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Times of Agriculture

A Resonance in Agriculture

Monthly Agriculture E-Magazine

October-2022

LUMPY SKIN DISEASE

A Deadly outbreak in India

Timesofagriculture.in

FROM THE EDITOR'S DESK

Respected readers, as you all know that our magazine discusses the contemporary issues related to agriculture and allied sector in every issue. We always shared current information with you through the cover story. This issue is based on the deadly viral disease **lumpy skin disease** in animals. It is a dreadful disease in which **chickenpox-like blisters** appear on the body of animals, especially in **cows**. This disease is spreading in older as well as in young animals. Our veterinary scientists are engaged in finding vaccine for this disease.

As we all know that it is a viral disease that spreads rapidly and it becomes difficult to control, yet it is very important to take precautions till we have proper treatment. It will be useful to imbibe the mantra of ***"prevention is better than cure".*** Just like we have made efforts to win the battle against the epidemic like Corona, in the same way give your support in saving our livestock from this epidemic. Hope you like this issue of our magazine and share it with your friends and colleagues.

Thanks a lot and best wishes.

Dr. Devraj Singh
Editor-In-Chief

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About us

"Times of Agriculture" is agriculture monthly e-Magazine initiated for the purpose of providing information about recent innovations and technologies in agriculture and allied sectors. This e-Magazine gives a platform to dignitaries like scientists, researchers, scholars, students and innovative farmers to share their views and vivid ideas about agriculture. The main objective of this e-Magazine is to provide an open access platform for authors to get on the soapbox and spread awareness regarding the technologies and awareness in agriculture sector by e-publishing articles addressing the upcoming needs in the field agriculture.

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AGRICULTURE UPDATES

"KRITAGYA 3.0"

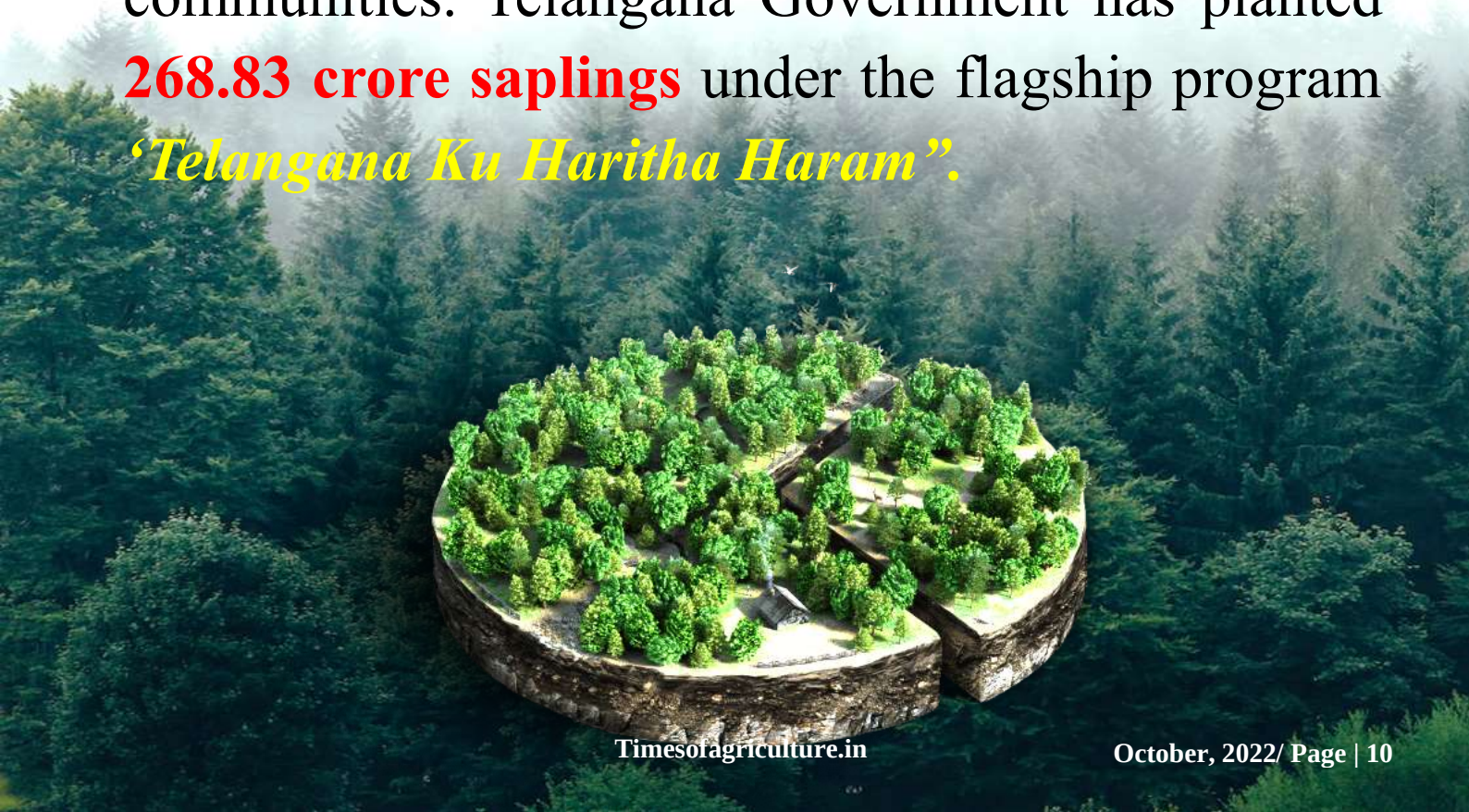
KRITAGYA 3.0 was launched by ICAR to promote **"speed breeding"** for crop improvement. The Indian Council of Agricultural Research along with its National Agricultural Higher Education Project (NAHEP) and Crop Science Division is organizing a **hackathon KRITAGYA 3.0** aimed at promoting speed breeding for the improvement of crops.

This initiative would give opportunities for students, faculties, entrepreneurs, innovators and others to demonstrate innovative approaches and technological solutions for the crop improvement.

‘First Forest University’ in India

India is going to have its first Forest University. The **University of Forestry (UoF),** will be the first of its kind in India. Globally, ***it will be the third University of Forestry after Russia and China.***

The University will work to develop ***agro-forestry models*** suitable for various agro-ecological conditions in addition to traditional forestry operations to reduce pressure on natural forests, and economic up-liftment of farming communities. Telangana Government has planted **268.83 crore saplings** under the flagship program ***‘Telangana Ku Haritha Haram”.***



"Indian fertilizer companies sign MoU with Canada Campotex"

Coromandel International, Chambal Fertilizers and Indian Potash Limited have signed a Memorandum of Understanding (MoU) with Canpotex, Canada.

MoU will reduce both supply and price volatility and ensure a stable long-term supple of potash fertilizer to India. Canpotex will supply up to 15 LMT (lakh metric tonne) of potash annually for a period of three years to Indian fertilizer companies.

"Naga Mircha Festival" 2022

The first-ever Naga Mircha (King Chilli) Festival 2022 was organized in the village hall of **Seiyhama village** in Kohima district of Nagaland. Last year, the Seiyhama village reporteda total income of **Rs.27 lakh** through the cultivation of Naga Mircha and this year's estimation of income from this activity is **Rs.1 crore.**

About Naga Mircha

Naga Mircha is popularly known as **Raja Mircha** (King Chilli). It is one of **top five hottest chillies** on the **Scoville Heat Units (SHUs)** list. It received **GI tag** to Nagaland in **2008**. It is also known as Bhoot Jolokia and Ghost pepper. The spiciness of this species is **1,041,427 SHU.**

"PM PRANAM Scheme"

In order to reduce the use of chemical fertilisers by incentivising states, the Union government plans to introduce a new scheme **PM PRANAM.** It is an initiative that encourages a balanced use of fertilisers with bio-fertilisers and organic fertilisers as alternative forms of nutrients.

The idea of the PM PRANAM Scheme was proposed during the National Conference on Agriculture for Rabi Campaign that took place on September 7.

Implementation– The idea of the scheme has been initiated by the **Union Ministry of Chemicals and Fertilizers.**

1st Advance Estimate of food grain production (Kharif 2022-23)

According to the First Advance Estimate of food grain production for the *Kharif* 2022-23, India's rice production is estimated to **fall 6%** while, total food grain output is estimated to fall 4%.

Ministry of Agriculture and Farmers Welfare, has estimated that **149.92 million** tonnes (MT) of Kharif crops will be produced. This will be **6.12 MT** or 3.9% less than last year, where production was **156.04 MT**.

Food grain (Kharif)	2021-22 (MT)	2022-23 (MT)
Rice	111.76	104.99
Coarse grain	50.90	36.56
Kharif oilseed	23.88	23.57
Total food grain	160.17	159.68

India bans broken rice export

India, the **world's largest exporter** of rice, has banned exports of broken rice, **amid a 6% reduction** in paddy acreage in the ongoing Kharif season and increase in rice prices. It has also imposed a **20% duty on exports of various grades of rice, except basmati.**

The ban will come into effect ***September 9***. The export policy was revised from **'free' to 'prohibited'** by a September 8 order from the ***Directorate General of Foreign Trade, Union Ministry of Commerce.***

World Bamboo Day 2022

World Bamboo Day 2022 is observed on September 18th in order to raise awareness about the conservation of this extremely useful plant. WBD was officially declared by the World Bamboo Organization on September 18 at the 8th World Bamboo Congress held in Bangkok in 2009.

Theme

Bamboo for Green Life and Sustainable Development.

India exports first contingent of plant-based meat products

APEDA has facilitated the export of first contingent of plant-based meat products under ***vegan food category*** from **Gujarat to California**, US.

This feat was achieved through the collaboration between Greenest Foods and Wholesome Foods. This makes plant-based meat and vegan food products a new highly potential addition to India's export basket.

IDF World Dairy Summit 2022

Prime Minister, **Shri Narendra Modi** inaugurated International Dairy Federation World Dairy Summit **(IDF WDS) 2022** organised at **India Expo Centre & Mart, Greater Noida.**

The IDF World Dairy Summit 2022 is an annual meeting of the global dairy sector, bringing together approximately 1500 participants from all over the world.

The last such Summit was held in India about half a century ago in 1974.

Theme

"Dairy for Nutrition and Livelihood"

COVER STORY

LUMPY SKIN DISEASE

A Deadly outbreak in India

About the Author

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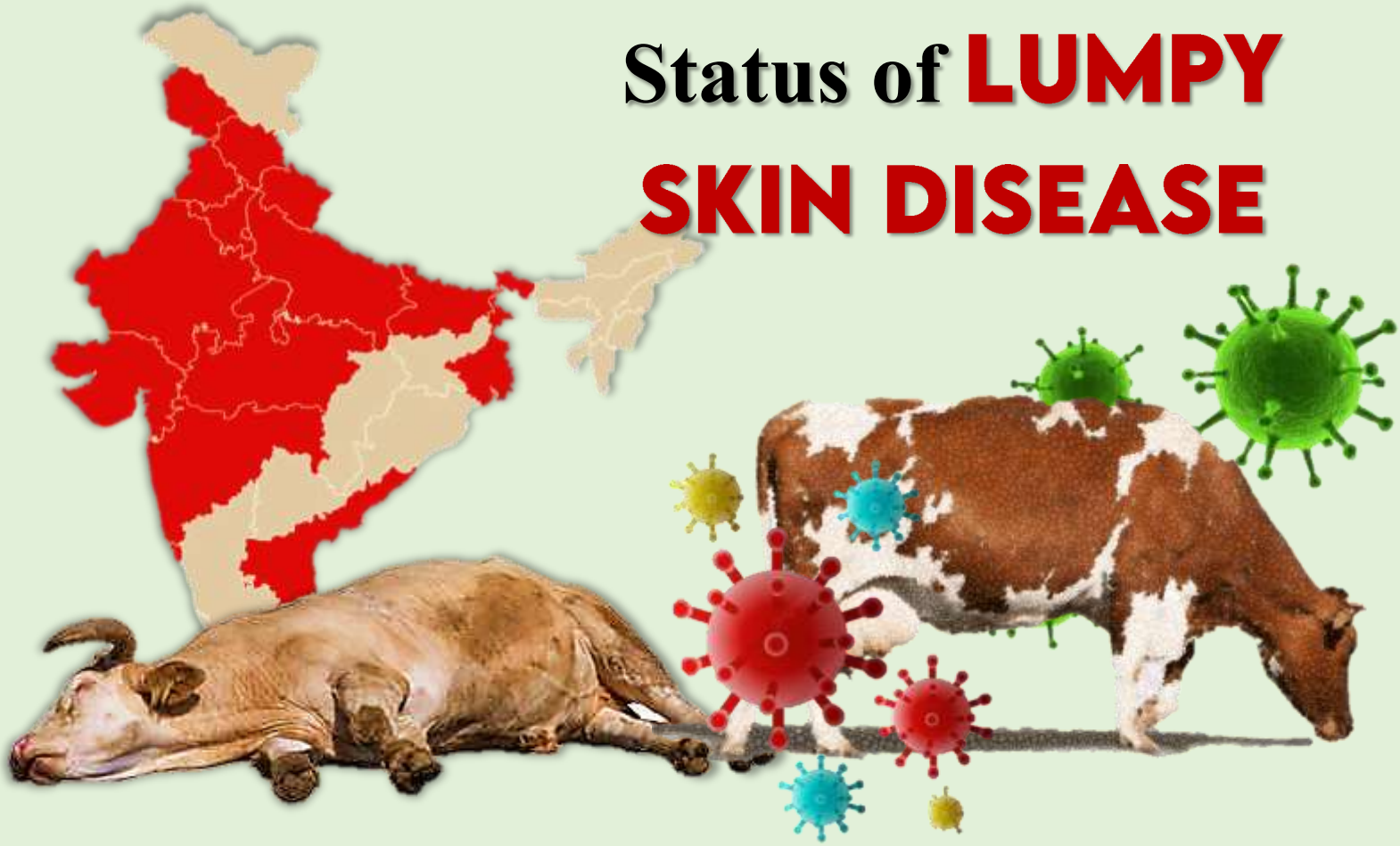
Lumpy skin disease has rapidly spread among cattle in **more than 10 states and Union Territories of India.** The death rates are rising and it continues to have a disastrous impact on the herd of cattle. *Being the world's largest milk producer, the dairy industry of India is facing a huge challenge as a result of the current outbreak.* The milk production has been severely reduced and states like **Rajasthan, Gujarat and Punjab have already reported a drop in milk yield.** ***Reports indicate a reduction of 5-6 lakh litres a day in the milk yield of Rajasthan.*** The disease poses a serious danger to the livelihoods of smallholder farmers and farmers in various regions have suffered losses as a result of the deaths of their cattle.

Current outbreak

The current outbreak started in ***Gujarat and Rajasthan around July and had spread to Punjab, Himachal Pradesh, Andaman & Nicobar and Uttarakhand by early August.*** It then spread to ***Jammu and Kashmir, Uttar Pradesh and Haryana.*** In recent weeks, it was reported in Maharashtra, Madhya Pradesh, Delhi, and Jharkhand. **Over 16 lakh cases** have been reported so far in **197 districts.** However, data on the total number of infected animals is still being collated of the **nearly 75,000 deaths.** More than 50,000 deaths, mostly cows, have been reported from Rajasthan only.

Status of LUMPY SKIN DISEASE

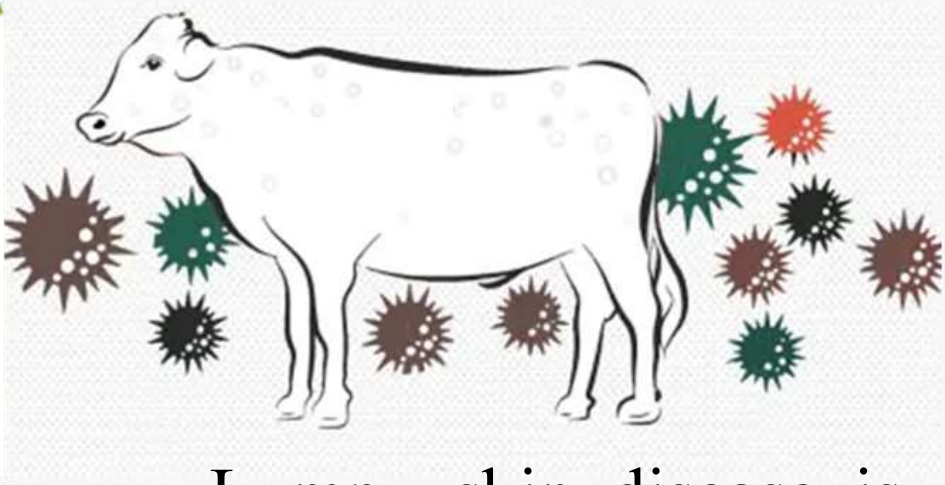


Affected Cattle	Total Death	Recovered
20.56 lakh	97435	12.70 lakh

Source- *26th Sept. 2022- Indian express*

Affected Cattle in top 3 states

Rajasthan	13.99 lakh
Punjab	1.74 lakh
Gujarat	1.66 lakh



What is Lumpy skin disease ?

Lumpy skin disease is an infectious viral disease caused by **Lumpy skin disease virus** of *Capripoxvirus genus, subfamily Chordopoxvirniae, family Poxviridae.* It is a non-zoonotic, vector borne and trans boundary disease with limited host range and currently restricted to ruminants *viz*. cattle and water buffaloes. **Calves are more susceptible and develop lesions within 24 to 48 hrs.**

Transmission

- Mechanically through arthropod vectors such as ***biting flies, mosquitoes and ticks.***
- Indirect transmission through ***milk, nasal secretions, saliva, blood and lachrymal secretions for animals sharing feeding and watering troughs.***

Outbreak of LSD

1928

First Outbreak

First outbreak in **Africa** and now endemic in **African countries**

Since 2012

Spread

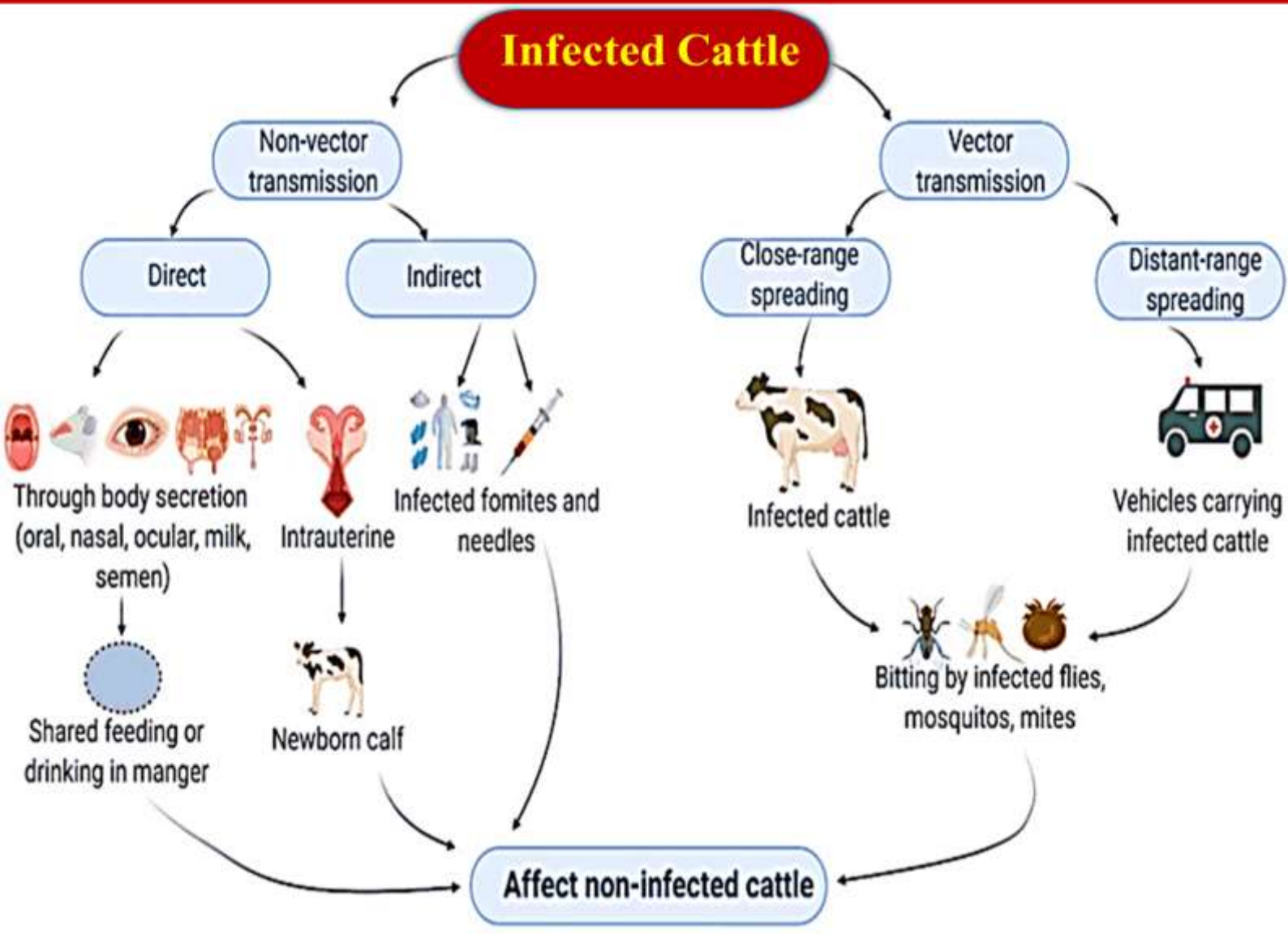
has spread rapidly through the **Middle East, Southeast Europe, And West and Central Asia**

Since 2019

In Asia

Several outbreak reported in Asian countries such as **China, Bangladesh, Pakistan, India, Shri Lanka, Myanmar, Nepal, Taiwan, Vietnam, Thailand, Malaysia, Indonesia**

- From infected mother to calf *via* milk secretions and skin abrasions.
- Through use of single needle for mass vaccination that can acquire the virus from the skin scabs or crusts.



Incubation Period

- 2-5 weeks in natural conditions
- 7-14 days in experimental conditions

Clinical Signs Lumpy Skin Disease

Biphasic Fever

Swelling of the limbs, brisket and genitals

Nodules on skin

Reduction in milk production

Watering eyes

Treatment

- Symptomatic treatment including the treatment of secondary infection (if any).
- Based on the symptoms and clinical signs:
  - Use of **anti-inflammatory** drugs (preferably non-steroids) to treat the inflammatory condition.
  - Use of **anti-histamine** preparations / drugs to treat allergic conditions.
  - Use of **Paracetamol** in case of high fever.
  - In case of secondary bacterial infections like respiratory infections, skin infections **antibiotics** may also be used judiciously.
  - Parental/oral **multivitamins.**
- **Oral treatment with 0.1% Methylene Blue (MB) solution (1 gram of MB powder in 1 litre of water).**

What govt. is doing?

The affected States have **prohibited movement of cattle and are quarantining infected cattle and buffaloes,** spraying insecticides to kill vectors like mosquitoes, with some affected States such as **Maharashtra, Rajasthan, Delhi, and Uttar Pradesh also setting up dedicated control rooms and helpline numbers** to guide farmers whose cattle have been infected. **97 lakh vaccine doses** had been given as of the first week of September. **Delhi government procured 25,000 doses of goat pox vaccine** and started a vaccination drive to prevent the spread of lumpy skin disease in cattle.

Advisories have been issued by DAHD for using **Goat pox vaccine for the vaccination of cattle and buffaloes.** However, affected animals should not be vaccinated. In a major breakthrough, **ICAR's National Research Centre on Equines (NRCE)** at Hisar, Haryana and the **Indian Veterinary Research Institute (IVRI) at Izatnagar, jointly developed Lumpi-ProVac^{ind}, an indigenous vaccine for LSD,** which the Centre plans to commercialise and roll out in the next three to four months.

Being an agriculture-based economy, it is a matter of great concern for the livestock rearing sector. ***Despite severe reduction in milk production, LSD can also lead to reduction in export of livestock and livestock products***. Therefore, strict implementation of advisories and biosecurity measures should be followed along with undertaking door to door awareness and vaccination drive to regulate the spread of disease.

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CLIMATE CHANGE-READY RICE VARIETIES

PROMINENT STRIDE TOWARD FOOD SECURITY AND SUSTAINABILITY

About Author

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Climate change and the need for climate change-ready varieties:

Agriculture is extremely vulnerable to climate change, and the negative effects of climate change are already being felt in the form of rising temperatures, rising sea levels, water scarcity, weather variability, shifting agro-ecosystem boundaries, invasive crops and pests, and other extreme weather events. Climate change reduces crop yields, nutritional quality, and productivity. Rice is the staple food for more than half of the world's population, contributing to food security and providing a source of income for over 200 million smallholder farmers worldwide. Rice is primarily grown under anaerobic conditions, where it has adapted and evolved. With Asia producing and consuming 90% of the world's rice and conventional transplanted rice cultivation systems requiring a lot of water, it's clear that water scarcity will have a big impact on rice production in the future. As a result of rising temperatures caused by the accumulation of greenhouse gases, the agricultural sector is likely to face another 10%-15% reduction in irrigation water by 2025. A rise in sea level, combined with more erratic and extreme weather events, will increase the risks of rice farming in addition to the direct effect of high temperatures. As a result, the abiotic stresses that cause reduced rice productivity and acreage are expected to worsen as a result of climate change, which includes high temperature, drought, flooding, and salinity stresses. Each growing season, drought, flood, salt water, and extreme temperatures devastate crops and jeopardize the livelihoods of 144 million smallholder rice farmers. While high temperature is not currently a major issue, the other stresses are already common yield-limiting factors in the unfavorable tropical Asian environments where rice is widely grown.

Climate Smart Agriculture aims to achieve food security and sustainable agricultural development in the face of climate change. Climate change-ready crop varieties provide three benefits: increased agricultural productivity and income, increased adaptation and resilience to climate change, and reduced greenhouse gas emissions. Rice high-yielding varieties (HYV) have spread throughout both irrigated and rainfed areas and now cover the majority of tropical Asia. However, these HYVs are invariably resistant to the current major abiotic stresses, which are likely to be exacerbated by severe climate change, such as drought, submergence, and salinity. These stresses have reduced yields in millions of hectares of rice production areas, and modern HYVs have had a limited impact on these areas. Climate change is causing a convergence of technology with the need for future adaptation of rice varieties to changing climates. Incorporating tolerance to the major

abiotic stresses (drought, flooding, salinity, and high temperature) into high-yielding varieties has proven to be a very effective approach for developing varieties that can cope with climatic change situations. These successes give hope that the problem of climate change can be addressed in part by developing and disseminating adapted stress-tolerant rice varieties (STRV) or climate change-ready rice varieties, which will provide significant protection against the adverse effects of climate change. Rapid progress has been made in the development of STRVs, and serious efforts have been made in the last decade for rapid dissemination to farmers in unfavorable growing environments, and this will be a continuing thrust in the future.

Submergence tolerance:

Submergence tolerance is defined as the ability of a rice plant to survive and continue growing after being completely inundated in water for several days. Submergence can affect rice crops at any stage of growth and can be either short-term (flash floods) or long-term (stagnant flooding). Flooding of water affects morphological and anatomical changes, such as leaf senescence, inhibition of growth in dry mass, faster underwater leaf elongation, partial injury, and even death of the entire plant. The chances of survival of rice plants are extremely low when completely submerged for long period during the crop's vegetative stage. Out of 16.1 million hectares of rice-growing areas in India, 5.2 million are occasionally affected by the flood. The rice plant elongates its leaves and stems during flooding to escape submergence. Deepwater rice varieties are able to do this rapidly enough to survive. Many high-yielding modern varieties cannot elongate enough and lack

Table: Few prominent and modern climate change-ready rice varieties in India

Year of Release	Variety	Submerge-nce Tolerant	Drought & Heat Tolerant	Salt Tolerant	Multistress Tolerant
2005	CSR 36			+	
2007	Shusk Samrat		+		
2009	Narendra Usar Dhan 2008			+	
	Swarna Sub1	+			
2010	DRR Dhan 39 (Jagjeevan)			+	
2011	Luna Sampad			+	
	Sahbhagi Dhan		+		
2012	CR Dhan 406			+	
2013	CR 1009 Sub1	+			
2014	Ciherang Sub1 (Bina 11)	+			
	CR Dhan 201 (DRR 44)		+		
	CSR 43			+	
2015	Bina Dhan 10			+	
2015	IR 64 Drt1 (DRR 42)		+		
	Samba Mahsuri Sub1	1			
2016	Gosaba 5 (Chinsura Nona-1)			+	
	Swarna Shreya		+		
2017	Sabour Ardhajal		+		
2018	Bahadur Sub1	+			
	Bina 17		+		
	CSR 46			+	
	CSR 60			+	
	DRR Dhan 47		+		
	DRR Dhan 50				+
	Ranjit Sub1	+			
2019	CR Dhan 801				+
	CR Dhan 802				+
2020	Sabour Harshit		+		
	Swarna Shakti Dhan		+		
2021	IR 64 Sub1	+			

submergence tolerance. Plant breeders have discovered a promising gene, called Sub1, which confers high tolerance to complete submergence of up to 14 days.

Drought tolerance:

Drought tolerance refers to a plant's ability to maintain biomass production in arid, drought, or water-stressed conditions. Drought is the most common and destructive environmental stress, affecting 23 million hectares of rainfed rice in South and Southeast Asia. Drought is the most serious threat to agricultural food production in the face of climate change. Drought intensity/severity is highly complex and is determined by a variety of factors such as rainfall frequency, evaporation, and soil moisture. Severe drought in some Indian states can result in yield losses of up to 40%. Terminal drought occurs when a prolonged lack of water causes plant death, whereas intermittent drought occurs when a brief lack of water causes improper growth. Rice grain yield and vegetative growth are severely reduced when water is scarce. Drought stress frequently causes reductions in grain size, grain weight, and seed-setting rate. Several drought-tolerant varieties are being developed in the last decade and have been widely adopted.

Heat tolerance:

A plant's heat tolerance is its ability to produce an economic yield and grow normally under high-temperature conditions by adjusting its structural or metabolic properties. Global warming has had a significant impact on rice production. Though rice originated in the tropics, high temperatures during the reproductive stages reduce rice productivity by causing low seed setting and yield. Increased nighttime temperatures during the ripening stage reduce rice yield and grain quality. Furthermore, heat stress can cause leaf yellowing and accelerated development even during the vegetative growth stage, resulting in low yield in sensitive rice varieties. Scientists are screening improved and traditional rice varieties for rice that can withstand high temperatures. These donors are used in a crossing program to incorporate high-temperature tolerance into elite rice lines in order to develop heat-tolerant varieties for 'hot and dry' and 'hot and humid' countries.

Salt-tolerant rice:

Salt tolerance in rice is defined as the ability to grow on land with a 0.3% saline/ alkali concentration while producing a significant economic yield. Millions of hectares of rice-growing land in Asia and Africa are currently underutilized due to high salinity. Rising sea levels bring salt water further inland, contributing to soil salinity. Salinity affects significant areas of land in coastal areas that could otherwise be used for rice farming. One of the most severe environmental stresses is salt stress. Salt stress causes osmotic stress, ionic toxicity, and nutritional deficiencies in plants, which eventually leads to growth inhibition and crop yield losses. In the past, salt tolerance varieties were developed in India and are now grown in large areas of the saline environment.

Multi-stress tolerance:

Rice crops are frequently subjected to more than one abiotic stress during the growing season. As a result, recent research emphasis has been placed on the development of multiple stress-tolerant rice varieties (MSTRV). MSTRVs with a combination of stress tolerance genes for submergence, drought, heat, and salinity are being developed using conventional and molecular breeding approaches. Few of these varieties have been released in India, and many more are being developed to be available to farmers for cultivation shortly.

CLIMATE CHANGE
A TOCSIN

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Since the inception of human beings on planet Earth, we have either in one or the other ways polluted the planet. This can be marked since the Industrial revolution till this time period. The concentration of pollutants such as soil pollutants, air pollutants or water pollutants has ruined the soil, air and water. This has aided in the concentration of greenhouses gases (majorly Carbon dioxide) into the earth atmosphere. The rise of CO_2 in the atmosphere traps the sunlight, resulting rise in the mean average temperature of the planet, melting of ice caps etc. and causing the phenomenon called Global warming.

Global warming brings drastic change to our climate, which we called as Climate change. This climatic change can be marked by irregular pattern of monsoon, droughts, floods, increase in incidences of tropical cyclones, famines, heat waves etc.

With all these factors on one side, the rise in global population puts a lot of pressure on land, resulting in shrinkage of cultivable land and expansion of land for residential purposes. Under such a condition, the dependency on pesticides is quite obvious. The overuse of chemicals to obtain the higher level of yields have impaired the soil, deteriorating its quality and making it unfit for agricultural use in long run. With rise in population, the demand of fresh water for commercial and domestic purposes has increased to multifold, making it scarce. Higher number of automobiles has led increased emission of air pollutants, causing rise in air pollution. The same situation prevails for all other natural resources too.

The gradual increase in mean average temperature of Earth , rise in mean sea level due to melting in ice caps, decrease in availability of fresh water, increase in frequency , complexity of environmental stress, all due to global warming and climate change have affected the production as well as quality of agricultural produce. Such a condition threatens global food security, which if not mitigated properly may lead to global unrest, famines and hunger.

