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Times of Agriculture

A Resonance in Agriculture

Monthly Agriculture E-Magazine

December-2022

GM MUSTARD

Will it be a Game Changer ?

Timesofagriculture.in

FROM THE EDITOR'S DESK

Dear Readers, we are pleased to announce the release of the December issue of **Times of Agriculture e-magazine**. As you all know that Times of Agriculture shares important trending topics of agriculture in each issue so that you are always full of new information. The aim of our magazine is to make its readers aware of the latest information and innovation in Agri and allied sectors.

In this issue, various activities and innovations happening in the agriculture sector have been shared through agriculture updates. The theme of this December issue is **GM Mustard: Will it be Game Changer?** Although it remains a debatable issue, but this can prove to be a worthwhile effort in achieving India's self-sufficiency in oil production and reducing oil imports.

Dear readers, love, and affection towards **Times of Agriculture e-magazine** family are increasing progressively and appreciation of the magazine's efforts is reaching us from time to time through various mediums from great personalities associated with agricultural science. Your love inspires all of us to do more good work.

Best wishes to all of you for the upcoming new year.

Dr. Devraj Singh
Editor-In-Chief

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Monthly Agriculture e-Magazine

About us

"Times of Agriculture" is a monthly agriculture 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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Azadi Ka Amrit Mahotsav

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AGRICULTURE UPDATES

Scientists develop paddy varieties that require 30% less Phosphorous

Scientists at **Indian Institute of Rice Research** have developed paddy varieties that required at least **30% lower phosphorus**.

DRR Dhan 60 is the first rice variety in the country with low phosphorous tolerance for any crop.

DRR Dhan 60 {RP 5970-2-6-19-16-24-1 (IET 28061)} is a **Marker Assisted Selection** (MAS) derived low soil phosphorous, bacterial blight resistant, high yielding and fine-grain type rice culture developed in the genetic background.

Indian Startup Kheyti among the 5 winners of The Earthshot Prize

Indian startup **Kheyti**, which provides ground-breaking yet simple farming solutions, has been named as one of the five winners of this year's prestigious **Earthshot Prize**, an initiative of that rewards each winner with **1 million pounds ($ 1.2 million).**

Kheyti, won in the **category Protect and Restore Nature which offers a pioneering solution for local smallholder farmers to reduce costs, increase yields and protect livelihoods** in a country on the frontlines of climate change, according to the statement on the Earthshot website.

India hosted the 2nd Agriculture Ministerial level meeting of BIMSTEC

India hosted the **2nd** Agriculture Ministerial-level meeting of the **Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)** under the chairmanship of the Union Minister for Agriculture Shri **Narendra Singh Tomar.** Agriculture ministers of **Bhutan, Bangladesh, Nepal, Myanmar, Sri Lanka and Thailand** participated in the meeting.

Himalayan Yak has been approved as a 'Food Animal' by FSSAI

The **Himalayan Yak** has been approved as a 'food animal' by the **Food Safety and Standard Authority of India (FSSAI).**

The move is expected to ***help slow the decline of the high-altitude bovine animal population by incorporating it into the conventional milk and meat industries.***

The FSSAI's recognition of the Yak as a food-producing animal will help farmers benefit economically from rearing the animal and will open up several vistas of economic benefits for both farmers and food processors.

100 Fodder-Centric FPOs Will be setup in 2022-23

The government has designated **National Dairy Development Board (NDDB)** as the implementing agency for setting up of **100 fodder-centric Farmer Producer Organisations (FPOs)** during this fiscal **to address the fodder deficit situation in the country.**

Ministry of Fisheries, Animal Husbandry and Dairying **proposed the setting up of fodder-centric FPOs in 2020.**

It requested the Union Agriculture Ministry to permit the establishment of fodder-centric FPOs under the central scheme ***"Formation and Promotion of 10,000 new FPOs".*** **During 2020-23, 100 of these FPOs** will be set up by NDDB under this scheme.

Krishify integrated with Platform of Platforms (PoPs) portal by e-NAM

Social networking platform for Indian farmers, **Krishify**, has integrated with the **Platform of Platforms (PoPs)** portal by **e-NAM**.

e-NAM would direct users to Krishify, where they may ask the pool of professionals for assistance. As a service provider, Krishify will provide **advisory services** to farmers widening the reach beyond the **1 crore user** base on its social network and consequently, catering to the needs of **14 crore farmers** in India.

HarvestPlus wins FICCI Award

HarvestPlus received the **'Sustainable Agriculture Awards 2022'** from the **Federation of Indian Chambers of Commerce & Industry (FICCI)** in New Delhi. This is the 2nd edition of the awards and HarvestPlus received this award under the **"Innovative Technology/Services Promoting Sustainable Agriculture" category.**

The list of awardees included global FMCG giants like **Coca-Cola, Yes Bank, ITC** and **Nestle, among others**.

Two high-yielding varieties of wheat introduced in Himachal

The **Himachal Pradesh Agriculture Department** has introduced two high-yielding varieties of wheat — **DBW 222 and DBW 187 — to boost foodgrains production in the state**.

These varieties have yield of **60 quintals** per hectare, compared to 35-37 per quintal of existing varieties.

Around 23,000 quintal seeds of these two varieties have been supplied to farmers at 50% subsidy.

First greenfield farm machinery plant of Mahindra & Mahindra

Union Agriculture Minister **Narendra Singh Tomar** inaugurated the **first greenfield farm machinery plant** of Mahindra & Mahindra at **Pithampur in Madhya Pradesh.** ***"India has reached a point where the world looks at us with hopeful eyes"*** Shri Tomar said that to make the country fully developed, we have to be fully equipped with technology.

National Milk Day

Department of Animal Husbandry were celebrated National Milk Day on **26th November 2022.**

26th November 2022 commemorates 101st birth anniversary of Dr. Verghese Kurien, the "Father of White Revolution in India".

COVER STORY

GM MUSTARD

Will it be a Game Changer ?

About the Author

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A bench of scientists are supporting it whereas, on the other hand, the fear and reservations expressed in some quarters. In fact, such objections are not new. ***They were also expressed when we imported the dwarf miracle seeds of wheat and rice to achieve food self-sufficiency through the Green Revolution.*** **The same concerns were raised when *Bt*-Cotton was being released.** Science-led revolutions have given India self-respect and global recognition.

In 2020-21, around **13.3 million tonnes of edible oil were imported** at a **cost of ₹1,17,000 crore**. Interestingly, of this, **2.0-2.5 mt soybean oil and 1.0-1.5 mt canola oil is already GM.** Hence, **we are consuming GM oil already, besides, the 1.5 mt of GM cotton oil produced domestically.**

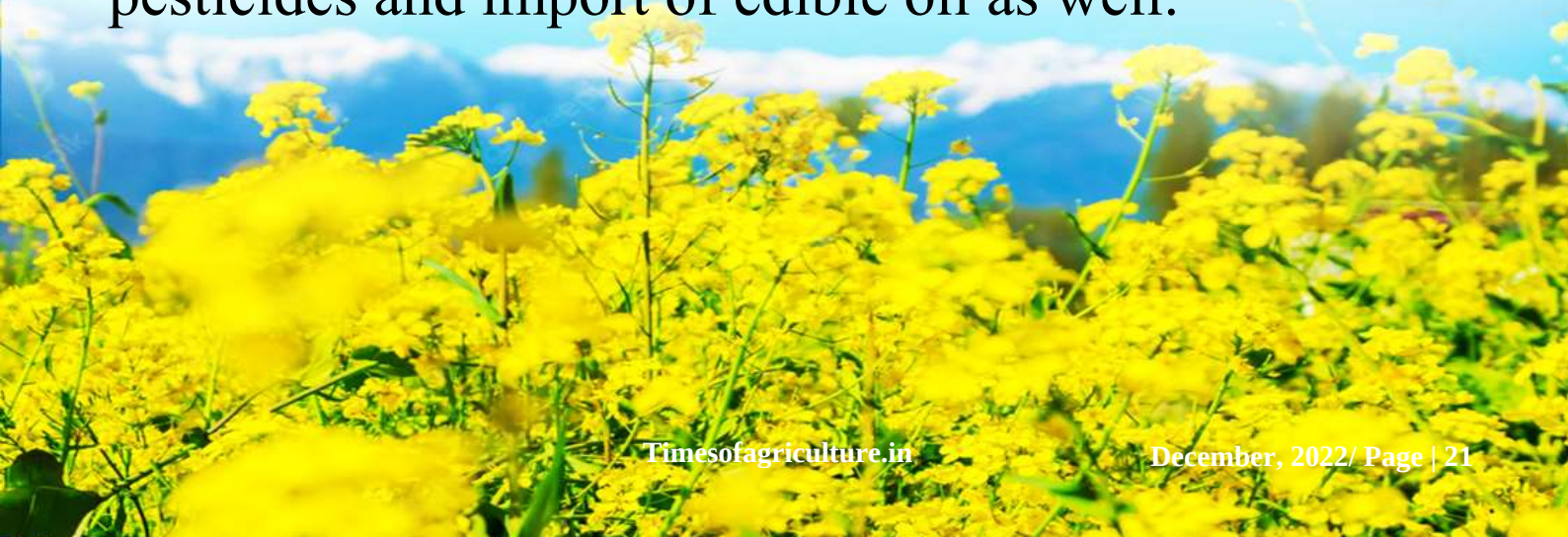
Moreover, it is scientifically proven that the consumption of refined oil does not allow any protein to enter the human system. **Thus, the consumption of GM oil is completely safe from a health point of view.**

Mustard at a glance

Mustard (*Brassica juncea*) is cultivated **in 6-7 million hectares** during the *Rabi* winter season predominantly in ***Rajasthan, Haryana, Punjab and Madhya Pradesh.*** India imports about **55-60% of its domestic edible-oil requirement.** This is primarily ***due to low productivity of about 1-1.3 t/ha*** that has been stagnant for over two decades.

Between Oct. 1 and Nov. 15, the **total oil-seed area touched 7.6 million hectares,** up from 6.7 million hectares during the same period last year. Although a major concern of our farmers is that yields of mustard are low and have stagnated for a long time at around 1,260 kg/ha, much lower than the global average of 2,000 kg/ha.

Yields of canola in Canada, China and Australia are almost three times higher than in India since they use GM hybrid technology. Thus, the government's decision to allow the production of GM Mustard hybrids will go a long way in increasing our yields, while reducing the use of pesticides and import of edible oil as well.



The story so far

The **Genetic Engineering Appraisal Committee (GEAC),** India's apex regulator of genetically modified plants and food products, has approved the environmental release of **Dhara Mustard Hybrid-11 (DMH-11),** a genetically-engineered variant of mustard. If approved for commercial cultivation it would be the first genetically modified food crop available to Indian farmers.

What is DMH-11?

