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Times of Agriculture

A Resonance in Agriculture

Agriculture Monthly E-Magazine

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INDIA BANS ON WHEAT EXPORTS

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A Monthly e-Magazine

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"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

Haryana grant NOC for field trial of Bt cotton

Haryana government has issued a no-objection certificate (NOC) to seed major **Mahyco** to conduct ***field trials on BG-2 RRF***, a herbicide tolerant and insect resistant variety of Bt cotton.

"India has allowed commercial use of BG-1 and BG-2 GM cotton in the country while, the ***approval for the BG-2 RRF has been pending at various stages.*** The field trials are likely for the North Zone.

The available BG-2 RRF can provide protection against devastating pest attack such as "American Bollworm".

4th State Food Safety Index Report

Food Safety and Standards Authority of India (FSSAI)'s 4th **State Food Safety Index (SFSI)** was released on the occasion of ***World Food Safety Day (June 7)***.

It seeks to measure the performance of States across **5 parameters of food safety.**

Performance of various states

Larger State

1. Tamil Nadu
2. Gujarat
3. Maharashtra

Smaller States

1. Goa
2. Manipur
3. Sikkim

Spices board sign ToU with Flipkart

Spices Board, under its initiative ***Flavourit Spices Trading Limited (FSTL)*** has signed a ***Terms of Understanding (ToU)*** with e-commerce platform **Flipkart to enhance market access and help promote farmers and grassroots organisations working in the spices sector.**

The ToU was signed under the ***Flipkart Samarth Program***, which aims to empower MSMEs, artisans, entrepreneurs and rural seller and farmer communities selling products associated with rich cultural heritage through Flipkart's e-commerce platform.

Piyush Goyal inaugurated "Mango Festival" in *Belgium*

Piyush Goyal, Union Minister of Commerce and Industry, inaugurated a ***"Mango Festival" in Brussels, Belgium to raise awareness among Europeans and establish a market for Indian mangoes in Europe.***

During the event, mangoes like ***Banganapalli*** from Andhra Pradesh, ***Malihabad Dasheri*** from Uttar Pradesh, **Amrapali** from Odisha, ***Lakshman Bhog, Himsagar, Jardalu mango, Langra mangoes*** as well as **12 GI-tagged items were exhibit.**

Agriculture loan NPAs rise by 15%

With the prolonged monsoon and erratic rainfall, several farmers suffered crop losses. Consequently, bad loans in the agriculture sector rose in FY 2022. According to the latest report by State Level Banker's Committee (SLBC) tabled at the 173rd SLBC meeting in Ahmedabad, non-performing assets in agriculture loans stood at **Rs. 6,572 crore in financial year 2021-22.** Bad loans in agriculture **grew from Rs. 5,696 crore in 2020-21, up 15% in the current fiscal year.** NPAs in **crop loans stood at Rs. 2,808 crore**, and in **agriculture loans at Rs. 3,764 crore** in the current fiscal.

China become the largest importer of Indian broken rice

China has emerged as the largest importer or buyer of broken rice from India. During the pandemic, China took the lead as the largest importer of broken rice from India. ***7.7 % has been imported to China which is 16.34 lakh metric tonnes and India's total export is 212.10 lakh metric tonnes in the year 2021-2022.***

Out of 16.34 LMT, **96 % of the rice exported to China was broken rice**. ***The total export for basmati and non-basmati altogether was 212.10 LMT in 2021-2022 which is 19.30 % higher than the export in 2020-2021 which stood at 177.79 LMT.***

Giant Stingray world's largest Fresh water fish Found

The largest freshwater fish ever recorded was captured in the Mekong River last week by a fisher collaborating with researchers to document the river's biodiversity in northern Cambodia. **The 4-meter (13-foot)** endangered **giant freshwater stingray *(Urogymnus polylepis)*** was hauled from the river on June 13 before being measured and released back into the wild.

The fish was caught by fishermen in the Stung Treng district of northern Cambodia on June 13, as per GWR.

‘Thailand’ First Asian country to legalise “Marijuana”

Thailand became the first Asian country to decriminalized cannabis. **Under decriminalization, it is no longer a crime to grow and trade marijuana** and hemp products or use parts of the plant to treat illnesses. But the recreational use of the drug remains illegal.

The government further issued a stern warning for foreign tourists saying that don't come to Thailand thinking you will get to smoke joints freely

Rajasthan Will Install 1 Lakh Solar Pumps

On June 22, 2022, Chief Secretary of Rajasthan Usha Sharma instructed to install 1 lakh solar pumps under the scheme in a review meeting on ***Solar Agriculture Livelihood Scheme (Sky) under Prime Minister Kusum-Component-C (Feeder Level Solarization).***

Through the online portal, interested developers will also be able to select the land and construct solar power plants. **A work award of 4.24 MW has been awarded under a pilot project in Tonk, under which 656 farmers will get solar energy.**

India's marine product exports in FY 2021-22

India's marine product exports record an all-time high in FY 2021-22. **Grow by over 30% to Rs. 57,586.48 crore (USD 7.76 billion).** India shipped ***13,69,264 MT seafood worth Rs. 57,586.48 crore (USD 7.76 billion)*** during 2021-22, despite heavy odds.

During the FY 2021-22 the export improved in rupee term by 31.71%, in USD terms by 30.26% and in quantity terms by 19.12%. **In 2020-21, India had exported 11,49,510 MT of seafood worth Rs. 43,720.98 crore (USD 5,956.93 million).**

INDIA BANS ON WHEAT EXPORT

About the Author

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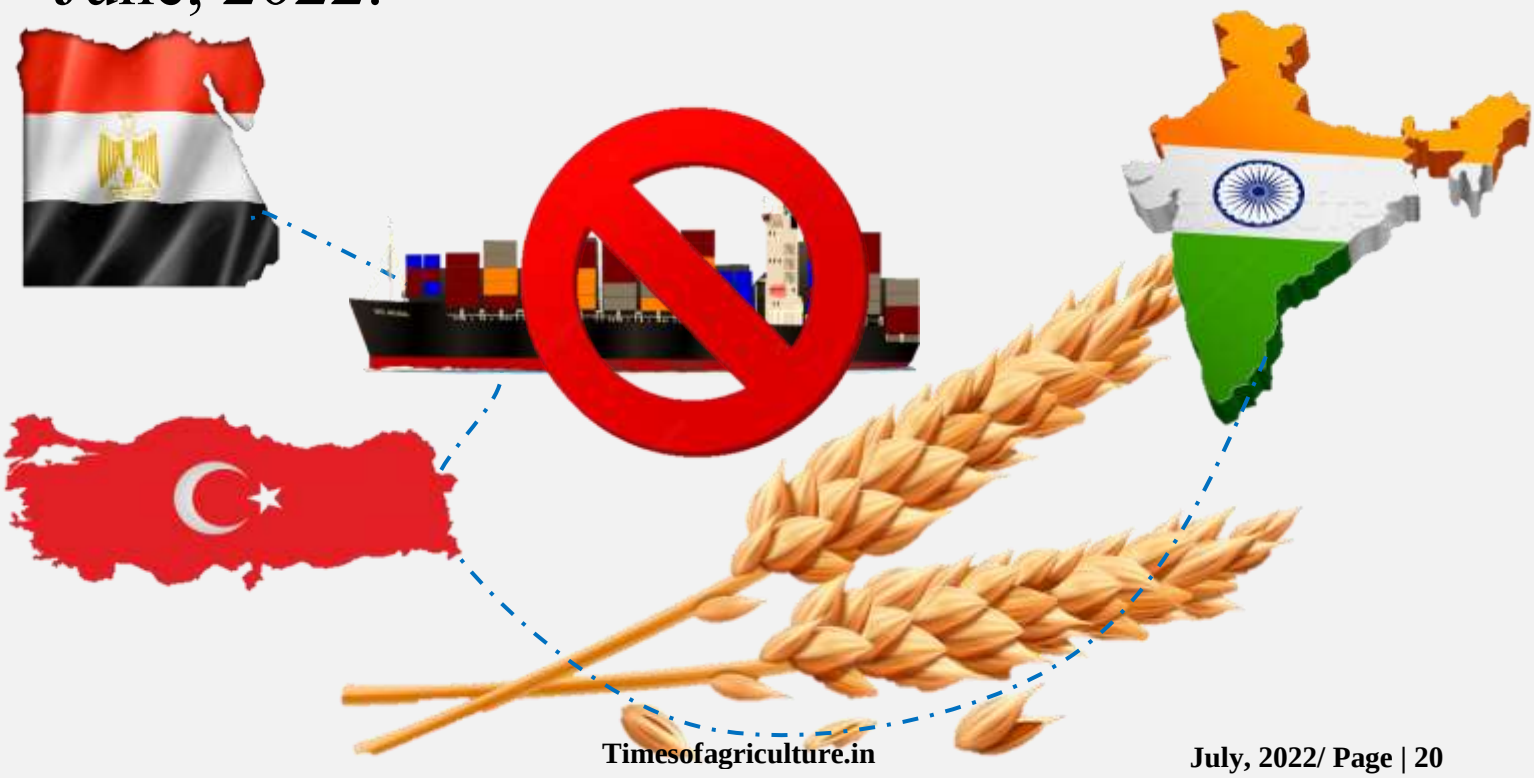
India has suspended wheat exports since **May 13, 2022**. In a notice published in the Official Gazette, the ***Directorate General of Foreign Trade (DGFT) justified the ban by explaining that the soaring global wheat prices have put pressure on food security, not only in India, but also in neighbouring and vulnerable countries.*** However, exports will be allowed on the basis of permission granted by the Government of India to other countries to meet their food security needs and based on the request of those governments.

Turkey rejected a shipment carrying more than 56,000 tonnes of Indian Durum wheat on 4th June, 2022.The Turkish authorities claimed that **the Indian shipment of wheat was infected with Rubella Virus** and due to concerns about the disease; the Turkish Ministry of Agriculture and Forestry refused the shipment.

The durum wheat consignment that Turkey rejected was **diverted to Egypt**, which was facing a bread shortage after supplies from Russia and Ukraine dried up in the wake of the war**, but the Egyptian state also rejected the wheat shipment from India out of concerns over the health of the Egyptian people** on 8th June, 2022.

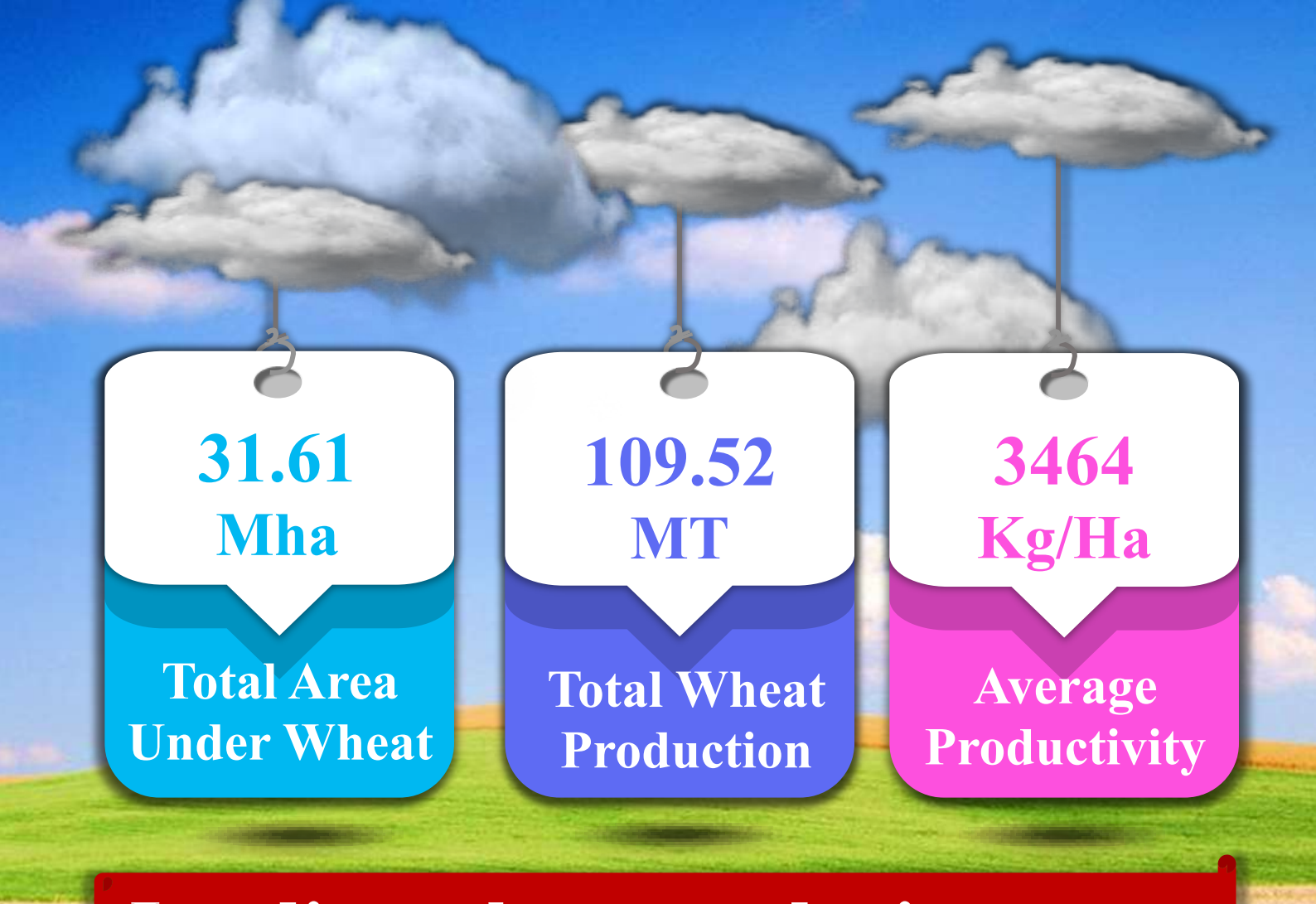


Statistical data on Wheat

Wheat is the ***2nd most important cereal crop*** after rice. It is the main food crop, in north and north-western part of the India. In 2020-21, the total area under this crop was about **31.61 Mha *(14% of global area)*** with production of **109.52 MT *(13.64% of global production)*** with a record average productivity of **3464 kg/ha** in the country. Wheat productivity of India increased from 1306.60 kg/ha in 1971 to 3464 kg/ha in 2020, growing at an average **annual rate of 2.17%.**

Leading wheat producing states in India in 2022 are **Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Rajasthan, Bihar, Gujarat, Maharashtra and West Bengal.**

India's wheat production in the 2021-22 crop seasons ending in June is officially projected to be around 106.41 million tonnes.



Leading wheat producing states

Uttar Pradesh	35..5 MT
Madhya Pradesh	17.6 MT
Punjab	17.1 MT
Haryana	12.3 MT
Rajasthan	11 MT

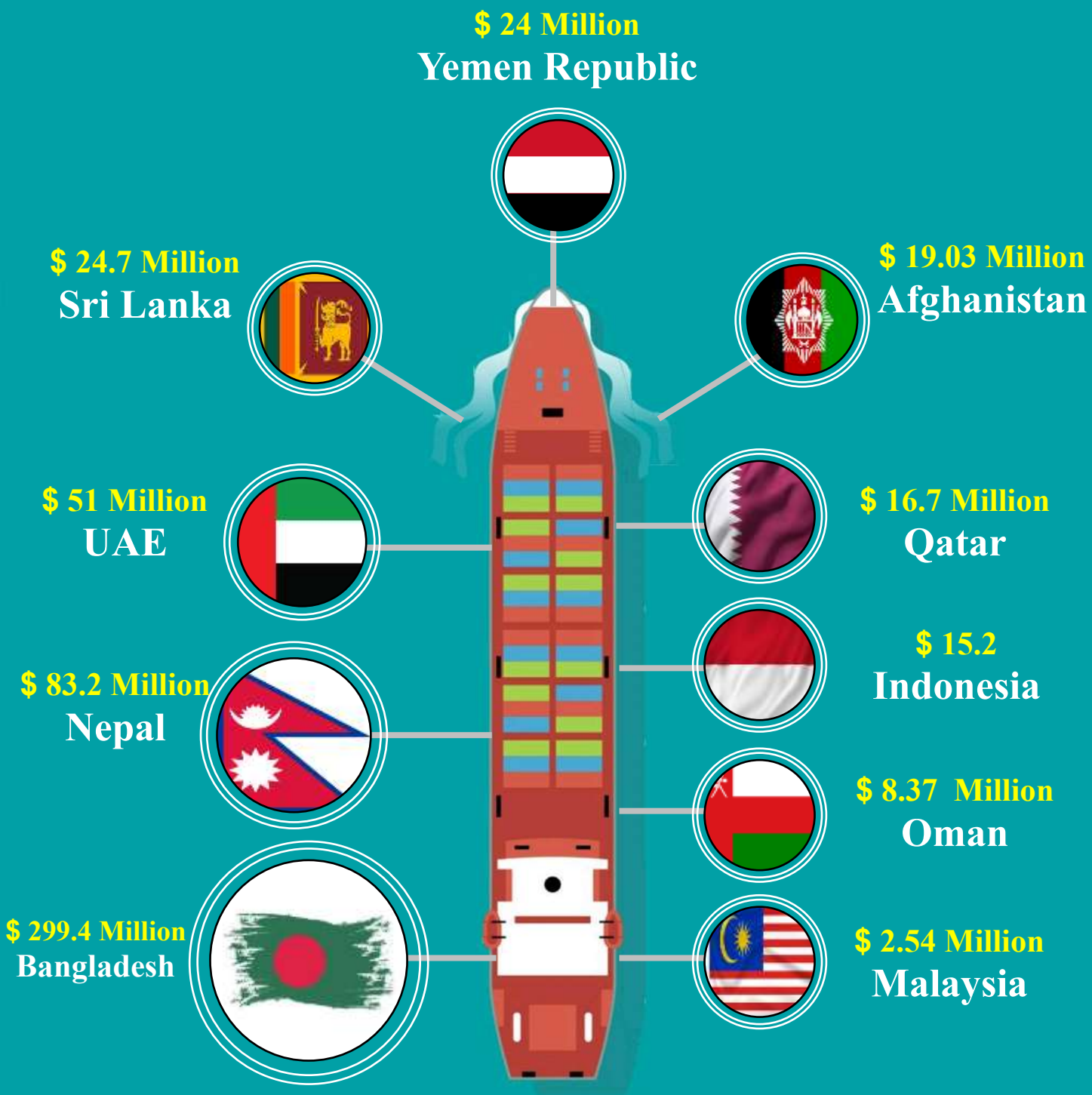
The amount is 3.8 million tonnes less than last year's output and 4.41 per cent lower than the previous estimate of **109.8 million tonnes**, ***as heat waves at the growth stage of the crop crimped production.*** **India is the 2nd largest wheat producer in the world after China. But it accounts for less than 1% of the world's wheat trade.** It keeps most of it to provide subsidized food to the poor. **Its main export markets are *Bangladesh, Nepal and Sri Lanka, as well as the United Arab Emirates (UAE).***

Status of Wheat Export of India

The top ten Indian wheat importing countries for 2020-21 are ***Bangladesh, Nepal, United Arab Emirates, Sri Lanka, Yemen, Afghanistan, Qatar, Indonesia, Oman and Malaysia*** according to the data **from Directorate General of Commercial Intelligence and Statistics.**

INDIA'S TOP WHEAT EXPORT DESTINATIONS

(2020-21)



India's top ten wheat export destinations (2020-21)

Country	Quantity (in tonnes)	Value (US$ million)	Share % in volume	Share % in value
Bangladesh	1157399.35	299.4	55.4	54.5
Nepal	330707.74	83.23	15.8	15.1
UAE	187949.46	51	9.0	9.3
Sri Lanka	94039.63	24.73	4.5	4.5
Yemen Republic	86000	24.05	4.1	4.4
Afghanistan	55584	19.03	2.7	3.5
Qatar	63452.87	16.75	3.0	3.0
Indonesia	56051	15.29	2.7	2.8
Oman	30179.33	8.37	1.4	1.5
Malaysia	9509.33	2.54	0.5	0.5
Total (Top 10 countries)	**2070873**	**544**	**99**	**99**
Total Exports	**2,088,488**	**550**	**100**	**100**

Source: *Directorate General of Commercial Intelligence and Statistics (DGCIS).*

Reasons for Banning of Export of Wheat

This suspension on export of wheat and flour from grain originating in India is basically an assurance that whatever it imports will be used only for domestic consumption.

- **Effect of Heat Wave and Shortage of Stock:** The ban has also led to a reduction in wheat production, after its output was affected by the heat wave that swept across the country during March-April, while the Food Corporation of India (FCI) was not able to collect enough reserves for buffer stocks.
- **Rising Prices due to Russo-Ukrainian War:** Domestic wheat prices began to rise due to export demand caused by the Russo-Ukrainian war and high inflation. Soaring world wheat prices could hit Indian consumers and fertilizer prices have more than tripled since the outbreak of the Russo-Ukrainian war. This will likely lead to a reduction in global wheat acreage and, as a result, the tight supply situation could continue up to 2023.

- **Increasing Inflation:** Rising inflation also spurred this step. The Wholesale Price Index (WPI) in India has moved up from 2.26% in early 2022 to 14.55 today. Retail price inflation also hit an eight-year high of 7.79% in April, driven by rising food and fuel prices.

Impact of India's Ban on Wheat Export

Impact on India: The impact of the wheat export ban on India's domestic food inflation is expected to fade away. This export ban is a precautionary measure and could prevent local wheat prices from rising significantly. However, with domestic wheat production likely to be constrained by the heat wave, local wheat prices may not drop significantly.

Impact on the World

The war between ***Ukraine and Russia*** has led to a decline in wheat production in the region known as the world's breadbasket. ***Russia and Ukraine together account for 25% of world wheat exports.*** This has led to higher wheat prices and supply problems. **India is the world's second largest wheat producer and one of the largest consumers.** When the government decided to ban wheat exports in the face of rising prices, there was much opposition from the international community.

In Asia, with the exception of Australia and India, most other economies depend on imported wheat for domestic consumption and are threatened by rising global wheat prices, even if they do not import directly from India. This recent export ban will raise prices worldwide and hurt poor consumers in Africa and Asia.

INDIA DIMINUTED SUGAR EXPORT

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Until the recent ordinance, sugar was freely exportable under the current export policy. This meant that unlimited amounts of sugar could be exported without any government intervention. **On May 24, the government-imposed restrictions on the export of sugar, stating that exports will be allowed with "specific permission"** from the Sugar Directorate and the Department of Food and Public Distribution. **The government has moved export of sugar from open category which requires no government intervention, to restricted category. The government has decided to allow the export of sugar up to 100 lakh metric tonnes (LMT) to maintain the domestic availability and price stability during the sugar season 2021-22 (October-September).** This is the first time in six years that India has restricted sugar export.

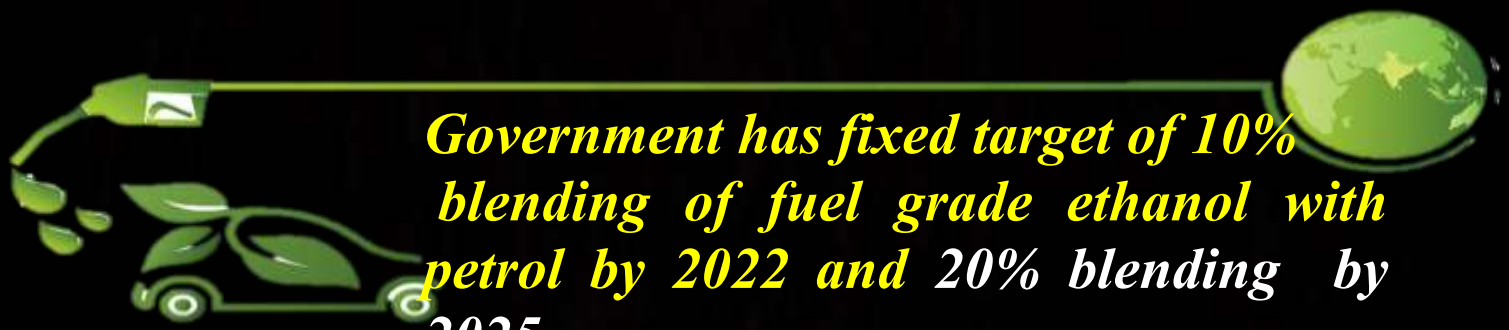
There is not a complete ban on sugar export. It can be exported, but from 1 June traders have to secure permission for export. Export restriction on sugar will not apply to the European Union (EU) under the CXL quota and the U.S. under the tariff-quota route (TRQ).

Status Sugar industry in India

Sugarcane is one of the important commercial as well as industrial crop in India. It has contributed significantly to the growth of Indian agriculture and National Gross Domestic Products (GDP). In India sugarcane is cultivated **on 4,867-thousand-hectare area** and **production of 3,77,766 thousand tones** with average **productivity of 77.6 tonnes per hectare** during 2019-20

In India, sugar industry is the second largest after cotton textiles which **contribute around 6% of the agricultural GDP.** India is the **2nd largest sugar producer in the world after Brazil and is also the biggest consumer.** The annual output of the Indian sugar industry is worth around Rs. 80 billion. There were 756 sugar factories installed in the country as on 30.11.2021, with sufficient **crushing capacity to produce around 350 lakh MT of sugar.** Out of 756 installed sugar mills, **506 mills** are operational and operated in sugar season 2020-21.

Sugar production in India had been cyclic in nature. Every 2-3 years of high sugar production were followed by low sugar production. However, from the sugar season 2017-18 and onwards, the country had produced surplus sugar than the **domestic requirement of about 250-265 Lakh Metric Tonnes. India is now structurally sugar surplus country** and is also exporting sugar to other countries. During last sugar season 2020-21, India has **exported around 70 LMT of sugar.** In the current sugar season 2021-22, it is expected that **India will export 50 LMT or more sugar.** In order to find a permanent solution to address the problem of excess sugar, Government is encouraging sugar mills to divert excess sugarcane to ethanol.



Government has fixed target of 10% blending of fuel grade ethanol with petrol by 2022 and 20% blending by 2025.

Sugar production in India, is estimated to increase by 2.90 per cent **to 31.9 million tonnes** in the ongoing 2021-22 marketing year, according to the first estimate released by the All-India Sugar Trade Association (AISTA). With estimated production of 31.9 million tonnes **plus opening stock of 8.3 million tonnes** with mills, the **total availability of sugar in the country is expected to be 40.2 million tonnes** in the current marketing year. However, the ***supply of sugar in the country would be sufficient to meet the domestic consumption, which is estimated to be at 27 million tonnes in the 2021-22.*** **India for first time has witnessed record production of sugar of 34.2 million tonnes till April 2022.** India's sugar export in 2021-22 grew 15 times to 70 lakh tonnes. India export 15 per cent of its sugar to Indonesia, 10 per cent of sugar to Bangladesh and 3 per cent

Domestic requirement of about 250-265 lakh metric tonnes.

India has exported around 70 LMT of sugar in 2020-21

Surplus sugar stock - 8.3 million tonnes.
Sugar availability- 40.2 million tonnes (Expected)

Sugercane contributes 6% to the Agricultural GDP.

India - 2nd largest sugar producer and also the biggest consumer.

Crushing capacity 350 lakh MT

506 Out of 756, mills are operational

Reasons behind the restrictions

- **Depleting domestic stocks**: The government's concern is low stocks at the start of the next season, which begins in October. The shortage of reserve stocks during this period could push up prices in the domestic market.
- **Raising prices:** The restrictions were introduced to improve the availability of sugar on the domestic market and also to check price increases.
- **Increasing inflation:** The decision to limit sugar exports comes at a time when retail inflation in April hit an eight-year high of 7.79%.
- **Russia's Ukraine invasion** has shaken the commodity markets that will keep global prices high through the end of 2024, according to experts food prices are expected to rise by 22.9 per cent this year.
- The restrictions are also another sign **of rising food protectionism around the world,** as major producers cut agricultural exports, adding to the supply shock caused by Russia's invasion of Ukraine in February.

Impact of India's restricted export on the world

The export restrictions are likely to have a significant impact on the global sugar market given India is a major producer and exporter. It has the potential to impact prices worldwide.

India's export limits can drive international prices higher. Most sugar stocks have decreased 30 to 40 per cent, but export restrictions will make more surplus sweetener accessible for domestic ethanol production which is a primary government target.

Industry view on restriction:

The first reaction to this restricted export was a Rs. 50 per tonne drop in ex-mill prices. National Cooperative Sugar Factories Federation (NCSFF) believes that India would end up exporting 100 lakh tonnes sugar this season even with the restriction. Most millers said the restriction would not affect them much and export would continue without problem.

Top Sugar producing countries	
Country	**Sugar Production (Million Tonnes)**
Brazil	**37.3**
India	**34.2**
China	**11.5**
Thailand	**10**
United states	**7.7**

Farmers view on restriction:

Farmers are unhappy with this government decision on export of sugar. Farmers are not convinced by the government reasoning that the export restrictions would maintain stable sugar prices in domestic market. They believe that the government decision will prevent them from getting a better price for their produce.

Conclusion:

This diminution of sugar export by second largest exporter has the potential to impact prices of sugar worldwide and In India prices of sugar in the domestic market will be in control. The decision will ensure that the closing stock of sugar at the end of sugar season (Sept 30, 2022) remains 60-65 LMT which is two-three months of stocks required for domestic use. ***Placing restrictions on sugar exports will ensure a closing stock which can be supplied in the domestic market as per consumption patterns around that time to prevent a increase in prices due to lack of supply***. Low stock at the start of the next sugar marketing season thus could pose an issue for the government since the months of October to December are primarily dedicated to the start of the sugarcane crushing process.