Mitigation efforts

The agricultural sector is the most sensitive sector prone to climate change as minute change in the climate may alter the production and quality of agricultural crops. Following efforts can be made to mitigate climate change:

- Using varieties of crops which are resistance to climate change such as drought resistant varieties, lodging resistance varieties etc.
- Using water harvesting techniques for water conservation.
- Use of green manures, mulches such as dhaincha etc to maintain soil moisture and improve soil quality.
- Using advanced agricultural practices such as drip irrigation, precision agriculture, climate resilient agriculture etc.
- Using the practice of Integrated Farming System.
- Diversifying agriculture by opting livestock farming, fisheries etc in order to maintain income availability throughout the year.

- Using climate forecasting to minimize production risk.

Conclusion

The potential damage climate change is causing and can cause in future can't be ignored. So, there is a need for concerted efforts at global and national level. To mitigate it, the Government of India has made various plans and policies. It includes National Solar Mission to enhance development of solar technologies, National Mission on Sustainable Habitat which aims at better waste management and power from waste, National Water Mission for improving water use efficiency, National Mission For Sustaining the Himalayan Ecosystem, National Mission For Green India, National Mission On Sustainable Agriculture, National Mission on Strategic Knowledge Platform for Climate Change etc.

Schemes like Pradhan Mantri Ujjawala Yojana to provide free LPG connections to reduce usage of traditional sources of energy, Unnat Jyoti by Affordable Lighting For All (UJALA) to enhance efficient lighting and conserve environment and the most important shifting towards renewable sources of energy, establishing solar parks, solar cities. Many plans with aim to reduce the emissions from the automobiles such as National Electric Mobility Mission Plan, Faster Adoption and Manufacturing of Electric Vehicles (FAME), Adoption of BS –VI norms have been implemented.

Many International Agreements and initiatives such as Paris Agreement, Kigali Agreement, International Solar Alliances etc. are some global efforts to tackle climate change problems. At individual level, we can take steps such as afforestation, avoid use of traditional sources of fuels such as coal, timber etc., stop burning straw after harvesting of crop, avoid practices such as Jhum cultivation, avoid deforestation etc. Thus, with joint efforts at global level and individual level we can save resources for our future generations and save our planet.

CONSERVATION AGRICULTURE

CONCEPT AND IMPORTANCE IN AGRICULTURE

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If we stop and think about healthy soil, we should come to the conclusion that soil is a living organism. Soil contains the entire universe of life. There is about 1000 pounds of biological material under the soil surface. Everything from microscopic protozoa and bacteria, through earthworms, insects and finally to lager organisms such as burrowing rodents. As human population is constantly increasing, it is estimated that by 2060 soil is the one that will be obliged to give us as much food as we consumed in the last 500 years.

Conventional agriculture is the greatest enemy of healthy soil. It wasn't designed for the betterment of the soil, but rather for the rapid economic growth. But what good will money have if we lose our health and our land? If we want to improve soil quality and with that our life quality, we should turn our field of interest to educating ourselves about conservation agriculture and its principles. By learning to use nature sustainably, we could reverse global warming in 30 years. The aim of this paper is introduction to conservation agriculture clarification of its principles and explanation of the benefit it could have in stopping global warming.

What is conservation agriculture?

Function of conservation agriculture is to protect the soil physically from sun, rain and wind and to feed soil biota. The soil microorganisms and soil fauna take over the tillage function and soil nutrient balancing. Mechanical tillage disturbs this process. Therefore, it is estimated that zero or minimum tillage and direct seeding lead to reduction in wind and water erosion. Based on Food and Agriculture Organization of the United Nations (FAO), conservation agriculture is based upon three principles: minimum tillage and soil disturbance, permanent soil cover with crop residues and live mulches, and intercropping. With different principals emerge diversity of branches. Branches that are related to conservation agriculture are: permaculture, agro ecology, holistic management, restoration ecology, Keyline design, agroforestry.

Principles of conservation agriculture

Conservation agriculture practices perused in many parts of the world are built on ecological principles making land use more sustainable. Adoption of CA for enhancing Resource use efficiency (RUE) and crop productivity is the need of the hour as a powerful tool for management of natural resources and to achieve sustainability in agriculture. Conservation agriculture basically relies on 3 principles, which are linked and must be considered together for appropriate design, planning and implementation processes. These are:

- Minimal mechanical soil disturbance.
- Permanent organic soil cover.
- Diversified crop rotations.

Recent status of conservation agriculture

Globally, CA is being practiced on about 125 M ha. The major CA practicing countries are USA (26.5 M ha), Brazil (25.5 M ha), Argentina (25.5 M ha), Canada (13.5 M ha) and Australia (17.0 M ha). In India, CA adoption is still in the initial phases. Over the past few

years, adoption of zero tillage and CA has expanded to cover about 1.5 million hectares. The major CA based technologies being adopted is zero-till (ZT) wheat in the rice-wheat (RW) system of the Indo-Gangetic plains (IGP). In India, efforts to adopt and promote conservation agriculture technologies have been underway for nearly a decade but it is only in the last 8 – 10 years that the technologies are finding rapid acceptance by farmers. Efforts to develop and spread conservation agriculture have been made through the combined efforts of several State Agricultural Universities, ICAR institutes and the Rice-Wheat Consortium for the Indo-Gangetic Plains. The spread of technologies is taking place in India in the irrigated regions in the Indo-Gangetic plains where rice-wheat cropping systems dominate. Conservation agriculture systems have not been tried or promoted in other major agro-ecoregions like rainfed semi-arid tropics and the arid regions of the mountain agro-ecosystems.

Importance in recent agriculture systems

Adoption and spread of ZT wheat has been a success story in North-western parts of India due to (1) reduction in cost of production by Rs 2,000 to 3,000 ha^{-1} ($ 33 to 50); (2) enhancement of soil quality, i.e. soil physical, chemical and biological conditions; (3) enhancement, in the long term C sequestration and build-up in soil organic matter constitute a practical strategy to mitigate Green House Gas emissions and impart greater resilience to production systems to climate change related aberrations; (4) reduction of the incidence of weeds, such as *Phalaris minor* in wheat; (5) enhancement of water and nutrient use efficiency; (6) enhancement of production and productivity (4% – 10%); (7) advanced sowing date ; (8) reduction in greenhouse gas emission and improved environmental sustainability; (9) avoiding crop residue burning reduces loss of nutrients, and environmental pollution , which reduces a serious health hazard; (10) providing opportunities for crop diversification and intensification-for example in sugarcane based systems, mustard, chickpea, pigeonpea etc.

Challenges in conservation agriculture

Conservation agriculture as an upcoming paradigm for raising crops will require an innovative system perspective to deal with diverse, flexible and context specific needs of technologies and their management. Conservation agriculture R&D (Research and Development), thus will call for several innovative features to address the challenge. Some of these are:

- **Understanding the system:**

Conservation agriculture systems are much more complex than conventional systems. Site specific knowledge has been the main limitation to the spread of CA system. Managing these systems efficiently will be highly demanding in terms of understanding of basic processes and component interactions, which determine the whole system performance.

- **Building a system and farming system perspective:**

A system perspective is built working in partnership with farmers. A core group of scientists, farmers, extension workers and other stakeholders working in partnership mode will therefore be critical in developing and promoting new technologies.

- **Technological challenges:**

While the basic principles which form the foundation of conservation agriculture practices, that is, no tillage and surface managed crop residues are well understood, adoption of these practices under varying farming situations is the key challenge.

- **Site specificity:**

Adapting strategies for conservation agriculture systems will be highly site specific, yet learning across the sites will be a powerful way in understanding why certain technologies or practices are effective in a set of situations and not effective in another set.

- **Long-term research perspective:**

Conservation agriculture practices, e.g. no-tillage and surface-maintained crop residues result in resource improvement only gradually, and benefits come about only with time.

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AGROCHEMICALS AND THEIR EFFECTS ON ENVIRONMENT AND HUMAN HEALTH

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The term "agrochemicals" refers to substances utilised in agriculture. It consists of hormones, concentrated reserves of raw animal manure, fungicides, insecticides, herbicides, fertilisers, fungicides, nematicides, and nematicides. They are used to increase crop yields and protect crops from pests. The Green Revolution was launched as a result of chemical fertilisers. High Yielding Varieties (HYVs) were introduced, which increased the demand for chemical fertilisers. Ingredients such as agrochemicals are crucial to ensure global food security. However, the requirement for recurrent application brought on by the significant losses incurred as a result of volatilization, photodegradation, leaching, and surface migration may make the use of agrochemicals economically unviable. Furthermore, extensive use of agricultural chemicals has seriously polluted the environment.

There are two ways to transmit pesticides. First, the majority of pesticides used on plants end up on the soil after being deposited on the plants, where they are then washed away by rain. Second, because of their mobility and long-term persistence, the residues of adsorbed pesticides continue to be pollutants. Within a few days of application, between 80 and 90 percent of the pesticides can volatilize and evaporate into the air. The amount of water soluble pesticides that get into lakes, rivers, streams, and other bodies of water depends on how soluble they are. Animals' bodies absorb the fat-soluble insecticides through a process known as bioamplification or biomagnification. In the case of fertilisers, the applied nutrients are lost due to runoff and leaching.

Air pollution, water pollution, and soil contamination are the three types of pollution caused by agrochemicals.

Effect of agrochemicals on environment

1. Eutrophication:

This is the process of enriching water with nutrients that leads to structural changes in the ecosystem, such as an increase in the growth of algae and aquatic plants, the extinction of fish species, a general decline in water quality, and other outcomes that limit and prevent use. The primary cause of eutrophication in aquatic bodies is phosphorus. It is ageing of water bodies because of nutrient enrichment. Eutrophication is a slow-moving natural process that affects all aquatic life, but in recent years, human activity has caused it to advance much more quickly.

2. Greenhouse gas emissions:

Agriculture is the primary source of non-carbon dioxide greenhouse gases, generating almost 60% of nitrous oxide and nearly 50% of methane, and contributes around 10% to 12% of total greenhouse gas emissions (Smith *et al.*, 2007). The main contributor to and driver of greenhouse gas emissions from agricultural soils is the use of fertilisers in agriculture. Agricultural soil emissions, both direct and indirect, are influenced by a variety of variables, including yield, area under cultivation, and the rate at which organic manure and fertiliser are applied.

3. Threats to Aquatic Biodiversity:

Pesticides used on land that drift into aquatic environments and are hazardous to fish and non-target creatures constitute a threat to aquatic biodiversity. Aquatic plants produce about 80% of the dissolved oxygen that is required for the survival of aquatic life. Herbicides' used to kill aquatic plants causes extremely low oxygen levels, which ultimately cause fish to suffocate and

diminish fish productivity (Helfrich *et al.* 2009).

4. Threats to terrestrial biodiversity:

Phenoxy herbicide drift can harm neighbouring shrubs and trees (Dreistadt *et al.,* 1994). Glyphosate lowers the quality of seeds and makes plants more susceptible to disease (Brammall and Higgins 1988) and reduces seed quality (Locke *et al.,* 1995). Bee and beetle populations are decreased by broad spectrum pesticides like carbamates, organophosphates, and pyrethroids. Honeybees are harmed by neonicotinoids insecticides like clothianidin and imidaclorpid as well as by the combined impacts of pyrethroids and imidazole fungicides (Pilling and Jepson 2006). While 2, 4 D prevents soil bacteria from converting ammonia into nitrates (Frankenberger *et al.,* 1991), glyphosate inhibits the growth and activity of nitrogen-fixing bacteria in soil (Santos and Flores 1995). Herbicides can harm soil-dwelling fungi because trifluralin and oryzalin are known to impede the development of symbiotic mycorrhizal fungi, which aid in nutrient uptake (Kelley and South 1978). According to Moore (1989), oxyadiazon has been shown to decrease the diversity of fungi, whereas triclopyr is hazardous to some mycorrhizal fungi species (Chakravarty and Sidhu 1987).

Effect of agrochemicals on human health

1. Methaenoglobinemia:

When the nitrate concentration of drinking water exceeds 50 mg/l, this disease develops. Iron will often be present in reduced ferrous form in haemoglobin. The methemoglobin (oxidised haemoglobin) in methaenoglobinaemia, however, contains iron in the ferric form, which is unable to bind, transport, or release oxygen.

2. Carcinogenicity:

N-nitroso compounds are created in the human stomach when excess nitrite in drinking water (above 3 mg/l) reacts with nitrosatable substances. Although some of the most easily produced N-nitroso compounds, like N-nitrosoproline, are not carcinogenic in humans, several of these N-nitroso compounds have been proven to be carcinogenic in all the animal species studied. The N-nitroso chemicals that cause cancer in some animal species also most likely to cause cancer in people.

3. Glyphosate-Carcinogenic agent:

At the moment, there is a lot of concern about how herbicides may affect people's health. One such herbicide is glyphosate, which is frequently used in agriculture and urban areas to control weeds and is a major carcinogen (Arajo *et al.,* 2016; Benbrook 2016). The most extensively used herbicide in the world is glyphosate, which farmers in the USA apply to croplands at a rate of roughly 1 kg/ha in 2014 (Benbrook 2016). The daily chronic reference dose for glyphosate was set at 0.5 mg/kg body weight per day by the EU, but the US EPA placed it at 1.75 mg/kg body weight per day.

4. Pesticide effects:

Headache, stinging of the eyes and skin, throat and nose irritation, skin itching, appearance of rash and blisters on the skin, dizziness, diarrhoea, abdominal pain, nausea and vomiting, blurred vision, blindness, and very rarely death are all immediate effects of exposure to pesticides. Acute effects are not serious enough to warrant seeking medical attention. Chronic effects are long-lasting, frequently fatal, and harm several organs. The brain health impacts of pesticide exposure include loss of coordination and memory, diminished vision, and impaired motor signalling (Lah 2011). Long-term exposure harms the kidneys, liver, and lungs and may result in blood disorders.

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SRILANKA's ORGANIC FARM POLICY

AN IMPACT ANALYSIS

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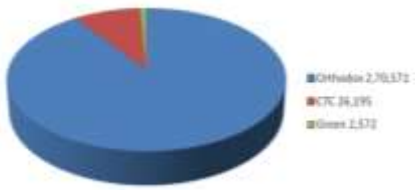
The Rajapaksa's administration delivered on the pledge in 2021 April by ordering the 2 million farmers in the nation to switch to organic farming and enforcing a national ban on the import and use of synthetic fertilisers and pesticides. The false economy of banning imported fertiliser hurt the Sri Lankan people greatly because the country had handed its agricultural policy over to organic true believers, many of whom were involved in businesses that would stand to benefit from the fertiliser ban. The reduction in currency outflows brought about by the ban on imported fertiliser was dwarfed by the loss of income from tea and other export crops. The increased import of rice and other food stocks caused the bottom line to go into even more negative territory. And the cost of paying farmers and providing public subsidies for imported food ultimately outweighed the budgetary savings from cutting subsidies.

Sri Lanka tea production (April 2022)

Sri Lanka tea production for the month of April 2022 totalled 22.91 million kgs, showing a decrease of 7.12 million kgs vis-à-vis 30.03 million kgs of April 2021. All elevations have shown a decline, over the corresponding month of 2021. January-April 2022 cumulative production totalled 86.23 million kgs, recording a significant decrease of 18.31 million kgs vis-à-vis 104.54 million kgs of January-April 2021. On a cumulative basis too, all elevations have shown a decline over the corresponding period of 2021. When compared to 74.50 million kgs of January-April 2020, cumulative production of 2022 shows an increase of 11.73 million kgs. On a cumulative basis, all elevations have shown a gain over the corresponding period of 2020. The available tea crop figures for the first four months period are appended below (in MT).

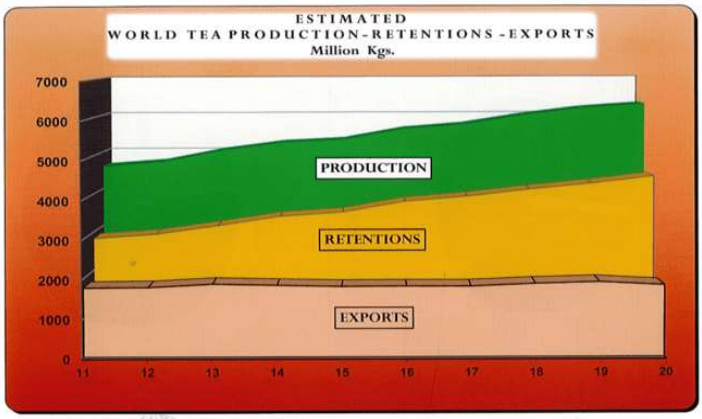
Sri Lanka tea exports (January to December 2021)

Tea exports for December 2021 totaled 24.17 million kg, up 0.24 million kg from the 23.93 million kg exported in December 2020. When compared to the corresponding period in 2020, the main categories of bulk tea and tea bags have increased, while packaged tea has decreased.The cumulative exports from January through December 2021 totaled 286.02 million kg, an increase of 20.45 million kg over the 265.57 million kg of January through December 2020.Bulk tea, tea bags, and packaged tea are the three main export product categories that have all increased since the corresponding period in 2020.Tea exports generated revenue of Rs. 263.35 billion in January-December 2021 shows an increase of Rs. 33.18 B in comparison to the Rs. 230.17 B of January-December 2020. It also surpasses the previous best of Rs. 240.6 B realised in January-December 2019.



The FOB value of Rs. 920.76 represents a gain of Rs. 54.06 over the FOB value of Rs. 866.70 for the period of January through December 2020, making it the highest FOB value ever recorded and surpassing the previous best that was realised during the aforementioned period of 2020.Even though the total value of rupees at the FOB has decreased slightly in USD terms in 2021, it has increased significantly overall.

While Tea Bags have shown a healthy increase when compared to the corresponding period of 2020, Tea in bulk and packeted Tea FOB values show a slight negative variance in USD terms. After an increase of 27% YoY in January–December 2021, Iraq has become the No. 1 major importer of Ceylon tea. With a decrease in imports of 23.5% YoY, Turkey has slipped to No. 2, and it is now followed by Russia, whose imports have also decreased (7.6% YoY). The United Arab Emirates has risen to the fourth position after significantly increasing imports (167% YoY). Iran, which dropped one spot to rank fifth, experienced a slight increase in imports (4.7% YoY) from January through December 2021. China, Libya, and Azerbaijan are three additional notable importers. Syria and Chile. While this was happening, imports to countries like Saudi Arabia, Chile, and Syria all experienced declines. Notable import trends include significant YoY increases of 58% and 17% for Libya and Japan, respectively. The tea export figures for the twelve months (January to December 2021) are listed below (in MT).



Description	Quantity (MT)
Bulk	125,388
Tea in Packets	128,344
Tea In Bags	24,665
Instant Tea	3,032
Green Tea	4,587
TOTAL	**286,016**

Market outlook for 2022

The following needs to be taken into account when imagining a potential market scenario. At this point, when there is a lot of uncertainty, forecasting the market outlook for Ceylon Tea for the year 2022 seems like a difficult task. However, we have examined the current supply and demand conditions and made projections based on the most likely market scenarios and recent changes in importer countries. It would be important to distinguish between the production of Orthodox and CTC tea when analysing the supply situation. The production of Ceylon tea in 2020 (278.8 M/Kg) is the lowest since 1997. A positive recovery was seen in 2021, largely as a result of favourable weather, but it is highly improbable that this recovery will continue in 2022. Therefore, when evaluating the overall assessment of the global supply, Kenyan tea production will be extremely vital. The rising demand for tea in tea-producing nations, which has resulted in lower exportable volumes, may be another factor that deserves careful consideration, as we have frequently highlighted.

Other factors that is likely to impact on prices:

- The likely devaluation of the Sri Lankan Rupee in early 2022.
- Improved demand from Iran following the Sri Lanka tea for oil payment deal.
- Importers of Orthodox teas are likely to have lower inventory levels in the backdrop of the deficit in the availability of Orthodox teas since 2015.
- Higher oil prices and greater demand from oil-rich Middle Eastern countries.

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FODDER MANAGEMENT & PRESERVATION TECHNOLOGY

About Author

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Animal husbandry is an important sector of our country. It contributes 4.1 per cent to the national GDP and 25.6 per cent to the agricultural GDP. However, despite being such an important sector, this enterprise is not relatively beneficial and competitive. The main reason for this is low animal productivity. The major factors responsible for low productivity of livestock are inadequate and low grade animal feed material, and various livestock diseases. A pastoralist usually invests about 60-70 per cent of the total expenditure of animal husbandry in arranging animal feed. Therefore, in such a situation, it becomes very important to provide animal feed in a balanced and adequate manner to make animal husbandry more productive and beneficial. The major components of the ideal animal feed are dry fodder, green fodder, lime bran, grain blank and mineral mixing. Out of all these components, green fodder is an important component whose availability throughout the year is very important.

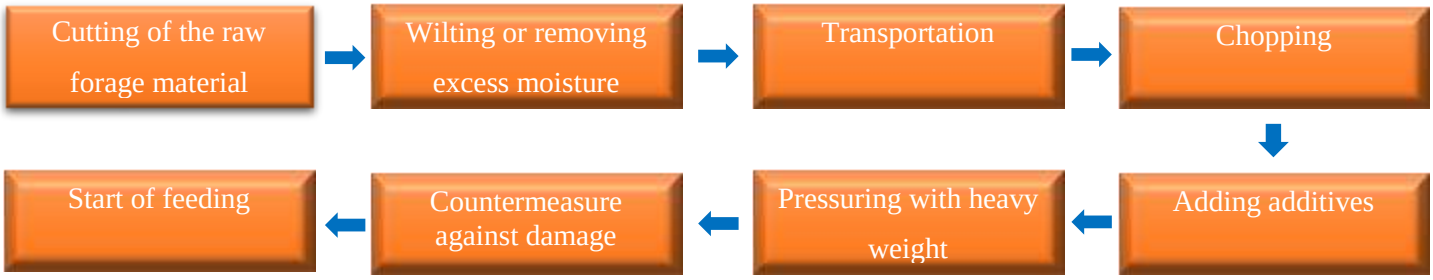
Introduction

Often, farmers use about 10 per cent of their total agricultural land to grow *Kharif* fodder and leave about 1 per cent for *Rabi* fodder. Thus, animals have to depend on fodder from *Kharif* season such as straw or kadvi etc. for most of the year. The nutrients contents in this type of fodder are generally low. Therefore, conservation of fodder is very important to provide balanced fodder for animals throughout the year, especially in the year-dependent areas where green fodder is available in a few months of the year. Silage and Hay are the main method of fodder conservation.

Silage

Green fodder preserved in windless conditions is called silage. To make silage, the fodder crop should chop to a size of 2-3 cm and have 30-35 percent of dry matter. Then the silos are filled with fine fodder material & they are covered with plastic from the top and closed with a fine clay paste. The quality of silage depends on the fodder crop, its condition and storage methods.

Grass crops are more suitable for making silage because these crops contain a high amount of sugar. Sugar converts into lactic acid in airless conditions, other harmful bacteria such as fungi etc. are not active when there is sufficient amount of lactic acid, due to which the quality of safe fodder is maintained. To further enhance the quality of fodder, 1.2 per cent urea or 8-10 per cent molasses, depending on the dry matter, are added to the fodder. Mixing pulses crops such as guar, cowpea, lucerne, berseem etc. with grass fodder also produces good silage. Along with fodder crops, such varieties of jowar, maize and bajra,



Silage making technology

whose stems are soft and the leaves are used in silage making. Due to the low sugar content in pulses fodder, they are generally not used for silage alone. Good silage are fungus-free and greenish-yellow in color with no viscosity. The amount of lactic acid is higher than other acids, ph value should be between 3.5-4.5 and dry matter should be about 30 percent. Ammonia content should not exceed 12 percent of the total nitrogen content.

Hay

Hey is a preserved fodder dried by cutting the green fodder crop in a suitable nutritional condition. The nutritional value of hay depends on the type of fodder, the stage of the crop, the method of making and the methods of storage. All fodder crops which can be fed to animals in green condition is suitable for making hay, but crops in which the leaves of the plant are wide, the stem is thin and soft, it is considered most suitable for making hay. The variety of fodder as well as the stage of the crop also has an impact on the quality of hay. Crops that are reaching the ripening stage are not considered suitable for Hay because the quality, digestibility and deliciousness of fodder decrease in this stage. On the contrary, in the initial stage of the crop, the total amount of nutrients and their ratio is not good, as well as due to the excess of water content, it is also difficult to dry. The appropriate stage for making hay is different in different crops of fodder. The following are some other important things to make good hay:

1. Crush the coarse-stemmed fodder crops with a roller before drying them.
2. The color of the hay should be green, for this turn the fodder 2-3 times a day while drying.
3. The amount of water in the hay should be less than 15 percent, when there is more moisture; the fodder is spoiled by mildew.
4. There should be a moisture-free ventilated place for storage of hay.

Diet and nutrition

The diet of animals in the desert region is mostly based on fodder that is fibrous, low-nutrient. Therefore, to keep the animals healthy and increase their productivity, it is necessary to give them the necessary energy and protein, mineral salts, vitamins etc. in a balanced manner. For this, The Rajasthan Cooperative Dairy Federation has made nutritious food chart by mixing molasses, jaggery, urea, mineral salts, wheat etc. which weighs 2.25 to 3.00kg. This one recommendation is used to lick an animal for about a week. By licking it, the animal gets the necessary elements daily and the animal takes more dry fodder and water, due to which the animal can maintain its body even on the basis of dry fodder. These dietary buckets can be preserved for a long time and can be easily transported from one place to another.

Method of obtaining green Fodder throughout the year

Method of year-round green fodder production for dense dairy areas in irrigated areas developed by Indian Grassland and Fodder Research Institute, Jhansi. In this method, in the first fortnight of October, the field is properly prepared and berseem is sown. At the time of sowing, it is sown by mixing Japanese mustard or Chinese rape seeds at the rate of 2 kg per hectare. This gives a good yield of fodder in the first harvest. By mid-February, plant rooted buds of hybrid Napier millet grass at a distance of one meter in rows are planted keeping plant-to-plant distance 30-35 cm. At the end of June, after harvesting the lobia, prepare the land between the rows and put 50 kg nitrogen in it at the rate of 100 kg phosphorus and 50 kg potash per hectare. In the first week of November, sow cowpea again in the rainy and summer as before. Add half of the phosphorus content in the second year before sowing berseem in the third year, prune the roots of hybrid napier-millet to provide enough space to grow berseem.■

FORAGE DAY

About Author

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Indian Council of Agricultural Research-Indian Grassland and Fodder Research Institute-Jhansi has announced to celebrate '**Forage Day'** on 9th Sep. every year in a detailed program. There were present mainly Director of IGFRI, Dr. A.K. Roy, Vice Chancellor of Central Agriculture University-Jhansi, Dr. S. K. Chaturvedi and Principle Scientist and project incharge of AICRPFCU-Agronomy Dr. Rajeev Agarwal in a program.

Program started with "Lighting of Lamp". After that Dr. Rajeev Agrawal told about the program. In the starting of the program he gave a quotation- "Fodder for every animal, fodder in every situation."

India is an agriculture dominated country and there are 109.9M Buffalos, 73.3M Ships, 148.8M Goat, 110M Cow in India. Total livestock in India is 535.8M (Ref.-NDDB).

Fodder is very important for animals but as well as industrialization is progressing in country, fodder area is decreasing day by day. By which the animal is not able to take food in sufficient quantity.

India is the biggest milk producer country, India produce 22% milk in all over the world. If quality and quantity of fodder will improve than India can cross 22% too. The market cap of forage seed is now 20,000crore which can be cross 40,000crore in the coming days. Keeping all this in mind IGFRI has announced to celebrate Forage Day on 9th September.

On the occasion of Diamond jubilee Foundation Day (1Nov2021), IGFRI has established "Forage Garden" in 55 places in India where farmers are given incentive and training for forage production. The research work done on cereals crop was not done in fodder crops due to which the fodder crops area is continuously decreasing but the condition is improving due to continuous effort of IGFRI.

In the next stage of program, the Vice Chancellor of Central Agriculture University, Dr. S.K. Chaturvedi discussed about the research on fodder and technology transfer to the farmer. He told the farmers should know about '*Alternate Land Use'* and apply indigenous technology. Integrated cultivation of fodder crops with food grain crops need attention. The humans need staple food equal as milk, curd, whey etc. obtained from animals. Fodder is very important for the health of animals.

Due to the less production in fodder crops, the cattle are destroying the crops of the farmers. In the last few years 45% of fodder is less, but 14% of fodder is less in the present time.

India has 2.5% of the total land area in the world, but 15% of the total livestock of the world is in India. In such situation, it is very important to promote fodder production.

In this direction, IGFRI is constantly work to reach the farmers by conducting new research. To make every citizen of the country aware about fodder crops, 9th September was declared as "Forage Day". Livestock must also be kept healthy society because humans and animals are dependent on each other.

■■■

NANO UREA
THE FUTURE'S THOUGHT

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The "urea" that is now available on the market in prills or granular forms is not only expensive for the producer, but they also pose a risk to both people and the environment. Additionally, "Nano Urea (liquid)" reduces environmental pollution and enhances the physiological and agronomical characteristics of crops growing under abiotic stress. Due to its smaller nanoparticle size, increased surface area, high reactivity, and water solubility, Nano urea increases photosynthetic rate, yield of the crop, and the amount of dry matter produced. In order to boost nutrient use efficiency, decrease fertiliser waste, and lower cultivation costs while also providing nutrients throughout the crop growth cycle, Nano urea is a key tool in agriculture. Additionally, it protects the plant from many biotic and abiotic stresses.

Introduction

In place of conventional urea, Nano urea is a liquid formulation of urea based on nanotechnology that provides nitrogen to plants and promotes sustainable agriculture. The nitrogen particles in Nano urea have a larger surface area (10,000 times that of a 1 mm urea prill) and are more numerous (55,000 nitrogen particles over 1 mm urea prill). Nano urea treatment considerably reducing the soil's exposure to agricultural chemicals also enhances crop production, biomass, soil health, and nutritional value and in detail benefits are shown in figure 2. The nitrogen in nano urea successfully satisfies the crop's nitrogen needs. It is more effective when used than regular urea.

Facts about nano urea

Technical information

At the Nano Biotechnology Research Centre in Kalol, Gujarat, Sir Ramesh Raliya and his team of scientists developed "Nano Urea (liquid)" in accordance with Atmanirbhar Bharat and Atmanirbhar Krishi. Since May 2021, the development of Nano urea has been a topic of conversation. Since June 2021, commercial production has been underway and priced at Rs. 240 per 500 ml bottle by IFFCO. One bag of conventional urea provides the same amount of nitrogen nutrients as 40000 mg/l of nanoparticles, or ppm, found in a 500 ml bottle. Nano urea comprises (in weight percent): 0.01 to 5 weight percent quinhydrone, 0.01 to 10 weight percent calcium cyanamide, and 85 to 99.98 weight percent urea, although it may also contain micronutrients that aren't nitrogen-containing for plants. The typical physical size of Nano urea particles is between 20 and 50 nm. The amount of nitrogen nanoparticles is 4% of the total weight. Although IFFCO asserts that 500 ml of a bottle is adequate for one acre, this is not a normal dose because the amount of nano urea needed depends on the variety of crops and their nitrogen needs.

Applying nano urea

Application guidelines

Since nano urea is sold as a liquid solution, it is sprayed over leaves. Before using, give the bottle a good shake. Spray on crop leaves during active growth stages using a solution of 2 to 4 ml per litre of water. Spray on the leaves using a flat fan or a nozzle that has been clipped. Spray in the morning/

evening to avoid dew, and repeat the application if rain falls within 12 hours of the initial application. Before combining and spraying, it is always advisable to choose a jar to ensure compatibility. Apply two foliar sprays for the greatest results, the first at the active tillering or branching stage (30–35 days after sowing or transplanting), and the second 20–25 days later or prior to the crop flowering.

(Note: Applying nitrogen via DAP or complex fertiliser shouldn't be stopped at the basal dose or dressing. Reduce only the top-dressed, 2-3 divided urea. The quantity of nano urea spraying can be increased. It depends on the crops and how much nitrogen they need).

What role does nano urea play in plant growth and how (Mode of action)...?

Due to its extremely small size, nano urea easily enters stomata and other openings when sprayed on leaves and is absorbed by the plant cell. Phloem facilitates its simple distribution inside the plant from source to sink in accordance with its requirements. The plant vacuole stores unused nitrogen, which is slowly released for appropriate plant growth and development (Figure 1).

Nano urea's (liquid) advantages in agriculture

In addition to reducing the need for traditional urea by at least 50%, Nano urea (liquid) has a number of other advantages, which are shown in picture "C" below. less is needed and more is produced; One bottle of Nano urea (500 mL) has the same effectiveness as one bag of urea; Farmers can easily transport and store nano urea; The nano urea liquid absorbs by plants more readily when sprayed on leaves due to its

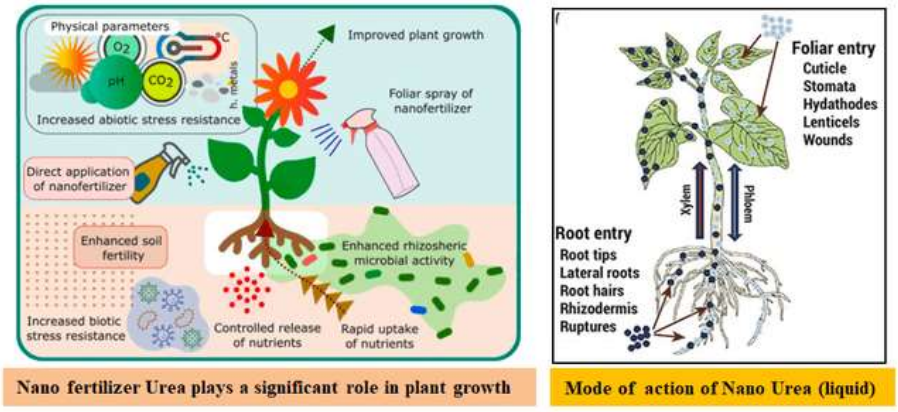

Fig. 1: Nano urea role and mode of action in plant growth

ultra-small size and surface characteristics; A sustainable agricultural tool. These nanoparticles penetrate the plant to the areas where nitrogen is needed, where they release nutrients in a controlled way to reduce usage and environmental waste. In addition, nano urea has been tested for biosafety and toxicity in accordance with Indian norms and the international standards created by the OECD, which are approved and accepted globally, in addition to boosting crop output, soil health, and nutritional quality.