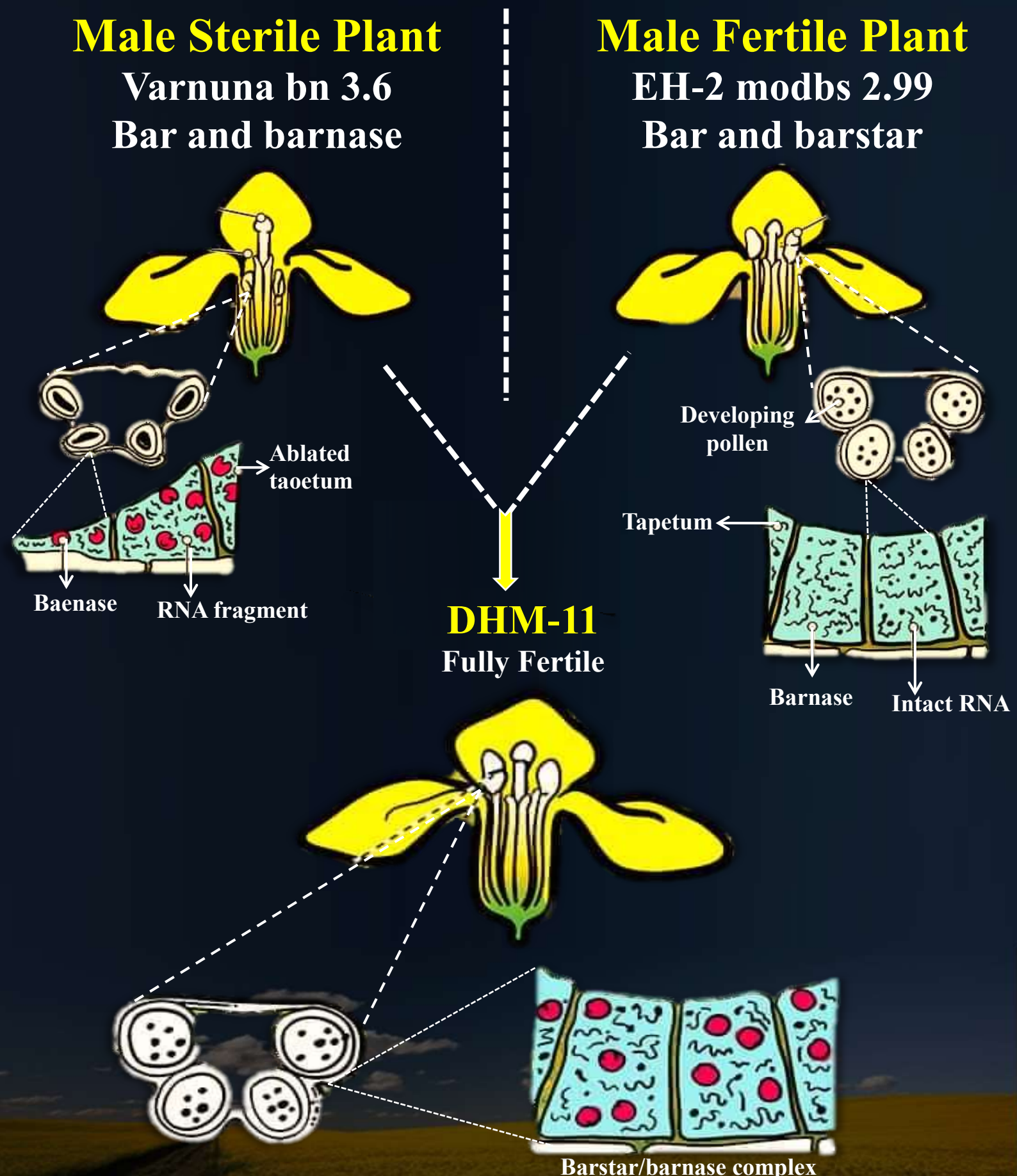
DMH-11 is a transgenic hybrid variant of mustard developed by researchers ***at Delhi University's Centre for Genetic Manipulation of Crop Plants (CGMCP).*** It began with DMH-1, a hybrid variant that was developed without transgenic technology. ***DMH-1 was approved for commercial release in northwest India in 2005-2006 but it is not cost-effective because hybridisation isn't easy in mustard.*** As is a self-pollinating crop and therefore it is challenging to cross different varieties and induce desirable traits. Being able to turn off this self-pollinating trait to enable such crossings and then restoring the trait, to enable seed production, is how the mustard plant's genes are to be manipulated. By genetic modification, scientists have developed the hybrid mustard **DMH-11** containing two alien genes isolated from a soil bacterium *called* ***Bacillus amyloliquefaciens.***

The *Barnase/Barstar* GM Technology

The first gene ***'barnase'*** codes for a protein that impairs pollen production and renders the plant into which it is incorporated male-sterile. **This plant is then crossed with a fertile parental line containing the second gene '*barstar*'** that blocks the action of the *barnase* gene. **The resultant F_1 progeny is both high-yielding and also capable of producing seed/ grain, thanks to the barstar gene in the second fertile line.**

The CGMCP scientists have deployed the barnase-barstar GM technology to create a robust and viable hybridisation system in mustard. This system was used to develop **DMH-11 by crossing a popular *Indian mustard variety* 'Varuna bn 3.6' (the barnase line) with an *East European* 'Early Heera-2 modbs 2.99' mutant (the barstar line).** The result is DMH-11 (*where 11 refers to the number of generations after which desirable traits manifest*) that not only has better yield but is also fertile. **DMH-11 is a transgenic crop because it uses foreign genes from a different species.**

Principle of the Barnase/Barstar system



Are hybrid mustard varieties better?

ICAR conducted trials at **8 locations** over 3 years and suggest that DMH-11 has **28% higher yields than its parent Varuna and was 37% better than zonal checks,** or local varieties that are considered the best in different agro-climatic zones (ICAR, 2022).

What has GEAC now done?

In this case, it has recommended the environmental release of DMH-11 ***"for its seed production and testing prior to commercial release",*** a green signal for commercial cultivation by farmers. GEAC has also recommended the environmental release of DMH-11's parental lines (carrying the barnase and barstar genes) for them to be used to develop new hybrids. Such hybrids could give even higher yields than DHM-11.

So, will Indian farmers plant GM mustard?

Definitely not this year, since there are no seeds available and the planting season for the crop (October to early-November) is virtually over. **The IARI has said that the crop would be commercially available after three seasons now that they can be grown in large quantities for evaluation. Also, it remains to be seen if the central government will accept the GEAC's recommendations.**

Why is it controversial? Why did it take so long for GEAC to clear?

There are **two main reasons** why transgenic mustards are a topic of debate. **The first is the use of genes that are foreign to the species. Secondly, the presence of a third 'bar' gene, which makes GM mustard plants tolerant to the spraying of glufosinate ammonium, a herbicide.** This, the opponents allege, will cause displacement of manual labour and promote use of chemical herbicides.

The DMH-11 developers, however, say that bar is only a marker gene**. It is used to identify those plants that have been genetically modified - the non-GM ones cannot withstand application of the herbicide - and necessary for large-scale seed production.** The GEAC has recommended the ***"usage of any formulation of herbicide exclusively for hybrid seed production",*** while not permitting the same ***"for cultivation in the farmer's field under any situation".***

Will GM mustard prove as a catastrophe for honeybees?

The concern over GM mustard is threatening or undermining the population of honey bees and this could have knock-off environmental catastrophes.

However, the **GEAC** has cited the report of an expert committee which stated that **"based on the examination of scientific evidences available globally it seems unlikely that the bar, barnase and barstar system will pose an adverse impact on honey bees and other pollinators"**

-The Indian Express, 2022.

The GEAC has, at the same time, recommended that **the applicant (CGMCP) should conduct "field demonstration studies with respect to the effect of (GM mustard) on honey bees and other pollinators"** post the environmental release, **"to generate scientific evidence in the Indian agro-climatic situation and as a precautionary mechanism".**

What next for GM mustard?

This isn't the first time that the GEAC has cleared the environmental release of GM mustard. In 2017 too, the apex body had cleared it but the process got stalled after a case was lodged in the Supreme Court. ***Bt*-Brinjal, the first transgenic food crop, too was cleared by the GEAC in 2009 but was put on hold by the then government on the grounds that more tests were needed. Currently the only transgenic crop grown in India is *Bt*-cotton.** The GEAC go-ahead only allows DMH-11 to be grown in fields under the supervision of the ICAR.

Even as the Supreme Court has called for status quo on planting genetically modified mustard, jeopardising the latest **GEAC "environmental" release of DMH-11, for many the latter's nod in itself is a milestone in the history of Indian agriculture research**.

The compelling motive here could be India's spiraling edible oil import bill. **The country produces only 8.5-9 mt of edible oil annually, while importing 14-14.5 mt which costs a huge amount of $18.99 billion in the fiscal year ended March 31, 2022**.

-Directorate of Economics and Statistics, 2022

DMH-11 rather than being an end in itself signals the proof of success of the barnase-barstar system that can act as a platform technology to develop newer hybrids. **This system of hybrid seed production provides hybrid seed with high purity and can be transferred to any set of combiners using backcross breeding, as compared to conventional Cytoplasmic Male Sterility (CMS) systems.** Moreover, mustard varieties in India have a narrow genetic base. The barnase-barstar system enables breeding of hybrids from a wider range of mustards, including those of East European origin such as **'Heera'** and **'Donskaja'. New traits relating to resistance against disease** ***(alternaria blight and stem rot fungus***) or **Canola oil quality** ***(zero/ low levels of erucic acid and glucosinolates)*** can also be intoduced.

ETHANOL BLENDED PETROL PROGRAMME (EBPP)

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What is ethanol?

Ethanol is a bio-fuel produced naturally during the fermentation of sugars with the help of yeast or by petrochemical processes such as ethylene hydration. It has disinfectant and antiseptic properties. It is used in the synthesis of organic compounds and also as a chemical solvent besides as a substitute for fuel.

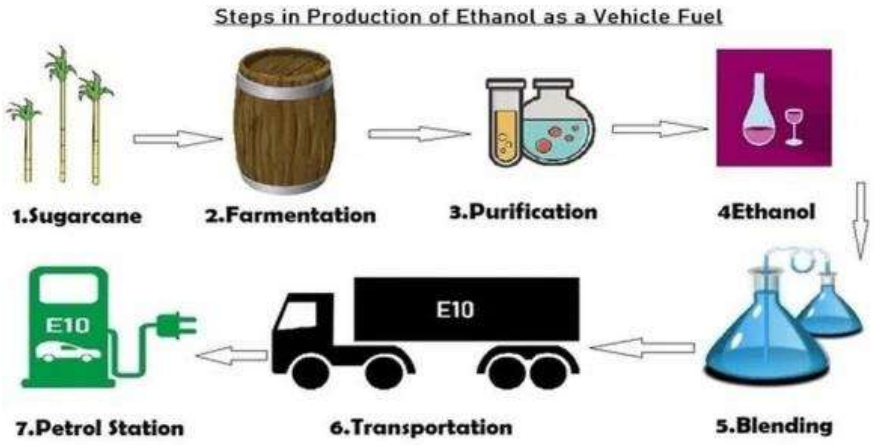
What is ethanol blending?

An ethanol blend is a motor fuel containing a mixer of petrol blended with at least 99% pure ethyl alcohol which is derived from agricultural products.

Ethanol Blended Petrol Programme

EBP programme was launched in 2003 under the Ministry of Petroleum and Natural Gases in accordance with National Policy on Bio-fuels with an aim to increase the use of sustainable, renewable and environmentally friendly fuels. This reduces our dependence on non-renewable fuels like diesel, petrol and imports.

- The blending was initially stated with 5% and the government has set a target to blend 10% ethanol by 2022 and 20% ethanol (E20) by 2030.
- Under the programme, oil companies will be procuring ethanol form the sources at the rates fixed by the government.
- Till 2018, ethanol was obtained only from sugarcane but later maize, bajra, fruit and vegetable waste were also used to produce ethanol.
- The programme was expanded to whole India expect Andaman and Nicobar, Lakshadweep islands from 1, April, 2019.
- Ministry of Petroleum and Natural Gases has issued "Long term Ethanol Procurement Policy" under EBP programme on 11.10.2019.



Benefits of ethanol blending

- When compared to the fossil fuels which are produced by the process of fossilization, ethanol is a bio-fuel obtained mainly from organic matter through fermentation process. This makes ethanol plant based, renewable and environmentally safe.
- As ethanol is rich in oxygen, vehicles produce less carbon emission reducing the carbon footprint.
- By blending petrol with 20% ethanol, we can save Rs. 30,000 crores on the import of fuels.
- With this move, farmers can also gain an additional income by selling their surplus produce and broaden the base of ethanol production.

