive dietary overlap between various herbivorous birds and the turnover of both bird and plant species throughout evolutionary time, though evolutionary responses to bird browsing generally are possible. As many plant species have successfully undergone evolutionary shifts to ornithophily, such as hummingbirds in the continental United States, honeycreepers in Hawaii, and honeyeaters in Australia, which are essential species for pollinating wildflowers, avian pollination is now recognised as an emerging field for agriculture production. According to Cronk and Ojeda (2008), several bird families, including Meliphagidae, Trochilidae, Nectariniidae, etc., effectively perform pollination tasks. Birds can serve as pollinators for plants that are further apart. Nectarivorous birds tend to adapt their foraging behaviour faster than insect-eating birds (Luck & Spooner, 2012).

Role as Bio-control agents in Integrated Pest Management (IPM)

A species that can cause significant harm to people or any important ecosystem resource because of its abundance, behaviour, or feeding habits is referred to as a pest. The majority of pests that seriously harm agricultural resources economically are insects, particularly in the absence of any efficient control measures. Birds' consumption of insect pests benefits farmers, aids in IPM, and lowers risks to people's general health, finances, and environment. Agrochemical use on cultivated land is growing daily in order to increase crop yields. Although these pesticides have some benefits for crop production, they also have drawbacks. They harm the environment by reducing soil fertility, killing non-target animals, and accelerating soil erosion. There are thought to be 70,000 pest species attacking farms that produce food. As pest species become more resistant to pesticides and the use of chemicals must be limited due to their long-term effects on human and animal health, biological control is becoming more and more important. Field pest control is greatly aided by insectivorous birds. Around 500 million metric tonnes of prey biomass

are consumed annually by insectivorous birds worldwide. According to scientific studies, about half of bird species are insectivorous, and two thirds of these species consume invertebrates (Barbaro et al., 2017). Several studies have identified Corvus splendens, commonly known as the House crow, as a species that feeds on a variety of food sources including carrion, offal, dead sewer rats, locusts, termites, and crabs, which are known to cause significant damage to paddy crops. The softer parts of the garden snail, Achatina fulica, are primarily consumed by crow pheasants. Numerous species were observed eating grasshoppers, including Bubulcus ibis, Merops philippinus, Merops orientalis, Acridotheris tristris, Centropus sinensis, Acridotheris ginginianus, Corvus splendens, Dendrocitta vegabunda, and Pycnonotus cafer. Moth and butterfly species are controlled by the Magpie Robin, Black Drongo, and Jungle Babbler. Motacilla maderaspatensis, a large-pied wagtail, manages aphids. Owls, Jungle crows, and House crows all consume the most destructive pests, such as mice and rats.

In the hierarchy of predators, raptors are at the top because they are sensitive predators. They are also crucial in regulating the rodent population because they destroy crops and pose a threat to human health by carrying various zoonotic diseases (Luna et al., 2020). By instilling fear in prey, raptors can reduce the population of their prey. Because they can alter prey behaviour and maintain the dynamics between predator and prey, these predators have a more indirect than direct impact on their prey, which promotes species richness through competition.

Role of birds as bioindicator

Bioindicators are the organisms that indicate or monitor the health of the environment that indicate the presence of pollutant that provide information about amount and intensity of exposure. Avian species serve as effective bioindicators due to their high detectability and ease of observation. Their distinctive coloration, vocalisations, and diurnal behaviours enable farmers to readily identify numerous species in agricultural settings, providing valuable insights into the overall health of the environment and any ecological or environmental changes that may be occurring. Avian species hold a significant position in the food web, rendering them susceptible to disruptions at lower trophic levels and contamination in the agricultural environment. This makes them a valuable indicator of agrochemical pollution.

Adverse effects of birds on agriculture

Crop Damage

Avian-related issues in the agricultural sector have been a persistent challenge since the inception of farming practices. Avian pests pose a significant threat to cereal crops in Africa, owing to their migratory nature, high population density, and adaptable feeding habits, which may include agricultural produce as a component. The incidence and magnitude of avian depredation on farmers is highly variable, both spatially and temporally, due to a multitude of factors that influence bird damage. These factors include, but are not limited to, field dimensions, the surrounding flora, cropping schedules, and climatic conditions. The crop damage by birds leads to economic loss affecting the economy of country and India being the country mostly dependent on agricultural production for its economy suffers huge losses every year due to depredation of agricultural crops by birds.

Spread of Zoonotic Diseases

Wild birds present potential disease risks in agricultural landscapes due to their ability to carry pathogens and act as reservoirs. They are susceptible to a diverse range of pathogens, including

zoonotic ones, which are of particular concern in agricultural production and processing. This is because they can contaminate crops and produce, posing human health risks.

Agriculture as threat to birds

The biodiversity of farmlands including farmland birds is declining markedly in recent decades due to agriculture expansion and intensification resulting in habitat loss and mortality in several bird species the use of agrochemicals such as pesticides and fertilizers in fields is increasing day by day to increase crop production and yield in order to fulfill the ever-growing demands of human population as a result several bird species are threatened with the edge of extinction in near future.

Practices for bird conservation in agricultural landscapes

In order to conserve birds to save them from extinction agricultural lands can play a crucial role to plan and develop conservation strategies. Awareness programmes should run for farmers and local peoples to aware them about the importance of birds in agriculture and ecosystem. Government policies should include incentive for farmers who opt out of intensive farming practices for organic farming along with use of biopesticides as an alternative to agrochemicals that causes harm to bird species Biodiversity friendly sustainable agricultural practices should be followed to enhance bird population and to flourish the biodiversity within the agricultural landscapes which is deteriorating otherwise.

References

Ali S (1971). Ornithology in India: its past, Present and future Scientific Culture 37(8): 99-113.

Barbaro L, Rusch A, Muiruri E.W, Gravellier B, Thiery D and Castagneyrol B (2017). Avian pest control in vineyards is driven by interactions between bird functional diversity and landscape heterogeneity Journal of Applied Ecology 54(2): 500-508.

Cronk Q and Ojeda I (2008). Bird-pollinated flowers in an evolutionary and molecular context *Journal of Experimental Botany* 59(4): 715-727.

Luck G.W and Spooner P.G (2012). The importance of managing the costs and benefits of bird activity for agricultural sustainability International Journal of Agricultural Sustainability 10(4): 268-288.

Luna A.P, Bintanel H, Vinuela J and Villanua D (2020). Next-boxes for raptors as a biological control system of vole pests: high local success with moderate negative consequences for non-target species Biological Control 146: 104- 267.

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THERMAL POLLUTION IN AQUATIC ECOSYSTEM

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Abstract
Thermal pollution results from human modifications to the natural temperature cycles of freshwater environments. Thermal pollution is any change in a habitat's natural temperature, which might include elevated temperatures brought on by industrial cooling processes to the discharge of cold water into streams beneath large impoundments. Freshwater species have a wide range of temperature tolerances, but they all have a safe zone as well as low and high temperatures where they cannot survive. Up to a point, temperature increases accelerate the pace of growth. Human-induced freshwater cooling can have a significant effect on aquatic life. The largest point sources of thermal pollution are industrial enterprises and power plants. Workers at the facility in this instance draw cool water from streams, cool generators and other machinery with it, and then return the cool water to the stream along with heated water.

Introduction
There has been a lot of concern expressed in the last five years about how waste heat from the rising power generation industry could significantly affect aquatic environments vital to fish and other aquatic animals. It is now necessary for society to consider if this fear is warranted, whether it justifies significant spending by the utility sector for cooling systems that avoid natural waters, and whether it should lead us to reevaluate all energy consumption. Water availability and quality are major issues that humanity has been dealing with recently (Unesco, 2009). However, industrial pollutants have polluted water resources, making them hazardous for human consumption and irrigating an activity, which has a negative impact on both ecology and human health. On our planet, there are two sources of water. Water that has been contaminated makes it unhealthy for humans to consume since it includes toxic or hazardous materials as well as germs and other organisms that can cause disease (Friedl, 2003).

The globe is currently dealing with the pollution that is damaging every element of the biosphere because human technological advances have consistently come before his studies into the repercussions of his progress on the environment. The impact of thermal pollution on the composition of the biotic community, particularly on the activities of the microorganisms in the aquatic ecosystem, is of fundamental concern. The temperature has a significant impact on microbial growth, which in turn influences the rate of reproduction, dietary needs, and enzymatic and chemical composition of the cells (Ingraham, 1962). By creating heterotrophic microcosms at various temperatures, Allen & Brock (1969) demonstrated how each microcosm evolved a distinctive species composition. Problems with "thermal pollution" brought on by condenser cooling operations are frequently more closely tied to how waste heat is discharged than how

much is released. This is due to the fact that every step in the cooling process, from condenser flow to heat dispersion in the receiving water, creates or interferes with distinct biological processes. Had adequate consideration been given to integrated design of temperature rise, outlet structures, and the mechanics of dispersion, dilution, and cooling in the incoming water, many water bodies would show little harmful impacts of extra heat (Parker and Krenkel, 1970).

Thermal pollution impact on fish

According to Hynes (1960), Malik et al. (2018), macrophytes, macrobenthos, fish species, phytoplankton, and zooplankton are all negatively impacted by biodegradable organic pollution. The fish population is one of the most desired sources of high-quality protein for humans. The gills, kidneys, and liver are the most commonly affected body parts and organs in some fish species when they are exposed to chemical pollutants (Bukola et al., 2015). These morphological, tissue, and biochemical alterations by the aquatic creature emphasise the various forms of stress and alterations to the ecological ecology. In order to evaluate the level of water pollution, a variety of histo-cytological alterations in fish species have been devised and approved as biomarkers. The freshwater ecosystem is seriously threatened by human and developmental activities such as industrial effluents, irrigation operations, waste management issues, and an increase in urbanisation (Zhu et al., 2018; Kamboj et al., 2020).

Impact of pollutants on the water quality

Pollutants' effects on the quality of the water numerous impacts of pollution on the physicochemical characteristics of water have been documented by Subhendu (2000).

Light: The amount of light that could penetrate due to the water bodies' varied colors and high turbidity was lowered.

Temperature swings: When water is used to cool power plants and to remove waste heat from businesses, the temperature of the water rises due to thermal pollution.

Depth and flow: Due to extensive siltation of sediments caused by land erosion, both the flow and depth of the water body were diminished.

pH: Acidic water causes acid rain or changes the water's pH when coal and oil are burned. Acids are created in significant quantities by mining and a number of industrial processes, including vinegar, battery waste, tanneries, and waste from the production of DDT. Large-scale fish species are known to live routinely between pH levels of 6.0 to 9.0, while they are unable to withstand abrupt changes within this range.

Dissolved oxygen: The amount of dissolve oxygen has been significantly reduced as a result of the discharge of highly polluted effluents and sewage into any water body. Additionally, liquid O2 is used by bacteria during their physiological processes to break down DO.

Causes of thermal pollution

Power plants and industrial factories: The largest point sources of thermal pollution are industrial enterprises and power plants. Thermal pollution is frequently caused by industrial operations using water as a coolant, as well as by power plants. When used as a coolant, water is returned to the natural environment at a higher temperature, which causes an abrupt change in temperature (Ottinger et al., 1990).

Reductions in stream flows or lake volumes: By limiting the water body's ability to act as a thermal buffer, decreases in stream flows or lake volume change temperature regimes. Irrigation, hydroelectric, and other human uses of water limit stream flows and cause water temperatures to rise dramatically during warm seasons (Caissie, 2006).

Deforestation: Deforestation is another factor in thermal pollution since it can make streams and rivers less shaded, which raises the temperature of the water (Beschta et al., 1987).

Anthropogenic cooling of freshwaters: The main point sources of thermal pollution are industrial enterprises and power plants. In this instance, chilled water is taken out of streams to cool generators and other equipment before being heated up and returned to the stream (Walter K. Dodds, Matt R. Whiles 2020).

Climate change: The primary causes of thermal pollution are businesses and power plants, which pull water from streams—a potent heat-waste sink—to cool their machinery and generators before reintroducing it to water bodies, raising the temperature of freshwater habitats (Miara et al., 2018).

Conclusion

Thermal pollution can be caused by industrial sources, urban runoff, and suburban runoff, especially during brief, strong thunderstorms in watersheds with plenty of impermeable surfaces like asphalt. Because the water body's ability to act as a thermal buffer is diminished by reductions in stream flows or lake levels, temperature regimes are altered. In warm weather, stream flows are greatly reduced and water temperatures are significantly raised as a result of water withdrawals for irrigation, hydroelectricity, and other human purposes. In the end, this warming may lead to an increase in fish deaths from high temperatures. Due to the elimination of riparian vegetation, which dramatically increases solar penetration and temperature, deforestation is also a significant cause of thermal pollution in streams, small ponds, and wetlands.

References

Beschta, R. L. (1997). Riparian shade and stream temperature; an alternative perspective. *Rangelands Archives*, 19(2): 25-28.

BROCK, T. D. (1969). Microbial growth under extreme conditions. In Microbialgrowth, ed. P. M. Meadow & S. J. Pirt, 15~,1. London, Cambridge University Press.

Bukola, D., Zaid, A., Olalekan, E.I. and Falilu, A. (2015). Consequences of Anthropogenic Activities on Fish and the Aquatic Environment. Poultry, Fisheries & Wildlife Sciences, 3(2): 1-12.

Caissie, D. (2006). The thermal regime of rivers: a review. *Freshwater biology*, *51*(8), 1389-1406.

Friedl, S. (2003). Water pollution: Definition, types, and sources. http://study.com/academy/lesson/water-pollutiondefinitiontypes-and-sources.html

Haider, Q., & Liu, L. C. (2013). Transformations between complex scattering length and binding energy. 1311.4232.

Hynes, H.B.N. (1960). The ecology of running waters. Liverpool: Liverpool University Press.

INGR~AM, J. L. (1962). Temperature relationships. In The bacteria, ed. I. C. Gunsalus & R. Y. Stanier, 4, 265-96. New York, Academic Press.

Kamboj, N., Kamboj, V. and Sharma, A.K. (2020). Length-Weight relationships of selected fish species at mining bed stretch of river Ganga at Haridwar. Annals of Agri-Bio Research, 25(2): 251-254.

Malik, D.S., Sharma, A.K. and Bargali, H. (2018). Status of phytoplankton diversity in relation to water quality of Bhagirathi riverine system in Garhwal Himalaya. International Journal of Advanced Science and Research, 3(1): 30-37.

Miara, A., Vörösmarty, C. J., Macknick, J. E., Tidwell, V. C., Fekete, B., Corsi, F., & Newmark, R. (2018). Thermal pollution impacts on rivers and power supply in the Mississippi River watershed. *Environmental Research Letters*, *13*(3), 034033.

Ottinger, R. L. (1990). Regulatory processes: Legal and institutional barriers (No. CONF-9010245--).

Parker, F.L. and Krenkel, P.A., CRC Critical Reviews in Environmental Control, 1, 101, 1970.

Subhendu, D. (2000). Effects of aquatic pollution on fish and fisheries. Pollution- An International problem for fisheries. Canadian Journal of Fisheries and Aquatic Sciences, 66: 400-480.

Unesco. (2009). The United Nations World Water Development Report 3: Water in a Changing World. Paris/New York: UNESCO/Berghahn Books

Walter, K., Dodds, W., & Matt, R. (2020). Trophic state and eutrophication. *Freshwater Ecology: Concepts and Environmental Applications of Limnology, 3rd ed.; Walter, K., Dodds, W., Matt, R., Eds*, 539-581.

Zhu, S., Zhang, Z. and Zagar, D. (2018). Mercury transport and fate models in aquatic systems: A review and synthesis. Science of the Total Environment, 639: 538–549.

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PRECISION FARMING: THE FUTURE OF FARMERS TO EARN HIGH INCOME THROUGH HI – TECH HORTICULTURE

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Abstract

Precision farming involves the application of technologies and principles to manage spatial and temporal variability associated with all the aspects of agricultural and horticultural production for improving crop performance and environmental qualities. In short it means adding the right amount of treatment at the right time and the right location within a field. Philosophy behind the precision farming is that production inputs (seed, fertilizer, chemicals, etc.) should be applied as needed and where needed for the economic production of the horticulture crops. About 17 Precision Farming Development Centre's (PFDC) have been established in different agro-climatic regions of India. In this article, what is precision farming, development of precision farming, its importance, steps, different tools, application of precision farming, future of farmers to earn high income through hi – tech horticulture, constraints and future thrust are discussed, which can be used in future point of view.

Keywords: Precision Farming, Production, Farmers, Hi- Tech horticulture, Income

Annotation of Precision farming

Precision farming or precision agriculture is a modern management strategy that employs the details of site-specific nutrient management, remote sensing, global information system, global positioning system, variable rate application to precise manage the production input. Precision farming or precision agriculture is about doing the right thing, in the right place, in the right way, at the right time through the right procedures. Managing crop production inputs such as water, seed, fertilizer etc to increase yield, quality, profit, reduce waste and becomes eco-friendly. Precision farming intends to match agricultural inputs and practices as per crop and agro-climatic conditions to improve the accuracy of their applications.

Chronicles of Precision Farming

Pierre Robert is often regarded as the father of precision farming because of his active promotion of the idea and organization of the first workshop, "Soil Specific Crop Management," during the early 1990s

PIERRE ROBERT

What is Precision Farming (PF)?

The word 'precision' means exactness or accuracy Precision agriculture is a management strategy that gathers, processes and analyses temporal, spatial and individual data and combines it with other information to support management decisions according to estimated variability for improved resource use efficiency, productivity, quality, profitability and sustainability of horticultural production (International Society of Precision Agriculture). Precision farming is a tool of several technologies which act together for efficient utilization of resources. In precision agriculture inputs are utilised in precise amounts to get increased average yields, compared to traditional cultivation techniques.

Necessity of Precision Farming

- The conventional farming systems has led to extensive usage of agricultural inputs like machinery, pesticides, water, and other inputs resulting in negative environmental impacts such as pollution of the environment by emission of greenhouse gases.
- Research suggests educational and economic challenges as the two most important in the application of precision farming.
- Among the variables that contribute to educational challenges, lack of Precision Farming; their tools and techniques local experts, funds, knowledgeable research and extension personnel have more of an impact compared to others.
- PF and initial costs have more of an impact on the economic challenges compared to the other issues. Rather than this PF increase horticulture productivity with prevents soil degradation.
- PF reduce the use of the chemical application in crop production and efficient use of water resources. It is also helpful in the dissemination of modern farm practices to improve

quality, quantity and reduced cost of production, developing favourable attitudes and changing the socio-economic status of farmers more cost-efficient farming A farmer's expense sheet is often the thing of doom and dread.

- Precision farming aims to reduce a farmer's expenditure by minimising the need for things like fertiliser, pesticide and herbicide. Over a growing season, growers are seeing significant reductions in the amount of money they are spending on all of the above where technology is using the components sparingly and only where needed.
- As an alternative to blanket spraying, this has seen massive savings and allows farmers to better budget and keeps costs to a minimum.

Intent of Precision Farming

- Promotion of new venture in the 'Agriculture and its allied sector' bringing together various component of horticulture to exploit the variability.
- Reduction in cost of cultivation due to site-specific crop management practices.
- Increase in production efficiency of inputs due to site-specific management of inputs
- Reduction in soil and environmental pollution.
- Reduction in the application of nutrients especially nitrogen fertilizer thus reducing nitrate in underground water and nitrous oxide to the atmosphere.
- Reduction in chemicals does through variable rate application technology.
- Reduction in the application of irrigation water thus reducing of nutrient along with deep percolations.
- Reducing erosion, runoff and sedimentation of water bodies.

Comparison between Precision farming and Traditional farming:

Precision farming	**Traditional farming**
Farm field is broken into —management zones‖	Whole field approach where field is treated as a homogeneous area
Management decisions are based on requirements of each zone	Decisions are based on field averages
PF tools are used to control zone	Inputs are applied uniformly across a field

Benefits/Advantages of Precision farming:

- Compile and analyze data in real time.
- Reduce water waste and improve crop management.

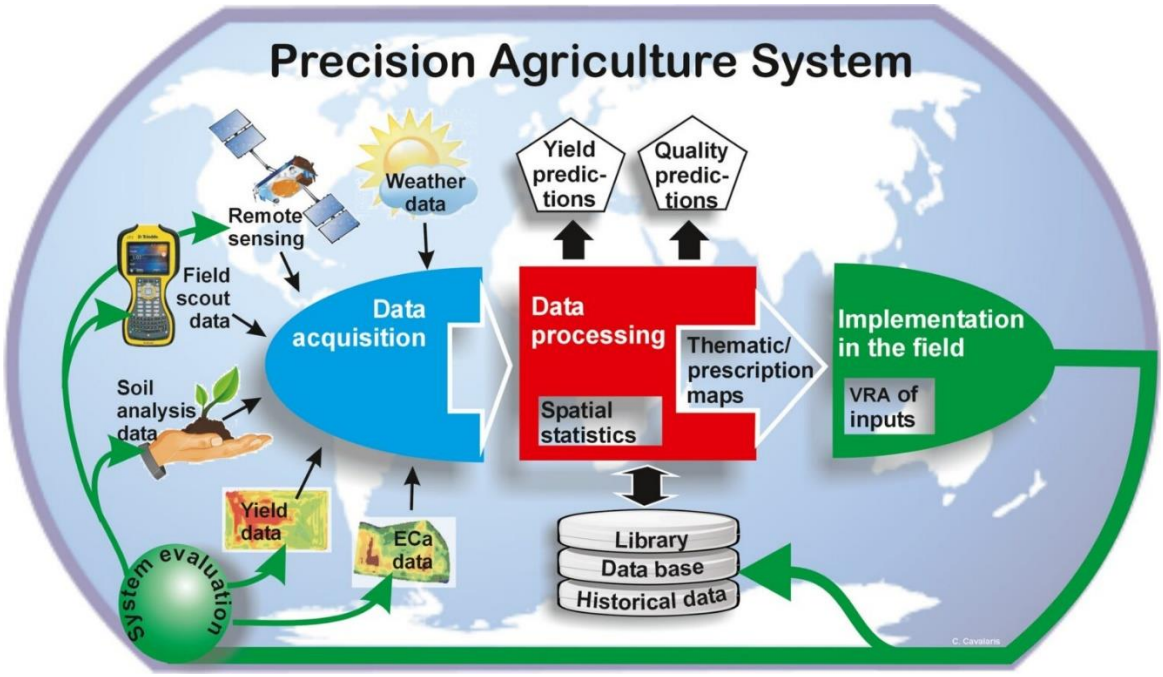
- Get optimum results from labour & resources.
- Produce food to feed the entire world.
- Monitor soil & plant parameters.
- Help automate field management.
- Provides better information for making management decision.
- Reduce pollution.
- Improve crop yield.
- Reduce chemical and fertilizer costs through more efficient application.
- Ability to achieve optimum produce of uniform and higher quality.
- Provide more accurate farm records.
- Reduction in cost of cultivation and increase in production efficiency of inputs.
- Reduction in chemical doses through variable rate application technology.
- Reduction in application of irrigation water, thus reduce the leaching of nutrients along with deep percolation.
- Reduced runoff, erosion and sedimentation of water bodies and reduction in environment pollution.

Key Aspects of Precision farming

The precision farming mainly depends on three key aspects.

They are:

- Information: is one of the important key aspects in precision farming as it mainly deals with the various aspects of spatial and temporal variability data on which the management decisions depend.
- Technology: it comprises the use of technologies like GPS, GIS, remote sensing etc., to acquire knowledge on various aspects of crop and land parameters.
- Management: it comprises the management decisions to manage the variability.



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The precision agriculture cycle consists of three interconnected stages. They are:

- **Data collection stage**: in this stage we collect the data about crop land parameters and weather parameters. Based on the data collected soil map, crop condition map and yield map.
- **Interpretation stage**: in this stage the data collected is integrated and analysed, compared to available crop/soil models and treatment map is prepared based on variability analysed.
- **Application stage**: in this stage the inputs and management decisions are carried out according to treatment map prepared on the basis of variability.

Component/tools or techniques of precision farming/geo-informatics

In the past, it was difficult for researchers to correlate production techniques and crop yields with resources variability. Precision farming in the form of farming location-specific practices is adopted playing due to consideration of spatial variability of land to maximize crop production and minimize the cost of inputs with the least damage to the environment, soil, water and human health.

The major constituents of precision farming are;

Geographical information system (GIS), Geographical positioning system (GPS), Remote sensing, Variable rate technology, NDVI, Nutrient expert system, SSNM, Bio-intensive farming, Real-time nitrogen management, DRIS approach, Soil testing and yield monitoring.

Geographical information system (GIS):

The use of GIS was started in 1960. GIS is a computerized mapping system to acquire, store, analyse and display information thatis specially referenced to the earth. It is software that imports, exports and processes spatially and temporally geographically distributed data. GIS system provides a way to overlay different layers of data, these data used for land use, irrigation management, the study of the crop, soil and environment etc. this system comprises hardware, software and procedures designed to support the compilation, storage, retrieval and analysis of feature attributes and location data to produce the map.

GIS Mapping

Computerized GIS maps are different from conventional maps and it's containing various layers of information. GIS can use any information that includes location. The location can be expressed in many different ways, such as latitude and longitude, address, or ZIP code. Many different types of information can be compared and contrasted using GIS. The system can include data about people, such as population, income, or education level. It can include information about the landscape, such as the location of streams, different kinds of vegetation, and different kinds ofsoil. It can include information about the sites of factories, farms, and schools, or storm drains, roads, and electric power lines.

Global Positioning System (GPS)

GPS is a navigation system based on a network of satellites that helps users to record positional information (latitude, longitude and elevation). It allows farmers to locate the exact position of field information, such as soil type, pest occurrence, weed invasion, water holes, boundaries and obstructions.

The right thing is in the right place and in right time '- This is where GPS comes into picture. In addition, the accuracy is important factor in PF. So, demands of DGPS comes (Differential Global Positioning System). GPS makes use of a series of military satellites that identify the location of farm equipment with-in a meter of an actual site in the field. Knowing right thing to do may involve all kinds of high-tech equipment 's and fancy statistics or other analysis. Doing the right thing however starts with good managers and good operators doing a good job of using common tools such as planters, fertilizer applicators, harvesters and whatever else might be needed. The GPS technology provides accurate positioning system necessary for field implementation of variable rate technology. The use of GPS in agriculture is limited but it is fair to expect wide spread use of GPS in future.

Applications of GPS in precision farming in Horticulture:

- Field mapping
- Soil sampling
- Yield mapping
- Variable rate application

Variable Rate Technology (VRT)

Variable rate technologies (VRT) are automatic and may be applied to numerous farming operations. VRT systems set the rate of delivery of farm inputs depending on the soil type noted in a soil map. Information extrapolated from the GIS can control processes, such as seeding, fertilizer and pesticide application, herbicide selection and application at a variable rate in the right place at the right time.

Remote Sensing (RS)

Remote sensing is the science of obtaining information about objects or areas from a distance, typically from aircraft or satellites. In another word, RS means to collect the information of an object without its physical contact. A remote sensor is used to collect the information. Remote Sensors are general categories of aerial or satellite sensors. They can indicate variations in the colours of the field that corresponds to changes in soil type, crop development, field boundaries, roads, water, etc. Arial and satellite imagery can be processed to provide vegetative indices, which reflect the health of the plant.