Figure 2. Nano urea's (liquid) advantages in the agriculture

Future outlook and summary

The first Nano Urea Liquid has been made in India it available to farmers worldwide, according to Indian Farmers Fertilizer Cooperative Limited (IFFCO). Only IFFCO Nano Urea has been authorised by the Indian government and is listed in the Fertilizer Control Order (FCO). It has been created and patent by IFFCO. One bottle of Nano Urea can successfully replace at least one bag of urea. We know that using Nano urea boosts farmers' income and crop productivity, which is the primary difficulty in agriculture. It also serves as a tool for sustainable agriculture and has no negative environmental effects. If Nano urea continues to operate as well as it now does, it will undoubtedly be a godsend and blessing for farmers and agriculture. By contributing to agriculture, Nano urea will transform "the age of science" into "the age of agricultural science." Nano urea will also improve the future of farmers and agriculture and revive interest in it among those who have turned away from it.■

NANO NPK (19:19:19)

A UNIQUE FERTILIZER FOR ENHANCING PLANT GROWTH AND PRODUCTION

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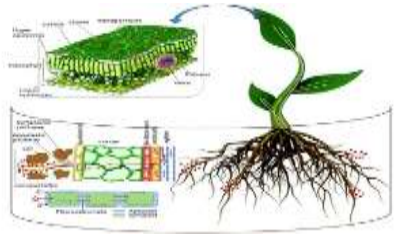
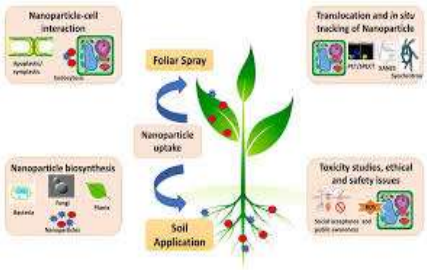
Nano NPK (19:19:19) is a 100% water soluble fertilizer containing all three major nutrients *viz.*, 19% Nitrogen, 19% Phosphorus and 19% Potassium in equal quantity, used for foliar application and fertigation (drip irrigation) to fulfils deficiency of any or all nutrients at any stage of plant growth. It is useful for all crops and gives crop early boost, increases vigor of the crop makes the crop healthy since pesticides and fungicides are very compatible with this product. All pesticides and fungicides can be mixed.

Benefits

- Nano NPK 19:19:19 is a very good source of soluble Nitrogen, Phosphorus and Potash.

- It encourages healthy vegetative growth of plants in early stages and seed and flower formation in later stage.
- It also play important role in formation of amino acid and chlorophyll which lead to growth and development of plants.
- It contributes to many fundamental plant processes such as strong roots and setting flower buds.
- It also helps in improvement of crop quality and increase resistance to plant diseases.
- It also helps the plant through stressed times such as diseases/insect damage, drought and cold temperatures.
- It performs very well for flowering plants and fruit bearing plants. Increases the quantity and size of fruits, leaves and flowers.
- It increases crop yield by 20-25%.





Recommended crops- All crops
Mode of application- Foliar spray/ drip irrigation
Doses- 200gm/Acre

Use of nano fertilizer is better than conventional fertilizer

It promotes growth and reduces environmental pollution. Excessive use of conventional fertilizer causes environmental pollution by leaching, dinitrification and volatilization of chemical fertilizers. Nano fertilizer offers a slow and gradual release of nutrients for a more extended period. Nano fertilizer also reduce the crop cycle period and increase yield.

Conclusion

Growing crops with heavier fertilizer concentrations further increses may be limiting to crops growth due to nutrient toxicity. Nano fertilizers provide more area for photosynthesis leading to more sunlight absorption and greater yields of the crop. It will happen plants survive challenging environmental factors such as drought. Limitations sin agricultural land and water supplies can improve production land and water use productivity through the use of new technologies.Nanotechnology has numerous potential to contribute significantly to sustainable agricultural production, particularly in developing countries.■

POTENTIAL OF CROP SPECIFICATION BIO-FERTILIZERS

About Author

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Bio fertilizers are low cost, renewable sources of plant nutrients which supplement chemical fertilizers. They are selected strains of beneficial soil microorganisms cultured in the laboratory and packed in a suitable carrier. They can be used either for seed treatment or soil application. Bio-fertilizers solubilizes or mobilizes plant nutrients *viz*– essential, non-essential through their activities in the soil or rhizosphere and make available to plants in a gradual manner and gains momentum. It maintains the soil health, minimize environmental pollution and cut down on the use of agro-chemicals in agriculture which is non-tedious and economically feasible. It thus increases the natural low budget organic farming.

Bio-fertilizers are organic source which plays an important role in meeting the nutrient requirement of crops through biological nitrogen fixation (BNF), solubilization of insoluble phosphorus, stimulating plant growth and accelerating decomposition of plant residues. *Rhizobium* bacteria are important bio-inoculants of legume seed, which have a symbiotic association to fix atmospheric nitrogen. Rhizobium inoculation to pulses can lead to a saving of about 20 to 40 kg N/ha. Phosphate solubilizing bacteria (PSB) assume greater significance because it helps to convert insoluble organic phosphates into simple and soluble forms. Inoculation of seeds with phosphate solubilizing bacteria increase nodulation, crop growth, nutrient availability, their uptake and crop yield of field pea. The blanket use of inorganic chemical fertilizers has led to soil and water pollution and affected the population and diversity of beneficial micro-organism in soil. This results to crops more prone to attack of insect pest and drastic decline of the crop yield.

Role of bio fertilizers in conservation agriculture

1. Increase the nutrients availability through atmospheric nitrogen fixer, increase the solubility of soil phosphorus.
2. Bio fertilizers are eco-friendly
3. It is reduce the negative impact on soil and environmental.
4. Price of bio fertilizers relatively low comparable other chemical fertilizer
5. Fast the germination and initial growth of the crops.
6. Decrease the total requirement of water of the crops.

How to work

1. Bio fertilizers fix atmospheric nitrogen in the soil and root nodules of legume crops and make it available to the plant.
2. They solubilize the insoluble forms of phosphates like tricalcium, iron, and aluminium phosphates into available forms.
3. They scavenge phosphate from soil layers.
4. They produce hormones and anti-metabolites which promote root growth.
5. They decompose organic matter and help in mineralization in soil.
6. When applied to seed or soil, bio fertilizers increase the availability of nutrients and improve the yields by 10 to 25% without adversely affecting the soil and environment.

Names of Rhizobia	Groups	Crops
Pea rhizobia (*R. leguminosarum*)	Pea group	Peas (*Pisum* spp.); vetches (*Vicia* spp.); lentils (*Lens culinaris*); faba bean *Vicia faba*)
Bean rhizobia (*R.*phaseoli)	Bean group	Beans (*Phaseolus vulgaris*); scarlet runner bean (*P. coccineus*)
Clover rhizobia (*R.*trifolii)	Clover group	Clovers (*Trifolium* spp.)
Alfalfa rhizobia (*R. meliloti*)	Alfalfa group	Alfalfa (*Medicago* spp.); sweet clovers (*Melilotus* spp.); fenugreek (*Trigonella* spp.)
Chickpea rhizobia (*Rhizobium* sp.)	Chickpea group	Chickpea (*Cicer arietinum*)
Soybean rhizobia (*Bradyrhizobium japonicum*)	Soybean group	Soybeans (*Glycine max*)
Leucaena rhizobia (*Rhizobium* sp.)	Leucaena group	Leucaenas (*Leucaena leucocephala*; *L. shannoni*; *L. lanceolata*; *L pulverulenta*); *Sesbania grandiflora*; *Calliandra calothyrsus*; *Gliricidia sepium*; *Acacia farnesiana*
Cowpea rhizobia (*Bradyrhizobium* spp.)	Cowpea group	Pigeon pea (*Cajanus cajan*); peanut (*Arachis hypogaea*); cowpea, mung bean, black gram, rice bean (*Vigna* spp.); lima bean (*Phaseolus lunatus*); *Acacia mearnsii*; *A. mangium*; *Albizia* spp.; *Enterolobium* spp., *Desmodium* spp., *Stylosanthes* spp., Kacang bogor (*Voandzeia subterranea*), *Centrosema* sp., winged bean (*Psophocarpus tetragonolobus*), hyacinth bean (*Lablab purpureus*), siratro (*Macroptilium atropurpureum*), guar bean (*Cyamopsis tetragonoloba*), calopo (*Calopogonium mucunoides*), puero (*Pueraria phaseoloides*).

ROLE OF PUSA DECOMPOSER

IN MANAGEMENT OF CROP RESIDUE PROBLEMS

About Author

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Stubble burning (known as 'Parali') is a practice of setting fire to crop residues that includes mainly all parts of plants viz. stems (stubbles), leaves, stalks, and seed pods of crops mainly paddy. Due to lack of knowledge among the Indian farmers, this practice is still being practiced by several farmers in India. The burning of stubbles not only leads to severe deterioration of air quality index (AQI) but also impose several health hazards. The smoke produced from stubble burning travels to larger distances thus endangering lives of hundreds of millions of people. Stubble burning in Uttar Pradesh, Haryana, Punjab threaten air quality index of Delhi. Farmers of these regions burn upto 35 million tonnes of crop residue from April to November.

In the recent several years, government have banned stubble burning and taken several measures to curb the number of stubble burning every year. Only banning this practice will not work, there needs to be a permanent and effective solution for stopping this menace.

Hazardous effects of stubble burning

Smoke contains Carbon monoxide (CO), Methane (CH_4), Nitrogen oxides, Sulphur dioxide (SO_2), Particulate Matter and Ground-level Ozone. These pollutants combined together to form a Toxic Cloud called as 'Smog' in Delhi. These toxicants leads to air pollution and soil erosion thereby causing health issues and productivity problems. Delhi Government has come up with solution of stubble burning issue by spraying solutions of Pusa decomposer in farmlands. This decompose the stubbles left after the harvest in fields.

Pusa decomposer

It a mixture of seven fungi which produce enzymes to digest lignin, pectin, and cellulose in paddy straw. The fungi thrive at 30-32 degree celsius which is the prevailing temperature at the time of harvesting of paddy. It is a low cost capsule that converts paddy stubble into bio-manure. A liquid formulation is formed using decomposer capsules and it is fermented for 8-10 days. Then the mixture is sprayed in fields having stubbles of crops in order to ensure bio-decomposition of stubbles in fast and effective manner. This eco-friendly technology has been developed by ICAR-IARI, New Delhi.

Method of preparation of mixture:

Decomposer mixture is prepared by using around 250 gm of jaggery boiled in approximately 5 litres of water. Around 50 gm of finely grounded chickpea flour is mixed into it. Cover it with thin cloth and let it undergo process of fermentation for a period of 4-5 days in dry place. One can use this culture for further preparation of the decomposer solution and it takes around 10-12 days.

Application of mixture in field:

For one acre of land around 10 litres of decomposer solution is sufficient. After spraying the decomposer solution turn the soil

thoroughly. Adequate supply of water needs to be ensured in the fields.

Farmers use 4 capsules, jaggery and chickpea flour to prepare 25 litres of liquid mixture which is sufficient for 1 hectare area. It takes about 20 days for the completion of decomposition process. Under normal condition, around 45 days are required for the decomposition of shredded and watered paddy straw mixed with soil.

Benefits of Pusa decomposer:

- Improves soil fertility and productivity as stubble works as manure and compost so low consumption of fertilizer will be required in future.
- It is effective, efficient, cheaper, doable and practical in nature.
- It is an eco-friendly and environmentally useful and safe technology.

Conclusion:

Since stubble burning has always been a burning issue in northern parts of India which leads to air pollution, health hazards in humans, soil erosion and loss in crop productivity. Government has come up with solution for this issue by introducing PUSA decomposer developed by ICAR-IARI, New Delhi and urged other states to adopt this green technology which in turn helps in the decomposition of crop residues. This technology improves the soil fertility, improves air quality index (AQI) by reducing air pollution. Hence, it is safe for humans as well as environment.

GREEN SEEKER

A INTENSIVE SITE-SPECIFIC REAL-TIME NITROGEN APPLICATION TOOL

About Author

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Excessive nitrogen (N) application to any crop causes environmental pollution, increases the value of farming, reduces yield and contributes to heating. Nitrogen is important for plant growth and development. The worldwide nitrogen utilisation efficiency for cereals and row crops is only 33%. Denitrification, volatilization, and leaching accounts for around 67 percent of fertiliser nitrogen loss. Green Seeker is one among of the most effective instruments for managing nitrogenous fertiliser inputs with precision, and it helps to avoid fertiliser overuse. It's often be used to estimate the accurate amount of nitrogen to be applied at critical period of crop growth.

Introduction

Due to field variations in soil nitrogen supply, varietal variability, and agro-climatic variables, nitrogenous fertiliser efficiency is restricted. Large temporal and field-to-field variability inhibits the efficient use of nitrogenous fertilisers when broad-based general fertiliser recommendations are applied. Precision nutrient management for nitrogen application are often utilised to improve fertiliser efficiency while also lowering production costs. However, optimal application of nitrogen also plays a valuable role in combating drought. Nitrogen (N) is taken into account a key component of many organic compounds. Nitrogen is one among the most essential nutrient elements for rice growth and metabolic processes. Nitrogen represents an important role in improving yield production and enhancing the photosynthetic activity especially during the grain filling stage of rice crops. So, for the precise recommendation of nitrogen fertilizer using green seeker. Its work on site specific, right time with right dose calculation of nitrogenous fertilizers for crop. Green Seeker has the potential to be a useful gizmo for nitrogen management.

Precision nutrient management and its need

Precision nutrient management is that the dynamic, field specific approach for nutrients management during a particular cropping system and or season to optimize the supply and demand of nutrients according to their differences in cycling through soil plant systems. With specialized application equipment or multiple application events supported site-specific real-time observation measuring actual crop requirement and find the difference between nutrient demand of the crop and nutrient supply has been optimized. It involves nutrient application on soil test basis, yield goals, factors influencing crop response to nutrient application. Within the current scenario, precision nutrient management is very crucial for:

- Reducing the nutrient losses.
- Reducing the off-site transport of agricultural chemicals via surface runoff, subsurface drainage and leaching.
- Sustainability.
- Improving fertilizer use efficiency.

Green seeker

Green Seeker, a hand-held device, can measure the NDVI easily within the field. It wants to calculate the nitrogen fertiliser demand in a wide area of crops but mainly in wheat, maize crops. Optical sensors could also be used to record site specific real-time data and are simple for farmers to utilise. Green Seeker is one among the most effective instruments for managing nitrogenous fertiliser inputs with precision, and it helps to minimise fertiliser overuse. It's often can be used to calculate the precise amount of nitrogen to apply during important stages of crop development. It conserves nitrogen while not lowering yield. It's a system that assesses a crop's nitrogen requirements using an integrated optical sensing, variable rate application, and mapping system. Various algorithms were developed by different scientists across the planet under different cultural conditions with application of graded doses of the N fertilizer in wheat crop. If the expansion of the crop is good then N requirement calculation with the help of Green Seeker will be more but if the growth is poor then it will guide us in quantifying of higher doses of N. A vegetative metric

called NDVI (normalised difference vegetation index) and an environmental element called GDD (growing degree days) are wants to determine crop production potential. Oklahoma State University within the United States created this technology, which was licensed to N Tech Industries in 2001. Thus, by utilising the precision of crop demand and to feed consistent with the deficit Green Seeker based nitrogen application provides high nitrogen use efficiency. As a result, blanket application of fixed N dosages over an enormous region should be gradually replaced by need-based fertiliser N management to ensure high fertiliser use efficiency. The green seeker used at Regional Research Station Jhanjharpur and Krishi Vigyan Kendra, Sukhet under the climate resilient agriculture (CRA) programme.

Fig 1: Using green seeker at field

Working mechanism of green seeker sensor

The sensor of Green Seeker uses light emitting diodes (LED) to get red at 660 nm wavelength and near infrared (NIR) at 780 nm wavelength light. Red light is absorbed by plant chlorophyll as an energy source during photosynthesis. Healthy plants absorb more red light and reflect larger amounts of NIR which indirectly show the greenness of the plant which successively reveal that the plant has no requirement of nitrogen at that point of time. The reverse phenomena occur when the plants suffer from nitrogen deficiency where the plant absorb larger amount of NIR and reflecting higher red light. Calculation of Nitrogen Requirement Nitrogen doses using Green Seeker were calculated as per the quality procedure developed by different researchers which can be separated into several discrete components. Normalized difference vegetation index (NDVI) measurements made by Green Seeker are supported following formula:

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

Where, NIR is the reflectance in the near infrared region and
RED is the reflectance in the red region of the electromagnetic spectrum.

In-season Estimation of yield (INSEY) was made by using following formula:

$$INSEY = \frac{NDVI}{Days\ from\ planting\ to\ sensing}$$

Yield potential (YP_0) with no added fertilizer was calculated from following equation:

$$YP_0 = a(INSEY)^b \text{ or exponential function}$$

NDVI readings can range from 0.00 to 0.99; the upper the reading, the healthier the plant. The worth 0 represents an absence of vegetation.

Advantages of green seeker

- It's simple, fast and non-destructive.
- Easy to installation and calibration.
- Site-specific real-time nitrogen management.
- Less labour required.
- It's often be used with existing rate & control systems.
- Works in any weather condition-summer, rainy and winter season in day or night.
- Can apply with or without GPS signal.
- Do not rely on historical information or mapping.
- Distinct management zones within the field can be identified.

Conclusion

The green seeker estimates the right amount of N required at the critical stages of crop growth and save N without yield reducing. Therefore, green seeker is the tool to identify, analyse and manage variability within fields for optimum profitability, sustainability and protection of land resources. Green seeker based nitrogen management has a great scope both at farm level and institution level for further research under the changing scenario of climate change.

■■■

ROLE OF PANCHGAVYA IN AGRICULTURE

About Author

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Traditionally, five components are mixed to create the panchagavya or pancha-kavyam, which is utilised in Hindu rituals. The two derived products are curd and ghee, and the 3 main ingredients are cow dung, urine, and milk. These are combined properly, after which fermentation is permitted. Panchagavya, a Sanskrit word, means as "five cow-derivatives." Its alternate name in Ayurvedic medicine is cowpathy.

An organic substance that has the ability to help plants grow and develop their defence mechanisms. Cow dung, cow urine, milk, curd, jaggery, ghee, bananas, tender coconuts, and water make up its nine ingredients. When combined and applied properly, these have miraculous effects.

Properties of panchagavya

It contains almost all of the major nutrients, micronutrients, growth hormones (IAA & GA), fatty acid, alkane, alconol and alcohol required for crop growth.

Preparation of panchgavya:

Panchgavya is an organic formulation, in Sanskrit, means the blend of five Cow products like cow dung, Cow urine, curd, ghee, milk, and some other important ingredients. All the ingredients added to a wide mouthed plastic can as per order e.g. first poured cow dung 7kg and cow ghee 1kg mixed thoroughly in morning & evening and kept that for 3 days. After 3 days cow urine 10 lit & water 10 lit was mixed and kept that for 15 days with regular mixing in morning and evening. After 15 days, cow milk 3 lit, cow curd 2kg, coconut water 3 lit, jiggery solution 3 lit and well ripened banana 12 nos. added, kept under shade another for 15 days.

Recommended dosage

Spray system

In comparison to the higher and lower concentrations examined, 3% solution was shown to be the most efficient. For all crops, the optimal ratio is three litres of Panchagavya to every 100 litres of water. The 10 litre power sprayers may require 300 ml/tank. Sediments must be filtered before being sprayed with a power sprayer, and manually powered sprayers must have a nozzle with a larger particle size.

Flow system

Through drip irrigation or flow irrigation, the Panchagavya solution can be mixed with irrigation water at the rate of 50 litres per hectare.

Seed/seedling treatment

Before sowing, seeds or seedlings can be soaked in a 3% solution of Panchagavya. A 20-minute soak is sufficient. Before planting, turmeric, ginger, and sugarcane rhizomes can be treated for 30 minutes.

Seed storage

The seeds can be dipped in 3% Panchagavya solution before being dried and stored.

Periodicity:

Pre flowering phase	Once in 15 days, two sprays depending upon duration of crops
Flowering and pod setting stage	Once in 10 days, two sprays
Fruit/Pod maturation stage	Once during pod maturation

Effect of panchagavya

Leaf

Panchagavya always causes plants to grow larger leaves and a denser canopy. For increased biological effectiveness, the photosynthetic system is triggered, allowing for the synthesis of the greatest amount of metabolites and photosynthates.

Stem

The lateral shoots that grow from the stem are strong and can support the most fruits through to maturity. Branching is significantly high.

Roots

There is extensive and heavy rooting. They also keep their freshness for a very long time. Additionally, deeper layer growth and root dispersion were seen. All of those roots support optimum nutrition and water absorption.

Yield

Under normal circumstances, when land is changed from inorganic systems of culture to organic farming, there will be a yield decrease. When land is transformed from an inorganic cultural system to an organic one starting in the first year, Panchagavya is effective in restoring the yield level of all crops. In all crops, the harvest has been delayed by 15 days. Vegetables, fruits, and cereals have a longer shelf life and a better flavour because to it. Panchagavya guarantees increased profit and frees the organic farmers from stress by lowering or substituting expensive chemical inputs.

Drought hardiness

The leaves and stems develop a thin oily film, which lowers the rate of water evaporation. The plants' wide-ranging, deep roots enable them to endure prolonged dry spells. The two aforementioned elements help assure drought resistance and a 30% reduction in the amount of water needed for irrigation.

Conclusion

Panchagavya increases productivity by encouraging the growth of roots, stems, branches, and leaves as well as associated metrics including leaf area index, chlorophyll content, oil content, protein content, and other quality and yield factors.■

WOMAN EMPOWERMENT THROUGH

SELF HELP GROUPS

About Author

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Self Help Groups are considered as one of the most significant tools in participatory approach for the economic empowerment of women. It is an important institution for improving life of women on various social components. The basic objective of SHG is that it acts as the platform for members to provide space and support to each other. SHGs Comprises very poor people who do not have access to formal financial institutions. It enables its members to learn to cooperate and work in a group environment. Today, in India, Self Help Groups (SHGs) represent a unique approach to financial intermediation. This combines access to low-cost financial services with a process of self-management and development for the women who are SHG members. SHGs are formed and supported usually by Non-Governmental Organizations by Government agencies. Linked not only to banks but also to wider development programmes.

The origin of Self Help Groups (SHGs) is the brain child of Grameen Bank of Bangaladesh, founded by Prof. Mohammed Yunus in 1975, who tried out a new approach to rural credit in Bangaladesh. Grameen Bank gave loans without asking borrowers either to provide collateral or engage in paper work. In India NABARD initiated SHGs in the year 1986- 87 But the real effort was taken after 1991- 92 from the linkage of SHGs with the banks. SHGs mainly consist of 10-20 women or men from the underprivileged section who work together and save an amount of money from their earnings in a common fund. The members of the group are given from the common fund in case of emergencies. These are also linked to banks for giving micro credits.

Characteristics

Some common characteristics of self-help groups that are associated with CBR programmes include there.

- Voluntary nature – they are run by and for group members, have regular meetings, and are open to new members.
- Generally being formed in response to a particular issue, e.g. no access to education for children with disabilities, limited income-generating opportunities.
- Clear goals, which originate from the needs of group members and are known and shared by all members.
- Informal structure and basic rules, regulations and guidelines to show members how to work effectively together.
- Participatory nature – involving getting help, sharing knowledge and experience, giving help, and learning to help oneself.
- Shared responsibility among group members – each member has a clear role and contributes his/her share of resources to the group.
- democratic decision-making;
- Governance by members, using an external facilitator only if necessary in the formation of the groups.
- Evolution over time to address a broader range of issues.
- Possibility of joining together to form a federation of groups across a wider area.

Goal

People with disabilities and their family members participate in groups to resolve common problems, enhance their individual strengths, and improve their quality of life.

Key benefits of woman empowerment (SHG)

- Promotes participative and vibrant grass-root democracy.
- Enhances sustainability.
- Enhances effectiveness in poverty reduction.
- Promotes gender equity Strengthens demand system of poor at grass roots.
- Creates multi-faceted partnership through nested.
- structures Enables poor to shape their own destinies.
- Ensures co-learning among member organisations.
- Provides scale advantage.

Importance

Self-help group members develop knowledge and skills that enable them to become contributors of experiences collectively knowledge, building problems, solving and resource mobile

in their families and communities. People with disabilities and their family members are able to access mainstream self-help groups that are available to other members of the community.

- Self Help Groups (SHGs) are creating a platform for sharing satisfaction and other institutions that are not being addressed by existing organizations, institutions, or other types of groups.
- A SHG is formed independently without any political influences.
- It can be all-women or mixed-gender group.
- The SHG provides not only savings mechanism, which suit the needs of the members but also provides a cost effective delivery mechanism for small credit to its members.

Conclusion

Self-help groups of women is a means of development. This study basically focused on the promotion methodologies of SHGs in two different context of rural and tribal. And this proved it again that a development is dynamic element. It defers while the place, time and people changes. One single plan or one single methodology for a whole nation can never be sufficient. Yes, it also prove that there will be similarities in the approach, may be in all cases base can be same, but small changes or value additions can bring a tremendous result.

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VIOLENCE AGAINST WOMEN IN INDIA

About Author

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Violence against women in India is a result of gender relations that assumes women to be inferior to men. It is a technical word that refers to all violent crimes committed particularly or only against women. Similarly, this kind of violence targets a specific group with the victim's gender as primary motive. Cultural and social factors are interlinked with the development and propagation of violent behavior. With various processes of socialization men and women undergo, men take up stereotyped gender roles of domination and control. A female child grows up with a constant sense of being weak and in need of prediction, whether physical, social or economic. Because of her, helplessness has led to her exploitation at almost every stage of life. The law distinguishes several types of violence against women: psychological violence, physical violence, economical violence and sexual violence.

Forms of violence

Violence against women widespread forms around the globe include: Intimate partner violence, domestic violence, spouse or partner abuse, rape, harassment, family violence, sexual abuse, sexual violence, exploitation, molestation and forced prostitution and harmful practices, such as female genital mutilation /cutting (FGM/C), forced and child marriage.

Less documented forms, include: crimes committed in the name of "honour", prenatal sex selection, female infanticide, economic abuse, political violence, elder abuse, dowry-related violence, acid-throwing.

Types of violence and abuse:

Physical violence: It occurs when someone uses a part of their body or an object to control a person's actions.

Psychological violence: When someone uses threats and causes fear in an individual to gain control.

Verbal abuse: When someone uses language, whether spoken or written, to cause harm to an individual.

Sexual violence: It occurs when a person is forced to unwillingly take part in sexual activity.

Spiritual violence: When someone uses an individual's spiritual beliefs to manipulate, dominate or control that person.

Financial abuse: When someone controls an individual's financial resources without the person's consent or misuses those resources.

Emotional violence: When someone says or does something to make a person feel stupid or worthless.

Cultural violence: It occurs when an individual is harmed as a result of practices that are part of her or his culture, religion or tradition.

Neglect: When someone has the responsibility to provide care or assistance for an individual but does not.

Effects of violence on women:

Mental health: Depression, low self-esteem, guilt or shame, shock and disbelief, anxiety and panic attacks, anger, self-hate or self-blame, sense of fear and suicidal thoughts.

Behavior: Back or neck pain, high blood pressure or chest pain, high stress and lowered immune system, respiratory problems such as asthma and shortness of breath.

Economic: Medical bill, Legal fees and extra child care and protection costs.

Social: Discrimination and social isolation (from family, friends, and others who could help).

Conclusion

The prevalence of violence against women is rising daily because weak laws allowed victims to easily elude justice. Women's lives and health are significantly impacted by violence; the effects can continue for years or even a lifetime. But there are resources available, safeguards you can take, and there is still hope for recovery and a brighter future.■

to

THE KISAN RAIL

AN INITIATIVE FOR FARMERS IN INDIA

About Author

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As per the President of India, "The Kisan Rail, started throughout the country, is helping to chart a new course by increasing the access of Indian farmers to new markets. This rail is like a mobile cold storage. So far, over 100 kisan trains have been started, which have enabled the farmers to transport over 38,000 tonnes of food grains, fruits and vegetables from one region to the other."

Kisan Rail is an initiative to make it possible for farmers to access distant, larger, and more profitable markets by utilising the extensive railway network. The first Kisan Rail ran from Deolali in Maharashtra to Danapur in Bihar in August 2020 launched by Union minister of agriculture, Narendra Singh Tomar. In its initial days Kisan Rail used to run only once a week but by the end of the year it began 3 time service a week.

Kisan Rail

Impact

Various studies have shown that in last one year, since the introduction of first Kisan Rail on 7 August, 1,62,881 tonnes of perishable farm produce like Fruits and Vegetables were transported in 486 trips of Kisan Rail by Central Railway. Kisan Rail transformed smaller stations into a major farm produce loading hubs & thus enriched small & marginal farmers due stoppages at small stations.

Kisan rail routes

Till 22nd Jan 2021, 157 services of Kisan Rail have been run, transporting more than 49,000 Tonnes of consignments. Routes on which Kisan Rail trains have been operated so far are as under:

Route No	From - to	Date of Inaugration
1	Devlali to Danapur	7/8/2020
2	Ananatpur to Adarshnagar,New delhi	9/9/2020
3	Yashwantpur to Nizamuddin	19/9/2020
4	Nagpur to Adarshnagar (New Delhi)	14/10/2020
5	Chhindwara to Howrah	28/10/2020
6	Sangola to Howrah (Via Secundrabad)	29/10/2020
7	Sangola to Shalimar	21/11/2020
8	Indore to New Guwahati	24/11/2020
9	Ratlam to New Gawahati	5/12/2020
10	Indore to Agartala	27/12/2020
11	Jalandhar to Jirania	31/12/2020
12	Nagarsol to Guwahati	5/1/2021
13	Nagarsol to Chitpur	7/1/2021
14	Nagarsol to New Jalpaiguri	10/1/2021
15	Nagarsol to Naugachia	11/1/2021
16	Nagarsol to Fatuha	13/1/2021
17	Nagarsol to Baihata	19/1/2021
18	Nagarsol to Malda Town	20/1/2021

Important features of Kisan rail:

1- **Subsidy on transportation of fruits and vegetables:** Under Operation Green the Government of India also provided up to 50% subsidy for transportation of fruits and vegetables.

2- **Time saving:** The railway service saves an average of 15 hours of transportation time through roads. It also saves almost 1000 rupees per tonne on transportation costs. Saves times and encourages farmers to transport their perishables to greater distances and bigger markets.

3- **No issue of quantity:** The railway services can transport up to any distance in any time. There is no minimum or maximum quantity issue in this mode.

4- **Cold storage:** The fruits and vegetables are carried from one place to another in cold storage thus they do not lose any shelf value.

5- **Reduced wastage:** Almost 8 million dollars of vegetables and fruits are wasted every year due to various issues listed above which are saved through Kisan rail.

6- **No issue of network :** Vast network of Indian Railways enables farmers from remote villages to connect to the mainstream market and sell their agricultural produce.

Conclusion

Kisan rail will be game changer in ensuring a fast transportation of agriculture produce across the nation. There is no need to pay the tariffs while crossing the various states and route instead of that rail route provided a better option for the farmers and ensure that their shipment reaches in short period of time and in a safe way.

Also Indian railways have been maintaining food grains supply chain during covid 19 times in a vast scale. Our Indian railway lend a hand to farmers by helping their double income source with the launch of kisan rail. The train with frozen containers is expected to build a seamless national cold supply chain for perishables, inclusive of fish, meat and milk which help the farmers in generating more income.

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CHALLENGES IN INDIAN AGRICULTURAL MARKETING SYSTEM

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Agricultural marketing refers to all activities involved in the transfer of agricultural product from the produce to the final consumer. They include storage, transport, processing, grading and finally sale of the product. Agricultural product marketing basically consists of buying and selling of agricultural products. In India agriculture market is not well organised and farmers are facing many problem to sell their product.