Impact of using E20 as a fuel

Impact on vehicle manufacturers:

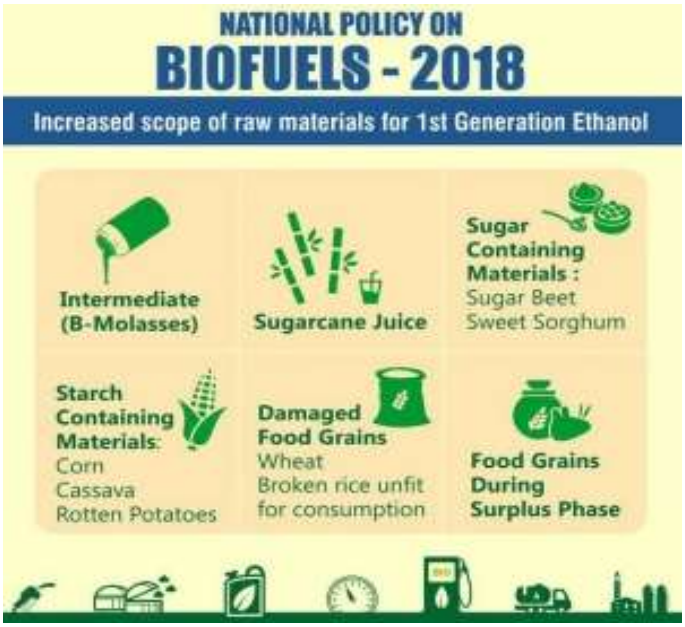
- Engines and components should be tested such that they can work efficiently with the E20 fuel but there will be no major changes in the assembly of the components.
- Vendors have to procure additional components which are compatible with E20 fuel.

Impact on environment:

- Use of ethanol reduces carbon emissions by 30% in four-wheeler and by 50% in two wheeler vehicles.
- Emission of hydrocarbons is also reduced with the blended petrol when compared to non blended petrol.

Impact on customers:

The efficiency of vehicles will be reduced by



- 6 to 7 % in 4 wheelers designed for E0 and E10 is calibrated,
- 3 to 4 % in 2 wheelers designed for E0 and E10 is calibrated and
- 1 to 2 % in 4 wheelers designed for E10 and E20 is calibrated.

However, the loss in efficiency can be minimized by making improvements in the engine.

Challenges in Ethanol Blending Programme

Although the programme is promising, it still has several challenges and concerns:

Availability of sufficient raw material on a sustainable basis:

Based on current regulations, ethanol can be produced from sugarcane, molasses, maize, damaged food grains unfit for consumption, surplus rice. In the period of hunger and malnutrition, diverting food grains from human consumption to ethanol production is a rising issue.

Availability of ethanol:

Due to area specific availability of ethanol, the transportation and logistics cost for supply of ethanol all over the country is increasing. Moreover, handling and storage of ethanol are also risky because of its high flammable properties.

Production facilities:

Ethanol production is mainly confined to sugar producing states and these mills were able to supply only 57.60% of the total raw material required for the production of ethanol. In order to achieve goal of 20% blending by 2030, the production of ethanol should be increased.

Challenges for vehicle manufacturers:

Vehicle manufacturers should focus on producing parts that are more compatible with ethanol and help in increasing the fuel efficiency.

Environmental clearances:

As ethanol production fall under "Red category", clearance under the Air and Water acts is required for new projects/ for expanding existing projects.

Price uncertainty:

The price of bioethanol is leading concerns among the investors as both sugarcane and ethanol prices are fixed by the government.

■■■

AGRI-ENTREPRENEURSHIP
A RISING SECTOR

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India is an agrarian country with about 65% of its population, either directly or indirectly engaged in agriculture and allied sectors. It is among one of the core sector of the country, providing employment to 2/3rd of the work force and contributing approximately 24% of nation's GDP in 2020-21. Agriculture is practiced throughout the country stretching from the hilly areas of Jammu Kashmir to the coastal areas of Tamil Nadu.

Agri-Entreprenuer is an individual / person who unites all means of production i.e, land, labour and capital to produce an agricultural produce (both organic food and fortified products),developing agri-business units ,establishing agro-service centers in accordance with rising demand. Wide varieties of agricultural crops, vegetables, spices, medicinal crops etc are grown throughout the country. Different types of soil, varied agro-climatic zones, varied ecosystem supports the cultivation in vivid topography throughout the year. It also helps in establishing entrepreneurial units in agri-inputs for the manufacture of pesticides, fertilizers, agricultural implements, hybrid varieties of seeds etc. Having such a wider scope in Agriculture attracts the interest of people towards it, in this way Agri-entrepreneurship comes into light.

Opportunities for agri-entrepreneurship:

- In India, malnutrition is still a problem which needs to be tackled especially among women and infants. Thus, there is an opportunity to prepare food items rich in vital nutrients.
- With increasing interest of people towards organic food, there is wide scope to grow organic and quality rich crops in order to meet the demand of the target people.
- Providing fresh product at the door step of the customer is now-a –days widely practiced, in such a situation , Agri-entrepreneurship comes into play.
- Low cost production technologies such as mushroom cultivation, rainfed farming, goatry etc are proving to be fruitful as it increase benefits and creates opportunity for Agri-entrepreneurship.
- Farmers need advices, guidance and follow-up throughout. Thus, developing technologies which are socially and psychologically beneficial, is also an opportunity for Agri-entrepreneurship.

Possible areas of Agri-entre-preneurship development

Agri- enterprise can be established on- farm and off- farm, depending upon geographical location, resource availability, vicinity to market etc.

- **Establishing Agro-produce processing units:** These enterprises convert the agricultural produce into processed items. Examples : Puffed rice and pressed rice mills, flour mills etc.
- **Establishing Agro-produce manufacturing units:** These enterprises completely convert the raw materials into an entirely new finished product. Examples: Sugar factories, Vegetable oil factories, tea manufacturing unit, essential oils etc.
- **Establishing Agro-inputs manufacturing enterprises:** These enterprises develop tools or inputs such as chemicals which helps in drudgery reduction.
- **Establishing agro-service centers:** These enterprises are set up for repairing and servicing agricultural implements and equipments.
- Enterprises can also be established in fields such as textile industry such as cloth stitching, knitting, printing, carpet making, candle making, chalk making, pottery, toy making etc.
- In the allied sector also, agri-enterprises can be well established such as in fisheries, goat farming, piggery, poultry, nursery etc.

Conclusion

There is immense scope in the field of Agri-entrepreneurship. All it needed for being a successful entrepreneur are having a clear vision, calculated risk taking, urge for innovation, risk bearing ability, economic support, managerial skills and strong desire to reap benefits. Any person with all the qualities along with dedication and proper planning can become successful and earn benefits throughout in the field of Agriculture and allied sectors.

■■■

RETENTION OF RURAL YOUTH IN AGRICULTURE

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Agriculture is one of the major sources of the Indian economy where more than 60 per cent of the population depends on it for survival. The increase in population size directly affects economic growth in the agriculture field. Over the past decade, many researchers have addressed this problem and provide solutions for the retention of rural youth in agriculture and methodologies for effective implementation of projects for rural youth. Most studies have only focused on the effective implementation of schemes, projects and programmes of youth development but till date challenged to retain rural youth in agriculture. This present study used an exploratory research design with a sample of 300 rural youth of Nagpur and Yavatmal district of Maharashtra state. Hence this paper is based on the field experience and major findings of research outcomes. The prime challenge for the stakeholders is "How to retain rural youth in agriculture". The prescriptive model is multidisciplinary, focusing on all the possible ways and means for retaining the rural youth in agriculture and providing them handhold support to stay in agriculture. The twenty-one-point programme on RRYA - 2021 consists of 21 indicators and 77 sub-indicators items considered for computation of retention index. The proposed model is designed with the objective of retention of rural youth in agriculture.

Introduction

The global population is predicted to be around 8.0 billion by 2025 and 9.0 billion by 2050. Youth would represent around 26 per cent (FAO, 2014) global population. It's well-known that the Asia-Pacific region is incredibly young, because, it's home to over 60 per cent of the world's youth. The Asia-Pacific region supports 70 per cent of the world's agricultural population with one-fifth of the world's landmass. Youth are a very important asset of our country which are full of energy and enthusiasm. They are the future communities of states and nations. Youth are the foremost powerful division of the population of a country. They are the backbone of the country. Agriculture remains the key sector, providing livelihood and employment opportunities to over 60 per cent of India's population living in rural areas. Overall, within the developing world, youth and agriculture are the twin pillars of progress and prosperity, especially for achieving sustainable development goals (Paroda *et al.,* 2014). This noticeably seems to reflect a bright future since around half of this population (nearly 200 million) lives in rural areas, which may well be motivated and attracted professionally to agriculture and allied fields. Contrary to the present situation only around five per cent of the agricultural youth is currently getting engaged in agriculture (TAAS, 2018).

The investment in youth in agriculture remains minimal, as there are just some youth-focused programs and thus, few clear samples of impact. Nevertheless, the Indian Council of Agriculture Research (ICAR) and departments of Agriculture in many nations are recognizing the farmers including the young and innovative ones for the innovative and diversified farming ventures preoccupied with them. Many young farmers are taking over high-risk high returns agri-ventures like protected agriculture, precision farming, organic agriculture, floriculture, medicinal and aromatic plant cultivation, food processing, value addition, agro-tourism, etc. which are mostly avoided by the aging farmers. These new agri-ventures should be actively supported by the government agencies and financial institutions with skill training, financing and marketing support.

Youth participation in agriculture can solve the crisis of unemployment and migration. Questions required to be answered are whether the agriculture sector has enough prospects to provide decent livelihoods to youth, how youth are motivated to take up farming and farm-related businesses, and most importantly, whether leveraging youth for agriculture is an instrument for modernization and future growth of Indian agriculture. (Sukanya Som, *et. al.,* 2018).