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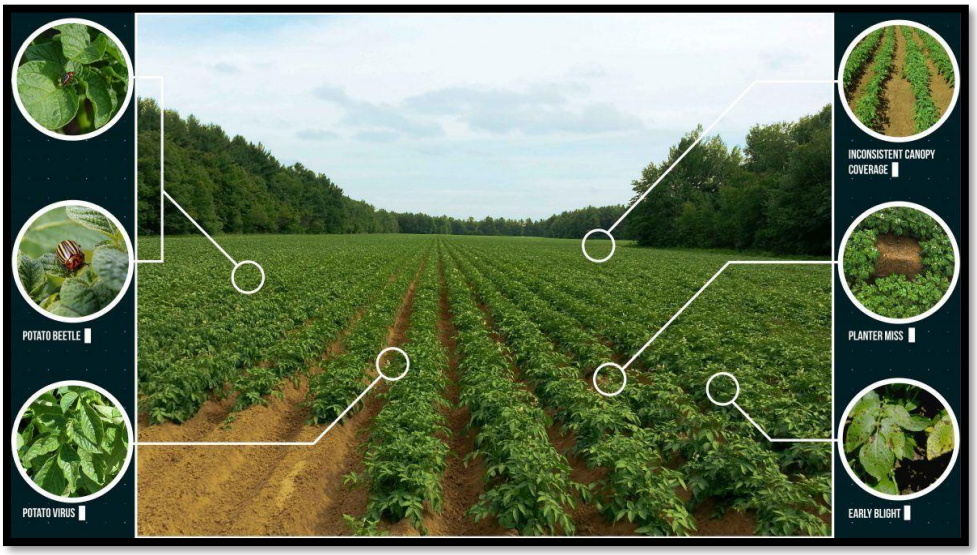
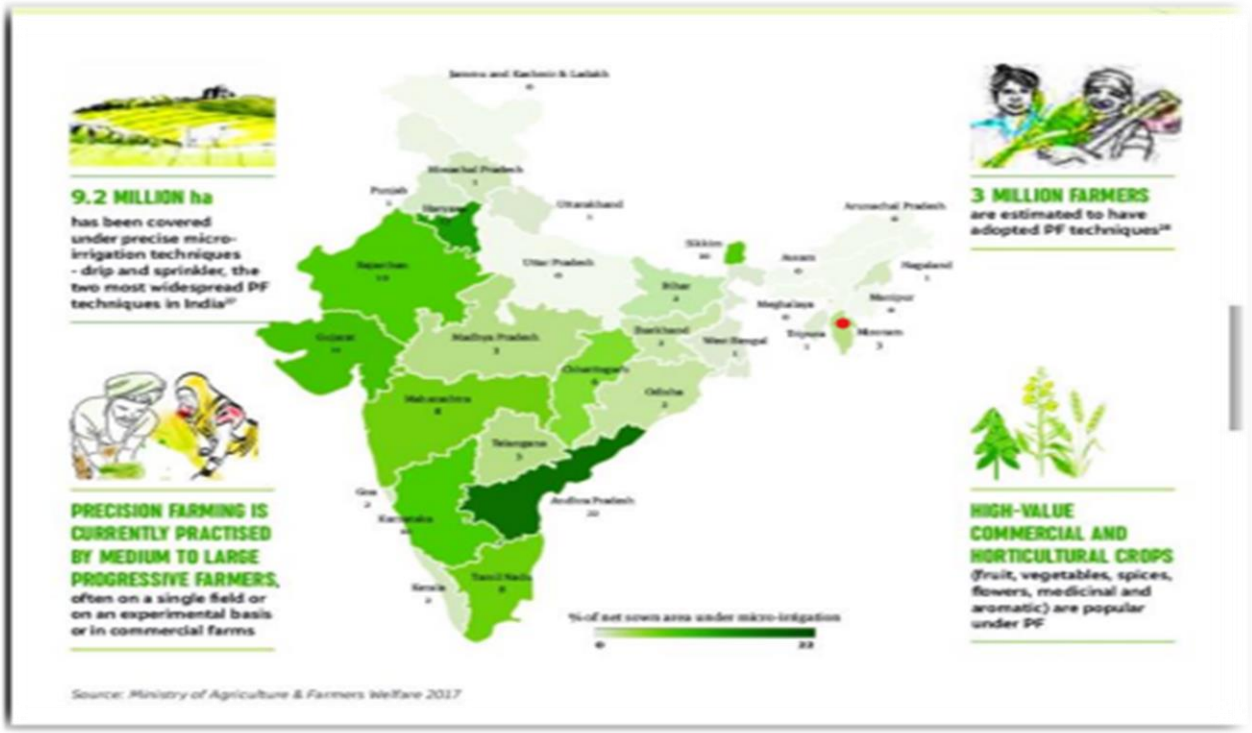


Remote Sensing in Potato Crop

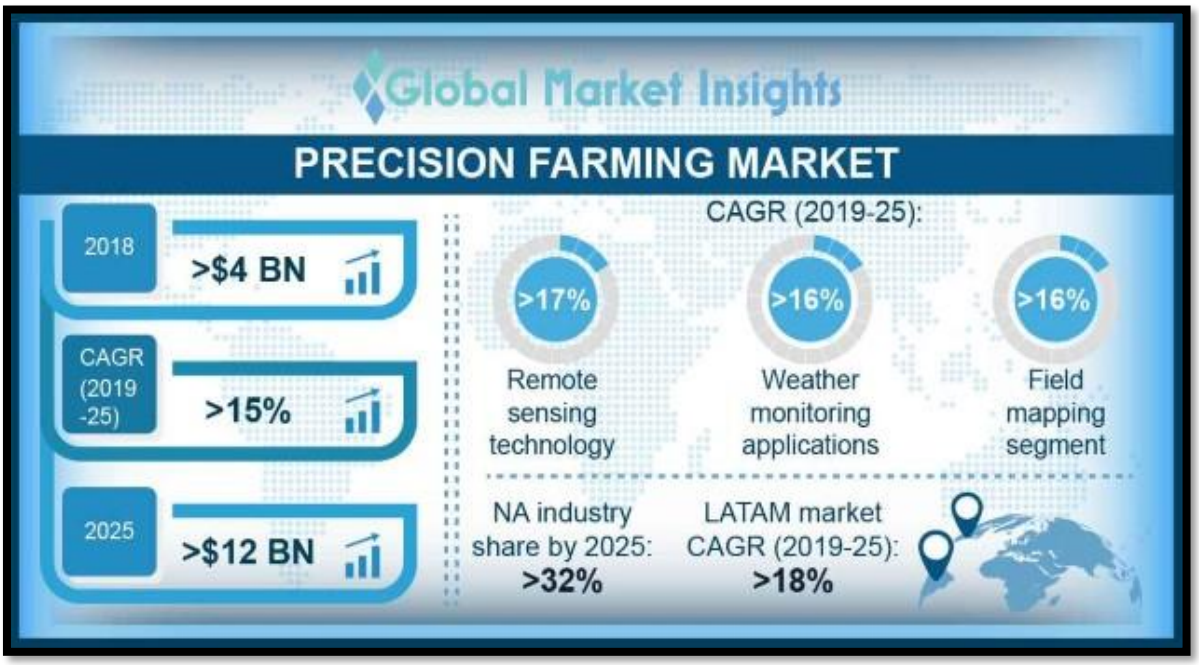
Status of precision farming in India

It is estimated that in India 20-million-hectare area is under mulching and 1.9 million hectare is under cover crops, which includes plantations having leguminous cover crops. Almost 5 million farmers have adopted mulching technique in India.

It is estimated that in India 3 million farmers have adopted precision farming techniques and around 9.2-million-hectare area has been covered under precise micro-irrigation techniques-drip and sprinkler irrigation.



Precision agriculture marketing



The growth of precision agriculture is attributed to the burgeoning proliferation of the Internet of Things (IoT) along with the use of advanced analytics by farmers. Advanced analytics is a part of data science that uses numerous tools and methods to forecast data and ensure that the crop and soil receive adequate nurturing. This helps farmers to plan their actions accordingly. For a deep understanding of different farming aspects such as irrigation and ploughing, numerous technologies such as IoT, GPS, and remote sensing application control are used. IoT helps farmers address various challenges involved in the proper monitoring of crops. It provides real-time data about environment temperature and water content in the soil through sensors placed on the farm, which assists farmers in making improved decisions about harvesting times, crop market rate, and soil management. This is one of the key factors contributing to the growth of the market for precision farming. Technological innovations, such as vertical farming with smart designs to maximize yields and reduce waste, have unfolded numerous growth opportunities.

Moreover, increasing investments in technologies such as driverless tractors, guidance systems, and GPS sensing systems are also expected to contribute to the growth of the precision agriculture market size during the period of study. For instance, numerous sensors such as soil sensors, climate sensors, and water sensors are placed around the fields to help farmers monitor their crops and gain Realtime information. Additionally, these sensors also help farmers obtain a high yield with less crop wastage.

Constraints in adoption of Precision farming: The constraints in adoption of precision farming technologies in India are:

- Small size of land holding High cost of investment.
- Highly skilled labour requirement.
- Lack of training programs.
- Complexity of tools and techniques requiring new skills.

- Lack of local technical expertise.
- Heterogeneity of cropping systems and market imperfections.
- Inadequate knowledge about PF among the farmers.
- Un assured availability of quality seed or planting material of desired crop and variety.

Steps to be taken for Implementing Precision Farming in India

The following methodology could be adopted in order to operationalize precision farming in the country;

- Formation of multidisciplinary teams to study the overall scope of precision agriculture. Formation of farmer ‘s co-operatives.
- Government legislation restraining farmers using indiscriminate farm inputs.
- Pilot study should be conducted on farmer ‘s field to show the results of precision agriculture implementation.
- Creating awareness amongst farmers about consequences of applying imbalanced doses of farm inputs like irrigation, fertilizers, insecticide and pesticides.

Government initiatives under precision farming

- Pradhan Mantri Krishi Sinchai Yojana (PMKSY)
- National Horticulture Mission (NHM)
- Micro Irrigation Fund (MIF)

Conclusion

Precision farming in developing countries including India has numerous opportunities for farmers to identify specific crops and to enhance the production and productivity. Farmer can produce high yielding varieties by using PA system. Three components namely, single PA technology ‘, PA technology package ‘and integrated PA technology ‘, have been identified as part of the general adoption strategies of PA in developing countries. Suitable application sectors of these strategic components have been highlighted. PA may provide a platform for industrial corporate social responsibility (CSR) activity by helping the rural poor to improve their livelihood through high-tech horticulture farming. The government of India can facilitate in this process by giving soft loans to the industry so that they get encouraged and engaged themselves in agriculture Horti allied sectors and PA activities. High-tech PA can help in bringing next green revolution in India and can produce tremendous rural in a sustainable and environmentally sound way to produce higher yields in horticultural crops. In the light of today ‘s urgent need, there should be an all-out effort to use new technological inputs to make the Green Revolution’s an Evergreen Revolution and it can be stopped migration from rural to urban area.

References

Bongiovanni R, and Lowenberg-Deboer J. Precision Agriculture and Sustainability. Kluwer Academic Publishers. Precision Agriculture, 2004; 5: 359–387.

Brisco B, Brown RJ, Hirose T, McNarairn H, Staenz K. Can. J. Remote Sensing, 1998; 24: 315-327.

Dawson CJ. In Precision Agriculture (ed. Stafford, J.V.), BIOS Scientific Publishers Ltd., 1997; 1: 45-58.

Mandal SK. Maity A. Precision Farming for Small Agricultural Farm: Indian Scenario. American Journal of Experimental Agriculture, 2013: 3(1): 200-217.

MOKARIYA, L. K. AND MALAM, K. V., 2020, Precision agriculture – a new smart way of farming. Agricultural & Environment E- Newsletter. 1(2):87-92.

RAJESH, C. M., 2020, Performance of horticulture crop growers under protected cultivation in Chikkaballapur district. M.Sc. Thesis (Unpub.), Univ. Agric. Sci., Bangalore.

SAMPRITI BORMUDOI, 2022, Precision farming's potentials and prospects in Indian agriculture. Agricultural & Environment E- Newsletter. 3(7):33-38.

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EUBIOTICS CONCEPT CLASSIFICATION AND ROLE IN AQUACULTURE

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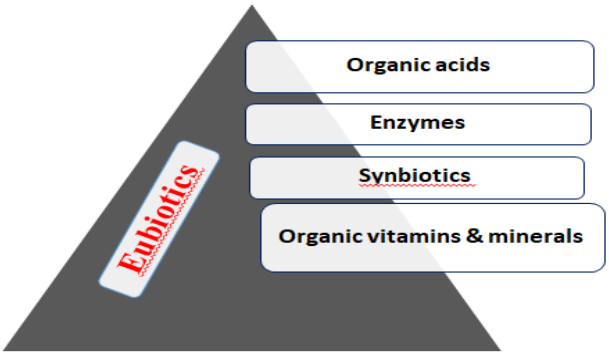
Abstract
Nowadays Aquaculture industry increases production by intensification but the major problem is diseases. In the aquaculture industry antibiotic are used for the protection of diseases and as an antibiotic growth promoter. Long-time use of antibiotics increases the occurrence of microbial resistance. Modern aquaculture systems need alternatives to antibiotics to support better feed utilization and better performance of aquaculture. Eubiotics are alternative and innovative feed additives that play an important role in the mitigation of antimicrobial resistance and support the better performance of animals.

Introduction
Aquaculture is one of the fastest-growing food-producing sectors in the world. Global aquaculture has grown by intensification. The major problem faced by the aquaculture industry is diseases outbreak this problem leads to a loss of economics and production. Aquaculture industry, antibiotics are commonly used for protection from diseases against pathogens and also used antibiotic as antibiotic growth promoters. This type of practice has become controversial due to increased occurrences of microbial resistance. Antibiotic administration long-term as antibiotic growth promoters (AGPs), in aquafeeds creates an optimal environment to enable antibiotic resistance genes to multiply. use of Eubiotics as a feed additive in poultry and livestock for mitigation of antimicrobial resistance. According to the world health organization (WHO), anti-microbial resistance is the ability of Bacteria, viruses and some parasites to stop working against antimicrobials like antibiotics, and antivirals. The importance of Eubiotics is gaining importance in developing countries were are limiting the use of antibiotics. Eubiotics are innovative feed additive that plays an essential role in supporting intestinal gut health and animal growth performance. Advanced and Modern aquaculture systems have good gut health support efficient feed utilization and better performance of aquaculture.

Eubiotics
The term 'Eubiotics', which is related to the Greek word 'Eubiosis', is meaning to an optimal balance of microflora in the gastrointestinal tract or gut. The purpose of the use of Eubiotics is to maintain intestinal eubiosis, which will result in the improved health status of the animal and performance in culture species. The term Eubiotics refers to the maintenance of microflora in the intestinal tract. The basic function of Eubiotics is to improve the health status as well as also improvement of animal growth performance. They mostly include probiotics, prebiotics, organic

acids and essential oils. The efficiency of the Eubiotics is mainly dependent on their antimicrobial properties as well as their capacity to alter the microflora of the gut.

The fish gut is colonized by abundant microorganisms in which the highest proportion is bacteria of this colonization that live in a symbiotic relationship with the host. The balance of microflora in the gut is eubiosis is essential for optimal gut performance. The diversity of the Gut microbiota and its composition varies in species to species in cultured animals. Several factors influence the colonization of gut microbiota such as age, diet, sex, immunity, host genetics and health or disease state of the host, use of drugs, geographical area, and socio-economic conditions such as urban/rural and sanitary conditions. So, they improve the gut microflora for maximizing nutrient absorption and promoting effective gut performance.



“An integrated strategy to combine different kinds of feed additives in order to achieve a healthy intestinal microbial flora by lowering pathogenic bacteria (dysbiosis) while increasing lactic acid bacteria (eubiosis) throughout the animals’ digestive tract”.

Why use of Eubiotics in aquafeed

- For better animal gut health
- Reduced the use of antibiotics
- Improve the efficient utilization of natural resources
- Decrease antimicrobial waste residue on farm
- Increase aquaculture production and income

Types of Eubiotics

A. Prebiotics B. Probiotics C. Organic acid D. Essential oils

The Eubiotics market not only growing in the Europe and US but also in developing countries like China, India & Brazil. The ban on the use of antibiotics as a growth promoter in the region this scenario has shifted to the development of new alternatives such as Eubiotics. Antibiotic residue has been observed in meat, causing adverse effect on human health. Increasing concern regarding the quality and safety of meat discouraging antibiotics use is promoting farmers to shift towards viable alternatives such as the use of Eubiotics as a feed additive.

Livestock farmers try to raise yield by using various feed additives such as Eubiotics. The availability of land resources is limited as increasing shortage of water has put limitations on animal fodder production. Eubiotics help in improving the immune system of farm animals and shellfish. It is a natural digestive stimulant which makes the healthy balance of microflora in the gut. For the activation of the immune response against disease, the inclusion of organic acid in the

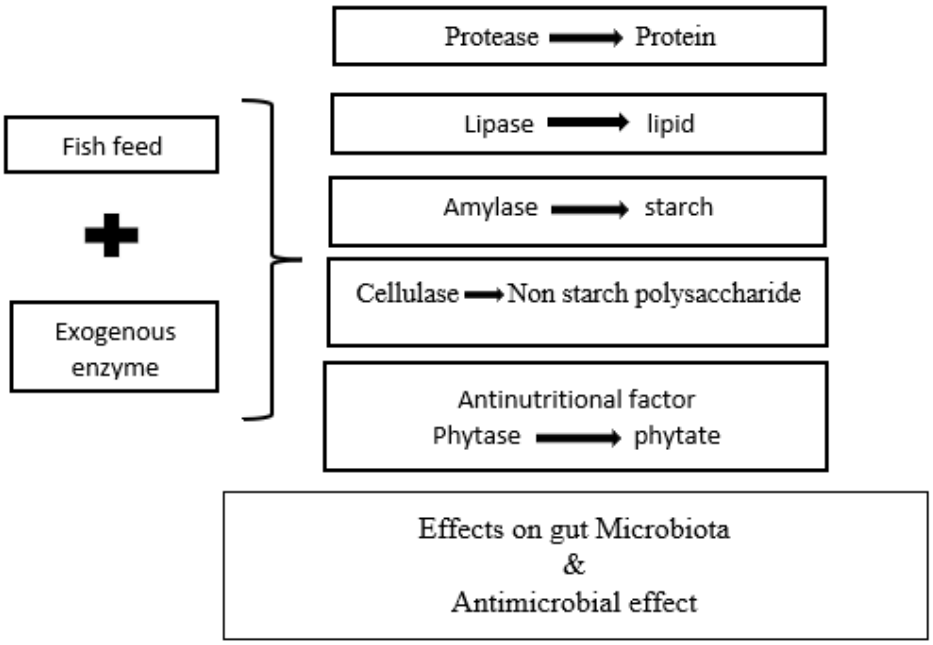
diets has a Eubiotics effect on the propagation of native lactic acid bacteria. Eubiotics play a significant role in digestion and serves as an alternative for antibiotics in aqua feed.

Livestock farmers try to optimize feed utilization to increase aquaculture production. The application of Eubiotics optimizes the utilization of feed and helps in increasing yield, maintaining gut wall and increasing immunity.

Eubiotics nutrition strategy

Release energy and proteins from feed by an exogenous or multi-enzyme system
Maximize the nutrient absorption
Manage an optimal GI-microflora to stimulate gut health

Multi-enzyme approach **-** Modern aquaculture system must be sustainable in terms of energy consumption. Use of raw materials alternatives are needed to replace fish feed with other raw materials. Enzyme use in the agri-food industry is based on their efficiency, safety, and protection of the environment. Enzyme supplementation in fish feed can improve digestibility and absorption of both plant- and animal-derived feed ingredients, increasing the growth performance of fish. A multi-enzyme system containing fibre-degrading enzymes such as xylanase, beta-glucanase, cellulase and pectinase are required to gain full benefit from the aqua feed or aquafeed ingredients. Presence of non-digestible oligosaccharides in leguminous seeds, also alpha-galactosidase and beta-mannanase required. Therefore, the supplementation of protease and alpha-amylase are required to maximize the utilization of proteins and starch. Phytase added to plant-based feed ingredients maximize the utilization on the phytate phosphorus from plant materials (Liang et al. 2022).



Maximize nutrient absorption – Break down of feed into single nutrients, they need to be absorbed in the small intestine. lysolecithins or hydrolysed lecithins are Nutritional emulsifiers are hydrolysed soy lecithin's contain high levels of lysophosphatidylcholine (LPC) and lysophosphatidylethanolamine (LPE). LPC and LPE are important components of cell membranes

and have the ability to fluidise this membrane allowing an easier nutrient absorption, lipids and fatty acids. Hence the addition of Eubiotic nutrition is the addition of lysolecithins improve the absorption of nutrient in small intestine by fluidise to the membrane layer.

Gastro-intestinal microflora managing- use of short chain and medium chain fatty acids (SCFA & MCFA) for their beneficial effects of animal health and performance. α-monoglycerides of these fatty acids are much more powerful in their antibacterial effect. α-monoglycerides of SCFA are more active against gram-negative bacteria and the α-monoglycerides of MCFA more towards gram-positive bacteria. Moreover, α-monoglycerides are stable molecules that are active through the entire GIT to improve the optimal microbial gut balance and gut health. Alpha-monoglycerides use in aqua feed is a key strategy in Eubiotic nutrition.

Organic acids

Citric acid, lactic acids, formic acids and their salts are most commonly used organic acid in aqua feed. Various feed additives such as organic acids have been studied for use in aquaculture feeds and have increased attention due to their strong antimicrobial and prophylactic properties against various pathogenic bacteria. The use of these acidifiers mainly consists of organic acids and their salts as a potential replacement for improving the growth performance, digestion and health status of fish (wang et al., 2019).

Antimicrobial action of organic acids

The ability of organic acids to lower the pH of the feed, to reduce the buffer capacity of feed, to lower the pH value of the stomach and finally by the ability of organic acids to directly impair pathogen cells. The direct effect on pathogen cells is closely related to the pH dependent behavior of the acid molecule. Depending on its natural pKa value an organic acid binds or releases H+ ions. If the pH value of the environment is lower that the acid's pKa value (e.g. in the stomach), the acid will bind the H+ ions and is said to be undissociated. In the undissociated state the acid molecule is unionized and can therefore easily penetrate the cell walls of pathogen cells. Inside the pathogen cell the pH environment is close to neutral and therefore higher than the pKa value of the organic acid. Under these circumstances the acid releases (dissociates) its H+ ion and the acid molecule become ionized. Now the ionized acid molecules are trapped in the pathogen cell and start to accumulate. This accumulation will lead to a pH-drop and intracellular damage in the pathogen cell. Or the pathogen has to spend a lot of energy to pump out the ionized acid molecules.

What is the use of organic acid in aqua feed?

- Upgrading of palatability of aqua feed and reduction the pH of the diet
- Organic acid also has antimicrobial properties
- Organic acid use as preservative
- Reduction of gastric pH and enhancement of pepsin activity
- Effects on microflora in the gastro-intestinal tract
- Increased digestibility of nutrients and nutrient absorption

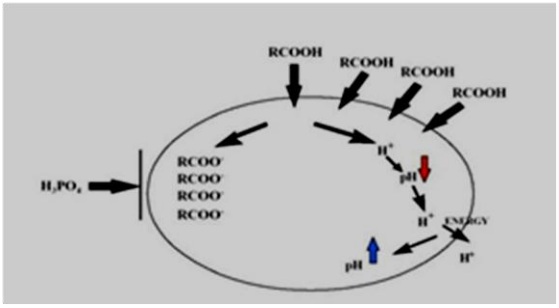


Figure: - mode of action of organic acid on pH. sensitive bacteria

Probiotics are provided as an aquatic feed that can act as the source of nutrients and enzymes that can help in better digestion of food. probiotics use for fish farming improve the immune system of aquatic organisms by activating non-specific immune systems boosting the defense against many diseases. Competitive adhesion of probiotic microorganisms to epithelial receptors may prevent the attachment of pathogenic bacteria, Production of specific antibacterial substances (Hai, 2015).

Characteristics of good probiotics

- Exerting a beneficial effect
- It should be non-pathogenic and non-toxic.
- It should be capable of surviving & metabolizing in the gut environment
- It should be stable & capable of remaining viable for periods under storage & field conditions
- Do not induce resistance to antibiotics which will compromise therapy

Another role of Probiotics In aquaculture

- Decrease toxic level of amines and ammonia levels in the gastro-intestinal tract
- Beneficial effects on the intestinal immune system
- Improved intestinal defense against viral infections
- Growth-promoting effects

Prebiotics

The prebiotic concept was first developed and introduced by Gibson and Roberfroid (1995) in human nutrition (Glenn and Roberfroid 1995). Prebiotics is based on the feeding of certain non-digestible carbohydrate (oligosaccharides) in order to control microbial composition and activity and they maintain a beneficial microflora. various oligosaccharides are natural constituents of plants. oligosaccharides considered as potential probiotic products for animal nutrition, such as fructo-oligosaccharides, xylo-oligosaccharides, Isomaltose-oligosaccharides, mannan-oligosaccharides and some fructans (inulin, lactulose). Dietary inclusion levels of potential prebiotics are usually 0.1 to 0.5%. Prebiotics also regulate the intestinal microflora, reduction of pathogens and promotion of beneficial microorganisms (Mohanty et al., 2018). Prebiotics are used in diets usually 0.1 to 0.5%. Inclusion of prebiotic in the diet has been reported to increase the uptake of glucose (Breves et al., 2001) and bioavailability of trace elements (Bongers and van den Heuvel, 2003). Prebiotics (β-glucan) detoxifying adverse effects of aflatoxin B1 (AFB1) on common carp (Cyprinus carpio L) (Jamal,2014). Prebiotics are fermented by probiotic bacteria e.g. Bifidobacteria, Lactobacillus and Bacteroides. Product of bacterial fermentation are short chain fatty acids (acetate, butyrate, propionate) and lactate. SCFa are absorbed through the intestinal epithelium, thus becoming an energy source for the host, whereas lactate enters the liver and is used as precursor for gluconeogenesis (Smiricky-Tjardes et al.,2003).

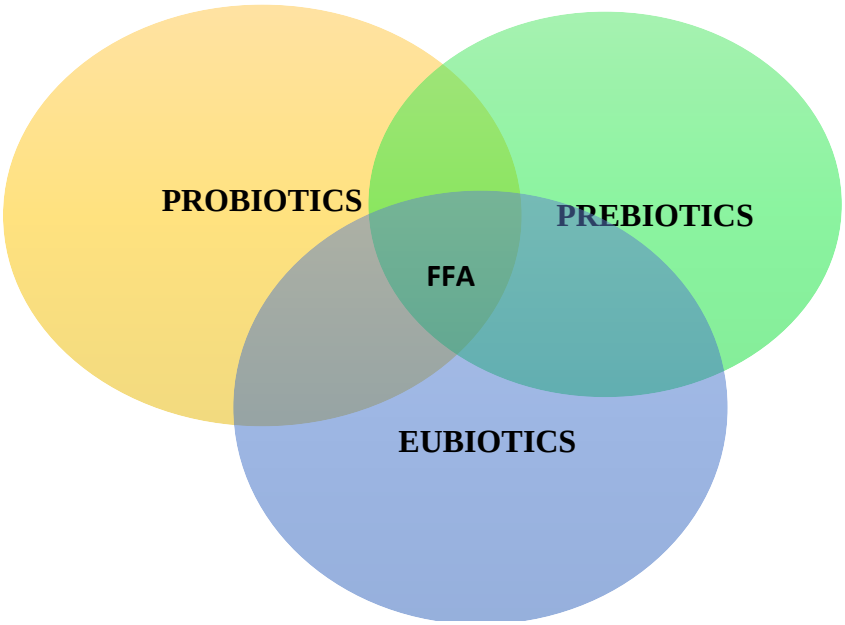
Criteria of prebiotic

- Resistance to gastric acidity
- Fermentation by gastrointestinal microflora
- Increase the abundance of intestinal bacteria related to health

Essential oil compounds

Essential oil is another group of feed additives, the potential for the replacement of AGP, which are active ingredients present in various plants, and spices, Essential oil also affects the gut microflora Hume (2006). Also, increases in digestive enzyme secretion Jang (2007).

Substantial research has been conducted over the past few years to evaluate the potential of alternative antimicrobial agents for the replacement of AGP. Natural compounds such as antimicrobial peptides, lysozyme, lactoferrin and bacteriocins show beneficial effects.



Conclusion

Use of Eubiotics for aquaculture production is the potential of alternative antimicrobial agent for the replacement for the antibiotic growth promoter. It is used as alternative of additive for aquafeed enhance the gut microbiota and health. Future research needs to be evaluated the as a Eubiotic, like probiotic, prebiotic essential oils and organic acids for growth promoter and act as alternative of antibiotics.

References

Glenn G., Roberfroid M. (1995) Dietary modulation of the human colonic microbiota: Introducing the concept of prebiotics. *J. Nutr.*;125:1401–1412. [PubMed.

Hai, N. V. (2015). The use of probiotics in aquaculture. *Journal of applied microbiology*, *119*(4), 917-935.

Hume, M. E., Clemente-Hernández, S. E. R. G. I. O., & Oviedo-Rondon, E. O. (2006). Effects of feed additives and mixed Eimeria species infection on intestinal microbial ecology of broilers. *Poultry Science*, *85*(12), 2106-2111.

Jang, I. S., Ko, Y. H., Kang, S. Y., & Lee, C. Y. (2007). Effect of a commercial essential oil on growth performance, digestive enzyme activity and intestinal microflora population in broiler chickens. *Animal Feed Science and Technology*, *134*(3-4), 304-315.

Liang, Q., Yuan, M., Xu, L., Lio, E., Zhang, F., Mou, H., & Secundo, F. (2022). Application of enzymes as a feed additive in aquaculture. *Marine Life Science & Technology*, *4*(2), 208-221.

Mohanty D., Misra S., Mohapatra S., Sahu P.S. (2018). Prebiotics and Synbiotics: Recent concepts in nutrition. *Food Biosci.* 2018; 26:152–160. doi: 10.1016/j.fbio.