Challenges faced by producer/ farmers in marketing their produce:

1. **Poor infrastructure and Lack of grading system:** Storage facilities are required for keeping rescue stock. Lack of availability of storage facility damage the produce. Cold storage units exist in less than one- tenth of the market and grading facilities in less than one- third of the market. In case of agricultural commodities mixing of good and bad product are very common. There is no proper method of grading of agricultural crops. It creates a problem of marketing both inside and outside the country. It hinders farmers from fetching the prices commensurate with the quality of their produce.
2. **A large Number of Middleman:** Middleman also takes a big share of farmers s borrows money without doing anything. Middleman makes excessive profits and farmers cannot get the retail prices of market product
3. **Licensing Barriers:** Commission Agents and traders have to compulsorily own a shop or go down for getting a license; it has led to the monopoly of license. Also the incidence of cartelization among the commission agents.
4. **High Incidence of Market Charges:** APMC are commissioned to collect market fees ranging between 0.5 to 2.0% of sale value of the product. Further other charges such as purchase tax, weighing charges etc.
5. **Lag in Demand Signal:** The absence of efficient real-time information channels create a lag in demand signals. Farmers often follow the price trend of previous season and this causes glut or scarcity of produce in a cyclic manner.
6. **Limited information Channels and content:** The current information dissemination systems (like local newspaper APMC display board) provide information only on price of major commodities. Although availability of such information are far away from farmers location and generally not available in local language.
7. **Absence of National Integrated Market:** Even though national level physical market in the form of APMC is present, there is no national level regulation for the same.
8. **Limited Public Investment:** Public expenditure on the agricultural marketing subsector ranges approx. 4-5% of the total public expenses on agriculture activities. Credit facilities are not adequate to meet the farmer's requirement.
9. **Lack transport of facility and Low land holding:** Collection of produce from small farmers is very expensive and difficult process. A main obstacle in way of efficient marketing is that rural areas are not linked with marketing road. A lot of agriculture product is wasted due to transport problem.

Conclusion

It can be concluded that India being an agricultural country have more than 70% population rely directly or indirectly on agricultural activity, although agriculture sectors contribute major share in country GDP. A good marketing system required for selling of product is lacking in country. The prevalent marketing practices are mainly unorganized with several defects. The measure required to solve these shortcomings involve different facets such as policy, infrastructure, standardization and technology. As a well-organized agricultural marketing system has potential to improve economic condition of farmers. Apart from all, there are many initiatives taken by Government such as e-NAM, Farmers Producers organisation (FPO), Market intelligence and early warning system etc., but in real world they are lacking in their value. A good market system ensures better return to farmers, stable market price and avoids exploitation of producer as well as consumers.

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WINTER VEGETABLES

AND THEIR INCREDIBLE HEALTH BENEFITS

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There is availability of almost every type of fresh vegetables in winter, which is a part of very important food from the point of view of human health. Information about the usefulness of some winter vegetables is given below.

Fenugreek

Botanically, this crop comes under the category of annual, herbaceous plant, which is grown for dual purpose (dry or fresh leaves and seeds). Fenugreek is used in food, fodder, medicine, cosmetics. Its fresh green and dry leaves are extensively used as winter vegetable, which contains fat, protein, fiber, carbohydrate, fiber, magnesium, calcium, potassium, iron, sulfur as well as vitamin A, C and Nicotine is found in abundance. Its seeds are used as a spice in vegetables and pickles. Fenugreek is used in Ayurvedic medicine for the treatment of various diseases due to its nutritional power. The use of seeds has been found to be more beneficial mainly for patients with dysentery, diarrhea, diabetes and high cholesterol.

Spinach

Spinach is one of the most common leafy vegetables in Indian households. Spinach is a nutritious green leafy green leafy greens, whose consumption is very beneficial in many diseases. And also fulfills the deficiency of many types of vitamins. Spinach should be consumed regularly in your diet. Spinach has an important place in leafy vegetables, which is cultivated all over India. Spinach is a crop rich in iron, minerals and vitamins. It is used as a green vegetable. Calcium Vitamin A is found in abundance and Iron Phosphorus Vitamin C is found in moderate amounts. Consumption of spinach leaves prevents cancer, stones, asthma, scabies etc. This coolant is healthy, blood purifier, antipyretic and also lowers blood pressure, which means it is great for anyone suffering from high blood pressure. Lastly, spinach also promotes healthy skin and hair growth.

Carrot

Carrot is another vegetable which is mostly available during the winter months. It is a great source of vitamins and nutrients. Consuming carrots can lead to a deficiency of vitamins A, B, and C in the body. In addition to important vitamins, carrots also contain folate, iron, copper, potassium and more. There are many health benefits from carrots. Its daily consumption improves eyesight, improves immunity and prevents cancer.

Radish

Radish is commonly used as a salad and cooked vegetable. It has a pungent taste; it is also used as a breakfast paratha with curd. Its leaves are also made into vegetables. Radish is a good source of vitamin C and minerals. Radish is also recommended for liver and jaundice patients. They are high in fiber and packed with vitamins E, A, C, B_6, and K, as well as antioxidants, zinc, phosphorus, potassium, magnesium, and calcium.

Sarson Saag

Think of winters in India and the first thing that comes to mind is Sarso Ka Saag, served with hot fresh makki ki roti. They are rich in antioxidants as well as iron and dietary fiber.

Green peas

Peas are another important winter vegetable, although you can consume peas throughout the year, but fresh green peas should be consumed during winters. They are rich in antioxidants as well as fiber, which prevent digestive problems and are excellent sources of plant-based protein. The added benefit is that peas can be easily incorporated into most Indian foods. Peas contain sufficient amounts of vitamins A and B. Peas can also be eaten raw and doing so does not harm the person in any way.

Turnips

Turnips are also considered one of the top produce for the winter months. The green part of turnip is full of vitamin C. It promotes better health for your lungs by limiting lung inflammation and emphysema. Another beneficial effect of turnip consumption is that it can treat kidney stones in some cases. Unless you have major stone formation, regular turnip consumption can ease the disorder.

Beetroot

Beetroot occupies an important place among root vegetables. Beetroot is grown for various purposes. It is mainly used in salads and juices. Its use removes the lack of blood in the body. Magnesium, calcium, potassium, phosphorus, iodine, iron, manganese, vitamins A, C, B-1, B-2 are found in abundance. They also boost immunity due to the presence of vitamin C in them. They are great for hair and skin.

Cole crops

Cole crops are one of the largest groups of temperate vegetables, which include important crops such as cauliflower, cabbage, cauliflower, broccoli, Brussels sprouts. Cole crops are rich in vitamin C and are good sources of minerals. Several volatile sulfur compounds are responsible for the characteristic taste of cole crops. Dimethyl trisulfide is indicated as a major flavoring ingredient in cooked brassy vegetables. Cabbage has a characteristic sweet aroma due to the 'synigrin' glucoside. It is rich in nutrients. It is rich in vitamins 'A' and 'C' and minerals like calcium, phosphorus. It is used as a vegetable and salad. Preserved by drying and preparing pickles. In cauliflower, vitamin B is found in sufficient quantity as well as protein is more than other vegetables, lump cabbage is rich in nutrients. It is rich in vitamins 'A' and 'C' and minerals like calcium, phosphorus. Broccoli It is rich in many nutrients. Along with protecting against many diseases, it also reduces the risk of breast cancer and prostate cancer. Brussels sprouts are a very good vegetable from the nutritional point of view. Protein, vitamin-A, calcium, iron are found in sufficient quantity in it.

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POSTHARVEST TECHNIQUES

TO IMPROVE THE SHELF LIFE OF EDIBLE MUSHROOM

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Edible mushrooms are highly nutritious food and play an important role in reducing malnutrition among people. But they have a very short shelf life of 1 to 2 days due to high respiration rate and water content leading to quality detonation like discolouration, loss of texture, off flavour and nutrient loss. Hence its postharvest preservation is very much important to improve its shelf life. The preservation methods include physical (irradiation, map, vacuum packaging, pulsed electric field), chemical (antibacterial agent washing, ozone, electrolyzed water, and coating), and thermal processes (drying and cooling) which are summarised in this article.

Introduction

Edible mushrooms have a short life span due to high moisture content. They don't have a cuticle to protect them from physical or microbiological attacks, or from losing water. They have a high respiration rate and a high-water content, which makes them susceptible to microbial deterioration and enzymatic browning. Mushrooms are the fungi, like other vegetables and fruits, that breathe, grow, mature, and die after harvest, affecting quality and shelf life significantly. They are perishable because they contain 85 to 90% water. They have a short shelf-life (1 to 2 days). Since ancient times, mushrooms have played an important part in the lives of people who harvest them in the wild. Mushroom quality degrades continuously after harvest, resulting in discolouration, texture changes, moisture loss, an increase in microbial count, and nutrient and flavour loss. Postharvest preservation strategies, including physical, chemical, and thermal processes are necessary to maintain postharvest quality and extend the shelf life of mushrooms. For postharvest quality management of mushrooms, drying and cooling are two useful thermal techniques. Modified atmosphere packaging, Modified humidity packaging, pulsed electric field and irradiation are examples of different preservation approaches. Chemical procedures include antibacterial agent washing, ozone, electrolyzed water, and coating treatments. Such different techniques to improve the storage stability of mushrooms are summarized in this article.

Preservation techniques

Drying: Microbial growth, enzymatic or non-enzymatic reactions, and physiological and morphological impairments are all prevented by reducing the moisture contents nearly to 13-14% by drying. To increase drying efficiency and product quality, edible mushrooms can be dried using a variety of techniques, including sun drying, mechanical drying, microwave drying, freeze, osmotic drying, vacuum drying, and dehumidified air dryers. During sun and convective air-drying heat transfer from the food surface to the centre is slow. As a result, a long dehydration period is required, resulting in reduction in the quality of final product. Microwave drying is a high-tech drying method that uses electromagnetic waves with frequencies ranging from 300 MHz to 300 GHz to dry the materials. In a short period of time, water particles absorb microwave energy, which is then converted to heat, causing water to evaporate quickly. Microwave drying can greatly reduce drying time when compared to solar or hot air drying. Based on water sublimation, freeze-drying can produce high-quality products by removing water from the solid phase to the vapour phase immediately during drying. Because freeze drying occurs at low temperatures, heat-sensitive qualities of items such as vitamins can be preserved without being damaged by heat. The water between mushroom cell walls and interhydral cavities is evaporated under low pressure during vacuum cooling, and evaporative cooling decreases the temperature from ambient to 20^{o}C in 15 to 20 minutes. Vacuum-cooling is a speedier and more uniform procedure in which mushrooms are exposed to low pressure and water evaporates, releasing the latent heat of vaporisation. Microwave vacuum drying assisted to produce more uniform dried products with a higher level of taste-active amino acids left over when compared to hot air, vacuum, microwave, and microwave vacuum drying.

Packaging: During postharvest storage, respiratory commodities like mushrooms absorb O_2 and emit CO_2. Microorganisms in fresh food are inhibited by the drop in O_2 and increase in CO_2 concentrations in modified atmosphere packaging (MAP). Low O_2 concentrations may slow mushroom respiration, delay cap opening and reduce discolouration. There are two ways to achieve the desired relative humidity (RH): piercing of the package, which prevents the changed atmospheric conditions from being achieved within

the package, and usage of active ingredients for water absorption, such as calcium chloride, silica which can maintain the necessary in-package relative humidity. Mushrooms are commonly wrapped in PVC film or other flexible films and packaged in plastic films e.g., polyethylene terephthalate (PET), or polyvinyl chloride (PVC). Other materials, such as PET with varying degrees of performance and materials derived from renewable resources, such as poly (lactic acid)/poly (-caprolactone) blend films and wheat gluten (WG) coated paper, have emerged. When WG coated paper was compared to a flexible PVC film, which is frequently used to over-wrap mushrooms, it was shown to be the most effective for extending their shelf life.

Pulse Electric Field: A pulsed electric field (PFE) is a non-thermal treatment for preserving the quality of mushrooms. In brief PEF therapy, electrical pulses can inactivate bacteria and improve the mass transfer process. The electric field strength in PEF causes transitory gaps in biological membranes, resulting in irreversible cell disruption, which aids in the killing of microorganisms from mushrooms.

Irradiation: To protect the quality of mushrooms, gamma irradiation, UV irradiation, and electron-beam irradiation were utilised. The World Health Organization (WHO) considers any food product irradiated with dosages up to 10 kGy to be safe. Gamma irradiation (up to 1 KGy) is a viable option for maintaining quality and extending the shelf life of *Lactarius deliciosus* L. wild edible mushroom. It inhibits the polyphenol oxidase activities in mushrooms, which reduces enzymatic browning. The effective dose of UV-C radiation helps to increase microbial safety of the mushrooms. In the case of electron-beam treatment, 1 kGy irradiation level extends the shelf life of mushroom slices by lowering aerobic and psychrotrophic populations.

Chemicals: Washing treatments such as sodium metabisulphite, sodium chloride, and sodium hypochlorite were employed to remove undesirable case particles and improve the whiteness of the mushrooms. However, washing with 1 g L^{-1} sodium metabisulphite had a negative effect on mushroom quality; the use of sulphite has been decreased and superseded by stabilised chlorine dioxide in Irish mushroom processing. By dipping whole fresh Mushrooms into citric acid solutions (0.5 %, 1.5 % and 2.5%), H_2O_2 solutions (1.5 %, 2.5%, and 3.5 %), and EDTA solutions (2 %, 4 %, and 6 %) for 10 minutes, researchers study the effect of various washing solutions on mushroom postharvest preservation. In terms of reducing weight loss, postharvest maturity index, and microbiological development, 2.5 % citric acid was found to become the most efficient option for mushroom quality preservation.

Coating: Coatings and films operate as a barrier between food products and the surrounding atmosphere, preventing the exchange of O_2, CO_2, and water vapour. Furthermore, the majority of them contain antioxidant and antibacterial preservatives such as phenolic compounds, ascorbic acid, and tocopherol. Brown algae are used to make alginate, a type of edible coating substrate. Mushrooms covered with alginate (2%) for 2 minutes before storing them in jars with hundred per cent oxygen ventilation. This treatment preserved the hardness of the mushrooms, delayed discolouration and cap opening, and prevented the loss of soluble solids concentration, total sugars, and ascorbic acid. Mushrooms' shelf life was effectively extended to 16 days. Chitosan is a biocompatible and biodegradable polysaccharide produced from natural resources that can be used to cover a wide range of food products.

Ozone: After reacting with intercellular enzymes and cell components, ozone quickly inactivates germs due to its high oxidation ability. Ozone swiftly decomposes into oxygen after cleaning, leaving no undesired residues behind. The USFDA has determined that gaseous ozone is a safe cleaning agent that can be directly interacted with food.

Electrolyzed water: Electrolyzed water is a disinfectant made by electrolyzing a salt solution with chlorine. It is utilised in the food business. EW, like ozone, has the benefit of leaving no hazardous residues on the food it is applied on. EW is turned into regular water when it is diluted with tap water. EW wash has less harsh damage to food quality than other disinfectants. EW could also be converted to regular water by diluting it with tap water. Varied amounts of electrolyzed water (5, 25, 50, and 100 mg/L) paired with a passive MAP affected the viability of postharvest mushrooms.

Conclusion

Edible mushrooms can be successfully preserved for a longer time, like up to a week even at the ambient condition with barely a minimum nutritional and sensory loss by using any of the postharvest preservation methods mentioned above. All these methods have their advantages and disadvantages in terms of technological and economic considerations which need to be analysed carefully before using them on a commercial scale for better returns.■

UNDEREXPLOITED VEGETABLES

UNEXPLORED TREASURE TROVE FOR FOOD, NUTRITIONAL AND ECONOMIC SECURITY

About Author

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Vegetables are rich and comparatively cheaper source of vitamins. Consumption of these vegetables provides taste, palatability, increases appetite and provides fibre for digestion and to prevent constipation. Most of the vegetables contain the minerals and vitamins which boost the immunity system. Vegetables are the key component of balanced human diet and also the main drivers in achieving global nutritional security by providing nutrients, vitamins and minerals. Several minor vegetables are there which have less importance and more nutrients and minerals and these are considered as underexploited vegetable crops. They are the sources of important minerals and nutrients. Although having these advantages in some places consumption of these plants is not socially acceptable by some community sectors because they are considered to be food for the poor.

Nutrition has captured the international spot light in an unprecedented way as persistent global hunger and under nutrition has underscored and neglected the need for urgent action. One in eight people around the world still suffer from hunger and more than that number are victims of hidden hunger. Minor/ under-exploited vegetables make an important contribution for food and nutritional security and can enhance the livelihood of small and marginal farmers.

What are underexploited vegetables?

Underutilized crop species as crops whose potential contribution to the national economy have not been adequately explored due to the decreased attention to their production, consumption and utilization. Important vegetable crops nutrient dense that grown as underexploited are lettuce, celery, leek, parsely, asparagus, amaranthus, basella, moringa, ivy gourd, globe artichoke, kale, broad bean, etc.

1. The vegetable crops, which are neither grown commercially on large scale nor traded widely, may be termed as underutilized.
2. The under-utilized vegetable crops are the plant species that are traditionally used for their food, fiber, fodder, oil or medicinal properties.
3. However, those species have potential to ensure food security, nutrition, health, income generation and environmental services. Here some examples of the crops.

Lettuce (*Lactuca sativa*): Lettuce is probably a native of Europe and has been in cultivation for over 2,500 years. Lettuce is grown in almost all the states of India. It is a popular salad crop mostly in cities. It is rich in vitamin A and minerals like calcium, phosphorus, sodium, sulphur, magnesium and potassium. It also contains protein, carbohydrates and vitamin C. Lettuce is a very good salad vegetable with low nutrient density. It has a crisp texture. In India, lettuce is grown on small scale in Kitchen gardens and to some extent by large number of commercial growers to meet the growing demand of continental hotels.

Celery (*Apium graveolens*): Celery stalks have only moderate levels of vitamins, but have a low percentage of carbohydrate and negligible fat. It is popular with dieters because it has 94% water and only 21 calories/100 g portion consumed. Sliced stalks are also used as an ingredient in soup or stews. Celery is cultivated for its succulent flavoured leaves, seeds and essential oils the leaf stalks & petioles are eaten as salad also used in soups, sauce, and puree, fried & spiced In India, it is mostly grown for seed to export for culinary sauces, oleo protein & tonics. These beverages are anti-flatulent, diuretic, nerve builder etc.

Leek (*Allium porum*): It is a non bulbing crops grown for its blanched stem and leaves to be taken as salad or cooked with other vegetables or used in flavouring soups. The long white stem and leaf base and green tops which are edible are good source of carbohydrate (5%), protein (1.8%), phosphorus (70 mg/100 g), iron (2.3 mg/100 g) and Vitamin C (11 mg/100 g). Like all other alliums, leeks are rich in potassium, calcium, phosphorus, iron, and vitamins C, thiamine (B_1) and riboflavin (B_2). Leek contains allicin and diallyl disulfide, that block or suppresses cancer causing agents, boost immunity and prevent infections. It is a non-bulb

bearing crops grown for its blanched stem and leaves. It is milder and more delicate flavour though of course texture, eaten as raw alone or mixed in salad.

Parsley (*Petroselinum crispum*): Parsley leaves are ready for use about 3 months after seeding. A few leaves at a time may be removed from each plant, or the entire bunch of leaves may be removed for use. Although parsley leaves are used most commonly in the fresh green condition as a garnish, their characteristic flavour and green colour can be retained if the leaves are dried rapidly. Dehydrated parsley flakes are produced from parsley grown in commercial fields. Green parsley leaves have a mild, agreeable flavour and are an excellent source of vitamin C, iodine, iron and other minerals.

Moringa (*Moringa oleifera*): *Moringa oleifera* popularly known as Sehjan or drum-stick, native to India, is a multi- purpose tree due to its diverse uses and helpful in eco-restoration. It is widely used as natural medicine, food, feed, biostimulant, forage and migration of bees. Moringa tress is known as a "miracle tree" due to its multipurpose uses. It is an evergreen tree with a straight trunk, corky and whitish bark. It grows well in hot, semi-arid and humid regions. Every part of *Moringa oleifera* (leaves, flowers, fruits, seeds, bark and roots) has nutritious value. The leaves and seeds of moringa are a good source of protein, calcium, iron, Vit-A, Vit-C, anti-oxidant compound like carotenoids, flavonoids, vitamin E and Phenol. Moringa leaves (100g) fresh contain 2.6 mg Vit-B1 (Thiamine), 20.5 mg Vit-B2 (riboflavin), 8.2 mg Vit-B3 (Nicotine acid), 220 mg Vit-C, 16.3 mg Vit-A and 113 mg Vit-E along with 423 mg lipotropic element chorine, 19.2 g fibre, 2003 mg Ca, 368 mg Mg, 204 mg P, 1324 mg K, 3.1 mg Cu, 28.2 mg Fe and 870 mg selenium. The protein content in leaves of moringa is higher than protein content in eggs and milk. Gopalkrishnan *et al.* (2016) reported that on dry matter basis moringa leaves contained 27.2% protein, 17.1% fat, 5.9% moisture and 38.6% carbohydrates. Moringa leaves have 7 times more vit-C than orange and 15 times more K than banana. It is envisaged that the popularization of this miracle tree will help us towards sustainability and nutritional security particularly in arid and semi-arid regions of the country.

Basella (*Basella alba*): *Basella alba* is an underutilized green leafy vegetable predominantly grown in the Asian subcontinent. It is rich in vitamins, minerals, dietary fiber, phenols, and antioxidants. Ferulic acid, gallic acid, caffeic acid, lutein, zeaxanthin, and β-carotene are the major bioactive compounds present in *B. alba*. However, their potential as ingredients for development of functional foods has not been fully explored. Extraction and encapsulation of bioactive compounds from *Basella alba* will helps in their incorporation into foods imparting functionality to the developed foods. Therefore, it is important to explore the potential of *B. alba* as functional food.

Amaranth (*Amaranths spp.*): Amaranth is primarily used as pot herb which is most commonly grown during summer and rainy season. It is originated from India and Indo- China regions. Cultivated amaranth utilized as food grains, leafy vegetables and forage crops in diverse geographical regions. It is highly recommended for consumption by the patient with colon cancer, diabetes, mellitus and high blood cholesterol.

Strategies for the development of underutilized vegetable crops

- Systematic local specific crop planning in accordance with agro-climatic suitability of the region.
- Rapid expansion of infrastructure facilities with priority on market development, transport and communication.
- Rapid expansion of infrastructure facilities with priority on market development, transport and communication.
- For proper utilization and better economic returns from underutilized crops, emphasis should be given on developing processing unit in the area.
- Domestication of potential wild species through homestead cultivation should be encouraged for avoiding over-exploitation from natural sources. Supports are required in terms of multiplication of planting materials and their distribution besides providing market access through marketing network for perishables.
- Under-utilized horticultural crops are nutritionally rich and adapted to low input agriculture. More R & D efforts in these will add substantially to food security and nutrition vis-à-vis human welfare.
- Systematic local specific crop planning in accordance with agro-climatic suitability of the region needed. Rapid expansion of infrastructure facilities with priority on market development, transport and communication needed.
- Special emphasis should be on export oriented production programmes and border trade involving high value produce such as mushroom, orchids and cut flowers, spices, frozen fruit juice, concentrate etc.

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ROLE OF BEES POLLINATION IN HORTICULURAL CROP PRODUCTION

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Pollination is essential for maintaining ecosystem balance and is the foundation of crop production, bridging the gap between agriculture and the natural cycle of life. Pollination is the process of pollen transferring from male anthers to female stigmata, either within the same flower (self-pollination) or between plants (cross-pollination). Cross pollinated plants solely rely on vectors to transport their pollens. These vectors (pollinators) are wind, water, birds, insects, bats, and other animals. Among them insect pollinators are major players in the crop production. For example, pollinators such as bees, birds, and bats affect 35% of world crop production (FAO, 2021). The frequency of visits and the cumulative effects of different bee species influence not only the quantity but also the quality of crops produced, which is relevant primarily from an economic viewpoint. Pollination of plants by multiple bee species, such as honey bees, carpenter bees, stingless bees, bumble bees, long-tongued bees, feral bees, social bees, and solitary bees, improves the pollination process.

Honey bees

Since the beginning of pollination services, European honey bee (*Apis mellifera*) have been widely utilized as pollinators and they are the most widely managed species for both honey production and crop pollination globally. It is the most effective pollinator and crop visitor worldwide.

However, there are at least eight honey bee species in genus *Apis*, such as *A. florea Fabr.*, *A. cerana Fabr.*, *A. andreniformis*, and *A. dorsata* Fabr. The exchange of nectar and pollen between plants and honey bees creates a mutualistic relationship. Many countries have used honey bees as pollinators for improving the crops quality and quantity. In India, using honey bees as pollinators enhanced the quality of guava (*Psidium guajava* Linn) fruit, as well as the length and girth of coconut (*Cocos nucifera* Linn) and citrus (Citrus spp.) fruits, when compared to controls. Enhanced flower visitation rates by high-quality honey bee colonies increased fruit set by 15%, as well as fruit sugar content and seed set, when compared to visits by conventional colonies, resulting in a 70% increase in farmer earnings for the apple (*Malus domestica* Borkh). Pollination by high-quality colonies also resulted in a 20 % increase in fruit weight.

Bumble bees

Bumble bees (Apidae: Bombini) are important pollinators for both agricultural and horticultural wild plants all over the world, and their pollination helps to ensure food security. Bombus terrestris Linn (Europe, North Africa, Asia, and Australia), *Bombus occidentalis* Greene (western North America), *Bombus ignitus* and *B. lucorum* Linn (East Asia), and Bombus impatiens Cresson (in North America) are the most commonly utilised bumble bee species for commercial crop pollination. Bumble bees pollinate a wide range of crops, including buzz pollinated crops like blueberries and tomatoes, as well as large-flower and small-flower crops, indicating that they have the potential to be sufficient pollinators in both open fields and greenhouses.

Stingless bees

In tropical and subtropical places around the world, stingless bees (Apidae: Meliponini) are common flower visitors. They forage more diversely and intensely than honey bees, and hence are more likely to impact the future development of pollination solutions that are best suited to the needs of specific crops and environments. Stingless bees are a big and diversified eusocial bee species that

make good pollinators. Cucumber pollination by the stingless bee Heterotrigona itama and manual cross-pollination boosted crop quantity and quality, enabling for the production of heavier, longer, and wider fruit.

Carpenter bees

The genus Xylocopa belongs to the tribe Xylocopini, and large carpenter bees are a group of bees that live in tropical and subtropical regions (Apidae: Xylocopinae). Carpenter bees have significant advantages in crop pollination over other non-Apis bees, as they eat on a wide variety of plant species during their long activity seasons. They can also buzz-pollinate flowers, giving them even greater versatility as crop pollinators. However, there is an

urgent need to develop a strong breeding programme that includes genotype selection, controlled mating, and nest foundation. Yellow passion fruit is pollinated successfully when only native bees, particularly carpenter bees, visit the blooms.

Solitary bees

Solitary bees make up the vast majority of the world's bee species. Solitary bee species comprise 85 percent of the total number of bee species. The majority of solitary bees are polylactic (i.e., they collect pollen from a wide variety of plants), while a smaller number are oligolectic (i.e., they only collect pollen from a limited number of plants) and only a few are monolithic (i.e., they only collect pollen from a single plant species).

Bees vigitation

For a variety of plants, pollination is carried out by bees and other insects. Plants have evolved to be more appealing to pollinators since pollination is so crucial to them. Floral colour, flower motion (as in bumble bees), visual and olfactory cues (as in honey bees) and nectar and pollen grain production (as in apple pollination) are all ways that plants attract bees. As a result, plants play an essential role in influencing pollinator visitation rates. The colour of the blooms is one of the most essential characteristics of plants that attract bees. Bees have a trichromatic visual system that allows them to see a wide range of colours since it is sensitive to green, ultraviolet, white, and blue wavelengths. Blue or purple flowers are frequently visited by bees, but they prefer blue blossoms.

Challenges in bees pollination

Some factors like pathogens, nutritional deficiencies, climate change, and deforestation limit bees' ability to pollinate. Pathogens such as viruses and bacterial diseases have a severe impact on bee health and longevity, posing a threat to crop and wild plant pollination services. Viruses attack the immune systems of bees, causing sickness in entire colonies. Colony collapse disorder (CCD) is a phenomena in which managed bee colonies experience inexplicable fast losses of adult working bees, leaving only the queen and a few nurse bees. The parasites Nosema ceranae and Nosema apis are also very harmful in the United States, causing massive honey bee losses. Pesticides such as acetamiprid and ergosterol-inhibiting fungicides, in addition to natural factors affecting bee pollination, are a threat to pollination services. Pesticide and other synthetic product residues persist in bee nectar and pollen, causing neurotoxicity, immunological deficiencies, behavioural abnormalities, and chronic illnesses.

Conclusion

Pollination by bees serves humanity in a variety of ways, including food processing, raw materials, pharmaceuticals, textiles, social and cultural values, biodiversity preservation, and environmental protection. Pollination by bees has a direct impact on the profitability and productivity of a large number of crop kinds around the world, including most vegetables, seeds, and nuts, as well as some high-value agricultural crops like coffee, cocoa, and rapeseed. Without the pollination service rendered by bees, 5–8% of all global crop output would be lost, necessitating dietary modifications and the development of agricultural fields to address crop production deficiencies. Researchers should concentrate their efforts on determining the effects of bees on crop quality, as this will provide more precise information on how bees might modify the chemistry of certain crops.■

SUCCESS STORY OF

ADAPTION OF MODERN CONCEPTS IN TOMATO FARMING AT GRASS ROOT LEVEL IN DISTRICT SHIVPURI

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Tomato (*Solanum lycopersiculam*) is one of the major vegetable crops on basis of culinary applications it is 2nd most consumed vegetable after potato and used widely all over world in form of ketchup, sauces, puree and paste.

Farmers of Shivpuri which is one of the district of Madhya Pradesh has bought revolution in production techniques of tomatoes in all India where people finding it difficult to tackle problems of pest and resting on the lower tomatoes on the ground losses in field they has efficiently managed these problems by using various techniques in producing tomatoes lead the district to be part of "One District One Product" under tomatoes production and apart from Shivpuri 10 other districts are also selected for ODOP under tomatoes production which are described below:

Staking technique

In this technique the tomatoes plants are tied with the help of Bamboo and wires or any other materials according to their convenience this has by far helped in providing support to tomatoes and preventing the various diseases and excessive vegetative growth because tomatoes can be trained better when tied with the wires and it has improved the yield too.

Mulching

As we all know that it is the best technique as studied in books but the farmers of Shivpuri are so much acknowledged and modernized that the used it on field and tried it on tomatoes production it not only increased tomatoes yield but also prevented weed growth, saved water, prevented diseases and more probably it protect lowest growing fruit from resting on the ground and further developing blossom end rot.

Drip irrigation

It reduces the risk of diseases like grey mould, downy mildew, alternaria etc. and saves water and reduces wastage of fertilizer because fertigation can be done easily, when it comes to tomatoes it has helped in saving tomatoes from uncertain rainfall usually in Shivpuri during October and November there is no rainfall and tomatoes suffer a lot and consistently yield loss in tomatoes but drip irrigation providing water at appropriate time when required at different growth stages.

All such techniques together helped farmers in obtaining yield upto 400-600 q/h by using hybrid seed and 350-400 q/h by using indigenous varieties in Shivpuri district as told by the senior scientist S.S. Kushwaha (KVK, Shivpuri) and farmer Gotu Dhakad who has used

all those techniques on his farm for tomato production.

Shivpuri farmers are using Abhilash hybrid seed which cost on an average 575 rupees for 10 GM packet while many of the farmers in recent trend are directly purchasing sapling at rate of rupees 1.5-2 per sapling which is somewhere time saving.

According to current trend Madhya Pradesh has took over Andhra Pradesh in tomato production and according to National Horticulture Board Madhya Pradesh is leading in tomatoes production this year 2021-2022 with 2.9 million tons (1st advanced estimate) and with 3 M tons in 2020-2021 and from now onwards after such modern concepts Madhya Pradesh will set new records in upcoming years.

Farmers of Shivpuri on other hand have produced 383.32 thousand MT in 12.37 thousand hectare of land (2016-2017) which is among highest producing tomatoes in India. While in between farmers of Jabalpur under organic production is producing "cherry tomato" which is hybrid small in size special tomato worth up to rupees 400-600 a kg which is also have high nutritional status is transported from Jabalpur to various states of India.

Yield of tomatoes under above mentioned techniques also increases which ultimately provides high return only initial setup is somewhere slightly more but yet it is much profitable but in forthcoming tomato season it gives huge benefits be let's have a look on cost of cultivation of tomatoes in Shivpuri.

Description	Quantity and rate per unit	Cost (Rs.)
Land preparation		
Number of tillage	02, Rate 500/- per hr	1000
Number of workers	06, Rate 300/-	1800
Manures and Fertilizers		
Dung manure 10 tons, once in 2 years	1000/- per tonne,	10000
Nitrogen	200 kg rate 12.50/-	2500
Phosphorus	100 kg rate 32.85/-	3285
Potash (as per soil test)	100 kg rate 19.98/-	1998
Number of workers	20, Rate 300/-	6000
Staking		
Boss & Wire		32000
Number of workers	20, Rate 300/-	6000
Drip irrigation and mulching setup		
Pipes, nozzle and polythene		140000
Number of workers	20, rate 300/-	6000
Seed quantity	200g rate 575/10g	11500
Number of laborers on sowing	15, Rate 300/-	4500
Irrigation number	10	5000
Condemned		
Number of workers	20, Rate 300/-	6000
Crop protection		
Trizophas	2 times, rate 450/-	900
Imidacloprid	2 times, rate 200/-	400
Acephate	2 times, rate 160/-	320
Profenophos	2 times, rate 500/-	1000
Number of workers	15, Rate 300/-	4500
Breaking (number of workers)	40, Rate 300/-	12000
Total cost		**256703**
Total income (average yield 600 quintals per hectare) (as per wholesale rates currently 1200/quintals)		**720000**
Net Profit		**463297**

Conclusion

As told by Senior scientist S.S Kushwah(KVK Shivpuri) and many farmers that a coin has two sides one you have showed in terms of profit other is that farmers also suffer losses too but not in field but in whole sell prices because during this time they get up to rupees 1200 rupees per quintal that means up to 500-600 rupees per crate which consist up to 25-30 kg of tomatoes which cost around rupees 20 per kg but during November and December they get their only 2-3 kg rupees per kg which is huge loss.