Retaining rural youth in agriculture is critical for Indian farming. Most of the innovations (both technical and institutional) required a talented agriculture workforce. Young farmers and producers often have a greater capacity to adopt innovation and entrepreneurship than older farmers. The genuine solution is to take a position of "the rural youth of today, the farmers of tomorrow". Based on study findings of 21 retention indicators to formulate the "Perspective model of the twenty-one-point programme on retention of rural youth in agriculture" are expected to contribute significantly towards the worldwide and national efforts of skyrocketing production and ensuring

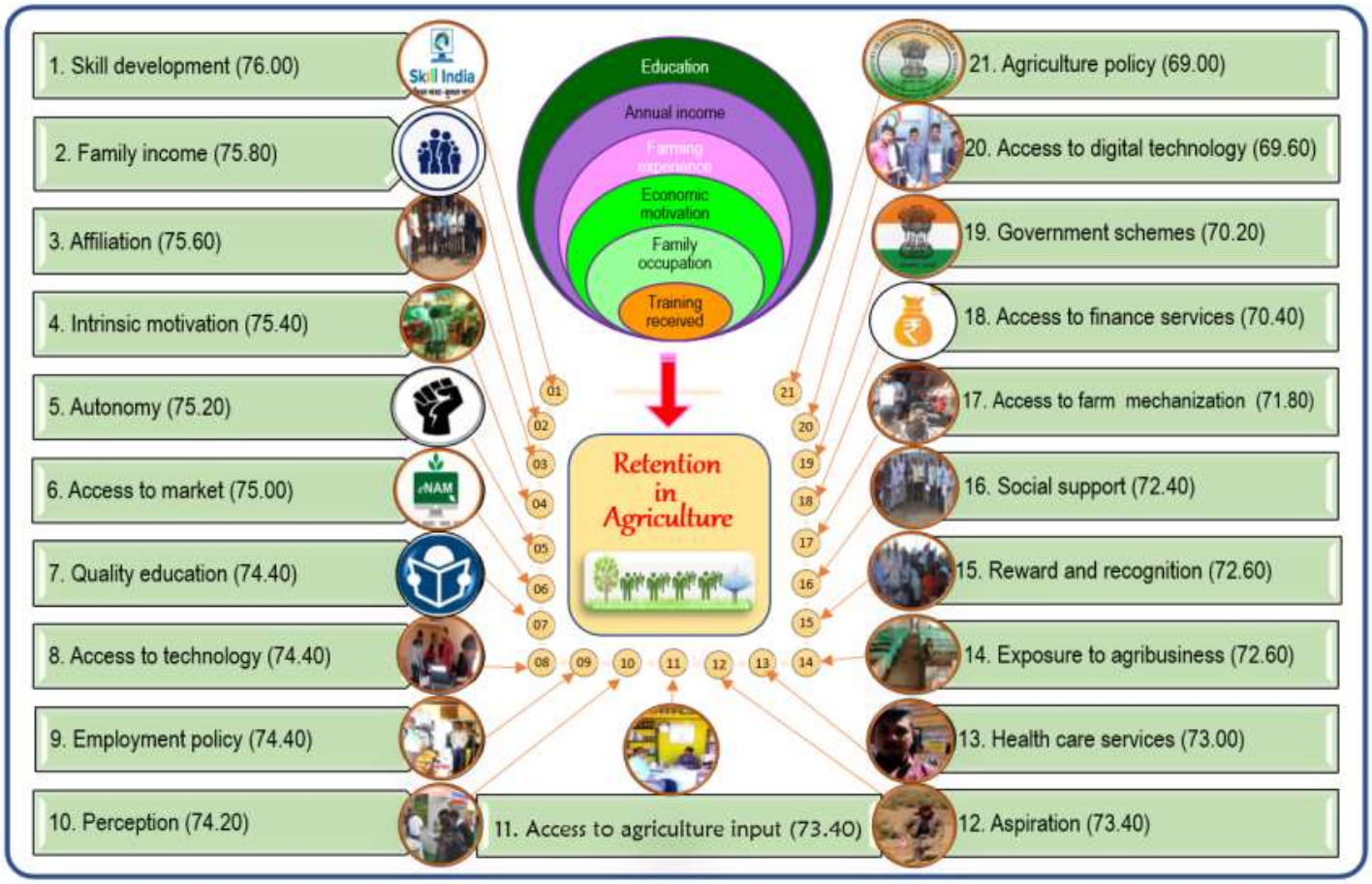

Fig. 1 Prescriptive model of the 21-point programme on retention of rural youth in agriculture

food security through increasing rural youth retention in agriculture.

The prime challenge for the stakeholders is "How to retain rural youth in agriculture". Keeping in view the outcome of the study, an attempt was made to retain rural youth in agriculture. The prescriptive model is multidisciplinary, focusing on all the possible ways and means for retaining the rural youth in agriculture and providing them handhold support to stay in agriculture.

The twenty-one-point programme on Retention of Rural Youth in Agriculture- 2021 consists of 21 indicators and 77 sub-indicators items considered for computation of retention index. The details of each of the 21 indicator points included in the model.

The recommendations of this prescriptive model suggest the necessity or need for a concentrated effort of extension agency on skill development, increasing in family income, institutional affiliation, training on motivational aspects, make them self-sufficient, easy access to market information, facilitated quality education in rural areas, easy access to technology, with better employment policy, increases perception towards agriculture, supply of quality inputs, increase aspiration, better health care facility, training on agribusiness management, innovative rural youth facilitated with reward and recognition at various levels, gives more social support, avail facility of custom hiring centre for farm machinery, better access to financial services, proper implementation of government schemes, availability of high speed ICT connectivity and involving rural youth in agriculture policymaking to prepare reliable new image of agriculture that can help to the retention of rural youth in agriculture.

These indicators are very important in the development of a project or programme. Therefore, it is implied that policymakers, development agencies and extension functionaries should consider these indicators while preparing and planning programs or projects for the development of rural youth.

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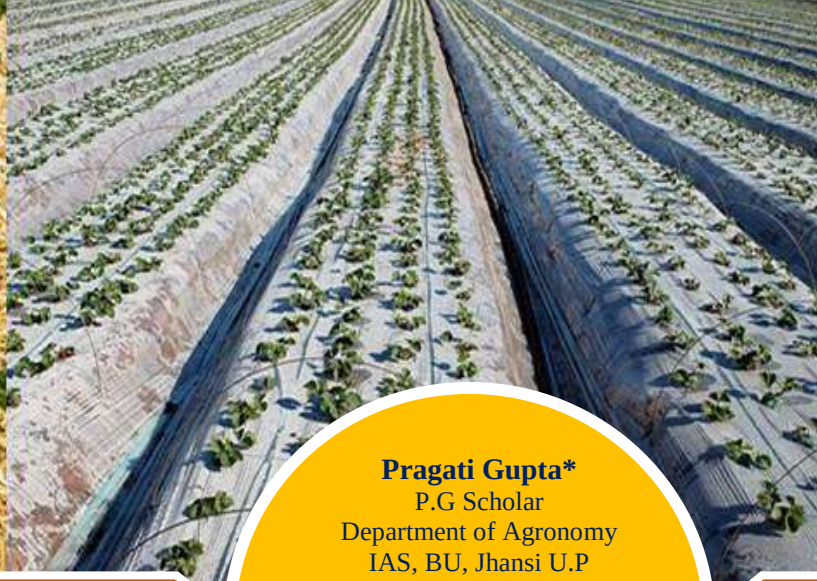

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IMPACT OF MULCHING ON CROP PRODUCTION

We must adopt measures to sustain our agricultural growth because India's population is constantly growing, and this can be done by conservation agriculture. Adopting the traditional practise of mulching in our agricultural fields is the best solution. Due to advantages like increased soil temperature, decreased weed pressure, moisture conservation, reduction of some insect pests, higher crop yields, and more effective use of soil nutrients, mulching has become a crucial practise in modern field production. The most common mulching material is plastic, especially black polyethylene, which is used almost everywhere because of its low cost and production-proven benefits. Biodegradable films are also increasingly used in fields because they can be left there safely after harvesting but are less durable and cost much more than plastics.

Introduction

The word mulch has been probably derived from the German word "molsch" means soft to decay, which apparently referred to the use of straw and leaves by gardeners as a spread over the ground as mulch. Mulches are used in agriculture for a variety of reasons, but in arid and semi-arid areas, water conservation and erosion control are the most crucial goals. Mulching is also used to change soil temperature, control weeds, conserve soil, add plant nutrients after organic mulch decomposes, improve soil structure, and increase crop quality and yield. Mulching minimises weed infestation, decreases water evaporation, and prevents runoff and soil loss, all of which slow down the deterioration of soil. Farmers and horticulturists use mulching as a method of improving the condition of agricultural soils by covering the soil surface with different kinds of materials. Improvement of the soil physical environment contributes to better plant production. Mulches discourage certain insects, act as a barrier against soil pathogens, and also slow the growth of weeds. Mulch is thought to be a great substitute for chemical herbicides and has a negative effect on weed growth. Mulches serve as a barrier of protection that keeps sunlight from directly hitting the soil. This regulates soil temperature, speeds up seed germination, and increases crop yield.

Type of mulching materials:

A. Organic mulch- Materials from plants and animals, such as straw, hay, peanut hulls, leaf mould, compost, sawdust, wood chips, shavings, and animal manures, are used to make organic mulches. Organic mulch is effective at stopping the leaching of nitrates, improving the physical characteristics of the soil, and maintaining C:N ratio of the soil.

B. Inorganic mulch- Plastic mulch is a type of inorganic mulch that makes up the majority of the mulch used in industrial crop production. Mulch is made of poly vinyl chloride plastic or chloride films. Now a day's application of black plastic mulch film is becoming popular and very good results have been achieved particularly in arid and semi-arid regions. Mulches made of black polyethylene are used in the organic system of crop production to control weeds in a variety of crops. Black polypropylene woven mulch is typically only used with perennial plants.

Effect of mulch on soil:

1. **Conserve soil moisture-** the retention of soil moisture through

mulching as a result of the alteration of favourable microclimates in the soil When organic mulch is applied to the soil's surface, weed growth is inhibited, evaporation is decreased, and rainwater infiltration during the growing season is increased.

2. **Reduce the infiltration rate-** The amount of crop residue mulch at the soil-atmosphere interface directly affects how much rainwater infiltrates the soil and evaporates. Mulch cover slows down surface runoff and keeps rainwater at the soil's surface longer, allowing it to soak into the ground.
3. **Maintain the soil temperature-** Mulching prevents temperature extremes by raising soil temperature in the winter and lowering it in the summer. In general, the capacity of the mulching material to reflect and transmit solar energy determines how mulching affects the soil's temperature regime.
4. **Add organic matter in soil-** After decomposing, organic mulches improve the physical, chemical, and biological characteristics of the soil, reintroducing organic matter and plant nutrients that in turn boost crop yield. The soil beneath the mulch is still loose and friable, creating an ideal environment for root penetration. The addition of organic matter to the organic mulches increases the soil's nutrient content while also preserving the soil's moisture.
5. **Reduced fertilizers leaching-** The root zone is drained of excess rainfall, which lowers the amount of fertiliser lost through leaching. In sandy soils, this is particularly true. This enables the grower to plant a larger amount of pre-plant fertiliser in the row.

Another benefit factor of mulching

Conclusion

Numerous researchers and farmers have talked extensively about the advantages of both organic and synthetic mulches for crop production. Mulch helps crop production in many ways, including by conserving soil and water, enhancing soil biological activity, and enhancing the chemical and physical characteristics of the soil. Transparent polyethylene mulch lowers the number of whiteflies, aids in the capture of aphids in yellow traps, and lowers the occurrence of virus diseases. In light of the previous, it is concluded that mulching has a number of positive effects on horticultural crop production in arid and semi-arid regions, including an increase in soil moisture (4.70-12.50%), a decrease in water infiltration rate (15.35-18.40%), a decrease in runoff (30.0- 70.50%) and soil erosion (70.0-85.0%), a decrease in weed growth (90.0-95.0%), pest control (15.0-27.35). So now farmers will start using this ground-breaking method soon because it helps them produce more while conserving moisture, preventing weeds, and improving soil health. Additionally, this will significantly contribute to achieving sustainable global food security.

■■■

USE OF SMART PHONE IN SMART FARMING

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Smart phone is currently most important electronic device in agriculture where farmers it self getting the solution their farming problems and boost the knowledge regarding farming practices with the help of mobile apps. smart phone with its current trends and most applicable in field of agriculture to assess the weather and climate (cloud computing,) information for selection of cropping system,and carryout the timely

agriculture cultural practices, soil description, agriculture market information related to price of crops, and government schemes, sensor control, GPS, GIS, data mining, language processing and other technique have used to provide knowledge about smart farming. Smart farming is the process, technique and method of better manage farms at the field level by using information.