MEDICINAL FLOWERS

POTENTIAL BENEFITS AND USES

About Author

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Flowers are one of the fascinating creations of God having innumerous uses in daily lives. They are commonly used for temple offerings, beautification of home, ceremonial functions, personal adornments, bouquets to offer loved ones and many more to count. Moreover, there are some flowers which are used as medicines since ancient times. The therapeutic properties of certain flowers have long been acknowledged by medical practitioners for healing. In many cultures, around the globe, usage of these medicinal flowers has been noticed. As flowers possess completely natural medicinal properties, the medicines prepared from them come under the category of herbal medicines and are considered to be safe as being devoid of any scary side effects unlike the modern pills and medications. Besides, the cures prepared from flowers can be comparatively cheaper than drugs available different pharmaceutical industries.

Some important flowers having potential medicinal benefits are mentioned below:-

1. Lotus

The national flower of India symbolizes purity, peace, spirituality and enlightenment. Lotus flower helps in bringing down high fever, also cure bronchitis and diarrhea problems. As per ITM (Institute of Traditional Medicine), lotus seeds are reported to strengthen heart, kidney and spleen. Leaves are quite useful for better stomach functioning. Roots of lotus being rich in fibers and complex carbohydrates help in reducing high blood pressure and blood sugar level.

2. Begonia

The medicinal tea made from begonia helps in soothing and helps in relieving headaches. It also alleviates the body toxins. The flowers and leaves of begonia can be crushed and rubbed on sores and burn areas for instant relief.

3. Chrysanthemum

The flowers can be brewed into tea which is an assured remedy against common cold and headaches. This tea after cooling down can help soothing tired eyes. The tea made from chrysanthemum is quite popular in Asian countries used during summer days. *Chrysanthemum morifolium* along with other herbs is used for treatment of prostate cancer.

4. Chamomile

Chamomile tea is treated as patent medicine for common cold, runny nose, sore throat and also provides glow to skin. Chamomile is used in medicines as it helps in treating hemorrhoids, wounds, ulcers, insomnia, gastrointestinal disorders, rheumatic pain and menstrual disorders. The medicinal constituents of this plant are extracted from dry flowers by water, ethanol or methanol as solvents, whereas the extract thus formed is termed as aqueous ethanolic or methanolic extracts.

5. Carnation

The tea prepared by using carnation petals helps in reducing anxiety, agitation, stress and fatigue, as it assists in calming the mind and also cools down the nerves. The tea can be served as an unfailing tonic for bringing down fever. It stimulated sweating in body which

helps in detoxification and also quite beneficial for treating excessive hair loss, gastric problems and sore muscles.

6. Passionflower

The flowers, roots, fresh or dried leaves of this plant are packed with abundant of antioxidants. They are known best for their use to reduce blood pressure and an effective treatment against depression. Drinking tea made from passionflower is an excellent remedy against insomnia that has been proved in earlier researches.

7. California poppy

According to research, unlike other poppies, California poppy flowers possess chemical constituents that induce calming effect causing relaxation and enhance sleepiness because of its sedative properties. After combining with magnesium and hawthorn, it is used to treat mild to moderate anxiety issues. The flower is an efficient remedy for bladder related problems both in children and adults.

8. Gardenia

The beautiful gardenia flowers serve as a wonderful remedy in relieving stress, depression, insomnia, anxiety and related issues owing to their delightful and soothing fragrance. Citations of gardenia are there in Chinese medicines, where it is being extensively used for blood purification, treatment of external physical injuries and as a cure for bladder related problems. It contains some chemicals which in helpful in insulin resistance reduction and inhibit intolerance against glucose. The plant extract works wonder in reducing swelling, alleviate blood fat and cholesterol level, protects liver and also helps in treating various viral infections.

9. Jasmines

The jasmine tea assists in improving digestive systems, treating stomach ulcers and most importantly insomnia and anxiety related problems by helping to get a quality sleep. It is also proved to be beneficial for treating menstrual pain and inflammation.

10. Calendula

The bright yellow colored petals of calendula are widely used for ointment and cream preparations by mixing with other substances. The extract made from flowers can be applied on skin to heal cuts, burns and wounds.

11. Plumeria

They are mostly used Ayurveda medicines for several ailments such as wounds, ulcers and skin diseases. The floral decoction is used for the treatment of fevers, nausea, cough, vertigo and bronchitis.

12. Hibiscus

It is used widely in Ayurveda teas for bringing down the blood pressure. This flower is also known well for its medicinal properties to cure diarrhea, hemorrhage, piles, hypertensions and hair loss problems. It can also be used as contraceptive.

13. Morning glory

Care should be taken not to ingest seeds of morning glory as it may cause strong hallucinations. In several cultures, the flower has been used as laxative and general purge. It also plays an important role as emmenagouge to stimulate and increase menstrual flow.

14. Rose

Rose hips are excellent source of Vitamin C. Ingestion of raw petals of rose can enhance blood circulation and also provides relief from depression. Rose tea is known to possess mild laxative properties and can treat digestive issues like dyspepsia, flatulence and constipation. Petals are widely used for preparation of creams and pastes which are applied on face to improve skin conditions.

15. Common daisy

The common daisy flowers are good source of laxative and act as an expectorant to purge the body toxins. It is also an efficient homemade cure for treating various physical disorders like rheumatism and arthritis. It can be applied directly on skin in the form of ointment or poultice aids for wound healing.

16. Periwinkle

For treating diabetes and high blood pressure, the rose colored periwinkles has been traditionally utilized in form of tea. Recently, its potential health benefits have been harnessed for treating diseases like leukemia, cancers and Hodgkin's Disease.

17. Lavender

This flower has got a wide application in aromatherapy and also helpful in curing acute and chronic anxiety disorders. Flowers are used to prepare calming tea potion.

Conclusion

Not only the flowers are grown for their aesthetic beauty and alluring fragrance, but also the healing power of flower of flower is well acknowledged. Apart from their capability to cure several health issues, they are also well known for their immune boosting potential. Thus, it is a healthy practice of growing theses flowers both indoors and outdoors in order to harness their medicinal benefits.

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STEPS OF PLANNING AND ESTABLISHMENT OF AN ORCHARD

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After the selection of the site and drafting the plan, next comes the establishment of an orchard with fruit plants. For this, the selected site should be thoroughly surveyed for studying its size, topography, flow of irrigation water, drainage and fertility gradients. The positioning of main and subsidiary roads, wells, wind breaks etc. should be planned clearly.

Steps:

1. Clearing of the land: Preparation of the soil depends largely on its condition, previous history and grower's plans. On the other hand if the site is a new one and was never under cultivation earlier, much has to be done well in advance for planting. If the land is a virgin land i.e. it is not under cultivation previously, the existing vegetation is to be cleared. Standing trees, shrubs, bushes etc. should be cut down and uprooted along with the stumps and removed. No vegetation should be left on the site. Otherwise, they may shade the young plants; compete for water, light and nutrients. Further, their removal at a later date is expensive and risky.

2. Levelling: Levelling is important for efficient irrigation, drainage to check soil erosion and also for improving appearance. If the land is sloppy contouring (if the slope is 3 to 10%) or terracing (if the slope is >10%) is to be done. During levelling sub soil should not be exposed.

3. Fencing: Fencing is necessary to protect trees from stray cattle, human trespassing and also for attractiveness. The fence may be of stone, barbed wire or live fence. Growing of live fence is an expensive one. At the initial stage it may be cheap but afterwards the maintenance is costly. Live fence needs periodical punning or trimming to shape and also to control their growth and encouraging more branching.

4. Wind break plants: The wind breaks are provided to resist the velocity of wind which causes loss of bloom, wind erosion and evaporation of moisture and to keep the orchard warm by checking frost and cold waves. The beneficial effect of wind break is felt up to a distance equal to 3 times its height.

5. Roads and drains: These are laid out according to the plan prepared in advance taking the convenience and levels into consideration. Main irrigation channels also have to be plotted. Silt catching devices should be employed in the drains. Covered drains should be filled with big stones at the base and smaller ones over them and the top 12 inches should be covered with the orchard soil so as not to impede ploughing and other operations.

6. Tillage: Tillage including sub soil should be done thoroughly at this stage, since it cannot be done after

planting without disturbing the roots of the trees.

7. Marking plant positions: The system of layout should be decided first. Then one of the fence lines or a road should be chosen as the base line. In deciding the base line, due regard should be given to appearance of the rows from the road along which the visitor or the manager is expected to walk.

8. Digging and filling of pits: Generally the pits are dug 2 to 3 months in advance of planting i.e. March to May. A planting board (a plank about 1.5m long or longer with two end notches and a center notch) is applied to the marking peg by its central notch and two pegs are driven at the end notches. Then the board and the marking pegs are removed and a pit of 1-meter cube is dug. All pits are dug similarly so that plant position is not altered at planting time. While digging, the topsoil should be kept on one side and the bottom soil on another side separately as the topsoil is somewhat fertile than the bottom soil.

9. Filling of pits: Filling is done a fortnight or two after digging pits. The pits are filled with a mixture of top soil; FYM, leaf mould and bone meal. Pits are filled a few inches above the ground level for shrinkage and settlement.

10. Selection of plants from the nursery: Generally the plants are purchased from the nursery well in advance. The grower should visit the nursery and select the plants. The main branches on the young plants become leaders on a grown up tree. These branches arise on a plant at an angle (crotch).This crotch should neither wide nor narrow but it should be medium i.e. 40-50. If the crotch is wider splitting or breaking of limbs will occur because of heavy crop load. So plants having medium crotches are best. Growers generally prefer older plants believing that these plants come to bearing early. For this there is no experimental evidence. Younger plants make up in a few years and become equally vigorous and out grow older plants. So, no benefit of selecting older plants.

11. Lifting and packing: Before lifting of plants from the nursery the nursery is thoroughly irrigated one day in advance for easy lifting of the plants without damage to the root system. Then the plants are lifted carefully along with a ball of earth attached to the root system. The roots are wrapped in straw or grass or covered with a gunny cloth and placed in a basket or a wooden crate for packing. Depending on the size of the basket or crate 6-7 plants are kept for each basket.4-5 long bamboo splinter or wooden pegs are forked into the sides of the basket and tied at the top.

12. Season of planting: In tropical climate, most trees are planted between July and December and few in January also. In general planting is done during the monsoon in moderate rainfall areas and at the close of the monsoon in heavy rainfall areas. Planting should be done on cloudy days and preferably in the afternoons rather than in the morning.

13. Planting: The planting board should be used at the time of setting the plants, so that they are in a perfect line. The plants should be set in the soil to the same level as it was in the nursery. The bud / graft joint should not be covered with soil. Plants should be irrigated once copiously to get the soil particles to closely adhere to the roots and also to drive away the air around the roots completely.

14. Heeling inn: If the plants after transport are not directly planted in the field, they may be kept in shade in a slanting position along the side of a trench moistening the ball of earth They may be left in this position till active growth commences by which time they should be planted in the field. This process is known as healing inn.

Conclusion

Orchard soil management practices and integrated nutrient management with use of organic manures (FYM, vermicompost, bio-fertilizers, cakes etc.) and cover cropping helps in improving physical, chemical and biological properties of the soil for quality fruit production. Mulching encourages proliferation of feeder roots resulting in efficient uptake of plant nutrients and more retention of moisture and improves thermal regimes under weed free conditions as well as drip irrigation with use of plastic mulch significantly influence tree yield and fruit quality.

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NEEDS & STRATEGIES

TO INCREASE THE SUNFLOWER PRODUCTION IN INDIA

Sunflower is the fourth most important oil seed crop next to soybean, rapeseed and groundnut in world as well as in India. It is the state flower of Kanas in USA. As the sunflower has a feature to turn in the direction of sun up to anthesis period, the literal meaning of sunflower is 'turn with the sun'. Sunflower is the day neutral plant and exhibits the character of heliotropism. Being a thermo and photo insensitive crop, sunflower can be cultivated in any season in the year under any type of cropping system.

In 2019-20, sunflower was cultivated in the area of 0.24 million ha with the production of 0.22 million tonnes and productivity of 8.91 q/ha in India. While, the oil production from the sunflower oil seeds was only 0.72 lakh tonnes. Karnataka alone contributes about 54% (0.12 million tonnes) of sunflower production in India. Sunflower seeds contains about 48-53% oil in kernel, 28-35% oil in seeds and 14-19% protein. Compared to *Kharif* sunflower, seeds of *Rabi* sunflower has higher oil content, while the Spring sunflower oil has higher iodine value. The keeping quality of rainfed sunflower oil is better than irrigated sunflower.

Needs to increase the sunflower production in India

As sunflower oil contains higher amount of polyunsaturated fatty acid with higher proportion of linoleic acid (66%), it is good for the patients suffering from cardiac disorders. In addition to this it is also rich in vitamin E. Hence, a majority of population prefers sunflower oil as a vegetable oil for cooking. But due to the various challenges in sunflower cultivation due to biotic and abiotic factors its cultivation decreases, but the demand is in increasing trend. Among the edible oils import, share of sunflower oil is about 12%.

In 2020-21, 2.2 million tonnes of sunflower oil was imported from other countries. Among which, 1.74 million tonnes was imported from Ukraine. Import of sunflower oil was 24 times more than its production (0.072 million tonnes) in India. Annually more than 90% of sunflower oil import is from Ukraine and Russia. Now a days, due to its demand, adulteration is increasing in market. The price of sunflower oil also hiked in recent days due to Ukraine-Russia war. Hence there is a need to increase the sunflower production to meet the increasing demand. Hence in this article let us discuss the five basic important Agronomic strategies to increase sunflower oil seed production.

1. Selection of high yielding cultivar

As the sunflower cultivars are classified into giant, semi dwarf and dwarf varieties, their growth characters and yield potential vary from one to another. As the seed set percentage is low in sunflower, in recent years there is a demand for the supply of good quality seeds at the time of sowing. Hence the varieties or hybrids with high yield potential

should be selected in right time for cultivation.

2. Application of manures and fertilizers

The recommended dosage of fertilizers and manures should be applied at the right time according to the soil test results. The secondary nutrient sulphur @ 20 kg/ha should be applied along with the recommended dosage of primary nutrients N, P and K. Phosphatic fertilizer Single super phosphate (SSP) can be recommended as the alternate to DAP as SSP supplies the three major nutrients phosphorus, sulphur and calcium. Sulphur is essential for the synthesis of oil and sulphur containing amino acids such as cysteine, methionine. Hence the application of sulphur increases the quality (protein and oil content) of sunflower seeds. Micronutrient mixture @12.5 kg/ha should be mixed with 38.5 kg of sand and can be applied on the furrows.

3. Foliar application of nutrients

Boron is essential for anthesis. It also plays an important role in germination of pollen grains and stigma receptivity which maintain the fertility of flowers. Hence the foliar application of 0.2% boron should be done twice at 15 days interval at ray floret opening stage. Foliar application of Naphthalene Acetic Acid (NAA) @ 20 ppm concentration should be done at 30 and 60 days after sowing. It is made by dissolving 280g of NAA in 625 litres of water and can be sprayed for one hectare.

4. Hand pollination

As sunflower is the self-incompatible crop, seed set is the main problem due to insufficient

pollinators. Sunflower consists of thousands of flowers which are arranged in Fibonacci sequence which are together called capitulum or head. The soft muslin cloths should be used for hand pollination. Gently, the muslin cloth should be rubbed to one sunflower head such that the pollen grains should stick to muslin cloth. Then the muslin cloth should be rubbed to another sunflower head in such a way that the pollen grains in muslin cloth should stick to stigma of flowers in another head.

Rubbing of sunflower heads directly face to face without use of muslin cloth is the another way of hand pollination. Hand pollination can be done by rubbing one sunflower head to another head directly in such a way that the pollen grains sticks to the stigma gently without causing any damage to head and flowers. These two operations should be done in morning hours from 9:00 to 11:00 AM during which the pollen shedding is high.

5. Maintenance of honey bee hives

Sunflower head consists of two different types of florets. The outer or peripheral florets are ray florets which are normally sterile, but attracts the pollinators. The inner or centre florets are the disc florets consists of unisexual and bisexual flowers. These are completely fertile and form the seeds. If the pollination does not occur, then disc florets produce the chaffy seeds which are poor quality and economically not valuable. Hence the honey bee hives @ 5/ha should be kept in the sunflower garden to improve the seed set percentage. As spraying of pesticides affects the pollinators, pesticides should not be sprayed after anthesis stage. Birds are the main menace during seed formation stage. Hence, proper care should be taken to scare the birds.

Conclusion

Sunflower is the most important oil seed crop in world as well as in India. There is an increasing demand for sunflower oil due to its health benefits. Hence the care must be taken to increase the production of sunflower oil by adopting the various technologies. Though the above discussed strategies are basic, but farmers not aware to adopt these strategies. Hence the farmers should be recommended to adopt these strategies in order to increase sunflower oilseed production for the future demand.

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SITE SELECTION
A CONSIDERATION FOR SHRIMP FARMING

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India has a long coastline, which allows for extensive exploitation of marine wealth. Fishermen in India are engaged in shrimp farming due to the high profitable return on investment due to their export value.

Site Selection

The selection of an appropriate site is a critical activity that must be carefully considered before establishing a shrimp farm. Site evaluation is carried out not only to determine whether a location is suitable for shrimp farming, it is also useful in determining what changes are required in terms of layout, engineering, and management practises to make shrimp farming feasible at a given location. Because no site will have all of the desirable characteristics, a number of decisions must be made for each site. Several factors must be considered when choosing a location:

Netting at shrimp farm

Litopenaeus vannamei

Lining of pond

Climatic condition and topography

The best locations for shrimp culture are those with average natural ground elevations of 1-3 m above mean sea level or at least 1 m above the highest high tide level to allow drainage and harvesting. Pumping costs more in high-altitude locations. The sites should have little vegetation, be near the sea or other natural waterways such as rivers and streams, be easily accessible by road, have a small population, and be nearly square or rectangular in shape. Climate-wise, areas with a short and less pronounced dry season and moderate rainfall distributed throughout the year are best suited for shrimp farming. A prolonged dry season

may cause an increase in water temperature and salinity, promoting excessive algae growth and resulting in oxygen depletion at night.

Infrastructure accessibility

To facilitate supervision and transportation of materials and products, the farm must have good access by road or water, as well as communication systems that are operational all year. It is critical that the farm be located within 3-6 hours of the hatchery to avoid excessively long transportation times for the larvae and within 10 hours of the processing plant to avoid product deterioration.

Electricity

The availability of a relatively inexpensive and dependable power source is an important consideration in site selection. In areas where electricity is available, it is practical and advantageous to use electric power to run the farm, particularly for the intensive culture system. It is recommended to have a backup generator as a secondary power source.

Security

Security areas that are free of security risks have better working conditions, higher productivity, and lower extra costs.

Labor availability and other factors

The availability of labour, equipment, commercial feed, and supplies ensures that operations run smoothly and that the crop is successful. Water supply site should have a clean supply of both freshwater and brackish water. The following water quality parameters are required for maximum feed efficiency and growth of *Penaeus monodon*:

Avoid water from polluted areas with high concentrations of suspended solids and organic wastes, such as effluent water from industry, urban areas, agricultural and other farm locales. In such cases, a settling pond or a large reservoir should be used for sedimentation and treatment. A source of freshwater is useful in saline areas for adjusting the salinity in ponds and for domestic use by farm staff. Freshwater should be safe to drink and plentiful throughout the year.

Soil conditions

Because the shrimp will spend the majority of their time on the pond bottom during the culture period, the type of soil is the most important factor in site selection. Generally, clay or loam-based soil with more than 90% clay and a pH between 6.5 and 8.5 is preferred. Sites with sandy or silty soil should be avoided due to their porous nature, which can lead to erosion, water seepage, and easy waste infiltration into the soil. Before building ponds, soil samples should be taken at random from 5-10 spots on the surface and at 1 metre depth and sent to a laboratory for analysis of soil texture and pH. This information will be useful during the pond's construction and preparation.

Because of their high organic matter content and acidic nature, mangrove or acid sulphate soils are not suitable for shrimp pond culture, necessitating a high water exchange rate and low stocking density. A pond constructed on mangrove soil will also experience hydrogen sulphide and ammonia accumulation in the pond bottom. When the soil in acid sulphate soil areas is dried and then flooded, it develops high acidity, making it difficult to stabilize the pH of the pond water and induce plankton growth during the culture period.

Water Supply

The site should have a clean water supply that includes both freshwater and brackish water. The following water quality parameters (TNAU, Agritech Portal, 2022) are required for maximum feed efficiency and growth of shrimps:

Water Parameters	Optimal concentration
Dissolved Oxygen	3.5-4 ppm
Salinity	10-25 ppt
Temp.	26-32°C
pH	6.8-8.7
Total Nitrite Nitrogen	1 ppm
Total ammonia	< 1ppm
Transparency	35 cm
Carbon Dioxide	10 ppm

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FISHERIES AND AQUACULTURE:

A SOURCE OF FOOD SECURITY AND INCOME

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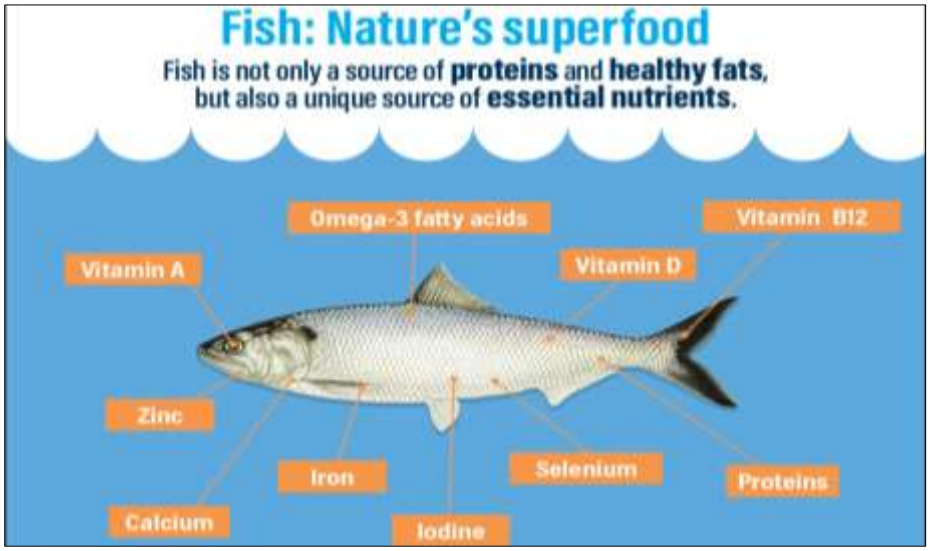
In 2018, global fish production was predicted to be at 179 million tonnes. Human consumption accounted for 156 million tonnes of the total, the worldwide average availability of aquatic food increased by 1.5% each year, reaching 20.5 kg per capita. Aquaculture was responsible for 46% of overall output and 52% of fish for human consumption. Total worldwide catch fisheries production achieved 96.4 million tonnes in 2018. In 2018, global aquaculture output reached an all-time high of 114.5 million tonnes of live body weight, with a net farm - gate prices selling value of USD 263.6 billion (FAO, 2020). Fisheries and aquaculture provide for the lives of 800 million people employment and livelihoods worldwide, 50% of whom will be women and 90% of whom living in the Developing Nations (WorldFish, 2020).

Introduction

Over 845 million of people were starving in the globe in 1990. Hunger increased from 873 million to just over 1 billion people between 2006 and 2009, before dropping somewhat to 925 million in 2010, along with evidence of global economic recovery. The challenge of how to produce and distribute enough food for a predicted global population of 9 billion people in 2050 has become a fundamental concern of development strategy in the face of this economic turbulence. The projected adverse impacts of climate change on agricultural output, increased availability of land, water, and energy, and the need to sustain regulatory environmental benefits all exacerbate the difficulty of feeding present and future populations.. This extraordinary convergence of challenges on the global food system necessitates a deliberate, well-coordinated strategy that connects the food industry to other policy areas. Fish is among the most commonly exported and high value foods, accounting for around 38% of total worldwide industry in value.

Fish as nutritive food

Micronutrients such as minerals such as calcium, phosphorus, iodine, zinc, iron and selenium, vitamins A, D and B_{12} as well as important omega fatty acids and protein, are abundant in a common fish, crustaceans and other aquatic animals. Almost all nations that rely primarily on aquatic foods for nutrition are in the Global South, including several globally poorest states in Africa, Asia, and the Pacific regions. Because aquatic foods make such a large contribution to diets and micronutrient intakes in these areas, preserving and expanding their accessibility and availability is critical to combating malnutrition. If present losses in catch fisheries landings continue, it is anticipated that 845 million people will be deficient in one or more micronutrients.



Nutrients in fish

Income, poverty alleviation and livelihoods through aquaculture and fisheries

The total revenue generated by aquaculture and fisheries including both marine and freshwater habitats is not known, however it is estimated to be in the range of US$ 225 to 240 billion per year for marine capture fisheries only. The sector's contributes to poverty alleviation and food security in three ways: (1) Health and nutrition advantages from eating fish; (2) Revenue for those employed in the industry, as well as cumulative and overspill impacts in fishery-dependent areas; and (3) Generating revenue from exported goods, taxation, license fees, and payment for access to resources by foreign fleets or overseas investment in fish culture.

Aquatic food resources are significant sources of income, revenue, and employment, directly employing 59.5 million people in production, 85 percent of whom are in Asia and 9% in Africa. Capture fisheries account for two-thirds of these occupations. Workers and owners of a variety of small and medium businesses benefit significantly from aquatic food value chains. Aquaculture and Fisheries is becoming a larger part of the world fish supply, and it is commonly thought to play a key role in satisfying future demand for fish. The diversity of aquaculture systems makes it difficult to make definitive statements about how the sector affects poverty, but it is widely acknowledged that, like capture fisheries, aquaculture plays a role to alleviating poverty both direct and indirect ways by offering nutrition, income, and work opportunities to producers and other value chain actor households.

Key outlines of a proposed global Food Security

- The requirement for linked governance, with policies in all aspects of the food system taking into account their consequences for volatility, sustainability, climate change, and hunger, as well as policies in energy, water supply, land use, marine, ecosystem services, and biodiversity.
- To empower food producers to take advantage of new technology. In addition, demands for the most resource-intensive forms of food must be limited, and waste in all aspects of the food system must be reduced.
- Give rural and agricultural transformation a higher priority as a driver of broad-based economic growth, by investing in gender equity and reducing subsidies and barriers to trade that disadvantage low-income countries.
- Create food system governance that maximizes globalization's advantages while also ensuring that they are dispersed fairly.

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INTEGRATED FISH FARMING

Integrated Farming System (IFS) is a combination of many systems, means agriculture which includes crop production, raising livestock, fishery, poultry, beekeeping etc. on a specific farm with a aim of higher profitability without altering ecological and socio-economic balance on one hand and to meet the national goals on the other hand. Integrated Fish Farming (IFF), when fish becomes a major commodity of Integrated Farming System it is known as Integrated Fish Farming.

Integrated Fish Farming (IFF), the practice of Combining Fish Culture with Agriculture or livestock for full Utilization of resources and increased production is commonly known as Integrated Fish Farming. It provides fish, meat, milk, vegetables, fruits, fodder, eggs, grains, & mushroom etc. efficiency in resource utilization, efficient utilization of wastes from other culture practices, reduction in risks by diversifying crops, recycling of wastes/ by products of one farming system as input for another system, efficient utilization of available farming space for maximum production, additional source of food and income, a reduction in additional cost for supplementary feeding & fertilization.

India offers a huge potential for freshwater aquaculture development as it is blessed with extensive river and canal system of about 195.210 km, consisting of 14 major rivers, 44 medium rivers and numerous small rivers and streams.

Advantages of fish farming:

- Better waste management for ecosystem.
- Increased output with economic benefits.
- Increased food supply.
- More employment opportunity.

Types of fish farming:

A. Fish farming with agriculture:

1) **Paddy-cum fish culture:** Fields remain flooded with water for considerable duration (3-8 months) hence fish can be grown along with rice at low additional cost. It is practiced in countries like Japan, Malaysia, China and India (Southern and North eastern states: Assam, Bengal, Bihar Orissa, AP).
2) **Horticulture-cum fish culture:** Vegetable cum fish culture, fruits-cum fish culture, flowers-cum fish culture, mushroom-cum fish culture, sericulture-fish culture, fodder crops fish culture

B. Fish farming with livestock: (Live-stock fish farming): resources can be successfully cultured along with a variety of fishes having good food value. Pigs, poultry, ducks, cattles, goats and rabbits etc. Fish cum pig culture, fish cum duck culture, fish cum poultry culture, fish cum cattle culture.

Conclusion:

Integrated fish farming or fish culture integrated with agriculture and livestock provides a higher source of income to the farmer having a small land holding. It helps in improving production with little additional expenditure. It is expected that IFF practices will increase in the near future in suitable agro-climatic regions of the country as they are dependent on eco-friendly measures and ensure higher returns as well as sustained production levels of fish and other bio-resources.

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HEALTH PROMOTING PROPERTIES OF CITRUS PEEL WASTE

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Citrus fruits such as oranges, grapefruits, lemons, limes, tangerines, and mandarins are among the most popular fruits grown around the world, with production increasing every year due to increased consumer demand. The Citrus genus, which belongs to the Rutaceae family, has long been known for its health benefits. Many beneficial nutrients and bioactive substances may be found in these plant groupings.

Antimicrobial, anticancer, antidiabetic, antiplatelet aggregation and anti-inflammatory properties are all present in these substances. Citrus trash, which is produced in vast quantities by citrus-processing enterprises every year, has a significant economic potential due to its high concentration of bioactive chemicals.