But this can be tackled if government set up processing units in districts because current variety which is "Abhilash" has thick outer layer called exocarp because this variety is mainly used for long transportation with setting up of processing units in Shivpuri district farmers can have more option of tomatoes varieties and increased yield which will not only increase profit but will also generate employment, reduce risk bearing capacity of farmers, provide alternative, local available processed packed items at cheaper rates and motivate farmers to grow more and more tomatoes and also promote slogan of "Vocal for local".

DIVADANDI

A DEVICE TO PROTECT THE CROP FIELDS FROM HOGS AND ANTELOPES

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A successful and innovative farmer named Shri Haribhai P. Thummar from Khambhaliya, Ta. Bhesan, Dis. Junagadh, cultivating mainly cotton, groundnut, maize, chickpea *etc*. huge economic yield losses caused by hogs and antelopes were the major problem for the all crops, so he become hopeless regarding the control of such devastating condition of his field. The problem was not so new or personal, as for many years farmers were suffering from the same in that area and living through the restless nights to control the damage. It was a loss not only on an economic level but affecting the positive attitude of farmers towards farming as they were compelled to invest more and more in different chemicals, labors, boundaries and electrical fencing which were on one hand costly and reduce the remuneration and on other hands were against the ethics of many farmers proved to be a major hindrance for their adoption. As we all know "Necessity is the mother of inventions", this farmer is one of the successful examples with his innovative ideas and mind turning the scrape into a new and innovative technology named as "Divadandi".

The materials used were simple and cheap *viz.*, a tin box (oil container), a light source (torch), bearing, an iron rod, nut and steel dish. He opened the tin box from two opposite sides and fix a torch inside and fit the box with a bearing for free movement and hang it on the iron rod, the nut was tied with a string to make a sound with the dish like a "*Damru*". Torch provides light all around the field by rotating throughout the night. The device is so light in weight, can easily and freely rotate on its own through normal winds and the nut hanging is used to produce sound, creating a sense or inkling of human presence for the animals and keeping them away from the crop fields. This saves the farmers from keeping watch for the whole night and also saves their lives from wild animals. The farmer, Shri Haribhai P. Thummar by this innovation not only eases his own life but also gives a simple and cheap solution to many other farmers which can save economic loss and their lives. For this self-service, Shri Haribhai P. Thummar got the consideration and was honored by Shri R.C. Faldu, ex- Agriculture Minister, Gujarat at Sahakari Mandli, Bhesan, Junagadh.

Problem to be discussed

The problem was not so new or personal, as for many years farmers were suffering from the same in that area and living through the restless nights to control the damage. It was a loss not only on an economic level but affecting the positive attitude of farmers towards farming as they were compelled to invest more and more in different chemicals, labors, boundaries and electrical fencing which were on one hand costly and reduce the remuneration and on other hands were against the ethics of many farmers proved to be a major hindrance for their adoption.

Damages

A single group of 10 hogs can destroy 10 to 20 acres in one night

Lust for killing animals

- Bihar, one of five states that applied for permission after the environment ministry invited culling proposals in December 2015**,** reported four times more crop damage from wildlife incursions into farms over two years to 2012.
- The environment ministry is showing a "lust for killing animals", Gandhi said on 9 June, 2016,
- "Wild pigs and nilgais have been disturbing farmers for several

years," said Anish Andheria, President of the Wildlife Conservation Trust, an NGO. "So, states have started to finally give in to demands to cull animals on farmland and not in wildlife sanctuaries, national parks or forests.

- Andheria said killing "too many animals" can affect the food chain, since carnivores prey on *Nilgai* and wild boar. If prey decline, carnivores could turn their attention to farm animals and humans, he said, suggesting that culling be done "under proper supervision and monitoring".
- Acc. to report of Rajya Sabha 2015 still under consideration.
- "The centre should have tried to explore other options instead of advising the states to shoot animals," the report said.
- Bihar and Himachal Pradesh were among five states that responded to this environment ministry advisory asking states to list animals that destroy crops.
- Uttarakhand wants to cull wild boar, and Maharashtra and Gujarat both want to curb nilgais.
- While proposals from Bihar, Uttarakhand and Himachal have been considered by the ministry, proposals from Maharashtra and Gujarat are under "active consideration", according to this report in *The Quint.*

Was it an accident?

Conventional management options

- Fencing
- Electric fencing
- Chemical pesticides
- Repellents also as fertilizers.

The available solutions are not sound and affecting the positive attitude of farmers towards farming as they were compelled to invest more and more in different chemicals, labors, boundaries and electrical fencing which were on one hand costly and reduce the remuneration and on other hands were against the ethics of many farmers proved to be a major hindrance for their adoption.

"Divadandi"

How its works ?

He opened the tin box from two opposite sides and fix a torch inside and fit the box with a bearing for free movement and hang it on the iron rod, the nut was tied with a string to make a sound with the dish like a "*Damru*".

Torch provides light all around the field by rotating throughout the night. The device is so light in weight, can easily and freely rotate on its own through normal winds and the nut hanging is used to produce sound, creating a sense or inkling of human presence for the animals and keeping them away from the crop fields.

Sr. No.	Material used	Price (Rs.)
1.	Tin box (oil container)	15
2.	Light source (torch), bearing	400
3.	Iron rod, nut and steel dish	50

Alternate but can't be ultimate scope for improvement

There is a need to have regular upgradation in the device to prevent the animals to get familiar to the patter of lighting and sound.

E.g. Sensor can be fixed to spray the repellent when animal came too closer to the device.

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BIO-NANOTECHNOLOGY

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The globe is currently experiencing a number of issues as a result of the rapid urbanization and population growth, which have reached a crucial point for human survival. The main issues include the depletion of conventional and natural energy sources, environmental pollution, global warming and the greenhouse effect, a lack of appropriate diagnostic tools for disease detection, improper agricultural practices involving the use of large amounts of chemical fertilizers, pesticides, and herbicides, and a lack of adequate food and shelter. The United Nations introduced the 2030 Agenda for Sustainable Challenges and Opportunities Development and the Sustainable Development Goals in 2015 to replace the Millennium Development Goals. These objectives balance the three facets of sustainable development-economic, social, and environmental and are indivisible from one another. The development of a number of tools, materials, and processes known as bio-nanotechnology that are helpful in addressing the major issues facing humans and nature today, such as green agriculture, the production of renewable energy, diagnostic tools for spotting human and plant diseases at an early stage, the use of nanoparticles in the treatment of diseases, pollution monitoring

through Nano biosensors, bioremediation of polluted sites, waste water treatment, and water purification, has given the field a great deal of importance.

Nanotechnology- environment

1. Pollution checking through nanosensors and its control

Checking for the presence and various concentrations of contaminants in air, water, and soil is another use for nanotechnology. Due to its long-term stability and repeatable results, zinc oxide nanotubes and nanorods (ZnO) were used as pH sensors in the monitoring of water contamination.

2. Water purification

As one of the inputs for agriculture and a necessity for human survival, water is a crucial raw element for the economic development of the majority of nations. Sediments, trace elements, various chemical effluents, oil, charged particles, and pathogens can all be removed from water using nano filters in order to purify it.

3. Nanotechnology in producing renewable energy

Natural fossil fuels are being used at an increasing rate due to global population growth, which has led to their depletion and the release of several hazardous contaminants into the environment. A cleaner, more efficient and more affordable form of energy generation is possible with nanotechnology.

4. Bioremediation

The contaminated land, water, and air can be cleaned up and used again for human purposes. Salipira *et* al. reported employing multi-walled carbon nanotubes to remove dangerous xenobiotic contaminants including polychlorinated biphenyls and aromatic hydrocarbons from polluted water samples (MWCNT).

Nanotechnology-Agriculture

1. Nano-pesticides

Chemical pesticides that are extremely fragrant and more dangerous are increasingly employed in agriculture to eradicate dangerous pests. These dangerous chemical insecticides are seriously harming unintended organisms.

2. Nanoparticles in disease detection and control

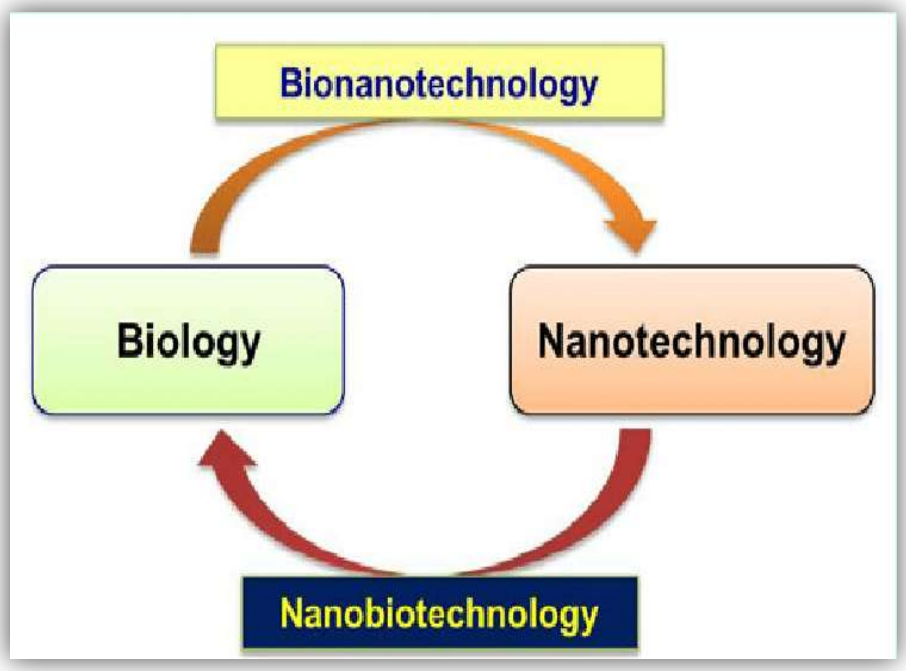
The early detection of plant diseases using nanoparticles can prove to be a crucial tool in identifying the pathogen infiltration at early stages, allowing for the right curative action to be done eradicating the pathogens and minimizing agricultural output loss.

Nanotechnology- applied sciences

1. Nanotechnology in Biotechnological Research-
   1.1. DNA Detection
   1.2. Gene Delivery
2. Nanotechnology in Sericulture.

Nanotechnology- Medical science

1. Diagnosis and screening systems.
2. Drug delivery and release.
3. Treatment of cancer and diseases.



Future prospects and challenges of nano-biotechnology

1. Wide-ranging applications of nanobiotechnology are found in the medical field, including the creation of novel nanoparticles for precise imaging of infectious and affected body parts in people, for effective gene and medication delivery, illness detection, and in the treatment of cancer and other disorders.
2. The energy issue may be solved by nanobiotechnology, which may also produce nanomaterials that can purify contaminated water sources, lands, and ecosystems.
3. In terms of precision engineering, designing, and production of smaller, more nimble gadgets, it has the potential to revolutionise the electronics industry.

Conclusion

Despite several contentious issues surrounding the safety of nanoparticles, by 2030 nanomaterials will enter the market with significant uses in a number of global sectors. Therefore, it is necessary to support the development of new advanced nanodevices, nanomaterials, and nanotechniques in order to advance sustainable agriculture and address other issues. In order to ensure that the created nanomaterials, gadgets, and procedures are safe for all species as well as the environment, it is also crucial to do research on them.

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PRECISION FARMING
URGENTLY NEEDED IN INDIA

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Precision farming is sometimes referred to as satellite agriculture, required farming, and site-specific crop management. Better management decisions result in improved output, high profit due to lower cultivation costs, and lower environmental effect due to the reduced addition of input to the soil. Our nation's entire land area (328.7 million ha) is impacted by land degradation due to declines in total productivity, diminishing and deteriorating natural resources, stagnant farm incomes, a lack of an eco-regional approach, declining and fragmented land holding, and global climatic variation, all of which have become significant obstacles to the growth and development of crops. The technology for tomorrow's environmentally friendly agriculture may be provided by the precision agricultural developments of today. Therefore, it is important to act appropriately at all appropriate times and places.

Precision farming is a technique where inputs are used in precisely calculated amounts to produce higher average yields than traditional cultivation methods. This is done by designing comprehensive systems to optimize production using important components of information technology and management in order to improve product quality, increase the effectiveness of crop chemical use, conserve energy, and protect the environment. Farmers will be able to identify fields that need treatments and determine the best amount of water, fertilizer, and pesticides to apply thanks to the agricultural control centers' integration of all collected data and imaging input with other data. This will automatically prevent resource waste and runoff, ensure that soil has the ideal amount for optimum health, and lower costs while controlling the farm's environmental impact.

Components of precision farming

1- Remote sensing

It is a collection of methods used to gather data about something or somewhere without coming into direct contact with it. In order to locate the farms' soil, vegetation, and other criteria that are suitable for remote sensing, this is for the acquisition of the farms. Remote sensing provides continuously obtained data about agricultural products, such as vegetation, that is growing on various soil types with varying water availability, substrate, impact of agriculture, and relief, etc.

2- GPS (Global Positioning System)

GPS is a satellite-based navigation system that enables users to record positional data. This enables farmers to accurately identify the locations of their fields so that variable-rate inputs, such as seeds, fertiliser, pesticides, herbicides, and irrigation water, can be applied to a particular field based on performance standards and previous input applications.

3- GIS (Geographic Information System)

It is a management system that is computer-based and used to calculate, save, retrieve, analyze, and display geographical data in the form of a map. It provides topographic maps, maps of soil types, maps of soil nutrients, soil moisture, pH, fertility, maps of weed and pest severity, etc.

4- Technology Variable (VRT)

Based on the soil type identified on a soil map, the VRT system determined the rate of delivery of agricultural inputs.
Processes like seeding, fertilizer and pesticide application, herbicide selection and application at variable rates in the correct place at the right time can all be controlled using GIS information.

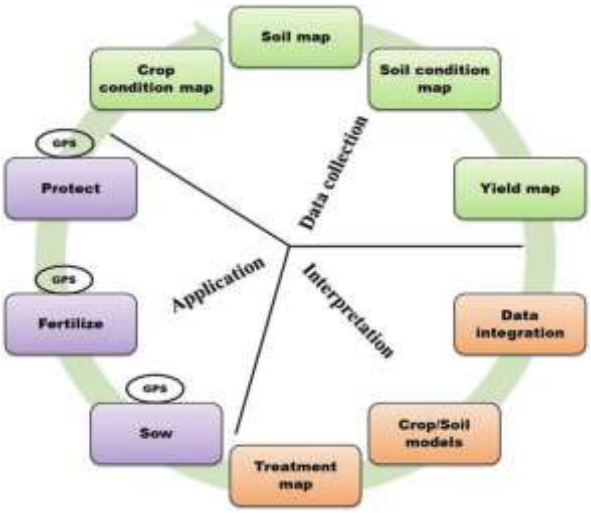
5.-Grid Soil Sampling

More than one region of a field that falls within the same range of yield, soil colour, etc. may have its soil samples gathered. Grid soil samples are analysed in the lab, and for each soil sample, crop nutrient requirements are interpreted. Following that, a map of fertilizer application is created using all of the soil sample data. Farming with accuracy is important.

6. Other technologies used in precision farming

(A) Yield monitors:

Yield monitors are made up of a number of different parts, including sensors, a data storage device, a user interface (display and keypad), and a task computer that is housed in the combine cab and



controls how these parts work together.

In order to attain accuracy in land leveling, laser leveling smooth's the surface of the land by around 2 cm from its average elevation. In order to achieve a continuous slope of 0 to 0.2 percent, the fields must be modified. One such tested technology that is very helpful in irrigation water conservation is the use of a laser leveler to level the land. Farmers have always used animal- or tractor-drawn levelers to level their fields. Through the efforts of the Rice-Wheat Consortium and Project Directorate for Cropping Systems Research in India, over 1000 farmers have adopted the technology and covered more than 10,000 acres in western Uttar Pradesh and Haryana.

Present scenario

Most farmers are aware of the uneven yields that exist throughout their crops. The entire farm area must be divided into tiny farm units since it is impossible to maintain the degree of understanding of field conditions due to vast sizes and changes brought on by annual shifts. The opportunity for automating and simplifying the information gathering and processing from such tiny agricultural units is provided by precision agriculture. It enables the quick and effective implementation of management choices on smaller fields within bigger fields. Precision farming can help to lessen the issue of land degradation, increase output, lower production costs, and lessen the possibility of environmental damage brought on by excessive input use.

Conclusion

With the adoption of precision farming, keeping in mind the diminishing resources, there is a chance of preventing excessive extra-judicious use of agricultural inputs by farmers as well as increasing crop yield with precise usage of agricultural input at a right amount, at the right place, and at the right time with the prevention of disturbance on ecological environment to provide a means for sufficient food production technology for the growing population demand.

■■■

FOOD IRRADIATION
AN EMERGING TECHNOLOGY

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Fresh fruits and vegetables that have been adequately packaged and processed centrally for distribution and marketing are becoming more and more popular in both developed and many developing nations. The rise in demand for fresh cut or minimally processed fruits and vegetables has been attributed to changes in demography, lifestyles, and eating habits, among other factors. Low dose irradiation is among the most promising new methods that can be used to guarantee the safety of fresh produce. Food irradiation is a physical means of food processing that involves exposing the foodstuffs to gamma rays, X-rays, or electrons. It's a cold process and after more than 50 years of research and development, it has been established as a safe and effective method of food processing and preservation.

Action of ionizing radiation

The term "radiation" encompasses the entire electromagnetic spectrum as well as all high-energy atomic and subatomic particles. It can be grouped in terms of ionizing and non-ionizing radiation. Electromagnetic radiation with a wavelength of at least 1.0 nm is considered non-ionizing radiation while the remainder of electromagnetic spectrum and all high-energy atomic and subatomic particles fall under ionizing radiation.

Ionization describes a radiation's capacity to ionize the atoms and molecules of the material it travels through. Depending on the nature of the matter and the radiation's properties, ionising radiation penetrates matter to varying degrees. The penetration strengths of all atomic and subatomic particle types are inferior to those of gamma and X-rays. Positive and negative ions are produced when ionising radiation interacts with the atoms and molecules of the material being irradiated by transferring energy to electrons.

Source of ionizing radiation

Food is irradiated using ionizing radiation. It includes X-rays produced by machine sources operating at or below 5 MeV, gamma rays produced by naturally occurring radioactive elements and artificially induced radioactive isotopes created in nuclear reactors, typically ^{60}Co, less frequently ^{137}Cs, and electrons produced by accelerators operating at or below a level of 10 MeV. After the decay of ^{60}Co isotope, two gamma rays with average energy of 1.17 and 1.33 MeV are generated. The electron and X-ray energy used in food irradiation applications are restricted to 10 and 5 MeV, respectively.

Doses used in radiation processing

In irradiation processing, the energy that the target material absorbs is referred to as the absorbed dose. Dose is measured in a grey (Gy) Unit, which is equal to the energy absorption of one joule per kg. Kilograys are used to signify large doses (kGy). The rad (1 rad = 0.01 Gy) was also widely used in the past.

The radiation dose administered to a food depends on the resistance of the organisms present and the objective of the treatment. The maximum dose advised for food processing is 15 kGy, with an average exposure of not more than 10 kGy. Potato, onion, and garlic sprouting is inhibited at very low doses of radiation (less than 0.1 kGy). Low doses (below 1 kGy) have an excellent anti-infestation impact and also prolong shelf life by delaying ripening. Low dosage irradiation can be used to delay the deterioration of fresh produce. By irradiating foods at still higher doses (medium doses), it is possible to significantly reduce or eradicate populations of bacteria that might cause foodborne illnesses and food spoilage. High radiation dosages are used for sterilisation, also known as radappertization (25–50 kGy).

Effects of irradiation on fruits and vegetables

Irradiation can alter the morphological traits and microflora of radiation-exposed foods, as well as physical properties like electrical impedance, viscosity, and wetability, along with chemical properties including alterations in proteins, lipids, carbohydrates, nucleic acids,

vitamins, and volatiles. The effects of irradiating food differ based on the type of food and the dose used. The effects of irradiation on dried foods, such as spices and seasonings, are minimal. Fresh fruit and vegetables have active metabolisms; therefore irradiation may affect ripening as well as quality characteristics.

Irradiation was found to have beneficial effect on fruits and vegetables like retarding the ripening, firmness and colour of irradiated food items, sugars, organic acids, vitamins and phenolic compounds of the commodity irradiated.

Advantages and disadvantages of food irradiation

Like any other method of food preservation, food irradiation has advantages and disadvantages that are rather obvious. Minimal food waste, enhanced public health, increased international trade, a substitute for fumigation, and higher energy savings are benefits of food irradiation. Irradiation's gains in disinfestation and shelf-life extension can be utilized to reduce and manage post-harvest losses brought on by insect infestation in grains, legumes, and fruits.

Even though the irradiation process uses little energy and has minimal running costs, it has substantial startup costs and needs a certain minimum capacity and output to be profitable. The food irradiation process is not suitable for all foods, but there is no preservation method that can be used for all foods.

Conclusion

Reducing agricultural waste after harvest is a big issue in most nations, particularly in emerging and less developed ones. It is well known that a sizeable portion of the food produced around the world, including fruits and vegetables, is lost due to bacterial, fungal, insect and other pest damage. For the management of insect pests, spoilage causing organisms, and physiological processes, particularly in the case of perishable crops, irradiation offers a long-term, environmental friendly and less energy-intensive solution. Food irradiation is taking centre stage as a preservation method alongside other technologies following decades of study, development and discussion in the media. As a recognized sanitary, phytosanitary, and preservation procedure, irradiation of fruits and vegetables is beginning to play a significant role in enhancing food safety and security and promoting increased trade. In the foreseeable future, this position will become even more significant.

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BIO-FORTIFICATION

REDUCE HIDDEN HUNGER IN PULSES

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The richness in protein, vitamins and minerals and micronutrient makes the pulses importance in the world and our country India. The production and productivity of pulses are not increasing as they are demanded cause of lower micronutrient. With better productivity of micronutrient in plant, the micronutrient is required by human for their consumption. The lack of micronutrient in plant as well as soil causes malnutrition of micronutrient in human consumption. The zinc and iron deficiency are the major causes of malnutrition. The pulses play significant role in the proper functioning, metabolism, and development of various plant parts and functioning in the human being as metabolic activity.

Introduction

Bio-fortification is defined as the process of breeding nutrients into food crops, provides a comparatively cost effective, sustainable, and long term means of delivering more micronutrients. The production and consumption of pulses have three objectives to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture. The total per capita availability of pulses is 40 g per day per person in India whilst the minimum requirement is 140 g per day per person. Pulses play an important role in ensuring food and nutritional security and in sol nutrient recirculation, with a huge potential to address the need of future global food security, nutrition and environment sustainability. The major limiting constraint in the productivity is micronutrient imbalance due to abiotic stress. Micronutrient deficiencies document the problem by causing yield reduction and nutrient quality. The cultivated land is deficient in the Zn (49%) and Fe (15%). The micronutrient soil deficiency result in poor uptake of micronutrient leads to grain deficient in micronutrient. The micronutrient deficiency and hidden hunger is more recorded in cultivated land of rice and wheat compared to pulses. To access the more nutrition in food and to cure the micronutrient deficiencies among the people the bioavailability of nutrient in edible crop tissues is to be enhanced.

Role of zinc (Zn) in human health

Zn interacts with large number of enzymes and protein in the body to perform structural, functional and regulatory roles. The deficiency of the Zn leads to the growth retardation, impaired brain development and increases the chance to make body susceptible to infectious diseases such as pneumonia and diarrhoea. The deficiency also disturbs the physiological issues such as physical activities and work productivity decreases. In pregnant women, poor birth of children occurs. The children of age below 5 years required large amount of Zn for the growth and development.

Role of iron (Fe) in human health

The deficiency of Fe effects on the growth and immune function and causes the diseases anaemia. Deficiency of the Fe increases the probability of children death by infectious disease such as pneumonia, diarrhoea, malaria and measles. The Fe deficiency and anaemia also reduce learning ability and are associated with increasing rate of morbidity. In pregnant women its deficiency adversely affect the mother and infant, with including risk of sepsis, maternal mortality, perinatal mortality and low birth weight.

Management of micronutrients in pulses

Management of soil is one of the easiest and simplest ways to manage the micronutrient deficiency. There are mainly soil environmental factor such as pH, CEC, moisture content, organic matter, soil depth, soil type, root characterization and interaction with nutrient availabity affect the availability and mineralization of micronutrient. The gradual decrease in both total and available Fe and Zn gradually decreased from top soil to the bottom soil because the solubility and availability of micronutrients are decreased if soil pH increases (mainly due to precipitation). The precipitation can be prevented by maintain the soil pH 5.5 to 6.5.

Organic matter plays an important role in Cu management in soil.

The micronutrient enhance by the involvement of sustainable inputs to supply the organic matter in soil like application of FYM, residue resistance, compost and green manure, biochar application, zero tillage and bio inoculants. For example in mungbean, the application of micronutrient along with rhizobia isolates enhances the root growth attributes due to the greater nitrogenise activity and better assimilation of macro and micronutrients.

Nutrient assimilation in edible plant parts can be enhanced by adopting or modifying the fertilizer of application methodology *viz;* foliar, soil application, seed coating, seed priming. The bio-fortification is the process by which the mineral content increases in the edible parts of crops, through the application of fertilizers to soil or foliar. There are several factors like source of fertilizer, quantity of fertilizer and time and methods of application regulate the nutrient intake to the edible plant parts and it's bioavailability to the consumer.

To maximize the content of micronutrient like Fe and Zn in crop can be enhanced by genetic modification, conventional breeding, and marker assisted breeding and enhanced use of fertilizers. This breeding strategy approaches to discovery of genetic variation affecting heritable minerals characters, and to identify their stability under different soil and temperature conditions. The most important role to use breeding management is to increase the mineral content in the edible tissue without affecting the yield and other quality character of a particular crop.

Conclusion

Eradicating the hidden hunger of Zn and Fe in pulse is a major objective for future. The proper strategy should be applied to eradicate the deficiency of these micronutrient collaborating with management of soil properties, management of micronutrient through sustainable inputs, fertilizer management (agronomic bio-fortification) and breeding strategies. As the aim of bio-fortification is to increase micronutrient concentration in edible portion. The method should be cost effective to reduce the micronutrient deficiencies from the rural people where the problem is prevalent. The availability of nutrient by increasing the mineral concentration through manipulation helps in bio-fortification.

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CHIA | A UNKNOWN SUPER FOOD CROP

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Chia is an annual plant and currently perceived as the super food crop due to its nutritional composition. Chia was domesticated for food in Mexico for about 5500 years ago. It is native to Mexico and Guatemala. Chia was the staple food crop of South America during earlier period. However, it loses the importance of cultivation due to Spanish conquest and became an unknown crop. It again came into existence for cultivation after independence of Mexico. Chia seed is an economic material which contains high dietary fiber content, proteins, carbohydrates, vitamins, minerals, antioxidants and essential fatty acids such as omega-3 and omega-6 fatty acids. It met out the standards of Nutritional Science Research Institute and proclaimed as healthy food. Food and Drug Administration in the United States recommended chia seed as nutritional supplement to dietic peoples. Chia is a pseudocereal and was cultivated in some countries *viz.* Western South America, South Western US and Western Mexico. While, chia is now cultivating in several countries.

The word 'Chia' is derived from Nahuatl - chian which implies that oily. *Salvia hispanica* which belongs to Lamiaceae is called Chia and cultivated for seeds. There are two category of chia seeds *viz*. Black chia and White Chia. Black chia produces purple flowers with brown seeds. While, white chia has flowers and seeds are white in color. However, both seeds are differed in nutritional composition. Central Food Technological Research Institute (CFTRI), Mysore introduced chia from Central America for cultivation for the first time in India. Moreover, research work was begun on chia seeds in 2012. Andhra Pradesh and Karnataka are the states in India where chia is growing. Eventually, it is cultivated in some parts of Madhya Pradesh and whereas, now chia cultivation is reported in Amseruva, and Siddhaur regions of Uttar Pradesh.

Nutritional composition and utilization of chia seeds

Chia seeds are gaining attention due to its nutritional value (Table 1). Chia seeds have oil content of 25-39 per cent by weight. It contains higher amount of poly unsaturated fatty acids (PUFA). It includes omega-3 fatty acid (58-64% of the total lipids) and omega-6 fatty acid, which are beneficial to the heart patients. It is considered as an alternative to non-vegetarian sources for omega-3 fatty acid and also known as vegetarian meat.

Black Chia

White Chia

Omega-3 fatty acid comprises Docosohexaenoic acid and Eicosapentanoic acid. Docosohexaenoic acid aids normal brain activities and later compound involves to protect against joint problems and good for vision. In addition, it also has antioxidants, vitamins and minerals particularly, calcium and magnesium. Antioxidants present in the seeds restrict the activity of free radicals in the human body to the level of 70 per cent.

The seeds of chia are utilized

Table 1. Nutrient content of chia seeds

S. No.	Particulars	Composition
1.	Carbohydrates	26-41%
2.	Lipids	31-35%
3.	Fats	30-33%
4.	Protein	15-25%
5.	Fiber	18-30%

as topping in various food items. Chia is reported with higher essential fatty acids (PUFA) and found superior over conventional edible oils. It helps to meet out the daily fatty acid requirement of human by consuming 25-50 g per day. Chia seeds are employed to making gel and utilized as substitute for egg in cake preparation. Moreover, chia seeds can also be used in bread making with permissible limit of 5 per cent. Oil obtained from chia seeds are used in cosmetics industry.

Chia cultivation

Chia is a short-day plant and optimum temperature of 16-26˚C favors for better crop growth. The minimum and maximum temperatures of chia plant are 11 and 36˚C respectively. Chia's flowering time falls in the month of October in the northern hemisphere and whereas, April in the southern hemisphere. It is sensitive to frost and cause poor establishment or crop failure at higher altitudes. It can cultivate in tropical and sub-tropical regions and optimally establish with an altitude range from 400 to 2500 m above sea level. However, it can grow successfully with an altitude of up to 975 m. Chia may cultivate in regions with latitude between 20° 55' N and 25° 05' S. Chia is a hardy plant with height of up to 60 cm under favorable conditions. It requires well drained soil and also thrives well in light textured soil. Seeds are tiny and crop duration is 100-150 days. Ideal sowing period under Indian condition is after June-July or in October-November.

Moreover, it requires less inputs and maintenance. However, application of primary nutrients (nitrogen, phosphorus and potassium) promoted the crop growth. CHIAmpion W-83 and CHIAmpion B-1 are two white chia varieties were released by CFTRI in 2015.

With this background, chia crop has greater significance due to its health benefits. In addition, chia cultivation would be profitable to the growers due to less maintenance. It can be grown successfully and however, needs adequate research in the aspects of crop management under Indian condition.

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HUMUNGOUS BENEFITS OF MUSHROOMS

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Mushrooms have been considered as ingredient of gourmet cuisine across the globe; especially for their unique flavor and have been valued by humankind as a culinary wonder. More than 2,000 species of mushrooms exist in nature, but around 25 are widely accepted as food and few are commercially cultivated. Mushrooms have been consumed since earliest history; ancient Greeks believed that mushrooms provided strength for warriors in battle, and the Romans perceived them as the "Food of the Gods." For centuries, the Chinese culture has treasured mushrooms as a health food, an "elixir of life." They have been part of the human culture for thousands of years and have considerable interest in the most important civilizations in history because of their sensory characteristics; they have been recognized for their attractive culinary attributes. Nowadays, mushrooms are popular valuable foods because they are low in calories, carbohydrates, fat, and sodium: also, they are cholesterol-free. Besides, mushrooms provide important nutrients, including selenium, potassium, riboflavin, niacin, vitamin D, proteins, and fiber. All together with a long history as food source, mushrooms are important for their healing capacities and properties in traditional medicine. It has reported beneficial effects for health and treatment of some diseases. Many nutraceutical properties are described in mushrooms, such as prevention or treatment of Parkinson, Alzheimer, hypertension, and high risk of stroke. They are also utilized to reduce the likelihood of cancer invasion and metastasis due to antitumor attributes. Mushrooms act as antibacterial, immune system enhancer and cholesterol lowering agents; additionally, they are important sources of bioactive compounds.

The most cultivated mushroom worldwide is *Agaricus bisporus*, followed by *Lentinus edodes*, *Pleurotus* spp., *Flammulina velutipes*. Mushrooms could be an alternative source of new antimicrobial compounds, mainly secondary metabolites, such as terpenes, steroids, anthraquinones, benzoic acid derivatives, and quinolones, but also of some primary metabolites like oxalic acid, peptides, and proteins. Moreover, edible mushrooms provide a nutritionally significant content of vitamins (B_1, B_2, B_{12}, C, D, and E).