Smiricky-Tjardes M, Grieshop C, Flickinger E, Bauer L, Fahey Jr. G (2003). Dietary galactooligosaccharides affect ileal and total-tract nutrient digestibility, ileal and fecal

bacterial concentrations, and ileal fermentative characteristics of growing pigs. J. Anim. Sci. 81: 2535- 2545

Wang, A., Ran, C., Wang, Y., Zhang, Z., Ding, Q., Yang, Y., ... & Zhou, Z. (2019). Use of probiotics in aquaculture of China—a review of the past decade. *Fish & shellfish immunology*, *86*, 734-755.

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ROLE OF BIOINFORMATICS IN PLANT GENOMIC STUDY

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Abstract
As genomic research increases and researchers explore more data related to genomics, they face problems with the storage, retrieval, and analysis of these data. The demand increases for the storage and management of data and the development of software for analysis, visualisation, modelling, and prediction of large data sets. For this, bioinformatics comes and helps to store the genomic data, do data mining, database searches, analysis, and interpretation. It works as a parallel to genomic studies in order to study particular characters according to the needs of researchers for crop improvement to secure food safety in terms of both quantity and quality.

Key words: Database, genomics, data comparison, data interpretation.

Introduction

Bioinformatics is a new and emerging science that combines the power of computers, mathematical algorithms, and statistics with concepts in the life sciences to solve biological problems. It is an emerging interdisciplinary area of science and technology encompassing the systematic development and application of information technology solutions to handle biological information by addressing biological data collection, warehousing, data mining, database searches, analyses and interpretation and product design. Some major fields where bioinformatics is widely used are as follows: microbial genome applications, molecular medicine, gene therapy, drug development, antibiotic resistance, evolutionary studies, waste cleanup, biotechnology, climate change studies, alternative energy sources, crop improvement, forensic analysis, bio-weapon creation, insect resistance, improved nutritional quality, and the development of drought-resistant varieties. Bioinformatics will help advance crop improvement programmes in varietal development.

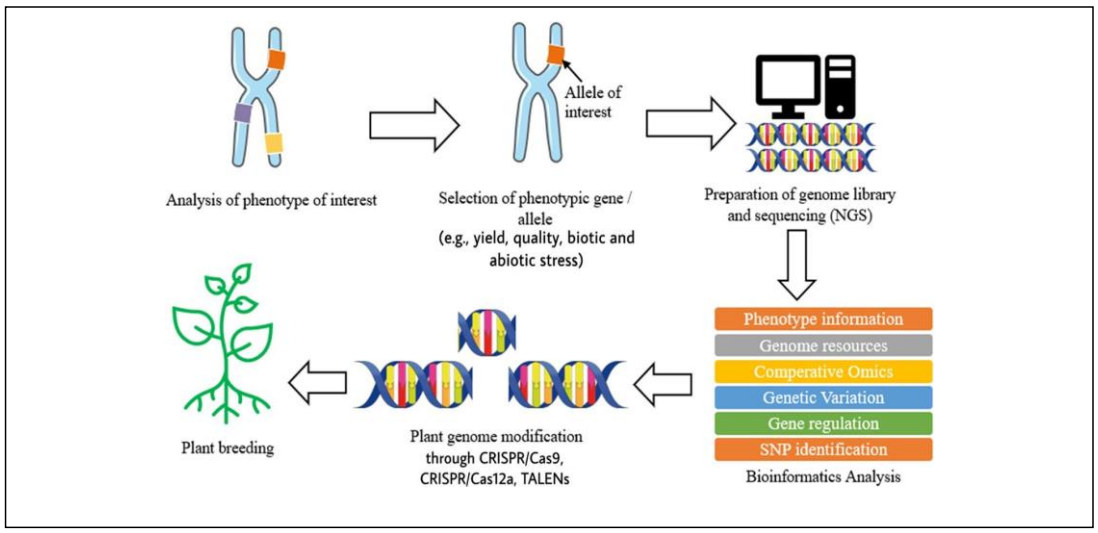
Main Activities of Bioinformatics

1) Development of new algorithms and statistical techniques for the assessment of relationships among enormous biological datasets.
2) Use of these tools and techniques for analysing and interpreting the huge biological datasets.
3) Development of datasets for efficient storage and management of the huge amounts of information, and fast search, retrieval and analysis of the desired data.

Brief process of plant breeding involving NGS and bioinformatics (Tan *et al*, 2022)

Some important bioinformatics tools: AutoSNP: The computer program carries out automated analysis of EST sequence data and identifies SNPs as well as insertion/deletion (InDel) variations present in them, SNP2CAPS: Valuable cost-effective tools for analysis of SNP and InDel

polymorphisms in laboratories that are not highly equipped, STRUCTURE: The STRUCTURE software is capable of detecting the presence of two or more homogeneous group within a single population, MAPMAN: MAPMAN tool displays the large datasets in form of diagrams that depict the concerned metabolic pathways of cellular functions and processes; that facilitates the interpretation of these datasets, ClustalW: It helps in prediction of protein structure and function, and is the basis for polygenetic analysis.



Biological database: Biological databases are libraries of life sciences information collected from scientific experiments, published literature, high throughput experiment technology, and computational analysis. Some important databases related to plant breeding are given below(Tan *et al*, 2022):

Database	Description	URL
EMBL	General public sequence repository	http://www.ebi.ac.uk/embl/
DDBJ	General public sequence repository	http://www.ddbj.nig.ac.jp
Uniprot	Protein sequence and functional information	http://www.uniprot.org
NCBI	Biomedical and genomical information	http://www.ncbi.nlm.nih.gov/
Gene Index Project	Transcriptome repository	http://compbio.dfci.harvard,edu/tgi/
Phytozome	Genomic plant database	http://phytozome.net/
Plantgdb	Genome Plant database	http://plantgdb.org
CropNet	Genome plant database	http://ukcrop.net/
SGN	Solanaceae information resource	Http://solgenomics.net/
Gramene	Grass information resource	http://www.gramene.org/
MaizeGDB	Maize information resource	http://maizegdb.org/
Tair	Arabidopsis information resource	http://arabidopsis.org/
CotthonDB	Cotton information resource	http://cottondb.org/
CPGR	Phytopathogen genomic resource	http://cpgr.plantbiology.msu.edu/

Conclusion

This stream has many important applications in parallel to plant genomics studies. It will play a very significant role in crop improvement by advancing plant breeding to develop varieties with

biotic and abiotic stress resistance. There is an unsubstitutive need for breeders to study the complexity of the plant genome. To fulfil this, improved algorithm development is required to allow data mining, interpretation, and comparison. Therefore, it is important to improve the skills of bioinformatics, including math and programming, in order to run an advanced plant breeding programme to improve production and food nutritional quality in order to secure global food requirements.

References

Gomez-Casati DF, Busi MV, Barchiesi J, Peralta DA, Hedin N, Bhadauria V (2018) Applications of bioinformatics to plant biotechnology. Curr Issues Mol Biol 27:89–104.

Kyriakidou M, Tai HH, Anglin NL, Ellis D, Stromvik MV (2018). Current strategies of polyploid plant genome seuuence assembly. Front Plant Sci, 9:1660.

Tan YC, Kumar AU, Wong YP, Ling APK.(2022) Bioinformatics approaches and applications in plant biotechnology, *Journal of Genetic Engineering and Biotechnology,Springer, 20;106.*

Zhang SY, Liu SL (2013) Bioinformatics. In: Maloy S, Hughes K (eds) Brenner's Encyclopedia of Genetics, 2nd edn. Academic Press, London.

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BIOFORTIFICATION: THE NUTRITIONAL REVOLUTION TO COMBAT GLOBAL MALNUTRITION

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Introduction

In an era where food security and nutrition are paramount concerns, biofortification has emerged as a game-changing solution. It holds the potential to combat malnutrition and address dietary deficiencies that affect millions worldwide. This revolutionary approach has garnered significant attention from scientists, policymakers, and humanitarian organizations. In this article, we will delve into the concept of biofortification, its benefits, and its role in shaping a healthier and more sustainable future for our global population.

What is Biofortification?

Biofortification is a process that enhances the nutritional value of crops by increasing the concentration of essential vitamins and minerals. This is achieved through conventional breeding techniques or modern biotechnology, with the ultimate goal of producing nutrient-rich crops that can improve human health when consumed regularly. Biofortification in agriculture is a transformative approach that focuses on developing nutrient-rich crops to address malnutrition and improve public health. By enhancing the nutritional content of staple crops through conventional breeding techniques or genetic engineering, biofortification aims to provide populations with improved access to essential vitamins and minerals. Biofortification is the process of improving the nutritional quality of food crops. This can be achieved through agronomic practices, conventional breeding or biotechnology-based approaches like genetic engineering and genome editing.

How Does Biofortification Work?

Through careful selection and crossbreeding, scientists identify crops that naturally contain higher levels of specific nutrients. By focusing on traits such as iron, zinc, vitamin A, and vitamin C, they develop new varieties that carry these essential elements in greater quantities. The result is a range of biofortified crops, including rice, wheat, maize, sweet potatoes, beans, and more, each tailored to address particular nutritional deficiencies prevalent in different regions of the world.

Benefits of Biofortification

- Combatting Malnutrition: Malnutrition, whether due to deficiencies in iron, vitamin A, or other nutrients, has severe consequences for physical and cognitive development.

Biofortified crops offer an accessible and sustainable means to combat these deficiencies, especially in areas where access to diverse diets or supplements is limited.

- Improved Health Outcomes: By integrating biofortified crops into regular diets, communities can experience reduced rates of nutrient-related health issues, such as anemia and vision impairments. This leads to an overall improvement in the health and well-being of vulnerable populations, including children and pregnant women.
- Agricultural Resilience: Biofortified crops not only benefit human health but also contribute to the resilience of agricultural systems. By breeding plants with enhanced nutritional content, farmers can better cope with changing environmental conditions, such as soil depletion and climate change, ensuring sustainable crop yields.

- Cost-Effective Solution: Compared to other interventions like supplementation and food fortification, biofortification offers a cost-effective long-term solution. Once biofortified seeds are distributed, farmers can save and replant them in subsequent seasons, reducing the need for continuous external support.

Key aspects of biofortification in agriculture

- Targeted Nutrient Enhancement: Biofortification concentrates on increasing specific nutrients in crops that are commonly consumed by populations at risk of malnutrition. These nutrients often include iron, zinc, vitamin A, vitamin C, and other essential vitamins and minerals.
- Breeding and Genetic Modification: Traditional breeding methods involve selecting and crossbreeding plants with naturally higher levels of the targeted nutrients. On the other hand, genetic modification can accelerate the process by introducing specific genes responsible for nutrient accumulation.
- Nutrient-Rich Crop Varieties: Biofortification has led to the development of new crop varieties with significantly increased nutrient levels. For example, vitamin A-rich "Golden Rice" and iron and zinc-enhanced beans and sweet potatoes have been successfully created through this process.
- Improved Crop Yields: In addition to enhancing nutritional content, biofortification research often focuses on increasing crop yield, disease resistance, and other desirable agricultural traits, ensuring that farmers benefit from these improved varieties.
- Sustainable Agriculture: Biofortification aligns with sustainable agriculture principles by promoting the cultivation of nutrient-rich crops using conventional farming practices. This

approach reduces the need for costly external interventions like food supplementation and fortification.

- Combating Hidden Hunger: Hidden hunger refers to micronutrient deficiencies that may not manifest as visible symptoms but have long-term health consequences. Biofortification helps combat hidden hunger by making essential nutrients more readily available in daily diets.
- Impact on Vulnerable Populations: Biofortification has a profound impact on vulnerable populations, especially in developing countries where malnutrition is prevalent. Access to nutrient-rich crops can positively influence the health and well-being of children, pregnant women, and the elderly.
- Public Health Benefits: By increasing the availability of nutritious foods, biofortification plays a vital role in reducing the burden of nutrient-related health issues, such as anemia, stunting, and impaired immune function.
- Collaboration and Adoption: The success of biofortification relies on collaboration between agricultural scientists, governments, NGOs, and local communities. Adoption of biofortified crops requires raising awareness, promoting cultural acceptance, and facilitating the distribution of improved seeds.
- Future Prospects: As research and technology continue to advance, the potential for biofortification to make an even more significant impact on global nutrition and food security is promising. Continued investment in research and development is crucial for expanding the range of biofortified crops and optimizing their nutritional content.

Challenges and the Way Forward

- While biofortification shows immense promise, several challenges lie ahead. One obstacle is ensuring that these nutrient-rich crops are accessible and accepted by communities with traditional dietary habits. Education and awareness campaigns are vital in promoting the adoption of biofortified foods and fostering cultural acceptance.
- Collaboration among governments, NGOs, and private sector players is also crucial in supporting research, distribution, and monitoring of biofortified crops. By building partnerships, we can expedite the integration of biofortification into global food systems and maximize its impact on malnutrition eradication.

Conclusion

Biofortification represents a beacon of hope in the fight against malnutrition, offering a sustainable and scalable solution to address nutritional deficiencies worldwide. Through the cultivation and consumption of nutrient-rich crops, we have the power to create a healthier, more resilient, and prosperous future for all. Embracing biofortification is not just an investment in agriculture; it is an investment in the well-being of current and future generations, paving the way for a more nourished and thriving world. biofortification in agriculture represents a sustainable and cost-effective solution to address malnutrition and hidden hunger. By enriching staple crops with essential nutrients, biofortification holds the potential to create a healthier and more nourished world, improving the lives of millions of people around the globe.

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CONQUERING ABIOTIC STRESS IN AGRICULTURE: STRATEGIES FOR EFFECTIVE MANAGEMENT

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Introduction

Agriculture is the backbone of human civilization, providing sustenance and livelihoods for billions of people worldwide. However, the unpredictable and changing climate poses a significant challenge to farmers. Abiotic stress es, such as extreme temperatures, drought, salinity, and nutrient deficiencies, threaten crop productivity and food security. To secure a thriving agricultural future, it is crucial to understand these challenges and implement effective management strategies to mitigate their impact.

Understanding Abiotic Stress

Abiotic stress factors, unlike biotic stress caused by living organisms, arise from non-living environmental factors. These stresses can adversely affect plant growth, development, and yield. Common abiotic stresses include:

- Temperature Extremes: Heatwaves and extreme cold can disrupt physiological processes, leading to reduced crop growth and development.
- Water Scarcity: Drought and inadequate irrigation can cause water stress, leading to wilting, stunted growth, and reduced crop yields.
- Salinity: High levels of salt in the soil can inhibit water uptake, negatively impacting plant growth and nutrient absorption.
- Nutrient Deficiencies: Lack of essential nutrients such as nitrogen, phosphorus, and potassium can hinder plant growth and reduce yields.

Climate Change Exacerbating Abiotic Stress

The global climate is experiencing rapid changes, primarily driven by human activities. The intensification of abiotic stresses in agriculture is closely linked to climate change. Rising

temperatures, altered precipitation patterns, and increased frequency of extreme weather events contribute to the severity and frequency of abiotic stress episodes.

Key effects of abiotic stress in agriculture:

1. Reduced Crop Growth and Yield:

Abiotic stress factors such as extreme temperatures, drought, and nutrient deficiencies directly impact plant growth and development. High temperatures can lead to heat stress, which affects photosynthesis and can cause flower and fruit drop, reducing crop yields. Drought conditions can result in wilting, stunted growth, and lower harvests. Nutrient deficiencies can lead to nutrient imbalances, affecting plant metabolism and reducing overall crop productivity.

2. Decreased Nutritional Quality:

Abiotic stress can alter the nutritional composition of crops, affecting their quality and nutritional value. For example, drought-stressed plants may have reduced levels of essential nutrients, leading to lower nutrient content in the harvested produce.

3. Increased Susceptibility to Pests and Diseases:

Plants under abiotic stress become more vulnerable to pest infestations and diseases. Stress weakens the plant's defence mechanisms, making it more susceptible to attacks from various pathogens and pests. This can lead to additional losses in crop yields and quality.

4. Soil Degradation:

Certain abiotic stress factors, such as salinity and excessive use of chemical fertilizers, can degrade the soil quality over time. High salinity levels can render the soil unsuitable for plant growth, leading to reduced crop yields. Additionally, the excessive use of fertilizers can cause nutrient imbalances and soil acidification, negatively impacting soil health and fertility.

5. Loss of Biodiversity:

Abiotic stress can alter ecosystems and lead to a decline in biodiversity. Some plant species may struggle to survive under specific stress conditions, leading to a shift in the composition of plant communities and a reduction in biodiversity.

6. Economic Losses and Food Insecurity:

The cumulative effects of abiotic stress on crops can result in significant economic losses for farmers and agricultural industries. Reduced yields, poor crop quality, and increased expenses for managing stress contribute to financial hardships. Additionally, food production can be compromised, leading to food shortages and increased food prices.

7. Climate Change Feedback:

Abiotic stress in agriculture is interconnected with climate change. As global temperatures rise and weather patterns become more erratic, the frequency and intensity of abiotic stress events can increase. In turn, agricultural activities contribute to greenhouse gas emissions, further exacerbating climate change.

8. Social and Environmental Impact:

The effects of abiotic stress in agriculture can extend beyond economic losses. Rural communities that heavily rely on agriculture for their livelihoods may face social and cultural challenges due to reduced income and job opportunities. Additionally, the use of agrochemicals to manage stressors can have environmental implications, including pollution and harm to non-target organisms.

Effective Management Strategies

To tackle the challenges posed by abiotic stress in agriculture, farmers and researchers are adopting innovative strategies. Here are some effective management techniques:

- **Crop Selection**: Option for crop varieties that are better adapted to local environmental conditions, such as drought-tolerant or heat-resistant cultivars.
- **Irrigation Management:** Implement efficient irrigation systems, such as drip irrigation, to conserve water and deliver it precisely to the plant roots.
- **Soil Management:** Enhance soil health through practices like organic matter addition, cover cropping, and reduced tillage, which improve water retention and nutrient availability.
- **Genetic Modification:** Develop genetically engineered crops with enhanced tolerance to specific abiotic stresses.
- **Precision Farming:** Utilize technology to gather real-time data on soil conditions, weather, and crop health, enabling precise and timely interventions.
- **Sustainable Agriculture**: Promote sustainable farming practices that aim for long-term productivity without depleting natural resources.
- **Agroforestry:** Integrate trees and shrubs within agricultural landscapes to provide shade, windbreaks, and additional sources of income.
- **Climate-Smart Agriculture:** Implement climate-resilient strategies that adapt to changing environmental conditions and minimize greenhouse gas emissions.

Government Support and Farmer Education

Governments play a vital role in supporting farmers' efforts to combat abiotic stress. They should invest in research and extension services, providing farmers with access to the latest technologies, information, and training. Financial incentives and subsidies can encourage the adoption of climate-smart agricultural practices.

Conclusion

Abiotic stress in agriculture is a formidable challenge, but with the right management strategies, it can be mitigated. Through a combination of sustainable practices, technological advancements, and policy support, we can safeguard global food production and build resilient agricultural systems capable of weathering the storms of climate change. By embracing these solutions, we pave the way for a more sustainable and food-secure future for generations to come. Abiotic stress poses significant challenges to agricultural systems worldwide, impacting crop growth,

yield, and overall sustainability. Addressing these challenges requires a combination of sustainable agricultural practices, crop breeding for stress tolerance, improved water management, and policy support from governments and international organizations. By prioritizing research, education, and investment in climate-resilient agriculture, we can mitigate the effects of abiotic stress and build a more sustainable and food-secure future.

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THE NEGLECTED PART OF PLANT BREEDING: ROOTS

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Abstract
In an array of cultivation circumstances, roots might be focused to increase crop production as they are essential for the absorption of water and nutrients. Because of their subsurface location, advantageous root traits are currently difficult to characterize and for select in plant breeding., Plant breeding initiatives directed at altering root characteristics can produce new, highly stress tolerant crop and greater production by increasing the ability of plant for exploration of soil and consequently, nutrient and water accession.

Introduction
The association between harmful and beneficial microbes at the point of contact with roots in the rhizosphere, that act as storehouse systems, link plant tissues to the ground and carry out crucial functions including moisture and nutrient uptake for the growth of plants. The ability to explore natural diversity and find advantageous root features to increase yield of plants in agricultural systems is made possible by the elasticity of root development and growth in reaction to fluctuating soil nutritional and water levels. The geographic organization of all root elements inside a specific growth environment is referred to as root system architecture (RSA). The external factors (soil pH, nutrients, temperature and moisture) and nearby microbial populations have a direct effect on RSA, which is dynamic and affects how a plant perceives and reacts to its surrounding circumstances. Different root traits give plants the ability to react, adjust and flourish in many conditions.

Root breeding
Determination of the underlying root characteristics that allow a plant to more effectively use nutrients and water in various conditions is necessary for approaches to adopt "root breeding". Root breeding offers breeders clear objectives to choose individuals with the optimal root traits to employ as parents to generate breeding material that progress via the crop enhancement phase. The particular trait being selected in various crops, its heritability, its capacity to accurately and effectively phenotype roots from several genotypes, the particular farming system being used (row crops vs. pastures or swards), the soil characteristics and the set of goals of breeding conditions are all factors that affect the success of breeding programmes focused on altering RSA. (Meister *et al.,* 2014).

Addressing the molecular processes that modulate RSA in crops has received growing attention as a result of the significant functions that roots play in the development of plants. Reverse and forward genetics using mutants of the model plant organisms Arabidopsis thaliana, Medicago truncatula, or Brachypodium distachyon, as well as the discovery of QTL (quantitative trait loci) beneath the naturally occurring phenotypic variability of root characteristics among populations, are methods to comprehend root growth and RSA (Kamoshita *et al.,* 2002; Zhu *et al.,* 2005 and

Cane *et al.,* 2014). Breeders can choose target root features for existing or recovered soils for enhanced agricultural productivity by fusing expertise on the genetic mechanisms underlying RSA with the identification of optimum root morphologies for crops thriving in specific circumstances.

Ideal Root type

- It should produce strong fibrous root system
- It should give maximum economic life to the plant
- It should have uniform growth rate
- It should be well adaptable to the agro climatic conditions
- It must have resistance against biotic stress like soil borne pests and disease
- It should have tolerance to abiotic stress like drought, salt and frost
- It should be reasonably free from suckers

Table 1: Different root traits and their importance in plant breeding

Root Traits	Importance
Primary root length	Provides better access underground water lying in deeper layers
Gravitropism	Robust seedling growth, drought tolerance and steeper root angle
Root hairs	Protects water status of young root tissue
Crown root number	Yields in low N soil, deeper roots reduces crown root number
Cluster roots	Better access to Phosphorus by higher production of exudates
Respiration	lowers the metabolic expenditure of soil investigation when P is limited
Cell wall modification	Lignification /Suberization helps in reducing the loss of water and affects radical water conductance
Root cortical aerenchyma	Root depth improvement upto 15%–30%
Cortical cell size	Improved tolerance to water stress
Rhizosheaths	Aluminum tolerance to root hairs

Challenges in Root breeding

The problem lies in creating non-invasive root characterization tools that can correctly represent and record the RSA. As component of the breeding programme, these techniques should enable effective evaluation of a substantial amount of genotypes through reasonably high throughput systems. They should also provide constant surveillance of root development including its reaction to various growing circumstances.

Root phenotyping strategies

A. Greenhouse /Container methods

1. Glass rhizotrons filled with soil for displaying roots
2. Employing the root box-pinboard approach for root sampling
3. PVC tubes to characterize roots
4. Evaluation of roots' capacity for roots to penetrate and extraction of resources from deeper layers of soil
5. Applying the basket technique for determining the root development angle quantitatively

Advantages of greenhouse /container methods:- Highly controlled method, which makes it possible to manage some factors, like light intensity, soil type, temperature, moisture, water and

fertilizer inputs, pot sizes and the evaluation of a plant's genetic potential without intraspecific competition.

Disadvantages of greenhouse /container methods:- In the absence of other plants and/or microorganisms in the soil, plant performance is nevertheless influenced by the growing container and experimental design with respect to RSA.

B. Field methods

1. Field sampling of roots using soil cores and monoliths
2. Deep-root restriction and raised-bed system

Advantages of field methods:- Provides real time field conditions.

Disadvantages of field methods:- Time and labor consuming, difficulties resulting from the field's heterogeneity, transgenic plant evaluation calls for damaging tests and licenses

Conclusion

Root systems can vary a lot among different genotypes of the same species. Plant breeders can wisely use these genotypes in breeding programs. The root system traits can be transferred to popular cultivars through conventional backcross breeding or through marker aided backcross breeding. In the upcoming future, root breeding can be useful to improve traits *viz.,* yield, biotic stress tolerance, drought tolerance, plant vigour, hardiness, fruit quality and earliness.

References

Canè M. A., Maccaferri M., Nazemi G., Salvi S., Francia R., Colalongo C., Tuberosa R. (2014). Association mapping for root architectural traits in durum wheat seedlings as related to agronomic performance. Mol. Breed. 34: 1629–1645.

Kamoshita A., Zhang J., Siopongco J., Sarkarung S., Nguyen H. T. and Wade L. J. (2002). Effects of phenotyping environment on identification of quantitative trait loci for rice root morphology under anaerobic conditions. Crop Sci. 42: 255–265.

Meister R., Rajani M., Ruzicka, D., Schachtman, D. P. (2014). Challenges of modifying root traits in crops for agriculture. Trends Plant Sci. 19: 779–788.

Zhu J., Kaeppler S. M., Lynch J. P. (2005). Mapping of QTL controlling root hair length in maize (*Zea mays* L.) under phosphorus deficiency. Plant Soil 270: 299–310.

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UREA GOLD (SCU- SULPHUR-COATED UREA): A GOLDEN STEP IN INDIAN AGRICULTURE

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Introduction

In a ground-breaking move to revolutionise Indian agriculture, the Cabinet Committee on Economic Affairs has approved the introduction of a game-changing fertiliser called Urea Gold. This innovative product, also known as sulphur-coated urea (SCU), promises to address sulphur deficiencies in soil, leading to improved crop yields, reduced input costs, and enhanced sustainability. With its controlled-release technology, this innovative product ensures efficient nutrient absorption, minimises losses, and fosters sustainable agriculture practices, making it a game-changer for Indian farmers. Let's delve deeper into the world of Urea Gold and understand its unique characteristics and benefits.

Fig:1 Layers of Sulphur coated Urea

What is sulphur-coated urea?

Sulphur-coated urea, or Urea Gold, is a specially formulated fertiliser that combines urea with a sulphur layer. This coating serves a dual purpose: it provides a slow-release mechanism for nitrogen and enriches the soil with sulphur, a vital nutrient for plant growth. The controlled release of nitrogen ensures a steady supply to the crops, minimising wastage and maximising nutrient absorption efficiency.

How does it differ from traditional urea and neem-coated urea?

Urea is a nitrogen Fertiliser that is commonly used in Indian farming. However, urea can be quickly released into the soil, leading to nitrogen leaching and other environmental problems. Neem-coated urea is a type of urea coated with neem oil. This helps to protect the urea from pests and diseases, but it does not slow down the release of nitrogen.

Sulphur-coated urea differs from urea and neem-coated urea because it is a slow-release Fertiliser. This means that the nitrogen from sulphur-coated urea is released over a longer period, which is better for the environment and plant growth.

Table 1: Difference Between Urea, Neem Coated Urea, and Sulphur Coated Urea

Properties	Urea	Neem coated urea	Sulphur coated urea
Nutrient content	46% Nitrogen	46% Nitrogen	30-40 % Nitrogen and 20 % Sulphur
Hygroscopic	High	low	low
Nitrogen use efficiency	Low	High	High
Volatility and leaching	High	Low	It depends upon the type of coating
Value addition	None	Pest and disease resistant	Sulphur content
Price	Low	Low	High
Layers	Urea core	Urea core + Neem	Urea core + Sulphur layer + Polymer coating
Colour	White granules	White granules	Yellow granules

Why is it needed for Indian farming?

Indian soils are often deficient in sulphur. Sulphur is a low-cost plant macronutrient for plants, and it helps improve the soil's structure and fertility. Nitrogen and sulphur deficiency symptoms are quite similar, so adding nitrogen to improve sulphur deficiency doesn't work. Sulphur-coated urea can help to improve soil health and increase crop yields. Sulphur also increases the efficiency of nitrogen.

How does it work?

The sulphur coating delicately wraps around the urea, creating a protective barrier that slows down the release of nitrogen. This means the nitrogen is gradually released over time, allowing plants to absorb it more efficiently. It's like a well-choreographed dance between the coating and the plant, ensuring optimal nutrient uptake.