Major role of smart phone in farming

1. **Resource information-** To identified and provide the information about fertilizers, pesticide insecticidal, herbicide, seed quality.
2. **Agriculture input calculation:** Use to calculate the precise amount of agriculture input in a short time. *viz.* seed rate, fertilizer dose, pesticide dose.
3. **Current agriculture news:** Provide the valuable news regarding agriculture in local and global market, such as agriculture produce market prices (MSP), subside in agriculture farm inputs, and warning related to use of high toxic residue agricultural chemicals.
4. Maintain crop and livestock calendar.
5. Records the farm input and out put cost.
6. Weather information.
7. Insect and pest warning.
8. Providing tips for organic crops cultivation.
9. Calculation of total field area and provide field map.
10. Pollution and activity report submission.
11. Government schemes.

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Mobile apps and their use in agriculture

Information area	Application	Mobile Apps name	Developers
Crops related	Selection of crop variety		
	Time of sowing	Agri app	
	Management of soil		
	Precise irrigation management	KSNM Drip	
	Fertilizer calculate	Fertilizer calculate	Dr. Vishwanath Koti
	Disease identified and control	Plantix	
	Weeds identified	Plantix	
	Better and timely harvest		
	Processing		
	Storage		
	Pest warning	Agri Smart version beta	Punjab Agriculture Department
	Complete crop production information	Agri app	
Weather Forcasting	Amount and time of rainfall	MyRML Version 2.0.2	
	Temperature		
	Solar radiation		
	Humidity		
	Information on current weather. Next 5 days	Kisan suvidha	Launched PM Narendra Modi
Market price	Indian agri. Commodity market price list	Digital mandi version 1.0	Appkiddo
Government schemes	Provide Government schemes	Kisan youjana version 3.0	ANN India

TECHNOLOGICAL TRANSFORMATION OF INDIAN OF INDIAN AGRICULTURE

NEED OF THE HOUR

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New challenges, such as climate change, degradation of natural - resources and undernourishment, need a different approach and larger research resources. Future agricultural research would be more expensive, requiring more sophisticated infrastructure, equipment, and skilled personnel. Frontier technologies, digital agriculture and other next-generation technologies all call for a different method of developing and disseminating technology. The agricultural research and extension system needs to be reformed by allocating more financial resources, enhancing human resource capacity, developing an enabling management structure, encouraging multidisciplinary and multiinstitutional research, boosting public-private partnerships, and creating the necessary research infrastructure. It is necessary to focus on cost-effective solutions that safeguard the environment and conserve our natural resources.

Agricultural technologies that requires innovation in India

a. Genetic enhancement

Genetic enhancement research has over the years tackled a variety of issues at various stages, such as yield enhancement, resistance to biotic and abiotic pressures, product quality improvement, adapt and mitigate to climate change, nutritional fortification, and genetically modified products. The research efforts paid off in a favourable way by assuring food security, raising farmer incomes, lowering poverty, creating job opportunities, and boosting the export of agricultural products. Therefore, new developments in these scientific fields are required to develop climate resilient crop varieties.

b. Natural resource management

Improving water use efficiency, making the best use of inputs (fertilisers and pesticides), and protecting soil and water resources are all examples of promising innovations in the field of natural resource management. Adoption of water-efficient technologies, such as land-leveling technology, micro-irrigation technology, agronomic techniques, and multiple water use systems, is one of the most well-known strategies to address the sustainability of agriculture. The development of watershed technology is regarded as beneficial for rainfed regions. It entails conserving rainfall and using it wisely in order to boost agricultural output and to stop soil erosion. To safeguard our natural resources, more of these technologies must be developed.

c. Farm mechanisation

Farmers primarily use the equipment and tools already in existence. India's smaller land area (about 1.08 ha) compared to Europe's (14 ha) restricts the use of machinery designed for huge land areas. The development and promotion of adequate farm equipment that meets the needs of smallholders is necessary.

d. Conservation agriculture technologies

A few examples of conservation agricultural approaches are direct sowing, minimal or no tillage, surface incorporation of crop residues, and installation of cover crops in both annual and perennial crops. The United Nations' Food and Agriculture Organization (FAO) has concentrated on the idea of resource-saving agricultural crop production as a way to integrate farm income and soil health. As defined by the FAO, conservation agriculture aims to produce reasonable earnings, high and sustained production levels, and environmental preservation (FAO 2009). Direct seeded rice, laser land levelling, and zero tillage are the three most crucial elements of conservation agriculture. To advance the acceptance of conservation agriculture, further study is required in various agro-ecologies and alternative production methods.

e. Climate smart technologies

There are several components of climate smart agriculture technologies. These include crop diversification, energy management, site-specific nutrient management, weather advisory, low tillage, and stress-tolerant cultivars. For the technologies and their extension to be further improved, more research and extension activities are required.

f. Biotechnology and genetic modified crops

The use of contemporary science in crops, such as biotechnology and nanotechnology, offers the chance to improve their genetic potential, including agricultural production, input needs, and agricultural sustainability. Using scientific tools and methods,

agricultural biotechnology is being applied to increase genetic potential and/or lower hazards associated with biotic and abiotic stresses. The issues related to food safety and biodiversity are yet to be resolved for giving clearance by the government for Bt brinjal and other GM crops in India.

g. Biofortification

By using traditional plant breeding techniques, biofortification increases the nutrient density of food crops. Economic affordability is a significant barrier to the intake of nutrient-dense foods in low- and middle-income nations, which has a negative impact on a number of health issues, particularly for women and children. The public distribution system (PDS), the mid-day meal programme, and the integrated child development programme are examples of government social safety net programmes that need to be integrated with nutrient-dense food items. By involving both the public and private seed sectors, an efficient seed value chain for biofortified cultivars needs to be developed in order to scale up their cultivation and production.

h. Frontier technologies

Frontier technologies are known to have positive implications for the - agricultural food systems. These include vertical farming, hydroponics, protected agriculture, and precision agriculture. Particularly in developing nations like India, their adoption is still fairly low. The primary barrier to implementing protected agriculture is the upfront fixed expense. To implement low-cost protected agriculture systems, fresh research must be conducted. For example, including photovoltaic green house structures in protected agriculture greatly reduces cost.

i. Digital technologies

Digital technology use and dissemination in agriculture can contribute to the transformation of agricultural systems towards sustainability. The use of technology like artificial intelligence, robots, remote sensing, image analysis, optical sensors, the Internet of Things, and equipment design for monitoring has enormous promise for sustainable development (UNCTAD 2021).

Conclusion

Adoption of more advanced technologies has clearly had a favourable effect on agricultural productivity and output. More precisely, these have a bearing on raising farmers' incomes, diversifying their sources of income, protecting the environment, enhancing the efficiency of input use, creating employment oppurtunities, and encouraging diversification. For a quicker and more widespread adoption of new technologies, it is necessary to address issues such as land consolidation through institutional reforms, connecting farmers with technology delivery networks and markets, and strengthening the agricultural credit system.

■■■

CROP ROTATION AND INTERCROPPING IN VEGETABLES

WAY TO REDUCE THE COST OF CULTIVATION BY CONTROLLING THE PEST AND DISEASE NATURALLY

About Author

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What is crop rotation?

The term "**rotation**" describes the circular motion of a wheel or shaft. Planting of the different crops by arranging them in a sequence or circular motion to improve soil health and increase the quality and yield of the crops from year to year is known as crop rotation. Crop rotation is essential for long-term success in both commercial vegetable production and home gardening. Growing of the same crop year after year in the same plot causes low productivity and increases the infestation of disease and pest.

When rotation is not used, the following factors contribute to decreased garden potential: 1. Increased soil-borne diseases, nematodes, and soil insects; 2. Lower organic matter in soil; 3. Increased risk of toxic chemical residues; and 4. Imbalance of essential mineral elements.

Criteria for crop rotation

- In a rotation, vegetables should arranged according to their families so that individual vegetables from the same family do not follow each other in the rotation. The reason is that each family of vegetables has unique effects on conditions which reduce garden potential.

There are ten distinct families of the vegetables-

1. Pea or legume family: Peas and beans of all kinds.
2. Amaranthaceae family: Beets, chard, amaranths and spinach.
3. Brassicaceae family: cabbage, collards, brussels sprouts, kale, cauliflower, broccoli, kohlrabi, rutabaga, turnip, cress, horse-radish, and radish.
4. Parsley family (Apiaceae): Carrot, parsley, celery, coriander, cumin, fenugreek, dill and parsnip.
5. Nightshade family (Solanaceae): Potato, tomato, eggplant, and pepper.
6. Gourd family (Cucurbitaceae): Summer squash, winter squash, pumpkin, watermelon, cantaloupe, cucumber, bitter gourd, bottle gourd, spine gourd, ash gourd, pointed gourd.
7. Composite family: Chicory, endive, salsify, dandelion, lettuce, Jerusalem artichoke, and globe artichoke.
8. Lily family (Liliaceae): Onion, garlic, leek, and chives.
9. Grass family (Poaceae): Sweet corn.
10. Mallow family (Malvaceae): Okra.

- When only a few plants of each family are planted, it is frequently possible to rotate vegetables in a home garden. For instance, in a rotation, tomato, pepper, eggplant, and potato can all be treated as a single group.
- It is best to plant clean-culture crops such as tomatoes, peppers, summer squash, or melon before shallow-rooted crops that require close cultivation, such as lettuce, beets, and other greens, because they extend roots deeply into the soil and discourage weed growth by shading the soil surface.
- Planting surface feeder crops immediately after heavy feeder crops to ensure that the subsequent crop does not run out of nutrients during its growth. If celery is planted after heavy feeders like tomatoes, soil testing and fertilisation are essential to avoid nutrient deficiencies.

How crop rotation help to control disease and pest in vegetables?

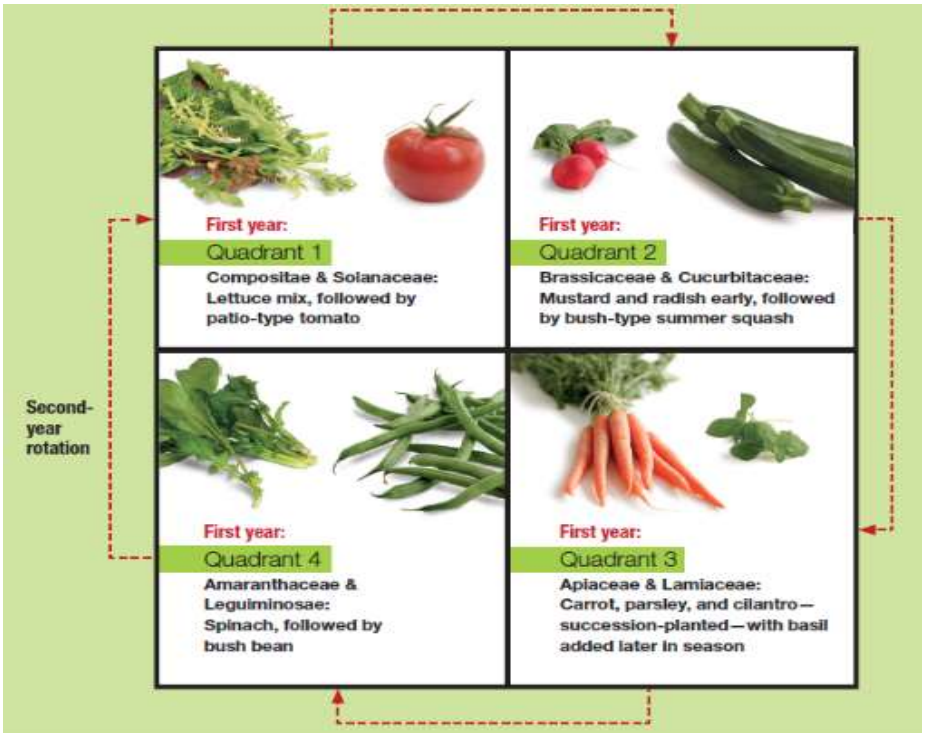
1. Rotation can help prevent common vegetable diseases that live in the soil and attack vegetables. Fusarium root rot fungus infection will increase in beans and peas unless there is a two to three-year gap between plantings on the same plot of land. Cabbage disease club root, which is caused by a fungus, will infect subsequent mustard family crops for four to five years. Planting of broccoli, cabbage, or cauliflower that contracts club root fungus disease in one year leaves fungus behind to infect broccoli, cabbage, or cauliflower planted the following year. Tomato bacterial canker once introduced into the soil, will remain viable for three years. A Verticillium wilt fungus that infects a tomato crop one year will most likely live in the soil for many years, infecting subsequent tomato, pepper, eggplant, and potato crops. There are vegetable varieties that can withstand or resist infection by specific fungi and bacteria. Gardeners who are aware of the presence of Verticillium wilt, Fusarium wilt, and root knot nematodes in their soil can now select tomato varieties that are resistant to all three diseases, such as Carnival, Celebrity, and Santiago.
2. Tomatoes, okra, potatoes, and carrots are all susceptible to root knot nematode and promote its growth in the soil. This nematode is suppressed by sweet corn and other grasses. Root knot nematodes rarely infest onion, watermelon, or black eyed peas.
3. Wireworms and white grubs thrive in grass turf, and a new garden plot will typically have a high concentration of active soil insects. Sweet corn, watermelons, and winter squash are better choices for planting in newly tilled soil than root or tuber crops.
4. Some vegetables leave organic residues in soil that are toxic (allelopathic) to certain succeeding crops. Arrangement of crops in compatible sequence is important so that one which produces a toxic effect will not precede one that is susceptible to that toxin.