Introduction

Citrus fruits are the most widely farmed fruit on the planet, and they may be found in tropical, subtropical, and temperate climates alike. One-third of all citrus fruits are processed, and the peel is thrown away. Vitamins, minerals, dietary fibre, pectin, and active phytochemicals abound in citrus fruits (e.g., flavonoids, phenolic acids). Citrus peels from a variety of sources are thought to be a good source of health-promoting bioactive chemicals such phenolic compounds.

It's utilized in dietary supplements, as a raw material in cosmetics, as natural food additives, and in the pharmaceutical and nutraceutical industries. Citrus peels are a readily available, inexpensive, and cost-effective plant-based resource for addressing lifestyle-related disease.

Peel mineral content

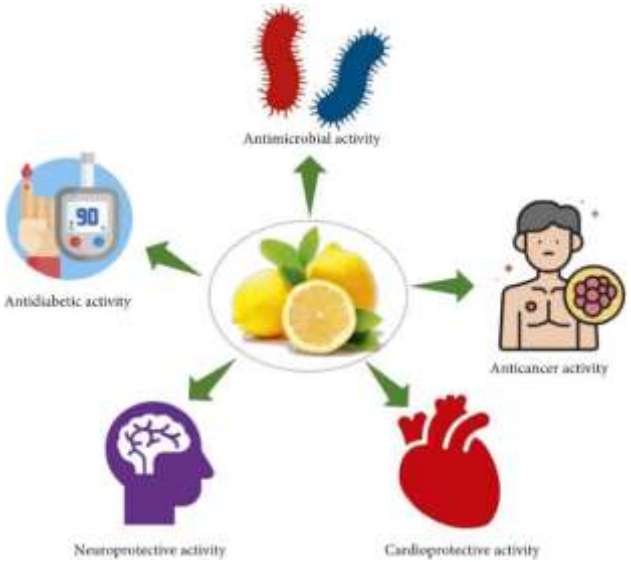
Citrus peels are a valuable source of minerals such as calcium, salt, magnesium, phosphorus, iron, and others, and removing the peel results in a considerable nutritional loss. The potassium content of an orange, lime, or lemon peel was found to be higher than that of the pulp, but the sodium content of an orange, lime, or mandarin peel was found to be higher than that of the pulp. These minerals are in charge of maintaining water and electrolyte equilibrium.

Calcium, which is important for bone development, is found in greater quantities in the peel of citrus fruits. The phosphorus in the peel, coupled with the calcium, helps to build strong bones and teeth. Citrus fruit peels are also high in micronutrients such as iron, zinc, and magnesium. Iron is the most common micronutrient, and it is found in larger concentrations in the peel than in the pulp in all kinds. The peel of lemon, orange, and all grapefruit kinds has more zinc than the pulp, which protects the body from oxidative stress and boosts immune processes.

Citrus fruits are high in selenium, an antioxidant that helps to boost the immune system. The peel has a higher concentration of this element. The lemon displayed the most difference in the peel and pulp, with the peel having more than twice as much selenium as the pulp.

Citrus peel bioactive compounds

Phytochemicals are important bioactive molecules that have been linked to a variety of health benefits. Polyphenols, particularly phenolic acids and flavonoids, are abundant in the peel and have important antioxidant, anti-inflammatory, anti-atherogenic, anticlotting, antitumor, anti-



Various important bioactivities of Citrus

Table 1: Health benefits of peels of different species of citrus fruits:

Peel source	Beneficial effect
Lemon (*C. limon*)	Antidiarrheal activity; anti-diabetic activity; anti-urolithic activity.
Mandarin (*C. reticulate*)	Anti-inflammatory; anticancer; anti-proliferative activity; hypo-cholesterolemic and antidiabetic effects.
Orange (*C. sinensis*)	Antioxidant; cytotoxic effect against cancer cells; hypocholesterolemic and hypoglycemic effects; improves intestinal health and function; antiproliferative activity; anti-inflammatory activity.
Grapefruit (*C. paradise*)	Inhibits oral carcinogenic.
Bitter orange (*C. aurantium*)	Attenuated liver fibrosis; anticancer.

inflammatory, anti-allergic, antiproliferative, antiviral, anti-carcinogenic, neuroprotective, and anti-microbial properties. Free radical scavenging and metal chelating are two mechanisms that phenolics use to have an antioxidant effect. By scavenging free radicals and quenching reactive oxygen species, Phyto phenols can help prevent and treat free radical-mediated disorders like diabetes, cancer, neurological diseases, the ageing process, and cardiovascular dysfunction (ROS).

Fruit with a citrus flavour in compared to the edible parts of the fruit, the peel contains greater flavonoid, which has anticancer, antiviral, and anti-inflammatory properties, as well as reduced capillary fragility and inhibiting human platelet aggregation. Chemical interactions of saponins. They have hypoglycemic and cholesterol-lowering properties. Citrus peel limonoids have a diverse spectrum of biological actions, including antibacterial, antioxidant, anti-angiogenic, and anti-inflammatory properties.

Antitumor, diuretic, antiviral, antihypertensive, antidepressant, antibacterial, and anti-inflammatory are some of the biological properties of alkaloids. The alkaloid portion of dried citrus peels also has anti-asthmatic properties, according to the study. Synephrine and N-methyl tyramine are the main alkaloid components found in orange peel. Synephrine is the most common alkaloid in dried citrus peel, and it has the ability to constrict blood vessels, elevate hypertension, and widen the trachea, as well as promote metabolism and calorie consumption.

Monoterpene and sesquiterpene hydrocarbons, as well as their oxygenated derivatives such as aldehydes, ketones, acids, alcohols, and esters, are found in the majority of citrus peels. The main components of citrus peel essential oils are limonene and terpinene, which have antimicrobial, antioxidant, and anticancer effects. Citrus peel's pectin component has been demonstrated to relieve intestinal inflammation, lower the risk of heart disease, and lower cholesterol levels.

Health benefits

Sweet orange (*C. sinensis*), bitter orange (*C. aurantium*), lime (*C. aurantifolia*), lemon (*C. limon*), grapefruit (*C. paradise*), and mandarin orange (*C. reticulate*) are the most important citrus fruits. The following table lists the health advantages of various species' discarded peel.

Conclusion

Citrus peel is a rich source of micro and macronutrients, as well as bioactive substances like flavonoids, alkaloids, limonoids, and pectin, all of which contribute to the citrus peel's health-promoting properties. Peels are viewed as a potential nutraceutical resource because they are inexpensive and readily available. Citrus peel can also help to solve the problem of pollution generated by peels owing to improper disposal of this non-edible waste.■

IMPACT OF SEED PRIMING

ON SEED GERMINATION

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Seed germination efficiency is critical in agriculture. Rapid and uniform emergence and root growth are required for successful early seedling establishment. The simple imbibition of water by the seed is frequently the immediate cause of germination. However, there may be other obstacles to germination that must be overcome. The seedling's early growth is heterotrophic. The seedling can't photosynthesize at first because the chloroplasts haven't differentiated, or it can't photosynthesize at high enough rates to support its growth. The accumulated food reserves are a source of carbon, nitrogen, and metabolizable substrates that the sprouting seedling can utilise for energy and biosynthesis. During germination, these food reserves are released. Food reserves must be digested where they were deposited since they are complex, water-insoluble compounds. As a result, hydrolytic enzymes are required for the mobilisation of stored food reserves. Proteases, lipases, and amylases are examples of hydrolytic enzymes.

Water-based seed priming is a pre-sowing treatment that partially hydrates seeds while preventing them from emerging. During the reversible period of germination, a variety of interventions can be used. They vary greatly depending on the priming solution's osmotic potential, the duration, the external temperature, and the presence of specific chemical substances. The effective treatments engage metabolic pathways that are initiated during germination and then temporarily inhibited before desiccation is lost. The overall result of seed priming is increased seed vigour, which is defined as the entire set of qualities that influence a seed lot's performance in a variety of environments. Priming techniques may benefit cultivated plants for a range of economic and agronomic reasons. Numerous studies in the literature indicated not only an increase in germination rate and uniformity, but also a noticeable improvement in the behaviour of the seedlings in terms of plant growth and stress resistance.

Primed seeds have a higher germination rate and more uniform germination. Regular crop establishment may be helped by improved and uniform seedling emergence. Priming may improve processes that occur at the start of germination, but the entire process is halted at a specific point, which is the same for all seeds involved. Priming may also cause structural and ultrastructural changes in the seeds, facilitating subsequent water uptake and reducing initial discrepancies in imbibition, resulting in more uniform germination.

A change in plant hormone biosynthesis and signaling could explain the priming-induced increase in germination. Priming has been shown to increase the ratio of gibberellins (GA) to abscisic acid (ABA), which could be the result of a priming effect on gene expression. A more consistent GA endogenous concentration in primed seeds should help with endosperm weakening, embryo cell elongation, and reserve mobilisation. Ethylene also has a direct impact on the rate and

percentage of germination. Increased ethylene production during priming may facilitate endosperm weakening and post-priming germination by increasing endo-mannase activity. Priming has been shown to trigger the repair and reactivation of pre-existing mitochondria, as well as the synthesis of new mitochondria. As a result, it may be possible to sustain final germination with a higher amount of energy for a shorter period of time.

Methods of seed priming

Seed priming techniques are separated into two categories: traditional and sophisticated. Hydropriming, osmo-priming, nutrient priming, chemical priming, bio-priming, seed priming with plant growth regulators, and priming with plant extracts are examples of traditional seed priming techniques, whereas advanced seed priming techniques include seed priming with nanoparticles and priming with physical agents.

Hydro-priming is a simple and cost-effective process that involves soaking seeds in water for a set amount of time and then drying them to a specific moisture level before sowing (Singh *et al*. 2015).

Osmo-priming is a commercial procedure in which seeds are watered to a specific level to allow for pregermination metabolic activities.

Micronutrient seed priming is a well-known strategy for increasing osmosis in seeds during the germination period in order to regulate water (Singh, 2007). To soak a variety of crop seeds prior to germination, a range of chemicals are used. Seeds that have been pre-treated with these compounds develop more quickly and are more resistant to abiotic stressors.

Bio-priming was first described by Callan and Coworkers in 1990 for the biological management of Pythium pre-emergence in sh2 sweet corn. Imbibitions containing a biocontrol mediator and served at a specific temperature improve fortification. Additionally, seed priming combined with helpful microbes may help agricultural plants mature more quickly, mainly if the inoculated microorganisms colonize the rhizosphere of the plant and maintain plant (Waqas, M. *et al*., 2017) physiology and plant growth for a longer period (Bennett and Whipps, 2008). Plant growth regulators (PGR) seed priming has been shown to reduce the negative impacts of a variety of environmental stressors (Bahrani and Pourreza 2012; Jisha *et al*. 2013).

Allelochemicals such as phenolic compounds, terpenoids, flavonoids, saponins, alkaloids, and steroids may restrict or accelerate plant growth when used as a priming agent (Narwal 1994).

Seed priming with nano particles has been reported to enhance seed germination and vigor in many crops. Ghafari and Razmjoo (2013) reported that seed priming with calcium-phosphate, SiO_2, ZnO, and Ag nanoparticles enhanced germination and seedling development.

Some of the physical agents utilised for seed priming include the magnetic field, UV radiation, gamma radiation, X-rays, and microwaves (Bilalis *et al*., 2012). It has been observed that priming with a magnetic field improves germination rate, vigour, and seedling biomass, as well as stress resistance.

Effects

Seed priming is a physiological process that involves controlling seed hydration in order to promote a suitable pregerminative metabolic process, efficient nutrient uptake and water use efficiency, dormancy breaking, timely maturity, and crop production. Using existing messenger ribonucleic acid (mRNA), water intake drives protein synthesis and respiratory processes during imbibition, as well as the commencement of many physiological functions connected to germination. In most field crops, this approach has been shown to be the most viable and cost-effective for uniform seed emergence. Hydro-priming, osmo-priming, nutritional priming, chemical priming, bio-priming, priming with plant growth regulators, priming with plant extracts, seed priming with nanoparticles, and seed priming with physical agents are only a few of the well-developed seed-priming approaches.

Limitations

However, there are still certain drawbacks to priming technique. The extended seed treatment during priming may result in seed desiccation tolerance loss, which lowers seed viability. Similarly, all priming techniques may not result in considerable germination and growth if the priming circumstances are improper, causing the protective proteins to degrade.

Conclusion

As a result, substantial research is needed to determine the best priming technique for diverse plants in terms of germination and growth under varied climatic circumstances. ■

HYDROPONICS

FODDER PRODUCTION TECHNOLOGY

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Currently the demand and availability of domestic fodder the difference between 60-65% unripe dried fodder is 20-25%. Fodder can be easily produced by the farmer. However, there are limits to the availability of fodder. In the country only 4-5% of the cultivable land is used for fodder production. But, according to Veterinary Scientists 10-12% land is required for production of fodder. Climate change and lack of water availability is major problem to provide fresh fodder to the animals for around the year. But if we apply modern technologies then easily solve this problem. Hydroponics system helps in to produce fresh and good quality fodder in less time and in less area of land. With the help of this technology money expenditure on fodder production and time for production in under control.

Hydroponics word is derived from Hydro means water and ponic means work. In that system crops are grown in soilless media such as Cocopeat, peat moss, perlite and vermiculite etc. or in nutrient culture medium. This system was firstly used by Dr. Alen Cooper in 1930. Now-a-days this technology is most popular in Australia, America and other countries. In India ICAR Goa Department works on development and marketing of the hydroponics system. Maharashtra is also a leading state in production of fodder in hydroponics system.

What is hydroponics fodder

Hydroponics fodder means growing of maize, wheat, and other fodder crops in without soil cultivation as well as in low space and low water requirement. Sometimes nutrient culture system is also adopted to grow fodder crops in hydroponics system.

Hydroponics fodder technology system

- In that technology, crops are grown in soilless media with the help of trays. For that purpose, greenhouses, low cost greenhouses and shade net are required. If they are not available then open shade also suitable.
- For production of fodder select the maize because this crop is sustaining in any environment and season. Also, wheat, barley, oats etc. crops are also suitable. But in bajra hydrocyanic acid is present therefore bajra is not suitable for hydroponics system.
- Good quality seeds are soaked in normal water for 12-14 hr. before sowing. After that these seeds are placed and packed in cold cloth for 24 hrs. Also spread the water on it at some interval. Due to that seeds are easily germinated and grow very well.
- Germinated seeds are placed in tray at a rate of 2 Kg per tray. Water gives to seeds up to 4-6 times at a day according to requirement.

- After 7-8 days 20-30 cm height fodder is grown. 10-12 Kg green fodder can be developed and grow well as compare to open field.

Energy content in fodder:

Calcium	0.11 %
Vitamin A	25.01%
Vitamin C	45.01%
Vitamin E	26.03%
Proteins	13-20%
Rizestic Fiber (Important for Milk production)	80.92%

How to serve hydroponics fodder to the animals

Hydroponics fodder is easily digestible fodder therefore animals eat the fodder easily. Fully grown fodder crops looks like a mat and at the bottom grains, roots and plant parts are trapped in each other. Therefore, it gets easy to remove the fodder from tray. Also, this fodder is served as it is or by cutting into pieces. If we provide only hydroponics fodder to the animals then it effects on digestion of animals as well as stomach infection also takes place. To avoid this problem hydroponics fodder is mixed with dry fodder and provide mixture of fodder to the animals. For 1 animal 20 Kg fodder is sufficient for feeding. 7-8 kg fodder replaces the 1 Kg of ready feed and simultaneously reduces the cost. This food is beneficial to all age of animals.

Benefits of hydroponics fodder

- In case of fodder scarcity problem hydroponics fodder is one of the options to provide fresh and green fodder.
- Hydroponics fodder sustain in any situation, climate change and drought condition.
- 7-8 days are required to complete the growing of fodder in hydroponics system but in traditional farming 40-60 days are required.
- Required less space to growing fodder. 400 Sq. Ft. area required for production of fodder for 10 animals.
- This fodder is organic fodder.
- Production cost is less.
- This fodder is not wasted because animals eat fodder from roots. Also, this fodder is coarse, luscious, juicy, palatable, and digestive. Digestion rate is up to 90-95%.
- Daily fodder is provided therefore storage problem is reduced. The loss of nutritional value is also reduced.
- This is soilless farming therefore loss of nutrients from soil is reduced.
- Ability to convert japravak value in fodder is 7-8 times.
- Up to 25-40% expenditure is reduced in animal feed.
- 90 % fodder is digest to animals.
- Increase in immunity of animals.
- More production in less space, less water, less time and at low cost.
- Increase in reproductive system of animals.
- Increase in proteins, minerals and vitamins to the animals.
- Only 5-10 % water is required as compared to traditional farming.
- In this fodder proteins, vitamins, antioxidants, folic acid, omega-3, fatty acids are available.
- Increase in milk production and production capacity of milk. Also, fat is increases in milk. Milk production is increases from 1-2.5 litres. Sweetness and whiteness of milk also get increases.
- Requires less solar radiation, therefore we grow fodder in tray in shade net also.

3. Conclusion

Hydroponics system helps in to produce fresh and good quality fodder in less time and in less area of land. With the help of this technology money expenditure on fodder production and time for production in under control. Also, More production in less space, less water, less time and at low cost.

■■■

GROW STRAWBERRIES

SUCCESSFULLY IN CONTAINERS

About Author

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The modern cultivated strawberry (*Fragaria* × *ananassa* Duchesne) belonging to the family Rosaceae, is one of the most delicious, refreshing, and soft fruits in the world. The fruit is technically known as an accessory fruit because the fleshy part is derived not from the ovaries (achenes) but from the receptacle. Its plant is cherished in gardens and in commercial fields for its beautiful, red fruit that has a pleasant aroma. It is an attractive, luscious, tasty, and nutritious fruit with a distinct and delicate flavor. The fresh ripe fruits of strawberries are a rich source of vitamin A and vitamin C. The flavor of the fruit is due to the presence of volatile esters. Strawberry also has high pectin, available in the form of calcium pectate, which serves as an excellent ingredient for jelly making. Strawberry is polytropic and is cultivated in temperate, subtropical, and tropical areas of the country. Strawberries are a wonderful plant to have around the house. Strawberries are both attractive and delicious, and cultivating them in containers is simple. Strawberry plants are frequently chosen for their fruiting characteristics by gardeners. Strawberries come in four different varieties, all of which can be grown in pots. Here are some of the most popular varieties of strawberries like Chandler, Cornwallis, Cavendish, Jewel, Kent, Alexandria, White Soul, Yellow Wonder Seascape, Selva and Tribute.

Ideal strawberry containers

Strawberries are perfect container fruits because to their compact and rapid growth habits, but they can also be grown in a separate bed. Strawberry plants can be grown in a variety of containers, including hanging baskets, terracotta pots, and specialty strawberry planters, but for a more rustic look, use old wooden wine or vegetable crates. Willow window boxes and tubs salvaged animal drinking troughs, and reused wheelbarrows are also high on the list of typical rural garden-style favorites. Growing strawberries in any type of tub have a lot of distinct advantages. Plants can be moved to follow the path of the sun, allowing them to get more warmth and light than they would otherwise. They can be lifted above the ground to avoid attracting slugs and avoiding diseases spread through soil. To encourage an extra-early yield, plants might be moved under cover in the winter. It is feasible to enjoy a considerably longer harvest from exactly the same kind of strawberries by leaving some plants outside and others under the cover of a greenhouse or polytunnel. Then when you've collected all of your supplies, then we can plant

strawberries using the following steps:

- Fill your container midway with soil and add organic matter or compost an inch or two below the surface.
- Make a small mound in the soil and place the plant in it.
- Spread the roots
- Cover with soil from root to crown
- Place each plant at least 10-12 inches apart to allow room to grow
- Water thoroughly
- Set the plant in full sun for at least 6 hours

Make sure the crowns are just above the topsoil surface while planting. If you run out of the potting mix, you can always add more. To be sure, just let soil settle first.

Planting strawberries in containers

Planting bare-root runners that have been cold-stored to slow them down in late spring or early summer is the best time of year. They will get away extremely quickly after being brought out of the cold and marketed, giving a pick of fruits in as little as two months. You can also plant normal pot-sold strawberries, which should ripen in the same summer. Plants should be spaced 25-30cm (10-12 inches) apart in multipurpose potting soil since this will make it easier to water and feed them than if they were in the ground. With their sparse top growth and typically underdeveloped roots, bare-root runners can appear extremely rough.

Caring for strawberries in containers

When the soil dries out, moisten the compost to keep it moist. Keep moisture off the leaves when watering to avoid fungal infections from taking hold and damaging the fruits. Carefully pull the leaves to add the water to your buried pots if possible. Your plants will also benefit from regular feedings of a high potash liquid feed as soon as the first blossoms develop a brand intended for feeding tomato plants will usually suffice. To encourage young fruits to swell and ripen, place straw tubs in a sunny area of the yard, and terrace. Tucking wood chips or straw beneath developing strawberries to elevate them will keep them clear of compost. If birds try to steal your fruits, drape netting over the tubs. After fruiting is over, cut back the foliage to just the centre, young leaves. Unless you want to produce new plants, remove the runners to ensure that now the plants bulk out before winter. Tubs can be stored in a greenhouse or polytunnel during the winter to encourage an earlier harvest the following year.

Steps to harvest and store strawberries grown in containers

Once you have the fruit, harvest it to feed your family or preserve what you can't eat for use later on.

Harvest of strawberries

It's time to harvest the fruit when you notice them turning red. Taste a ripe one to know for sure. To harvest strawberries, which are sweetest when they're fully ripe, follow these steps: When you see a strawberry nearly ripe, allow it to sit for another day or two. Instead of plucking the strawberry away from the stem, cut the stem above the strawberry. Store berries in a shady, cool location and leave the fruit unwashed until you plan to eat it to keep it fresh longer.

Preserve of strawberries

Preserving strawberries is easy and there are many different methods and recipes that can use. Fresh strawberries will taste the best, regardless of which method you use. When they're in season, you can use them to make jams or preserves. Another alternative is to freeze them, which makes a perfect addition to smoothies. Frozen strawberries can last up to three months in the freezer, and you can always use them to create jam later.

Keep in mind

Container strawberries will need to be replaced every three years or more, even with the best care. If you want your June-bearing berries to fruit as much as possible one time only, you can skip pinching the blossoms and other maintenance tasks for simple growing. Replace the plant each year for a fresh yield, and transfer the plants outside to allow them to grow.

Conclusion

As human As human efficiency improves as a result of technological advancements, more and more nice things may be shared and produced. Growing strawberry plants in India will help to improve the nutritional options and quality of life for the country's billions population. The development of containers and the successful crop of strawberries in India may just signal a new era of strawberry passion proliferation in one of the most populous regions of the world.

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DIGITAL AGRICULTURE
FUTURE OF INDIAN FARMING

About Author

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Any use of telephone, mobile, Internet, remote sensing, digital photography, computing, satellite imagery, drone technology, and other ICTs in any activity throughout the spectrum of agricultural value chains is referred to as Digital Agriculture (DA). This includes information on weather, agriculture, and newer and more advanced methods of improving crop quality and yield. The adoption of novel approaches to improve existing information and communication systems has expedited agricultural and rural development in India through the use of technology, or e-agriculture. It has revolutionised smallholder agriculture in various agricultural economies, assisting in the resolution of several issues related with traditional agriculture. Indian farmers need reliable agricultural information and alternate marketing channels Information Technologies can bring an overall qualitative improvement in their life by providing timely and quality information inputs for decision making. Digital farming technology also helps to empower rural farmers.

Digital Agriculture or farming is integrating both concepts- precision farming and smart farming.

Precision farming

The simplest way to comprehend precision agriculture is to think of it as anything that makes farming more precise, optimised, and regulated when it comes to crop production and animal management. The utilisation of information technology and a wide range of goods such as automated hardware and software, autonomous vehicles, drones, GPS guidance, robots, sensors, soil sampling, and telematics are all important components of this.

Smart farming

Information and data technology are used in "smart farming" to optimise complex farming systems. The focus is on data availability and how farmers may make good use of the information gathered. The goal is to improve product quality and quantity while maximising human labour productivity. The technology used in smart farming range from IoT and robotics to drones and AI. With these tools, farmers can monitor field conditions without going to the field. This enables them to make decisions for the whole farm, a lot, or even a single plant. Smart farming is not only for large agricultural corporations. It's also able to boost family farms, organic farms, and other smaller operations.

Importance of digital farming

Improves farming techniques helped in increase the production of safe and sustainable food, ensuring that enough food is available to feed the world's rising population. Increased access to digital farming solutions in emerging markets will

enable local sustainable and efficient food production, and distribution of digital solutions will ensure that negative externalities of farming, such as environmental damage, are reduced.

Climate change will require digital agriculture to establish systems that are highly productive, predictable, and flexible. This can lead to increased food security, profitability, and long-term sustainability. Access to digital technology can improve emerging markets and customers by enabling consumers with access to and use of manpower services, strategic relationships, and support services such as training, finance, and legal services.

Current initiatives

- Hon'ble Union Minister of Agriculture and Farmers Welfare, Shri Narendra Singh Tomar announced the launch of the Digital Agriculture Mission 2021–2025 in September 2021, while also signing five memorandums of understanding (MoUs) with CISCO, Ninjacart, Jio Platforms Limited, ITC Limited, and NCDEX e-Markets Limited (NeML) to advance digital agriculture through pilot projects. The Digital Agriculture Mission 2021–2025 aims to encourage and accelerate projects based on emerging technologies such as artificial intelligence (AI), blockchain, remote sensing and geographic information systems (GIS), and the use of drones and robotics.
- The Jio Agri (JioKrishi) platform launched in February 2020, digitises the agricultural ecosystem along the entire value chain to empower farmers. The core function of the platform uses stand-alone application data to provide advisory, the advanced functions use data from various sources, feed the data into AI/ML algorithms and provide accurate personalised advice. The pilot project for this initiative will take place at Jalna and Nashik (Maharashtra).

Advantages of digital innovation in agriculture

- Increased agricultural productivity.
- Increasing level of farmer's livelihood.
- Better market linkages.
- Better decision making.
- Effective policy making and implementation.

Challenges for digital farming

- High capital cost
- Small lands
- Lack of resources
- Illiteracy in rural areas

Conclusion

Digital agriculture has the ability to effectively combine the benefits of agricultural research advancements with developments in the information and communication technology domain to help favourably transform the entire spectrum of pre-farm to post-fork operations in the agriculture sector. Digital Agriculture aimed "ICT and data ecosystems to support the development and delivery of timely, targeted information and services to make farming profitable and sustainable while supplying safe, nutritious, and affordable food for all. By providing farmers with access to big data to manage their crops through the use of digital technologies, risks and uncertainties can be eliminated. Farmers may also have access to contemporary crop and livestock management methods, ensuring that they are not making decisions alone. Better performance, supply chain optimization, and better decision making have all contributed to enhanced industrial performance. Digital farming is also a technique to increase quality control and assurance, and it is gaining traction in rural areas.

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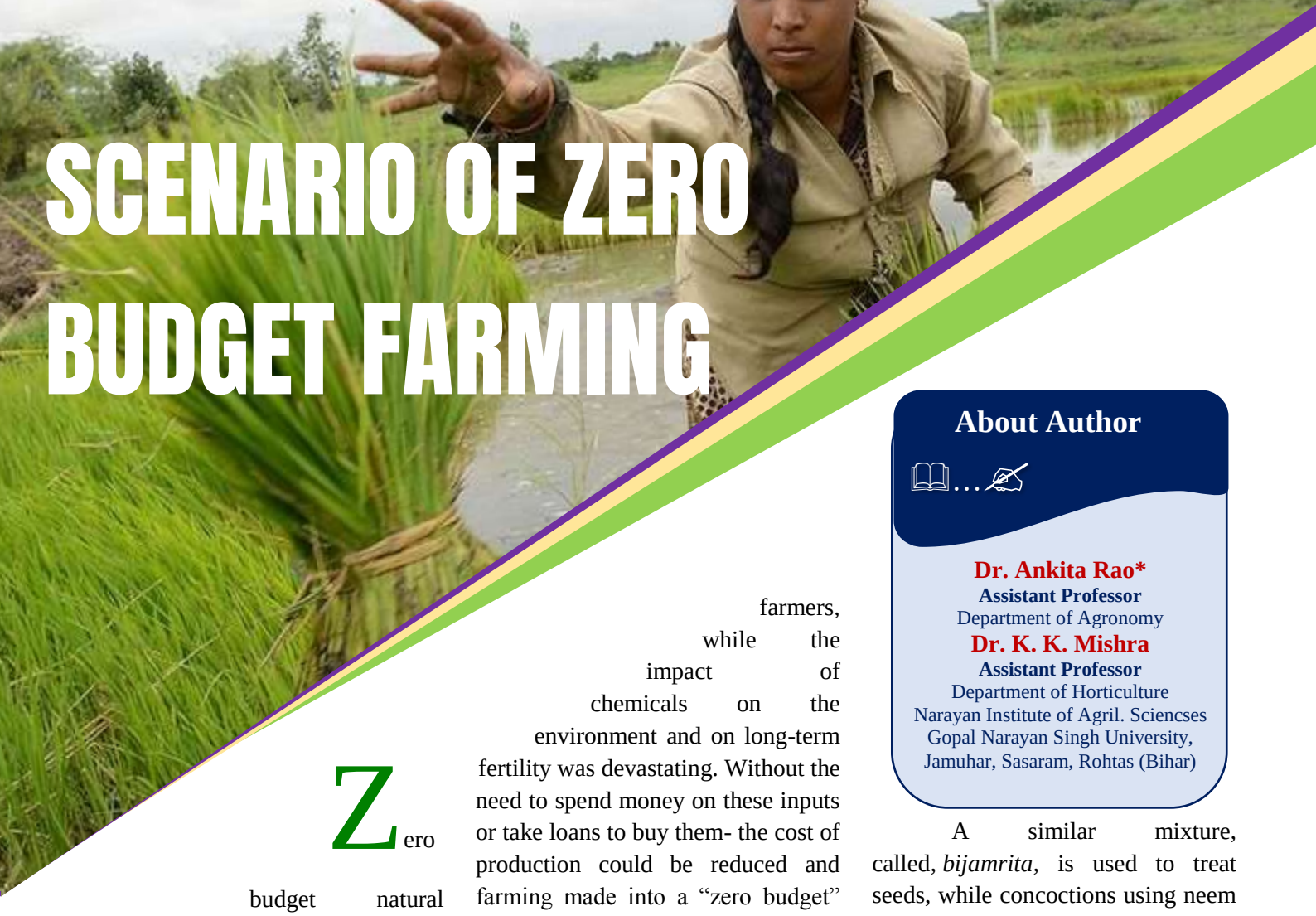

SCENARIO OF ZERO BUDGET FARMING

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Zero budget natural farming (ZBNF) is a method of chemical-free agriculture drawing from traditional Indian practices. This unique initiative was launched in September 2015 under the central government's scheme of Rashtriya Krishi Vikas Yojana. 50 villages across 13 districts of the state were selected for the pilot project. After witnessing an overwhelming success, the government wants to cover approximately six million farmers by 2025-26. It was originally promoted by Maharashtrian agriculturist and Padma Shri recipient Subhash Palekar, who developed it in the mid-1990s as an alternative to the Green Revolution's methods driven by chemical fertilizers and pesticides and intensive irrigation. He argued that the rising cost of these external inputs was a leading cause of indebtedness and suicide among farmers, while the impact of chemicals on the environment and on long-term fertility was devastating. Without the need to spend money on these inputs or take loans to buy them- the cost of production could be reduced and farming made into a "zero budget" exercise, breaking the debt cycle for many small farmers.