Water vapour plays a crucial role in disrupting sulphur-coated urea (SCU). It gently passes through the sulphur coating, reaching the urea within the shell. As it comes into contact with the urea, an osmotic pressure builds up, creating a force that disrupts the coating. But that's not all. The fate of the sulphur coat lies in the hands of the soil's microorganisms. They are the masters of decomposition, breaking down the sulphur coating through oxidation. It's a symbiotic relationship between the soil and the coating, where microbial activity determines the availability of these sulphur-coated fertilisers.

Benefits of using sulphur-coated urea

There are many benefits to using sulphur-coated urea in Indian farming. These benefits include:

- Improved soil health: Sulphur-coated urea can help to improve soil health by increasing the levels of sulphur in the soil. This can help improve the soil's structure and fertility, increasing crop yields.

- Reduced nitrogen leaching: Sulphur-coated urea helps to reduce the risk of nitrogen leaching. This is because the sulphur coating slows the release of nitrogen from the urea, giving the plant more time to absorb the nitrogen before it can leach out of the soil.
- Increased crop yields: Sulphur-coated urea can help to increase crop yields. This is because the sulphur coating helps improve soil health and reduce nitrogen leaching, which can lead to increased crop growth.
- Reduced input costs: Sulphur-coated urea can help reduce farmers' input costs. This is because sulphur-coated urea is more efficient than other fertilisers, such as urea. Farmers can use less sulphur-coated urea to achieve the same results, saving them money.

Issues in sulphur coated urea:

- Sulphur-coated urea can lower the soil's pH, leading to nutrient disorders like calcium and magnesium deficiencies.
- The granules of sulphur-coated urea have three types of coatings: damaged coatings with cracks, damaged coatings sealed with wax, and perfect and thick coatings. When sulphur-coated urea with damaged coatings comes into contact with water, it releases urea immediately.
- The equipment needed and the cost of the coating material make sulphur-coated urea more expensive than other forms of urea.

Conclusion

Sulphur-coated urea is a promising new Fertiliser that can positively change Indian farming. It can improve soil health, lower input costs, and increase crop yields. One remarkable feature of sulphur-coated urea is its ability to address the mimic symptoms of yellowing leaves with either nitrogen or sulphur deficiency in plants. This unique Fertiliser is a valuable addition to farmers' toolkits and has the power to impact Indian agriculture significantly.

References

Baboo, P., & Manager, S. (2016). SULPHUR COATED UREA. *ResearchGate*. https://www.researchgate.net/publication/301799338_SULPHUR_COATED_UREA

Fertilizer urea. (n.d.). https://extension.umn.edu/nitrogen/fertilizer-urea

Neem coated urea. (n.d.). https://www.kribhco.net/urea.html#:~:text=Urea%20is%20a%20white%20crystalline,soluble%20and%20contains%2046%25%20nitrogen

Rajan, M., Shahena, S., Chandran, V., & Mathew, L. (2021). Controlled release of fertilisers—concept, reality, and mechanism. In *Elsevier eBooks* (pp. 41–56). https://doi.org/10.1016/b978-0-12-819555-0.00003-0

Unique package for farmers announced. (n.d.).https://pib.gov.in/PressReleseDetailm.aspx?PRID=1935893.

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THE CHAMELEON PLANT (*Houttuynia cordata* THUNB.): A MULTIFACETED MEDICINAL HERB

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Abstract
The Chameleon plant or Fish-mint (*Houttuynia cordata* Thunb.) is an herbaceous perennial belonging to the family Saururaceae and is well-known for its culinary use, as leaves and rhizomes are consumed as vegetables, spices, and condiments in some regions. Besides its culinary value, the chameleon plant has a long history of use in traditional herbal medicine systems, particularly in Ayurvedic and Chinese medicine. The chemical compounds identified from *H. cordata* include alkaloids, phenolic acids, flavonoids and volatile oils, which are characteristics of medicinal plants. The primary active ingredients are flavonoids and volatile oils. It is recognized for its anti-inflammatory, antioxidant, diuretic, respiratory, gastrointestinal, skin healing, and potential anti-tumor properties, making it a versatile and valuable herb.

Introduction
The chameleon plant, scientifically known as *Houttuynia cordata* Thunb., is an herbaceous perennial plant belonging to the family Saururaceae. It is native to parts of China, Japan, Korea and Northeast India (Luo *et al*., 2022), but has also been naturalized in other regions around the world. It is prevalent in the Northeastern parts of India, Bhutan, Nepal, China, Japan, Korea, Vietnam, Indonesia, Thailand, Taiwan and Myanmar (Rathi *et al*., 2013). The plant gets its common name, "Chameleon Plant" and "Fish mint", due to its ability to change colour and its remarkable adaptability and have a distinct fishy flavour. The chameleon plant is known for its attractive foliage and unique growth habit. It typically grows in dense clusters and spreads rapidly through underground rhizomes, making it an invasive species in some areas. Leaves and rhizomes are consumed as vegetables, condiments and spices in the north-east region of India.

Botanical description
The chameleon plant is an herbaceous perennial with a non-woody stem that persists year after year. It typically grows in dense clusters and forms spreading mats of vegetation. The leaves are alternate, simple and have a distinct heart-shaped (cordate) appearance. They are typically around 4-9 cm long, 3-6 cm wide and have a serrated or toothed margin. The leaves are known for their variegated coloration, featuring shades of green, red, yellow and pink. The coloration patterns can vary among different cultivars or environmental conditions. The plant produces small, inconspicuous flowers that are arranged in terminal spikes or clusters. The individual flowers are usually white or pale yellow in colour. The flowering period occurs in the late spring or early summer and the plant may continue to produce sporadic flowers throughout the growing season. The plant spreads through underground rhizomes, which are modified stems that grow

horizontally beneath the soil surface. These rhizomes give rise to new shoots and allow the plant to expand vegetatively, forming dense colonies. The plant typically reaches a height of about 20-60 cm (8-24 inches), although it can grow taller under favourable conditions. When the leaves are crushed or brushed against, they emit a distinctive and somewhat pungent odour. It is important to note that the chameleon plant has invasive tendencies in certain regions due to its rapid growth and ability to spread vigorously.

Soil and climate

Houttuynia cordata Thunb. has specific preferences when it comes to soil and climate conditions. It prefers moist to wet soil conditions. It thrives in areas with high humidity and can even grow in shallow water or marshy environments. Good drainage is important to prevent waterlogging, as excessive standing water can lead to root rot. The plant prefers slightly acidic to neutral soil with a pH range between 6-7.

The plant prefers moderate temperatures. It can tolerate a range of temperatures but grows best in regions with average temperatures between 15-25°C. It can tolerate full sun and thrives well in partially shaded areas. It prefers dappled sunlight or filtered shade rather than intense direct sunlight. It is well-adapted to humid environments and performs best in areas with high humidity levels.

Ethnopharmacological uses

The chameleon plant (*H. cordata* Thunb.) has a long history of medicinal use in traditional medicine systems, particularly in Ayurvedic and Chinese medicine, dating back to the Eastern Han dynasty (25-220 A.D.) (Yang, 2019). It is believed to possess various therapeutic properties and is used for several medicinal purposes. In the Northeastern part of India, the leaves and rhizomes are consumed raw as salad and in chutneys to lower blood sugar levels (Kumar *et al*., 2014). Here are some of the commonly known medicinal uses of the chameleon plant:

Anti-inflammatory and antioxidant: The chameleon plant is known for its anti-inflammatory and antioxidant properties. It is used to reduce inflammation and oxidative stress in the body, which are associated with various health conditions. A study conducted by Kusirisin *et al*. (2009), found that high antioxidant activity was observed in *Houttuynia cordata* Thunb. (18.93 mg Trolox/ g dry weight of plant extract) (Trolox is an antioxidant derived from water-soluble vitamin E). *In vitro* and *in vivo* studies conducted by Shingnaisui *et al*. (2018) have shown that phyto-constituents such as Afzelin, Hyperoside and Quercitrin reduce inflammation.

Diuretic: The plant is used as a diuretic, promoting the production and flow of urine. It is believed to help in detoxification, flushing out toxins and waste products from the body. diuretic property is due to quercitrin and inorganic substances contained in fish mint. The presence of quercitrin and iso-quercitrin has a diuretic effect.

Respiratory Ailments: The chameleon plant is used in traditional medicine for respiratory conditions such as coughs, colds, and bronchitis. It is believed to have expectorant properties, helping to loosen and expel mucus from the respiratory system. At a dosage of 250 mg/ml, *H. cordata* exhibited effective anti-influenza virus activity and totally suppressed viral neuraminidase (Han *et al*., 2016).

Gastrointestinal Disorders: The plant is used to alleviate gastrointestinal issues such as diarrhea, abdominal pain, and indigestion. It is believed to have antibacterial properties that can help

combat certain gastrointestinal infections. The gastrointestinal flora plays a vital role in intestine protection (Lu *et al*., 2019). Polysaccharides and sodium houttuyfonate present in *H. cordata* have been found to protect the intestinal flora in recent investigations (Wu *et al*., 2021).

Skin Conditions: The chameleon plant is used topically for various skin conditions such as eczema, rashes, insect and snake bites. In the North-east region of India, it is believed to possess antimicrobial and anti-inflammatory properties that may help soothe and heal the skin (Singh, 1996).

Anti-tumor: Primary colorectal cancer/tumor cells showed chromosomal condensation and death after 24 h of treatment with 250 g/ml *H. cordata* extract (Lai *et al*., 2010). Furthermore, investigations have revealed that an ethanol extract of H. cordata causes apoptosis in breast tumor cells (Subhawat *et al*., 2020).

In conclusion, *Houttuynia cordata* Thunb. is a versatile and resilient herbaceous perennial plant and has a long history of traditional medicinal use, particularly in Ayurvedic and Chinese medicine, where it is believed to possess anti-inflammatory, antioxidant, diuretic, and anti-tumor properties. While more scientific research is needed to fully understand its medicinal potential, the chameleon plant offers promising possibilities for natural remedies. Overall, the chameleon plant is an intriguing botanical specimen that holds both aesthetic and medicinal significance.

References

Han, X., Zhang, D. K., Guo, Y. M., Feng, W. W., Dong, Q., Zhang, C. E., Zhou, Y. F., Liu, Y., Wang, J. B., Zhao, Y. L., Xiao, X. H. and Yang, M. (2016). Screening and evaluation of commonly used anti-influenza Chinese herbal medicines based on anti-neuraminidase activity. *Chinese Journal of National Medicines*, 14(10): 794–800.

Kumar, M., Prasad, S, K., Laloo, D., Joshi, A. and Hemalatha, S. (2014). Pharmacognostical and phytochemical standardization of *Houttuynia cordata* Thunb.: A potent medicinal herb of North–Eastern India and China. *Pharmacognosy Journal*, 6(1): 34-42.

Kusirisin, W., Srichairatanakool, S., Lerttrakarnnon, P., Lailerd, N., Suttajit, M., Jaikang, C. and Chaiyasut, C. (2009). Antioxidative activity, polyphenolic content and anti-glycation effect of some Thai medicinal plants traditionally used in diabetic patients. *Medicinal Chemistry*, 5: 139-147.

Lai K. C., Chiu Y. J., Tang Y. J., Lin K. L., Chiang J. H., Jiang Y. L., Jen, H. F., Kuo, Y. H., Agamaya, S., Chung, J. G. and Yang, J. S. (2010). *Houttuynia Cordata* Thunb extract inhibits cell growth and induces apoptosis in human primary colorectal cancer cells. *Anticancer Research*, 30(9): 3549–3556.

Lu, L., Li, W., Chen, L., Su, Q., Wang, Y., Guo, Z., Lu, Y., Liu, B. and Qin, S. (2019). Radiation-induced intestinal damage: Latest molecular and clinical developments. *Future Oncology*, 15(35): 4105–4118.

Luo, Q., Meng, P. H., Jiang, D. W., Han, Z. M., Wang, Z. H., Tan, G. F. and Zhang, J. (2022). Comprehensive assessment of *Houttuynia cordata* Thunb., an important medicinal plant and vegetable. *Agronomy*, 12(10): 2582

Rathi, R. S., Roy, S., Misra, A. K. and Singh, S. K. (2013). Ethnobotanical notes on *Houttuynia cordata* Thunb. in North-Eastern region of India. *Indian Journal of Natural Products and Resources*, 4(4): 432-435.

Shingnaisui, K., Dey, T., Manna, P. and Kalita, J. (2018). Therapeutic potentials of *Houttuynia cordata* Thunb. against inflammation and oxidative stress: A review. *Journal of Ethnopharmacology*, 220: 35-43.

Singh, A. J. (1996). Vegetable in Manipur, 1st edn. Published by A Ibobi Singh, Mongsangei, Imphal, Manipur; Press Padma Printers, Paona Bazar, Imphal, Manipur, India, 209 pp.

Subhawat, S., Chewonarin, T. and Banjerdpongchai, R. (2020). The Effects of *Houttuynia cordata* Thunb and Piper ribesioides wall extracts on breast carcinoma cell proliferation, migration, invasion and apoptosis. *Molecules*, 25(5): 1196.

Wu, Z., Deng, X., Hu, Q., Xiao, X., Jiang, J., Ma, X. and Wu, M. (2021). *Houttuynia cordata* Thunb.: An ethnopharmacological review. *Frontiers in Pharmacology*, 12: 714694

Yang, Y. (2019). Textual research on *Houttuynia cordata* and historical change of its role as food. *Agricultural Archaeology*, 4: 211–218 (in Chinese).

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CLIMATE RESILIENT AGRICULTURE FOR FOOD, NUTRITION AND ENVIRONMET SECURITY

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Abstract
Indian agriculture is facing manifold challenges for producing more food to feed rapidly growing population. To ensure food, nutrition and environment security for 1.70 billion people by 2050, the country must focus on its agriculture sustainability with limited cultivable area and dwindling natural resources, and climate change and its impact in form of extreme weather events. This paper aims to highlight strategies and technologies to promote climate resilient agriculture to ensure food, nutrition and environment security for better livelihood of rural community.

Introduction
The growth story of Indian agriculture since the days of food scarcity (in the mid-1960s) to the present satisfactory production level of food grains has been very impressive. Land degradation and environmental challenges have emerged to thwart sustainability of agri-food systems. Climate change is one of the most extreme challenges Indian agriculture is facing today and will have to deal with in future. Feeding a growing population and ensuring food and nutritional security in future thus becomes a daunting challenge in a changing climate. It is in this context, suitable policy actions with scientific interventions become imperative for Indian agriculture to adapt and mitigate climate change impacts. There has been a growing interest in India to scientifically ascertain the impacts of agriculture sector on climate change and the impact of climate variability as well as climate change on farm sector of the economy. This paper aims to highlight strategies and technologies to promote climate resilient agriculture to ensure food, nutrition and environment security for better livelihood of rural community.

Climate Change: A Big Challenge for Agriculture and Society
Foodgrain production in India saw sustained increase and stood at 315.7 million tonnes (Mt) in 2021-22. However, this is a reality that Indian agriculture is facing manifold challenges for producing more food to feed rapidly growing population. To ensure food, nutrition and environment security for 1.70 billion people by 2050, the country must focus on its agriculture sustainability with limited cultivable area and dwindling natural resources, and climate change and its impact in form of extreme weather events, which is proving to be one of the most critical challenges for the country's food security. Land degradation and environmental challenges have emerged to thwart sustainability of agri-food systems. The frequent occurrences of natural disasters like flood, drought, storms, hails, cyclones etc. have led to severe hardship and farm distress. Climate change is affecting agriculture in a number of ways, including through changes in average temperatures, rainfall, and climate extremes (e.g., heat waves), changes in pests and diseases, changes in atmospheric carbon dioxide and ground-level ozone concentrations, changes

in the nutritional quality of some foods. Agriculture contributes to climate change by (1) anthropogenic emissions of greenhouse gases (GHGs), and (2) by the conversion of non-agricultural land (e.g., forests) into agricultural land. Agriculture, forestry and land-use change contributed around 20 to 25% to global annual emissions. Climate change is posing a big challenge for agriculture and the entire ecosystem and stresses on the need to step up efforts to fight it.

Climate Change and Agriculture

The impacts of climate change on agriculture are being witnessed all over the world, but countries like India, with >80% of small and marginal farmers with poor coping mechanisms, are more vulnerable in view of their dependence on agriculture and excessive pressure on natural resources. In recent years, there has been a significant rise in the frequency of extreme weather events affecting farm level productivity and impacting availability of staple food grains at the national level. Within a season, severe droughts and floods are being experienced in the same region, worsening the plight of all stakeholders. Since climate change poses complex challenges like multiple abiotic stresses on crops and livestock, shortage of water, land degradation and loss of bio-diversity, all stakeholders should join hands to find solutions to the problems specific to specific location. Future climate change will likely negatively affect crop production in low latitude countries, while effects in northern latitudes may be positive or negative. The impact of climate change is directly or indirectly related to crop, water and soil as it influences the water availability, changes the intensity and frequencies of drought, effects microbial population, soil organic matter reduction, yield reduction, depletion of soil fertility as driven by soil erosion, etc. Climate change will probably increase the risk of food insecurity for some vulnerable groups, such as the poor.

Climate change and agriculture are interrelated processes, both of which take place on a global scale with effects unevenly distributed across the world. There has been a growing interest in India to scientifically ascertain the impacts of agriculture sector on climate change and the impact of climate variability as well as climate change on farm sector of the economy. The second Biennial Update Report (BUR) submitted by Government of India to the United Nations Framework Convention on Climate Change (UNFCC) in December 2018 mentions that agriculture sector is responsible for 16.2% of the total Greenhouse gas (GHG) emissions. Scientific analyses have predicted that the trend could lead to a decline in agriculture production due to further climate change. Studies carried out at the Indian Agricultural Research Institute (IARI), New Delhi, have indicated the possibility of a loss of 4 to 5 MMT in wheat production with every 1^0C rise in temperature. This study has assumed that irrigation would be made available at present level, which of course may not be a possibility considering the receding Himalayan glaciers and increased demand of water from other sectors.

The predicted 1-2.5^{0}C temperature rise by 2030 is likely to show serious effects on crop yields. High temperatures may reduce crop duration, permit changes in photosynthesis, escalate crop respiration rates and influence pest population. Climate change accelerates nutrient mineralisation, hampers fertilizer use efficiency (FUE) and hastens the evapotranspiration in soil. The impact of climate change is directly or indirectly related to crop, water and soil as it influences the water availability, changes the intensity and frequencies of drought, effects microbial population, soil organic matter reduction, yield reduction, depletion of soil fertility as driven by soil erosion, etc. Therefore, the strategies and technologies related to climate resilient agriculture

to tackle the serious problems of extreme weather changes need to be popularized and promoted among the farmers to ensure food, nutrition and environment security.

High temperature causes moisture stress situation, directing to sunburn and cracking symptoms in fruit trees like apricot, apples and cherries. The temperature increase at the ripening stage causes fruit burning and cracking in litchi plantation (Kumar and Kumar, 2007). If the ozone concentration reaches more than 50 parts per billion/day, the yield of vegetable crops will come down 5-15 per cent (Raj, 2009). This creates food shortages, nutrient deficiencies in humans due to inadequate intake of healthy food makes humans vulnerable to health issues. An average of 30 per cent reduction in crop yields is anticipated by the mid-21st century in South Asian countries.

Research has shown that the decline in grain protein content in cereals could partly be related to increased carbon di-oxide concentrations and temperature. There are also reports of quality of Basmati rice being adversely impacted due to temperature increase beyond the optimum level. The yield in temperate crops like apple has been seen to be directly related to climatic extremes. Average productivity of apples in the traditional Kullu and Shimla regions of Himachal Pradesh has often been attributed to inadequate chilling in recent decades, crucial for good apple yields.

Pest and disease incidences in any crop are functions of ambient temperature and humidity. Crop -pest/ disease interactions will, therefore, change significantly in an era of climate change. Feeding a growing population and ensuring food and nutritional security in future thus becomes a daunting challenge in a changing climate. It is in this context, suitable policy actions with scientific interventions become imperative for Indian agriculture to adapt and mitigate climate change impacts. There has been a growing interest in India to scientifically ascertain the impacts of agriculture sector on climate change and the impact of climate variability as well as climate change on farm sector of the economy.

Higher temperatures alter the animals' body physiology like an increase in heart rates (more than 70-80/ minute), blood flow and body temperature (more than 39.17°c). Dairy breeds are more prone to heat stress than meat breeds. An increase in metabolic heat production breeds leads to higher susceptibility to heat stress; while the low milk giving animals are resistant. Poultries are severely sensitive to temperature-associated problems, particularly heat stress. Because of heat stress, feed eating by poultries will come down, which leads to lesser body weight and egg production, and affects quality of meat. It decreases the density of eggshell and enhances the egg breakage. Increasing environmental temperature may cause seasonal betterment in the growth and development of fishes, but enhances the dangers to the populations living away from the thermal tolerance zone.

Strategies and Technologies for Climate Change Adaptation

The challenge before the scientists, society, governments and all the stakeholders associated with agriculture development including fertiliser industry is to build systems to sustain focus and integrate activities aligned to sustainable agriculture practices as climate change poses new risks to yields and quality of food crops. Climate-resilient agriculture (CRA) is an approach that includes sustainably using existing natural resources through crop and livestock production systems to achieve long-term higher productivity and farm incomes under climate variabilities. This practice reduces hunger and poverty in the face of climate change for forthcoming generations. CRA

practices can alter the current situation and sustain agricultural production from the local to the global level, especially in a sustainable manner.

For meeting the challenges of climate change impacting agriculture, the Indian Council of Agricultural Research (ICAR) initiated a mega project titled *"National Initiative on Climate Resilient Agriculture"* (NICRA) in 2010-11 with the objectives of enhancing the resilience of Indian agriculture covering crops, livestock and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies; demonstrating site-specific technology packages on farmers' fields for adapting to current climate risks; building up the capacity of scientists and other stakeholders in climate-resilient agricultural research and its applications. NICRA has four components, viz., strategic research on adaptation and mitigation, technology demonstration to cope with current climate variability in 100 vulnerable districts, human resource development, and sponsored/competitive research to address critical issues. The strategic research will involve twenty-one ICAR Institutes, and the demonstration of the existing technologies to cope with current climate variability will be carried out in 100 districts through KVKs, Coordinating Centres of the AICRPDA and the Transfer of Technology (TOT) Divisions of the above core Institutes. It is high time that all the stakeholders including fertiliser industry should join hands with these institutions to help farmers to tackle climate change related adversities affecting agriculture and livestock sectors. Expected outputs of the National Initiative on Climate Resilient Agriculture (NICRA) are:

- Selection of promising crop genotypes and livestock breeds with greater tolerance to climatic stress
- Existing best bet practices for climate resilience demonstrated in 100 vulnerable districts.
- Infrastructure at key research institutes for climatic change research strengthened.
- Adequately trained scientific manpower to take up climate change research in the country and empowered farmers to cope with climate variability.

A brief description of selected climate resilient practices related to soil and nutrient management are being given below.

Soil Management

Soil Conservation: With the rise of the environmentalist movement in the 1960s and afterward, it has become common to speak of conserving natural resources such as trees or fossil fuels. Soil conservation measures are important to control soil erosion. Farmers should use contour ridges as a strategy to minimize soil erosion to encourage better root penetration and enhance moisture conservation. These help in holding soils together and arresting desertification. Failure to conserve soil has turned many a fertile farmland into temporary dust bowl or even permanent desert. Techniques such as crop rotation aid in conservation. Natural mulches moderate the soil temperatures and extremes, suppress diseases and harmful pests, and conserve the soil moisture.

Carbon Sequestration: Intensive cropping and tillage system have led to substantial decrease in soil organic matter levels of Indian soils. Soil organic matter may be maintained by the addition of crop residues. Carbon sequestration is the process involved in carbon capture and the long-term storage of atmospheric carbon dioxide or other forms of carbon to mitigate or defer global warming.

Crop Residue Management: Rice and wheat straws left in the field after combine harvesting are generally burnt by the farmers to facilitate seed bed preparation and seeding. These crop residues contain large quantities of nutrients accumulated by rice and wheat crops. Burning of crop residues in the states like Punjab, Haryana, Uttar Pradesh and Rajasthan has significantly contributed to deterioration of air quality. The Government is encouraging the farmers to go in for mechanized options of residue management by way of providing subsidies on purchase of machines and equipments such as zero till seed drill, happy seeder, straw baler, rotavator, paddy straw chopper/ mulcher, gyro rake, straw reaper, shredder, etc., as custom hiring centers or village level farm machinery banks.

Conservation Agriculture (CA): CA-based production systems also moderates the effect of high temperature (reduced canopy temperature by 1-4 °C) and increases irrigation water productivity by 66–100% compared to traditional production systems, thus auguring well to adapt to the water and heat stress situations of Indo Gangetic Plains.

Minimum Tillage: While intensive soil tillage reduces soil organic matter through aerobic mineralization, low tillage and the maintenance of a permanent soil cover (through crops, crop residues or cover crops and the introduction of diversified crop rotations) increase the soil organic matter. A no- or low-tilled soil conserves the structure of soil for fauna and related macrospores (earthworms, termites and root channels) to serve as drainage channels for excess water. Surface mulch cover protects soil from excess temperatures and evaporation losses and can reduce crop water requirements by about 30%.

Crop Management

Early Warning and Information Systems (EWIS): With the improved use of Early Warning and Information Systems and Disaster Information Management Systems, the short- and long- term impacts of extreme events on agriculture livelihoods can be assessed. These can help in getting prepared for disaster management preparedness and mitigating the potential risks. Farmers will be benefitted with this approach.

Crops and Varieties: Climate change adaptation for agricultural cropping systems requires a higher resilience against both excess of water (due to high intensity rainfall) and lack of water (due to extended drought periods). To combat the impacts of these extremes, use of indigenous and locally-adapted plants and animals as well as the selection and multiplication of crop varieties and autochthonous races adapted or resistant to adverse conditions is being propagated.

Responsible Plant Nutrition: Balanced plant nutrition is indispensable in meeting these objectives ensuring food security needs in the 21st century. Therefore, sustainable efforts are being made through nanotechnologies to synchronize nutrient availability and improve NUE so as to enhance crop yields with a healthy agro-ecosystem without a further deterioration of surrounding environments under environmental adversities.

Integrated Nutrient Management: Use of fertilizers along with organic manures, green manures, vermicompost, biofertilizers, neem, *karanj*, pongamia cakes etc., color chart and nitrification inhibitors will improve nutrient use efficiency and soil health and help reduce greenhouse gases emissions. Components of Integrated Nutrient Management and the benefits are depicted in **Figures 1** and **2**, respectively.