Important mushrooms

Agaricus- *A. bisporus*, from the *Agaricus* genera, is the most cultivated mushroom worldwide. This group of edible mushrooms is nowadays widely used and studied for its medicinal and therapeutic properties. A lectin from *A. bisporus* and a protein from *A. polytricha* have been found to be potent immune stimulants; thus, these macromolecules may be considered for pharmaceutical utilization and these fungi may be classified as healthy food. *A. bisporus* extract has been shown to prevent cell proliferation in breast cancer *A. blazei* is an edible mushroom native to Brazil and it has been cultivated especially in Japan. It is a very popular basidiomycete known as "sun mushroom," and at these days it is consumed globally as food or in tea due to its medicinal properties. Its fruit bodies exhibit antimutagenic, anticarcinogenic, and immunostimulative activities *A. subrufescens* is called the "almond mushroom" for its almond taste, and it is cultivated in the US and has been incorrectly referred as *A. blazei*. It produces various bioactive compounds that have potential to treat many diseases and has been used as a medicinal food for the prevention of cancer, diabetes, hyperlipidemia, arteriosclerosis, and chronichepatitis. The antitumor activity has been found in lipid fractions, that is, ergosterol.

Lentinus- *L. edodes* or "shiitake mushroom" has been used for many years to investigate functional properties and to isolate compounds for pharmaceutical use; this is because of its positive effects on human health. It has been utilized to alleviate the common cold for hundreds of years and some scientific evidence has supported this belief.

Pleurotus- This genus, also known as oyster mushrooms, has approximately 40 species (all are commonly edible and available).

These species have been used as medicinal mushrooms for long time since they contain several compounds with important pharma-cological/ nutraceutical properties. Some of these substances are lectins with immunomodulatory, antiproli-ferative, and antitumor activities; phenolic compounds with anti-oxidant activities; and polysaccharides (polysaccharo-peptides and polysaccharide proteins) with immunoenhancing and anticancer activities.

Ganoderma- The "mushroom of immortality," commonly known as Lingzhi or Reishi, has been used in traditional Chinese medicine to improve health and longevity for thousands of years, as well as in the treatment of neurasthenia, hypertension, hepatopathy, and carcinoma. In Asia, it has been administered for centuries as treatment for cancer; it exhibits anticancer effect alone or in combination with chemotherapy and radiotherapy. *Ganoderma* decreases viability of human cancer cells, induces cell apoptosis, inhibits cell proliferation, suppresses the motility of invasive breast and prostate cancer cells, and prevents the onset of various types of cancer. Modern pharmacological and clinical trials have demonstrated that this fungus shows a significant effect on the prevention and treatment of various diseases, especially cancer, including immunomodulation, induction of cytokine production, antiallergic, antiradiation, antitumor, anti-inflammatory, antiparasitic, and antioxidant effects, as well as benefits for the cardiovascular, respiratory, endocrine, and metabolic system.

Huitlacoche- *U. maydis* belongs to the Ustilaginales order that includes semiobligate biotrophic plant pathogenic fungi that infects only maize and its progenitor plant teosinte (*Zea mays*). It is a heterothallic fungus with a dimorphic life cycle, saprophytic and a parasitic phase; in nature, the pathogenic and sexual development is inseparable. On the other hand, *U. maydis* is responsible for the corn smut, characterized by the formation of galls or tumors, mainly in ears. These ear galls have been used as food in Mexico since pre-Columbian times. Cuitlacoche or *huitlacoche* is the Aztec name given to the young, fleshy, and edible galls. In Mexico, it has been traditionally prized and many hundreds of tons of fresh, prepared, or processed *huitlacoche* are sold annually. Nowadays, it is a culinary delight for international chefs and has been accepted as a food delicacy in several countries and introduced into countless worldwide markets in countries like Japan, China, and some of the European Community, as France, Spain, and Germany. The nutritional value of this mushroom has great importance for human diet. The protein content of *huitlacoche* varies from 9.7 to 16.4% (wet basis) and it is similar or sometimes superior to other edible mushrooms and definitely superior to the maize protein content (10%). Therefore, *huitlacoche* may be proposed as an alternative protein source for vegetarian diets in the same way as other edible mushrooms have been suggested. *Huitlacoche* contains almost all essential amino acids, lysine (6.3–7.3 g/100 g protein) being one of the most abundant.

Huitlacoche can be an excellent source of carbohydrates, proteins, fats, vitamins and minerals. (photo courtesy of CIMMYT)

Other important mushrooms

Some other species of mushrooms are also edible and possess health benefits. *Trametes versicolor, Grifola frondosa, Cordyceps militaris, Cordyceps sinensis, Antrodia cinnanomea, Panellus serotinus* (Mukitake), *Auricularia, Flammulina velutipes* are medicinal importance.

Cordyceps militaris has several beneficial effects and it is used for multiple medicinal purposes. It acts as an antitumor, antiproliferative, antimetastatic, insecticidal, and antibacterial compound. More than 21

clinically approved beneficial effects for human health have been found in this mushroom.

Cordyceps sinensis contains substances called cordycepin, cordycepic acid, with therapeutic applications like the effects of increased oxygen utilization, ATP production, and stabilization of blood sugar metabolism. Besides, it has antibacterial function, reduces asthma, and lowers blood pressure. On the other hand, it has been reported as organ protector, as well as with a protective effect for heart, liver, and kidney diseases.

GUAVA CHEESE
A NUTRITIONALLY ENRICHED PROCESSED PRODUCT

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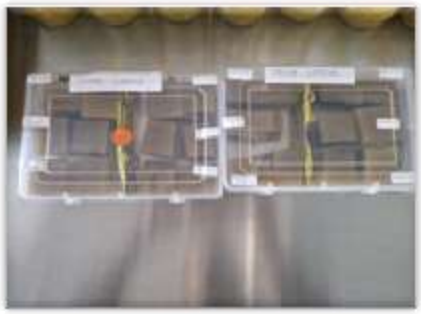
The Guava or *Psidium guajava* L., is a significant global fruit. It has been grown in India from the early 17th century and over time developed into a crop with significant economic value. Practically all of the states in the nation grow guava, which outperforms most other fruit crops in yield, hardiness, and adaptability. Guava is the tropical equivalent of the common man's apple. With little maintenance, this tree produces an excellent harvest. Every year, it produces an abundance of fruit and generates substantial profits with little effort. All throughout the year, there are fresh guava fruits for sale in the market. Fruit harvests grown throughout the winter months have superior quality than those grown during the rainy season. Depending on the type, ripe fruits from a winter harvest can be kept for up to 6 to 9 days under ambient circumstances, but mature fruits from a rainy crop can be kept for up to 2 to 4 days. Hisar Surkha, Hisar Safeda, and Lucknow-49 are the principal guava cultivars planted in Haryana. One of the most beautiful, nutritiously valued, and highly profitable crops is guava. It is a crucial element of the human nutritional system. Ascorbic acid (260 mg/100 g), pectin (0.52 to 2.0%), phosphorus (23 27 mg/100 g), and calcium (14-30 mg/100 g) are all abundant in guava fruit. Vitamins including niacin, pantothenic acid, thiamin, riboflavin, and vitamin A are also present in the fresh guava fruit. Guava fruits that are still immature are used to treat blood pressure, cardiovascular illness, diarrhea, dysentery, and gastroenteritis. India has been a significant producer of horticulture commodities in recent years, producing 50 million tonnes of fruits annually; nevertheless, its ability to export is constrained by inadequate post-harvest management, processing, and utilization technologies. Seasonal gluts occur rather frequently. The farmers provide throwaway rates for their fruit products. Because fruits are perishable, especially in tropical climates, it is exceedingly difficult to store them for prolonged periods of time. Typically, 20–25% of fruits are entirely harmed and rotten before they reach customers. A very genuine method of increasing the value of fruit harvests is through processing, which results in food items that create additional sources of revenue and employment. Processing rids the product of undesirable components and changes it into a more usable form, extending its shelf life relative to fresh goods. In the nation, there is a huge surge in demand for processed food goods. In order to ensure that producers receive fair pricing and that customers have the chance to enjoy guava flavor in food items, it is vital to focus more attention on the processing of guava fruits as well as the manufacture of quality goods. The manufacture of jam, jelly, pulp, puree, toffee, leather, juice, infant meals, beverage bases, syrup, and wine now uses guava varietals. Guava pulp is also used to make cheese, in addition to the aforementioned goods. The consumption of traditional jam, jelly, paste, and puree is changing due to contemporary goods in terms of customer taste. Fruit cheese and cheese-like products are becoming more popular on the global market.

Preparation of guava cheese

1) **Sorting of fruits-** Each variety's well-ripened, healthy, and fresh guava fruits were chosen. Fruits that were overripe, under ripe, or rotten were thrown away.
2) **Washing of fruits-** Before processing, the fruits were carefully cleaned in tap water to get rid of any dust or other unwanted foreign objects that had adhered to the fruit's surface.
3) **Cutting of fruits-** For each treatment, freshly washed fruits were sliced into slices with a thickness of about 1 cm using a stainless steel knife.

4) **Boiling of fruit slices-** Fruit slices for each treatment were repeatedly cooked in water until the time came when every slice was entirely soft. After that, the fruit slices from each variety that had been cooked were allowed to cool naturally.

5) **Mashing and sieving of fruit slices** - To make sieving quick and simple, the delicate fruit pieces were carefully mashed by hand. Slices were mashed, and pulps were then utilized for sieving.



Material required for guava cheese:

S. No.	Name of material	Quantity
1	Pulp of fresh guava	1kg
2	Sugar	1.25 kg
3	Butter	100g
4	Citric Acid	2gm
5	Salt	5gm

6) **Addition of sugar, butter and citric acid-** Fruit pieces were properly mashed and sieved before the necessary amount of sugar, butter, and citric acid were added to make cheese.

7) **Determination of end point for cheese preparation-** After adding sugar, butter and citric acid to the fruit pulp in accordance with treatments, the mixture of pulp was left to cook in a metallic pan while being constantly stirred until the mixture had thickened enough and had begun to pull away from the edges of the pan. Once the cheese had reached this stage, the pan was taken off the heat.

8) **Setting of guava cheese-** After being taken from the stove, the cooked guava cheese was spread out onto a plate that had been coated in butter and measured 20 cm by 20 cm. Each plate was evenly covered with a layer of guava cheese that was one centimeter thick, which was then, given three hours to solidify.

Future thrust

About 20–25% of fruits are entirely ruined and destroyed before they reach customers as a result of inadequate post-harvest management, processing, and usage technologies. Therefore, it is essential to pay attention to the processing of guava fruits in order to ensure that producers receive fair compensation and that customers may enjoy guava in the form of culinary items. It has been noted that current goods like fruit cheese are influencing how consumers feel about eating traditional jam, jelly, paste, and puree. Glass and plastic containers can be used to monitor changes in the primary ingredients of guava cheese. When stored in a glass container for the whole of the storage period, the guava cheese received a better rating for acceptance without the addition of any additives.

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MULTIPLE BENEFITS OF COCONUT WATER

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Despite its recent explosion in popularity, coconut water has been consumed for centuries in all tropical regions throughout the globe. In traditional Ayurvedic medicine, it is believed to improve digestion, urination, and even semen production. It has also traditionally been used to given as ceremonial gifts throughout the tropics. It has many health benefits also. Now a day's coconut water has become a very trendy beverage because of its taste and several important nutrients present in it. Coconut water is refreshing and also happens to be good for all. It is the clear liquid found inside immature coconuts. It is one of the best powerful natural sports drink for an instant boost of energy and to combat summer heat. As the coconut fruit matures, the coconut water is replaced by coconut meat. It is also known as green coconut water as the immature coconuts are green in color. Coconut milk is produced from an emulsion of the grated coconut meat of a mature coconut. Coconut milk is made from the water and the flesh inside of a mature coconut. . Coconut water is the clear liquid inside of green coconuts.

How does coconut water work?

More than 95 percent of coconut water is water. Coconut water is a rich source of carbohydrates and nutrient like sodium, potassium and magnesium. Because of such electrolyte composition, there is a lot of interest in using coconut water to treat and prevent dehydration related to exercise and diarrhea. It is packed with essential nutrients like manganese, potassium, Vitamin C, calcium and dietary fibers that make it a refreshing and healthy drink.

It is also used to treat high blood pressure and to improve sportsman performance. Coconut water contains lauric acid, which boosts our immunity and kick-starts metabolism. It also helps pregnant women to fight dehydration and constipation. It also helps in relieving morning sickness and heartburn, which are common symptoms of pregnant ladies. Coconut water contains natural enzymes and minerals that make it a miracle drink. Coconut water is low in calories also. Regular drinking of coconut water before meal helps in maintaining the electrolyte balance in body and thus, keeps our blood pressure in control and improves digestion. Drinking coconut water acts as a digestive as it is low in calories and easy on the stomach. It helps in proper digestion and prevents bloating after meals.

Coconut has sweet and pleasant fragrance that's why it has a psychological effect that helps reducing anxiety and slows heart rate.

Drinking some coconut water before going to bed fight stress and calm our mind. Moreover, sipping coconut water at bedtime may help in flushing out all the toxins from the body and cleaning your urinary tract, thus preventing kidney problems.

Best time to drink coconut water

It is good to drink fresh coconut water anytime of the day. But sipping it at the right time may surely double the health benefits that we can derive. The best time to drink coconut water to reap the maximum benefits are:

1. Drink it early morning on an empty stomach.
2. Before workout for hydrating body and boosting energy or after a workout for replenishing the lost electrolytes.
3. Pre and post meals drinking of coconut water before a meal prevents overeating and constipation.
4. Drinking of coconut water before going to bed help in flushing out all the toxins and thus preventing urinary infections.
5. It is a great hangover cure as it prevents headache and a nauseous feeling next morning and restores the lost electrolytes due to dehydration.

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HEMORRHAGIC BACTERIAL SEPTICEMIA, COLUMNARIS DISEASE, ERYTHRODERMATITIS AND INDIAN MAJOR CARP ILLNESS

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The majority of diseases that affect Indian major carp can be prevented by keeping a healthy habitat by routinely cleaning their surrounds and administering appropriate medications. We have briefly discussed common diseases in this post, along with their preventative and treatment options. This will assist Indian fish farmers in raising healthy, disease-free fish and ensuring a high level of production all year long. These bacteria- *Aeromonas*, *Vibrio*, *Edwardsiella*, *Pseudomonas*, and *Flavobacterium* spp.; are responsible for the majority of aquatic bacterial illnesses. Methods for diagnosing the main diseases that affect cultivated fish, crustaceans, and molluscan species have made fantastic strides. These have repeatedly been shown to be facultative illnesses with the capacity to have devastating effects on populations of animals under other circumstances marginal physical or chemical conditions; overcrowding. Fish health issues can be caused by a variety of external events. Infections may occur as a result of elements such a lack of oxygen, chemical poisoning, and physical or physiological abnormalities. Fresh-water fish can contract a variety of diseases. When a fish's immune system is weak or they are under constant stress due to poor water quality, overcrowding, unsuitable foods, or other environmental problems, they are more likely to get sick. Treatments will only have a temporary impact if these problems are not addressed.

Fishes health problems

Health issues with freshwater fish are typically brought on by different bacterial, fungal, protozoan, or parasitic illnesses. Fish health issues can be caused by a variety of external events. A wide range of illnesses and parasites can harm carps when they are under stress, especially due to the unfavourable environment and inadequate nourishment. Poisoning by ammonia. In your fish tank, high levels of ammonia can accumulate. Columnaris, a typical bacterial infection, appears as mold-like sores on your fish. Tattered tail and fins. Skin lesions. Skin and mouth have fuzzy patches. Flavobacterium, a type of bacteria. Fins and skin have bumpy growths. Carp Flu Fins and skin with white "pimples. Fish, eggs, and uneaten food have "hair" that resembles cotton. Higher gill movement. White spots on the body and fins. Golden spots on the skin.

General causes of the diseases

It can be described that most of the disease outbreaks result from two combined factors, they are:

- The appearance of disease organisms.
- Abnormalities of both the affected fishes (stress, malnutrition, factors that can cause and handling abrasions).

General principles to avoid diseases

- Reliable husbandry techniques.
- Fresh nutrition.
- Fresh water.

1. Carp Erythrodermatitis (CE)

This is an ulcerative skin condition that is brought on by the *Aeromonas Salmonicidia* bacterium. *Furunculosis* in salmonids is thought to be caused by *Aeromonas salmonicida*. On the skin and fins, hemorrhagic ulcerative sores developed, but mortality is not particularly noteworthy. The medication is given by combining it with feed. To treat this condition, a variety of sulphonamide medications are employed. Sulfamorazine, sulfaguandine, sulfadiazine, sulfamethazine, and sulfisoxazole are the names of these drugs. The most significant antibiotic is terramycin, which has been successfully administered intraperitoneally at a dose of 25 mg/kg body weight or as a feed additive at a rate of 5-7 g/100 kg fish per day for 7–10 days.

2. Columnaris disease

The primary symptom of this illness is the development of lesions, which typically arise on the head, back, and gills. The causal agent of this disease is Flexi-bacter columnaris. If gills are compromised, then chances of mortality are very high. This illness

is frequently linked to environmental stress, particularly a sharp rise in water temperature. Although highly challenging to treat, the following methods have been proposed.

- 500 ppm copper sulphate dipping for 1-2 minutes.
- 5-10 ppm adding chloromycetin to the water in tanks or ponds.

3. Hemorrhagic septicemia

Pseudomonas fluorescens is the primary cause of this bacterial illness. Bighead and silver carp are particularly prone to this illness. Severe anaemia and high mortality are reported after haemorrhages of the skin, fins, buccal cavity, and internal organs. Treatment is very challenging. Infected fish can be treated with oxytetracycline. For valuable fish, intraperitoneal injection with antibiotics like Kanamycin is performed.

Conclusion

The most frequent occurrence in all living things is the development of diseases. Fish have a variety of ailments because they are excellent hosts for parasites and pathogens. Pathogens which are responsible for fish infections are mainly virus, bacterium, fungus, protozoa, moulds etc. As we all know, prevention is preferable to treatment. In order to prevent the occurrence of those diseases, we need be concerned about various water quality measures and environmental conditions. The most popular treatment for bacterial fish diseases is antibiotics. Some herbs can also enhance leukocyte and bacteriolytic activity, two non-specific immune functions. Aquaculture without disease will not only guarantee the fish's health and cleanliness but also boost the fish producers' economies.

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USE OF MICROALGAE

FOR AN ECO-FRIENDLY AQUACULTURE ECOSYSTEM

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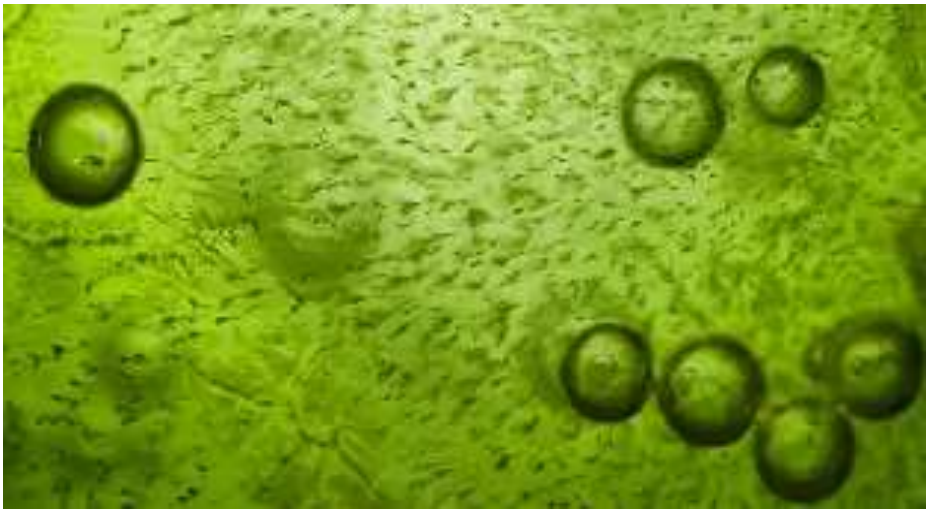
It is believed that microalgae have great importance in the aquatic ecosystem for a sustainable aquaculture. The cells present in microalgae are rich in proteins, essential amino acids and polyunsaturated fatty acids which regulates the growth of aquatic organisms. It can be used for fish in the form basic feed, and as the aquaculture industry is growing at a rapid rate so does the demand for aquafeed is increasing, therefore microalgae can be used in replacement of the fish meal and plant derived feed which will be viable for the ecosystem as well as economical. Apart from being used as a feed, microalge helps to regulate the quality of water in aquaculture and purifies it, the cells of microalgae absorbs nutrients like nitrogen and phosphorus which improves the water quality.

What are microalgae?

Microalgae or microphytes are known as the microscopic algae and are abundant in nature with high nutritional value. They are the unicellular species which can be found individually, in chains or in groups. It estimated that in global market the annual world production of microalgae by industry is between 10,000 and 20,000 tons. It represents one of the richest sources of bioactive compounds. Some of the microalgae are rich in antioxidants and are non-toxic therefore has a medicinal importance for human and animals. The most frequently used microalgae genus in aquaculture are *Chlorella, Tetraselmis, Scenedesmus, Pavlova, Phaeodactylum, Chaetoceros, Nannochloropsis, Skeletonema and Thalassiosira*. They have rapid growth rate and are stable in culture to possible variation in temperature, light and nutrients. It has been estimated that currently 30 per cent of the world algal production is used for animal feed and the use in aquaculture is mainly for larval fish, molluscs and crustaceans.



Microalgae assisted aquaculture

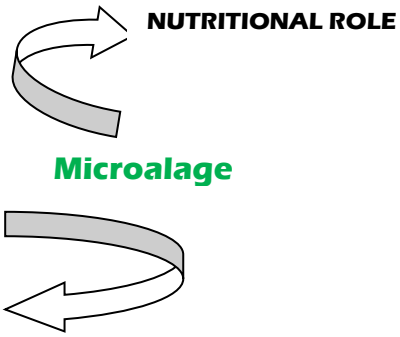
The basic approach of Microalgae in aquaculture is to convert the organics present in the eutrophic effluents into biomass by the growth of microalgae and use the value added biomass as a feed in aquaculture. The microalgae system increases the carbon dioxide fixation which promotes the release of oxygen, acting like a bio-pump which helps to create a good environmental surrounding for the aquatic organisms.

The specific scheme of microalgae-assisted aquaculture:

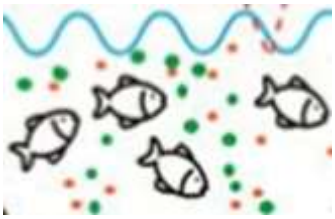
1. The microalgae introduced into a fish pond or tank, will enhance the capacity of self-purification of the water system, in which the microalgae act like a bio-pump by digesting the waste produced by aquatic organism to maintain the level of dissolved oxygen in the water system.
2. The microalgae cultivation system is established in the water body to assimilate nutrients in aquaculture effluent.
3. Third, harvesting technology, which is considered suitable for the aquaculture system, is employed to obtain the microalgae biomass in an environmentally friendly and cost-saving way.
4. The harvested fresh biomass is used as an improved and beneficial feed for aquaculture to

Applications

- Biopump
- Water quality regulation
- As an immunostimulant
- Aquafeed



Aquaculture system



reduce the fish rearing cost and the treated effluent is recycled in the system.

Microalgae as feed for the aquaculture industry

The demand for Global microalgae is estimated to reach US$3.4 billion by 2020 and is expected to grow by 4.3% over the next seven years (Globenewswire, 2021). Microalgae has the right proportion of protein, lipid and carbohydrate as compared to other alternative ingredients like bacteria and yeast, hence is very beneficial for the fish health. The protein content in dry microalgae biomass ranges between 26.5% and 53.3% and compared with the soybean protein. Microalgae protein has much higher productivity, making it a viable protein source for aquaculture. The size and structural function of microalgae differs with the digestive function of aquatic animals. Therefore different type of feeding microalgae is required for different aquatic organisms at different growth stages. For example, certain microalgae like *Chaetoceros calcitrans, Isochrysis galbana*, etc. are rich in eicosapentaenoic acid (EPA) or docosahexaenoic acid (DHA), so they are given to the early developmental stages of molluscs. *Tetraselmis spp., Thalassiosira pseudodonana, and C. calcitrans*, are usually preferred and provided to the crustaceans.

Microalgae as an immunostimulant or antioxidants

The bioactive substance present in microalgae said to have natural antibacterial activity, which prevents an organism from attack of pathogenic bacteria and kills it. It is also reported that some polysaccharides in microalgae enhances phagocytic capacity of macrophages and the gene expression level of pro-inflammatory cytokines which directly activates the natural immune response in the organisms. Examples of some commonly used microalgae species which found very beneficial for the growth and immune system of the aquatic organisms are *Haematococcus pluvialis, Arthrospira platensis (Spirulina), Chlorella spp.*, etc.

Conclusion

The feed made from microalgae for the fish has high potentials to replace fish and soybean meal and develop a sustainable aquaculture ecosystem. Based on the microalgae - assisted aquaculture many benefits has been provided to the aquaculture system like it can convert wastes to value-added biomass as aquaculture feed, reduce water deterioration and also reduces the energy consumption for aeration. They can also use in the form of Prebiotics and Probiotics and makes the organism disease resistant. Still microalgae-assisted aquaculture has some problems related with the biomass safety level, economic feasibility, and the lack of knowledge on economic assessment and life cycle analysis, which obstruct its industrialization or commercialization in a real-world application. But by solving all the problems, microalgae will play a more vital role in aquaculture for sustainable development in the future and will become very beneficial for the farmers too.

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TRANSGENIC TECHNIQUES

A CONTEMPORARY FISH PRODUCING TECHNOLOGY

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Fig 1 (a). Transgenic Glofish

Fig 1 (b). Transgenic Green Tetra Fish

Since the first transgenic fish were made in China in 1985, numerous transgenic fish have been created utilising a range of transgenes, techniques, and species. Early research centred on producing novel fish strains with commercially desirable traits and advancing transgenic technology, with an emphasis on enhancing growth. Transgenic organisms are those whose genomes have successfully incorporated a transgene that was introduced intentionally. As of 2013, over 50 fish species had undergone genetic modification. The majority of the alterations have been made to food species such Common Carp, Tilapia and Atlantic salmon (*Cyprinus carpio*). There are numerous fish species being examined for gene transfer experiments, and they can be divided into two categories: Model fish for fundamental research and aquaculture animals. The most popular fish for eating are Channel Catfish (*Ictalurus punctatus*), Tilapia (*Oreochromis* spp.), Salmon (*Salmo* spp.), and Medaka (*Oryzias latipes*), whereas Goldfish (*Carassius auratus*) and Zebra fish (*Danio rerio*) are used for fundamental research.

Methods in the production of transgenic fish

Several significant actions are routinely conducted in order to produce the desired transgenic fish. An acceptable fish species must first be chosen based on the purpose of the research and the accessibility of the fish-holding facility. Making a specific gene construct is the next stage. An important gene product is encoded by a structural gene in the gene construct. Third, for the transgene to be permanently incorporated into the DNA of each cell, the gene construct needs to be injected into developing embryos. Fourth, a screening process for identifying transgenic people must be implemented because not all instances of gene transfer are successful.

Electroporation method

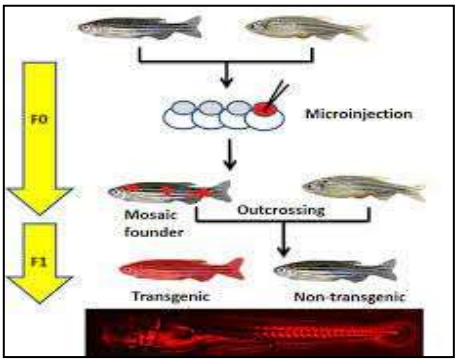
The most effective method of gene transfer in fish has been found to be electroporation because a large number of fertilised eggs may be treated in a short amount of time. The cell membrane is punctured by a series of brief electric pulses during electroporation, allowing the transgene to enter the cytoplasm and then be transported by the cellular machinery to the nucleus. Electroporation has taken over as the preferred method for gene transfer in fish systems in many labs due to its effectiveness, rapidity, and simplicity.

Microinjection method

The microinjection procedure has been used to produce transgenic fish successfully because it is straightforward and repeatable. The most popular method of fish gene transfer, microinjection enables delivery of the transgene directly into the nucleus. It was discovered that the DNA injected into the cytoplasm of fertilised zebra fish eggs integrated into the fish genome and was handed down to the following generations. In zebra fish, the frequency of germline transmission of a microinjected DNA may reach 20%.

Method of retroviral infection

Retroviruses have reportedly been utilised successfully to transfer genes to fish.



Advantages of transgenic fish

The development of human therapeutics, experimental models for biological research, environmental monitoring, ornamental fish, and aquaculture are just a few of the uses for transgenic fish that have been developed. Reduced feed waste and effluent from fish farms are two examples of how transgenic fish's improved feed conversion efficiency has led to economic and possibly environmental advantages. In order to better understand the genetic, physiological, and ecological effects of growth promotion, transgenic strains serve as crucial model systems. Growth of transgenic tilapia is significantly faster than that of non-transgenic tilapia without extra copies of the trout growth hormone gene. Researchers have employed transgenic fish to study how genes are regulated during development, increase cold tolerance, hasten growth, and enhance feed utilisation.

Applications of Transgenic Fish Technology in Research Transgenic fish are used in research covering five broad areas:

- Improving fish characteristics that are available for purchase.
- Making proteins that are crucial to biomedicine in them as bioreactors.
- Using them as indicators for contaminated water.
- Creating innovative models of non-mammalian animals.
- Studying functional genomics.

Environmental impact of transgenic fish

Concerns regarding the possible effects of GM organisms escaping from aquaculture operations have been raised by several scientists and environmental organisations. Scientists and opponents of GM fish are concerned that undesirable genes would spread by interbreeding with wild populations of the same species. Wild fish may be put in danger due to increased competition or predation from escaping transgenic fish. The size of the natural population, the number of escaped fish and their genetic strain, as well as regional environmental factors, would all have a role in determining the outcomes of such competition. According to the Food and Drug Administration (FDA), only sterile GM fish might be used in ocean enclosures.

Conclusion

The future success and adoption of transgenic fish will depend on the ability to successfully demonstrate a potential absence of environmental risk, food safety, suitable government regulation, labeling, public education, and the development of transgenic fish genetic sterilisation. Transgenic technology is rapidly evolving. To achieve widespread consumer acceptance of transgenic fish from an environmental perspective, as well as maybe in reference to how "organic" a transgenic fish is, appropriate, well-executed public education may be necessary. Future research should concentrate on DNA sequences from fish rather than mammals to increase public acceptance and prevent sequences of bacterial or viral origin. On the other hand, consumers and environmentalists are concerned about its safety.

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STATISTICAL METHODS FOR HANDLING THE MISSING DATA

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The values or information that are missing from some variables in the provided dataset are referred to as missing data. Incomplete data (or) missing data is frequently encountered in many disciplines and is quite common in many real-life datasets. Understanding missing values is necessary for efficient data management. The researcher may wind up inferring incorrect conclusions about the data if the missing values are not handled correctly, which reduces statistical power and the model's accuracy. Lost data can cause bias in the estimation of parameters. The statistical field has shown a great deal of interest in statistical analysis with missing data. In this article, we discussed the problems and types of missing data, along with the techniques for handling missing data with examples.

Reasons for data missing from the dataset

There may be a number of reasons for some values in the data to be missing. For instance, the responder may not answer because the question is sensitive, or the respondent may not answer because they do not know the answer. Inadequate maintenance could lead to distorted historical data. Human error could result in a failure to record the values.

Types of missing value

Formally the missing values are categorized as follows in Fig 1.

Missing Completely at Random (MCAR)

In this case, missing values are completely independent of other data. There is no pattern. The missing data may be the result of human error, equipment or system failure, sample loss, or unsatisfactory technicalities during the recording of the values. For example, suppose in a library there are some overdue books. Some values of overdue books in the computer system are missing. The reason might be a human error like the librarian forgot to type in the values. So, the missing values of overdue books are not related to any other variable/data in the system.

Missing at Random (MAR)

Missing values in this case only occur in subsamples of the data, are dependent entirely on the observed data, and show some sort of pattern. For example, if you check the survey data, you may find that all the people have answered their 'Gender' but the 'Age' values are mostly missing for people who have answered their 'Gender' as' female'. (The reason is that the majority of women don't want to reveal their age.) The statistical analysis in this case can produce bias. The only way to estimate the parameters realistically is to model the missing data.

Missing Not at Random (MNAR)

The missing data might be classified as MNAR if it does not fit into the MCAR or MAR categories. Missing values depend on the unobserved data. It might occur as a result of a particular group of persons failing to respond to some survey questions. For example, people with less income may refuse to share that information in a survey.

Dealing with missing data

Analyze each column with missing values carefully to understand the reasons behind the missing values as it is crucial to find out the strategy for handling the missing values.