Instead of commercially produced chemical inputs, the ZBNF promotes the application of *jeevamrutha*- a mixture of fresh desi cow dung and aged desi cow urine, jaggery, pulse flour, water and soil- on farmland. This is a fermented microbial culture that adds nutrients to the soil, and acts as a catalytic agent to promote the activity of microorganisms and earthworms in the soil. About 200 litres of *jeevamrutha* should be sprayed twice a month per acre of land; after three years, the system is supposed to become self-sustaining. Only one cow is needed for 30 acres of land, according to Mr. Palekar, with the caveat that it must be a local Indian breed- not an imported Jersey or Holstein.

A similar mixture, called, *bijamrita*, is used to treat seeds, while concoctions using neem leaves and pulp, tobacco and green chillis are prepared for insect and pest management.

The ZBNF method also promotes soil aeration, minimal watering, intercropping, bunds and topsoil mulching and discourages intensive irrigation and deep ploughing. Mr. Palekar is against vermicomposting, which is the mainstay of typical organic farming, as it introduces the the most common composting worm, the European red wiggler (*Eisenia fetida*) to Indian soils. He claims these worms absorb toxic metals and poison groundwater and soil.

- Zero budget natural farming is a method of chemical-free agriculture drawing from traditional Indian practices.
- It was originally promoted by agriculturist Subhash Palekar, who developed it in

the mid-1990s as an alternative to the Green Revolution's methods that are driven by chemical fertilizers and pesticides and intensive irrigation.

- It is a unique model that relies **on** Agro-ecology.
- It aims to bring down the cost of production to nearly zero and return to a pre-green revolution style of farming.
- It claims that there is no need for expensive inputs such as fertilisers, pesticides and intensive irrigation.

ZBNF is based on 4 pillars:

- **Jeevamrutha:** It is a mixture of fresh cow dung and aged cow urine (both from India's indigenous cow breed), jaggery, pulse flour, water and soil; to be applied on farmland.
- **Bijamrita:** It is a concoction of neem leaves & pulp, tobacco and green chilies prepared for insect and pest management, that can be used to treat seeds.
- **Acchadana (Mulching)**: It protects topsoil during cultivation and does not destroy it by tilling.
- **Whapasa**: It is the condition where there are both air molecules and water molecules present in the soil. Thereby helping in reducing irrigation requirement.

Eliminating chemical fertilisers

This method was created by subhash palekar who belongs to a rural family in maharashtra. The objective of ZBNF is to reduce the usage of chemical fertilisers and pesticides and promote sound agronomic practices. Farmers use earthworms, cow dung, urine, plants, human excreta and such biological fertilisers for crop protection. The method reduces the farmers' investment to a greater extent while increasing the levels of production. A major chunk of the farmers' investment is spent on chemical fertilisers. Also, repeated usage of fertilisers on the land degrades its quality over a period of time and renders the land unfit for cultivation.

Increased productivity

Ponds form a vital component of the ZBNF as one of its objectives is fighting drought conditions. In rain-fed agriculture, availability of water in the form of moisture becomes important. Hence, the composting is done on the farm itself so as to increase the organic matter in the soil. More the organic content in the soil, higher will be its water retaining capacity.

Another important feature of ZBNF is intercropping, wherein two or more crops are grown in proximity. This is done to produce a higher yield on a given piece of land by making optimal use of resources. Farmers in the villages of Andhra Pradesh often grow chillies, tomatoes, red gram and pearl millet. According to reports, in Anantapur district, a 136 percent increase was observed in groundnut yield.

Collaboration with United Nations

In its path towards sustainable agriculture, the government of Andhra Pradesh has collaborated with Sustainable India Finance Facility (SIFF) which is a combine initiate of un environment, world agroforestry centre and bnp paribas. This collaboration will increase the number of states adopting the natural farming method in the country. Also, the credibility of the initiative increases, which attracts more states to encourage the practice. Assistance in the form of scientific research in agriculture and soil testing will be delivered.

Towards a food-secure world

An United Nations report projects the world population to reach 9.6 billion by 2025. To feed the growing population, we need to adopt intensive agricultural techniques that ensure high yields of crops. In most of the developing countries of the world today, including India, land holdings are considerably small in size. Hence, there is a need to develop methods that help produce higher output with fewer resources. Natural farming not only ensures food security by increasing the crop yield but also contributes to combat the spectra of climate change. Agriculture is also one of the main sectors affected due to climate change. The effects of climate change can be in the form of extreme weather conditions, droughts and increased variability in temperature and rainfall. These events will decrease the productivity of agricultural land, making it unfit for cultivation. Such conditions can be avoided by introducing climate-smart agriculture (csa), which is an approach that helps and guide actions to transform and reorient agricultural systems to effectively support the development and ensure food security in a changing climate. In the economic survey of India 2017-18, it was stated that the government of India would implement various schemes to sustain agriculture.

About 30 percent of the climate change process can be

prevented if sustainable mechanisms are put to use in agriculture. However, less than three percent of the total finance goes towards this sector. Therefore, there is a grave need to increase the flow of finance into agriculture. The measures taken by the government of Andhra Pradesh are commendable. With its success, other states are also expected to give due importance to such schemes and reinvigorate the rural economy.

Benefits of ZBNF

- With the rising cost of external inputs (fertilizers and pesticides), which is the leading cause of indebtedness and suicide among farmers. According to the National Sample Survey Office (NSSO) data**,** almost 70% of agricultural households spend more than they earn and more than half of all farmers are in debt.
- Since in ZBNF there is the need to spend money or take loans for external inputs, the cost of production could be reduced and farming made into a "zero budget" exercise.
- This would break the debt cycle for many small farmers and help to envisage the doubling of farmer's income by 2022.
- At a time when chemical-intensive farming is resulting in soil and environmental degradation, a zero-cost environmentally-friendly farming method is definitely a timely initiative.
- The ZBNF method promotes soil aeration, minimal watering, intercropping, bunds and topsoil mulching and discourages intensive irrigation and deep ploughing.
- It suits all crops in all agro-climatic zones.
- Citing the benefits of ZBNF, in June 2018, Andhra Pradesh rolled out an ambitious plan to become India's first State to practice 100% natural farming by 2024.

Issues related to ZBNF

- Sikkim (India's first organic state), has seen some decline in yields following conversion to organic farming.
- Many farmers have reverted to conventional farming after seeing their ZBNF returns drop after a few years.
- While ZBNF has definitely helped preserve soil fertility, its role in boosting productivity and farmers' income isn't conclusive yet.
- ZBNF advocates the need of an Indian breed cow, whose numbers are declining at a fast pace.
- According to Livestock Census, the country's total population of indigenous and nondescript cattle has dropped by 8.1%.
- Low expenditure by the government: Last year, the government launched Rashtriya Krishi Vikas Yojana, a flagship Green Revolution scheme with an allocation of Rs 3,745 crore for the financial year 2019-20.

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DRONE TECHNOLOGY IN AGRICULTURE

USES AND CHALLENGES

About Author

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Government have initiatives to enhance development in agriculture by means uses of technologies. uses of drones in almost each and every sector of the every sector of the economic system is growing fast ,but drone uses in the agricultural sector is booming .From scouting to security ,drone use will become more omnipresent on large and small scale farms in a few years. The facts gathered through drones on farms are often used to better inform agronomic decision and is section of a machine generally referred to as 'Precision agriculture'. Modern farmers have already started out the uses of high- tech options such as UAVs for monitoring and forecasting in agriculture. Drones can gather records on crop yield, cattle health, soil quality, nutrient assessments, weather and rainfall patterns and other aspects.

There are different kinds of unnamed aerial vehicles available and can be categorized into the following groups:

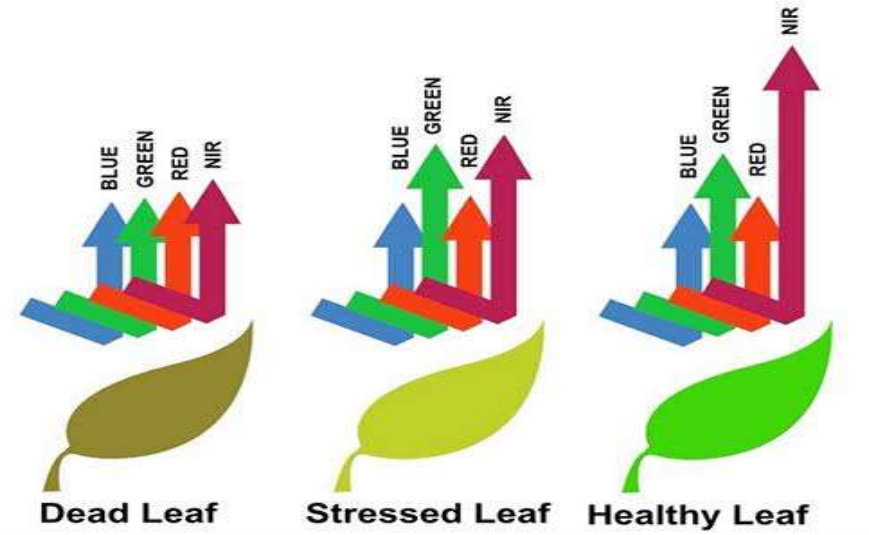
- ❖ Fixed wing.
- ❖ Rotatory wing.
- ❖ Tethered vehicle.
- ❖ Lighter-than air.

Component of agricultural drones include

- ✓ Frames
- ✓ Controller system
- ✓ Propulsion system
- ✓ Camara system
- ✓ Navigation system
- ✓ Batteries (power system)

Government announces heavy subsidies to farmers for buying drones

The "sub-mission on agricultural mechanization" (SMAM) scheme envisages granting up to a hundred percent or Rs 10 lakh as supply funding for drone purchase by means of ICAR institutions, Krishi Vigyan Kendras and State agriculture universities. It provides for 75% supply funding for drone purchases to farmer producer companies (FPOs). Rs 6,000 per hectare (will) be given as contingent expenditure to enforcing corporations that rent drones for demonstrations. Rs 3,000 per hectare to be given as contingent expenditure to implementing groups that purchase drones for drone



The basic principle of NDVI relies on the fact that, due the their spongy layers found on their backsides, leaves reflect a lot of light in the near infrared, in stark contrast with most non-plant object. When the plant becomes dehydrated or stressed, the spongy layer collapses and the leaves reflect less NIR light, but the same amount in the visible range. Thus, mathematically combining these two signals can help differentiate plant from non-plant and healthy plant from sickly plant.

(image courtesy Agribotix.com)

demonstrations. Forty per cent or up to Rs. four lakhs of grant funding for drone buy to current customized hiring. Fifty per cent or up to Rs 5 lakh of provide funding for drone buy to agriculture graduates establishing custom Hiring centeres.

Application of drones in agriculture

Monitoring plant health

- Drones equipped with special imaging equipment called Normalized Difference Vegetation Index (NDVI).
- Software analysis can be used to change values in order to reflect the specific crop type and even in which stage of life a specific crop is in.

Planting and seeding

- Automated drone seeder is mostly being used in forestry industries.
- Planting with drones means very hard to reach areas can be replanted without endangering workers.

Spray application

- Crop spraying drones can carry large liquid storage reservoirs, can be operated more safely.
- It can be operated and Maintained at a fraction of the cost compared to crop dusters.

Monitoring field condition

- Drones provide accurate field mapping.
- Having information on field elevation is useful in determining drainage pattern and wet/dry spots which allow for more efficient watering techniques.

Security

- Drones are used to monitor the far reaches of a form and allow for more frequent monitoring of hard to reach areas.
- Monitoring remote areas, which used to take hours of walking, can now be completed in a few minutes.

Drone irrigation

New research out of Australia is also creating exciting opportunities for drone use in agriculture. As climate change increasingly affect drought conditions, creating more efficient irrigation solution is vital.

Challenges of using the drones in the agriculture industry

- High cast to set up.
- It may contribute to airspace interferences, especially for the manned aircrafts
- There are flight time limitations, which has negative impacts on the distance that can be covered at any given time.
- The image quality is affected when there are heavy rains.
- A high amount of sunlight is required for image capture
- The battery life a drone survey is a limitation. it reduces the drone's flight times.
- A traditional farmer is unable to perform the necessary analysis on drone images.
- To operate agriculture drones, you'll need some basic knowledge and skills.

Conclusion

Drones have already vastly altered the agricultural enterprise and will proceed to develop in the coming years. While drone use is turning into greater useful to small farmers, there is nevertheless a methods to go before they come to be section of each and every farmer's gear roster, especially in creating nations. Regulations round drone use want to be made and revised in many nations and greater lookup wishes to be finished on their effectiveness at sure tasks, such as pesticide utility and spraying. There are many approaches drones can be beneficial to farmers however it is important to apprehend their barriers and functions earlier than investing in luxurious equipment.

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UNMANNED AERIAL VEHICLES (UAV)

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The technology of unmanned helicopters that had been developed by Yamaha corporation (Japan) for rice cultivation gave rise to the idea of aerial spraying by means of UAV and it possess tremendous merits over the conventional ground sprayers. Being known as the most advanced spraying technology, unmanned aerial vehicles are helpful for effective and precision spraying. Moreover, UAV aircrafts are used to avoid the health problems of humans with the manual spraying mechanism. The potential of UAVs gets increased by the addition of vision and sensor systems and reduces the spray loss in the form of spray drift by accurate spray application with perfect target detection sensors and a good handling system. Crop production and pesticide efficiency on weeds and insects in the field are increased by the advancement in the spray application technologies. It also solves the spray loss problem. Ease plant production practices come true by the use of unmanned aerial vehicles and also provide the conform to spray on the tall stalk crop such as cotton, maize and water ponding crop such as rice. In UAV spraying operation, droplet deposition efficiency is one of the major concerns. Spray coverage, absorption, and attachment to the target get influenced by droplet size, weather conditions and operational parameters of sprayers. Using GPS and inertial guidance, UAVs are operated remotely either by using telemetry or autonomously along planned paths. Old UAV sprayers were very large and in comparison, mainly for small fields and diversified crop planting zones, small size unmanned aerial vehicle (UAV) crop protection operations provide the advantages of a low flight altitude, a flight velocity control, and well field adaptability. Four-rotor, six- rotor, and eight rotors are used nowadays which is easily handled, transport, use senor technology more easily, use in orchards, trees, and crop very sufficiently. A six-rotor UAV is thought more stable than a four-rotor UAV and consumes less energy than an eight -rotor UAV based on the current UAV models, crop protection operation measurements, UAV loading capability, and flight duration, under an identical load. When using a variable spray system, UAVs have high control precision and fast response speed and during the pesticide spraying operations, spray drift is a practical reality. To increase the spraying efficiency and enhance productivity, robotics and automatic spraying technologies like variable rate sprayers, UAV sprayers and electrostatic sprayers has gained more attention.

■■■

FARMER'S SAFETY KAVACH

SOLAR FENCING SYSTEM

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What is solar fencing?

In today's time, security has become an important topic for the farmers, whether it is to ensure the safety of the farmer's property, crops, residence or factory etc., which has become the primary concern of any person today. . Solar fencing is a modern and unconventional method that is one of the best options for providing security as it is both effective and efficient. Solar fencing not only guarantees the safety of the farmer's property, but it also uses renewable solar energy for its functioning. A solar fence works similarly to an electric fence, which provides a safe and balanced yet strong shock when a human or animal comes into contact with the fence. The blow enables a deterrent effect, while ensuring that the person who receives the blow does not suffer any serious injury or any risk of death.

Working principle of solar fence system

Solar fencing system works when the solar module starts generating direct current (DC) from sunlight, which is used to charge the system's battery. Depending on the duration and capacity of sunlight, the system's battery can typically last up to 24 hours on a single charge.

The output of the charged battery goes to the controller, fencer, charger and energizer. When it is powered up, the energizer generates a brief but sharp voltage. The primary function of the energizer is to produce a pulse of about 8000 volts that generates a fast and short-lived current. These pulses are passed through the wires of the fence system at a rate of approximately 1 pulse every 1-1.5 seconds, each pulse lasting about 3ms, thus the solar fence also ensures that any type of Infiltration cannot take place and if any intruder comes in contact with it, then he cannot cross the fence and there is no physical harm to him.

The major advantages of electric fences over traditional fences are:

1. Fence posts are erected at a distance of 6-8 meters depending on the terrain.
2. Barbed wires are not used. Only plain high tensile (strong) wire is used, and these wires are not prone to breakage.
3. It is used in more than 165 countries around the world.
4. It is the most effective method of fencing, and is safe for all types of animals and humans.
5. It can be easily made and maintained.
6. It is long lasting and can be modified, expanded, moved and reinstalled from one place to another without material loss and waste of labor.
7. This is the only method of fencing, which can effectively keep out all kinds of wild animals.
8. It does not depend on regular power supply, as it is battery operated.

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INTEGRATED NUTRIENT MANAGEMENT IN MAIZE (*zea mays* L.) CROP

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Integrated nutrient supply/ management (INM) aims at maintenance or adjustment of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity through all possible sources of plant nutrients in an integrated manner which include; maintenance or enhancement in soil productivity through a balanced use of fertilizers combined with organic and biological sources of plant nutrients. Soil fertility maintenance requires a balanced application of inorganic and organic nutrient sources. Sustainable agricultural productivity might be achieved through a wise use of INM. Integrated use of chemical and organic fertilizer on yield and yield components of maize is very crucial for assurance of food security though improvement of the stock of plant nutrients in the soils and the rapid uptake of plant nutrients, thus, limiting losses to the environment thus reduce inorganic (fertilizer) input cost. Different kinds of organic materials such as FYM, animal manures, green manures, crop residues, composts, and industrial wastes have been used in maize systems. Hence an attempt has been made in this review to elaborate the effects of INM on various growth parameters, nutrient uptake and yield of maize based on the available literature.

What is nutrient management?

Nutrient management refers to the efficient use of crops to improve productivity. It is necessary to balance the soil nutrient input with the crop requirement. If the nutrients are applied at the right time and in adequate quantities, optimum crop yield is obtained. If applied in huge amounts, it will harm the crop, and if applied in small quantities it limits the yield. The nutrients that are not utilized by the crops leach into groundwater or nearby surface water.

Concepts of integrated nutrient management

- The nutrients stored in the soil.
- The nutrients purchased from outside the farm.
- Plant nutrients present in crop residues, manures, and domestic wastes.
- Nutrient uptake by crops at harvest time.
- Plant nutrients lost from the field during crop harvest or through volatilization.

Importance of nutrient management

Nutrient management is important for the following facts:

- Nutrient management helps to reduce contamination to waterways by plant nutrients.
- Improve soil fertility.
- Enhance plant productivity.
- Reduce the cost of chemical fertilizers.
- Providing balanced nutrition to crops.
- Promotes carbon sequestration and prevents the deterioration of soil, water, ecology, and also leaching of nutrients from the soil.

Fig. Schematic diagram of integrated nutrient management

Maize (*Zea mays* L.) has becoming very popular cereal crop in India because of the increasing market price and high production potential of hybrid varieties in both irrigated as well as rainfed conditions. More ever in irrigated areas farmers produce the income equal to the cash crops such as sugarcane, onion, cotton, etc. in comparatively short time period of 120-130 days by cultivating hybrid maize varieties. Hence the trend of replacing some cash crops with maize in intensive cultivation is observed in present condition.

For increasing the profitability of maize in only economic view, farmers are cultivating the crop intensively with the huge use of chemical fertilizers, pesticides, weedicides, etc. Maize crop has better yield response to chemical or inorganic fertilizers. Hence heavy doses of these fertilizers are applied to maize. Though these practices are helps to increase the temporary increase the production of crop; deterioration of natural resources (*viz*. land, water and air) is also the another side of such high input intensive cultivation. Over reliance on use of chemical fertilizers has been associated with declines in soil physical and chemical properties and crop yield and significant land problems, such as soil degradation due to over exploitation of land and soil pollution caused by high application rates of fertilizers and pesticide application.

Use of organic sources

The organic sources besides supplying N, P and K also make unavailable sources of elemental nitrogen, bound phosphates, micronutrients, and decomposed plant residues into an available form to facilitate to plant to absorb the nutrients. But, it is also the fact that optimum yield level of maize production can't be achieved by using only organic manures because of their low nutrient content. Efficacy of organic sources to meet the nutrient requirement of crop is not as assured as mineral fertilizers, but the joint use of chemical fertilizers along with various organic sources is capable of improving soil quality and higher crop productivity on long- term basis. Highest productivity of crops in sustainable manner without deteriorating the soil and other natural resources could be achieved only by applying appropriate combination of different organic manures and inorganic fertilizers. It is important to identify the best type of available organic resources which can be used as fertilizers and their best combination with appropriate proportion of inorganic fertilizers. Keeping this point in view, present investigation was conducted to find out best combination of organic and inorganic fertilizers for maximum production of maize with higher income level in sustainable manner without affecting the soil qualities.

Boosting crop productivity can be attained through the application of inorganic fertilizer; however, safeguarding the environment for future generations is overbearing especially for continuous increase in the world population. Sustainable crop productivity might be attained through the judicious use of both organic and inorganic fertilizers. The substitution of parts of inorganic fertilizers with organic fertilizer could maintain and sustain soil productivity and improve crop productivity. This paper has reviewed the past research work carried out by various scientists. A comprehensive literature review revealed that integrated nutrient management enhances maize yield, nutrient uptake, and economic return compared with the sole application of organic and inorganic fertilizers.

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NANO FERTILIZER

ITS USES AND BENIFITES

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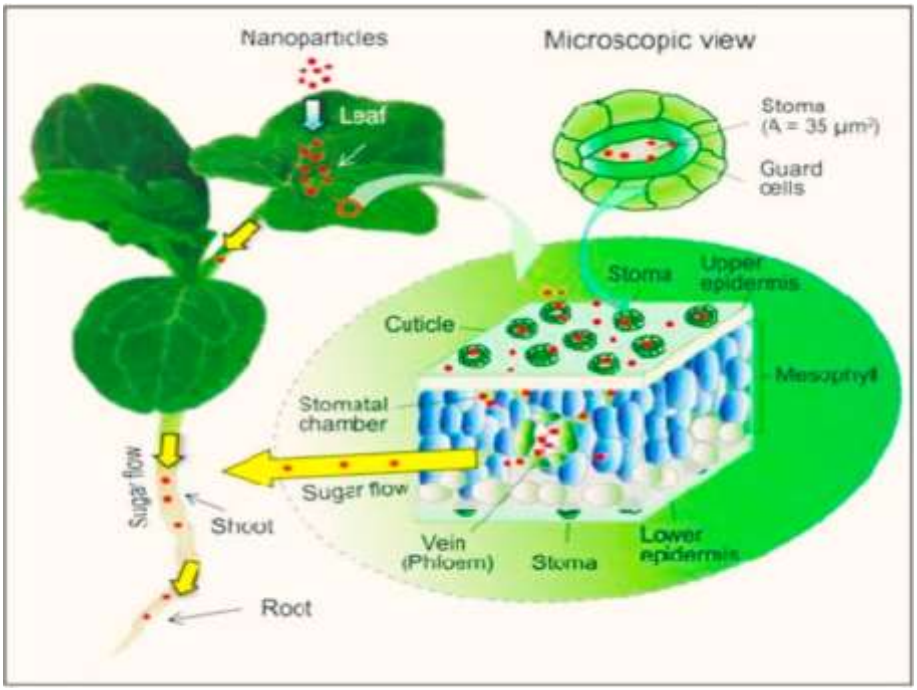

Agricultural cultivation around the sector is intensively growing the usage of big quantities of fertilizers, insecticides and herbicides in a few places, however the use of greater than those chemical substances and fertilizers will pollute the surroundings (soil, Water) and plenty of different issues occur). , Air pollution), inefficiency, reduced most important vitamins, elevated resistance to positive weeds, illnesses, insects, drastically decreased production benefits, soil degradation, loss of micronutrients in soil, diagnosed Beneficial Toxicity to Organisms Despite those issues, there can be extra initiatives to feed the sector`s growing population. Therefore, in the future, it can be proper to offer nutritious produce wealthy in proteins and different essential vitamins wanted for human and animal intake. For this motive, you want to attention on growing the best pleasant diets that include marketed ranges of nutrients and protein. For solving the ones issues in crop manufacturing nano-fertilizers, pesticides and herbicides also can moreover effective equipment in agriculture for better pest and nutrient manipulate because of the reality the ones nano-materials having extra penetration capacity, ground area and use overall performance which avoid residues in environment. Size under one hundred nm nano-particles can use as fertilizer for inexperienced nutrient manipulate which may be extra ecofriendly and reduce environment pollution. Hence, the ones agricultural useable nano-particle extend with the help of nanotechnology can be exploited in the fee chain of entire agriculture manufacturing machine.

About the nano fertilizer:

Nano-fertilizers "Nano fertilizers are synthesized or changed shape of conventional fertilizers, fertilizers bulk substances or extracted from different vegetative or reproductive components of the plant with the aid of using distinct chemical, bodily, mechanical or organic strategies with the assist of nanotechnology used to enhance soil fertility, productiveness and pleasant of agricultural produces. Nano fertilizer can crafted from absolutely bulk substances. At nano scale physical and chemical reidences are fluctuate than bulk material.

Important residences of nano fertilizers which facilitate better nutrient use performance :

NFs are coated or encapsulated with a nano material that controls the release of nutrients according to the plant requirements, and these results in an increase in the NUE values of plants. NFs can release their nutrients in 40–50 days, while synthetic fertilizers do the same in 4–10 days.

Nanoparticles also influence some plant metabolic processes that influence the potential to mobilize nutrients like P in plants. The nano-fertilizers have higher surface area and particle size less than pore size of root and leaves of the plant which can increase penetration into the plant from upplied surface and improve uptake and nutrient use efficiency of the nano fertilizer.

They have excessive solubility in distinct solvent inclusive of water. Particles length of nano-fertilizers is much less than a hundred nm which helps greater penetration of nano particle in to the plant from carried out floor inclusive of soil or leaves.

Reduction of particle length effects in elevated unique floor place and wide variety of debris in line with unit place of a fertilizer that offer greater possibility to touch of nano-fertilizers which ends up in greater penetration and uptake of the nutrient.

Fertilizers encapsulated in nano-debris will growth availability and uptake of nutrient to the crop vegetation. Zeolite primarily based totally nano-fertilizers are successful to launch nutrient slowly to the crop plant which growth availability of nutrient to the crop aleven though out the boom length which save you lack of nutrient from denitrification, volatilization, leaching and fixation with inside the soil specifically NO_3-N and NH_4-N.

Advantages of nano fertilizers over conventional fertilizers:

Nano fertilizers are high-quality over traditional fertilizers as they growth soil fertility yield and pleasant parameters of the crop, they are reliable and much less dangerous to surroundings and humans, they reduce fee and maximize profit. Nano particles growth vitamins use performance and minimizing the expenses of surroundings protection. Improvement in the nutritional content material of plants and the pleasant of the taste. Optimum use of iron and increase protein content material in the grain of the wheat. Enhance vegetation growth with the aid of using resisting illnesses and enhancing balance of the vegetation with the aid of using anti-bending and deeper rooting of plants. Additionally recommended that balanced fertilization to the crop plant can be executed *via* nanotechnology.

Effects of nano-fertilizers on seeds germination & boom parameters of the plant:

Several researches said that Nano fertilizers drastically prompted the seed germination and seedling growth which found out the impact of nano fertilizers on seed and seed vigor. Nano fertilizers can without problems penetrate into the seed and growth availability of nutrient to the developing seedling which end result healthful and greater shoot period and root period however if awareness is greater than the optimal it can display inhibitory consequences at the germination and seedling growth of the plant.

NFs may be advanced from artificial materials (i.e., changed sorts of artificial fertilizers) or inexperienced synthesized from distinct components of vegetation via diverse chemical, mechanical, or bio logical strategies the use of nanotechnology

NFS for developing smart agriculture:

In the approaching decades, the agriculture region will face growing strain to offer meals safety for a unexpectedly growing international populace without growing its ordinary environmental footprint. One option to attain higher biomass and grain yield could be the modification of present fertilization techniques.