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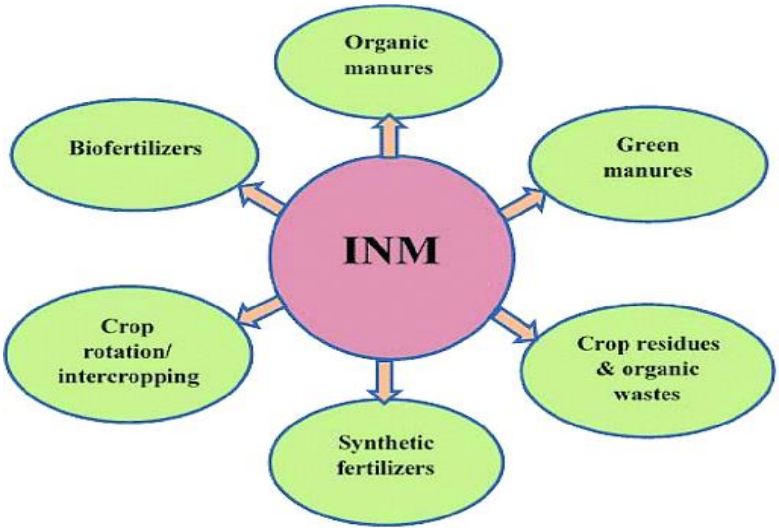

Figure 1. Components of Integrated Nutrient Management

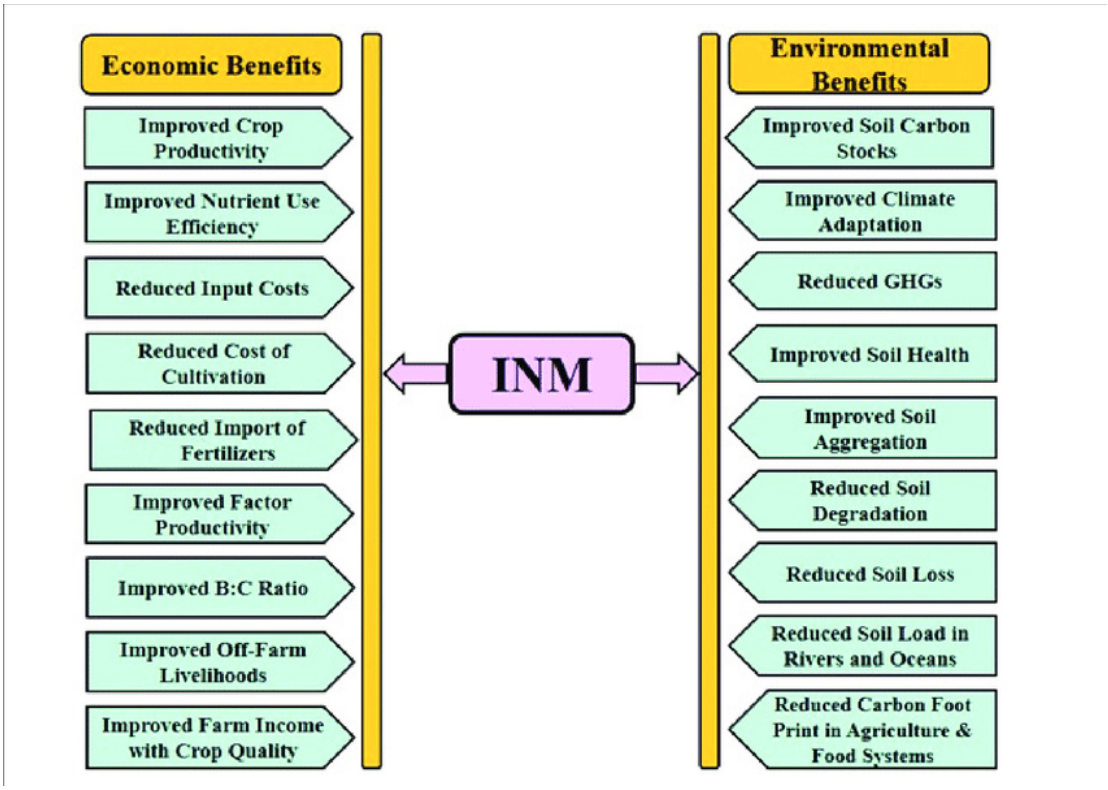

Figure 2. Benefits of Integrated Nutrient Management

PM-PRANAM: The idea behind the recently announced PM-PRANAM (Prime Minister-Programme for Alternative Nutrients for Agricultural Management) is very progressive. It aims to replace chemical fertilisers with natural (organic and bio) fertilisers. Overdoses of chemical fertilisers to increase yields have exterminated the natural nutrients of the soil in large parts of the three green revolution states-Punjab, Haryana and western U. P. The soil in other states is headed for the same destiny. The Government is promoting organic farming and *Prakritik Kheti* to address the issues of climate change.

Nutri-Cereals: Sorghum and millets are the most important staple foods for millions of people in the semi-arid tropics of Asia and Africa. In India, eight millets species ie. Sorghum (Jowar), Pearl millet (Bajra), Finger millet (Ragi), Proso millet (Cheena), Foxtail millet (Kodo), Barnyard millet (Indian barnyard millet) and Little millet (Sawaan) are cultivated under rainfed conditions and are considered as a staple diet for the people living in the dryland regions (**Figure 3).**

Figure 3. Nutri-Cereals are Eco-Friendly and help Mitigating Climate Change Adversities

Nutri-Cereals need less water, nutrients and care and are rich in minerals, proteins and vitamins and thus can ensure future food, nutrition and environmental security. The UN, on the initiative of Prime Minister Modi declared 2023, the International Year of the Millets.

Nanofertilizers: Urea and Di-Ammonium Phosphate (DAP) are largely consumed fertilisers in the country but their nutrient use efficiency is very low. The higher rate of nutrient release from chemical fertilizers and subsequent bioleaching, nutrient immobilization and fixation are some of the important factors responsible for causing a dramatic reduction in nutrient uptake and utilization abilities of the plants. Therefore, to tackle such challenges, the controlled release of the nutrients can be an effective strategy. Nanotechnology has the potential to reinforce the mission toward ever-green revolution by enhancing agricultural productivity with limited inputs. Nano fertilizer have large surface area and particle size less than the pore size of root and leaves of the plant which can increase penetration into the plant from applied surface and improve uptake and nutrient use efficiency of the nanofertilizer. Reduction of particle size results in increased specific surface area and number of particles per unit area of a fertilizer that provide more opportunity to contact of nano-fertilizers which leads to more penetration and uptake of the nutrient. Fertilizers encapsulated in nano-particles help increase availability and uptake of nutrient to the crop plants (**Figure 4**).

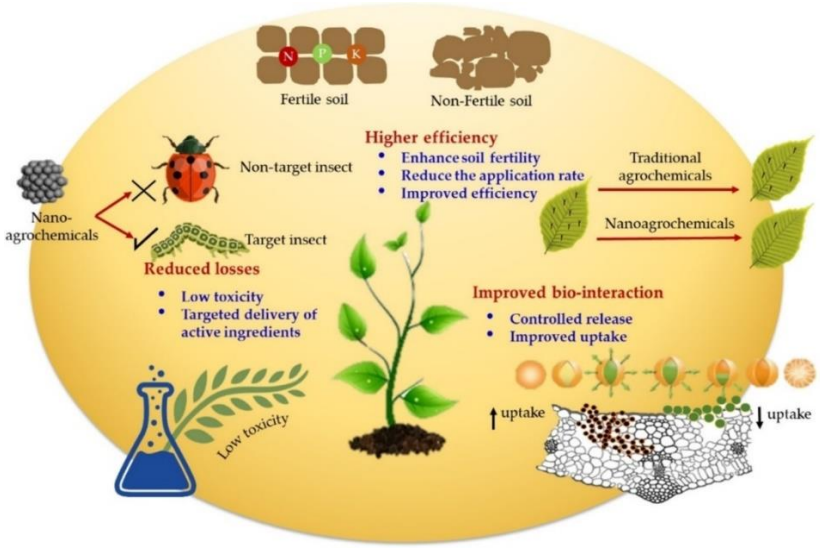

Figure 4. Benefits of Nanofertilizers towards climate resilient agriculture

IFFCO has received the patent for NanoUrea and NanoDAP from the Indian government for a period of 20 years. The Managing Director, IFFCO, Dr. US Awasthi said "This intellectual property of IFFCO Nano Urea and Nano DAP will strengthen Indian economy by reducing input cost to agriculture. IFFCO's nano urea and nano DAP next-generation fertilisers are benefiting farmers and the environment. These products will be instrumental in reducing soil, air, and water pollution. The products require fewer quantities to produce quantities of quality crops, while at the same time keeping soil healthy. This is an effort to save soil from excessive use of chemicals, a long-standing vision and commitment of IFFCO". IFFCO's IFFCO Nano Urea and Nano DAP are in sync with OECD testing guidelines (TGs) and "Guidelines for Testing of Nano Agri inputs (NAIPs) and Food Products released by the Department of Biotechnology, Government of India. Harvested produce of crops applied with IFFCO's nano urea, nano DAP have been found to be fit for application in agriculture with no adverse effect. These are safe for application, both to the user and for the environment. These have other incremental benefits such as these are cost-effective, eco-friendly and apart from irrigated agriculture, can be applied in rainfed and dry land agriculture as well as in protected cultivation. These are also compatible with most of the agrochemicals, bio-stimulants and specialty fertilizers (**Figure 5**).

Figure 5. IFFCO's Nano Urea and Nano DAP for mitigation and adaptation of climate change

4R Nutrient Stewardship: The International Plant Nutrition Institute (IPNI), The Fertilizer Institute, International Fertilizer Industry Association (IFA), and other partners, developed a frameworkthat enables better use of fertilizer: 4R Nutrient Stewardship (*Right Source, Right Rate, Right Time, Right Place*). The 4R Nutrient Stewardship is a science-based framework that promotes economic, social, and environmental sustainability on the farm by considering collectively the source, rate, time, and placepractices for fertilizer and other crop nutrients. The implementation of 4R Nutrient Stewardship can help the farmers to increase sustainable agriculture production, while reducing emissions of nitrogen and phosphorus to the air and water. The 4R Nutrient Stewardship can be used to dramatically reduce nitrous oxide emissions while significantly improving productivity through adaptable and incremental implementation of best management practices in fertilizer management.

Water management: To address the issues related to efficient water management, water-smart technologies like a furrow-irrigated raised bed, micro-irrigation, rainwater harvesting structure, cover-crop method, greenhouse, laser land levelling, reuse of wastewater, deficit irrigation and drainage management, sprinkler and drip irrigation, and fertigation can support farmers to decrease the effect of variations of climate. Apparently, development of cost-effective and environmentally friendly water-conserving devices as climate resilient technology is the need of the day.

National Programmes for Climate Change Adaptation

The convergence of various policy programmes and sectoral plans has been undertaken by the Government of India to ensure synergy and effective utilisation of existing resources is given below:

National Mission of Sustainable Agriculture (NMSA): NMSA was implemented in 2010 under the National Action Plan on Climate Change (NAPCC) to promote the judicious management of available resources and this was one of the eight missions under NAPCC.

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) was launched in 2015 to address the issues of water resources and provide a permanent solution that envisages Per Drop More Crop, by promoting micro / drip irrigation for the conservation of maximum water.

Paramparagat Krishi Vikas Yojana mission was executed to extensively leverage adaptation of climate-smart practices and technologies in conjunction with the Indian Council of Agricultural Research and state governments of India.

Green India Mission was launched by the GOI in 2014 under the umbrella of NAPCC with the primary objective of protecting, restoring and enhancing India's diminishing forest covers, thereby reducing the deleterious effects of climate change.

GOI Soil Health Card scheme was launched to protect the soil health. Additionally, Neem-Coated Urea was also introduced to minimise the excess addition of urea fertilizers, thereby protecting soil health and supplying plant nitrogen.

National Project on Organic Farming and National Agroforestry Policy was introduced in 2004 and 2014 respectively to encourage farmers with more income benefit and ecosystem protection. These policies are aimed at supplying plant nutrients in the form of organic amendments, soil carbon stock improvement, and soil protection from erosion loss.

Sikkim as organic state: Andhra Pradesh, Himachal Pradesh, Sikkim, etc, have already initiated several programmes to adopt and promote organic farming practices on a wider scale. Recently, GOI announced Sikkim as organic state.

The ICAR, through its network research Institutes, state agriculture universities and all line departments is implementing agriculture contingency plans in about 650 districts of India towards climate change preparedness for the last seven years.

These models are taken forward to SAARC countries towards adaptation to climate change impacts like floods, cyclones, droughts, and heat waves and seawater intrusion. ICAR has established climate-resilient villages across India in 151 districts, which are replicated by the state governments towards the overall objective of building carbon positive villages.

*Mahatma Gandhi National Rural Employment Guarantee Act (*MGNREGA) was initiated in 2005 with the key objective of "enhancing employment opportunities, additionally, providing economic security and protecting the environment".

The Way Forward

Apart from these approaches the following Climate-Smart Farming Practices should be taken into consideration.

- Using clean energy sources like solar for irrigation. The farmers have been incentivized to transfer electricity generated through solar to the local grid.
- Crop yield prediction models using artificial intelligence and drones for monitoring soil and crop health have been initiated.
- Smart farming enables crop diversification, which will help farmers reduce their dependence on monsoonsfor water.
- Reduction of greenhouse gas emissions from all agriculture and non-agricultural sources.
- Structured training to build confidence in stakeholders and sensitise them to understand the climate change events
- Fine tuning the gap between current management practices and essential agro-advisories
- Implementing CRA across the country
- Flagship farmer-oriented programmes to improvise skills in agriculture and allied sectors
- Collaboration between farmers, research institutions, fertilizer industry, funding agencies, governments, and non-government organisations and private sectors combine strengths to promote CRA.

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APPLICATION OF ALPHAFOLD IN FISHERIES AND AQUACULTURE

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Abstract
Alphafold is highly accurate artificial intelligence-based protein structure prediction software available freely. This tool can be used for prediction of structures of important protein sequences reported from aquatic animals. The predicted structure can be visualized and analyzed by freely available tools such as UCSF-Chimera structural modeling suit. A lot of research is going on in fisheries and aquaculture but the research targeting of bimolecular structure and function is lagging behind. In this context structure prediction and analysis can help us not only in understanding the physiology but also in developing new molecules for growth improvement, reproductive success and disease treatment in aquatic animal.

Introduction
Inside every living cell, billions of tiny molecular machines called proteins continuously work to make us alive. They are responsible for carrying out all life processes including digestion, respiration, metabolism, vision, brain activity, and decoding genetic information. A protein is like a string of beads made of a sequence of different chemicals known as amino acids. These sequences are assembled according to the genetic instructions of an organism's DNA. Attraction and repulsion between the 20 different types of amino acids cause the string to fold a unique three-dimensional (3D) structure spontaneously. This unique 3D structure determines its interaction with other biomolecules thus its function. Predicting the 3D structure of proteins from its sequence only, is one of the fundamental grand challenges in biology. By solving this challenge, we can dramatically deepen our understanding of human health, disease, and our environment, especially within areas like drug design and sustainability. In the last 60 years, the scientific community has been using tedious experimental methods namely X-ray crystallography, NMR spectroscopy, and cryo-electron microscopy to determine the structures of over 180,000 proteins in atomic detail. This work has already improved our understanding of many fundamental processes in health and disease. But this number is a very small fraction of the total known protein sequences which is more than 200 million.

If we talk about the number of protein structures known from aquatic animals including fish, crustaceans, and molluscs, the number is very less as compared to mammals. Aquatic animals are cold-blooded and have unique physiology which is different from mammals. The processes of digestion, metabolism, gaseous exchange, osmoregulation, reproduction, nervous physiology,

endocrine system, and immune system are significantly different compared to mammals. Moreover, these animals belong to very diverse groups of taxa adopted in different environments ranging from high mountain lakes to deep trenches of oceans giving them. To survive in these unique environmental conditions the animals have adapted to their unique physiology. To understand their unique physiology, the structure determination of involved proteins is must. Understanding their food and feeding, growth, reproduction, and immunity is also important for their commercial farming. So structural understanding will not only boost our knowledge but also supports their farming.

AlphaFold, the state-of-the-art AI software developed by DeepMind, is able to computationally predict protein structures from their amino acid sequences only with unprecedented accuracy and speed. DeepMind is a scientific discovery company that has created the famous AI-based game AlphaGo and works in collaboration with Google. Working in partnership with EMBL's European Bioinformatics Institute (EMBL-EBI), they have released over 200 million predicted protein structures including structures from non-mammalian organisms in the form of AlphaFold Database freely available to mankind (https://alphafold.ebi.ac.uk). In 2020, AlphaFold was recognized as a solution to the protein folding problem by the organizers of the CASP14 benchmark, a biennial challenge for research groups to test the accuracy of their predictions against real experimental data (Jumper et al., 2021).

Structural prediction and methodology

Predicting 3D structure of a protein from its amino acid sequence is one of the most important unsolved problems in biophysics and computational biology. The computational methods for predicting protein structure from its amino acid sequence spring up like mushrooms since the end of the 20th century. From the physical point of view, the amino acid sequence determines the basic molecular composition of the protein, and its native and functional structure. This structure corresponds to the most stable conformation with the lowest free energy. Although we know that the protein folding process is governed by various physical laws, it is very hard to give such a complicated macromolecule (including its interaction with surrounding solvent molecules) an accurate physical description. On the other hand, the huge amount of conformational space needed to search through is also a crucial issue remaining to be solved based on the current computing power.

There is a basic observation that similar sequences from the same evolutionary family often adopt similar protein structures, which forms the foundation of homology modeling (Xiong 2006). In this technique, protein structure is predicted by taking its homologous structure in PDB as a template. With the rapid growth of PDB database, an increasing proportion of target proteins can be predicted via homology modeling. Various tools are available for homology modeling including SWISS-MODEL, Modeller, etc. When no structure with obvious sequence similarity to the target protein can be found in PDB, it is still possible to find out proteins with structural similarity to the target protein. This method is called threading or folds recognition, which matches the target sequence to homologous and distant-homologous structures, based on some algorithm and takes the best matches as structural template. The basic principle behind threading procedure is that the protein structure is highly conservative in evolution and the number of unique structural folds is limited in nature (Xiong 2006). Threading can be done with a very popular and effective freely available webserver I-TASSER. Both homology modeling (based on sequence comparison) and

threading methods (based on fold recognition) can be called template-based structure prediction methods. Unlike homology modeling and threading methods, *ab initio* method aims to build structure from the first principles of physics which does not rely on any previously solved structure (Xiong 2006). The development of *ab initio* method is also the exploration of the second genetic code. However, successful *ab initio* methods are very rare and there are still many problems and challenges waiting to be conquered.

AlphaFold is an AI-based first computational method that can regularly predict protein structures with atomic accuracy even in cases in which no similar structure or template is known (Jumper et al., 2021). This method is based on a neural network-based model demonstrating accuracy competitive with experimental structures in a majority of cases and greatly outperforming other methods. The latest version of AlphaFold, AlphaFold 2 is a novel machine learning approach that incorporates physical and biological knowledge about protein structure, leveraging multi-sequence alignments, into the design of the deep learning algorithm. The deep neural network of the AlphaFold algorithm, which combines features derived from homologous templates and from multiple sequence alignment to generate the structure, has shown outstanding accuracy in predicting the 3D structure of proteins with otherwise unknown fold.

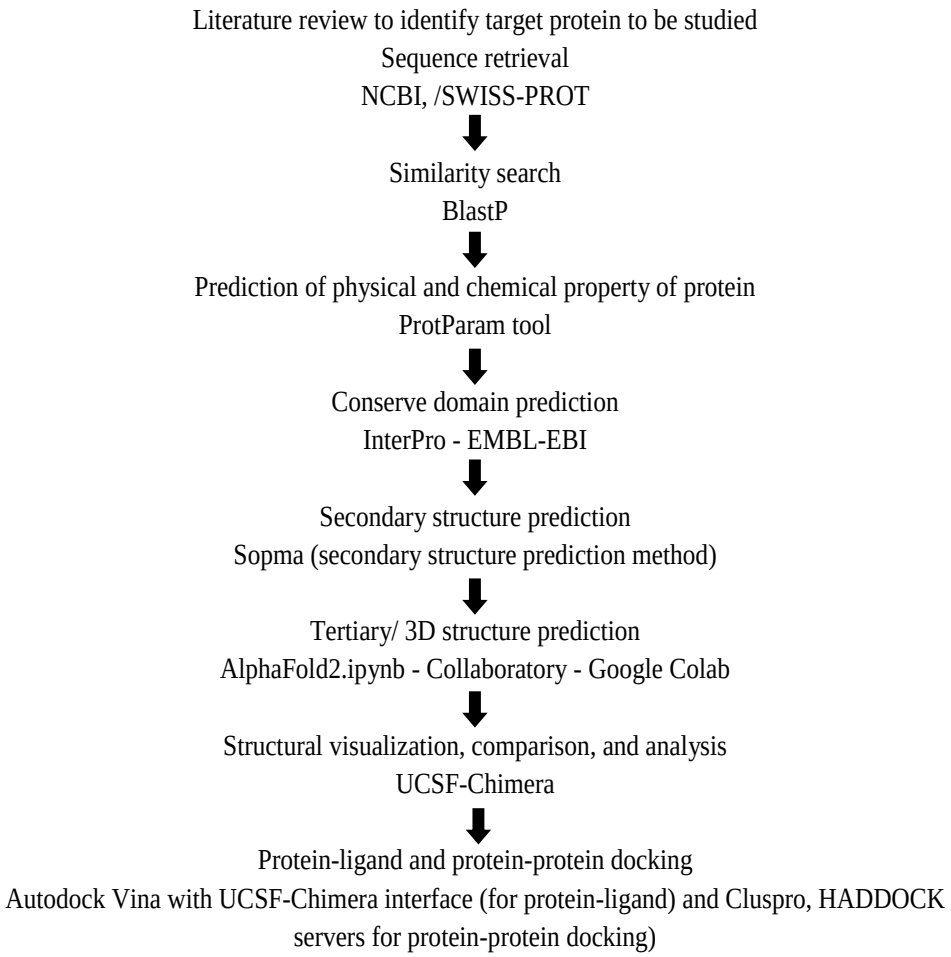

Figure 1. Workflow of bioinformatics analysis of an unknown protein. The tools used in each step are also mentioned.

Merits and demerits

AlphaFold as a structural prediction tool has several advantages which are mentioned below.

- AlphaFold is a simple but accurate structural prediction method. Other experimental techniques like X-ray crystallography and cryo-electron microscopy are very labor-intensive and time consuming.
- Experimental techniques are not equally applicable for all kinds of proteins for example membrane proteins. But computational methods especially AlphaFold can predict their structure like other proteins.
- AlphaFold can predict the structure of a protein sequence without any prior structural information. This extends its application broader than any other computational method. This tool can be used for less studied organisms including crustaceans, molluscs and pathogens infecting these animals.
- AlphaFold is currently freely available also as a webserver as ColabFold, a Google Colab platform. This feature is very handy and does not need installation of any software. The methodology of use is also very simple.

There are several demerits too when using AlphaFold for structural prediction.

- At present, the models released by AlphaFold do not allow user selection of the appropriate ligand-bound template, which is facilitated by many of the traditional template-based methods.
- For a given sequence of protein chains not all the residues are modeled with same accuracy and confidence. A large fraction of the protein structures released in the database has a high proportion of amino acids that remain unfolded or disordered.
- Another major challenge in the field of structural biology and protein modeling is the identification of the correct placement of domains in a multidomain protein, also known as inter-domain accuracy. AlphaFold still does not predict the quaternary structure of multidomain complexes with same accuracy as monomers.
- Another challenge for protein structure predictions is that several proteins are very long. Currently, the AlphaFold database on the EBI website does not include models for proteins longer than 2700 residues. Thus, no models are available for 207 large (residue range 2701– 34350), biologically important proteins, such as Titin and Dystrophin (David et al., 2022)

Applications

AlphaFold can be applied to understand and solve a large number of problems related to fish physiology and structural biology.

- It can be applied to model key enzymes and proteins involved in feed intake and growth of aquatic animals. This information can not only be helpful in understanding growth physiology but also in developing noble growth promoters and genome-edited species.
- Aquatic animals specially farmed fish does not breed in captivity without induction. Several inducing agents containing reproductive hormones are used. Structural prediction of key hormones and receptors can be helpful in understanding reproductive dysfunction and developing new formulations for mitigation.
- A variety of diseases infect farmed aquatic animals. Shrimp disease leads to loss of a huge amount of money globally. To combat these diseases understanding the host-pathogen

interaction is key. In this regard, structural prediction of key pathogen and host molecules involved in pathogenesis and drug targets will help us to develop new therapeutics against the diseases.

- Aquatic animals are diverse groups of animals adapted to different environmental conditions. They evolved unique enzymes, receptors, and pathways for survival and reproduction. Our current knowledge regarding the physiology of these animals is very limited especially in case of crustaceans, molluscs, and other invertebrates. Structural prediction and bioinformatics analysis of key proteins involved will be very helpful in understanding the physiology of these animals.
- Aquatic organisms living in marine and freshwater environments synthesize a variety of bioactive compounds. These compounds serve as nutraceutical and a variety of drugs against lethal human diseases including cancer, AIDS, and other pathogenic diseases. These bioactive compounds are synthesized by noble enzymes whose structure is not known mostly. Understanding the structure and function of these key enzymes using bioinformatics tools can facilitate their large-scale commercial production.

Conclusion

AlphaFold is a freely available highly accurate computational method to predict tertiary structure of protein. This method does not require any prior structural information making it suitable for modeling of non-mammalian proteins including invertebrates. As the knowledge of tertiary structure of proteins sequenced from aquatic organisms is less known, this tool has an immense application for them. Due to high accuracy and ease of use, AlphaFold can bring the structural biology of aquatic animals to new heights.

References

David, A., Islam, S., Tankhilevich, E. and Sternberg, M.J. (2022). The AlphaFold database of protein structures: a biologist's guide. Journal of molecular biology 434(2): 167336.

Jumper, J., Evans, R., Pritzel, A., Green, T., Figurnov, M., Ronneberger, O., Tunyasuvunakool, K., Bates, R., Žídek, A., Potapenko, A. and Bridgland, A. (2021). Highly accurate protein structure prediction with AlphaFold. Nature 596(7873): 583-589.

Xiong, J. (2006). Essential bioinformatics. Cambridge University Press. New York, USA.

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THERAPEUTANTS FOR FUNGAL DISEASES OF FISHES AND THEIR TREATMENTS

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Introduction

Like other vertebrates, aquatic animals are susceptible to a variety of pathogenic organisms, including fungi. Fungal Infections called mycoses are among the most common diseases seen in temperate fish. The first clinical report of a fungus infecting a vertebrate was of a fish. The ability of aquatic fungi to cause diseases in eggs, fry, fingerling, and adult fishes. Therapeutants are chemical substances used in fish farms or aquaculture operations to treat diseases. Most commonly, Malachite green, Formalin, Hydrogen peroxide, Sodium Chloride, CIFAX (developed by CIFA Bhuvneshwar), Trifluralin, and Azole drugs, are used as therapeutics to treat fungal disease.

Most common Fungal Diseases

1. Saprolegniasis (water mold or cotton wool disease)

Causative agents: *Saprolegnia parasitica*, *Saprolegnia diclina, etc.*
Species affected: Many FW fishes ex.: carp, Goldfish, etc.

Clinical signs: Lesion is Focal, has Grey-white patches on the skin, and has a Cotton wool-like appearance where hyphal filaments extend out into the water. The early lesions are often almost circular and grow by radial extension around the periphery until the lesion merges. At a later stage, the oomycetes patches are often dark grey or brown in color. and loss of epithelium leads to ulceration, edema, and myofibrillar degenerative changes in the muscle mass.

Treatments for saprolegniasis

1. Malachite green: It is a respiratory poison. It Strongly binds with the internal cytoplasmic structures of parasites and interferes with normal metabolism. Malachite green at 1 % is swabbed directly on dermal lesions and fins to control secondary fungal infections. To treat Saprolegnia infection 1-2 mg/L bath treatment for 30-60 minutes and 0.1 mg/l for prolonged immersion treatment. (J. Mayer & M. Donnelly 2013). Controlled Saprolegnia infections on eggs with minimal mortality to used at concentrations between 3 and 5 mg/l for a 60 min exposure (Marking et al., 1994a,b.).

2. Formalin

For effective control of Saprolegniasis, 150– 300 mg formalin /l was used in rainbow and brown trout for a 60-minute bath treatment. (Cline and Post, 1972). Effective control of saprolegniasis outbreaks has been recorded for rainbow trout following a 60 min exposure at 250 mg/l (Bailey and Jeffrey, 1989). To Control saprolegniasis for infection on eggs, 1-2 ml/l formalin (37%

formaldehyde) up to 15-minute bath treatment and 0.23 ml/l up to 60-minute bath treatment. For the control of fungi of the family Saprolegniasis on all finfish eggs 1000 to 2000 µL/L for 15 minutes bath treatment. (Tayler and Francis 2019H2O2 are generally administered as a bath treatment.

3. Hydrogen peroxide: A commercial sanitizing agent containing 20% hydrogen peroxide and 5% peracetic acid has also been effective in decreasing oomycete infection on rainbow trout eggs, following treatment at 100 mg/l for 60 min (Marking et al., 1994a). Hydrogen peroxide at 50 and 75 mg/L for 60 minutes was administered every other day for three treatments for the control of mortality from Saprolegnia on walleye, rainbow trout, and channel catfishes. (NADA 2019).H2O2 control oomycete infections on adult Chinook salmon at 25 mg/l bath treatment. It controls mortality in freshwater-reared finfish eggs due to saprolegniasis through 50–100 mg/L of hydrogen peroxide. (Tayler and Ross, 1988).

4. Sodium chloride: Sodium chloride is applied as a bath/dip treatment. At 20 g/l, the salt mixture is effective for the control of Saprolegniasis on uneyed eggs fish. (Edgell et al.1993). A decrease in Saprolegniasis infection of trout eggs and an improved hatching rate using a NaCl bath at 30 g/l. For treating Saprolegniasis in small fry, a treatment dose of 0.5 % (5000 ppm) for 30 min or 1 % (10,000 ppm) for 6-10 minutes of bath treatment is recommended.

5. Copper Sulphate: 10-mg/L CuSO4 was sufficient to control fungus on eggs, whereas higher concentrations did not increase the effectiveness. (David l. Straus et. al.2009). CuSO4 (5-10 g in 100 lit water for 10-30min) is generally used to treat Saprolegniasis. (Subha Ganguli et.al. 2016). Provide dip treatment with Copper Sulphate @ 1g/liter water for 1 minute.

6. **Iodophores** Eggs are agitated gently in the disinfectant bath for 5–15 min and then rinsed thoroughly. Iodophores are commonly used in fish farming at concentrations of 100 mg/l of available iodine, for 15 min to 30 min. Iodophor baths are sometimes reused until the strong yellow color has faded, the iodophor becomes ineffective at 25 mg/l. (Ross and Smith, 1972).