There are 3 primary ways of handling missing values categorized as follows:

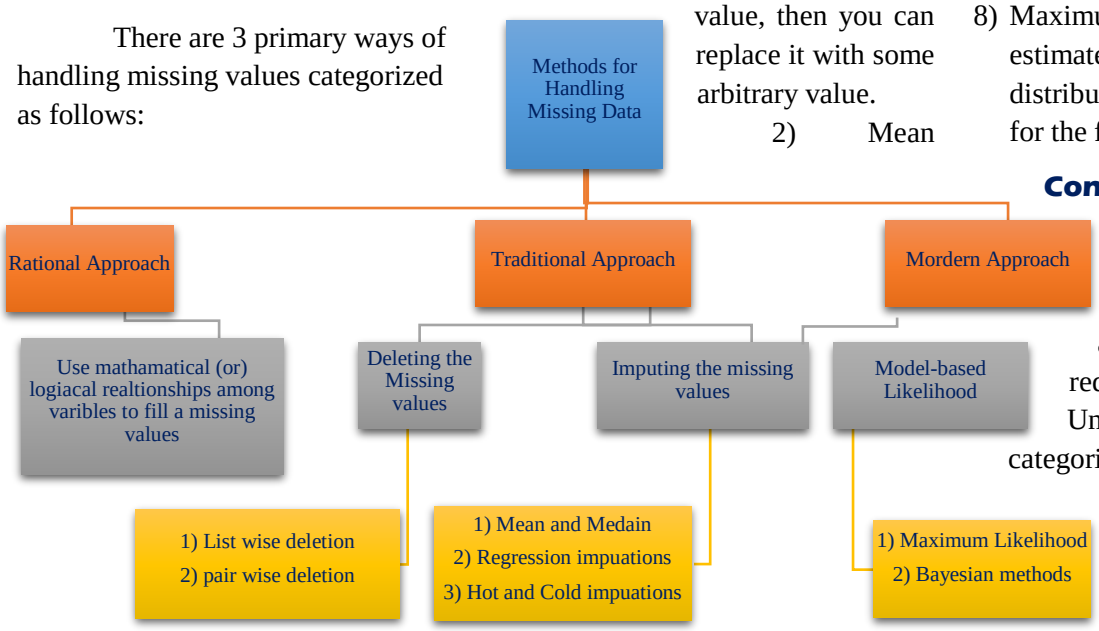

Fig. 2. The main techniques for dealing with missing data

Deleting the missing value

This technique is frequently used when dealing with large amounts of data. The missing value may be deleted if it is of type MCAR. In that list-wise deletion, you delete any row with one (or), more missing values that are present in the data set. In pair-wise deletion, data is only deleted if there is missing data for the variables involved in a specific analysis.

Imputing the missing value

Imputation is used to replace the data if they are not MCAR. The missing values can be replaced in a variety different ways.

1) Simple imputation method, an educated guess about the missing value, then you can replace it with some arbitrary value.
2) Mean imputation is the most common method for missing values. The mean won't be suitable if there are outliers.
3) Replacing with Median imputation is used in the case of outliers present in data.
4) Substituting mode, it is used in the case of categorical features.
5) Using the previous value as a replacement It is mostly used in time series data.
6) Regression imputation substitutes a missing value that is predicted from other variables.
7) Multiple imputations are a prediction of the missing data using the existing data from other variables.
8) Maximum likelihood method is estimated by using the conditional distribution of the other variables for the fill missing data.

Conclusion

Handling missing values is one of the challenges of data analysis. Missing data reduces the statistical power. Understanding different categories of missing data helps in making decisions on how to handle it. In this article, we looked at the various types of missing data and how to handle them. The most efficient way to deal with missing data is to collect as much of it as possible throughout the design or data collecting stages of the research study. Modern and traditional approaches are best used with large samples. In general, Multiple imputation is often a good method when analyzing data sets that contain missing data.

■■■

SELF-INCOMPATIBILITY

A MECHANISM FOR POLLINATION CONTROL IN PLANTS

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Self-incompatibility is the mechanism in which the prevention of self-fertilization and inbreeding occurs. The prevention of self-fertilization occurs by inhibition of the pollen germination or the pollen tube growth when pollen from same / another flower of same plant falls on the stigmatic surface. Here the pollen grains fail to germinate on the stigma of the flower producing them. If some of the pollen grains do germinate, the failure of the pollen tube to enter the stigma occurs. Sometimes, pollen tube enters the style, but before the flower drops, their growth is too slow to effect fertilization and if the fertilization is effected, the degeneration of embryo occurs at early stage. Different types of self-incompatibilities are heteromorphic type and other is homomorphic types. There are several mechanisms also on molecular basis for self-incompatibility in different crops.

Introduction

In plant breeding, mode of pollination holds important role in determining the genetic constitution, ease in pollination control, nature of gene action and after release, stability of varieties. Various mechanisms are there that encourage the cross pollination and out of these self-incompatibility (SI) holds a great significance because of its utilization in hybrid seed production. Self-incompatibility (SI) is the mechanism involves the prevention of fusion of fertile (functional) male and female gametes after self-pollination. Self-incompatibility (SI) is a mechanism in which self-recognition and then rejection occur. It is first reported by Koelreuter in the middle of eighteenth century. It leads to the prevention of inbreeding depression. Inbreeding depression is the loss of vigor as a result of inbreeding. In this article, we will discuss in brief about the different self-incompatibility classifications and its molecular models.

Classification of self-incompatibility

Lewis (1954) gave the classical classification of self-incompatibility. He classified self-incompatibility (SI) into two main groups, i.e. homomorphic and heteromorphic system. The homomorphic system is sub classified again into gametophytic and sporophytic system of incompatibility.

Heteromorphic self-incompatibility

In this, flowers of different incompatibility groups are different in morphology. The example for this system is in Primula having two different types of flowers namely pin and thrum. Long style and short stamens describes the pin type while short styles and long stamens describe the thrum flowers. This type of situation is termed as distyly. These both pin and thrum flowers are developed on different plants. Pin and thrum flowers have the only compatible mating. Single locus s governs this character. Thrum is produced by Ss, while pin flower is produced by ss. The pin flowers produce the pollen grains would be all s both in genotypes and in incompatibility reaction. On the other hand, the pollen grain produced by thrum flowers would be of genotypically two types i.e. S and s, but phenotypically all of them would be S.

Homomorphic self-incompatibility

The morphology of the flower does not have a role with incompatibility reaction. The incompatibility reaction is controlled either by genotype of the pollen (gametophytic self-incompatibility) or by genotype of the plant on which it is produced i.e., sporophytic self-incompatibility.

Gametophytic self-incompatibility

Pollen parent is having the genetic constitution (S1 S2) produce two gametes S1and S2 and two alleles are co-dominant in female parent and expressed of both will be there. Therefore, when pollen grains having S1 or S2 genetic constitution falls on a S1 S2 female plant, both will not germinate since there is co-dominance reaction in stigma. When it falls on the S1 S3 stigma of a female plant, S2 can only germinate and results in partial incompatibility and it is completely compatible occurs when falls on a S3 S4 female.

Sporophytic self-incompatibility

In this, pollen parent with male gametes have both S1 and S2 developed from S1 S2 will behave as S1 and also in stigma as S1 . Hence, a cross in between S1 S2 x S1S2 results in incompatibility and S1S2 x S1S3 results in incompatibility also while S1 S2 x S3 S4 results in compatibility.

Molecular models of self-incompatibility

Molecular model of self-incompatibility in brassicaceae:

There are two genes namely, SP11/ SCR are present, SP11 acts as a male determinant and SRK acts as a female determinant. The promoter of incompatibility reaction is SLG. SRK acts in stigma i.e. in the plasma membrane of papilla cells while in the anther tapetum, expression of SP11 occur during pollen grain maturation. In a self-incompatibility (SI) reaction, when landing of pollen grain on stigma, SP11 will tend to bind with SRK and results in auto-phosphorylation and leads to pollen tube growth prevention. But in case of a compatible reaction, activation of SP11 does not occur and therefore, germination of pollen and fertilization takes place normally.

Molecular model of self-incompatibility in Solanaceae

In case of Solanaceae family, the male determinant is SLF/ SFB and the female determinant is SRNase. When pollen grains falls on stigmatic surface, the production of SRNase occur and then enter into the stigmatic surface. They will lead to the degradation of the RNA which encodes the enzyme for pollen tube growth and result in pollen tube death. In case of incompatible reaction, production of RNase also occurs and it enters the stigmatic surface and it will lead to formation of complex with SLF. Therefore, there is no disturbance in RNA encoding enzyme for growth of pollen tube and pollen tube growth and fertilization occurs normally.

Molecular model of self-incompatibility in Papaveraceae

In Papaveraceae family, identification of only female determinant is there which is called as S-protein. Male determinant on the other hand is unknown. Here, S protein will tend to bind with SBP (S-protein binding protein) and results in increasing the concentration of Ca++. This will start different reaction mainly actin depolymerisation which results in pollen tube death but in compatible reaction, S protein will not tend to bind with SBP. So, there is no fluctuation in Ca++ concentration and hence results in growth of pollen tube normally.

Conclusion

Self-incompatibility (SI) is among the most important systems used by various flowering plants for the prevention of self-fertilization and hence, generation and maintenance of genetic diversity occur within a species. Moreover, there are two genes present in S-locus which control self-incompatibility. The nature of genes which are responsible for self-incompatibility are multi-allelic. For determination of self-incompatibility, there are different methods which vary with the type of self-incompatibility as well as the crop. Self-incompatibility will tend to prevent self-pollination effectively. Therefore, it has great effect on the breeding approaches and also on the objectives.

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WATER CONSERVATION TECHNIQUES
AND RAIN WATER HARVESTING

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Water conservation comprises of all the policies, strategies and activities to sustaining and to protecting the hydrosphere, effectively manage the natural resource of fresh water, and to meet the present and future human demand. The key components of water conservation are avoiding degradation of water are avoiding degradation of water quality, reducing water loss, use and waste of resources and enhancing water management practices that reduce the use/boost up the beneficial use of water. Rainwater harvesting is the most important water conservation approach. Rainwater harvesting is the art and science of collecting and productive utilization of runoff from rooftops, ground surfaces and from intermittent watercourses.

Water conservation

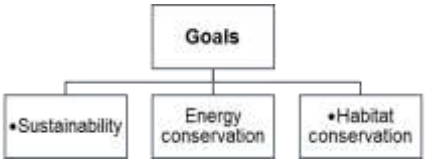
A Water conservation measure is an action, technology, or improved design or process implemented to reduce works water waste, loss or overuse.

Strategies for water conservation technologies

- Rainwater harvesting.
- Use of saline water for irrigation.
- Better irrigation practices.
- Dew and fog
- Mulching
- Contour farming
- Tippy tap for water conservation
- Long distance transfer of water
- Soak pit construction
- Propagation of eco lawns / dry garden
- Tree plantation
- Desalination.

Goals

The following are some goals of water conservation efforts:



Water conservation practices in India

1. Andhra Pradesh: Cheruvu
2. Arunachal Pradesh: Apatani
3. Assam: Dongs, Garh and Dam
4. Bengal's: Inundation channel
5. Bihar: Ahar, Pynes
6. Gujrat: Virdas
7. Himachal Pradesh: Kul, Khatri
8. Island: Jackwell
9. Jammu and Kashmir, Ladakah: Zing
10. Kerala: Surangam, Karambu
11. Karnataka: Madakas, Neeruganti
12. Madhya Pradesh and Orissa: Katas, Mundas, Bandhas
13. Maharashtra: Bhandara Phad irrigation
14. Meghalaya: Bamboo Drip irrigation
15. Nagaland: Zabo
16. Rajasthan: Naada/Bandha, Johads, Talabs, Tankas/Tanks, Stepwells or Baoli
17. Tamil Nadu: Eri, Ooranis
18. Uttarakhand: Naula, Gul, Dhara, Simar, Khel
19. Uttar Pradesh: Kunds

Fig 1. (Source: www.cpreecenvis.nic.in)

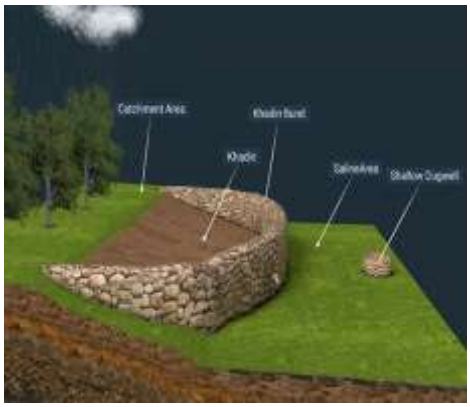


Fig 2. (Source: www.youtube.com/labinapp)

Rain water harvesting

Rainwater harvesting is defined as a method for including, collecting, storing and conserving local surface runoff for agriculture in arid and semi-arid regions.

Rainwater harvesting covers three types of water harvesting:

1. Rainwater is collected from roof tops, courtyards and similar compacted or treated surfaces are used for domestic purpose/household use or garden crops.

2. Internal (Micro) catchment water harvesting is a method of collecting surface runoff (sheet or rill flow) from a small catchment area and storing it in the root zone of an adjacent infiltration basin. The basin is planted with a single tree or bush or with annual crops.

3. External (Macro) catchment water harvesting is also called "Water harvesting from long slopes" or

"harvesting from external catchment systems". Runoff from hillslope catchments is conveyed to the cropping area, which is located below the hill foot on flat terrain.

Rainwater harvesting and management strategies consisting of both *in situ* and *ex situ* harvesting can be alternative.

- *In situ* rainwater harvesting can be achieved by increasing infiltration rate via deep ploughing, profile modification, vertical mulching and by keeping soil surface rough. *In-situ* rainwater harvesting techniques are location specific and are dependent on the rainfall intensity, slope, and soil texture.

- *Ex situ* rainwater harvesting includes root top collection, dug out storage/pons tanks, nala bunding, gully control structures/check dams/bandharas (weirs), water harvesting dams, percolation ponds/tanks, subsurface dams/ barriers, etc. These technologies are highly area specific and strategies evolved in a given region have a limited application in other regions.

Components of rainwater harvesting

The rainwater harvesting system that utilized storage has four components:

Advantages of rainwater harvesting

- Improved water quality, soft and low in minerals at a low cost and reduces demand for ground water
- Rise in the water levels in wells and bore wells that are drying up.
- Mitigation of the effects of drought and attainment of drought proofing
- An ideal Solution to water problems in areas having inadequate water resources and reduces water bills.
- Rainwater harvesting promotes self-sufficiently and fosters an appreciation for water as a resource. It also encourages the water conservation.
- Reduces soil erosion by reducing surface runoff.

Disadvantages of rainwater harvesting

- Poorly constructed water containers/jars can suffer from algal growth and invasion by insects, reptiles and rodents.
- Supplies can be contaminated by animal/bird droppings on catchment surfaces and guttering structures unless they are flushed/cleaned before we use them.
- They can act as a breeding ground for disease vectors, if they are not properly maintained.

Conclusion

Water conservation is a key component of any strategy that aims to alleviating the water scarcity crises in India. With rainfall patterns changing almost every year, the Indian government has started looking at means to revive the traditional systems of water harvesting techniques in the country. These methods are simple and eco-friendly for the most part, they are not just highly effective for the people who rely on them, but they are also good for the environment. Rainwater harvesting technology is especially relevant to the semi-arid and arid regions, where the environmental degradation, drought and population pressure are most evident. It's an important component of the package of remedies for these problem zones. Water harvesting, as unlike to pumping water, saves energy and maintenance costs.

■■■

SOIL AND WATER CONVERSATION

THROUGH CROP MANAGEMENT AND SOIL TILLAGE PRACTICES

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Soil and water are the most important natural resources on which survival of humans depend. Soil and water conservation is a worldwide strategy in the context of a sustainable and poverty orientated natural resource manage-ment soil and water conservation measures are best needed for maintaining a balanced ecosystem for sustainable crop production in dry lands. Efficient management of rain water can boost agricultural production from dry lands.

Objectives of soil and water conservation (SWC)

1. Effectively conserve soil, rainwater and vegetation & harvest the surplus water in addition to ground water recharge.
2. Promote sustainable farming and stabilize crop yields by adopting suitable cropping and crop management systems.
3. Cover the non-arable area effectively through afforestation, horticulture and pasture development based on land capability.
4. Enhance the income of the individuals by adopting alternative enterprises.
5. Restore the ecological balance.

Keeping the above said principles in view, agronomist and soil scientist have devised following methods, which can prevent the loss of soil during its erosion.

❖ Agricultural conservation

1. Contour cultivation.
2. Manuring.
3. Mulching.
4. Mixed cropping.

(A) Crop management: Keep soil covered is fundamental principle of conservation agriculture. Soil protection from erosion by leaving crop residues on soil surface after harvesting the crops. .

(i) Crop selection: The stability of the conservation agriculture system is increased by cover crops and erosion impacts are reducing by the improvement of soil properties.The more effective crops in soil erosion are perennials than annual crops.

(ii) Crop rotation: The practice of growing a series of dissimilar types of crops in the same space in sequential seasons.

(iii) Inter-cropping: The impact of raindrops is reduced with the soil cover by the fast-growing legumes such as cow peas and beans early in the season before a canopy is developed by cotton or maize to shield the soil.

(iv) Strip cropping: This is the practice of growing different crops in alternate strips in the same field. It helps minimizing wind and water erosion.

❖ Tillage practices should be adopted

1. Soil is neither too fine nor powdery.
2. It breaks up the hardpan if necessary.

The main tillage methods are:

1. Slash and burn,
2. Hand hoeing,
3. Ploughing and harrowing,
4. Conservation or minimum tillage,
5. Deep tillage.
6. **Contour tillage** -All agricultural operations are to be done on the contour/across the direction of slope where holdings are very small.

   Reason- conserves soil and due to increased time of concentration, more rain water seeps through the soil profile to recharge water

7. **Dead furrows** -When all tillage operations are complete, it is advisable to leave a dead furrow at every 10m interval. This should remain in position until the crop is harvested

   Reason-Dead furrows 'aid' in reducing the run-off velocity and they also conserve water.

❖ Physical conservation measures:

(a) Cut-off drains: Cut-off drains are made across a slope for intercepting the surface runoff and carrying it safely to an outlet such as a canal or stream.

(b) Retention ditches: These are made along the contours to capture and retain incoming runoff water and hold it until it seeps into the ground.

(c) Infiltration ditches: The structure used to harvest water from roads or other sources of runoff is infiltration ditches. They comprise dug along the contour, up slope from a crop field and a ditch of 0.7-1.5m deep.

(d) Water-retaining pits Water-retaining pits allow runoff water to seep into soil after by trapping the water. The runoff normally occurs into a series of pits which are dug into ground.

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APPLICATION OF REMOTE SENSING IN WATERSHED MANAGEMENT

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The watershed profile divides the terrain into unequal segments with diverse terrain characteristics, varied endowment of nature and distinctly different susceptibility to the natural environmental constraints viz. flood, water logging, riverine erosion, drought and soil erosion. The livelihoods of the local population mainly rural largely depend on these natural resources as well as constraints. Development of the watershed needs better understanding about the various natural resources their relations with each other and their relations with livelihood of the stakeholders.

The use of Remote Sensing Data for faster assessment of natural resources such as soil, geology, drainage etc. as well as assessment of economic activities through land use and infrastructure of the watershed area is well known. This is also used for monitoring of watershed development at later years. GIS is a very powerful tool for development of the watershed area with all natural and socio-economic facets for better planning, execution and monitoring of the project. It gives a clear perspective for analysis at various levels to different partners of the watersheds.

Watershed

The term "watershed" refers to a geo-hydrological unit area that drains to a single point and is regarded as the best unit for environmental planning, natural resource management, and analysis. It has been acknowledged as the fundamental unit to take into account for all significant soil and water conservation initiatives. Size, shape, relief, drainage, geology, soils, erosion state, run-off, and deposition are all significant watershed features.

Objectives of watershed management

The different objectives of a watershed management programme are:

1. To control damaging runoff.
2. To manage and utilize runoff for useful purposes.
3. To moderate floods in the downstream areas.
4. To enhance ground water storage.
5. To control erosion.
6. To reduce sediment production.
7. Appropriate use of the land resources in the watershed.

Watershed characteristics

Each watershed has a number of distinct characteristics, which affects the behaviour of receiving and disposal of water. Following are the important watershed characteristics:

Size, shape, slope, hydrologic soil cover complexes - (i) Soils (ii) Vegetal cove, drainage, climate, time of concentration.

Steps involved in watershed management

1) Generation of drainage map.
2) Delineation of watersheds.
3) Characterization of watersheds on a smaller scale.
4) Prioritization of watersheds/ selection.
5) Characterization of watersheds on a larger scale.
6) Preparation of action plan.
7) Implementation.
8) Monitoring of developmental activities.
9) Impact assessment.
10) Post treatment management.

Conclusion

The interrelated nature of land and water resources calls for a holistic approach towards watershed management. Because of the ability to obtain synoptic view and repetitive coverage, remote sensing lends itself as a powerful input media. Unbiased reproduction of the natural features in the form of photograph/imagery and thereby economising the multi-disciplinary approach for planning of natural resources in a watershed for integrated development.

Technologies like GIS, REMOTE SENSING lends a helping hand in organisation of these huge databases in a structural format. GIS integrate multi-thematic information, analyse the information in an objective manner. GIS help arrive at timely and appropriate decisions related to resource management.■

WASTEWATER SURVEILLANCE

AN EMERGING EPIDEMIOLOGICAL TOOL

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Wastewater surveillance also referred to as water based epidemiology (WBE) is the process of continuously monitoring sewage/ waste water for the presence of contaminants over a period of time. The contaminants could comprise of any biological agents (viruses), AMR genes or legally prohibited drugs that are excreted in the feces of humans and/or animals. Recently, COVID-19 has brought forth the use of WBE as an essential forecasting epidemiological tool, due to the fact that COVID-19 is easily available in feces apart from the respiratory secretions. The inadequacy in detection of asymptomatic cases alongwith the reluctance for swab collection for RT-PCR by the individuals make feces an easy and efficacious sample for investigating trend in COVID-19 and forecasting onset of new waves.

Sewage water testing is an ancient practice with its first use by Swedan in year 1920 to detect typhoid. Since, then it has been used to keep a track on pathogens that are excreted in feces like poliovirus, measles, influenza etc. Additionally, WBE had been used in monitoring poliovirus, which augmented the eradication efforts through the discovery of reservoirs of virus (i.e., unidentified infections). Nowadays, researchers are attempting to explore potential of WBE in identifying newer antimicrobial resistant genes (ARGs) and variants of COVID-19 in order to justify WBE as an emerging epidemiological tool.

Temporal and spatial comparisons using WBE

WBE is an effective tool to analyze sewage samples at different time points or for a given period of time. Recently, WBE has been utilized to investigate the changes in pattern of occurrence of COVID-19 over the period of time. Additionally, WBE helps to identify the hotspot for different diseases in-order to aim for curating preventive strategies in identified communities.

Surveillance of water borne viral diseases using WBE

Waste water includes excretions from the domestic, hospital and industrial sectors, which are heavily enriched with viruses excreted in feces *viz*., enteroviruses, poliovirus, aichivirus and coronavirus. The systematic WBE for poliovirus has revolutionized the control of polio by forecasting the viral circulation in suspected households or community where the mainstream surveillance is still lagging behind. Additionally, WBE has the potential of detecting any viral outbreak a week prior to the manifestations of symptoms, thereby aiding in forecasting and evading the hazards of serious outbreaks. The utilization of WBE in COVID-19 surveillance helped the researchers to outline the ongoing trend and identify the suitable hotspots for formulating vaccination and medical strategies beforehand.

Role of WBE in COVID-19 surveillance

COVID-19 pandemic, a result of infection with SARS-CoV-2 overwhelmed and alarmed the healthcare system unlike any other healthcare event in the past years. The early infection was misdiagnosed as bacterial pneumonia and therefore was left untreated with antibiotics. The faulty and prolonged antibiotic usage hampered the antimicrobial stewardship programs that aimed to reduce the consequences from excess and inappropriate antimicrobial use. Apart from the health alert that COVID-19 outbreak led, it also phenomenally improved the available diagnostic aids, therapeutic strategies, vaccine production and utilization of surveillance on a vast scale. However, the reluctance towards swab sampling by patients and their relatives hampered the clinicians to draw a true picture of the magnitude of outbreak. Consequently, the hazards could not be eliminated leading to a massive surge in COVID-19 cases on a daily basis. This prompted the researchers to search for an effective tool that could evade rejections by the general public and aid in surveillance. Wastewater surveillance or water based epidemiology (WBE) was thus conceived as an effective tool for quantifying and characterizing emerging COVID-19 variants and understanding the dynamics of

infection in order to selectively use preventive strategies.

A key factor contributing to the successful sampling of COVID-19 using WBE is the design of sampling protocol, since COVID-19 is capable of infecting the gastrointestinal tract in addition to respiratory system. Time of defecation and sampling, rainfall, diversified viral shedding, convergence of household wastewater and industrial effluents could temporarily affect the detection of viral genome in available sewage, however, WBE provides an array of information to predict the dynamics of infection. The technique utilized for detecting viral load is RT-PCR, which is also a highly sensitive and specific technique utilized in available diagnostic kits against COVID-19.

Role of WBE in Antimicrobial Resistance

The world is facing and is anticipated to go through a huge health crisis, commonly known as antimicrobial resistance (AMR). The unavailability of new antimicrobials and increasing resistance against the already known antibiotics has further widened a gap between emergence and combating of AMR. In addition, environment acts as a reservoir of antimicrobial resistant genes (ARGs) which can be acquired by wide variety of bacteria making them resistant. The molecular biology studies reveal the diversity of antibiotic resistant genes (ARGs) and their complex routes of transfer across the food chain that further exaggerates the problems of AMR. The abundance of ARGs in wastewater treatment plans (WWTPs) from municipal, hospital, slaughter houses along with the presence of huge selection pressure against a consortium of pathogenic microbes further aids in dissemination of ARGs via horizontal gene transfer (HGT) and proliferation of resistant bacteria. WWTPs are therefore termed as double edged sword, which can eliminate the potential health hazard from the wastewater and also subject an environmental risk by disseminating ARGs to the sensitive bacteria thus inducing AMR. The detection of ARGs in wastewater is therefore necessary to predict the burden of AMR and help in strengthening antibiotic stewardship in the defined localities. The quantification of ARGs can be successfully done using amplification based methods *viz*., quantitative PCR (qPCR), high-throughput qPCR (HT-qPCR) and digital PCR (dPCR). These techniques are particularly useful in ARG detection due to their ease of execution, robust nature and higher sensitivity and specificity.

Conclusion

The wastewater surveillance acts like an alarm for the healthcare management which enables the early detection of potential health hazards in a community juts by monitoring the presence and dynamics of pathogens over a period of time. It is advantageous due to the fact that the samples can be collected with ease and without disturbing or panicking the general public. The circulating infection in the asymptomatic patients can also be detected using WBE. The health authorities can prioritize the containment zones where more preventive or therapeutic emphasis is needed. With the timely detection of circulating variants in the wastewater from selected communities, many outbreaks can be averted. However, the design of sampling plan remains the major critical control point for an effective WBE.

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HYDROGEL TECHNIQUE

AN ALTERNATIVE OF WATER IN AGRICULTURE

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Hydrogel technique uses insoluble gel forming polymers to improve the water holding properties of different types of soil and also reduce soil erosion, leaching and improve plant growth.

Types of hydrogel

a) Super Absorbent Polymers (Water Absorbent Polymer).
b) Potassium Polyacrylate (Water Retention Polymers).
c) Pusa Hydrogel.

a) Super Absorbent Polymers (SAP)

- SAP is a natural and nontoxic starch based biodegradable materials.
- It is synthetic material which can absorb water more than a hundred times of its weight.
- It is hygroscopic substance which swells by absorbing water.
- SAP maintains the soil moisture.
- Due to high water absorbance power, SAP releases 95% of absorbed water in soil.

b) Potassium Polyacrylate (Water Retention Polymers)

- It is unique type of hydrogel which is applied in seasonal crops.
- It is very useful in rainy and dry season for greater retention power.
- Water retention polymer mainly uses by farmer to protect their crops from seasonal variability.
- Maintain the high growth of crops in changing environment.

c). Pusa hydrogel

- It is semi synthetic crosslinked hydrophilic polymer uses for improving in water use efficiency in agricultural crops.
- It is free of toxic monomer.
- Absorb water a minimum of 350 times of its dry weight.

Importance of hydrogel

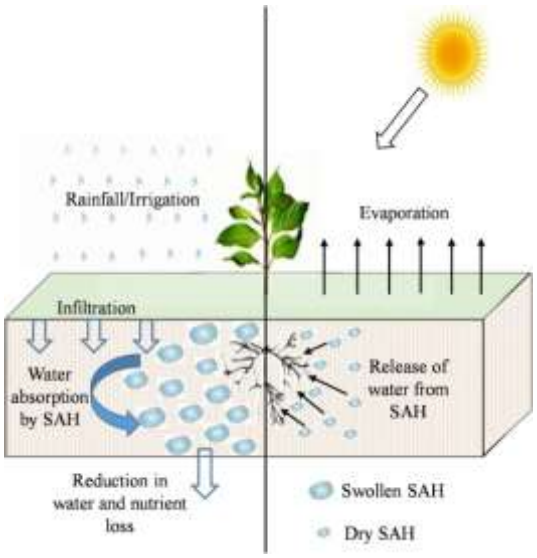
- Improve the physical properties of soil.
- Promotes the seed germination rate.
- Improve root growth and plant density.
- Reduce irrigation frequencies and fertilizer requirements of crops.
- Protect the plant from moisture stress.

Effect of hydrogel in soil and plant establishment

- Hydrogel can absorb and hold rain water and irrigation water and help to reduce deep percolation.
- Hydrogel is used as a soil conditioner which increases the sustainable agriculture in moisture stress conditions.
- Application of hydrogel polymer creates a water reservoir near the root zone of plants and decreases osmotic pressure.
- Hydrogel enhanced the nutrient retention and decreases the soil compaction tendency.

Mechanism of hydrogel

- The hydrogel group i.e., acrylic acid, carboxylic acid is responsible for water absorption mechanism of hydrogel.
- When these polymers are put in water, the water enters into hydrogel system by osmosis and hydrogen atoms react and come out as positive ions.



- This process leaves negative ions along the length of the polymer chain.
- Hydrogel can absorb more than 400 times its weight of water in this process.
- When polymers are exposed to water again, it will start to rehydrate and repeat the process of storing water.

Application of hydrogel

- **Conservation in agricultural lands–** Addition of hydrogel polymers increase water retention capacity of soil by 50-70%.
- **Drought stress reduction-** Hydrogel reduce drought impact on plant leading to reduced stress and oxygen radical formation.
- **Enhanced fertilizer efficiency–** Use of synthetic fertilizer can be greatly reduced when hydrogel agriculture is practiced without hindering with crop yield and nutritional value.
- **Bio degradability of hydrogel power–** Hydrogel is sensitive to the actions of UV rays and degrade into oligomers microbiological degradation degrade at the rate of 10-15% per year into water, CO_2, N compounds.■

SUGARCANE WOOLLY APHID AND THEIR MANAGEMENT

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Incidence of woolly aphid in India

The incidence of aphids as sucking pest is common on sugarcane crop in India. The occurrence of sugarcane woolly aphid, *Ceratovacuna lanigera* (Zehntner) (Aphididae: Homoptera) has been recently noticed to cause damage in sugarcane crop. Earlier the woolly aphid was recorded on sugarcane from North-Eastern States like Nagaland, Assam, Tripura, Sikkim, also from West Bengal and even from Uttar Pradesh. There was no infestation on sugarcane crop in Maharashtra but from last few years its infestation has been observed. Earlier, this pest was merely listed as minor pest of sugarcane. Sugarcane woolly aphid is also known as main pest of sugarcane in tropical region. Sugarcane is a primary host of this aphid while bamboo, *Miscanthus sinensis* and *Cynodon dactylon* are the secondary hosts.

Nature of damage

The nymphs and adults of sugarcane woolly aphid congregate on the central surface of leaves along midrib and de-sap resulting in drying up of leaves besides excreting honey dew on the upper surface of the lower leaves on which fungus develops quickly resulting in sooty mould showing complete blackening of leaves, sooty mould affect photosynthesis, resulting quality and quantity loss. Favourable climatic conditions enhance the reproduction capacity and in a short period a huge population is reproduced. During severe infestation on an average 1600 nymphs may be found on a single leaf to a maximum of 8000 nymphs. The winged female of woolly aphid can fly with wind to a distance of 1.5 km to 2.0 km. This facilitates further spread of the pest. The life cycle of this aphid is completed in a period of one month

Fig.1: Infected Plants of sugarcane by woolly aphid *(Ceratovacuna lanigera* Zehntner*)*

depending on the climatic conditions and sugarcane varieties.

The pest population is influenced by weather parameters and cultural operations. High humidity coupled with intermittent rains and moderately high temperature favour the build-up of pest population. Dry and hot summer days are unfavounable for the pest. The optimum temperature for aphid development ranges from 20-23^{0}C. Temperature below 15^{0}C or above 28^{0}C makes the aphid inactive. Dense crop canopy, high rate of nitrogen and irrigation water application promote aphid development. High wind velocity helps the winged female to migrate to other locations. There are a number of natural enemies of woolly aphid. Of these, the predator *Dipha aphidivora* and *Micromus igorotus* are most promising. The pest is easily killed by the insecticides which also act against the natural enemies.

Management

Management of woolly aphid in sugarcane crops of different stage:

Seed selection, treatment & planting

Seed should not be taken from woolly aphid infested crop. Use Certified seed and resistant variety. Select seed material with care from pest free areas and uninfested fields. Setts should be dipped in Malathion (0.1%) or Dimethoate (0.08%) for 15 minutes before planting (In case seed is taken from crop with stray incidence of the pest). Wide row spacing should be followed in Maharashtra & Karnataka (75 x 150 cm), Andhra Pradesh (30 x120 cm), Tamil Nadu (45 x 120 cm) and Uttar Pradesh (30 x 60 cm). Intercropping with suitable crop is preferred to reduce pest spread. Use of bio-fertilizers and organic manures should be maximized with reduction in chemical nitrogen fertilizers. Soil application of granular insecticides is less harmful to predators of woolly aphid.