Nanotechnology concepts can help the farmers to know the effects before and input solutions for a better after. Controlled use of the technology will help the sustainability. In concern with the ecosystem and the farmers, these technologies will benefit the agricultural engineering and technology in overcoming all the local myths and ethics decreasing the mega problems in the agriculture arena. Availability of technology is more only proper utilization of it is. Therefore, sustainable efforts are being made to synchronize nutrient availability and improve nitrogen use efficiency values in agricultural system without a further deterioration of surrounding environments.

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FOLIAR SPRAY OF MICRONUTRIENTS TO MULBERRY

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Mulberry (*Morus* spp), is a perennial deep rooted high biomass producing foliage crop cultivated as a sole food for silkworm, *Bombyx mori* L. But, due to repeated harvests and soil problems, mulberry is exhibiting nutrient deficiencies in recent years. Besides other measures, foliar application is particularly relevant for timely application of specific nutrients to the foliage during growth and development. Micronutrients play a major role in several metabolic activities responsible for protein, sugar and enzyme synthesis leading to better quality mulberry leaf production.

Foliar fertilization is an important tool for the sustainable and productive management. It is theoretically more environmentally friendly, immediate and target oriented than soil fertilization since nutrients can be directly delivered to plant tissues during critical stages of plant growth. Mulberry as a foliage crop responds well to foliar sprays. So, Fortification of mulberry leaves with supplementary nutrient and feeding silkworms is a useful

Functions of micronutrients in plants:

Element	Function in Plant
B	Sugar transport, cell division and amino acid production.
Cl	Turgor regulation, disease resistance and photosynthetic reactions.
Cu	Component of enzymes, involved with photosynthesis.
Fe	Essential for photosynthesis and chlorophyll synthesis.
Mo	Nitrogen metabolism and nitrogen fixation.
Mn	Chloroplast production, cofactor in plant reactions, activates enzymes.
Zn	Plant hormone balance and auxin activity.

Critical levels of micronutrients required for mulberry:

Micronutrients	Concentration (ppm)
Molybdenum	0.1
Copper	6.0
Zinc	20.0
Boron	20.0
Manganese	50.0
Iron	100.0
Chlorine	100.0

technique to increase economic value of cocoon.

Commonly used Multi-nutrient foliar formulation in mulberry

Poshan SeriBoost Plus:

- Poshan SeriBoost Plus is a multi-nutrient foliar spray formulation for improving the Quality & Yield of mulberry leaves.
- It contains all the essential nutrients in a balanced proportion and easily available form for the healthy growth of the mulberry thereby catering the complete nutritional requirement of the silkworms.
- It ensures faster absorption of micro and macronutrients by Mulberry leaves.

- Enhances protein and carbohydrate content in mulberry leaves.
- An average of 15-20 % of good quality nutritious leaves can be harvested and thereby producing good quality and quantity of cocoons.

Method of preparation and application

- Mix 7 ml of Poshan SeriBoost Plus in 1 litre of water (or) 1 litre of Poshan SeriBoost Plus in 140 litres of water and spray for 1 acre of mulberry garden. Poshan SeriBoost Plus costs around Rs. 280/ Litre.
- Spraying should be done after 25 - 30 days of pruning mulberry shoot or leaf picking. During the rainy season, if it rains within 6 hours after spray; another spray should be repeated again.

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PHYTOREMEDIATION

THE MANAGEMENT OF SOIL CONTAMINATED WITH HEAVY METAL

About Author

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Phytoremediation is technology which utilizes living plants to clean up soil, air and water contaminated with hazardous contaminants. It is defined as "the use of green plants and the associated microorganisms, along with proper soil amendments and agronomic techniques to contain, remove or render toxic environmental contaminants harmless." The term "Phytoremediation" is an amalgam of the Greek word, Phyto (plant) and Latin remedium (restoring balance). Although attractive for its cost, phytoremediation has not been demonstrated to redress any significant environmental challenge to the extent that contaminated space has been reclaimed. Phytoremediation is proposed as a cost-effective plant-based approach of environmental remediation that takes advantage of the ability of plants to concentrate elements and compounds from the environment and to detoxify various compounds. The concentrating effect results from the ability of certain plants called hyperaccumulators to bioaccumulate chemicals. Toxic heavy metals cannot be degraded, but organic pollutants can be and are generally the major targets for phytoremediation.

How does phytoremediation work?

The uptake of contaminants in plants occurs mainly through the root system, in which the principal mechanisms for preventing contaminant toxicity are found. The root system provides an enormous surface area that absorbs and accumulates water and nutrients essential for growth, as well as other non-essential contaminants.

The findings by many researchers suggest that the use of trees (rather than smaller plants) is effective in treating deeper contamination because tree roots penetrate more deeply into the ground. In addition, deeplying contaminated ground water can be treated by pumping the water out of the ground and using plants to treat the contamination.

Plant roots also cause changes at the soil-root interface as they release inorganic and organic compounds (root exudates) in the rhizosphere. These root exudates affect the number and activity of the microorganisms, the aggregation and stability of the soil particles around the root and the availability of the contaminants.

Root exudates, by themselves can increase (mobilize) or decrease (immobilize) directly or indirectly the availability of the contaminants in the root zone (rhizosphere) of the plant through changes in soil characteristics, release of organic substances, changes in chemical composition, and/or increase in plant assisted microbial activity. Phytoremediation is an in-situ remediation technology that utilizes the inherent abilities of living plants. It is also an ecologically friendly, solar-energy driven clean-up technology, based on the concept of using nature to cleanse nature.

Types of phytoremediation

There are major three types of phytoremediation for metal pollutants:

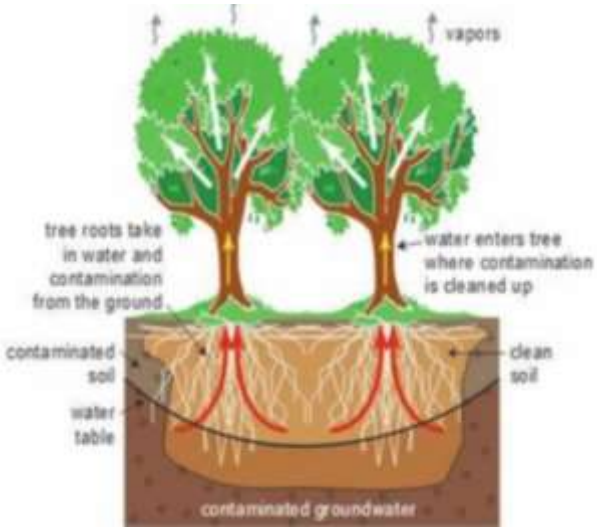

Fig1: How does phytoremediation work

a) Phytoextraction
b) Phytodegradation or Phyto-transformation
c) Rhizofiltration.

There are three types of phytoremediation process for organic pollutants:

i. Rhizodegradation or Phyto-stimulation
ii. Phyto-stabilization,
iii. Phyto-volatilisation.

♣ **Phytoextraction**: Uptake and concentration of substances from the environment into the plant biomass.

♣ **Phytotransformation:** Chemical modification of environmental substances as a direct result of plant metabolism, often resulting in their inactivation, degradation (phyto degradation) or immobilization (phyto stabilization).

♣ **Rhizofiltration:** Filtering water through a mass of roots to remove toxic substances or excess nutrients. The pollutants remain absorbed in or adsorbed to the roots.

♣ **Phytostabilization**: Reducing the mobility of substances in the environment, for example, by limiting the leaching of substances from the soil.

♣ **Phytostimulation**: Enhancement of soil microbial activity for the degradation of contaminants, typically by organisms that associate with roots. This process is also known as rhizosphere degradation. It also involves aquatic plants supporting active populations of microbial degraders, as in the stimulation of atrazine degradation by hornwort.

♣ **Phytovolatilization**: Removal of substances from soil or water with release into the air, sometimes as a result of phyto transformation to more volatile and/or less polluting substances.

Advantages of phytoremediation technology

1. Low capital and operating cost.
2. Metal recycling provides further economic advantage.
3. Permanent treatment solution.
4. Applicable for wide range of contaminants.
5. Environmentally friendly method.
6. Less disruptive than current techniques.
7. In-situ application decrease spread of contaminants via air and water.

Limitations of phytoremediation technology

1. It is time consuming method.
2. Most of the hyper accumulators are slow growers.
3. Not capable of 100 percent reduction.
4. May not be functional for all mixed wastes.
5. Restricted to sites with shallow contamination within rooting zone of remediative plants.
6. Climatic conditions are a limiting factor.
7. Level of contamination.
8. The age of plant.

Application of phytoremediation

1. Heavy metal removal: Heavy metal is one of the most toxic environmental contaminants. It can affect soil and water quality, plant and animal growth and human health. Metals have metallic properties such as density, conductivity. These contaminants enter the environment through anthropogenic activities; Mining, foundries, metal plating and paper industry are the major sources of heavy metals. This is where phytoremediation and its applications come in. Most of the plant species have the ability to immobilize metals. Conventional techniques are generally used but they have their own disadvantages. Phytoremediation is the best alternative because it is cost-effective and environment friendly.

2. Removal of fly ash: Coal fly ash is one of the major air and land pollution constituents. Thermal power plants produce a large amount of coal fly ash (600 million (tonnes/year). The disposal of fly ash causes important health and environmental hazards. Thus, its disposal has become a major worldwide concern. Phytoremediation is a practical and cheap way for revegetation of fly ash dump sites. A study has shown that (*Vetiveria zizanioides*) grass can remediate fly ash dump sites. Besides phytostabilization of heavy metals *Vetiveria zizanioides* also reduces genotoxicity.

3. Phytoremediation of landfills: Disposal of waste to landfills is a common method of waste management globally. Landfilling offers an inexpensive means of waste disposal. But, if not managed it can cause serious contamination to the environment. Studies have aimed at finding an alternative method to the convention remediation methods. Phytoremediation has proven to be a promising technique. It is because of advantages such as low-cost and eco-friendly. Phytoremediation technique use trees to remediate the contaminants on landfill sites. This makes phytoremediation technology more attractive for communities in residential areas.

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RHIZOBIUM

AS SOIL HEALTH ARCHITECT

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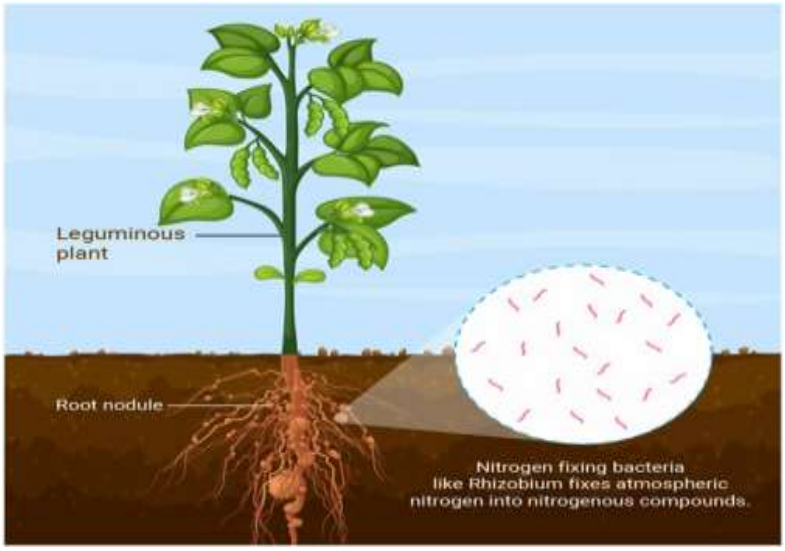
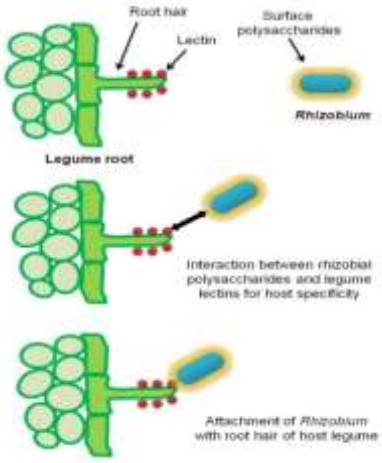


Rhizobium is the Gram-negative bacteria found in soil that fixes nitrogen in leguminous plants. Fixation of nitrogen in plants can not be done independently therefore rhizobium requires a plant host. This symbiotic relationship between rhizobium and legume lead to nodule formation. Rhizobium is the excellent source of nitrogen in soil which ultimately convert nitrogen into ammonia. Nitrogen fixation done by rhizobium helps in improving soil fertility and plant growth.

Characteristics of rhizobium

- They are aerobic. As such, they need oxygen for respiratory purposes.
- They appear as elongated rods when viewed under the microscope.
- They are Gram-negative bacteria.
- Like other bacteria, *Rhizobium leguminosarum* do not form spores in their life cycle.
- Apart from various types of carbohydrates, the bacteria also use nitrates and nitrite, ammonium salts and various amino acids among others for development.
- There are various strains of the bacteria some of which have granules.
- They appear as elongated rods when viewed under the microscope.



Species of Rhizobium

Host Group	Rhizobium Species	Crops
Pea group	*Rhizobium leguminosarum*	Green pea, Lentil
Soybean group	*R. japonicum*	Soybean
Clover group	*R. trifoli*	Trifolium
Alfalfa group	*R. melliloti Medicago*	Melilotus
Beans group	*R. phaseoli*	Phaseoli
Lupini group	*R. lupine orinthopus*	Lupinus
Cicer group	*R. species*	Bengal gram
Cowpea group	*R. species*	Moong, Redgram, Cowpea, Groundnut

Source – *Katyayan, Arun., Fundamentals of Agriculture, Vol.1*

Mechanism of nitrogen fixation

This is also known as biological nitrogen fixation in which atmospheric or molecular nitrogen is converted into ammonia by an enzyme named nitrogenase. It converts atmospheric nitrogen into nitrogenous salts and helps in making it available for the absorption of plants. The

biochemical reaction involved in nitrogen fixation is as follows-

$N_2 + 8H^+ + 8e^- \rightarrow 2NH_3 + H_2$

The reduction of N_2 into NH_3 requires 6 protons and 6 electrons where 12 molecules of ATP are also involved. The role of nitrogenous compounds in plants is huge as Nitrogen is the constituent element of chlorophyll, cytochromes, alkaloids and many vitamins. It plays an important role in different processes like metabolism, reproduction and growth. Rhizobium nitrogen fixation is an essential process that takes place biologically and it is the initial stage in the nitrogen cycle.

Benefits of rhizobium

- Keeping soil humidity, temperature, drainage and acidity stable and optimum so that next crop will adapt better to their new environment.
- Fertilizing farmland by planting legume and nut plants in crop rotation so that these free-N fixation bacteria stay active.
- Fertilizing farmland because Rhizobium species is important in nature's Nitrogen cycle.
- Causing easy growth for seeds planted on soil after it is used to plant legume and nut plants.
- Helping plants, trees, fruits and vegetables flourish.

Conclusion

Legumes have been an integral part of agriculture because of their fixation of atmospheric nitrogen and their capacity to minimize the impacts of disease, pests and soil infertility when used in rotation with crops.

Nitrogen fixation by rhizobium is one of the most important biological processes on this planet, and a continued improvement in the understanding of the legume/rhizobia interaction will be necessary to sustain a food supply to its inhabitants.

■■■

SOIL HEALTH CARD SCHEME

SWASTH DHARAA KHET HARAA

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In order to achieve a dream of a land which is truly "Sujalam, Suphalam," Hon'ble Prime Minister Narendra Modi launched the Soil Health Card Scheme on 19 February, 2015 at Suratgarh, Rajasthan by giving the slogan: "Swasth Dharaa. Khet Haraa." - Healthy Earth, Green Farm. The International Year of Soils was celebrated in 2015; the same year, the unique programme of soil health card was launched in India to assess the nutrient status of every farm holding in the country. The soil health card (SHC) scheme was introduced on 5th December 2015 by the ministry of agriculture. SHC will be provided to all farmers in the country at an interval of 3 years.

This scheme has been introduced with the aim to assist the State Governments to issue soil health cards to all farmers in the country. It is field-specific detailed report of soil fertility status and other soil parameters that affect crop productivity. It provides information to farmers on nutrient status of their soil in terms of 12 parameters, namely N (Nitrogen), P (Phosphorus), K (Potassium) [Macro-nutrients]; S (Sulphur) [Secondary- nutrient]; Zn (Zinc), Fe (Iron), Cu (Copper), Mn (Manganese), Bo (Boron) [Micro-nutrients]; and pH, EC, OC (Physical parameters) also along with recommendation on appropriate dosage of nutrients which is to be applied for improving soil health and its fertility.

Objective

The prime objective of Government behind launching this scheme are aimed to strengthen functioning of Soil Testing Laboratories (STLs) through capacity building programme of agriculture students and effective linkage with Indian Council of Agricultural Research (ICAR). Also by doing uniform sampling across states and diagnosing soil fertility related constraints with standardized procedures will in turn help in designing taluka / block level fertilizer recommendations in targeted districts. This will help in enhancing nutrient use efficiency and soil test based nutrient management approach in the districts. Moreover it will provide financial assistance to the farmers so that they can apply corrective measures for deficiencies and popularizing balance and integrated nutrient management practices for their cropping systems. Thus, in due course of time it will build capacities of district and state level staff and of progressive farmers for promotion and achievement of nutrient management practices.

Benefits

There are a lots of benefit of the Soil Health Card Scheme from farmers point of view. It will help them to decide which crops they should cultivate and which ones they should skip based on their soil test reports. Farmers can also study the soil management practices and plan the future of their crops and land accordingly. Besides assessing their soil test values the Government also employs experts to help the farmers in carrying out the corrective measures.

Payment per sample

A sum of Rs. 190 per soil sample is provided to State Governments. This covers the cost of collection of soil sample, its test, generation and distribution of soil health card to the farmer.

Key achievements of this scheme:

- In cycle- I (2015-17), 107348416 Soil Health Cards were issued to farmers. In cycle-II (2017-19), 119773040 Soil Health Cards have been issued to farmers across the country.
- So far, 11531 new labs (491 static, 107 mobile, 8811 minilabs and 2122 village level labs) and strengthening of 829 labs have been sanctioned to the states.

- Since 2015, around 6.04 lakh demonstrations, 36928 farmers' trainings and 7425 farmers' *melas* are organized/ conducted under the programme. Along with state/ district agriculture machinery and *panchayats*, village level rural development workers like Krishi Sakhis, Pasu Sakhis are involved in educating farmers on right use of fertilizers.

Study on impact of soil health card scheme by National Productivity Council

National Productivity Council (NPC) carried out a study on 'Soil Testing Infrastructure for Faster Delivery of Soil Health Card in India' and submitted its report in February 2017 with 76 districts in 19 States covering 170 soil testing labs and 1700 farmers. Some of the findings of the study are as follows:

- More than 90 per cent of farmers surveyed informed that they have not got their soil tested before the implementation of this scheme.
- 92 per cent farmers reported not having used balanced fertilizer and micro nutrients in absence of information related to availability of nutrients in their soil.
- As a result of application of fertilizer and micro-nutrients as per the recommendations on the Soil Health Cards, it was reported that there has been a decrease of use of chemical fertilizer application in the range of 8-10 per cent.
- Overall increase in the yield of crops to the tune of 5-6 per cent was reported due to application of fertilizer and micro nutrients as per recommendations available in the Soil Health Cards.

Some important parameters lacking in soil health card (SHC):

- Many farmers are unable to understand the content on SHC, hence unable to follow the recommended practices.
- Number of soil samples taken per unit area is not based on soil variability.
- Lack of Coordination among agricultural extension officers and farmers.
- Microbial activity, moisture retention activity is essential but missing in SHC.
- The soil health card is more focused on chemical nutrient indicators; among physical and biological properties only soil color is included.
- Some important indicators (i) cropping history (ii) water resources (soil moisture) (iii) slope of soil, (iv) depth of soil (v) color of soil (vi) soil texture (bulk density) and (vii) Micro-biological activity etc. are not included.
- Inadequate soil testing infrastructure.

Way forward

- There is a need for demonstration of benefits of SHC on an experimental basis in each block by adopting a comprehensive approach (systematic and scientific analysis of soil and water) and adoption of recommended doses.
- A specialized body is needed both at central as well as at state level for the management of soils. They should be given responsibility of monitoring the quality of service by various agencies. This also provides continuity of the work by the department.
- SHC distribution and awareness campaigns needs to be arranged before sowing season, so that farmers will practice recommended crop choice and fertilizers.■

MASS PRODUCTION OF MUSHROOM SPAWN

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In dictionary term “spawn " actually refers to the fingerlings of fish, but here spawn means the vegetative mycelial network of a mushroom developed after the germination of one or more than one fungal spore (s) grown on a convenient medium. It comprises of the mycelial network along with a supporting medium which provides nutrition to the fungus for its growth and development.

Once pure culture of a particular mushroom is established or procured from some reliable source, then the process of mass production of mushroom spawn involves the following steps:

Procedure:

1. Take wheat grain for making spawn.
2. Boil wheat grains partly so that the grains become slightly soft but do not burst.
3. Put grains on a sieve to drain out the excess water and allowed to dry for evaporation of surface water.
4. Add chalk/calcium carbonate 5 gm / kg and calcium sulphate 20 gm / kg, mix thoroughly and fill in bottles/ polypropylene bags.
5. Plug the bottles using plugs made of non-absorbent cotton.
6. Put sterilize bottles/bags in autoclave for 15 min, 15 psi .The temperature inside the autoclave should reach to about 121^0 C.
7. Take out bottles/bags, cool and inoculate with mother culture of mushroom in laminar air flow.
8. Incubate bottles/bags at 25 ± 3 °C for 2-3 weeks during which the mushroom mycelium fully colonizes (covers) the whole wheat grains.
9. After fully growth of mycelia, spawn is ready for sell.

Precautions:

1. Always keep the inoculation chamber and its surroundings very clean and sterilized.
2. Use new and clean grains for spawn production.
3. Take utmost caution in autoclaving.
4. Switch on UV tube in the inoculation chamber for 30 minutes before inoculation for keeping sterilized substrate and forceps inside the chamber. Switch off UV tube 15 minutes before you enter the inoculation room.
5. Inoculation is always done near the spirit lamp flame to avoid contamination.
6. Swab your hands and clean inoculation area using alcohol.
7. Shake bottles and bags after 10 days or so to ensure uniform white silky growth and also to remove contaminated bottle.
8. All the bottles must be labeled indicating firms name, species, variety, date of

Fig 1: Boiling wheat grains

Fig 2 : Drying wheat grain

Fig 3 : Mix calcium carbonate 5 gm/kg and calcium sulphate 20gm/kg

Fig 4 : Plug the polypropylene bags using plugs made of non-absorbent

Fig 5: Sterilization of bags in autoclave for 15 min at 15 psi and 121 ^{0}C temp

Fig 6: Inoculate with mushroom culture in laminar air flow

Fig 7: Put in BOD at 25 ± 3 °C for spread of mycelium on the grains

HEALTH OF FARM WOMEN ENGAGED IN AGRICULTURE SECTOR

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Women in agriculture are prone to major health issues due to work patterns, under nutrition, occupational hazards, health problems due to the use of agricultural machines, use of pesticides, abuse, and stress in work and family life. Occupational health is a key component of the nation's infrastructure, and the safety and health of workers enhance productivity and has a positive impact on economic and social development. Morbidity pattern among women agricultural workers reveals that their ailments were more with poverty and occupation rather than lifestyle.

Gender-specific obstacles such as lack of access to land, financing, markets, agricultural training and education, suitable working conditions, and equal treatment. Increasing number of farms are family owned and women are directly involved in the farming operations as an independent manager or partner. Women play an important role in farm management by marketing farm products, purchasing materials, and financial planning. Because of this involvement, women can be exposed to potential health hazards that can result in chronic illness, debilitation, or death.

Women-friendly, labour-saving devices on farms and at home can support the growing participation of women in agriculture, but a stronger policy response is needed in India where women constitute over a third of the farm labour force.

Women in India spend about 32 percent of their time on agricultural activities such as transplanting, weeding, harvesting; juggling multiple roles, they spend an average of 300 minutes per day in unpaid work at home in cooking, and other domestic activities including caring for children/family.

But when their work on farms is extended in peak seasons, they pitch in more time. On average, a woman spends almost the same time as a man in agriculture, but men spend limited time in food preparation, domestic work, and care activities.

Agricultural interventions and development programs should make sure that the benefits of participation in agriculture outweigh losses such as time for household activities and leisure, says the study. Moreover, it is vital to introduce labour-saving strategies both in agriculture as well as in domestic work. “Labour-saving technologies at home reduce the unpaid time burdens, health hazards and workload which support women to have more time for productive work or leisure which helps to improve their decision-making roles at the household level. According to India’s Economic Survey of 2017-2018, growing rural to urban migration by men is leading to the feminisation of agriculture, with more women stepping into roles of cultivators, entrepreneurs, and labourers. “There is a demand for women-friendly farm mechanisation as agriculture is facing labour scarcity and there is a rising trend of feminisation of agricultural labour force and work.

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CHALLENGES OF AGRICULTURAL SUPPLY CHAIN MANAGEMENT IN COVID-19 PANDEMIC

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The covid-19 was declared as a pandemic by World health organization (WHO) as an ongoing global health emergency being faced by countries across the world. It has not only resulted in the global tragedy for human deaths but also touches the various economic sectors and activities including manufacturing, supply chain logistic etc. It has caused widespread global disruptions and serious crisis in agricultural supply chain management that could have a long lasting impact on human livelihood including the loss of earnings, settlements, rise of food production and consumption costs. It is a misfortune that covid-19 pandemic has serious concerns when improvement in the food security and under nourishment just begun to progress. From its initial emergence in China in December 2019, the disease has rapidly spread across infecting more than 157.36 million people globally and fatally affecting 3.27 million people as of 11th May 2021. The first official covid-19 case in India was duly reported on 30th January 2020. Since then the Indian government announced regulated measures to restrict the spread of the disease and to manage the resulting impact. The highly transmissibility nature of the disease forced several countries to impose restrictions and regulations such as social distancing, self-isolation and travel restrictions. On 12th March the international travel bans were implemented whereas on 25th March, a nationwide lockdown was declared with restrictions of mobility across the country. Implementation of a nationwide lockdown, including the closure of domestic and international borders was an instant and important measure adopted by most of the countries to control the spread of the virus. The resulting lockdown and restrictions across the nation had an extensive impact on Indian agriculture especially supply chain bottlenecks for various agricultural commodities affecting agricultural supply and production. Food supply chain disruption was a highlighted area of concern during the covid-19 pandemic for countries such as India where largely farmers are comprised of small agricultural producers. However, the covid-19 pandemic is expected to have more severe socio-economic implications which may range from increased food insecurity and malnutrition to a rise in poverty and inequality.

Major challenges for agricultural supply chains during covid-19

The agricultural food supply chains can be divided into five stages, including agricultural production, postharvest handling, processing, distribution/retail/service and consumption. Agricultural food supply chains are highly complex in nature which integrates several players such as farmers, governments, industries, retail shops, hawkers, and other organizations. The covid-19 pandemic has resulted in unprecedented stresses on agricultural supply chains, with bottlenecks in farm labor, processing, transport and logistics as well as momentous shifts in consumer's behaviour, supply and demand. However, the supply chain of crops has been widely disrupted due to lockdown prevailing in the country because of covid-19 pandemic. Some of the major challenges in the agricultural supply chain include:

Lack of human resource

Shortage of human work force due to covid-19 pandemic is the biggest challenge in the agricultural supply chains which are generally workers intensive in nature starting from various pre-harvest to post-harvest operations. However, due to lockdown, labors are forced to return back to their home towns due to lack of employment opportunities

resulting in a shortage of labor whereas farmers are facing problems for performing various activities in the field affecting agricultural supply chains.

Logistics and transportation

The restrictions due to the lockdown has seriously affected the movement of various agricultural commodities in agricultural supply chains management resulting in disruptions in food supply chains. It is the most critical challenge for the government to ensure proper supply and access of food items, fruits, vegetables, and other essential items to consumers across the nation comprising of both urban and rural areas during the lockdown. The inadequate supply of these items may hamper the supply chain. The biggest risk for food security is not only concerned with food availability but also with consumers' access to food safety nets which are essential to tackle increase in hunger and food insecurity.

Demand and supply

Supply chain disruptions due to the nationwide lockdown have affected the demand and supply of various agricultural goods and commodities. Farmers are restricted to sell their goods in the markets including various semi-perishable and perishable products. The large unsold quantity left out with farmers decreases there prices and will be not able to even cover their costs of production facing lower incomes and unemployment.

Consumer's behavior

Concerns about covid-19 infections are extensive due to which we see a huge shift in consumption behavioral pattern of the individuals. Customers are willing to buy healthy and fresh food without exceeding their budget while the demand of various fresh fruits and vegetables has increased significantly as compared to normal consumption patterns. Many consumers are worried about the impact of covid-19 on their health and mental fitness so they prefer to buy healthy food products which will improve their health conditions.

Conclusion

The food sector faces different sets of challenges as compared with other sectors which are not critical for daily life such as tourism, aviation etc during a pandemic. It involves various processes and stages which are strongly connected to each other and a slight delay or glitch at any part of the supply chain can trigger a butterfly effect resulting in huge loss in the yield and output of agricultural commodities. However, keeping the distribution chain alive and maintaining the flow of food and commodities throughout the supply chain by implementing various supply management strategies is also important to meet the consumer demands. At this critical phase of crisis, food security is associated with consumers' access to food rather than to its availability. Ensuring the confidence of consumers with the contribution of all stakeholders in the food supply chain is also essential for food safety and security.