7. Bronopol: It protects fish from infection by *S. parasitism* when it is administered in a daily bath/flush treatment at concentrations of 15 mg/l. (Pottinger and Day, 1999). Rainbow trout ova from *S. parasitic* could be treated as a daily bath/ flush treatment at concentrations of between 30 and 100 mg/l.

8. Chitosan: Chitosan (a deacetylated form of chitin), inhibits Saprolegniasis at 0.05 & 0.06% chitosan respectively. (Min et al. (1994)). The chitosan indicated mycostatic action against *S. parasitic* with no radial growth for 50 h at 20°C.

2. Epizootic ulcerative syndrome (Red spot disease)

Causative agent: *Aphanomyces invadans*, *Aphanomyces piscicida*

Species affected*:* FW fishes eg: snakehead, catfish, gourami, gobi

Clinical Sign: Large grey, or red, shallow ulcers often with a brown necrotic center are on the side of the body, and in a particular species all affected individuals may have lesions in the same place. Infection and necrotizing ulcerative lesions,

typically lead to granulomatosis and ulcerative mycosis. It causes complete erosion of the posterior body and necrotic destruction of the cranial bones of the brain. Tissue sloughs, leaving, a crater-shaped cavity that is surrounded by dark red to white colored muscle.

Treatments for EUS

1. Malachite green

It uses 0.5 mg/L malachite green (0.5 ppm) bath treatment for 1 hour. (J. Mayer & M. Donnelly 2013).

2. Copper

It uses 5 ppm/l copper (a chelated copper compound) use to treat EUS through bath treatment.(Leaño, E. M. (2001).Copper sulfate @ 100- 200g/100-liter water for bath treatment and Spray 1-2kg copper sulfate per hectare.

3.Lime: Apply slacked lime @ 400-600kg per hectare pond to treat EUS.(Avdhesh k et al 2021).

4. CIFAX: It is a highly effective and recommended formulation for the prevention and cure of EUS (Epizootic Ulcerative Syndrome). CIFAX maintains optimum pH, DO, Alkalinity, and Hardness of water. CIFAX treats the soil and improves nitrogen content. 1st dose is given 7 days before the stocking of CIFAX, and it should be applied in the culture pot at regular interval.2nd and 3rd doses 4th dose is given once every quarter from the first dose.

3. Branchiomycosis or gill rot disease

Causative agent:*Brahiomyces-sanguinis*,*Branchiyces-demigrans*

Species affected: Carp, goldfish, eels

Clinical Sign: The affected fish appear weak, lose their appetite, are lethargic, and can't tolerate handling with respiratory distress. The tissue is mottled in appearance due to areas of thrombosis and ischemia which cause alternating areas of dark and light regions in the tissues. *B.demigrans* affects the entire gill with hyphae and it enters blood vessels.*B.sanguinis* is restricted to gill blood vessels. Fish may appear lethargic and it gulping at the water's surface. Gills appear as striated or marbled representing infected and dying tissue.

Treatments for Branchiomycosis

1. $CuSO_4$: To treat Branchiomycosis in ponds and aquarium systems formalin and $CuSO_4$ solution are used and also ponds are treated with quicklime (calcium oxide) solution.

2. Benzalkonium chloride: It is an antiseptic and disinfectant. 1-4 ppm active ingredient of benzalkonium chloride used for 1 h bath treatment to treat Branchiomycosis.

3. Malachite green: 0.3 mg/L of malachite green for 24 h and 0.1 mg/L for prolonged immersion to treat Branchiomycosis.

3. Copper sulfate: 100 ppm of copper sulfate used for 10-30 min bath treatment to treat Branchiomycosis.

4. Sodium chloride: 3-5% through immersion treatment for Brachiomycosis.

4. Ichthyophoniasis (swinging disease)
Causative agent: *Ichthyophonus hover*

Species affected: Groupers, trouts, flounders, herrings, and cod

Clinical Sign: Ichthyophoniasis cause roughened skin surface described as the sandpaper effect. It principally occurs on the tail region and raised nodules in an internal organ. The sandpaper effect is due to the loss of epithelium over the proliferating fungal granulomata (ring nodules). Chronic inflammation contains Neurological signs (swinging disease). Heavily infected rainbow trout may demonstrate petechial hemorrhages on the skin and pigmented ulcers on the ventral surface.

Treatments for Ichthyophoniasis:
Fungicidal drugs, such as phenoxyethanol, could be partially effective against the early stages of infection of Ichthyophoniasis. (Van Duijn (1956). No fungus was reisolated from the organs of *O. niloticus* after treatment with *Azadirachta indica* and isolated from organs after treatment with Fucus vesiculas. (Nadia A. et.al. 2008). While increased salt levels, combined with good electrolyte and calcium levels in the water, are good treatment options for an *Ichthyophonus hover* infection. Another possible measure is raising the water temperature to 82 degrees Fahrenheit (consult a veterinarian first), as the *Ichthyophonus* fungi are more virulent in colder waters.

5. Larval Mycosis
Causative agent: *Lagenidium spp., Sirolpidium spp.,*
Species affected: *All Penaeus spp*

Clinical Sign: It causes sudden mortalities in the larval stages of shrimps and crabs. Crab eggs are also susceptible to mycotic infection. The commonly affected larval stages among shrimp species are the protozoal and mysis stages. Infected larvae become immobile and will settle to the bottom of the tank if aeration/circulation is interrupted. The presence of an excessive mycelial network is visible through the exoskeleton of moribund and dead larvae.

Treatments for Larval Mycosis
1. Trifluralin: A dosage of 0.2 to 1.0 ppm of treflan used to cure larval mycosis with no inhibitory effect on the hatching rate of eggs of *Penaeus monodon*. (I.S. Bright Singh et al 2005). Treflan at 0.01 ppm, 0.2 ppm is recommended to treat *Lagenidium* infections in shrimp.

2. Azole drugs: Econazole nitrate is an azole derivative most commonly use to treat larval mycosis. Residues up to 1 ppm level of Econazole nitrate show no inhibitory effect on the hatching rate of eggs of P. monodon and cure larval mycosis.

6. Black Gill disease: Fusarium Disease
Causative agent:*Fusarium solani*
Species affected: All Penaeus species

Clinical Sign: Appearance of "black spots" that preceded mortalities in juvenile shrimps grown in ponds. It starts on damaged tissues such as wounds, gills damaged from chemical treatments or pollutants, and lesions resulting from other disease processes. Once the infection is established, it is usually progressive with a 30% remission rate. Lesions may also serve as a route of entry for other opportunistic pathogens.

Preventive measures: Elimination of sources of Fusarium conidiophores and destruction of infected individuals. Avoid heavy metal discharges from nearby factories from getting into the rearing facilities to prevent black gill disease. Remove black soil by scraping after each harvest and by draining pond water from the bottom during the culture period for prevention.

Treatments for Black gill disease of shrimp:

1. **B.G CURE (Black Gill Disease Protector)** is a power antifungal & anti-protozoal agent formulated using potassium iodide, iodine, and acriflavine as active compounds. Used by mixing with sand and spreading evenly throughout the pond. **B.G CURE** can treat broken antennae, body wounds, gill infections, and tail rot conditions. It is known to be highly effective in nature and assures better results with low amounts.

7. Aflatoxicosis: Red Disease

Causative agent: *Aspergillus flavus,Aspergillus sp*

Species affected: Penaeus monodon &All Penaeus species

Clinical Sign: Yellowish and eventually reddish discoloration on the shrimp body can be observed among pond-cultured shrimp juveniles also. Affected animals become lethargic with weak swimming activity near pond dikes. Soft shelling can also be observed. Necrosis in the tubule epithelium. The proximal portion of the tubules to peripheral tubule tips in the hepatopancreas can be observed.

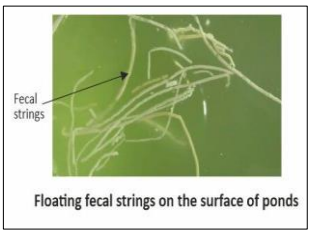
Preventive measures for AFLATOXICOSIS: Do not use moldy feeds. Feeds should be properly stored (for not more than 6 months) in dry and well-ventilated areas to prevent, or at least minimize the growth of fungal contaminants. Prepare the pond bottom properly. Reduce lime and organic matter content inputs.

8. EHP DISEASE OR WFS (White Faecal Syndrome)

Causative agent: *Enetrocytozoon hepatorenal*

Species affected: Penaeus monodon &All Penaeus species

Clinical Sign: It causes dark discoloration of the gills. Hepatopancreas and gut become white and pale in color. Floating white faces strings at the water's surface.Slow growth after EHP infection. Infected shrimps show loose shell.

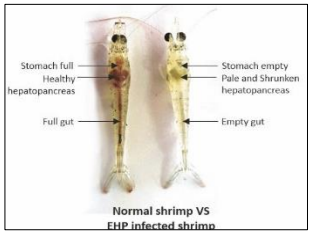


Floating fecal strings on the surface of ponds

Treatments protocols for EHP disease

Washed with 2.5% sodium hydroxide solution (25 gm NaOH/L freshwater) washed off after three hours of contact time to treat EHP diseases. This treatment should include all equipment, filters, reservoirs, and pipes. After washing to remove the NaOH, Then it should be rinsed down with

acidified chlorine (200 ppm chlorine solution at pH <4. 5.To disinfect earthen ponds of EHP spores, apply CaO at 6 ton/ha. Plow the CaO into the dry pond sediment (10-12 cm) and then moisten the sediment to activate the lime. Then leave for one week before drying or filling**.**



9. Beko disease (Microsporidian)
Causative agent: *Microsporidium seriolae*

Species affected: *Seriola dumerili*, *Seriola quinqueradiata*, Yellow tail, greater amberjack, and Yellowtail amberjack.
Clinical Sign: Infected fish have small cyst-like bodies (a few mm to 1 cm) in the muscles and show a concave body surface. The white 'cyst' exhibit a variable shape. After cyst degeneration, the neighboring muscle tissue shows colliquative necrosis. Depression in areas of degenerated muscle can be observed.

Treatments for Beko disease:
Lysozyme hydrochloride, a mixture of sulfa-metono-methoxine hydrate and olometoprim, monesin sodium salt was effective against *M.seriolae*. (Soetsu Yanagi et. al 2021).

10. Cotton Shrimp Disease (Milk or Cooked shrimp disease)
Causative agents: *Agmasoma-penaie* ,*Pleistophora*, *Thelohania*, *Perezia*, *Agmasoma* and *Ameson*
Species affected: shrimps, prawns, crabs and lobsters

Clinical Sign: Disease recognized by the progressive white opacity associated with the musculature. Heavy infection of the muscle tissues causes the muscle to become opaque and the shrimp appear cooked although they are still alive.

Treatments for Cotton shrimp disease
1. **Chlorine**: About 1500ppm chlorine is required to achieve >95% spore death for treating cooked shrimp disease.

Other Recommended Treatments for Microsporidian
1. **Lemon(*Citrus limon*)**

Mode of Action: acetic acid in lemons can destroy pathogen cell membranes, causing cell damage thereby inhibiting the growth of pathogens. In addition, the flavonoids and tannins in lemons inhibit the growth of Enterocytozoon hepatopanaei (EHP).

Doses and control Protocol:50 ml of lemon juice mixed with 1 kg of feed. Let dry for 30 minutes in low light before feeding.

2. **Garlic (*Allium sativum*)**

Mode of Action: active ingredients like alliin, allicin and allistain. Old garlic extract also has antibacterial and liver protective effects in shrimp.

Doses and Control protocol:20g of crushed garlic is mixed with 50 ml of food binder, then mixed with 1 kg of feed. Let dry for 30 minutes in low light before feeding.

3. **Ginger (*Zingiber officinale*)**

Mode of Action: phenolic compounds in ginger help reduce gastrointestinal (GI) stimulation caused by WFS, stimulate bile production, inhibit stomach contractions when food and fluids move through the intestinal tract in shrimp.

- Doses and Control Protocol:20g of crushed ginger is mixed with 50 ml of food binder, then mixed with 1 kg of feed. Let dry for 30 minutes in low light before feeding.

Reference

Fish Diseases and Disorders, Volume 3: Viral, Bacterial and Fungal Infections, 2nd Edition: Patrick T.K. Woo Department of Integrative Biology College of Biological Science University of Guelph, Ontario Canada and David W. Bruno Marine Scotland 375 Victoria Road PO Box 101 Aberdeen AB11 9DB Scotland.

Fish Pathology FOURTH EDITION Edited by Ronald J. Roberts BVMS, PhD (Glasgow),

Marking LL, Rach JJ, Schreier TM (1994). Evaluation of antifungal agents for fish culture. Prog. Fish-Cult. 56: 225e231. https://doi.org/10.1577/1548-8640(1994)056%3C0225:AFSEOA%3E2.3.CO;2

Marking LL, Rach JJ, Schreier TM 1994b. Evaluation of antifungal agents for fish culture. Prog Fish-Cult 56:225– 231. https://doi.org/10.1577/1548-8640(1994)056%3C0225:AFSEOA%3E2.3.CO;2

Taylor, N. I., & Ross, L. G. (1988). The use of hydrogen peroxide as a source of oxygen for the transportation of live fish. Aquaculture, 70(1-2), 183-192.

The book of Aquaculture Medicine and Aquatic Animal Health Management: I S Bright Singh, S Ranjit, R Preetha and Roseman Philip. National Centre for Aquatic Animal Health, Cochin University of Science and Technology, Kochi– 682 016, Kerala.

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THE TREASURE OF THE HIMALAYAS: EXPLORING HIMALAYAN HERBS

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Abstract
The majestic Himalayas are known for their peaceful environment, beauty, adventures, biodiversity and a wide range of medicinal and aromatic plants. The ancient medical systems, such as Ayurveda, Tibetan medicine, and traditional Himalayan medicine, have long recognized the curative potential of these herbs. Himalayan herbs have been used to treat various ailments, ranging from common colds to chronic diseases. Herbs like black turmeric, sarpgandha, ashwagandha, triphala, arjuna and brahmi have been extensively utilized in these traditional systems. However, the increasing global demand poses a challenge to their conservation and sustainable harvesting. Efforts are ongoing to promote responsible harvesting practices, cultivation initiatives, and the involvement of local communities in conservation efforts.

Keywords : Majestic Himalayas, Ayurveda, Himalayan herbs, Curative potential, Sustainable harvesting

Introduction

The Himalayan region has a diverse ecosystems, encompasses a staggering range of herbs, a treasure trove of medicinal and aromatic plants. It has a rich biodiversity and unique climatic conditions, making it a perfect habitat for a wide range of herbs with exceptional therapeutic properties. Each herb has adapted to the specific microclimates and soil conditions found in different parts of the Himalayas, resulting in a diverse range of species. The Himalayan region spreads across five countries, India, Bhutan, China, Nepal and Pakistan, all of which retained a strong traditional medicine system, for example, the well-known and increasingly popular Ayurveda (India) and Traditional Chinese Medicine (TCM) (China). These ancient healing systems based on sovereign herbs poses immense potential.

Medicinal Properties

The medicinal properties of Himalayan herbs are a result of their unique biochemical composition, which includes potent bioactive compounds such as alkaloids, flavonoids, essential oils, and polyphenols. These compounds are responsible for the therapeutic effects observed in these herbs, making them valuable resources in traditional as well as modern medical system. These herbs can cure from common colds, anxiety, digestive disorders, skin conditions to more complex issues like respiratory problems, diabetes, stress-related disorders, vision issues and immune system support. They are often prepared as powders, tablets, paste, teas, infusions, decoctions, or incorporated into oils, ointments, and capsules to harness their healing properties. In recent years, scientific interest in Himalayan herbs has grown, leading to extensive research on their

healing properties. Studies have focused on identifying and isolating the bioactive compounds present in these herbs, unveiling their potential therapeutic effects.

Key Himalayan Herbs

Ashtavarg: The rare Ashtavarg herbs are only found in the Uttarkashi region of Uttarakhand. In Ayurveda, it is believed that Ashtavarga is a combination of eight herbs that are known for vitality enhancing, reviving youthful condition, body nourishing, and antioxidant properties.

Sarpgandha (*Rauvolfia serpentia*): Sarpgandha(Figure 1.) is also known as black snakeroot or Indian snakeroot and devil pepper, It reduces blood pressure and has the ability to reduce heart rate and is also often used for treating diseases like Schizophrenia. With more than 50 different alkaloids, sarpgandha works as an anti-depressant and can help treat even snake bites.

Figure 1. - Sarpgandha (*Rauvolfia serpentia*)

Source – Nutrixia food*

Ashwagandha (*Withania somnifera*)**:** This herb helps the body manage stress, promote overall well-being, boosts the immune system, enhances vitality, supports cognitive function and helps improve memory and concentration.

Arjuna (*Terminalia arjuna*): This herb's bark decoction is being used in the Indian subcontinent for angina pain, hypertension and congestive heart failure. It Possesses antioxidant properties and helps reduce oxidative stress. Supports cardiovascular health and helps maintain healthy blood pressure levels.

Brahmi (*Bacopa monnieri*): Brahmi(Fig.2.) enhances cognitive functions like memory, learning, and concentration. Alleviates anxiety and stress-related disorders. Supports the nervous system and promotes overall mental well-being.

Figure 2. - Brahmi (*Bacopa monnieri*)

Source – Times of India*

Shyonaka (*Oroxylum indicum*): Commonly known as Sonapatha, This plant has long leaves with a long stalk and is known for antiseptic, astringent, anti-arthritic and anti-fungal properties. This plant is often used for treating non-healing ulcers, infantile, erythema, female disorders and dysentery.

Triphala: This herb is a combination of Amalaki, Bibhitaki, and Haritaki. It acts as a natural laxative and helps regulate bowel movements. Supports digestive health and aids in detoxification.

These are just a few examples of the major Himalayan herbs and their benefits. The Himalayan region is rich in diverse herbs, each with its own unique properties and uses in traditional medicine systems like Ayurveda.

Conservation and Sustainable Harvesting

The global demand for Himalayan herbs is increasing day by day and due to which conservation efforts have become vital to preserve the fragile ecosystems and ensure their sustainable use. Organizations and local communities are working together to promote responsible harvesting practices, cultivation initiatives, and the protection of endangered species like . Unregulated and excessive harvesting can deplete the natural populations of these valuable plants, leading to environmental degradation and loss of biodiversity. The integration of local communities in conservation efforts is crucial. Involving indigenous communities in sustainable herb harvesting not only ensures their livelihood but also encourages a sense of governance and promotes the preservation of traditional knowledge.

Conclusion

Himalayan herbs serve as a nature's invaluable gifts. The Himalayan region, with its abundant natural resources, offers a wealth of medicinal and aromatic herbs that have been revered for centuries and our responsibility is to protect them for generations to come. Himalayan herbs represent a remarkable natural resource with immense potential for medicine, wellness, and sustainable economic development. Organizations and local communities need to look after exploration, preservation, and responsible utilization of Himalayan herbs so that it’s sustainability is maintained and potential of himalayan herbs are retained. There is a need to maintain the delicate balance between human needs and biodiversity to harness the potential of Himalayan herbs and protect their natural habitats.

Reference

https://timesofindia.indiatimes.com

Heinrich M, Jiang H, Scotti F, Booker A, Walt H, Weckerle C, Maake C (2021). Medicinal plants from the Himalayan region for potential novel antimicrobial and anti-inflammatory skin treatments. Journal of Pharmacy and Pharmacology, 73(7):956–967.

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UTILIZATION OF SOLAR ENERGY IN AGRICULTURE

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Abstract

Solar energy is a renewable power source with vast potential to address global energy and environmental challenges. This article explores solar photovoltaic energy applications in agriculture for irrigation, greenhouse operation, farm electrification, Livestock operation, solar powered pest control, cold storage and rural transportation by solar rickshaw. The Solar thermal energy utilize for the drying of agricultural produce through the solar dryer, solar water heater, solar air heater through the collector and soil solarizations. The solar energy systems reducing greenhouse gas emissions that depends on fossil fuel. Solar energy minimizes costs and environmental impacts through its application in various operations. It also provides electricity to off-grid remotely not well connected rural areas for enabling development. Research in solar technology is vital for a sustainable future. Solar energy offers diverse benefits, reducing reliance on fossil fuels, combating climate change, and fostering a cleaner world.

Introduction

Global electricity generation has increased significantly over the past three decades from 12,000 terawatt-hours to 29,000 terawatt-hours from 1990 to 2022 (Anonymous, 2023). Of this amount, 41% is produced from coal, 22% from gas, 16% from hydropower, 11% from nuclear power, 4% from oil and a mere 6% from renewables (biomass as well as geothermal, wind and solar power), which remain marginal despite making progress (Anonymous, 2016a). China is the world's largest generator of electricity (24% of global output) followed by the United States (18.3%), India (5.1%), Russia (4.5%) and Japan (4.5%), then by Canada, Germany, Brazil, France and South Korea (Anonymous, 2016a). India and China in particular are forecast to step up their power generation by 261% and 177% respectively up to 2030 (Anonymous, 2016a).

Electricity is essential to residential and commercial sector, including farming and public services which, absorbs 56.2% of electricity output to power such things as home appliances, electronic devices, televisions, lighting, heating and air conditioning. Industry uses 42.3% to run electric motors, cool IT servers, and keep production lines running. Transportation currently consumes just 1.5% due to its heavy dependence on gasoline and diesel (Anonymous, 2016a).

Electricity generation is responsible for 42.5% of global CO_2 emissions (). Out of this, 73% can be attributed to coal-fired power plants, which emit 950 grams of CO_2 for every kilowatt-hour of electricity they generate as compared with 350 grams for gas-fired power plants (Anonymous, 2016a). Furthermore, if power plants that run on renewable energies, such as hydro, wind, solar PV and solar thermal, the only CO_2 emissions are attributable to their construction. Solar PV system emits CO_2 between 60 to 150 grams for every kilowatt-hour of electricity generation accordingly the solar panels were manufactured (Anonymous, 2016a). The wind turbine and

hydropower plant emits CO_2 between 3 to 22 grams and 4 grams respectively. The CO_2 emissions still only represent 6 grams per kilowatt-hour of electricity generated in nuclear power plants which is stark contrast with the 950 grams emitted by coal-fired power plants (Anonymous, 2016a). Electricity generated from renewable sources has a much smaller impact on the environment and is virtually inexhaustible that's why it is attracting new investment. In 2015, for the first time, investment in new renewables capacity, at $266 billion which was more than double the $130 billion invested in coal and gas fired based power plants (Anonymous, 2016b).

Solar thermal systems on the other hand, harness the sun's heat to generate thermal energy. These systems use solar collectors to absorb the sun's radiation and heat a fluid, typically water or a heat-transfer fluid. The heated fluid can then be used for space heating, water heating, or industrial processes and drying of agricultural produce. One of the key advantages of solar energy is its sustainability. Unlike fossil fuels, which are finite and contribute to environmental degradation, solar energy is a clean and renewable resource. The sun's energy is virtually limitless, making solar power an excellent long-term solution to reduce dependence on non-renewable energy sources. Following are the various way of solar energy application for the electricity generation.

Photovoltaic systems

It is commonly known as solar panels directly convert sunlight into electricity using semiconductor materials. When sunlight hits the solar cells electrons are released creating an electric current. Solar panels can be installed on rooftops, open land, or integrated into building materials and generating electricity for various applications. India is endowed with vast solar energy potential. About 5,000 trillion kWh per year energy is incident over India's land area with most parts receiving 4-7 kWh per sq. m per day (Anonymous, 2022). Solar photovoltaic also provides energy independence by reducing reliance on centralized power grids. It enables individuals, communities and even entire countries to generate their own electricity especially in remote areas where grid access is limited or costly. This decentralization of energy production contributes to energy security and resilience. Following are the various application of solar photovoltaic application in agriculture.

1. **Solar pump:** Solar-powered water pumps and irrigation systems are widely used in agriculture. Solar panels generate electricity, which can be used to power pumps that draw water from wells, rivers, or reservoirs, enabling efficient irrigation without the need for grid electricity or fossil fuels.
2. **Greenhouse operations:** Solar energy can be used to power ventilation systems, heating, cooling, and lighting in greenhouses. Solar panels installed on the greenhouse roofs or nearby can generate electricity to meet the energy demands of these operations, creating a more sustainable and cost-effective solution.
3. **Farm electrification:** Solar panels can be installed on farms to generate electricity for various purposes, such as lighting, powering electric fences, running machinery and equipment, charging batteries and operating small appliances. This helps farmers reduce their dependence on fossil fuel-based generators or grid electricity.
4. **Livestock operations:** Solar energy can be utilized in livestock farming by providing power for electric fences, water pumping, lighting in barns and stables, and ventilation systems. It offers a reliable and sustainable energy source in remote or off-grid areas.

5. **Solar-powered pest control:** Solar energy can be employed to power electronic pest repellent devices and fencing systems. These devices emit sounds or vibrations that deter pests that helping to protect crops and reduce the use of chemical pesticides.
6. **Cold storage:** Solar-powered refrigeration systems can be used for storing agricultural produce. These systems utilize solar energy to power the refrigeration units which extending the shelf life of perishable goods and reducing spoilage.
7. **Solar farm rickshaw**: It could be referred to a rickshaw that utilizes solar energy for its power source instead of relying solely on human power. The rickshaw could incorporate solar panels to generate electricity and assist in propelling the vehicle. By harnessing solar energy, the rickshaw could potentially reduce the physical effort required by the operator and provide a more sustainable mode of transportation. The solar panels could charge a battery or directly power an electric motor, aiding in the rickshaw's movement. This kind of rickshaw could be useful for the small scale agricultural rural transportation. It's very useful for dairy farm to delivered milk at collection unit and small agricultural input transportation like seed, fertilizer, cattle feed etc...

Solar thermal Energy

Solar thermal dry the agricultural produce, heat the water and air or other fluid. The drying is a sustainable and cost-effective method for dehydrating and preserving agricultural produce. It involves harnessing the sun's heat to remove moisture from crops, fruits, vegetables, grains, and herbs, thereby extending their shelf life. Following are the various instrument of solar energy in thermal application.

1. **Solar Dryers:** Solar dryers are designed to capture and utilize solar energy efficiently. They typically consist of a solar collector and air circulation system with drying chamber. The solar collector absorbs sunlight, heating the air, which is then circulated through the drying chamber where the produce is placed. The heated air evaporates the moisture from the crops, facilitating the drying process. The benefits of solar drying offers several advantages like reduce post-harvest losses by preventing spoilage and preserving the nutritional value of the produce.
2. **Solar water heater:** Solar water heating systems consist of solar collectors, storage tanks and a circulation system. The solar collectors absorb sunlight and transfer the heat to a fluid, typically water or a heat-transfer fluid. The heated fluid is then stored in insulated tanks for later use. Solar thermal systems can be used for both small-scale and large-scale water heating requirements in various agricultural operations like cleaning, sanitation and animal husbandry. Solar water heating system significantly reduces the reliance on fossil fuel-based water heating methods that reducing carbon emissions and environmental pollution. Solar thermal systems have a long life span and require minimal maintenance, resulting in cost savings over the system's lifetime. Moreover, in remote areas or off-grid locations, solar water heating eliminates the need for expensive and challenging grid connections or fuel deliveries.
3. **Solar collector:** A solar collector generates the heat by trapping of the solar radiation which utilizes heating purposes. It can refer to a device that heats the air, water or any other fluid using solar energy. Solar heaters can be used for space heating, water heating,

or even heating swimming pools. So, a solar heater can encompass various applications beyond just water heating.

4. **Soil solarization**: It is practical approach effective technique to control pests, pathogens and weed growth in agricultural and horticultural practices. This process involves heating and sterilizing the top layer of the soil by using solar radiation. The process involve to solararization is to prepared the bed and irrigated thoroughly to ensure the soil is moist and suitable for conducting heat. Excess vegetation and debris may also be removed to facilitate even heat distribution. Transparent or translucent plastic sheets are spread over the prepared soil surface, ensuring that they are tightly secured to create an airtight seal. The plastic covering trap solar radiation and creating greenhouse effect that rise in temperature. The high temperatures achieved during soil solarization help control various pests, such as nematodes, weeds, fungi, bacteria and certain soil-borne diseases. The heat damages or kills these organisms, reducing their populations and suppressing their negative impact on plant growth.

Summary

By leveraging solar energy for the generation of electricity, drying of agricultural produce and heating of water, air or any fluid, farmers can reduce energy costs, improve efficiency, and contribute to sustainable agricultural practices. Solar energy offer an environmentally friendly and alternative to conventional methods that helping to reduce carbon emissions and promote green energy in future for agriculture. However the performance of solar heaters depends on the availability of sunlight. Cloudy or rainy days can reduce their efficiency, although most systems are designed to provide hot water even in less sunny conditions. The main constraint is the higher initial installation cost for harnessing of solar energy system as compared to traditional methods, although long-term savings on energy bills can offset this investment.