E.g.: Decomposition of sweet corn stubble liberates organic toxins which inhibit early season root growth of lettuce, beets, and onions. Grain and sweet corn are excellent alternate hosts for the fungus that causes onion pink root disease. Even in soil where onions have never been planted, onions that are planted after corn can suffer from severe pink root disease.

How to plan crop rotation for your field?

Expert vegetable growers and gardeners plan their rotations for several years in advance. A rotation is simple to set up and use. First, imagine your garden in the shape of a pie. Then, on a piece of paper, draw a large circle. As you would cut a pie, divide the circle into four sections. The number of sections will be the same as the number of vegetable families you intend to plant. A simple example of crop rotation in a garden with four vegetable families:

Sweet corn (grass family), then Blackeye peas and snap beans (pea



family), then broccoli, cabbage, and radishes (mustard family), then tomato, pepper, and potato (in that order) (nightshade family). Simply turn the plan one section clockwise to see which family will live on each of the four plots in the upcoming year. Where the corn grew this year will be planted with Blackeye peas the following year, and so on. Using the same method, other, more complex examples can be created.

Intercropping

Intercropping is the cultivation of two or more vegetables or a vegetable with a non-vegetable plant in the same garden space at the same time during the growing season. There are numerous possible combinations. It is preferable to intercrop members of the same family whenever it is feasible in order to maintain a rotation sequence in proper order. Between rows of transplanted cabbage, broccoli, and cauliflower, radishes can be planted. The radishes will be picked well before their slower maturing neighbours occupy the space.

The important thing to remember when intercropping is to space different types of vegetables in a pattern that allows each to receive the most light. When the leaves of one plant overlap those of another, the plants that are shaded grow less vigorously and produce less. For example, do not interplant marigolds with summer squash or tomatoes. Only one of the two plants will flourish, either marigolds or squash. Planting sweet corn in the field aids in the control of nematodes. Expert vegetable cultivation is a difficult skill, but intercropping and rotational farming strategies help to minimize disease pest infestation and ensure year-round vegetable production.

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Ocimum tenuiflorum

HEALTH BENEFITS

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Ocimum tenuiflorum, commonly known as holy basil, tulsi or tulasi, is an aromatic perennial plant in the family Lamiaceae. It is native to the Indian subcontinent and wide-spread as a cultivated plant throughout the South East Asian-tropics.

Tulsi is cultivated for religious and traditional medicine purposes, and also for its essential oil. It is widely used as a herbal tea, commonly used in Ayurveda, and has a place within the Vaishnava tradition of Hinduism, in which devotees perform worship involving holy basil plants or leaves.

The variety of *Ocimum tenuiflorum* used in Thai cuisine is referred to as Thai holy basil and is the key herb in phat kaphrao, a stir-fry dish;it is not the same as Thai basil, which is a variety of *Ocimum basilicum*. In Cambodia, it is known as *mreah-prov* (Khmer).

Holy basil is an erect, many-branched subshrub, 30–60 cm (12–24 in) tall with hairy stems. Leaves are green or purple; they are simple, petioled, with an ovate blade up to 5 cm (2 in) long, which usually has a slightly toothed margin; they are strongly scented and have a decussate phyllotaxy. The purplish flowers are placed in close whorls on elongated racemes.

The three main morphotypes cultivated in India and Nepal are *Rama tulsi* (the most common type, with broad bright green leaves that are slightly sweet), the less common purplish green-leaved (*Krishna* or *Shyama tulsi*) and the common wild *vana tulsi* (e.g., *Ocimum gratissimum*).

Chemical composition

Some of the phytochemical constituents of tulsi are oleanolic acid, ursolic acid, rosmarinic acid, eugenol, carvacrol, linalool, and β-caryophyllene (about 8%). Tulsi essential oil consists mostly of eugenol (~70%) β-elemene (~11.0%), β-caryophyllene (~8%), and germacrene (~2%), with the balance being made up of various trace compounds, mostly terpenes.

Uses

Tulsi (Sanskrit: Surasa) has been used in Ayurvedic and Siddha practices for its supposed treatment of diseases.

Insect repellent

For centuries, the dried leaves have been mixed with stored grains to repel insects.

Nematicidal

The essential oil may have nematicidal properties against *Tylenchulus semipenetrans*, *Meloidogyne javanica*, *Anguina tritici*, and *Heterodera cajani*.

Unique health benefits of Tulsi

Helps beat stress

Tulsi is a natural herb with anti-stress qualities. Hence, sipping a cup of Tulsi tea can help a person rejuvenate when they feel stressed or anxious.

Protection against infection and treating wounds

Tulsi is long known to have anti-inflammatory properties and anti-bacterial, anti-fungal and anti-viral properties. It can also act as a painkiller.

Improves digestion system

Tulsi plant is known to enhance livers health which is why it aids in improving the digestion system.

Aids in losing weight

Tulsi also helps you lose weight by releasing toxins from your body by improving your gut health. It accelerates the rate of metabolism in the body, which further accelerates the fat burning process in the body.

Dissolving kidney stones

Tulsi is a great detox agent; therefore, it can help people who suffer from kidney stones. It helps to reduce uric acid levels in the body, which is a leading cause of kidney stones.

Helps fight diabetes

Tulsi tea can be effective in managing type 2 Diabetes. It's one of the most preferred herbal teas for managing Diabetes.

Dental and oral health

Tooth cavity is the most common dental problem that people face in their life. The good news is that Tulsi has antimicrobial properties that help fight bacteria and germs in the mouth.

Skin and hair benefits

Tulsi is packed with antioxidants coupled with minerals and vitamins, which can help fight the signs of ageing. It can also reduce the itchiness of the scalp as well as control hair fall.

Good for the skin

Tulsi drops help the skin to get rid of blemishes and acne. It is rich in antioxidants and that helps to prevent premature ageing.

Enhances immunity

Tulsi contains zinc and vitamin C, two components that help fight infections. Daily intake of Tulsi leaves or Tulsi tea helps to boost immunity.

Conclusion

Tulsi is a common herb grown in many households with a wide range of therapeutic properties. It is evident that tulsi is a medicinal plant of great importance because of its varied application in medicine and hence can be called "Queen of Herbs".

■■■

PROBIOTICS IN FRUIT JUICES

A NEW KIND OF FUNCTIONAL FOOD

About Author

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Functional foods that contain probiotic microorganisms have been developed in response to consumer demand for foods that promote health while preventing diseases. Fermented dairy products are excellent vehicles for delivering probiotics, but due to the high prevalence of lactose intolerance, their high fat and cholesterol content, and the rising popularity of vegetarian diets, consumers are looking for alternatives. The potential for probiotic bacteria in non-dairy items such fruits, vegetables, and cereals has thus been thoroughly researched.

Introduction

The development of functional food items has become the primary focus of recent advancements in the food business. Consumer demand for meals free of chemical additives and with positive health effects is the foundation of this trend. "Functional food" refers to foods that offer additional health benefits beyond only meeting nutritional needs. Probiotic foods, in particular, are foods that have been fermented by probiotic microorganisms and are regarded as a significant subgroup of functional foods. They can guard against a variety of illnesses, stop vitamin deficits, and promote healthy growth and development.

The idea of functional food was created in Japan at the beginning of the 1980s, and the term "food for specified health use" (FOSHU) was first used in 1991. Described as any food or substance that, in addition to its nutritional worth, positively affects a person's health, physical performance, or state of mind.

Probiotic as a functional food

Probiotics can be regarded as functional foods because they have additional health benefits to those of a standard diet. Probiotics are "live microorganisms that, when administered in sufficient proportions, confer a positive effect on the host," according to the World Health Organization.

Elie Metchnikoff, a scientist at the Pasteur Institute and the recipient of the Russian Noble Prize and considered the pioneer of modern immunology, was the first to present the idea of probiotics. He is also referred to as the probiotics' father. The Greek words pro, which means "promoting," and biotic, which means "life," combine to form the word "probiotic." Lilly and Stillwell first used the word "probiotics" in 1965.

Need of non-dairy probiotics

Probiotic products are typically sold as fermented milks and yoghurts; nevertheless, lactose sensitivity and the presence of cholesterol in these products are two significant downsides. Nondairy probiotic beverages are especially appealing because they don't contain dairy allergies, have reduced cholesterol levels, and are vegan-friendly. Additionally, various substrates can deliver various blends of antioxidants, dietary fibres, minerals, and vitamins. The above-mentioned shortcomings of dairy probiotics have prompted researchers to look for new and alternative probiotic microbe carriers. Fruits, vegetables, and cereals have been shown to be among the finest non-dairy probiotic product developments, and demand for these goods is rising.

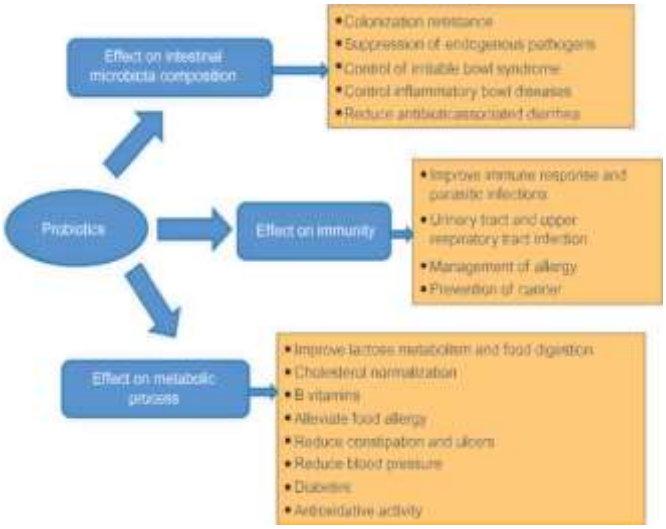
Why fruits are ideal chioce for probiotics

Fruits are among the most essential foods for humans because they are both nutrient-rich and essential for maintaining good health. Fresh and processed fruits both enhance the quality of the diet and offer necessary nutrients like carbohydrates, vitamins, minerals, and antioxidants. Fruit juices are rich in carbohydrates, vitamins, and minerals, all of which help probiotics survive while being stored. Fruit juices are a great option for customers who want to eat foods that are low in cholesterol or who have lactose sensitivity. Fruits are a desirable and optimal substrate for probiotic microorganisms due to their structural properties and nutritional make-up (nutrients such as antioxidants, dietary fibres, minerals, and vitamins, including a good amount of sugars).