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ROLE OF WOMEN ENTREPRENEURS IN SOCIETY

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Employment generation

It implies that women entrepreneurs not only establish their enterprise, but provide job to others. Women entrepreneurship is about women's position in the society and their role as entrepreneurs in the same society. It can be understood in two ways, namely, at the individual level (number of self-employed) and at the firm level (number of firms owned by women and their economic impact). In this way, woman entrepreneurs have an important impact on the economy in terms of their ability to create jobs for themselves as well as for others.

Economic development

It signifies that women entrepreneurs contribute to the gross domestic product of the country by establishing enterprises and producing goods and services. Due to their entrepreneurial activity, women entrepreneurs bring dynamism in market. In this way, they also help in increasing the national income of the country.

Better utilization of resources

It implies that the involvement of women in industrial development ensure the effective utilization of all available resources (labor, raw materials, capital). The issue of women in the industrialization process has been emphasized only in the last decade when the 'Declaration of Mexico in July 1975', the equality of womanhood and their contribution to individual development became the center of attention.

Improved quality of life

It implies that women entrepreneurs are now economically independent and take decisions independently. They are now capable of upbringing their children according to their wish. They are providing quality education to their children and a better living standard to their family members. They not only improve their living standards, but also the living standards of others by providing them the means of earning.

Women entrepreneurship in national perspective

Women entrepreneurs are the women who explore the prospects of opening a new enterprise; undertake risks, bring about innovations, coordinate administration and control of business and provide effective leadership in all aspects of business. They have curved out a commendable position in the traditionally male dominated arena of business. According to the census of India 2011, female population of India is 586,469,174 which constitute 48.5 percent of the total population. Traditionally baring few exceptions women were not found to be very liberally associated with economic activities and managing business firms and owning them. In the recent past and at present there has been a paradigm shift in the scenario. Women in India are liberated to take up all sorts of economic activities and venture into different avenues they can dream off. This could be a spinoff of the process of globalization and the process of modernization on the anvil. Women are able to compete and occupy a niche for them in all

the areas of business as well as all walks of life. The women entrepreneurs are not only confined to metropolitan cities and urban areas but they are successfully working in the rural areas as well. Women are found to be pursuing more and more professional and technical degrees in order to participate in the economic activities as designers, interior decorators, exporters, publishers, garment manufacturers, retailing, public relations, education services and still exploring new avenues of economic participation. No country can attain its full potential without adequately investing in and augmenting the capabilities of women. For the long-term development of a country it is indispensable to facilitate women empowerment. In order to understand the scenario of women entrepreneurship in Indian perspective let us at discuss the participation of women in SSI sector. As far as the SSI sector is concerned the women are identified to render three different roles. Some women are owners of enterprises, some are managers of enterprises and some are employees. Moreover, the estimated number of enterprises actually managed by women was 9, 95,141 which is around 9.46 percent of the total number of the enterprises.

Barriers in the path of women entrepreneurs

Financial problem: It refers to the major problem of women entrepreneurs that arise due to the lack of access to funds. It is really difficult for them to arrange the requisite fund as they may not possess any tangible security and credit in the market. Generally, the family members of women entrepreneurs do not have confidence in their capability of running the business successfully.

Production problem: Production problem act as a main problem that discourages women to be entrepreneurs. The data shows that the participation of women entrepreneurs in the production is minimal due to complications involved in the production process. In a manufacturing enterprise, production involves the coordination of a number of activities.

Marketing problem: Marketing problem refers to the problems of women entrepreneurs in marketing their products or services. Lack of mobility and heavy competition in the market makes the women entrepreneurs dependent on middlemen. Middlemen take a huge amount of money to market the products. Women entrepreneurs lack information on changing market and find it difficult to capture the market and make their products popular.

Socio-cultural barriers: Socio-cultural barriers refer to the constraints and barriers imposed on women entrepreneurs by the society. In conventional countries, such as India, the major role of a woman is acknowledged towards her family. She has to perform primarily her family duties irrespective of her career as a working woman or an entrepreneur. Our society even gives more preference to male labor than to female labor. A male labor is paid more wages than a female labor. It is ascertained that male labor force are generally reluctant to work under a female boss.

Lack of confidence: It refers to the personal problem of women entrepreneurs. Women have been dependent on their family members for a long time. They have been always protected and guided by the male members of their family. Right from taking any decision to going anywhere they are accompanied by male. This makes women feel less confident even about their own capabilities. Despite these all barriers women entrepreneurs have proved themselves in all the walks of industrial activities. They are successfully performing and managing their roles at work and home. Entrepreneurship does not depend upon man or woman. It is an attitude of mind and requires suitable motivation duly supported by cordial external conditions. Therefore, women entrepreneurs need to be supported by congenial environment to develop the risk-taking and decision-making qualities.

Conclusion

Women entrepreneurs need more support from their families and social circles to pursue their entrepreneurial ambitions. Household and care duties should not be understood as women's sole responsibility. Furthermore, granting maternity benefits to women entrepreneurs, improving child care, and cultivating social acceptance would help them combine their entrepreneurial pursuits and family responsibilities.

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FUTURE OF INDIAN AGRICULTURE

HOW TECHNOLOGY CAN GAME CHANGER FOR INDIAN FARMERS ?

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After a certain point, agricultural productivity on a given area of land can no longer expand, requiring the adoption of technology. Almost every agricultural technique, on the other hand, has an inherent constraint to express itself in a certain way in a specific geographical situation. For example, tomato yields in India are around 30-35 tonnes per acre, but in the United States can exceed 80-90 tonnes per acre. The various types and extents of implementing technology are one of the primary reasons for this dividend.

Although technology has an important role to play in enhancing agricultural productivity, can it actually help farmers' well-being? We commonly believe that technology may make a farmer wealthy, therefore raising his standard of living. However, this is not always the case, particularly in a country like India, where numerous complicated socio-cultural variables are at play. For example, farmers in India's Punjab and Haryana state fight so bitterly over a piece of communally owned farm equipment that a substantial amount of the projected economic benefits of that machinery is spent on damage control.

In many other situations, increasing production as a result of technological use creates adverse impacts. Farmers in several Indian states can be observed daily discarding their farm produce at local marketplaces for extremely low prices or no return at all. In such conditions, we are compelled to consider questions such as, "What is the purpose of Agricultural Technology?" and "Is it only to enhance agricultural productivity or something even more?"

To address these concerns, it's necessary to first know why and how technology ended up on Indian farms. Food production in India peaked in the 1920s at about 50 million tonnes and stayed stable for the next two decades. Between the early 1890s and the late 1940s, food production increased at the rate of barely 0.4 percent per year, but food grain production remained unchanged. The population, on the other hand, grew at an exponential rate. It became essential to break away from that stagnant era in order to feed the increasing population. There was a desperate need for new information, technology, and ideas. Many agricultural institutes and research stations such as ICAR or IARI etc. have been built throughout the nation with the objective of introducing new technology and innovations into the Indian farming industry. Many new enhanced and hybrid crop types, as well as new farming equipments, were introduced, and India quickly became food self-sufficient.

However, the problems of Indian agriculture have evolved over the decades. Today, the focus has turned away from boosting food production and toward putting that increased production to economical use. Having said that, the government must now take steps to assist it’s farmers in transferring the benefits of technology into productive use. Along with finding ways to enhance agricultural revenue for farmers, the government should also look at ways to come up with

complementing plans for the long-term and productive use of that additional income.

Through legislative measures, one essential component of a long-term agriculture strategy might be to balance this technology vs. welfare struggle. For example, the Indian government's recent proposal to allow the use of unmanned aerial vehicles (UAVs), such as drones, on farms can be implemented with certain normal ethical standards and laws. Also necessary is appropriate planning for the efficient use of the data provided by these technologies. Policies should also require that technology be implemented in a way that does the least amount of harm to the environment and society.

Because agriculture has become increasingly mechanized, the Indian government must invest in and promote ideas that result in the beneficial application of technology in agriculture. It is necessary to launch a campaign to raise public awareness and encourage the use of technology in agriculture. To successfully guide farmers, a network of information distribution must be developed. A well-informed adoption of technology in agriculture will pave the way for long-term solutions that will reduce farmer suffering.

Currently, producers select crops based on past season's patterns. Technology may help them make better growing decisions by carefully analysing demand, price, and climate variability. This will result in a better balance of supply and demand. Small producers can benefit from technology-enabled farming instruments. Heavy machinery used in developed nations has limited use in the majority of our small producers. The goal is to develop mechanised procedures appropriate for small farms, which lowers dependence on manual labour and increases production.

Crop consulting services based on technology, such as crop planning, pest management, and disease prevention, may be quite beneficial. Online marketplaces that provide a wide range of authentic agricultural inputs supported by scientific agri-advisory might also be beneficial.

In the conventional approach, intermediaries take a massive portion of a farmer's earnings. E-marketplaces such as e-NAM that connect buyers and sellers directly can disintermediate the chain and provide farmers with increased profits. An efficient cold chain system is critical for Indian agriculture. The majority of the current cold storage units are antiquated. Post-harvest losses can be avoided by adopting technology-enabled cold storage chains that are managed by smart devices. The use of robotic and machine vision to automate agricultural grading and sorting can help decrease labour and waste in the supply chain.

The modern Indian farmer, unlike the traditional ‘kisan,' is not the conventional ‘kisan.' They are technologically aware and ready to adopt new technology that might help them increase their income. For example, a Facebook page for organic farmers in India has around 22,000 members and has grown into an interesting platform for farmers to seek help or advise from other farmers. Farmers are increasingly using Whatsapp groups to communicate with one another and share information. Indian farmers are rapidly using information technology, from purchasing seeds online to seeking reviews on social media.

HAVE LOCKDOWN AFFECTED THE CROP PRODUCTION AND FARMERS INCOME ?

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Lockdown the word which describes itself more than anyone could because each person has its own definition of lockdown when we consider agriculture in our country it is sources of employment for nearly 56% of population even those people who work as entrepreneur are on the view and sees agriculture as huge opportunity because a large part of it is still not explored.

After independence the production in agriculture sector has increased year by year with a good rate because as population is increasing day by day it is necessary to produce food grains to meet demands of population but as we also know that we were hit by the covid in 2020 on 24 of march and a series of lockdown continued for almost 1 year it has always been a point of verdict that it has affected crop production or not some people says it has affected a lot some says that it has no effect but after reading data from many sources I concluded some point which defines that lockdown came till than the wheat was taken and almost got harvested if we clearly observe that we can conclude that lockdown has affected crop production but only a little but the alleged sectors were more affected which were associated with agriculture.

After closely observing the data through authorized sources i.e. Directorate of economics and statistics and various others it has been observed that crop production was affected by -2.8% only which is not a very huge loss but the imports and exports were adversely affected as an we residing in Bundelkhand region more over in Uttar Pradesh which is known food bowl of India produces huge amount of food grains to fulfill the need of Indian population and mainly our Bundelkhand region which produces pulses in huge quantity produced the food grains with full potential but due to lack of transportation facility it has not been transported to others states and lead to increase in prices of food grains in some parts of India during lockdown. From here we can conclude than production was stable a little bit fluctuating but it doesn't affect much a little bit decrease in 2.7 % is not such a big percentage, for this we have got a various data analysis released by government of India we will go through it and will reach to our conclusion.

Total food grains production 2017-18 was 285.01 million tones which certainly remain same on 285.21 in 2018-2019 but it tends to increase in 2019-2020 i.e. 297.50 million tones which is certainly high but when we see total pulses production it was 25.43 million tones in 2017-2018 which decreased in 2018-2019 to 22.08 million tones which tend to increase in 2019-2020 by 23.03 million tones, when we observed data of rice in *Kharif* when lockdown was in force it was 105.21 million tones in 2020-21.

The above observed data tend to show us that lockdown has very little effect in case of crop production but it caused majorly food scarcity and hike in prices at certain parts of India along with this it caused a much loss in various alleged and important sectors like poultry which decreased by 19.5%,fishery 13.6% dairy 6.6%,sheep/pig by 8.5% there were also loss in various other things like seed sale decrease by 9.2%,fertilizer by 11.2%,pesticide by 9.8% fodder by 10.8% this things do have direct and indirect effect on our crop production.

It has been seen that people discussing that farmers faced a huge loss but production was not the main cause because production has already rising trends, another reason was seen in such difficult situation that farmer was not able to harvest what they had grown due to shortage of agriculture labour around 263 people are included in agriculture sector and half of them are part of agriculture labour because the labor due to lockdown started moving their home with immediate effect this affected the large farmers because they need the large number of agriculture labor for harvesting process those farmers who were getting profit of 2-3 lakhs has sorted

there income to 1-1.5 lakhs due to labor shortage sell those surplus production in market due to rules an regulation of lockdown still government do have helped the farmers by providing them such opportunities in terms of various schemes which helped them or not in such situation of lockdown to face such consequences of lockdown will these schemes were enough for crop production and earn profit to farmers lets discuss about them farmers were on the point that government has not made roadmap before for the farmers because at some places farmers has thrown their produce on road but it was a famous statement of that time that with this lockdown has farmer income has also gone under lockdown farmers were worried that it will crush the prices of the food grains.

Government has announced the 1.7 lakhs crore to poor people which hardily helped people government has also announced Garib kalian yojna, MNREGA scheme for the worker who returned home who can get employment opportunity, kisan samman nidhi, food security mission and many more to help people.

After all such discussion we are here on the conclusion that lockdown itself has very devastating effect on the life of people many people lost their life many lost their home many people became unemployed but the farmers continued their work and once again proved that whatever the situation be they will be up in every situation and help in every situation our GDP has also decreases and came to stable when lockdown lifted.

Agriculture is backbone of the Indian economy it is the major sector which has helped the India and helps in contributing GDP this all efforts of farmers in agriculture sector has together helped in production of huge amount food grains even in the lockdown situation but with a little loss in terms of production but in terms of farmers income somewhere the farmers has faced loss and in some part of the country huge loss which confuses the people because people get confused thinking that less production could be the reason for farmers loss but we have the data above all such shows that production was normal to stable but loss to farmer post lockdown was mainly due to sudden crash in prices of food grains items.

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TILLING: A NEW CROP IMPROVEMENT TECHNOLOGY

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Food security has become a key worldwide concern for the twenty-first century, with the world's population expected to exceed 9 billion by 2050. Cereal output will need to expand by 50% by 2030, according to estimates. To accomplish this goal, a 37 percent increase in the historical annual incremental rate for crop production is necessary, demonstrating the magnitude of the proposed increases. However, the highly limited genetic basis of extant crop types, as well as the parental lines for developing new kinds, negates attempts to raise productivity and hence jeopardise food security. As a result, larger sources of heritable differences must be investigated for crop improvement.

Claire McCallum (with partners from the Fred Hutchinson Cancer Research Center and the Howard Hughes Medical Institute) started TILLING in the late 1990s to characterise the activity of two chromomethylase genes in Arabidopsis. Claire McCallum attempted to describe CMT2 using reverse genetic procedures such as T-DNA lines and antisense RNA, but was unable to do so. What became known as TILLING was the effective method (Targeting Induced Local Lesions in Genomes). This was done by combining chemically induced mutagenized plants, amplifying the area of interest, producing heteroduplexes among the pooled DNA, and using dHPLC (denaturing high performance liquid chromatography) to detect the mutants by chromatographic changes.

TILLING

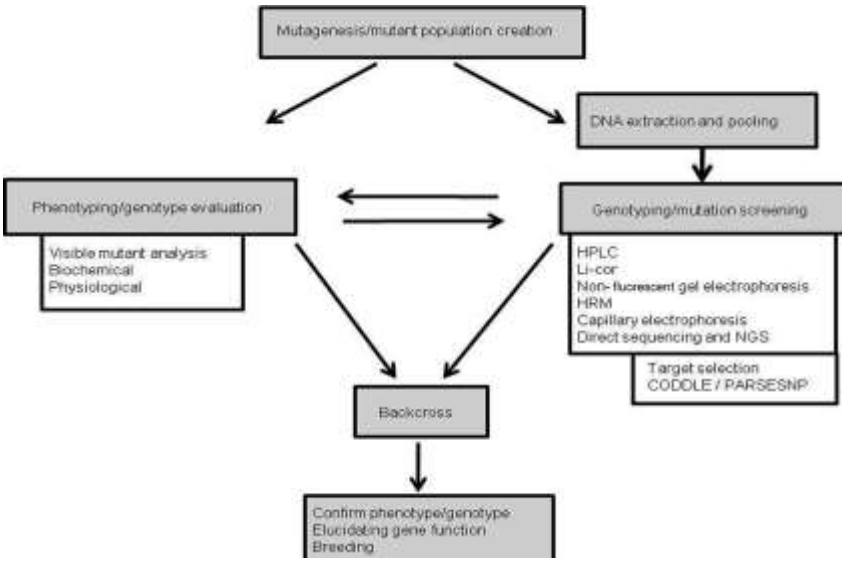
TILLING is a reverse genetic approach for identifying point mutations in regions of interest that combines chemical mutagenesis with polymerase chain reaction (PCR)-based screening. It was initially published in the late 1990s. This method detects induced or natural DNA polymorphisms in genes of interest using a mismatch-specific endonuclease. A novel universal reverse genetic technique aids in the identification of an allelic sequence of generated point mutations in genes of interest. It enables the identification of produced point mutations in groups of physically or chemically mutagenized humans in a timely and cost-effective manner.

Procedure

- The first step in the TILLING technique is to establish an induced population using physical/chemical mutagens. Due to their self-fertilized nature, most plant species are suitable with this procedure, and the seeds generated by these plants may be preserved for lengthy periods of time.
- Seeds are mutagenized and cultivated to harvest M1 plants, which are then self-fertilized to increase the M2 population. Mutational screening is carried out using DNA isolated from M2 plants (Colbert et al., 2001). Only one M2 plant from each M1 is utilised for DNA extraction to avoid mixing of the same mutation.
- The M3 seeds obtained by selfing the M2 progeny can be stored for a long time. Although other mutagens can be useful, ethyl methane sulfonate (EMS) has been widely employed as a chemical mutagen in TILLING investigations in plants to create mutant populations.
- By alkylating G residues with T instead of the conservative base pairing with C, EMS causes transitional mutations (G/C, A/T) (Nagy et al., 2003). It's a good idea for users to try a variety of chemical mutagens on germinal tissue to see how harmful and sterile they are before establishing big mutant populations.

Eco-TILLING

Eco-TILLING (Ecotype Targeting Induced Local Lesions IN Genomes), a well-established allele mining approach, has been found to be very effective in large-scale mining and high-throughput genotyping of novel natural and functional allelic variants (without prior knowledge of SNP alleles) of



Source: Chen *et al.* 2014

known and candidate genes related to useful agronomic traits in a variety of crop germplasm accessions. The Eco-TILLING approach, which adapted TILLING to mine for natural polymorphisms, was initially published in 2004 for Arabidopsis. TILLING is similar to Eco-TILLING, except the goal is to find natural genetic diversity rather than produced mutations.

Application of TILLING for crop improvement

1. Genomics with a purpose

Scientists can utilise the TILLING library to find mutations in their target genes. TILLING allows you to look into target GOI in any crop you're interested in without needing to know the gene product beforehand.

2. Genetic engineering

TILLING comes before transgenic because it involves the detection of many mutations in a specified area of the complete genome.

3. Natural population genetic diversity assessment

TILLING is an alternative to wild relatives for introducing important genetic diversity into top germplasm. Also applicable in a population which has several pre-existing polymorphism for developing SNPs.

4. TILLING for Starch Synthesis

In wheat, several relevant genes have been identified using mutant populations. For instance, in noodle production, fractional waxy wheat cultivars are **preferred.**

5. TILLING for plant architecture

In rice, TILLING was applied to an M2 population consisting of 961 mutant lines with the aim of examining nine target genes that play important roles in membrane transport proteins and the regulation of the salt-stress-tolerance mechanism.

6. Yield

With a genomic size of 5300 Mb, barley is an important crop. A mutant barley population was created utilising a chemical mutagen for use with TILLING (sodium azide). The discovery of mutant alleles by TILLING indicated that the target genes play an important role in DNA repair and water logging.

7. Disease resistance

The TaMlo gene, which is an orthologue of the barley Mlo gene, was studied using TILLING to find partial loss-of-function variants. Barley Mlo function loss, both natural and induced, resulted in long-term resistance.

Future scope

Several main crop species have had large-scale genome sequencing initiatives completed in the last decade and public databases currently have a massive amount of candidate gene sequencing data. As a result, the research community has wished for the development of powerful techniques for finding allelic series of mutations for gene functional investigations and crop breeding.

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MAINTENANCE OF AGRICULTURAL EQUIPMENT

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Every physical asset such as machinery put into practical use and service fulfills some specific functions, and failures of some components are inevitable. Thus the maintenance of these assets is obvious. Maintenance is generally recognized as the single largest controllable cost factor in any production assembly and up till now represents a challenge leading the managements to reevaluate their maintenance strategies. Maintenance can be defined as the practice of keeping in form or shape of equipments, machine system or object in its original status as much as possible. Note that maintenance is not repairing a machine after it breaks or when it stops work (Frank Buckingham 1981). It is a means of achieving optimum value for equipment in order to perform its desired and designed functions. Thus, maintenance is protecting a machine so that it does not break down or wear out quickly. You must protect your machine from the following enemies:

1. Wear (grease and oil are used to protect machines from wears).
2. Dirt (Filters are used to catch and hold dirt before it gets inside and damages parts).
3. Heat (The cooling and lubrication system protects the machine from heat).

Regular maintenance is one of the prerequisites for a long living and reliable engine performance. The recommended engine servicing procedure is contained in the Owners Handbook for each engine model. Additional servicing is often necessary and depends on the type of operation the engine is subjected to. I must stress that if you carry out your own servicing make sure you have the proper tools and perhaps attend maintenance training. Mistakes made due to lack of skill or knowledge are often more expensive than employing a reputable mechanic.

Objectives of good maintenance practices

Good maintenance practices are essential for efficient operation of all types of machinery. Efforts spent in this area of farm management is more than repaid by consistent and reliable operation of machinery, reduced fuel consumption and bills, extended equipment life among others. Maintenance of farm machinery is complicated by the usage pattern of short but intense activity, followed by periods of non-use or storage. Objectives of good maintenance practice include:

1. To intervene before failure occurs.
2. To do maintenance only when necessary.
3. To reduce number of failure and shutdowns.
4. To reduce maintenance cost and cost due to production lost.
5. Increase life of equipment.
6. Reduction in inventory cost / effective inventory control.

Types of maintenance

There many types of maintenance techniques *viz.* Preventive maintenance, Proactive maintenance, default type, discard type, offline and online type etc. Traditionally, maintenance is performed in either time based fixed intervals, called preventive maintenance, or by corrective maintenance. With the preventive approach, Maintenance is performed in order to prevent equipment breakdown with the corrective approach, Maintenance is performed after a breakdown or an obvious fault has occurred. For some equipment and faults, corrective maintenance action must be performed immediately, for others the maintenance action can be deferred in time, all depending on the equipment's function.

This is the aspect of maintenance, which is necessary to put machine and equipments in good working condition immediately to avoid serious consequences, for instance cleaning of distributor cap in the electrical system of an engine. The machine can still function but when not attended to, can cause major breakdown in the system.

Routine maintenance

Routine maintenance is the simplest form of planned maintenance but very essential. As the name, it is carried out at regular intervals. It involves periodic check of relevant areas. The frequency of such checks ranges between hourly, daily, weekly and monthly or as

recommend by the manufacturers. Routine maintenance reduces fuel bills and extends equipment life. Readings obtained from such checks could be collated in a maintenance record over a long period to give a behaviour history of the equipment. Examples are washing and cleaning, filing of distributor cap, change of oil, topping of battery electrolyte, lubrication, inspection and minor adjustments of pressure, flow, tightness etc.

Routine maintenance reduces fuel bills and extends equipment life. Good maintenance practices are essential for efficient operation of all types of farm machinery. Effort spent in this area of farm management is more than repaid by consistent, reliable operation of machinery, reduced fuel bills and extended equipment life. Maintenance of farm machinery is complicated by the usage pattern of short spells of intense activity, followed by periods of non-use or storage. During the "standing" or non-use periods chemical interactions between metals and fluids can cause more damage than normal wear and tear from active usage. This must be considered in planning machinery maintenance and the following suggestions are worthy of consideration-

1. Follow manufacturers' instructions for all settings, adjustments, maintenance instructions, operating requirements and long-term storage.
2. Follow manufacturer's recommenddations on safety aspects of operation and repair. Maintain all safety equipment as installed or recommended by manufacturers.
3. Do not overload equipment, or operate at higher speeds than manufacturer recommends.
4. Do not add counterweights to equipment to increase load capacity unless authorized by manufacturer. Store equipment in clean and dry conditions.
5. Remove all vegetation such as grass, hay, crops and crop residue from equipment before storage periods. Decomposing vegetable matter causes corrosion to metal surfaces. This is particularly important where surfaces are polished from usage.
6. Keep all cutting edges sharp and clean. Sharp cutters require less power and reduce overall load on equipment. Cracked or damaged cutting edges are also easier to detect on clean equipment.
7. Replace these items at end of season rather than at season commencement.
8. Inspect machinery at end of season or harvest.
9. Repair and adjust as required. Carry out maintenance work without pressure between seasons.

Preventive maintenance

This is one of the oldest method maintenance. It is used mostly along with corrective maintenance and condition-based maintenance (Diagnostic Maintenance) etc. Preventive Maintenance is a planned Maintenance of plants resulting from periodic inspection in order to minimize the breakdowns and depreciation rates. This includes the followings: servicing; adjusting; operating; repairing and caring for agricultural machines so as to prevent unnecessary wear out of parts, and keep time loss due to breakdown to a minimum. Once the unit is placed into full operation, a Preventative Maintenance Program should begin. This program should include regular inspection set up on a periodic basis. For instance, the Preventive Maintenance Program for conveyor or any belt system should include a general inspection of-

1. Drives.
2. V-belts of V-belt drives for wear on belts and proper tension.
3. Roller chains of chain drive for lubrication and proper tension.
4. Loose, worn and/or damaged coupling bolts.
5. Guards are all in place and properly installed.
6. Re-lubrication schedule.
7. Other items to be routinely inspected.
8. Screw flighting and hanger bearings for possible damage and/or wear.
9. Operating temperature, signs of wear (noise) and lubrication.
10. Oil in gearbox.

Preventive maintenance is divided into two categories; condition based maintenance (CBM) and predetermined maintenance. The condition based maintenance can have dynamic or on request intervals while the predetermined maintenance is scheduled in time.

Condition based maintenance systems (CBMS)

CBM has been defined as maintenance actions based on actual condition obtained from in-situ measurement [Mitchell, 1998]. The main point being that the asset condition is assessed under operation with the intention of making conclusions to whether it is in need of maintenance or not and if so at what time does the maintenance actions needed to be executed and not to suffer a breakdown or malfunction.

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CARBON TRADING

A SOLUTION TO MITIGATE CLIMATE CHANGE

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What is carbon trading?

Permit that allows a country or organization to produce a certain amount of carbon emissions which can be traded if the full allowance is not used. Carbon trade is the buying and selling of credits that permit a company or other entity to emit a certain amount of carbon dioxide or other greenhouse gases. The carbon credits and the carbon trade are authorized by governments with the goal of gradually reducing overall carbon emissions and mitigating their contribution to climate change.

Evolution of carbon trading concept

Carbon trading is based on the cap and trade regulations that successfully reduced sulphur pollution during the 1990s. This regulation introduced market-based incentives to reduce pollution: rather than mandating specific measures, the policy rewarded companies that cut their emissions and imposed financial costs on those that could not.

The idea of applying a cap-and-trade solution to carbon emissions originated with the Kyoto Protocol, a United Nations treaty to mitigate climate change that took effect in 2005. At the time, the measure devised was intended to reduce overall carbon dioxide emissions to roughly 5% below 1990 levels by 2012.

The notion is to incentivize each nation to cut back on its carbon emissions in order to have leftover permits to sell. The bigger, wealthier nations effectively subsidize the efforts of poorer, higher-polluting nations by buying their credits.

Can carbon be sold?

Carbon emissions rights can be sold on various marketplaces-some international, some at the country level, and some on the state or local level, like California's cap-and-trade system.

Ways of carbon trading

- Carbon CAP trade mechanism.
- Carbon offsetting.

Carbon cap trade mechanism

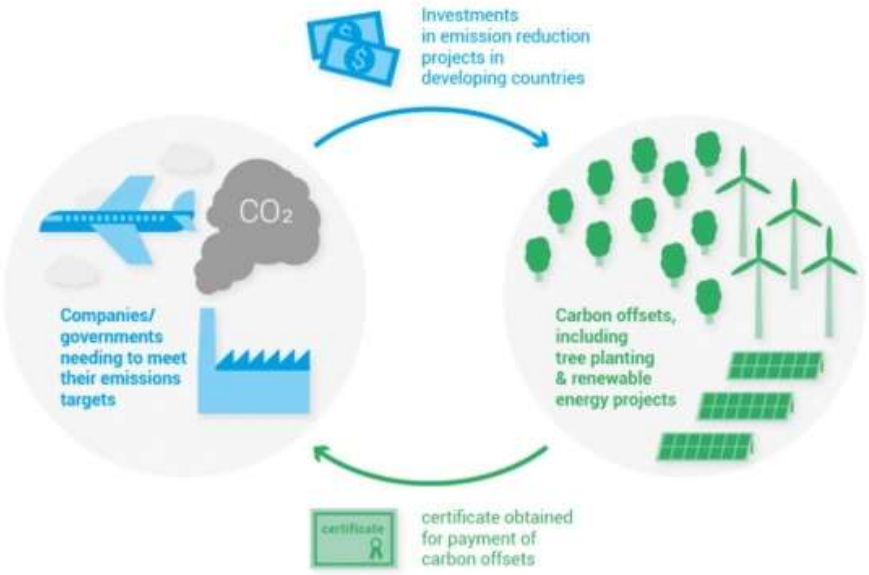
CAP- Assignment of upper threshold limit on the amount of pollutant that can be emitted (measured in Assigned Amount units or AAU's by the country). Emission permits or equivalent number of allowances or credits are issued to emit a specific amount of carbon di oxide (CAP) to the country.