Reference

Anonymous 2023 Global electricity production 1990-2022 in Statista Research Department. Available via DIALOG: https://www.statista.com/statistics/270281/electricity-generation-worldwide/

Anonymous (2016) Electricity Generation and Related CO_2 Emissions. Available via DIALOG: https://www.planete-energies.com/en/media/article/electricity-generation-and-related-co2-emissions

Anonymous (2022) Press information Bureau in India Union Budget 2022-2023: India Embarks on a Solar Journey. Available via DIALOG: https://static.pib.gov.in/WriteReadData/specificdocs/documents/2022/mar/doc20223321901.pdf

Anonymous (2016) Renewable Energy Investments: Major Milestones Reached, New World Record Set. Available via DIALOG: https://www.unep.org/news-and-stories/press-release/renewable-energy-investments-major-milestones-reached-new-world.

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ROLE OF AGRICULTURAL MARKETING INTELLIGENCE SYSTEM IN INDIA

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Market Intelligence

Market intelligence is a systematic procedure that furnishes insights into potential future market scenarios. This process relies on gathering data related to market trends and pricing, which serves as the foundation for deriving market intelligence. Market information and market intelligence are closely intertwined yet distinct concepts within the realm of business and market analysis.

Market information encompasses raw data, factual details, and statistical information about the market. This includes comprehensive insights on competitors, customers, suppliers, pricing, and market trends. It comprises objective and verifiable information that can be sourced from a variety of outlets such as market research reports, government publications, industry databases, and financial statements. Market information serves as the fundamental groundwork, providing businesses with a comprehensive understanding of the current market landscape.

In contrast, market intelligence represents a more sophisticated level of analysis and interpretation applied to market information, yielding valuable insights and actionable intelligence. It involves a systematic process of scrutinizing and analyzing market information to acquire a profound comprehension of market dynamics, emerging trends, customer preferences, competitor strategies, and potential opportunities or threats. Market intelligence necessitates the application of analytical techniques, strategic thinking, and business acumen, enabling businesses to make informed decisions and formulate effective strategies.

Agriculture Market Intelligence

Agricultural market intelligence is the process of gathering and analyzing information about the agricultural market. It involves collecting data on factors like crop production, prices, market trends, consumer demand, trade, and government policies. The purpose is to gain insights

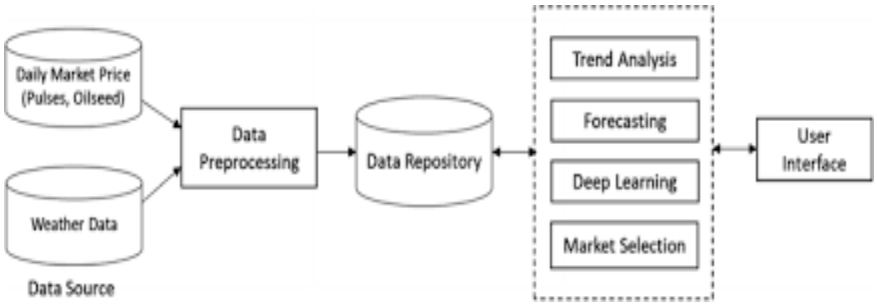

Fig: Schematic representation of agriculture market intelligence in India
Source: Srivastava *et al* (2019)

and understanding of the market, so that farmers, businesses, and policymakers can make informed decisions and develop strategies. It helps them identify market opportunities, reduce risks, improve production and marketing, and stay competitive in the agricultural sector.

Component of Agriculture Market Intelligence in India

In the realm of agricultural market intelligence in India, there are several pivotal components that play a critical role in providing profound insights and comprehensive understanding of the agricultural market. These essential components encompass:

- **Crop Production and Yield Data:** Accurate and up-to-date information on crop production and yield is indispensable for comprehending the overall supply and availability of agricultural commodities. Such data aids in discerning production patterns, facilitating crop output predictions, and evaluating market conditions.
- **Price Data:** In-depth knowledge of market dynamics, price trends, and fluctuations in agricultural commodity prices is contingent upon access to relevant price information. This encompasses data on wholesale and retail prices, price indices, and price spreads across various markets and regions.
- **Market Arrival Data:** To gauge supply chain efficiency, assess crop maturity, and identify market demand patterns, granular insights into the quantity and timing of agricultural commodities reaching different markets are indispensable. Market arrival data enables a comprehensive understanding of these factors.
- **Trade Data:** The international market scenario, trade policies, and the competitiveness of Indian agricultural products in the global market can be ascertained through the examination of trade data. This includes information on imports and exports of agricultural commodities.
- **Consumer Demand Analysis:** A profound understanding of consumer preferences and demand patterns is pivotal for effective agricultural market intelligence. Conducting surveys, studies, and market research assists in analyzing consumer behavior, preferences, and consumption trends, facilitating informed decision-making and strategic product planning.
- **Market Surveys and Reports:** Market surveys, reports, and studies conducted by government agencies, research institutions, and private organizations furnish invaluable insights into market trends, consumer behavior, production forecasts, and market competitiveness.

Advantages of Agriculture Market Intelligence

Agricultural market intelligence provides various benefits for stakeholders in the agricultural sector. Some key advantages include:

- **Informed Decision-making:** Agricultural market intelligence equips stakeholders with accurate and up-to-date information, enabling them to make well-informed decisions. It helps them identify market trends, understand consumer preferences, and assess potential risks and opportunities.
- **Market Opportunities:** Agricultural market intelligence aids in identifying and seizing market opportunities. It offers insights into emerging and niche markets, as well as evolving consumer demands, allowing stakeholders to develop targeted strategies and products that meet market needs.

- **Risk Management:** Understanding market dynamics and trends helps in mitigating risks. By staying informed about factors like price fluctuations, supply and demand imbalances, and weather patterns, stakeholders can proactively adjust their production, pricing, and marketing strategies to minimize risks and potential losses.
- **Enhanced Efficiency:** Agricultural market intelligence facilitates improved efficiency in production and marketing activities. With a clear understanding of market demand, farmers can plan their crop selection and production volume accordingly. Agribusinesses can optimize their supply chains, distribution networks, and marketing efforts based on market insights, reducing inefficiencies and enhancing profitability.
- **Competitive Edge:** Market intelligence provides a competitive edge by enabling stakeholders to stay ahead of the competition. It helps in understanding competitor strategies, market positioning, and consumer preferences, enabling businesses to differentiate themselves and offer unique value propositions to customers.
- **Targeted Marketing and Product Development:** Market intelligence allows for targeted marketing and product development. By understanding consumer preferences, trends, and needs, stakeholders can tailor their marketing messages, packaging, branding, and product features to better resonate with the target audience, leading to increased customer satisfaction and loyalty.
- **Policy Formulation:** Agricultural market intelligence assists policymakers in formulating effective agricultural policies. By analyzing market trends, supply and demand dynamics, and trade patterns, policymakers can design policies that support sustainable agricultural development, promote fair market competition, and ensure food security.\

Methods for Agricultural Market Intelligence

Agricultural market intelligence utilizes various methodologies to gather and analyze information. Here are some commonly used methods:

- **Surveys and Questionnaires:** Surveys and questionnaires are employed to collect primary data directly from farmers, consumers, traders, and other stakeholders. They cover aspects like crop production, market preferences, purchasing behavior, and satisfaction levels.
- **Data Collection and Analysis:** Gathering information from diverse sources such as government reports, trade publications, industry databases, and research studies, followed by statistical analysis, helps identify trends, patterns, and insights concerning the agricultural market.
- **Market Research:** In-depth studies are conducted to obtain information about market dynamics, consumer behavior, and competitor analysis. Market research may involve qualitative and quantitative research methods like focus groups, interviews, observations, and data analysis.
- **Price Monitoring:** Price data for agricultural commodities across various markets and regions is tracked and analyzed to comprehend price trends, fluctuations, and seasonal patterns, which are crucial for market intelligence.
- **Remote Sensing and Satellite Imagery:** Remote sensing and satellite imagery are utilized to assess crop conditions, vegetation health, and land use patterns. These technologies provide valuable insights into crop production, yield estimates, and potential risks such as drought or pest infestation.

- **Trade Data Analysis:** Analyzing import and export statistics helps understand international market trends, identify trade opportunities, and assess the competitiveness of agricultural products.
- **Expert Interviews and Expert Panels**: Experts in the agricultural industry, such as agronomists, economists, and market analysts, are interviewed or consulted to gather insights and validate findings. Expert panels are convened to discuss and analyze specific market trends or issues.
- **Forecasting and Modeling:** Forecasting and modeling techniques are employed to predict future market trends and conditions based on historical data, market dynamics, and relevant factors. This helps make projections and conduct scenario analysis for strategic planning.

Status of Agriculture Market Intelligence in India

Based on the recommendations of the Agricultural Prices Enquiry Committee in 1954, the Directorate of Economics and Statistics, Ministry of Agriculture (DESMOA), established 14 Market Intelligence Units (MIU) in the capitals of Andhra Pradesh, Assam, Bihar, Delhi, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal. The primary purpose of these MIUs is to support DESMOA in formulating, implementing, and evaluating agricultural price policies related to procurement, marketing, storage, transportation, import-export, and credit. The MIUs provide regular reports on various aspects such as market arrivals, off-takes, stocks, crop prospects, and market price outlook. Additionally, they offer their assessment of kharif and rabi crop production at regular intervals, which aids in the preparation of crop forecasts. The information provided by these units helps DESMOA make informed decisions and policies regarding agriculture and its associated activities**.**

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PROTEOMICS: TAKING OVER WHERE GENOMICS SIGNS OFF

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Abstract

The field of proteomics applies a number of methods for identifying and measuring the total protein composition of a cell, tissue, or organism. It is a supplement to other "omics" technologies like genomics and transcriptomics that explain the identities of an organism's proteins and help us understand the structure and purpose of a certain protein. Proteomics-based technologies are used in a variety of ways for various research settings, including the identification of various diagnostic markers, the development of vaccine candidates, the comprehension of pathogenicity mechanisms, the alteration of expression patterns in response to various signals, and the interpretation of functional protein pathways in various diseases. Proteomics involves analysing and categorising the entire protein signatures of a genome so it is essentially complex. In the contemporary era of proteomics, mass spectrometry with LC-MS and MALDI-TOF/TOF are widely utilised technologies. Due to intricate regulatory systems that regulate the level of protein expression, the proteome technology is also quite dynamic.

Introduction

A paradigm change in crop improvement strategies has been brought about by the recent addition of novel molecular technologies to the established plant breeding techniques. Because proteomics can offer fresh perspectives at the cellular level, it is a relatively new technology that is increasingly becoming indispensable for the next generation of plant breeders. The word "Proteome"—the equivalent of genomes for proteins—has sparked the interest of biomolecular scientists all around the world. While the proteins of any given cell change substantially when genes are turned on and off in response to the environment, the genome of that cell largely remains unaltered. Some researchers refer to the entire collection of proteins made by a cell as the "functional proteome" while maintaining the idea of the proteome's dynamic nature.

Shift towards proteomics

Genomics had given wide knowledge about structure and function if the genome but it does not predict Post translational modification (PTM) that proteins undergo. After synthesis on ribosomes, most of the proteins undergoes chemical modifications such as phosphorylation, methylation, acetylation, palmitoylation, sulfation and so on which are very static as well as dynamic in nature. As a result, single gene can encode as many as 50 different protein species. Genomics often does not provide accurate abundance, structure and activity as well as DNA/RNA analysis cannot predict the amount of the gene product including the type and amount of PTM. Specific advantage of proteomics over all other -omics methods in crop breeding advancement is itsability to consider post translational modifications that reflect the functional impressions of protein modifications on crop plant productivity.

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Classification of proteomics (Depending on level of complexity)

Structural Proteomics: Every protein in a protein complex is identified and every protein-protein interaction is characterized in structural proteomics. Purifying and isolating a single protein complex can simplify proteomic analysis.

Functional Proteomics: It mostly entails isolating protein complexes or isolating particular kinds of proteins using protein ligands. It enables the examination of certain protein subgroups' properties, which can provide vital details regarding protein signalling, disease mechanisms, and other topics.

Expression proteomics: Analysis of protein expression at a greater scale is a component of expression proteomics. It aids in the identification of key proteins in a given sample as well as proteins that exhibit differential expression in samples that are related, such as diseased versus healthy tissue.

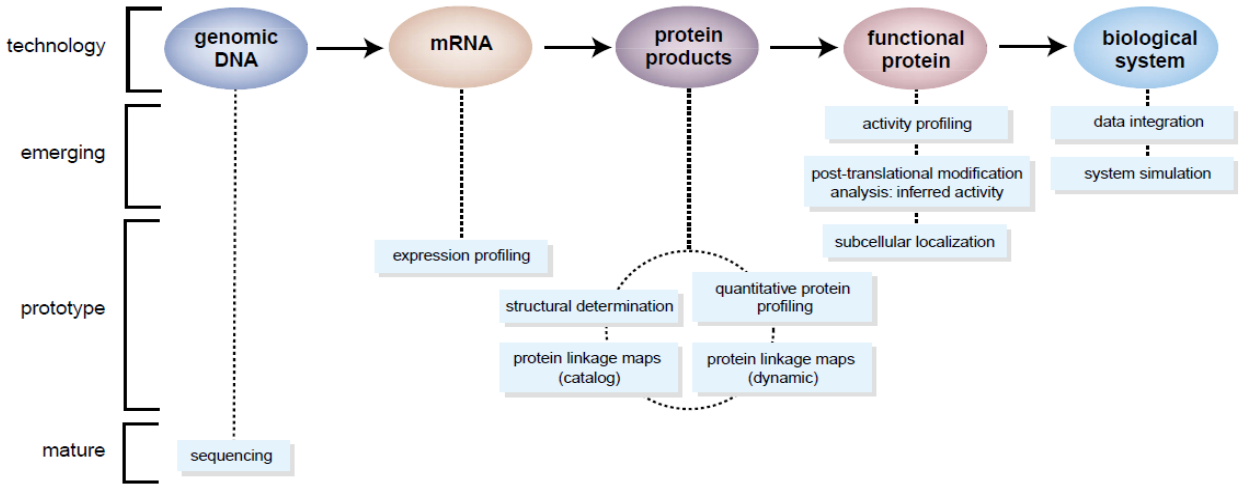

Fig-1: Current status of proteomics technologies

Proteomics technologies

Two-dimensional polyacrylamide gel electrophoresis (2-D PAGE): Proteins are divided in this structure with charge (isoelectric point) along the first dimension, known as the stacking gel, and by weight in the second dimension, known as the resolving gel, in the direction that is upwards. The protein can be seen with stains including Ruby, coomasie blue, SYPRO, deep purple and silver.

Liquid chromatography: Protease processing is accompanied by LC-MS and polypeptide mass identification from the bottom up LC/MS approach to generate single peptide.

Isotope-coded affinity tag labelling: The ICAT reagent consists of a tag with affinity such as biotin and a peptide responsive component (sulfhydryl-specific reactivity). Proteins are combined and then broken down by enzymes after the sensitive protein units have first been tagged individually with either a mild or a strong chemical. By using LC-MS/MS, the tagged peptides are collected, measured and finally characterised.

MALDI (Matrix lesser desorption ionization): The specimen is dropped on a test plate through the source, that is kept in vacuum, and then encased in a structure which encourages ionisation.

When a beam of light is aimed at the specimen that is co-crystallized within the matrix, this causes the analyte to desorb via the plate containing the sample as well as cause its ionisation.

Mass spectrometry: Charged analytes, such as peptides, can be accurately measured in terms of mass. It features an ionisation device and a mass detector and examines the mass/charge of charged ions in a vacuum.

Mass analyzer: Measures the mass/charge of molecules that are charged in a mass spectrometer. Time of flight (TOF), Ion trap and quadrupole detectors are employed in this situation.

Yeast two-hybrid system: Protein to protein association is studied in vivo using this technique. The yeast cell expresses two different kinds of proteins, including A protein called Bait is linked to a DNA binding area, while a protein called Prey attaches to a transcription activator's activating site. A standard colour response indicating transactivation of a reporter gene may be utilised to identify the transcription of its reporter gene, which is generated as a result of the contact that occurs between prey and bait.

Application: Drug development, Fractionating and visualizing large numbers of proteins from cells, Build databases of proteins expressed from certain cell or tissue types, Determining function of proteins, Studying complex protein interactions, Evaluation of the dynamics of protein networks, Monitoring protein interactions within living cells, Developing automated protein chip assays to evaluate thousands of proteins together, Integrate genomic and proteomic data to investigate complex biological processes, Provide tools to directly understand gene functions.

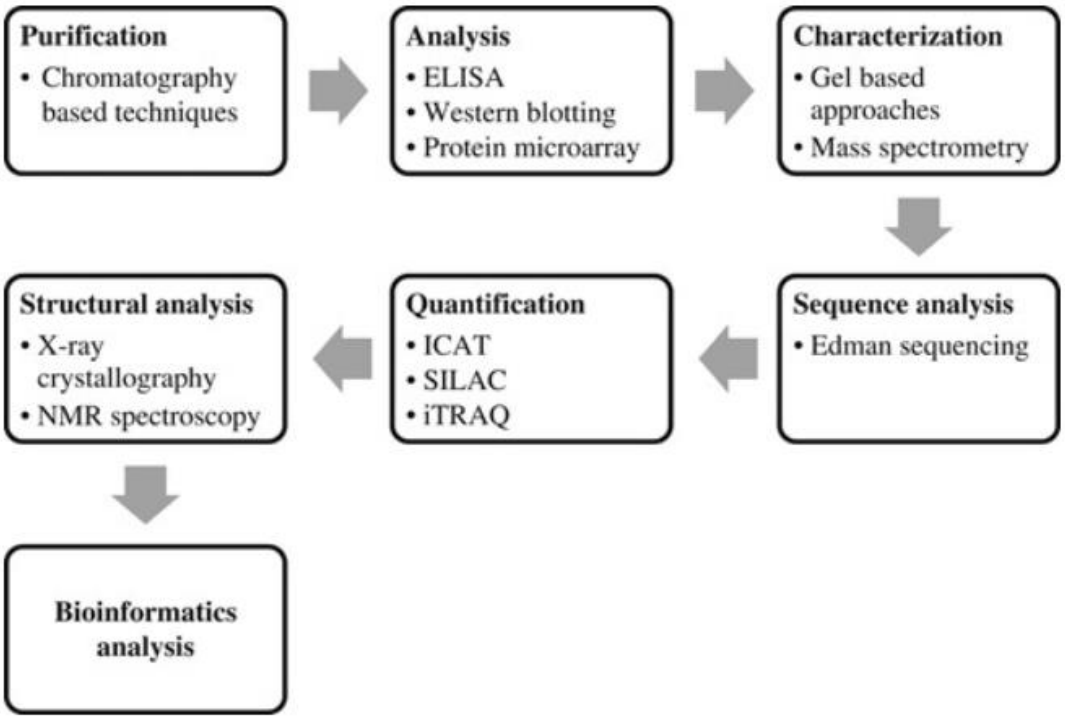

Fig 2: Application of proteomics

Conclusion

These techniques are rapid and delicate, and they span a wider section of the proteome. In addition, the combination of these methods has proved effective in the cleansing, evaluation,

analysis, measurement, structural and sequence examination, and bioinformatics evaluation of many proteins in diverse bacterial and eukaryotic cell types. A broad spectrum of innovative methods are now part of the rapidly growing field of proteomics, which aims to provide the molecular data necessary for a complete understanding of biological mechanisms.

References

Langride, P. and Fleury, D. (2011). Making the most of omics for crop breeding. Trends biotechnol., 29(1): 33-40.

Samaj, J. and Thelen, J. (2007). Plant Proteomics. Springer.

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PRUNING AND ITS IMPORTANCE IN HORTICULTURAL CROPS

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Introduction

Pruning is an essential cultural practice in horticulture that involves selectively removing certain parts of a plant, such as branches, shoots, or buds. It is a technique that has been employed for centuries to enhance the growth, productivity, and overall health of horticultural crops. Pruning plays a crucial role in shaping the plant's structure, improving air circulation and light penetration, controlling disease and pest infestations, and maximizing fruit or flower production. Many fruit crops undergo summer pruning to encourage large diameter fruiting wood in the bottom and interior of the tree, which increases both the quantity and quality of flower buds (large diameter fruiting shoots encourage robust flower buds and larger fruit size) (Sherman and Backman, 2002).

Importance

- **Structural Enhancement:** Pruning helps establish a desired framework or shape for horticultural crops. By removing unwanted or poorly positioned branches, it enables the plant to develop a sturdy and well-balanced structure. Proper shaping through pruning promotes an open canopy, allowing sunlight to reach all parts of the plant, leading to uniform growth and better fruit or flower development.
- **Improved Air Circulation:** Overgrown or crowded branches can restrict air movement within the plant canopy, creating a favourable environment for the growth of pathogens. Pruning helps improve air circulation by reducing plant density and opening up the canopy. This increased airflow reduces humidity levels, minimizes the risk of fungal diseases, and enhances overall plant health.
- **Enhanced Light Penetration:** Photosynthesis, the process through which plants transform light energy into chemical energy, depends on sunlight. Pruning facilitates better light penetration into the lower parts of the plant, ensuring that all leaves receive an adequate amount of sunlight. This not only boosts photosynthesis but also promotes the production of sugars and other essential compounds, leading to healthier and more productive plants.
- **Disease and Pest Management:** Pruning plays a significant role in disease and pest management. Removing infected or infested plant parts helps control the spread of diseases and eliminates hiding places for pests. Pruning also allows for better visibility, making it easier to detect and address any pest or disease issues promptly. Additionally, proper pruning techniques, such as pruning at the right time and using sterilized tools, minimize the risk of introducing infections to healthy plant tissues.
- **Increased Fruit and Flower Production:** Pruning can stimulate the production of fruits or flowers in horticultural crops. By removing excessive vegetative growth, the plant's energy is

redirected towards reproductive structures. Pruning also encourages the development of lateral buds, which can lead to a higher number of flower clusters or fruiting sites. Furthermore, removing weak or damaged branches prevents the plant from wasting energy on non-productive parts, resulting in more abundant and higher-quality yields.

Types of pruning

- **Thinning:** Thinning involves selectively removing a portion of branches or shoots to reduce plant density. This allows more light penetration and airflow within the plant canopy, promoting better fruit development, disease prevention and overall plant health. Fruit thinning is necessary for many horticultural crops, including grapes, apples, peaches, pears, pomegranates, citrus fruits and cherries (Wei *et al.*, 2021).
- **Heading back:** The term "heading back" describes the removal of a branch or shoot's tip. It is done to control the size and shape of the plant, encourage branching and lateral growth, and promote the development of a denser foliage. Examples: azaleas, roses, phalsa, ber and apple.
- **Topping:** Topping involves the removal of the upper portion of the plant, usually the main stem or branches. This technique is often used to control the height of trees, manage their overall size, and prevent interference with utility lines. Topping is commonly used in a variety of plant species, including fruit trees such as apple and citrus, as well as ornamental trees and shrubs such as magnolias and crape myrtles.
- **Training:** Training pruning is performed to guide the growth of the plant in a desired direction or form. It involves selectively pruning branches to create a specific shape, such as espalier or topiary forms, or to train vines along a support system, like a trellis.
- **Renewal pruning:** Renewal pruning is done to rejuvenate older plants and stimulate new growth. It involves removing older, unproductive wood to encourage the development of fresh, vigorous shoots.
- **Canopy lifting:** Canopy lifting refers to the removal of lower branches of a tree or shrub to raise the height of the foliage canopy. This technique is commonly used to create clearance for pedestrians, vehicles, or improve visibility.
- **Crown thinning:** Crown thinning involves selectively removing inner branches within the canopy of a tree. It aims to reduce the density of the foliage while maintaining the overall shape of the tree. Crown thinning improves light penetration, airflow, and reduces the risk of wind damage.
- **Deadheading:** Deadheading is the removal of spent flowers or seed heads. This pruning technique promotes continuous blooming in flowering plants, redirects energy towards new growth and encourages the development of more flowers.

These are some of the primary pruning techniques used in horticulture. The specific pruning methods employed may vary depending on the type of crop, growth habit, and desired outcomes for the plant.

Conclusion

Pruning is a vital practice in horticultural crop management, offering numerous benefits for plant health, productivity, and aesthetics. It promotes structural enhancement, improves air circulation, enhances light penetration, aids in disease and pest management, and increases fruit or flower production. However, it is important to note that different horticultural crops may require specific

pruning techniques and timing, so it is crucial to consult horticultural guides or seek professional advice when undertaking pruning activities. With proper knowledge and implementation, pruning can be a powerful tool to optimize the growth and yield potential of horticultural crops.

References

Sherman, W. B. and Beckman, T. G. (2002). Climatic adaptation in fruit crops. In *XXVI International Horticultural Congress: Genetics and Breeding of Tree Fruits and Nuts 622* (pp. 411-428).

Wei, M., Wang, H., Ma, T., Ge, Q., Fang, Y. and Sun, X. (2021). Comprehensive utilization of thinned unripe fruits from horticultural crops. *Foods*, *10*(9), 2043.

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FERMENTED FISH AMINO ACID: AN OVERVIEW

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Introduction

Nitrogen is one of the most essential nutrients for plant growth. A plant cannot complete its growth without nitrogen, and any other nutrient cannot replace it. It is directly involved in plant metabolism. Compared to inorganic-based sources, nitrogen-based sources in organic cultivation contain negligible nitrogen levels. For example, farmyard manure contains 0.5% nitrogen, while urea contains 46% nitrogen. However, a few concentrated organic fertilisers exist, such as Fish Amino Acid (FAA). It is derived from fish's bones, cranium, internal organs, epidermis, and crude sugar. A plant-required nutrient is combined with one or more amino acids to create a new molecule readily accepted by plants and delivers the nutrient efficiently. It traverses chemical and physical barriers in plants with excellent efficiency. It is used to increase crop production in most tropical regions, including Indonesia, Thailand, India, Laos, and other Asian regions, as well as in some agricultural institutions in the northern Philippines.

Nutrient present in FAA

Amino Acid Profile: Theonine, Aspartic Acid, Serine, Proline, Glutamic Acid, Glycerine, Alanine, Cystine, Valine, Methionine, Isoleucine, Tyrosine, Phenylalanine, Lysine, Histidine, Arginine, Hydroxyproline.

Elements: Nitrogen, Phosphorous, Potassium, Calcium, Sulfur, Magnesium, Iron, Manganese, Copper, Zinc, Boron, Molybdenum, Cadmium.

Fish Amino Nutrients: Fish Hydrolysate Processed Form Whole Fish – Natural

Method of Preparation

Fish pieces or wastes and jaggery are the two main ingredients mixed with a ratio of 1:1. This fertiliser derived from low-cost fish is used as a component (Fig.1). The equal amount of jaggery and fish pieces should be taken for the preparation. Chop the fish or waste into small pieces and later the jaggery and fish evenly in an air-tight plastic drum; add two well-ripped bananas for faster and better decomposition. Keep it out of direct sunlight for 25-30 days. After 30 days, the extract is filtered with a nylon cloth. This nutrient solution is used to be sufficient to improve plant growth. This solution can be used as fertiliser for up to 6 months. Bury the remaining residues under the plants like spinach, eggplant, tomatoes etc., and store them in room temperature. Avoid direct sunlight. A cool place is preferable.