Microorganisms used as probiotics

The most prominent probiotic microorganisms are LAB and *Bifidobacteria* species which are renowned “generally recognised as safe” (GRAS) in food industry. The strains of *Lactobacillus plantarum, Lactobacillus acidophils, Lactobacillus rhamnosus, Lactobacillus reuteri, Lactobacillus johnsonii, Lactobacillus lactis, Lactobacillus casei, Lactobacillus paracasei, Lactobacillus delbrueckii sub sp bulgaricus, Bifidobacterium lactis, Bifidobacterium infantis, Bifidobacterium longum,* and *Bifidobacterium brevis* were frequently used as commercial starter cultures. In addition to these, *Streptococcus thermophillus, Enterococcus francium, Pediococcus* and *Leuconostoc* species were also LAB and can be used as probiotics. The probiotics can be used as single or mixed cultures. In selecting probiotic bacteria for industrial manufacturing processes, safety, functional and technological characteristics should be considered.

Health benefits of probiotic



Preparation of fruit juice probiotics

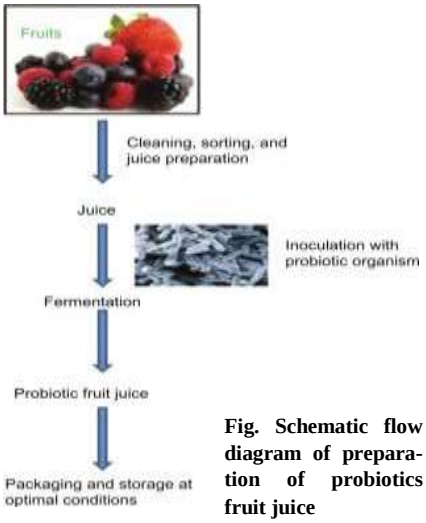


Fig. Schematic flow diagram of preparation of probiotics fruit juice

Conclusion

When consumed as a functional food as part of a balanced diet and healthy lifestyle, probiotic fruit juices have the potential to significantly enhance health and aid in the prevention of some diseases. Fruit juices containing probiotics have demonstrated significant health advantages for people, and their use may result in a decrease in the need for antibiotics to treat a variety of illnesses. The demand for non-dairy functional probiotics has increased, which has encouraged the creation of new fruit-based probiotic products. In order to guarantee product efficiency and safety, it is imperative to develop international standards to govern probiotics and prebiotics products as well as functional health claims on the label.■

DRONE TECHNOLOGY IN AGRICULTURE
UTILIZATION, ADVANTAGES AND PRECAUTIONS

About Author

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Agricultural sustainability determines the existence of human civilization on earth. Agriculture is the main livelihood of human beings in India. Climate change, over-agriculture and the ill effects of mono-cropping systems are putting multiple dimensions of stress on the fundamentals of agriculture. Due to untimely rains and climatic disturbances, timely sowing, crop protection and production activities must be undertaken in the largest area in the shortest possible time. Substantial population in India will be withdrawn from direct agricultural activities and hence, by 2050 India will face shortage labour. The percentage of agricultural labour in the total workforce is expected to fall from 50 percent in 2018 to 25.7 percent by 2050.

According to domestic demand, India increased food production from 50.8 million tonnes per 36.1 crore population in 1950 to 295.87 million tonnes per 135 crore population in 2019-20. To meet the growing demand ahead, India needs to increase its annual food production to 333 million tonnes by 2050 from its current level. A side from the arrival of monsoons - regression differences due to premature rains and climatic disturbances, shortage of farm labour, factors such as over-utilization of inputs thereby exorbitant cost of cultivation de-stabilize the farmer and the agricultural sector. If technologies that save time and reduce resource development are not developed, they will disrupt the country's food security and adversely affect the agricultural sector.

Frequent infestation of food and commercial crops requires regular spraying of chemicals to control them. The problem is solved by the drones that are widely used by Haiti. A UAV or drone (unmanned aerial vehicle) is a flying device that flies at pre-set altitudes, speeds, and directions with the help of autopilot and GPS coordinates. The drone device is operated by simple radio wave controls. It can be manually piloted in case of any error or dangerous situation or any obstruction.

The agricultural drone is an unmanned aerial vehicle applied to agriculture to increase crop production and monitor crop growth. Sensors and digital imaging capabilities can give farmers a great picture of their fields. This information is useful in improving crop yields and agricultural efficiency. Survey of watershed and command areas for sowing, fertilizing, spraying of pesticides, herbicides and liquid or water-soluble fertilizers with agricultural drone technology and crop monitoring, soil monitoring, watershed monitoring, canal discharge monitoring, water resource development planning and monitoring field 3-D mapping and accurate farming techniques can be imparted to farmers. It is like checking for respiratory diseases, especially those caused by spraying chemicals. In the wake of the sharp rise in labour costs, the investment costs to farmers through its consumption will also be greatly reduced. Also walking in the mud for crops like rice. This is a great solution to the problem of having to spray chemicals. This will significantly reduce the work pressure for farmers. In high altitude crops like maize, sorghum, sugarcane, horticultural crops, etc., spraying with drones can be done very easily and quickly.

Advantages of drone in agriculture

1. Agricultural drone technology can be used for spraying seeds, fertilizers, pesticides, herbicides, and liquid water-soluble fertilizers.
2. With a drone with a tank capacity of 10 liters, 1 acre can be sprayed in 6 to 10 minutes (16.2 Km / Hr @ 0.6–1.0 m above crop).
3. Spray with a farm drone is less expensive and can save up to 90% water and 95% time.
4. This reduces the need for water for spraying pesticides / fungicides /

herbicides from 100-200 liters / acre to 10 liters / acre.

5. Spraying with a farm drone can reduce consumption by up to 25% over the recommended dose of pesticides, insecticides, and herbicides.
6. Agricultural drone gives farmers the ability to analyze fields quickly and easily.
7. This will enable the farmers to apply the inputs in a timely manner with the highest accuracy and precision, thereby helping in carrying out accurate farming.
8. Drones can carry multispectral / hyperspectral / thermal / lidar cameras to perform remote sensing at low altitudes of crops, soils, and atmosphere.
9. Drones with soil moisture sensors can detect which parts of a field need more water and thereby assist with irrigation automation.
10. Helps to monitor the environment easily and closely with drone-based sensor systems.
11. Direct seeds of paddy / pulses can be sprayed and seed bombs can be thrown in the forest areas and plants can be planted in the forest areas for quick passage.
12. Helps farmers scout their farms quickly and efficiently. This saves time in determining the status of the fields.
13. Drone-based thermal cameras help detect wet and dry patches. This will help the farmers to avoid wasting water.
14. It helps in monitoring the environmental data which helps in smart and accurate farming.
15. Drones, integrated GIS (Geographic Information System) mapping. It helps to store and analyze all types of geographical and spatial data.
16. It helps farmers in mapping to increase yields and reduce costs to move the business forward.
17. If the home button is pressed, the drone can return to where we took off from.
18. It integrates easily with other IoT devices and facilitates the application of Artificial Intelligence and Machine Learning in agriculture using drone technology.

Precautions in the use of drones in agriculture

1. The initial cost of agricultural drones is very high. A unit can cost around Rs 10 lakhs (drone + generator + 5 sets of batteries + trolley auto to carry drone to farms).
2. It is necessary to keep an additional 6-7 sets of batteries to provide faster batteries during the spray with the drone, which meets the high initial investment.
3. To operate it, a scientifically trained pilot is required to avoid crash landing or miss drone.
4. Most farm drones have shorter flight times and drones with longer flight time, longer features and longer range are more expensive.
5. It requires all forms of government clearance and permission from the DGCA (Director General of Civil Aviation) to use it.
6. It uses the same airspace as commercial aircraft and can therefore interfere with human aircraft if it gets in their way.
7. These are difficult to fly in extreme weather conditions.
8. The cost of repairs and maintenance is very high and not available in rural areas.
9. Attracts legal penalties for flying over private areas. The agricultural drone only works in visual acuity (VLOS).
10. Spraying should be done only after 8.00 am to 11.00 am especially during the synthesis period (coating stage) in paddy.

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AUTOMATION IN AGRICULTURE
SMART FARMING

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The global population is dramatically increasing. The UN expects the world's population to hit 8.5 billion by 2030, rising to 9.7 billion by 2050. In order to produce enough food for the 2050 population, the World Bank has forecast that we'll need to produce 50 per cent more food. With climate change and a skills shortage limiting crop yields, farmers are turning to technology to increase efficiency. As well as producing more food, there is also a pressure on farmers to make processes greener – making the best use of water and cutting down on pesticides. This means that farming must focus on sustainably producing high quality food. Using robots and autonomous vehicles is just one way of doing this.

An agricultural robot is a robot deployed for agricultural purposes. Emerging applications of robots or drones in agriculture include weed control, cloud seeding, planting seeds, harvesting, environmental monitoring and the soil analysis. Farm automation technology addresses major issues like a

rising global population, farm labor shortages, and changing consumer preferences.

Pervasive automation is a buzz term in the agriculture technology industry, and it can refer to any technology that reduces operator workload. Smart farming and precision agriculture involve the integration of advanced technologies into existing farming practices in order to increase production efficiency and the quality of agricultural products. The agricultural workforce is declining, compelling the adoption of internet connectivity solutions in farming practices. Using IoT (Internet of Things) technology certifies the optimum application of provisions to achieve high crop yields and reduce operational costs. Surveys indicate that the use of IoT devices in the agriculture industry will reach $75 million this year, while escalating 20% a year. A smart greenhouse can use IoT intelligence to monitor and control the climate, putting an end for the need of manual intervention. It's no wonder that farmers are transforming to wireless technologies.

Only artificial intelligent (AI) based systems have proved to be feasible and reliable. Artificial intelligence does not generalize the problem; it gives a particular solution to a particular defined complex problem. AI manufacturers are developing robots that can perform multiple tasks on the farm without difficulty. These robots are trained to control weeds and harvest the crops at a faster pace with higher volume compared to humans.When used in farming, AI gives growers a weapon against pests. Pests are one of the worst enemies of the farmers, damaging the crops before they are harvested and stored. Insects like locusts, grasshoppers, and others are eating the profits of farmers and consuming the grains meant for humans. Farming automation has proved to increase the return from the soil while strengthening the soil's fertility.

Smart farming and automated operations

Unlike humans, machines can make use of seemingly meaningless data and interconnections to reveal new information concerning the overall quality of the crops. Pervasive automation in agriculture expands accurate and controlled growing through proper guidance to farmers about optimum planting, water management, crop rotation, timely harvesting, nutrient management and pest attacks. By using machine learning algorithms in connection with images captured by satellites and drones, artificial intelligence predicts weather conditions, analyses crop sustainability and evaluates farms for the presence of diseases or pests and poor plant nutrition.

One of the major advantages of robots is their flexibility to perform a variety of tasks and applications in any environment. They are more precise and consistent than people. They increase production and profit margin, as they can accomplish tasks more quickly. Robots can work 24 hours a day since they do not need holidays, sick days, or breaks. They also make fewer mistakes than people and save time. Robots eliminate work that is dangerous to humans. All these qualities make robots the perfect choice for agriculture, especially as farms grow in size. Traditionally, agriculture requires numerous repetitions and hard labor with considerably low speed for planting, irrigation, fertilization, monitoring, and harvesting a large area of crops. But today, a single robot can do all these processes with less dependency on human labor.