1 credit = 1 ton of carbon di oxide

Trade: The transfer or trade of allowances.

- Excess or unused allowances/credits can be traded to the countries whose emissions have exceeded their assigned CAP.
- The purchased allowances can be used to increase the allowance limit by the purchasing country.

Countries whose emissions are less than their assigned amount or the CAP can sell or trade the excess amount to countries whose emissions have exceeded their assigned amount.



Carbon offsetting

Investment in green technologies and harness alternative forms of energy in the developing counties. Example: A landowner plants an acre of field and can generate credits for how much Carbon Dioxide is reduced as a result of the plantation. The credits are known as offset credits. The landowner can sell the offset credits to the potential investors or industrial facilities. The facility can buy the offset credits and count it in favour of its emission responsibilities. It attests that same amount of carbon dioxide is reduced in the atmosphere as a result of the plantation process.

Advantages of carbon trading

- **Reduction in greenhouse gas emission:** Stringency in the CAP or upper threshold limit is contributing to lower emissions over the years.
- **Source of revenue of developing countries:** Developing nations can earn revenue by selling carbon credits to countries with more fossil fuel demand.
- **Supports free market system:** The carbon trade market without any economic intervention and regulation by government expect to regulate against force or fraud.
- **Impetus for alternative source of energy or green technology:** Threshold limits encourage industries to harness alternative sources of energy and invest in green technology globally or in indigenous research.

Disadvantage of carbon trading

- **Right to pollute:** Industries in the ratified nations are purchasing the legal rights to pollute the atmosphere.
- **Slow process:** Industries are opting the easy way-purchase more allowances than implementing greener technologies.
- **Lack of centralised system or global framework:** Absence of centralized and accepted global standards/act are missing.
- **No effective carbon reduction in the atmosphere:** leads to carbon reduction in one place and results in carbon emission in some other place.

What is the current price of carbon ?

There is no fixed price of carbon worldwide-prices fluctuate by jurisdiction and by market supply and demand-but the benchmark EUA Futures price ranged between €80 and €100 euros for the first four months of 2022.

Conclusion

Carbon credits provides an incentives to reduce greenhouse gases emission on an industrial scale and are key components of national and international emissions trading schemes that have been implemented to mitigate global warming.

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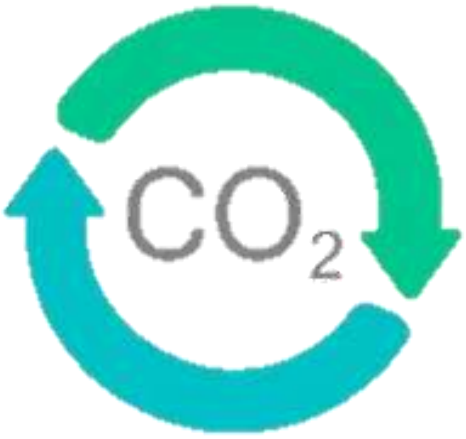
DEEP CO_2 REDUCTIONS ARE INSUFFICIENT



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Every day, the globe sends more indications of a climate catastrophe, from the melting of the poles to the weakening of ocean currents that transport warm water from the tropics into the North Atlantic. The United Nations Intergovernmental Panel on Climate Change released the first installment of the sixth assessment report on August 9, emphasizing, among other conclusions, that GHG emissions are not reducing, but rather increasing.

Unless we achieve significant reductions in CO_2 and other GHG emissions, the world faces global warming of more than 1.5°C (and maybe even 2°C) this century. The frequency and severity of hot extremes, marine heat waves, heavy precipitation, agricultural and ecological droughts in some locations, and the fraction of powerful tropical storms are all increasing, as well as decreased Arctic Sea ice, snow cover, and permafrost.

With these concerns in mind, it is critical to enhancing public policies at all levels – from local to worldwide – to reach net-zero emissions and adapt to climate change.

Countries require greater instruments to combat climate change

The OECD will launch the International Programme for Climate Action in May 2021 (IPAC). This program intends to assist nations in their efforts to achieve net-zero GHG emissions and more resilient economies by 2050. IPAC will assist nations in strengthening and coordinating climate action, as well as complementing and supporting the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, through frequent monitoring, policy review, and feedback on outcomes and best practices.

More countries, subnational entities, organizations, and corporations must set net-zero goals by 2050 or sooner

Nationally, there has been encouraging progress toward Net-Zero. 12 IPAC members currently have net-zero aims incorporated in national law, three have filed legislation in the legislature, and 18 have included net-zero targets in official policy papers. A regional net-zero aim applies to European Union member states. IPAC will support national efforts to attain net-zero emissions and will assist countries in aligning their economic and social development objectives with the need to safeguard the planet. Country effort alone will not suffice to achieve net-zero emissions. Subnational governments, cities, and businesses all play a vital role in accelerating climate action. In this regard, the United Nations Global Climate Action platform, created in 2014, has recorded about 25,000 activities by cities, businesses, and organizations trying to address and mitigate climate change.

Long-term climate plans must be devised and incorporated into legislation

Without these indications of determination and confidence, mobilizing political will to make cuts in crucial sectors in the short term would be difficult. Article 4 of the Paris Agreement states that all parties "should strive to formulate and communicate long-term low greenhouse gas emission development strategies that take into account their common but differentiated responsibilities and respective capabilities, in light of different national circumstances." Nonetheless, only 32 parties have submitted long-term strategies (LTS) to the UNFCCC secretariat to date,

with IPAC participating nations and the European Union accounting for 25 of these plans.

Climate technology financing and implementation have reached a standstill

Even though the majority of global CO2 emissions reductions through 2030 will come from already accessible technology, according to the International Energy Agency, progress is gradual and many industries are opposing the shift. The implementation of realistic, economically viable tactics that nurture these types of technology, as well as the necessary legislation to mass-deploy them, and the distribution of funding for green projects, have not progressed quickly enough. Energy efficiency and reduced fossil fuel usage are critical for lowering CO2 and other GHG emissions, as well as short-lived climatic pollutants.

A great chance amid a crisis

COP26, which will take place in Glasgow from October 31 to November 12, 2021, will provide a unique chance to finalize the Paris Agreement Rulebook, improve finance flows, and accelerate progress toward carbon neutrality and climate resilience. The OECD will actively support this joint endeavour. The spectrum of OECD contributions will be hosted on our Climate Hub's online Virtual Pavilion.

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IMPACT OF PESTICIDES

ON ENVIRONMENT AND HUMAN HEALTH

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The term "pesticide" is a comprehensive term that includes all chemicals that are used to kill or control pests. It includes herbicides, insecticides, fungicides, nematicides, and rodenticides. There are more than 1,000 pesticides used around the world to ensure food is not damaged or destroyed by pests. Different pesticide has different properties and toxicological effects. The application of these synthetic pesticides protects the crop from various pests along with increase in their yield. Contrary to this, they are potentially toxic and cause deleterious effects on human health and some cheaper, conventional pesticides pollute the environment due to their persistence in soil. Overuse of these chemicals cause degradation in quality of air, water and soil and thus polluting environment and cause various health issues in humans.

Classification of pesticides

Generally, there are three main ways to classify the pesticides. They are as follows-

a. Classification based on the mode of action

Pesticides are classified as non-systemic and systemic pesticides.

1. Non-systemic pesticides do not penetrate plant tissues and are not transported within the plant vascular system.
2. Systemic pesticides effectively penetrate plant tissues and are transported within the plant vascular system to bring about the desired effect.

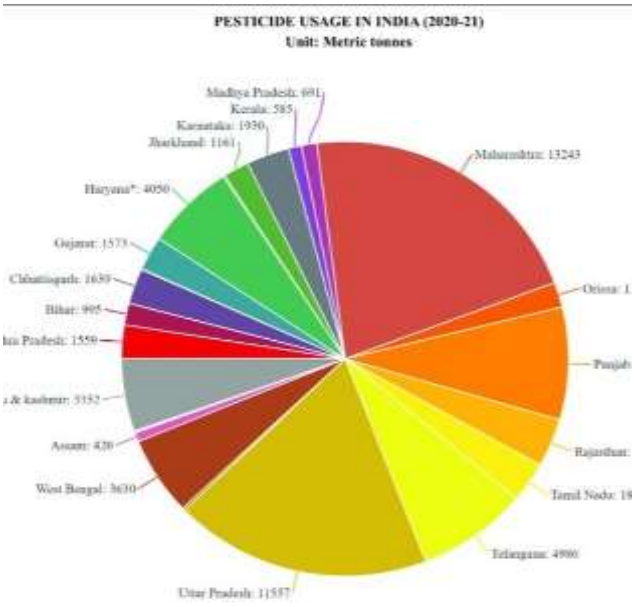
b. Classification based on the chemical composition

Pesticides can be generally divided into about seven types, including organochlorines, organophosphorus, carbamates, pyrethroids, amides, anilines.

c. Classification based on the targeted pest species

Insecticides, herbicides, rodenticides, fungicides, acaricides and miticides, molluscicides, bactericides, avicides, and virucides.

Pesticide Consumption in India

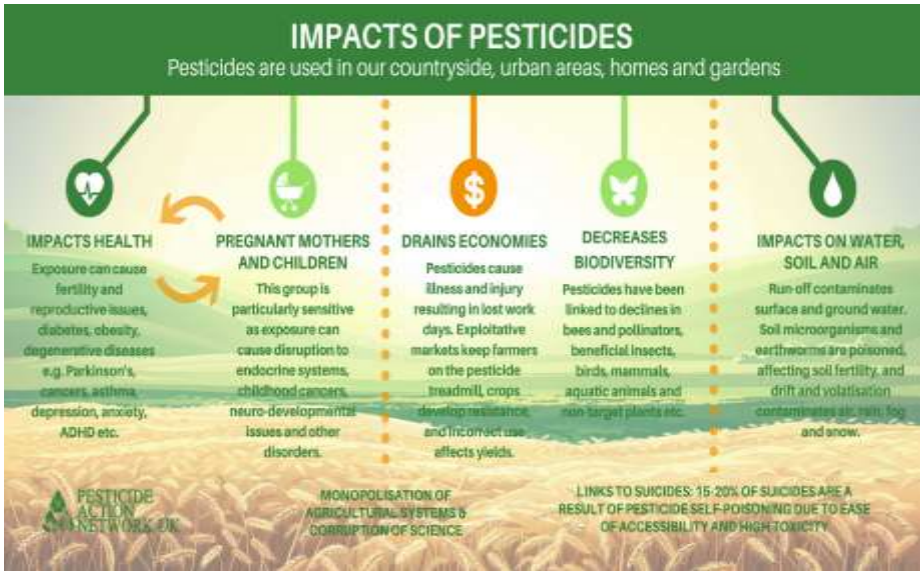


Source : Directorate of Plant Protection, Quarantine, and Storage (GOI, 2021).

This figure shows that highest consumption of pesticides is in Maharashtra 13,243 MT followed by UP 11,557 MT (DPPQ&S, GOI, 2021). Pesticides are major components of the modern agricultural production because of their reliability and high capability for crop protection against pests. In rural areas of developing countries, 3 million farmers suffer annually from serious pesticide poisoning and 25 million farmers suffer from mild poisoning, resulting in approximately 180,000 fatalities among agricultural workers annually because of incorrect perceptions, lack of knowledge, regulation, and education among farmers.

Impact of pesticides on environment and human health

Pesticides cause a widespread release of these xenobiotics into the environment. Their intensive use leads to an increased risk of environmental contamination and pose threats on biodiversity, food security, and water resources. Oerke reported that, globally, an average of 35% of potential crop yield is lost due to preharvest pests. More than 500 different pesticide formulations are being used in our environment, mostly in agriculture. In the past five decades, pesticide usages increased the quantity and improved the quality of food. However, due to their usage with increasing amounts, the concern about their harmful



effects on nontarget organisms, including human beings, has also been growing. Nontarget pesticide poisoning has been reported from fish, birds, and humans. Although it is estimated that less than 0.1% of pesticide applied to crops actually reaches the target, the rest of it enters the environment.

Pollution due to the uncontrolled use of pesticides has become one of the most alarming challenges when pursuing sustainable development. Soil is a major reservoir for a variety of pollutants and is a secondary emission source of contaminants to surface water, groundwater, and air. An accidental release of pesticides due to leaking pipes, spills, waste dumps, underground storage tanks, and groundwater may lead to their persistence in the environment for a long time due to long half-lives. One needs to assess the status of pesticide contamination accurately in soil, water, and air for proper management and application of pesticides.

Pesticides can contaminate surface water and leach to groundwater. Damage to nontarget organisms and pollution to the soil and air are well documented. DDT, dieldrin, and other toxic pesticides affect birds and other wild species and have been finally banned from agricultural use. Since then, however, decline in birds, wild bees, and aquatic organism populations have been continuing. Insecticides not only kill the target species but also other invertebrates on which birds rely on for their food. Similarly, herbicides not only kill weeds but also other plant species in fields, including the essentially beneficial species, which give both shelter and food to wildlife. Amphibians are rapidly decreasing species on Earth. Brühl *et al.* suggested that frogs are sensitive to the toxicity of currently used pesticides in agriculture. In addition, pesticide factory workers and agricultural farm workers have high risk direct exposures to pesticides. Use of pesticides also results in residue problems in soil thus causing soil pollution.

Pesticides lead to several disorders related to the central nervous system as most of these chemicals inhibit acetylcholinesterase receptor activity, causing nerve damage and disease like Alzheimer. Apart from it, inhalation of pesticides leads to several respiratory disorders and these chemicals also have mutagenic and carcinogenic potential causing disorders related to fertility, excretory system, skin, and eye defects. According to reports on poisoning and the impact of synthetic chemicals on human health, numerous cases of intoxication of farmers, rural workers, and their families have occurred during pesticide applications.

Conclusion

Since consumption of the chemical pesticides have increased to a larger extent and pose a huge threat to the environment and human health, it needs to be reduced by adopting other innovative eco-friendly approaches like biopesticides for control of various pests. It will not harm non-target pests and other invertebrates and will reduce the dependence on synthetic conventional pesticides thus preventing environmental and health degradation.

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ROLE OF GRAM PANCHAYAT

IN AGRICULTURAL DEVELOPMENT

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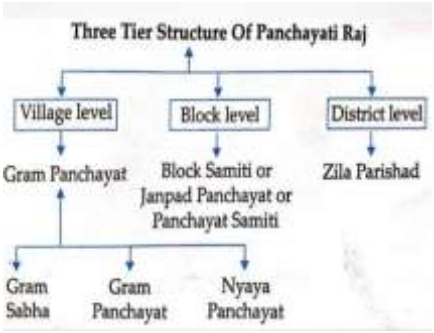
Panchayat Raj system empowers and aids in the development of villages. It is an age-old concept of local self -government or democracy practiced in the history of civilization in India. The term, Panchayat was derived from the Sanskrit word, Pancha "which means five. Traditionally, it represents, council of five members who were engaged in settling the disputes in a rural setup. After implementation of Panchayat Raj in 1959, the overall concept of Gram Panchayat has changed and it is the grass root level organization in a three-tier system (Village level, Block level and Zilla Parishad) of democratic decentralization, meant for serving the rural masses for their overall development. The Panchayats are expected to play an important role in rural development in India, particularly after independence. Various committees by Central and State governments emphasized the importance of Panchayat Raj in polity. The second Five Year Plan emphasize the importance of panchayat in development and transformation of social and economic life or rural areas. Additionally, it can be seen that rural progress entirely depends on the presence of active participation of village people including the weaker section, in common programmes.

India is essentially land of villages and ultimately our progress can really be regulated by the advancement that the village people can show. Rural population directly and indirectly depends upon agriculture. Hence, development in agriculture is very important for overall development of our country. Planning for development should start from the village level. Gram Panchayats are primarily basic unit of Panchayat Raj administration. Gram Panchayat is the most important basic institution for village development. It plays an important role at the village level in proper functioning of the Panchayati Raj system. It is the most potential school of social and political training for the rural masses. Gram Panchayat is grass root organization of Panchayati Raj System. Gram Panchayat members play important role in village developmental activities. India's ever increasing population has to be fed by increased food production. Improved agriculture production technologies should be employed or adopted in rural areas of farming. Government runs many agricultural development programmes to enhance the growth in agricultural production. These programmes should reach to the farmer's field in villages. *i.e.* to spread and adopt the agricultural development programmes. They should firstly be adopted by Gram Panchayat members the ultimate leaders of villagers so that villagers follow their leaders. Gram Panchayat members as the representatives of the people are expected to know the details of the various agricultural development programmes undertaken by government authority. This enables the Gram Panchayat members in motivating and guiding their followers particularly in agricultural development. Taking into consideration the role of Gram Panchayat members, there are certain expectations from their followers. Members who are aware and had detailed knowledge about agricultural development programmes should naturally work better for the people; it helps to fulfill the expectations of the people. Panchayat Raj system facilitates easy and effective implementation of schemes so that it could the poor in remote village areas.

Panchayat Raj is a government by itself and also an agency of the state government. The Gram Panchayat faces a number of problems in performing their roles. Ashok Mehta Committee report

(1978) pointed out that Panchayat Raj Institutions (PRIs) were dominated by economically or socially privileged sections of the society. Nearly half of the Indian population lives in rural areas



(Census, 2011). Rural population directly and indirectly depends upon agriculture. Hence, development in agriculture is very important for overall development of our country. Planning for development should start from the village level. After independence government of India appointed a committee under the chairmanship of Mr. Balvant rai Mehta in 1957 to review and assess the impact of Community Development Programme (1952) and National Extension Service Programme (1953). The committee observed that these programmes failed to achieve the expectation due to lack of involvement and active participation of people.

Role performance of Gram Panchayat members in agriculture development

- Maintenance of cold chain storage houses.
- Organizing farmers training Programme.
- Organizing farm women welfare programme.
- Organizing farmers meetings.
- Organizing agri. Exhibitions.
- Organizing animal exhibitions.
- Organizing crop protection programmes.
- Conducting meetings on new technologies.
- Construction of warehouses for grain storage.
- To conduct educational tours for farmers.
- Establishment of biogas plants in village.
- Development of roads connecting to main market.
- Development of veterinary hospital.
- Soil and water conservation programmes.
- Providing seed to farmers.
- Providing pesticides.
- Providing agricultural instruments
- Providing subsidy.
- To encourage farmers for agriculture based business
- Arranging storing and distribution of inputs, preferably through co-operatives.
- Assistance in the recovery of crop loan.
- Planning and implementation of watershed activities.
- Assistance in the management of improving crop production practices.

Conclusion

To prepare a good quality plan, quality of participation needs to be expanded and conscious efforts have to be made to ensure that every section of society participates in Gram Sabha with active contribution on discussions towards identifying and prioritizing development issues and suggesting optimum solutions. Panchayati Raj institution is the major driver in the development of rural areas. It acts as a single window for implementation of all developmental schemes.

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INTERNET OF THINGS (IOT)

IN AGRICULTURE AND ALLIED SECTOR

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The resurfacing of global recession has caused ripples across both the developed and the developing economies. Agriculture sector will have to be much more efficient and resilient to ensure global food security. Indian farmers are at great disadvantage in terms of size of farms, technology, trade, government policies, etc. Information and Communication Technology (ICT) can mitigate some of the problems of farmers. After the World Wide Web (of the 1990s) and the mobile Internet (of the 2000s), we are now heading to the third and potentially most "disruptive" phase of the Internet revolution—the "Internet of Things (IOT)" which is also known as "Ubiquitous Computing". IOT applications encompass diverse areas including agriculture, healthcare, retail, transport, environment, supply chain management, infrastructure monitoring etc. Applications in agriculture include soil and plant monitoring, greenhouse environment monitoring and control systems, monitoring of food supply chain, monitoring of animals, etc. The Internet of Things (IOT) is a worldwide network of intercommunicating devices. It integrates the ubiquitous communications, pervasive computing, and ambient intelligence. IOT is a vision where "things", especially everyday objects, such as all home appliances, furniture, clothes, vehicles, roads and smart materials, etc. are readable, recognizable, locatable, addressable and/or controllable via the Internet. This will provide the basis for many new applications, such as energy monitoring, transport safety systems or building security. Internet of Things will connect the world's objects in both a sensory and intelligent manner through combining technological developments in item identification (tagging things), sensors and wireless sensor networks (feeling things), embedded systems (thinking things) and nanotechnology (shrinking things). The following are the benefits of IOT applications in agriculture:

1. Improvement in the use efficiency of inputs (soil, water, fertilizers, pesticides, etc.).
2. Reduced cost of production.
3. Increased profitability.
4. Sustainability.
5. Food safety.
6. Protection of the environment.

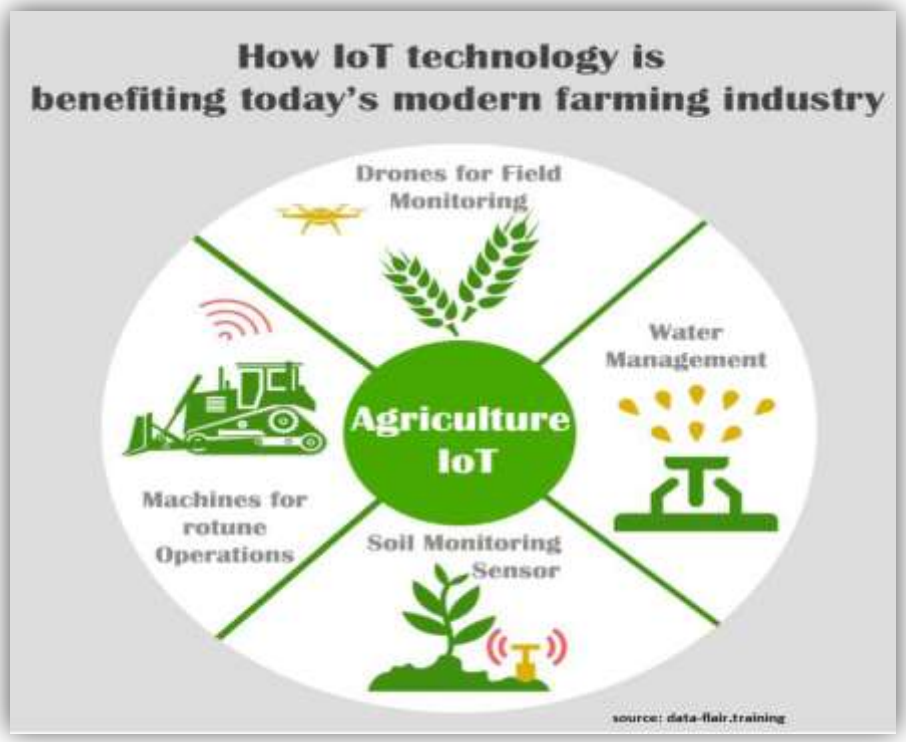
IOT agriculture applications include:

Precision farming

Precision farming is a process or a practice that makes the farming procedure more accurate and controlled for raising livestock and growing of crops. The use of IT and items like sensors, autonomous vehicles, automated hardware, control systems, robotics, etc. in this approach are key components. Precision agriculture in the recent years has become one of the most famous applications of IoT in agricultural sector and a vast number of organizations have started using this technique around the world. The products and services offered by IoT systems include soil moisture probes, VRI optimization, virtual optimizer PRO, and so on. VRI (Variable Rate Irrigation) optimization is a process that maximizes the profitability on irrigated crop fields with soil variability, thereby improving yields and increasing water use efficiency.

Agriculture drones

Agricultural drones are a very good example of IoT applications in Agriculture. Agriculture industries today have become one of the major industries where drones can incorporate. Two types of drones, that is, ground-based and aerial-based drones are being incorporated in agriculture in many ways such as, for crop health assessment, irrigation, planting, and soil & field analysis. The benefits that the usage of drones brings to the table include, ease of use, time-saving, crop health imaging, integrated GIS mapping, and the ability to increase yields. The drone technology will give a high-tech makeover to the agriculture industry



by making use of strategy and planning based on real-time data collection and processing. The farmers through drones can enter the details of what field they want to survey. Select an altitude or ground resolution from which they what data of the fields. From the data collected by the drone, useful insights can be drawn on various factors such as plant counting and yield prediction, plant health indices, plant height measurement, canopy cover mapping, nitrogen content in wheat, drainage mapping, and so on. The drone collects data and images that are thermal, multispectral and visual during the flight and then lands at the same location it took off initially.

Livestock monitoring

IOT applications help farmers to collect data regarding the location, well-being, and health of their cattle. This information helps them in identifying the condition of their livestock. Such as, finding animals that are sick so, that they can separate from the herd, preventing the spread of the disease to the entire cattle. The feasibility of ranchers to locate their cattle with the help of IoT based sensors helps in bringing down labor costs by a substantial amount.

Smart greenhouses

Greenhouse farming is a technique that enhances the yield of crops, vegetables, fruits etc. Greenhouses control environmental parameters in two ways; either through manual intervention or a proportional control mechanism. However, since manual intervention has disadvantages such as production loss, energy loss, and labor cost, these methods are less effective. A smart greenhouse through IoT embedded systems not only monitors intelligently but also controls the climate. Thereby eliminating any need for human intervention. Different sensors that measure the environmental parameters according to the plant requirement are used for controlling the environment in a smart greenhouse. Then, a cloud server creates for remotely accessing the system when it connects using IoT. Inside the greenhouse, the cloud server helps in the processing of data and applies a control action. This design provides optimal and cost-effective solutions to the farmers with minimal and almost no manual intervention.

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BIOFORTIFICATION

A MODERN WEAPON AGAINST HIDDEN HUNGER: CONVENTIONAL AND NOVEL APPROACHES

Once the father of Green revolution quoted "You can't build a peaceful world on empty stomachs and human misery". But in today's world, filling the stomach with balanced nutritious food has become more pertinent, given the enormity of the problem, called hidden hunger coupled with malnutrition. Changing lifestyle with altered food habits while on one hand has led to undernutrition, poor access to nutritious food by root level people has also pushed a major count of population into the ocean of malnourishment leading to poor health and increased susceptibility to various diseases which in turn drastically affects the socio-economic structure of the country. In spite of the fact that various means like dietary- diversification, food-fortification and medical supplementation are available, it is difficult to reach the economically weaker sections through these means. Considering these points, it is believed that biofortification of crop varieties would serve as an effective breeding tool to combat malnutrition in days to come.

Biofortification, a process of enhancing crop nutrition by utilizing various breeding procedures is resorted with the aim to serve a nutritious product to the targeted community. In order to overcome the problem of malnutrition an individual need to have a regular balanced dietary intake of fruits, vegetables, meat, egg, dairy products and so on. But all these food items are not always accessible by all sections of the population. In a developing country like India majority of the population is consuming less diversified food in their regular diet, considered to be the root cause of malnutrition. In south Asia, nearly 95 % of people are depending only on cereals and pulses for their diet. But cereals and pulses are highly deficient in micronutrients and the available minimum amount also get lost during processing of these crops. Hence their lies the need for working on biofortification of major food crops to enhance and enrich the bioavailability of various micronutrients for the human consumption. The various approaches employed to develop a biofortified crop variety are enumerated henceforth.

Approaches of biofortification conventional approaches:

Agronomic biofortification:

- Supplementation of micronutrients like iodine, copper, iron, zinc, nickel, manganese, molybdenum, etc. in the form of mineral nutrition through foliar or soil application thereby enriching the economic produce with the needed deficient nutrient.
- Addition of microbial biofertilizers like *rhizobium, bacillus, azotobacter*, phosphobacteria, *actinomycetes*, etc. to enhance the uptake of nutrients.

Conventional breeding:

- The available genetic variability in the gene pool of a crop species

can be utilized in the hybridization program to develop a nutrient enriched variety.

- The gene of interest for the nutrient breeding program can also be searched in the wild relatives and tailored as per the need for biofortification.

Example: BRRIdhan 62, BRRIdhan 72 and BRRIdhan 64 in rice for elevated zinc and iron; BHU 1, BHU 3, BHU 5, BHU 6, BHU 17 and BHU 18 in wheat for increased zinc content, etc.

New Plant Breeding Techniques (NBTs): The techniques make specific changes in the plant DNA in order to change the trait of interest. It may be done through single base pair addition, deletion, substitution to removal, or addition of complete gene of interest in an organism. NBTs includes:

Transgenics: The technique of transferring gene of interest searched across genomes of unrelated organism using genetic engineering tools is referred as transgenic technology.

The production of transgenic crops is achieved by recombinant DNA technology that enables to transfer the transgene into a plant cell and integrate into the plant genome for subsequent expression.

Genetically modified cells are selected and regeneration of genetically modified plant is achieved through tissue culture technology. Transgenic approach has been employed to enhance iron and zinc content in crops like rice, wheat, soybean, etc.

Insertions of ferritin and lactoferrin gene in rice and maize crops have been reported to increase the iron uptake.