Emergence till June

Intensive survey should be done for locating woolly aphid infestation especially near water sources (river, pond, marshy land). Alternative hosts should also be searched. In case of mild infestation, affected leaves should be stripped and burnt followed by spray with insecticide 2-3 times at 15 days interval. Reduction of dose of chemical N fertilizer is required as much as possible. Removal of grasses and weeds around sugarcane field should be regularly done. Avoid excess irrigation and stagnation of water.

July to October

No insecticidal spray should be undertaken in order to allow bio-agents to grow and multiply. Intensive search for predators of woolly aphid in infested fields. Two predators *viz*., Dipha (Conobathra) aphidivora and *Micromus igorotus* are most effective and should be collected from infested fields where their population is high and released in fields where population is absent or low. Agencies should come forward for conservation and mass multiplication of predators of woolly aphid in net house and their distribution in predator-free fields. Propping (tying) of canes should be done to avoid lodging and allow unrestricted movement of air. Avoid excess irrigation and humidity to build up in crop canopy.

November till harvesting

Woolly aphid infested crop should be harvested on priority for crushing in mills. Affected canes should not be used as seed or transported to pest-free areas. After harvesting, crop debris should be burnt immediately.

Ratoon initiation

Further ratoonig of a ratoon crop may be avoided and crop rotation should be followed. If preceding crop was infested with aphid and carried predator population, no insecticide should be sprayed during whole crop period.

Biological control

Conserve and augment natural enemies like *Dipha aphidivora*, *Micromus igorotus*, syrphids, etc. by avoiding the use of chemical pesticides whenever natural enemy activity is seen. Ensure that no chemical pesticides are used in at least 1% of the sugarcane field to serve as a refuge for the build-up of natural enemies. Release *Chrysopa carnea* 2500 eggs/ha. Set up *Dipha aphidivora* and *Micromus igorotus* nurseries under shade nets and augment their population in woolly aphid infested areas by periodic releases especially during June July. Augmentation may also be effected during this period from fields where *Dipha aphidivora* is present to fields where it is absent.

Chemical control

Not a practical and economic method of control. The application of insecticides will harm natural enemies. If chemical control is required, where the pest has reached uncontrollable proportions and use of chemical pesticides is inevitable, pesticides may be used as per approved policy of the state government. Many pesticides have been found to be effective against the SWA. They may be used only as a last resort and with caution. However since methyl-parathion and

phorate are highly toxic they should be avoided wherever possible. Since malathion has low mammalian toxicity it may be preferred over the other pesticides. Use plant-derived products, such as neem, derris, pyrethrum and chilli (with the addition of soap).

Use white oil (3 tablespoons cooking oil + 4 litres water +½ teaspoon detergent soap) and soap solution or horticultural oil (5 tablespoons of Soap + 4 litres water or 2 tablespoons of dish washing liquid + 4 litres water).Useful for smallholder plantings. Commercial horticultural oil can also be used. Spray the undersides of leaves; the oils must contact the insects. A second application of soap or oils may be necessary after 3-4 weeks. Home-made preparations are ideal for small numbers of plants, but commercial products are probably the only practical solution when crop areas are large.

Precautions

- Adopt proper water management practices and avoid excess irrigation. If possible adopt drip irrigation.
- Destroy affected leaves when the pest problem is initially noticed in a limited area, which helps prevent the spread of the pest. Utilize sugarcane varieties less susceptible to the woolly aphid.
- Adopt crop habitat diversity through intercropping in sugarcane ecosystem to reduce the pest population.
- In summer treat the epicenters of woolly aphid infestation with dichlorvos to prevent further population build up. If natural enemies like Dipha, Micromus etc. are seen, chemicals should not be sprayed.
- INM incorporating organic manures like FYM / vermicompost, etc., @ 20 t/ha and avoiding excess application of nitrogen. The fertilizer recommendations vary from state to state. Regular surveillance and monitoring of sugarcane woolly aphid for timely forewarning and adoption of IPM measures.
- While adopting chemical control measures good agricultural practices should be adopted and indiscriminate/ excess use of pesticides should be avoided at all cost.
- Resorting to chemical control may upset the biological balance by destroying the predators and parasitoids and result in flare up sucking pests like Pyrilla, scales and mealybugs.
- Prompt harvesting of cane should be ensured to reduce the development of woolly aphid population.■

ENDOSYMBIONTS

A NEW APPROACH TOWARDS SUSTAINABLE PEST MANAGEMENT

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The most cutting-edge research being done is looking at ways to control the crop pest with tiny microorganisms known as endosymbionts that live inside pest insects.

Endosymbionts: a new frontier in pest management

The world's most diversified animals are insects. While some insects are pests that pose a threat to agriculture or act as disease vectors, others play beneficial roles as pollinators or waste consumers. Some insects, like fruit flies, have long served as genetics model organisms, and new technologies like RNA-guided nucleases (like CRISPR/Cas9) have made it possible to genetically engineer new insect species. An alternative to editing the genomes of insects is to engineer the symbionts that live within their bodies. Bacterial endosymbionts can live in a variety of tissues and organs within the host, even inside the cells of insects. Some of these bacteria, which have evolved to resemble cellular organelles, are transmitted directly to the offspring of an insect. Numerous insects have distinct microbial communities in their guts, and these communities frequently contain particular bacterial symbiont species.

Endosymbionts in insects can have a significant impact on their ability to transmit viruses and their susceptibility to infection, as well as their ability to eat, reproduce, and resist external pressures like insecticides or climatic changes. Bacteria known as endosymbionts coexist symbiotically with other organisms inside their cells. Over a period of thousands (or, in some cases, millions) of years, endosymbionts co-evolve with their hosts and play a crucial role in a variety of survival processes.

Importance of endosymbionts in host insects

Symbionts provide array of functions to its host starting from growth, development and survival to other diverse functions. Endosymbionts also give protection to its host against the biotic and abiotic stress. Some of the major functions of the endosymbionts are:

1. Defense toward pathogens and parasites
2. Influence on insect-plant interaction
3. Adaptation to environment
4. Impact on population dynamics
5. Pesticide detoxification
6. Behavioral manipulation.

Mechanisms involved

1. Cytoplasmic incompatibility

Cytoplasmic incompatibility (CI), in which embryonic death occurs when infected males mate with either uninfected females or infected females' common example different type of Wolbachia. CI arises in mating between CI develops when Wolbachia-infected males' mate with uninfected females, or when partners who have different strains of Wolbachia are infected. According to a recent review, Wolbachia infection in males is thought to introduce a factor into their sperm that prevents embryogenesis in the fertilised egg unless the female partner also carries the same strain of Wolbachia, which would allow the sperm to be "rescued." Males infected with a single strain of Wolbachia and uninfected females typically experience unidirectional cytoplasmic incompatibility, although hosts may harbour multiple strains of Wolbachia. Hence, incompatibility has been reported with offspring arising only when both partners are infected with the same Wolbachia strains was used in pest management praticies.

2. Male-killing

Wolbachia are inherited intracellular bacteria that cause male-specific death in some arthropods, called male-killing. Although infected females may produce a mixed brood of male and female eggs, only the female eggs develop into adulthood. Wolbachia have been reported in taxa including Coleoptera (Coccinellidae, Tenebrionidae), Diptera (Drosophilidae) and Lepidoptera (Nymphalidae).

Example of endosymbionts in pest management

Insect classification	Insect	Bacterial symbiont	Purpose
Glossinidae	Tsetse flies (*Glossina morsitans)*	*Sodalis glossinidius*	Genetic modification
Cicadellidae	Leafhoppers (*Homalodisca vitripennis* and *Scaphoideus titanus*)	*Pantoea agglomerans* E325	Prevent transmission of plant pathogen *Xyllela fastidiosa*
Formicidae	Formosan termites (*Coptotermes formosanus*)	Enterobacter cloacae	Biological control of host insect
Crambidae and Noctuidae	Moths (*Glyphodes pyloalis* and *Spodoptera littoralis*)	Enterobacter cloacae	Biological control of host insect
Thrips	Western flower thrips (*Frankliniella occidentalis*)	BFo2	Symbiont-mediated RNAi, reduce crop damage

3. Parthenogenesis

Parthenogenesis-inducing (PI) Wolbachia are bacteria that cause male parasitoid wasp eggs to develop into females. These microbes have the potential to infiltrate populations and cause parthenogenesis to be fixed. PI Only haplo-diploid taxa are known to contain PI Wolbachia. These taxa frequently reproduce by arrhenotoky, in which males develop from unfertilized (haploid) eggs and females from fertilized (diploid) eggs. Transfer of PI *Wolbachia* via microinjection was recently accomplished for the first time in *Trichogramma.*

4. Feminization

Wolbachia induces the transformation of genetically male hosts into functional females. It is believed that Wolbachia prevents the androgenic gland, which produces this hormone cause male to function as female. Common among terrestrial isopods, these infections have been best studied in the woodlouse, *Armadillidium vulgare.*

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HERBICIDE TOLERANT RICE

NEW REVOLUTION IN RICE

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Puddled transplanted rice (PTR) is the conventional method of growing rice, which not only consumes a lot of water, but is also heavy and laborious. Different constraints such as lowering of water table, shortage of labour during peak periods of operations, deteriorating soil health require alternative establishment method to maintain rice productivity and natural resources. Direct seeded rice (DSR), the oldest method of crop establishment, is gaining popularity due to its low input demand. DSR have advantages, labour savings ranged from 0% to 46%, with an average of 25% in wet direct seeding and 4% to 60%, with an average of 29%, in dry direct seeding, reduces drudgery by eliminating transplanting operation, water savings ranged from 12% to 35% depending on type of DSR, reduces methane emissions 6–92% depending on types of DSR and water management, reduces cost of cultivation, ranging from 2% to 16% in wet DSR and from 6% to 32% in dry DSR and increases the total income of farmers depending on type of DSR. Direct seeded rice allows timely planting of subsequent crop due to early harvest of direct seeded rice crop by 7–14 days, it provides a better option to better adapt to different cropping systems. Comparative yields in DSR can be obtained by adopting practices like selection of suitable cultivars, proper sowing time, optimum seed rate, proper weed and water management. soil problems related to rice cultivation and subsequent crops can be solved by direct seeding of rice. There are several limitations associated with the shift from PTR to DSR, such as heavy weed infestation, evolution of weedy rice, increase in soil born pathogens and nematodes, nutrient cycle disruption, a poor crop establishment, lodging, incidence of diseases. By overcoming these limitations, DSR may prove to be a very promising, technically and economically feasible alternative to PTR.

However, In DSR crop suffers from a high infestation of weeds. Weeds pose a serious threat as they compete with the crop for water, nutrients and light, thereby reducing productivity. In India, upto 30% of the total cost of rice cultivation goes in controlling weeds. It has been demonstrated that with effective weed management, the yields from DSR is widely comparable to transplanted rice. The use of herbicides is the most effective and economical option to control weeds. However, the herbicides that are safe and effective at minimal doses should be used to ensure environmental safety.

Weeds are more problematic in DSR than in puddled transplanting because emerging DSR seedlings are less competitive with concurrently emerging weeds and the initial flush of weeds is not controlled by flooding in Wet- and Dry-DSR. Changes in rice establishment method as well as water, tillage, and weed management practices in DSR lead to changes in weed composition and diversity. Weed flora composition can change drastically with a shift from TPR to some form of alternative tillage and rice establishment methods. As well as, adopting DSR may result in weed flora shifts toward more difficult-to-control and competitive grasses and sedges.

Direct seeded rice (DSR) is a potential technology for sustainable rice cultivation as it saves water and

Direct seeded rice (DSR)

Puddled Transplanted Rice (PTR)

labor. However, higher incidence of weed under DSR limits productivity. Therefore, there was a need to develop herbicide tolerant rice varieties.

Herbicide tolerant rice

Recently, the Indian Agricultural Research Institute (IARI) has developed the country's first-ever non-GM (genetically modified) herbicide-tolerant rice varieties Pusa Basmati 1979 and Pusa Basmati 1985. these rice varieties have been developed by crossing over two existing popular varieties - Pusa 1121 and Pusa 1509 - with Robin, which, in turn, is a drought-tolerant rice variety derived from Nagina 22, another deep root, drought and heat-tolerant rice breed. The new herbicide-tolerant varieties have, however, been developed through mutation breeding

and not by genetic modification to ensure no foreign gene in the new varieties.

Under the current rice cultivation, transplantation in rice takes 30 irrigations, each consuming some 5 hectare-cm water (one hectare cm = 1,00,000 litre). Direct seeding of rice, however, reduces water consumption by 30 per cent less and Rs 3,000/acre in transplantation labour charges along with 10-15 days fewer nursery time.

The new rice varieties will save on labour and water input in rice cultivation compared to conventional transplanting varieties as they can be directly seeded (DSR). This is because the new varieties will allow the direct application of herbicides such as Imazethapyr, which eradicate a range of weeds. The use of herbicides is the most effective and economical option to control weeds. However, the herbicides that are safe and effective at minimal doses should be used to ensure environmental safety.

In conventional rice growing, herbicides are not directly applied as they can't distinguish between the rice plant and weeds. Therefore, paddy seeds are first raised as young plants in nurseries before being planted in the fields some 25-35 days later. This whole process is necessary because standing water in the nursery for eliminating weeds. But the process is a very water and labour intensive process as the young seedlings need to be maintained in standing water of up to 5 cm depth for almost a month. This requires massive labour work as the rice fields require watering every 2-3 days for the whole month along with puddling in the nursery. The new varieties being herbicide-tolerant, chemical application will destroy only weeds, thereby allowing farmers to sow paddy directly.

New varieties of rice

The new herbicide-tolerant varieties Pusa Basmati 1979 and Pusa Basmati 1985 contain a mutated acetolactate synthase (ALS) gene, which allows farmers to use Imazethapyr on rice crops, doing away with the need for massive water usage and maintaining rice crops at an early stage in flooded nurseries.

The ALS gene and resultant enzyme don't bind with herbicides such Imazethapyr, a broad-spectrum herbicide, when sprayed on the crop thus continuing the growth of the plant while killing only weeds. The ALS gene in rice codes for an enzyme (protein) that synthesises amino acids for crop growth and development. The herbicide sprayed on normal rice plants binds itself to the ALS enzymes, inhibiting their production of amino acids. Imidazolinone group of herbicides control weeds by inhibiting the enzyme acetohydroxyacid synthase (AHAS), also called acetolactate synthase (ALS). AHAS is a critical enzyme for the biosynthesis of branched chain amino acids namely, leucine, isoleucine and valine in plants. Imazethapyr, effective against a range of broadleaf, grassy and sedge weeds, can't be used on normal paddy, as the chemical does not distinguish between the crop and the invasive plants. However, the new basmati varieties contain a mutated ALS gene whose DNA sequence has been altered using ethyl methanesulfonate, a chemical mutant. As a result, the ALS enzymes no longer have binding sites for Imazethapyr and amino acid synthesis isn't inhibited. The plants can now "tolerate" application of the herbicide, and hence it kills only the weeds. It is important to note that, as there is no foreign gene involved in the process, the herbicide-tolerance is through mutation breeding. Thus, it is not a genetically modified organism.

Advantages of these varieties

1. The major benefits of growing herbicide-tolerant crops are the increased yields with reduced cost of cultivation.
2. Direct Seeding of Rice (DSR): The new varieties simply replace water with Imazethapyr and there's no need for nursery, puddling, transplanting and flooding of fields. Water is a natural herbicide that takes care of weeds in the paddy crop's early growth period. The new varieties will help in Direct Seeding of Rice (DSR) which has several advantages over paddy transplantation.
3. Cheaper Option: DSR cultivation is currently based on two herbicides, Pendimethalin (applied within 72 hours of sowing) and Bispyribac-sodium (after 18-20 days). However, Imazethapyr is cheaper than these two options.
4. Safer Option: Imazethapyr, moreover, has a wider weed-control range and is safer, as the ALS or AHAS gene isn't present in humans and mammals.
5. Flexibility
6. Possible to control weeds whenever critical growth stages for weeds.
7. Excellent weed control and hence higher crop yield.
8. Reduced numbers of sprays in a season.
9. Reduced fuel use because of less spraying.
10. Reduced soil compaction because of less need to go on the land to spray.
11. Use of low toxicity compounds which do not remain active in the soil.
12. The ability to use no-till or conservation-till systems, with consequent benefits to soil structure and soil organisms.

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REAL TIME
NITROGEN MANAGEMENT
UNDER PRECISION FARMING

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Nutrient management is a major part of a soil and crop management system. Nitrogen is that the most significant nutrient for plant growth, yield and quality. Adequate quantity of nitrogen is needed to support photosynthesis; meanwhile it's a vital a part of chlorophyll molecule. Crop plants can be acquire much of their required N from the soil and organic sources, however the supply of N from these sources is barely sufficient for supporting crop yield. Supplemental N from fertilizers is important for higher sustainable yield and profit underneath field conditions.

Precision nutrient management is an approach of feeding crops with nutrients at right time, right amount, right place and right manner. This concept can be applied to any field and any crop. It aims at optimum use of nutrients by the crop from indigenous sources (biomass, manure, and soil) and judicious application of fertilizers at optimum doses. Feeding of crops with nutrients is done as and when required by the crop. The goal of precision nutrient management is to match nutrient supply from various sources with crop demand and reduce nutrient losses from fields. For best effect, nutrients should be applied during the growing season to ensure that nutrients supply matches with the crop need at the critical growth stages.

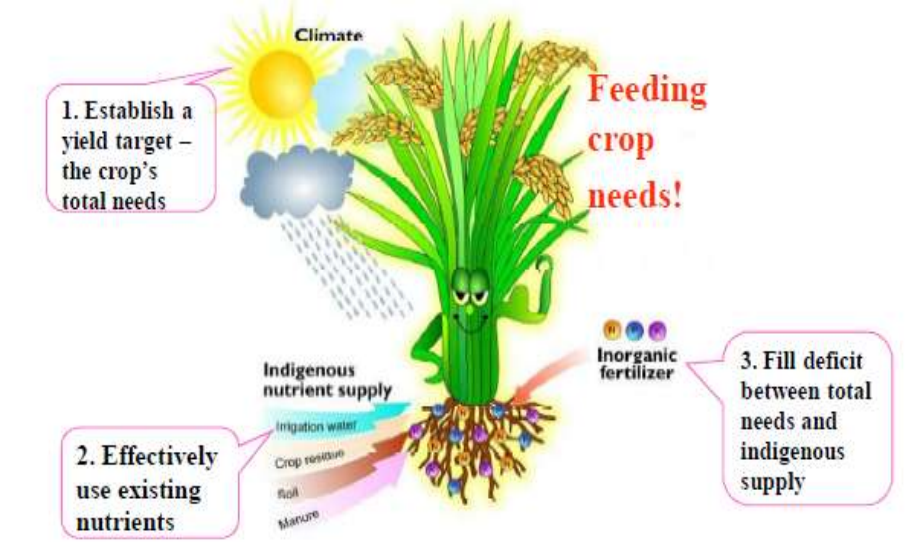
What is real time nitrogen management?

Nitrogen is the nutrient that most often limits crop production. Nitrogen can be lost from the soil plant system by leaching, denitrification, volatilization and runoff, creating the potential for N deficiency in crop. Crop use nitrogen inefficiently, generally more than 50% of N applied is not assimilated by plants. The reason is that, there is lack of synchrony of plant nitrogen demand with nitrogen supply. An important part of precision nutrient management is use of tools that can assess real N needs of crop plants. It can help us to apply N at optimum doses and achieve high nutrient use efficiency.

The most commonly used tools, which are used for real time nitrogen management includes leaf colour chart, SPAD meter and Green Seeker.

1. Leaf Colour Chart (LCC)

The leaf colour chart (LCC) is an innovative cost effective tool for real-time or crop-need-based N management. LCC is a visual and subjective indicator of plant nitrogen deficiency and is an inexpensive and easy to use. It measures leaf colour intensity that is related to leaf N status. The colour panels of the LCC are designed to indicate, whether crop plants are hungry or over-fed by



nitrogen fertilizer. By matching the colour of these crop's leaf to the colour on the LCC, farmers can decide proper time and amount of N fertilizer for application. Thus, it is an eco-friendly tool in the hands of farmers.

2. SPAD meter or chlorophyll meter

SPAD meter is a hand-held device that is widely used for the quick, accurate and non-destructive measurement of leaf chlorophyll content. The use of chlorophyll meter is based on the fact that leaf greenness is determined by N concentration, which in turn is correlated with yield. It displays 3-digit SPAD value proportionate to the amount of chlorophyll present in the leaf by measuring the transmittance of leaf in two wavelengths (600-700 nm and 400-500 nm). Generally, when SPAD value is less than the set critical reading than accordingly N fertilizer is applied.

3. Green Seeker

The Green Seeker optical sensor works on reflection of light from crop canopy and produce a normalized difference vegetation index value called NDVI that is correlated with leaf chlorophyll. These sensors use visible and near-infrared (NIR) spectral radiation from plant canopies to detect N stress and crop vigour (NDVI) values. Based on this information, top dress nitrogen rates that are aligned with site-specific crop needs can be prescribed. NDVI measurements range from -1 to 1, with higher values indicating better plant health.

Conclusion

The systematic implementation of precision nutrient management helps in saving of inputs, improve the nutrient efficiency and agronomic efficiency results in increases nutrients uptake, quality and yield of crops that sustain the crop production and increased the farmer's income. Real time N management helps to estimate N status of plant and is used to improve N management by assessing the need of the crop for fertilizer before sowing and by distributing the fertilizer during the cropping season based on crop requisite. It also helps in sustaining the nutrient balance of the soil and reducing the nutrient losses.

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ROOF GARDENS
AND THEIR BENEFITS

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A garden is any sort of vegetation established on the roof of a building. Other than the ornamental benefit, the garden provides architectural enhancement, temperature control, recreational opportunities, habitats for wildlife, and food. The method of cultivating food on the rooftop is observed as rooftop farming. It's usually administrated with the assistance of container gardens, air-dynamics systems or aeroponics, hydroponics, or green roof. Additional platforms referred to as "aero-bridges" also can be formed between high-rise buildings added to the roof space.

Types of roof garden

The following are the three basic types of roof gardens classified based on roof vegetation and maintenance.

Extensive roof gardens

These gardens are suitable for storehouses, garages, roofs, or other additional buildings around the house. At the same time, it has less aesthetical value as the types of vegetation that grow on this are very limited. Lichen and moss are the best-suited vegetation for this type of garden. Lichen can easily grow on surfaces like plastic, metal, and glass. Moss, on the other hand, is a small plant that requires less nutrition for its survival and high soil humidity for its growth.

Semi-intensive roof gardens

This type of roof garden requires a deeper soil layer that increases the diversity of plant species. More stable construction is required for this type due to vegetation, and the greater burden on soil and water retainment. Vegetation can be done with lower species of the Sedum genus. As these species are succulent, they do not need frequent watering.

Intensive roof gardens

Vegetation similar to that of a backyard garden like flowers, shrubs, trees, and several park elements can be planted in this type of garden. However, this roof garden requires large, stable constructions and hence most of the buildings are not suitable for intensive roof gardens. Besides basic maintenance needs, it also demands special attention during irrigation.

Roof garden design

The cross-section of a roof garden typically begins with an insulation layer at the bottom, a waterproof membrane for preventing leakages from the building, and a root barrier for preventing the penetration of roots via the waterproof membrane. A waterproof membrane that can withstand the effects of acids released from some plant roots must be employed.

Roof garden maintenance

The maintenance of roof gardens is perceived to be one of the major hindrances to their installation. However, it is essential to consider the maintenance schedule during the design process itself as all types of roof gardens require maintenance. All commercial buildings with roof gardens are required to undergo roof and gutter checks at least twice a year. The maintenance rather depends on the desired outcome of the client, which may vary from weekly checks during summer in case of an intensive roof garden to quarterly or even twice-yearly checks in case of the most extensive roof garden. Bio-diverse roofs and roofs designed to be low-maintenance will anyhow require maintenance checks once or twice a year to clean drains and gutters and eliminate unwanted debris. However, a less intensive regime of sedum roofs will result in the development of more mixed vegetation. For extensive roof gardens, it is necessary to develop a wildflower meadow. Low fertility substrates will in turn give rise to short vegetation that does not require cutting back yearly.

Benefits of roof garden

The key benefits of a rooftop garden are listed below:

- It converts CO_2 emissions
- It produces oxygen
- It creates a habitat for wildlife
- It reduces the ambient temperature
- It captures and harvests rainwater
- It reduces the heat of buildings and energy costs
- It reduces stormwater runoff and discharge
- It creates large catchment areas.

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MUSHROOM CULTIVATION

FOR INCREASING INCOME AND CROP RESIDUE MANAGEMENT

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Agriculture has an important place in Indian economy. Uses of modern agricultural technology / practices, quality seeds and fertilizers have increased the yield, but still a large number of populations suffering from malnutrition. Even nowadays nutritious food is the main challenge in a country like India. Simultaneously fertile land shrinkage, land division, climate change and population growth are formidable problem for agriculture. During this situation mushroom cultivation is the solution to all these problems, because mushroom cultivation can be regarded as farming without field or vertical farming and is highly relevant under both urban and rural condition to utilize vertical space for cultivation. Mushroom is a short duration crop, involves very low cost technology, no need of technical expertise, use of agro-wastes as raw material and provides nutritional and economic security. Mushroom is cultivated round the year and mushroom growers can get easily linked with mid-day meal programme, jails, hospitals, media etc. That is why a big market can be developed by motivating the people for mushroom production which will strengthen the Indian economy along with their income.

Numerous mushrooms are answer for a considerable lot of the human wellbeing issues. Some examples of edible mushroom are milky mushroom, button mushroom and oyster mushroom. Mushroom provides quality protein, fibre, minerals and vitamins. Some species of mushrooms are medicinal while some are poisonous also. Mushroom plays a key role to improve the malnutrition due to protein. Mushroom cultivation improves the socio-economy of the cultivating network through extra income. The substrate stays after development of mushroom is all the more promptly edible and acceptable to animals. Also, it very well may be used as raw material for organic manure, mulch for soil etc. Mushroom mycelium is proficient in bioremediation of wastewater, break down and detoxify harmful pesticides, extraction of heavy metal and increases plant development by mobilizing nutrients. Mushroom cultivation can tackle the problems of crop stubble burning as the crop stubble can be used as substrate for mushroom cultivation instead of burning thereby decreasing environmental pollution.

Mushroom production can be started by both rural and urban students. Mushroom production can be started in a small room initially but ideally a hut is required which can be easily made with locally available materials. Product can be marketed among the neighbors and family friends. Pupils can start selling 2 – 3 kg mushroom /day @ Rs. 80/kg. Student can brand the produced mushroom. We are sure that the spurt in demand will make this enterprise highly successful. The schools/Colleges can become a partner in the Indian Council of Agricultural research (ICAR, India) - Krishi Vigyan Kendras (KVK) interventions for on farm testing. Youth can be promoted to take up this venture as an enterprise. Apart from consumption in regular way value added products like mushroom samosa, biscuits and namkeens can also be made. This would generate additional income and employment. Apart from cultivation the

Fig. 1: Oyster Mushroom being cultivated in mushroom cultivation unit of Rama University

Figure 2: Crop residue being burned near Sultanpur Lodhi in Punjab India

mushroom spawn production is also an additional source of income. Spawn production requires laboratory and some equipments. For science graduate students most of the equipments may be already available else loans are easily available also Self-help group formation can be made in this regard.

Mushroom production can be managed by organic methods and spent substrates can be properly disposed making this enterprise highly ecofriendly which is a boon in this climate change scenario. Product will have huge demand in the market owing to the organic production techniques. The spent substrate is properly utilized for the production of vermicompost which can bag additional income to the students. Also the waste substrate can be turned into compost which can be utilized for growing vegetables in bags which are further additional benefit. The overall income of about Rs. 15,000/month can help students to become self-dependent and to take care of the family needs and thus enhancing their socio – economic status. Lack of knowledge about production technology, awareness about consumption, quality spawn availability and proper marketing and processing facility has to be taken care of before startup of mushroom cultivation. Some of the future prospects include, domestication of autochthonous strains of edible mushroom, development of spawn production laboratory in different districts, creation of mushroom hub in peri urban areas, development of marketing and processing facilities, strengthening of research on high yielding strains for commercialization of mushroom and special drive for prisoners and naxals and the unemployed people.

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ROBOTIC AGRICULTURE

NEW OPPORTUNITIES FOR AGRIBUSINESS

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Agriculture is swiftly evolving into an innovative high-tech sector that attracts new employees, businesses, and investors. Technology is evolving quickly; improving not only farming's capacity for production but also robotics and automation. The demand for much higher production yields is at the core of this problem. According to UN projections, there will be 9.7 billion people on the planet in 2050, up from 7.3 billion presently. The demand for food will increase dramatically, and farmers will be under tremendous pressure to meet it. Farmer yields are being increased in a diverse range of ways by agricultural robots. The technology is being used in inventive and creative applications, such as robotic arms, drones, and self-driving tractors. In the 1920s, research to combine autonomous vehicle steering into agriculture started to take shape, marking the beginning of robots in agriculture. The development of autonomous agricultural vehicles between the 1950s and 1960s as a result of this research. Although the idea was sound, the vehicles still required a cable system to direct their course.

Agriculture robot development continued as other industries' technological advancements also progressed. Machine vision guiding was not made feasible until the 1980s, following the introduction of the computer. An agricultural robot is one that is used in agriculture. At this time, the harvesting stage is where robots are most commonly used in agriculture. An agricultural robot, also known as an "Agribot," is a robot used in agriculture.

The productivity and output of agriculture have dramatically increased in many countries since the introduction of robots. Additionally, the use of robots in agriculture decreased the industry's operating expenses and lead time. Robotic agriculture's successes across various facets of agriculture. The research also sheds light on the potential of robotic agriculture, particularly in developing nations. Robotic material handling, material transfer, processing, inspection, and quality control are just a few of the industrial applications that have seen success. In recent years, the concept of mechanization (the use of automated machinery and robots) in agriculture has become increasingly apparent, and there are numerous examples of successful robotic agriculture. The use of robots in agriculture is being done to increase food quality and productivity while lowering labor costs and time. The lack of qualified labor in the agricultural sector, which has an impact on the development of emerging nations, is another significant factor in the rise of robotic agriculture. Robots have been employed successfully in agricultural tasks like planting, harvesting, weeding, watching over groves, applying chemicals etc.

Application of robotics agriculture

Farmers may now concentrate more on increasing total output yields because to the automation of sluggish, boring, and repetitive work by agricultural robots. The most popular agricultural robot applications include the following:

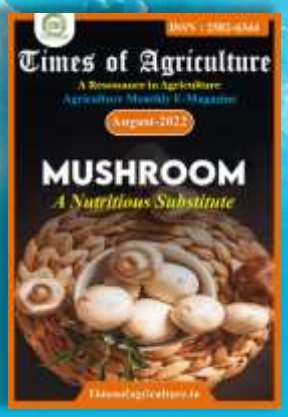
- Picking and harvesting.
- Weed control.
- Autonomous seeding, spraying, thinning, and mowing.
- Phenotyping.
- Packing and sorting.
- Work platforms.

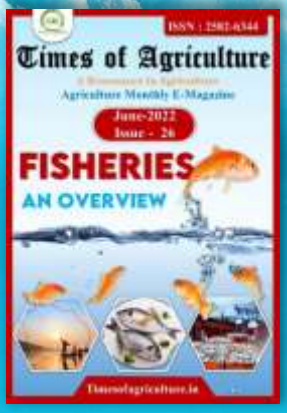
Due of the accuracy and speed that robots can attain, harvesting and picking is one of the most widely used robotic applications in agriculture. This helps to increase yield size and decrease waste from crops that are left in the field but automating these applications can be challenging. For instance, a robotic system intended to select sweet peppers faces numerous challenges. In challenging circumstances, like the presence of dust, variable light intensity, temperature changes, and movement brought on by the wind, vision systems must locate and assess the ripeness of the pepper but picking a pepper still requires more than just cutting-edge visual technology. To carefully grasp and position a pepper, a robotic arm must move through settings with the same number of hazards. When compared to picking and arranging metal parts on an assembly line, this process is extremely different. The agricultural robotic arm needs to be accurate enough to avoid damaging the peppers while picking them and flexible enough to operate in a dynamic environment.

Farmers are increasingly using robots for picking and harvesting, but there are hundreds of additional cutting-edge ways the agricultural sector is implementing robotic automation to increase production yields. Agriculture has rapidly evolved into a high-tech industry. Farmers must close the gap between the demand for food and the amount of cropland that is currently available. In order to do that, agricultural robots are aiding them.

Conclusion

The quantity determination process is made easier for humans by robotic engineering. Engineering for robotics includes mechatronics, electronics science, software, and mounting mechanics for wheels on axles, connecting motors, and balancing. The study mostly focuses on current trends. Design, research, and useful applications of novel robots are part of the expanding area of robotics. Agriculture is a crucial area for robotics applications. Electric farm and electric factory tools can be used interchangeably to boost manufacturing production, sustainably intensify agriculture, and support new food security technologies. Robotic technology was gradually introduced to farmers and food producers with its fascinating production systems. The current study is focused on the introduction of robotics, automation, national market segments, and cost budgeting in the field of agricultural robotics. These studies will be necessary for the future to help scientists comprehend issues and develop robotic and automated solutions.■





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