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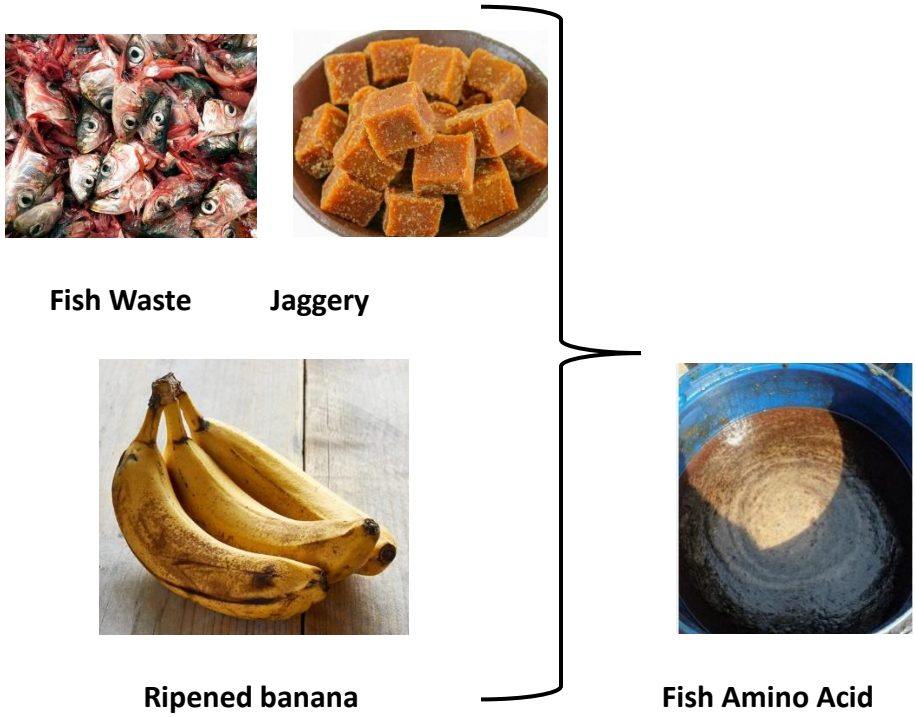

Fig. 1. Ingredients to prepare Fish Amino Acid

Fermented Fish Amino Acid Recommendation in Agricultural Crops

Use 1 litre of Fish Amino Nutrients in 500 Litres of Water. Drip Irrigation Use 1 litre Fish Amino Acid To 1000 litres of water. Foliar spray at 1.0 % to cereals and pulses increases the plant height, and crop growth rate (Priyanka *et al*., 2019). The 12 tablespoons of Fermented Fish Amino Acid for 5 gallons of water per plot was recommended for corn production. (Edwin *et al*., 2020). Do not apply FFAA if plants are at the reproductive stages of their production cycle when flowering or fruiting is desired. Avoid spray applications during total sunlight hours to prevent foliar burning and evaporation of the solution before the plant can absorb it.

Application Equipment

Fish Amino Acids fertiliser is compatible with conventional domestic garden and agricultural spraying equipment, such as hand sprayers, watering cans, hose-on applicators, backpacks, booms, air blasts, fertigation, and drip systems. It can be dispersed unadulterated by air. Eliminate extremely fine filters to maximise flow rate.

Foliar and soil application

FFAA is a liquid concentrate diluted with water and then applied to the plant's roots and other vegetative sections. The Fish Amino Acids fertiliser can be applied foliar during plant maturation's early to late stages. Trace elements, minerals, and complex organic compounds are rapidly transported from the leaf surface to the plant's roots. Foliar absorption is instantaneous. Increased brix (sugar/mineral) levels can be measured within 20 minutes. Residues left on the leaf surface help suppress insect and fungal attacks by fostering fungal bacteria and reducing insect leaf palatability - most insect pests dislike plants with higher brix levels. Fish Amino Acids fertiliser can be used as a soil drench to stimulate rapid microbial and earthworm activity, especially in areas where chemical use has reduced soil biological activity. Following application, root carbohydrates

are released as energy for plant growth and fruit/tuberous root production. These carbohydrates stimulate beneficial microbial activity around root hairs in the soil. These microorganisms proliferate and immediately initiate the release of the soil's stored nutrients. Fish Amino Acids fertiliser should be applied in the early morning, late afternoon, evening or under moderate, moist conditions. When used as a foliar, spray the foliage, stems, leaf undersides, and soil.

Conclusion

FFAA is categorised as an organic and non-chemical fertiliser that is safe for crop and human consumption. In order to maximise the yield potential of plants, it is necessary to apply the correct quantity of concentration at the appropriate time.

References

Edwin M P, Nurshima J, Alsadam I P, Abdul M and Kennedy S (2020). The influence of different rates of Fermented Fish Amino Acid (FFAA) on the yield of sweet corn under the Nalil soil and climatic condition. Asian Journal of Agriculture and Allied Sciences, 2 (1): 31-38.

Priyanka B, Anoob D, Gowsika M, Kavin A, Kaviya Sri S, Krishna Kumar R.V, Sangeetha Gomathi R, Sivamonica B, Vimala Devi G and Theradimani M (2019). Effect of fish amino acid and egg amino acid as foliar application to increase the growth and yield of green gram The Pharma Innovation Journal, 8(6): 684-686.

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ENHANCING FRUITS AND VEGETABLE CULTIVATION WITH ROW COVER PROTECTION

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Abstract

The application of row cover in vegetable and fruit cultivation has gained significant attention due to its numerous benefits for growers. Row covers, which are typically made of fabric or plastic materials, offer a range of advantages in crop production. They provide protection against adverse weather conditions such as frost, hail, and wind, helping to extend the growing season and enhance crop quality. Row covers also act as a physical barrier, preventing insect pests from infesting the plants and reducing the reliance on chemical pesticides. Furthermore, row covers create a microclimate that promotes optimal growth by regulating temperature, humidity, and light transmission. This article explores the utilization of row covers in vegetable and fruit cultivation, highlighting their role in increasing yield, improving crop health and contributing to sustainable farming practices. The various types of row covers and their specific applications are discussed, along with considerations such as cost, labour and environmental impact. By exploring the versatile approach of using row covers in fruits and vegetable cultivation, it is possible to minimize the risks of failure while optimizing the utilization of natural resources and maximizing productivity.

Introduction

The Indian economy continues to receive significant support from its most crucial commercial fiber crop (Prajapati and Subbaiah, 2018). In arid and semi-arid regions, irrigated agriculture stands as the largest consumer of water (Parmar *et al*., 2023, *Kunapara et al.,* 2016). To achieve manifold growth in fruit and vegetable production, protected cultivation has become essential (Sojitra *et al*., 2023). By employing a variety of techniques to modify the natural environment, protected agriculture enhances plant growth, including protection against frost and the extension of the growing season. The implementation of row covers has proven highly advantageous for commercial growers aiming to extend their crop's growing season. These flexible covers, ranging from transparent to semi-transparent materials, create a beneficial microclimate for plants by increasing air and soil temperatures while mitigating wind damage (Hochmuth *et al*., 2000; Arancibia and Motsenbocker, 2008; Gordon *et al*., 2008). Such practices enable earlier crop production, allowing farmers to seize opportunities in early markets and potentially obtain higher prices (Jensen and Malter, 1995). Furthermore, remote sensing and GIS play a pivotal role in agriculture by providing valuable temperature estimation data (Parmar *et al*., 2019). This technology has become extensively employed, enabling precise monitoring and analysis of temperature-related factors crucial for agricultural planning and decision-making.

The escalating impact of global warming is projected to heighten evaporation rates, resulting in drier ground conditions and a gradual build-up of water vapor in the atmosphere (Pandya and Gontia 2023). As temperatures rise, this evaporation process intensifies, leading to significant moisture loss from terrestrial surfaces, causing shifts in local and regional climate patterns and posing challenges to water resources and ecosystems. Understanding and addressing the implications of this evolving evaporation phenomenon are paramount for implementing sustainable water management and climate adaptation strategies. Row covers, whether made of fabric or plastic, play a multifaceted role in agricultural practices. They expedite crop maturity, protect against frost and hail, and act as barriers against certain insect pests. Traditionally, lightweight floating row covers made of spun fibres like polyester or polypropylene were used, but now commercial options with poly non-woven material in different thicknesses are available. These covers can either be loosely draped over the plants or suspended with wire supports. While they effectively shield low-growing vine crops and upright plants such as tomatoes and peppers, they may cause damage in windy conditions and, if in direct contact with leaves, can lead to frost damage. Nonetheless, the air temperature beneath the floating row cover remains consistently higher during the day compared to the outside air temperature (Arancibia and Motsenbocker, 2008). Plastic mulch has been shown to modify soil microclimatic parameters, promoting the growth of field crops like summer groundnut (Satasiya *et al*., 2022). Interestingly, many researchers have reported the successful combination of row covers and plastic mulches in enhancing the cultivation of a diverse range of crops, including watermelon, muskmelon, beans, tomatoes, peppers, cucumbers, squash, pumpkins, lettuce, as well as brassica crops like cabbage, broccoli, cauliflower, and tuber crops like potatoes, sweet potatoes, and carrots. Extensive research indicates that the utilization of row covers in conjunction with plastic mulches results in earlier crop maturity and higher yields compared to crops grown without covers on bare ground (Brown *et al*., 1998; Ibarra-Jiménez, 2004). This combination has emerged as a valuable technique for maximizing crop productivity and protecting plants from adverse environmental conditions. The laying out row cover was carried out as mention in following manner.

Laying of raw cover

Advantages of raw cover on fruits and vegetable cultivation:
The advantage of row cover on fruits and vegetable cultivation are given in brief following manner.

Frost protection: Frost protection is a crucial benefit of using row covers, with their effectiveness depending on the material type. Heavier materials like spun bonded polypropylene provide enhanced frost protection but may limit light transmission. In India, row covers are employed during the rabi season to shield specific crops from early frost, ensuring their survival and optimal growth. The choice of row cover material plays a significant role in determining the level of protection provided against frost, while also considering the balance between protection and the amount of light reaching the plants.

Early yields: The greenhouse effect of most row covers will not only warm air surrounding the plant but will also result in warmer soil temperatures, enhancing seed germination, root growth, shoot growth and maturity. Early crop production generally results in higher crop prices at local markets. When combined with black plastic mulch, many crops may mature one to three weeks earlier than under normal cropping practices. However, increased costs generally limit use to high-value horticultural crops but the protection of high-value plants, such as watermelon against light freezes may still justify the use of row cover in early plantings (Arancibia and Motsenbocker, 2008). Predicting agricultural drought, which leads to substantial yield losses in major crops, is a more challenging task compared to assessing meteorological and hydrological droughts. This difficulty arises from the intricate interplay between crop genotype, soil moisture availability, and climate conditions (Pandya *et al*. 2022). Nevertheless, accurate prediction of drought events holds immense value as it enables early yield forecasts, providing essential insights for proactive agricultural management and planning to mitigate the adverse impacts of drought on crop production.

Increased yields: Row covers have demonstrated their effectiveness in benefiting various crops, particularly cucurbits like squash, cucumbers, and melons, which have shown remarkable yield increases of up to 25% (Helbacka, 2002). Moreover, the application of row covers has led to earlier production of cool-season crops like watermelon and sweet potato, ultimately boosting total yields. In regions with shorter growing seasons, the early cane growth of ever-bearing red raspberries in the spring, facilitated by row covers, results in increased production during late summer to early fall, enhancing total yields in areas like New Mexico. Furthermore, an array of other crops has also exhibited positive responses to row covers, including tomatoes, peppers, eggplants, cauliflower, cabbage, strawberries, sweet corn, carrots, sweet potatoes, and peas. These covers have proven invaluable in improving the growing conditions, leading to higher yields and more efficient crop management. The significance of row covers becomes even more pronounced when considering the challenges posed by economic constraints associated with traditional irrigation methods. The erratic fluctuations in soil-water potential can adversely affect crop productivity (Vadalia and Prajapati 2022). As a solution, the strategic implementation of row covers in vegetable and fruit crops becomes crucial, as it offers a practical approach to mitigate the impact of water limitations and elevate yields effectively. By optimizing the microclimate around the crops, row covers provide a protective shield, enhance water use efficiency, and contribute to a more sustainable and productive agricultural system.

Wind protection. Using row covers with wire hoops provides valuable protection to crops against wind and blowing sand, leading to reduced plant stress and preventing desiccation of delicate early growth. Additionally, these covers serve as a shield against hail and pounding rain, safeguarding crops from potential damage. However, it is essential to consider that unsupported floating row covers may pose some risks. Without proper support, they have the potential to come into direct contact with plants, causing abrasion and harm to leaves, stems, or flowers. To ensure the maximum benefits of row covers while minimizing any negative impacts, it is crucial to employ appropriate supporting structures such as wire hoops or other methods. These structures not only provide the necessary elevation for the covers but also promote better airflow and proper contact between the covers and plants. As a result, growers can fully capitalize on the protective advantages of row covers while preventing any inadvertent damage to their valuable crops. Careful management and thoughtful implementation of row covers are key to maximizing their effectiveness in agricultural practices.

Pest control: Lightweight floating row covers are often used to cover some crops in the spring to protect them from insects. Edges of the cover must be covered with soil to ensure exclusion of insects. This will result in less use of insecticides and less frequency of insect-borne diseases. Floating and supported row covers can also be used to protect plants from birds.

Water conservation: Water scarcity poses a significant challenge in arid and semi-arid regions, making intensive irrigation difficult (Pandya and Rank, 2014). However, the use of row covers can potentially reduce the need for irrigation as they trap condensation, returning water to the soil. Additionally, row covers limit crusting by reducing wind movement and water evaporation. Despite this water-saving benefit, overall water consumption may increase due to earlier and more extensive crop growth that spans a longer period. In contrast, employing drip irrigation offers advantages over surface irrigation. It reduces input costs, increases yields, enhances water productivity, and minimizes the risk of yield reduction during dry spells between irrigations (Prajapati and Subbaiah, 2019). Mulching emerges as a highly effective approach in conserving water resources (Prajapati and Subbaiah, 2015). Research has demonstrated that different mulching and irrigation techniques can significantly impact crop yield, with the combination of drip irrigation and silver plastic mulch showing a relatively modest increase compared to other methods. Global warming further compounds the water-related challenges, as the evaporation rate is anticipated to rise, leading to drier conditions on the ground and increased water vapor in the atmosphere over time (Pandya and Gontia, 2023). Coping with these changes is essential to ensure sustainable water management practices and adapt to the evolving climate conditions.

Types of row cover:

There are several types of row covers commonly used in agriculture. Here are some of the most prevalent types of row cover:

1. **Floating Row Covers:** These covers are lightweight and made of spunbonded polypropylene or polyester materials. They are placed loosely over the plants or supported by wire hoops. Floating row covers allow for air and water permeability while providing protection against pests, frost, and light hail.
2. **Supported Row Covers:** These covers require a framework of wire hoops or other supports to create a tunnel-like structure. Supported row covers are often used for crops that require

more space or height, such as vine crops or tall plants like tomatoes and peppers. They offer protection against pests, frost, and adverse weather conditions.

3. **Perforated Row Covers:** These covers have small perforations or holes that allow for controlled ventilation and light transmission while still providing protection against pests and certain weather conditions. Perforated row covers are commonly used in warmer climates to regulate temperature and humidity.
4. **Insulating Row Covers:** These covers are typically made of thicker materials, such as heavyweight polypropylene or fabric, and provide increased insulation and frost protection. They are ideal for protecting crops during colder seasons or in regions prone to frost damage.
5. **Insect-Exclusion Row Covers:** These covers have a finer mesh or weave designed to keep out tiny insect pests while still allowing light, air, and water to pass through. Insect-exclusion row covers are often used in organic farming or for crops susceptible to insect damage, such as brassicas or leafy greens.

Each type of row covers offers specific advantages and is chosen based on the crop requirements, environmental conditions and the pests or challenges to be addressed.

Removal of Row Cover

Row covers are often applied three to four weeks before crops are normally planted to encourage growth enhancement or for frost prevention. Row covers must be removed as illustrated in following photograph at bloom for fruiting crops to encourage bee or wind pollination. Higher temperatures later in the season may reduce quality for cool-season crops, necessitating the removal of the row covers. Extremely high temperatures that develop later in the season under row covers can also reduce production of crops like tomatoes and peppers. Altering the land configuration offers a promising avenue to enhance both water use efficiency and minimize soil erosion in field crops (Vadalia *et al*. 2022). The strategic manipulation of land layout leads to improved water utilization, allowing crops to thrive with less water consumption. Moreover, this practice helps mitigate soil erosion, preserving the precious topsoil and ensuring sustainable agricultural practices.

Removal of Row Cover

Summary
The adoption of row covers in vegetable and fruit cultivation has gained considerable popularity among farmers. These covers, crafted from fabric or plastic materials, offer numerous advantages in crop production by creating favourable microclimatic conditions. They play a vital role in protecting crops from adverse weather conditions such as frost, hail, and wind, effectively extending the growing season and enhancing crop quality. One significant benefit of row covers is their ability to act as a physical barrier, preventing insects and pests from infesting plants, thus reducing the need for chemical pesticides. Moreover, they establish a controlled microclimate that optimizes plant growth by regulating factors like temperature, humidity, and light transmission. By embracing the use of row covers in vegetable and fruit cultivation, farmers can emphasize the potential to increase yields, improve crop health, and promote sustainable farming practices. The diverse types of row cover and their specific applications are thoroughly discussed, along with their pros and cons. Ultimately, incorporating row covers presents an efficient and versatile approach to optimizing microclimates and protecting crops from insect and pest infestations, thereby minimizing risks and maximizing productivity in vegetable and fruit production.

Reference

Arancibia, R. A., and Motsenbocker, C. E. (2008). Differential watermelon fruit size distribution in response to plastic mulch and spunbonded polyester rowcover. HortTechnology, 18(1): 45-52**.**

Brown, J. E., Woods, F. M., & Channell-Butcher, C. (1998). Effect of black plastic mulch and row cover on sweet potato production. *Journal of vegetable crop production*, 4(1): 49-54.

Gordon, G. G., Foshee III, W. G., Reed, S. T., Brown, J. E., Vinson, E., & Woods, F. M. (2008). Plastic mulches and row covers on growth and production of summer squash. International journal of vegetable science, 14(4): 322-338.

Helbacka, J. 2002. Row covers for vegetable gardens [Fact Sheet No. 19]. Renton: Washington State University, King County Cooperative Extension Service.

Hochmuth, G.J., S. Kostewicz, and W. Stall. 2000. Row covers for commercial vegetable culture in Florida [Circular 728]. Gainseville: University of Florida Cooperative Extension Service.

Ibarra-Jiménez, L., Quezada-Martín, M. R., & De La Rosa-Ibarra, M. (2004). The effect of plastic mulch and row covers on the growth and physiology of cucumber. Australian Journal of Experimental Agriculture, 44(1): 91-94.

Jensen, M.H., and A.J. Malter. 1995. Protected agriculture: A global review [World Bank Technical Paper, No. 253]. Washington, D.C.: The International Bank for Reconstruction and Development, The World Bank.

Kalisz, A., Cebula, S., Siwek, P., Sękara, A., Grabowska, A., and Gil, J. (2014). Effects of row covers using non-woven fleece on the yields, rate of bolting, and quality of heading Chinese cabbage in early spring cultivation. Journal of the Japanese Society for Horticultural Science, 83 (2):133–141.

Kunapara A. N., Subbaiah R., Prajapati G. V. and Makwana J. J. (2016). Influence of Drip Irrigation Regimes and Lateral Spacing on Cumin Productivity. Current World Environment. 11(1): 333-337. http://doi.org/10.12944/CWE.11.1.40

Pandya, P. A., & Rank, H. D. (2014). Summer sesame response to irrigation methods and mulching. Research on crops, 15(4), 810-815. DOI : 10.5958/2348-7542.2014.01416.8

Pandya, P., & Gontia, N. K. (2023). Development of drought severity–duration–frequency curves for identifying drought proneness in semi-arid regions. Journal of Water and Climate Change, 14(3), 824-842.doi: https://doi.org/10.2166/wcc.2023.438

Pandya, P., Gontia, N., & Parmar, H. (2022). Development of PCA-based composite drought index for agricultural drought assessment using remote-sensing. Journal of Agrometeorology, 24(4), 384-392. https://doi.org/10.54386/jam.v24i4.1738

Parmar, S. H., Patel, G. R., & Tiwari, M. K. (2023). Assessment of crop water requirement of maize using remote sensing and GIS. Smart Agricultural Technology, 4, 100186.

Parmar, S. H., Tiwari, M. K., Pargi, D. L., Pampaniya, N. K., & Rajani, N. V. (2019). Modeling the land surface temperature using thermal remote sensing at Godhra, Gujarat. Journal of Agrometeorology, 21(1), 107-109. DOI: 10.54386/jam.v21i1.216

Prajapati, G. V., & Subbaiah, R. (2015). Response of Bt cotton productivity to conjunctive stimulus of irrigation regimes and mulching. Research on Crops, 16(3), 509-514. DOI: 10.5958/2348-7542.2015.00071.6

Prajapati, G. V., & Subbaiah, R. (2018). Combined response of irrigation system regimes and mulching on productivity of Bt. Cotton. J. Agrometeorol, 20, 47-51. https://www.researchgate.net/publication/332112272_Combined_Response_of_Irrigation_Systems_Regimes_and_Mulching_on_Productivity_of_Bt_Cotton.

Prajapati, G. V., & Subbaiah, R. (2019). Crop coefficients of Bt. cotton under variable moisture regimes and mulching. Journal of Agrometeorology, 21(2), 166-170. DOI: 10.54386/jam.v21i2.227

Satasiya, R. M., Sojitra, M. A., Kothiya, A. V., & Chauhan, P. M. (2022). Performance of Summer Groundnut under different types of Plastic Mulch. *Agricultural Research Journal*, **59** (3): 418-422.

Sojitra, M. A., Satasiya, R. M., Rank, H. D., Chauhan, P. M., Parmar, H. V., & Patel, D. V. (2023). Study the Micro Climatic Parameter in Protected Structure. *Environment and Ecology*, *41*(2A): 953-960.

Vadalia, D. D. and Prajapati G. V. (2022). Determination of crop coefficients for wheat (Triticum aestivum L.) under different land configuration and irrigation systems. The Pharma Innovation Journal. 11(1), 1245-1249 https://www.thepharmajournal.com/archives/2022/vol11issue1/PartQ/11-1-108-142.pdf

Vadalia, D. D., Prajapati G. V., Parmar, S. H., & Gohil, G. D. (2022). Determination of Growth-Stage-Specific Crop Coefficients (Kc) for Drip Irrigated Wheat (Triticum aestivum L.) under Different Land Configurations. Research Biotica. 4(2) : 69-73 DOI: 10.54083/ResBio/4.2.2022/69-73

Vaughn, E.A. 1992. Nonwoven fabric primer and reference sampler. Carey, NC: INDA Association of Nonwoven Fabrics Ind.

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PLANT GROWTH REGULATORS: A BOON FOR VEGETABLE PRODUCTION

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Abstract
Plant growth regulators (PGRs) play a critical role in Indian agriculture for improving production and food safety. PGRs have a quick impact on crop improvement programs and take up less time, so their use must result in quantifiable results. However, the benefits for the user of PGRs need to be precise in terms of their working and safety for the environment and consumers. The PGRs sprayed in vegetable crops for increasing their production need to efficiently utilize for increasing vegetable output. The majority of physiological activities and development in plants are controlled by the activity and interaction of naturally occurring booster and inhibitor chemical substances called hormones in vegetables. Thus, their application to vegetable plants may increase their output sustainably.

Introduction
PGRs have been a crucial part of agricultural output for a long time. PGRs are organic chemicals that, in addition to nutrients and vitamins, can control plant growth when used sparingly. In the past, there was no application of PGRs. Today, PGRs are utilized to produce crops on more than a million hectares of land annually throughout the world. The idea of using PGRs as a management strategy for vegetable production is relatively new. Much research has been done to determine how growth regulators affect vegetable crops. To improve yield and quality, numerous plant growth regulators are being utilized in crops like tomato, cabbage, cauliflower, and okra in varying doses. These include GA_3, NAA, 2, 4-D, IAA, IBA, and 4-CPA.

PGR application for higher tomato yield and good quality
One of the biggest issues with solanum crops is poor fruit set. Applying 4-CPA, 2,4-D @ 2-5ppm, or PCPA 50-100 ppm to tomatoes will improve fruit set and ripeness. Tomato research using different GA_3 and NAA levels had an effect on tomato output and quality. In comparison to stock, GA_3 and NAA considerably improve fruit production and fruit yield per plant. P-chlorophenoxyacetic acid (PCPA) @ 50-100 ppm application in tomato induced parthenocarpy. A well monitored application rate of GA_3 @ 80 ppm and NAA @ 100 ppm resulted in the highest tomato fruit output.

Impact of growth regulators on okra:
An annual vegetable crop growing in tropical and subtropical areas is okra (*Abelmoschus esculentus* (L.). The objective of growth promotion in this crop may be attained by a variety of

actions, such as the application of growth regulators like GA_3, NAA, Miraculous, and others seem to be the most effective. GA_3 was determined to be advantageous in okra because it controls how the plant grows and develops. Maleic hydrazide delayed flowering in okra. IAA & NAA @ 20 ppm enhanced seed germination in okra.

Cabbage yield & quality influenced by PGR

Cabbage is a Cruciferae plant species (*Brassica oleracea* var. capitata L.). The use of GA_3 can enhance cabbage growth. The application of 50 ppm GA_3 reduced days to maturity and head formation in cabbage and same concentration significantly increased the diameter of cabbage head. Thus, the highest yield of cabbage was also achieved with application of 50 ppm GA_3.

Different concentration of PGRs impacted Cauliflower yield

Cauliflower, or *Brassica oleracea* var. botrytis sub-var. cauliflora, is one of the most significant varieties of Cole. It belongs to the Cruciferae family of vegetables. Numerous studies on the impact of PGRs on cauliflower production and quality have been carried out in industrialized nations. Due to the usage of PGRs, including NAA, GA3, IAA, and other compounds, promising effects on the production and quality of cauliflower and other crops have been reported.

Vegetables hybrid seed production with PGRs

Researchers employed Ethephon to produce female-line of cucurbits. Using female line breeding, an effective F1 hybrid of butternut squash was created with weekly Ethephon sprays of ten. Additionally, PGRs were utilized to maintain gynoecious lines. Cucumber was sprayed with GA_3 to encourage flowers to stamen on gynoecious sides.

Benefits of PGRs

- Promote and expedite root production on cuttings
- GA treatment results in larger, more cripsy celery stalks.
- prolongs the ripening of fruits
- Developing seedless fruits
- stem lengthening
- It encourages the growth of advective roots.
- encourages the germination and development of seedlings
- used to disrupt dormancy
- encourages the development of tiny plants

Negative effects of PGRs

PGRs negative effects are typically brought on by some kind of human mistake. PGRs application to unrecommended crops will almost certainly result in an unfavorable outcome. Other mistakes include overusing an additive, such a surfactant, or miscalculating the concentrations that are administered to the greenhouse vegetable crop. Depending on the application location, this may result in burning of the plant tissue (roots/leaves). It's critical to apply the PGRs at the proper period of plant development to prevent adverse effects.

Methods of PGRs application

1. **Soaking:** The cuttings are soaked in water for 24 hours before to planting. The estimated amount of PGRs is dissolved in alcohol, then diluted with distilled water to create the appropriate solution quantity and concentration (20-2000 ppm).

2. **Powder:** For preparation, PGRs granules are combined with an organic solvent and dissolved in moist charcoal powder, soybean flour, or wheat flour. You can leave the paste out until the solvent is gone.
3. **Lanoline paste:** The majority of PGRs promoting roots are easily soluble in lanolin; PGRs is mixed with lanolin and allowed to cool to create a paste that encourages beneficial plant roots.
4. Spraying
5. Root feeding
6. Injection of PGR into internal tissues

Various classes of plant growth regulators:

1.	Auxins	NAA, IBA, IAA, 2-4 D, 4-CPA
2.	Gibberellins	GA_3
3.	Cytokinins	Zeatin, Kinetin
4.	Ethylene	Ethereal
5.	Abscissic acid	Dormins, Phaseic Acid
6.	Phenolic substances	Coumarin
7.	Flowering hormones	Anthesin, Florigin, Vernalin
8.	Natural substances	Vitamins, Tranmatic, Phytochrome
9.	Synthetic substances	Synthetic Auxins, Synthetic Cytokinins
10.	Growth inhibitors	B-999, AMO-1618, Phosphon-D, Cycosel

Conclusion

A class of compounds called plant growth regulators are used to manage and improve the environment of crop. PGRs are one of the processes used in plant development to more effectively address needs related to the food supply. Utilizing PGRs may be advantageous in the short term. PGRs impact crop improvement activities in a quick and efficient manner. Plant growth regulators must be particular in their activities and ecologically and toxicologically safe for their actions to provide measurable advantages for the users. For farmers, distributors, and formation, they are not just practical but also profitable. So, use of PGRs in vegetable crops is highly recommended by researchers.

References

Prasad, R. N., Singh, S. K., Yadava, R. B., & Chaurasia, S.N.S. (2013). Effect of GA_3 and NAA on growth and yield of tomato. *Vegetable Science*, 40(2), 195-197

Lee, I. J. (2003). Practical application of plant growth regulator on horticultural crops. *Journal of Horticultural Science*, 10, 211-217.

Sentelhas, P. C., Caetano, J. R. G., & Teixeira, N. T. (1987). The effect of IAA and foliar nitrogen on wheat. *Ecossistema*, 12, 123-128.

Islam, M. A., Siddiqua, A., & Kashem, M. A. (1993). Effect of growth regulators on the growth, yield and ascorbic acid content of cabbage. *Bangladesh Journal of Agricultural Science*, 20(1), 21-27.

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