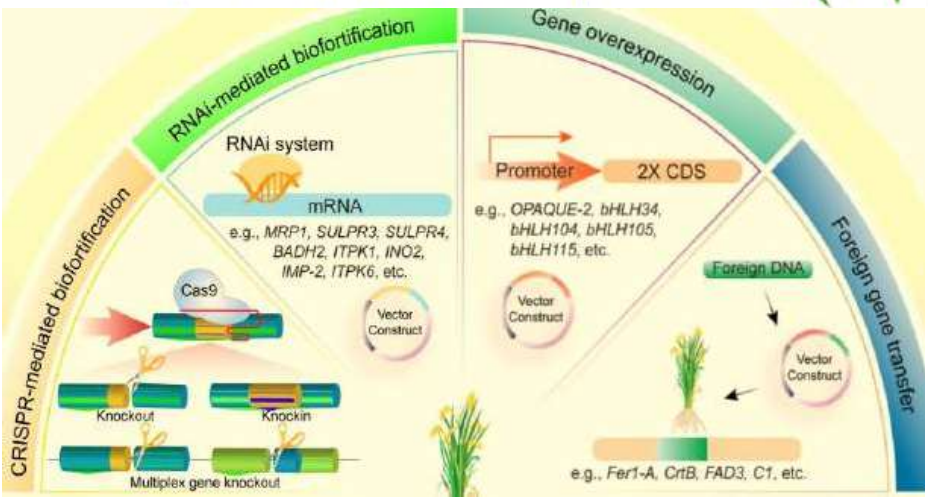

Figure 1: Pictorial representation of some new plant breeding techniques

Gene silencing: The process of suppressing the expression of a gene by using RNA interference technique. It is mainly employed to disturb the gene controlling anti-nutritional factors in crops. LGC-1, a low glutenin containing *Oryza sativa* cultivar was developed through silencing of gluB gene, Carotenoid content in Brassica napus was enhanced by RNA-mediated silencing of ε-Cyclases (ε-CYC).

Gene editing: The technique of insertion, deletion, modification, or replacement in a particular location of a genome without disturbing the other regions. Sequence Specific Nucleases like TALENs, ZFNs, and CRISPR-Cas system are employed for plant genome editing. Low gluten content wheat was developed by down regulating Alpha-gliadin 33-mer gene through CRISPR/Cas 9 technology.

Genome Wide Association Studies: Candidate genes controlling a trait for nutrient enrichment can be identified by using advanced next generation sequencing tools like genotyping by sequencing (GBS) or whole-genome sequencing (WGS) along with extensive phenotyping. Through GWAS, genetic architecture of seed molybdenum (Mo) and selenium (Se) in wild and cultivated chickpea have been ascertained.

Speed breeding approach: Development of biofortified crops in a less generation time is achieved by enabling changes in the crop growing environment like atmospheric temperature, light intensity, plant density, etc. These external stimuli are modified in a precise way for gaining 4–5 generations of a species in a year.

Conclusion

Thus, the limitations in conventional methods of biofortification of crops like lack of genetic diversity, hybridization barriers and unavailability of gene of interest could have been overcome through many technical advancements and new methodologies like genome-wide association studies and comparative transcriptomics studies for gene identification followed by suitable modification through the intervention of new breeding techniques. Nevertheless, the goal of all such endeavours remains centric around enhancing the bio availability of desired nutrients in the crop through their accumulation in the economic product.

MINICHROMOSOME TECHNOLOGY IN AGRICULTURE

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Genetic engineers have harnessed the use of minichromosome technology to improve a plant's genetic traits. Although the minichromosome contains only a small amount of genetic material, it can be modified through genetic engineering to produce bio-fortification, augmentation, or supplementation of the crop's nutritional value. It can also boost crop resistance by introducing new traits like drought tolerance.

Minichromosomes are effective vectors for expressing foreign genes without interfering with the host's natural development and growth due to the small quantity of genetic material they contain. The technique hasn't been thoroughly explored yet, but it has a lot of potential in agriculture. Because of the utilization of the plant's original chromosomes, there is a less negative connotation labeled by consumers compared to other genetically modified foods.

Genetic engineering is a scientific tool that is applied in a wide range of fields, including plant, animal, and human sciences. Plant genetic engineering has revolutionized plant science, with the first generation of transgenic crops becoming the most widely accepted technique in modern agriculture.

Minichromsome in plants:

As previously said, minichromosomes technology is well-known and has been successfully used to humans, fungus, yeast, and other animals. Minichromosomes were discovered in plant systems in the late 1990s. Previously, the function and use of minichromosomes were not well understood or documented in primary literature. Minichromosomes were eventually shown to be extremely valuable in understanding chromosomal function and in plant genetic engineering. Minichromosome technology has recently emerged as a powerful tool for improving crop plants. Technological breakthroughs, such as plant artificial chromosome technology, can improve the potential for genetic engineering by allowing for the management of a high number of genes in the next generation of genetic engineering. Through the above advancements in agriculture, both the herbicide resistant genes and the Bt toxin genes can be introduced into crops for effective weed control and insect resistance. As a result, the engineered crop will reduce the application of pesticides that are harmful to humans and the environment.

The usage of genetically engineered crops has spread across the world's major crop producers. The introduction of Bt toxin and herbicide resistance genes into plants from microorganisms has transformed agriculture, allowing weeds to be successfully controlled and chemical pesticides to be eliminated. Agriculture has undergone the most profound transformation in the last century, and genetic engineering is on track to become the dominant tool for satisfying future agricultural product demand. Arctic apples are one of the first food crops to catch the attention of customers due to features such as non-browning and preservation of flavour and nutritional value. Potato varieties that have been genetically modified to resist potato blight can reduce the usage of chemical fungicides by up to 90%, lowering the environmental impact of potato production. Additionally, potatoes will have less bruising and black spots, better storage ability, and less of a chemical that forms when potatoes are cooked at high temperatures and is potentially carcinogenic.

Researchers have discovered that altering a gene that helps plants grow well in any environment reliably increases corn yields by

10%. The newer varieties of genetically modified corn are drought tolerant, produce greater amounts of ethanol, and have higher lysine content. Insects, herbicides, and drought resistance are all features of these plants. GMO soybean oil has no trans-fat and more monounsaturated fats, which are considered for healthy heart. Herbicides and insects are also tolerant to the new soybean variety.

In Hawaii, genetically modified papaya varieties known as Rainbow and SunUp have been developed to resist papaya ringspot virus. Summer squash and zucchini have benefited from genetic manipulation. Most GMOs are engineered to withstand herbicides or produce pesticides, whereas GMO squash is engineered to resist specific viruses. Zucchini yellow mosaic virus is responsible for the majority of these viral diseases. It is transmitted by aphids and causes affected plants to produce undersized, poor fruit since it is related to ringspot disease in papayas. To improve the quality of canola oil and increase the plant's susceptibility to herbicides, genetic modification is frequently used. GMO canola crops account for nearly 90% of canola crops grown in the United States.

Minichromosomes in arabidopsis:

A minichromsome was discovered in the teleocentric line of A. thaliana using the Fluorescence *In Situ* Hybridization (FISH) method, and it was discovered to be from the short arm of chromosome number 4. This "mini4S" chromosome was estimated to be 7.5 mb in size. The same research group has also recently found two other minichromosomes. These two minichromosomes were found in a transgenic Arabidopsis plant produced by in planta vacuum infiltration technique.

Minichromosome in maize:

Maize minichromosomes have recently been created via telomere-mediated chromosome truncation of the A and B chromosomes. Backcrossing was used to maintain these minichromosomes stable by moving them to a diploid context. They were more interested in B chromosome-based minichromosomes than A chromosome-based minichromosomes because B chromosomes have a variety of fascinating features, including: (1). Truncation of B chromosomes, unlike A chromosomes, would not cause developmental or transmission complications; (2) the shape and location of a B chromosome unique repeat in and around the centromeric region distinguish B chromosome derivatives; and (3) the size of mini-B chromosomes is unimportant because there would be no residual endogenous genes to interfere with plant growth and transgene transmission.

Future prospects of minichromosomes:

Engineered minichromosomes can be used in all areas of future genetic engineering such as-

- recombination at specified sites or retrofitting minichromosomes with additional foreign genes.
- Plant gene stacking, which is now regarded as a difficult task in plant biotechnology.
- Aids in the investigation of chromosomal structure and function, including centromeres, neocentromeres, B chromosome nondisjunction, and chromosomal behaviour in general.
- Minichromosomes can be employed in any plant or crop to introduce numerous genes at the same time while preserving precise gene expression control.
- The minichromosome technology developed by Chromatin can be utilised to transfer genes to the agricultural, nutritional, energy, pharmaceutical, and chemical industries.

Conclusion:

Future innovations may benefit any programme that incorporates the inheritance of numerous foreign genes as a single unit. Plants will also have entire metabolic pathways added to them in order to confer new characteristics or produce large amounts of novel metabolites. To maximise the contribution of foreign genes on the minichromosome, the number of mini-B chromosomes can be increased. Because of the conserved telomere structure, minichromosomes may be generated in most plant species, allowing for a wide range of new uses in most agricultural crops. Engineered minichromosomes also offer an enormous opportunity to improve crop performance. With the rapid expansion of minichromosome research as a second-generation genetic engineering technique, we can expect a new generation of better crop species to fulfil the growing demand. It is currently being used to allow stacking of genes important in herbicide tolerance and insect resistance. With the addition of entire biochemical pathways, plants could gain new characteristics or synthesize new metabolites in the future. Most plant species may create minichromosomes, which can be used in a variety of different ways.

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NEEM: A POTENTIAL BIO-PESTICIDE FOR INSECT-PEST MANAGEMENT

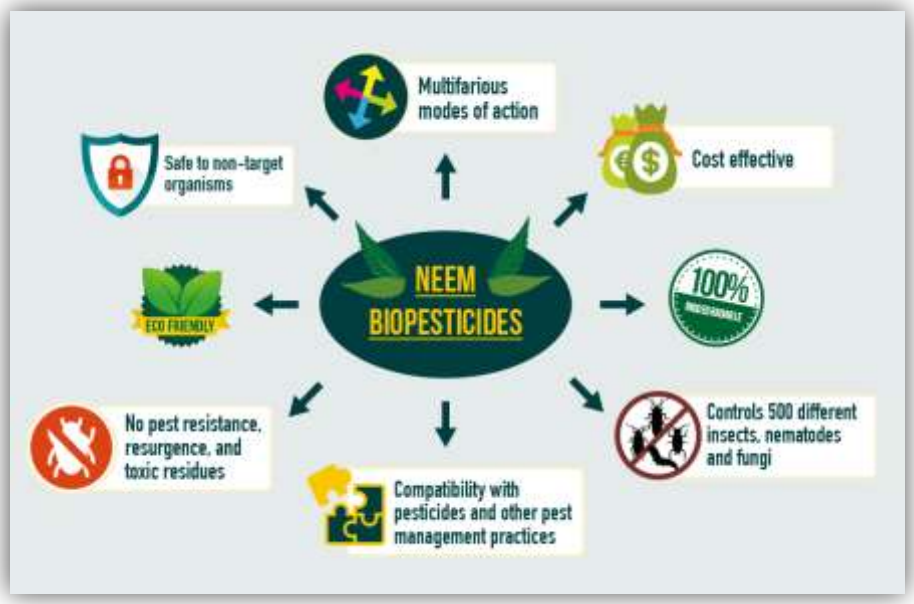
One of agriculture's primary challenges is to enhance food production while minimizing environmental damage. It is in this context that organic approaches are gaining significance in agricultural practices for managing the agro ecosystem as well as sustaining production goals. Moreover, pest management in modern agricultural techniques is frequently performed by the overuse of agrochemicals, which lead to pollution and the creation of resistant pests. Bio pesticides may be a better option than synthetic pesticides in this situation, allowing for safer pest population management. Among various bio pesticides, the naturally grown indigenous Neem, *Azadirachta indica A. Juss*, "the wonder tree" (Family: Meliaceae) finds significance. Moreover, unlike conventional insecticides, neem components target the insect's hormonal system rather than the digestive or neurological systems, preventing future generations from developing resistance. Thus, in the domains of pest control, resistance management, and environmental protection, neem exhibits a lot of promise.

Key components in neem

Neem trees release a variety of defence compounds that operate as a repellent, antifeedant, ovipositional deterrent, growth inhibitor, and toxicant. All components of the neem plant, including the seed, flower, bark, and leaf, have insecticidal properties, but the seed kernel is the most potent. Neem contains limonoids, which attributes to its insecticidal properties. Azadirachtin, salanin, meliantriol, and nimbin are the most important limonoids discovered in neem that have been shown to inhibit insect growth. One of the principal active components, azadirachtin (tetranortritterpenoid), is the most effective natural insect antifeedant. Azadirachtin is a compound made up of seven isomers *viz.* A-G. Isomer E is the most efficient insect growth regulator of all. Azadirachtin is highly unstable and is stabilized by preparing its oil-based extracts. It is somewhat soluble in water and mostly soluble in polar organic solvents *viz*. methanol, ethanol, acetone, chloroform, and ethyl acetate. Typically, aqueous solutions are prepared by dissolving first in ethanol or acetone and then diluting with water. Thus, commercial azadirachtin preparation is preferable to pure azadirachtin. The mode of action of neem is multifarious which includes its repellent behaviour, antifeedant activity, disruption of growth, metamorphosis, and reproduction. Although neem-based formulations may not kill insects directly, they can significantly alter their behaviour to limit pest damage to crops and their reproductive potential. Moreover, azadirachtin works by imitating a natural hormone to impact insect physiology i.e., it acts as an effective insect growth regulator (IGR). Different reports demonstrated that it has an impact on egg production and hatching rates. It can prevent larvae from growing into pupae by inhibiting moulting.

Neem for managing crop pests

Various neem products and formulations are being used to manage insect-pests. These include



aqueous neem seed kernel extracts, solvent extracts, homemade aqueous neem extract, neem oil, neem cakes, neem formulations like Econeem, Nimbicidine, Achook, etc. It has been found that neem when sprayed over the plant surface proved to be an effective antifeedant. Many foliage-feeding species will avoid or stop consuming plants treated with neem-based products. As a result, the extracts are particularly effective at protecting plants from defoliation while causing no harm to helpful pollinating insects such as honeybees. By 1990, scientists had discovered that neem extracts might affect nearly 200 insect species. The insects, for example, sweet potato whitefly, green peach aphid, western floral thrips, diamondback moth, and numerous leafminers, which have become resistant to synthetic pesticides or which are fundamentally difficult to manage with standard pesticides are ought to be managed with the application of neem. The range of insects against which neem as an insecticide proved to be effective includes, desert locust, brown plant hopper, green leaf hopper, cabbage looper, leaf miner, mealy bugs, rice gall midge, sorghum shoot fly, whitefly, bean aphid, pink bollworm, diamond back moth, and spotted cucumber beetle. Prophylactic sprays of neem-based products also prevent the attack of stem borers and armyworms. Aqueous extracts of neem provide effective control of sucking insect-pests of vegetables like cotton aphid, *Aphis gossypii* in okra and cucumber and mustard aphid, *Lipaphis erysimi* on cabbage. Among fruit crops, the menace caused by fruit fly is somehow managed by prophylactic applications of neem formulations, which not only hampers the egg-laying of fruit fly and at the same time does not impact its natural parasitoids (braconid wasps). In general, neem products show medium to broad-spectrum activity against phytophagous insects with little or no effect on natural enemies.

Neem for managing stored grain insects

Further, neem is also used for managing stored grain insects. Traditionally, neem leaves were used to control pests in stored goods. Farmers typically combine neem leaves with grains before storing them for months. Weevils, flour beetles, bean-seed beetles, and potato moths are all insects that are repelled by neem leaves, oil, or extracts. Neem oil treatment of jute sacks is also found effective and prevents pests such as weevils and flour bugs from penetrating. Treating the seeds of gram and other legumes with neem oil deter the egg-laying activity of bean-seed beetles (bruchids) and kill them in the egg stage.

Conclusion

In light of the global concern for sustainable production and environmental protection, neem has received worldwide interest due to its wide-ranging properties. Neem has shown tremendous promise in the management of a variety of insect pests that attack field crops, vegetable crops, fruit trees, and stored products. However, the slow mode of action and partial control of insect-pests limits its adoption by farmers but it can be successfully incorporated into the Integrated Pesticide Management module for managing pest problems.

BASELLA

A NATURAL MULTIVITAMIN SUPPLEMENT

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Basella commonly known as Malabar spinach, poi or Indian spinach is a popular summer vegetable in India. It is widely grown in tropical parts of new world, Asia and Africa. The plant is valued for its edible leaves and succulent stem. It has a trailing growth habit so the vines are trained on poles, pandals, trellis or grown on ground.

Nutritional importance

The young shoots and leaves are rich in salts and vitamins like calcium, iron, Vitamin A, Vitamin C and Vitamin B. It is a good source of fibres. Due to water soluble nature of nutrients, basella is primarily consumed in soups and stews. The leaves and stems are enriched with mucilaginous substances which are used as poultice. The juice of leaves is beneficial in curing constipation, particularly in infants and pregnant women. Basella contains secondary metabolites like saponins that act as phytochemicals. Roots of basella are used as rubefacient and poultice to reduce local swellings. A diuretic and mild laxative by nature, basella is applied to boils and ulcers. It has been found useful in treatment of gonorrhoea and balanit. Stem and leaf extracts cure headache and cancer.

Cultivars

There are two types of cultivars-

1. Red petioles, stem and leaves (*B. rubra*)- more common in West Bengal, Assam and South India
2. Green petioles, stem and leaves (*B. alba*)- commonly cultivated in U.P. and Punjab.

Basella is a water loving crop. Partial shade favours luxuriant growth of the plants and results in the formation of bigger leaves. The crop is sensitive to frost. Sandy loam soil is best suited for it's growth.

Propagation

Basella is mainly propagated through seed but stem or root cuttings can also be used to obtain true-to-type progenies. Sowing time varies in different parts of the country. While seeds are sown during March to May in northern and eastern parts of India, the crop is sown twice in Southern India, once in July and again in October-November. In the hilly regions, late spring or early summer is considered as the best time to sow the seeds. 12-15 kg seed is considered sufficient to raise crop in one hectare area.

Nutrient supply

Healthy rich soil is essential for a good crop. 200-300 q/ha of well decomposed farmyard manure is applied at the time of field preparation. A basal dose of 40-60 kg/ha phosphorus and potassium should be applied to soil at the time of sowing. Nitrogenous fertilizers play important role in boosting the vegetative growth of the plant. Therefore, 60-80 kg/ha nitrogen is applied to the soil in two to three split doses.

Water requirement

The crop requires 5-6 irrigations in total during the entire cropping season. The frequency of irrigation depends on the soil type. Sufficient moisture contributes to rapid and succulent growth of the plants. Moisture imbalance may lead to thin, wiry stem and small leaves.

Harvesting and yield

Harvesting begins after 8-10 weeks of sowing. The plants raised from root or stem cuttings develop early and become ready for harvesting in about 6 weeks after transplanting. One can get an average yield of 140-185 q of leaves and stems per hectare. *B. alba* gives a higher yield of 250-700 q/ha.

Plant protection

Basella is rarely attacked by any pest. Minor incidence of ermine moth has been observed. The crop is susceptible to wide range of pathogens. Damping off (*Pythium aphanidermatum*) and leaf spot (*Acrothecium basellae*), *Fusarium moniliforme* and *Cercospora sp*.) are the most commonly occurring diseases.

Seed production

Basella crop matures in spring in North India and in winter in South and East India. The seeds enclosed within fleshy berries are allowed to mature until the fruit ripens. The ripe fleshy fruits borne in clusters are collected and seed is extracted by fermentation method. The seeds are dried prior to storage to enhance the shelf life.

■■■


GARDENING OF ORGANIC VEGETABLES

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Organic vegetable gardening

Gardening without the use of pesticides or fertilisers. Synthetic fertilisers, pesticides, growth hormones, and regulators are prohibited under this system. The goal is to produce high-quality, nutritious food while also increasing income and employment.

According to IFOAM

Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved."

Hence, Can be Defined as:- The practices that emphasize the use of renewable resources, conservation of energy, soil, water, environment maintenance and enhancement along with the production of optimum qualities of produce without the use of artificial or synthetic fertilisers.

Need for organic vegetable gardening

- Being component of organic agriculture, organic vegetable gardening enhances and promotes natural diversity and biological cycles on the farm.
- It is based on the making garden self-sufficient and sustainable rather than relying on synthetic fertilizers and pesticides.

Why vegetables are preferred for organic gardening?

- Short duration crops
- Fits very well in the different multiple and inter-cropping system
- Capable of giving high yields and high economic returns in a short period of time
- Generating on farm and off farm employment.

Concept behind organic gardening:

Focuses on increasing the biological fertility of the soil so that crops can absorb the nutrients they require. The development of an ecological balance within the system helps to control pests, diseases, and weeds. Within a farm, recycle all wastes and manures.

Transitioning to organic gardening

Organic production of vegetable is a long-term process which is carried out in stages rather than a single production practice adopted within one growing season. Adopting organic production techniques involves a transition from conventional to organic gardening. The very first step in this transition is improving and maintaining soil fertility or quality. Thus we can say that healthy and fertile soils are the base of successful organic vegetable production.

Organic disease management:

- **Site selection:-** Choose a well-drained soil for growing vegetables.
- **Resistance or tolerance:-** Select disease-resistant vegetable varieties for growing.
- **Disease-free transplants:-** Many vegetables can be established as transplants. Thus, select healthy seedlings for transplanting.
- **Crop rotation:-** Continuous cropping of plants in the same botanical family allows for build-up of disease organisms. Hence, healthy crop rotation should be followed.
- **Rogue infected plants:-** Root out and destroy any plant showing severe disease symptoms to prevent the spread to adjacent plants.
- **Mulching:-** Organic mulches such as straw, hay, compost, newspaper or wood shavings will aid in disease prevention by reducing direct contact between soil and the plant.
- **Plant spacing and training:-** Dense plantings can often increase susceptibility to diseases. Proper spacing and training should be followed.
- **Sanitation:-** To prevent plant diseases from one growing season to the next, clean all planting trays and growing supplies such as wooden tomato stakes, planting trays and harvest containers.
- **Organic pesticides:-** Organic fungicides for vegetables include copper (Bordeaux mixtures or sulfates), hydrogen peroxide, and sodium bicarbonate (baking soda). Organic growers should check the OMRI list or consult the certifier before applying any new chemical.

Organic weed management

- **Reduce the weed seed bank:-** Raw manure, immature compost, hay or straw may contain weed seeds.
- **Flame weeding:-** Flame weeding, or using a hot flame to kill weeds, is effective for stale seed bed weed removal or weeds that emerge before the vegetable crop. Effective for weed control in slow-germinating vegetables such as onions, parsnips and carrots.
- **Drip irrigation:-** Drip irrigation reduces weed emergence by reducing the soil area that receives water.
- **Solarization:-** Clear plastic spread across an area where crops will be planted can kill weeds, weed seeds and even some plant pathogens.
- **Organic herbicides:-** Organic gardeners can use various organic herbicides, including acetic acid (vinegar), citric acid and corn gluten meal to control weeds.

Organic insect management

- **Habitat for beneficial insects and trap cropping**:- Create an environment favourable for natural enemies of harmful insects. More than 100 families of insects, spiders and mites contain species that are natural enemies of harmful insects.
- Insect traps are used to monitor and reduce populations of insects by trapping and killing them. For eg, yellow sticky traps attract whiteflies, aphids and other insects by colour.
- **Organic insecticides:-**Several organic insecticides are available for use by vegetable gardeners, including Bt (*Bacillus thuringiensis*), pyrethrums, rotenone, insecticidal soaps, diatomaceous earth, neem and horticultural oils.
- **Row covers:-** Row covers are lightweight, spunbonded fabrics that can be suspended or draped over vegetables to protect them from invasive insects.
- **Date of planting:-**Many vegetable insects will have peak populations throughout the growing season. Avoid high populations of insects by adjusting the planting date. For eg; Cutworms, aphids and root maggots tends to be more severe during early in the spring and decline severity as temperature increases and rainfall decreases.

Benefits of organic farming

- Consumer Benefits
  - Higher Nutrition
  - Poison free
  - Good Keeping quality
- Grower Benefits
  - Healthy soil
  - Drought resistance
  - Added value

Limitations

- Cost of organically grown vegetable is considerably higher.
- Marketable yields are frequently less with organic production as compared to traditional.
- Sources of nutrients and organic matter are limited.
- Greater time is required.
- Requires considerable skill to farm organically.

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ADVANCES IN BIOTECHNOLOGICAL APPROACHES

FOR IMPROVEMENT IN CUCURBITACEAE (PGRs) IN FIELD CROPS

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The *Cucurbitaceae* or cucurbit family (commonly referred to as the cucumber, gourd, melon, or pumpkin family) consists of most of its members with commercial important vegetables and fruits. The genus name comes from the Classical Latin word cucurbita, "gourd". *Cucurbitaceae* members are primarily found in the tropical regions of the world. China stands first in cucurbit production, closely followed by Turkey, India and Iran.

The *Cucurbitaceae* are among the more important plant families that supply man with edible products and useful fibres. It has a special place in an Indian diet, as a sources of carbohydrates when cooked (squash Pumkin, Marro, Chayote) or breakfast fruits (watermelon, muskmelon), as ingradients of salads (Cucumber, Gherkin) or as pickles (Cucumber, Gherkin). There are other minor uses of cucurbits, for example, the fruits of Langenaria Siceraria (white flowered gourd), before the advent of pottery, were indespensible to primitive peoples around the household; the rinds of some mature fruits were used for baskets, jugs, pots and cutlery; and the fibrous material of Luffa (dish-rag gourd was used for scouring).

Biotechnological approaches used for cucurbits improvement

Scientists and Year	Properties	Biotechnological tool used / Remarks
Melon- *Citrullus lanatus*		
Chen *et al*. (1998)	Resistance to *Fusarium* wilt	Squash DNA was transferred via the pollen tube pathway, and the co-transformation of GUS gene
Ellul *et al*. (2003)	Expressed the *Saccharomyces cerevisiae HAL1* gene related to salt tolerance.	*Agrobacterium*-mediated gene transfer
Sheng-Niao *et al*. (2005)	Resistance to virus diseases, *Watermelon mosaic virus* (WMV) coat protein (CP), and replicase genes of *Zucchini yellow mosaic virus* (ZYMV) and *Cucumber mosaic virus* (CMV)	*Agrobacterium-mediated transformation*
Cucumber- *Cucumis sativus*		
Yin *et al*. (2004)	seedless cucumber fruits	By transferring the *pDEfH9: iaam, DefH9* promoter was from *Antirrhinum majus* and the *iaaM* coding sequence was from *Pseudomonas syringae*.isolated from *Pseudomonas syringae* pv *savastonai*.
Bitter Gourd- *Momordica charantia*		
Tuan *et al*. (2011)	Carotene accumulation	Gene expression levels of phytoene synthase (*McPSY*) and phytoene desaturase (*McPDS*)
Thiruvengadam and Yang (2010)	Transformation and regeneration protocol	Used the GUS and NPT II genes, via callus culture and shoot regeneration on medium containing TDZ (thidizuron) and NAA.
Lin and Do	ACC synthase (ACS) gene	By pollen electroporation method

(2008)		
Muskmelon- *Cucumis melo* L.		
	Antibiotic tolerance to kanamcin	*Atwbc19* gene transferred from *Arabidopsis thaliana* ATP binding cassette (ABC) transporter
	Inhibition of high ethylene levels	Antisense ACC oxidase gene driven by the 35S promoter
	Double Haploidy	By Anther culture
Pumpkin/ Squash- *Cucurbita pepo*		
Variety ZW-20	Resistant to *Watermelon mosaic virus-2* (WMV2) and *Zucchini yellow mosaic virus* (ZYMV).	Derivatives of the cultivar 'Yellow Crookneck', obtained after *Agrobacterium*-mediated transformation of leaf discs. transformed using the A208.35 *A. tumefaciens* strain with the ZYMV72/WMBN22 vector, a modified pPRBN vector.
Variety CZW-3	Resistant to *Cucumber mosaic virus* (CMV), *Watermelon mosaic virus-2* (WMV2) and *Zucchini yellow mosaic virus* (ZYMV).	Derivatives of the cultivar 'Yellow Crookneck', obtained after *Agrobacterium*-mediated transformation of leaf discs.

GM melon is not approved for cultivation although it is approved as food.

Conclusion

After going through almost all the genetic improvement techniques used in cucurbits family, so far and understanding almost all the plant transformation techniques employed either antibiotic selection markers such as kanamycin, hygromycin etc., or herbicide selection markers such as PPT, glyphosate, or tissue culture etc., it can be concluded that scientists have successfully transformed the cucurbits, for various characters like- biotic and abiotic resistance, fruit nutritional quality etc. But, because of the number of possible but unlikely, unfounded and unsubstantiated food safety, health affecting concerns has been raised for using the transgenic plants, especially when these GMOs are used as food. Therefore, no promising varieties or cultivars have been developed in Cucurbitaceous family (Cucurbits) for commercial purpose, till now. To allay these concerns, it is prudent to explore alternate selection procedures that are unlikely to transfer to the natural environment and lower perceived health risks. Hopefully, in near future, improved GM varieties of cucurbits may become commercialized with the advances in the field of genetic transformation.

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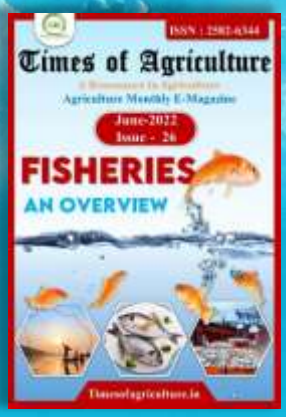

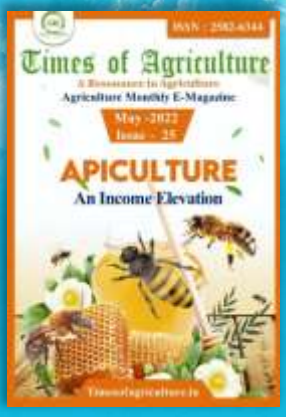

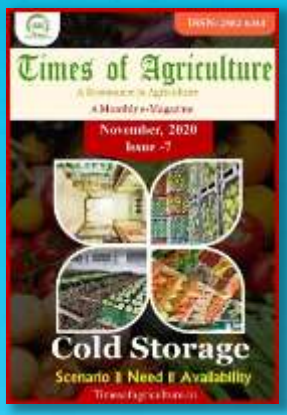

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