Advantages

1. The robots are not getting sick or tired, and the time off is not needed.

2. With higher speeds and closer tolerances, they can operate with fewer errors.
3. They make fewer errors and operate at higher velocities and higher quality.
4. The robots can reduce the use of pesticides by up to 80% of the farm.
5. In different fields, robots are more efficient and can work around trees, rocks, ponds, and other obstacles easily.
6. For technicians, the robots can create jobs that can fix the robots.
7. The robots can deliver products of high quality and lower the cost of production.
8. Robots gantry can function as both fertilizer or liquid sprays and, most importantly, as an automatic self-control system that meets weather conditions.
9. They can be small in size, allowing to accumulate near-crop data and perform mechanical weeding, mowing, spraying, and fertilizing.
10. Robotic cameras and sensors are capable of detecting weeds, identifying pests, parasites or diseases, and other stress. Usually, the sensors are selective and are only used to spray on the affected area.
11. Robots provide an opportunity to replace human operators with a good return on investment by providing effective solutions.

Disadvantages

1. It costs a lot of money to make or buy robots.
2. They need maintenance to keep them running.
3. The farmers can lose their jobs.
4. The robots can change the culture / the emotional appeal of agriculture.
5. Energy cost and maintenance.
6. The high cost of research and development.
7. Lack of access to poor farmers.■

ROOFTOP FARMING

BEST OPTION FOR SMART URBAN AGRICULTURE

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In recent years, Worldwide urbanization and industrialization have increased quickly, which has led to a daily decline in the amount of land that may be used to grow horticulture crops. Terrace and roof gardening is becoming more and more popular as a source of fresh fruits, vegetables, and flowers as well as for environmental benefits. In many developing nations, urban inhabitants who are impoverished and landless have increased their informal vegetable production in and around their cities. Many nations are adopting sustainable farming practices as a result of the growing population and resource scarcity. India, where urban life is becoming more popular, is adopting rooftop gardening due to its many advantages. The growing demand for fresh food can be met by rooftop farming, which can also significantly improve the quality of life for urban residents by promoting a number of environmental advantages, such as improving air quality by acting as a carbon dioxide storage facility and a location for stormwater management.

Rooftop farming is the term used for the activity of growing food on building rooftops. Green roofs, hydroponic, aeroponic, or air-dynamic systems, as well as container gardens, are frequently used for rooftop farming. In India, rooftop farms use the hydroponics approach since it eliminates the need for soil. Another effective option for organic gardening is hydroponics. There are various ways to implement rooftop farming. One of the easiest and most straightforward methods to start is container gardening. In order to prevent a blockage, it is necessary to regularly inspect irrigation and drainage systems. A plant should have sufficient sunlight and rich soil, and the plan should contain a suitable distance between them. For higher yield, the system needs to be installed by a professional. Urban dwellers who are environmentally concerned and proponents of organic living are beginning to understand the value of sustainable living as a necessity for surviving in the face of changing environmental conditions. Metropolitan agriculture is becoming to be seen as a sustainable method of producing and effectively supplying locally-grown fresh foods and vegetables to cities as more people move and migrate within urban areas. Due to the shrinking amount of agricultural land, particularly in Indian cities, rooftop farming may be a viable option for urban agriculture. It can significantly contribute to providing organic and fertilizer-free produce.

Benefits of rooftop farming

Rooftop farms provide the following advantages in addition to assisting in meeting the rising demand for food production:

- Improve the urban environment and human well-being. Rooftop farms literally make cities greener by growing crops like lettuce, kale, arugula, and other greens.
- Additionally, research has shown that being around plants and the natural world has a variety of positive psychological effects, from lowering anxiety to boosting productivity.
- Rooftop farms aid in the cooling of structures, thus lowering carbon emissions.
- Additionally, rooftop farmers reduce the environmental impact of food transportation by cultivating food close to where they are needed.
- Make more actual, wholesome food available. More people have access to fresh, healthful, and reasonably priced food when farmers produce inside or, better yet, on top of the concrete jungles and food deserts that many of us call home.
- Rooftop farming is the ideal place to take full use of the free water and energy that rain provides us with from nature.
- They are excellent insulators, keeping temperatures cool in the

summer and retaining heat in the winter.

- The insulation that rooftop gardens offer can be used for both noise and temperature control.

Plant selection for rooftop farming

The practicality, demand, and ability to survive environmental and climatic challenges are taken into account while choosing the crops that will be farmed. Fruit trees, leafy greens, flowers, and vegetables are a few examples. Pots, grow bags, and even plastic drums work well for growing them.

1. Seasonal vegetables

It is possible to cultivate a variety of vegetables, including brinjals, tomatoes, garlic, beans, carrots, broccoli, green peas, okra (bhindi), sponge gourds, ridge gourds, snake gourds, bitter gourds, and bottle gourds. In order for plants to receive enough sunlight and survive, it is best to grow them on the southern or western side of the roof.

2. Small fruit trees

These should be planted in the largest grow bags or plastic drums (minimum 100-litre capacity). Sapota, guava, apple, citrus fruits like orange and lime, soursop (Hanuman phal), Indian gooseberry (dwarf amla), and bananas are among the trees that can be produced in this method.

3. Leafy green plants

The following vegetables can be grown in separate plastic bags or pots that are deep enough to accommodate tubers: sweet potatoes, lettuce, spinach, potatoes, coriander, turmeric, and ginger.

4. Hanging plants

It is important to effectively use the vertical space on the roof wall. Near walls and railings, you can plant vegetable shrubs and vines like beans, gourds, and tall tomato kinds. For the purpose of luring local bees and other useful insects, cultivate flowers in your food garden. Planters can be used to grow a variety of flowers, including bougainvillea, jasmine, hibiscus, tulips, sunflowers, lavender, rose, and oleander.

A rooftop farming model for cost estimation

Rooftop farming has a significant upfront expense. However, the advantage will make up for it. Each roof area of 500 square feet will generally cost between Rs. 10,000 and Rs. 15,000 to cultivate. Up to Rs. 1 lakh will be provided as compensation (www.urbanmali.com).

Disadvantages

- High start-up costs.
- In some cases, insurance companies may charge a high amount than they would if they were covering an identical structure without a roof garden.
- Roof gardens require extra upkeep, including frequent watering and the replacement of the growing medium.
- A roof garden's structure and weight may pose issues for the entire structure.
- High winds could damage plants and young seedlings in high-roof gardens.

Conclusions

The potential for rooftop farming to provide food security in urban areas is enormous and highly diverse. A sustainable, environmentally friendly, and the intelligent city can be created by securing food supply, provided that the government and other responsible groups take the initiative to support rooftop gardening. Additionally, it contributes to meeting the need for wholesome meals and fosters a healthy environment by enhancing air quality, which lessens the effects of climate change. For promoting the production of vegetables organically, this farming is a preferable choice. Although rooftop farming is still a relatively new idea in India, there is a steady rise in the number of green roofs and rooftop farms.

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BLACK RICE

About Author

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Black rice is a type of the rice species *Oryza sativa* L. which is glutinous, packed with high level of nutrients and mainly cultivated in Asia. The pericarp (outer part) of kernel of this rice colour is black due to a pigment known as anthocyaninand antioxidant. Black rice is also known as purple rice, forbidden rice, heaven rice, imperial rice, prized rice and king's rice. Many people assume this rice as a panacea of many culinary diseases, because of its high nutritive value and curative effect. This rice is supposed to enhance the longevity of life, hence it is also known as long life rice. This rice includes several varieties with a long

history of cultivation in Southeast Asian countries such as China, India and Thailand. There are more than 200 types of black rice varieties in the world. Only China is responsible for 62 % of global production of black rice and it has developedmore than 54 modern black rice varieties with high yield characteristics and multiple resistances. China cultivates the black rice in higher areas followed by Sri Lanka, Indonesia, India and Philippines etc.

Cultivation in India

Black rice is indigenous to West Bengal, Manipur, odhisha and Jharkhand. Till now, Manipur is the highest producer of black rice in the North East. ***Manipur black rice***, popularly known as 'Chakhao' by the locals, has bagged the Geographical Indication (GI) tag recently. The Chakhao Amubi is one type of sticky black rice that is indigenous to Manipur. 'Chakho' means delicious while 'Ambui' means black. Black rice varieties brought from Manipur and Odisha to Assam have given hope of farming for tribal farmers of assam. Veteran farmer Upendra Rabha from Goalpara, known for popularizing black rice varaities in lower assam.

Types of black rice

1. ***Black Glutinous rice***: it is also known as black sticky rice because of its sticky texture and the grain size is shorter. It is used to make sweet dishes in Asian countries and the grains are unevenly colored.
2. ***Italian black rice:*** It has a rich aroma and buttery flavor and the grains are long in size.
3. ***Black japonica rice:*** It has a mild sweet spiciness and has an earthy flavor.
4. ***Thai black Jasmine rice:*** It is originated in Thailand and combines Jasmine rice with Chinese black rice. It gives floral aroma when cooked which is the characteristic feature of jasmine rice.

Benefits of black rice

1. **Rich in Antioxidants**

The deep black or the purple hue of the black rice is a result of its high antioxidant properties. Similar to blackberries and blueberries, that appear deeper in colour because of their high content of anti-oxidants. The bran and hull, which make up the grain's outermost covering, are incredibly rich in the antioxidant anthocyanin.

Anthocyanin can help to prevent cardiovascular disease, restricting free radical movements which can cause variety of diseases like diabetes and even cancer. It can also help improve brain function and reduce inflammation. Black rice also contains important antioxidant- vitamin E, which is useful in maintaining eye, skin, and immune health.

2. **Natural detoxifier**

The phytonutrients in black rice aid in the removal of poisons that cause disease from the body. Through its antioxidant activity, black rice aids the liver, one of the body's most important detoxifiers, in the elimination of harmful compounds.

3. **Good source of fiber**

The black rice has about 4.8 grams of fiber per half cup serving. This rich fibre content helps regulate the bowel movements, prevent diarrhea, constipation, and bloating. It helps to bind the waste and toxins in the digestive tract and flush it out of the digestive system on completion of digestion process.

4. **Preventing risk of diabetes**

To ward off the risk of diabetes and obesity, it is advised to consume black rice because it has low glycemic index. Black rice consumption helps in decreasing the levels of hormone leptin, which is responsible for appetite-regulating.

Nutritional facts of black rice

Nutritional value of 45 gm of uncooked black rice	
Calories	160 gms
Total fat	1.5 gms
Cholesterol	0 mg
Total carbohydrates	34 gms
Dietary fiber	4.8 grams per 100gram
Sugar	0 gms
Protein	4 gms
Iron	6% (of daily value)

Malia Frey, 2020.

5. **Support eye health**

Research shows that black rice contains high amounts of lutein and zeaxanthin two types of carotenoids that are associated with eye health. Lutein and zeaxanthin have been shown to help protect the retina by filtering out harmful blue light waves.

6. **May decrease your risk of non-alcoholic fatty liver disease (NAFLD)**

A study in mice found that adding black rice to a high fat diet significantly reduced fat accumulation in the liver.

7. Since black rice has a pigmented bran fraction, its extracts are used as a natural coloring agent in foods like bread and liquor.

Conclusion

Rice is the stable food of our country. Bringing awareness among the farmers about black rice cultivation and consumption will helps to improve the nutritional status of poor farming communities.

■■■

SELF-RELIANCE IN FOOD

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In the backdrop of the ongoing war between Russia and Ukraine, Prime Minister has emphasised the need for India to be Atmanirbhar (self-reliant) in defence equipment. However, we need to be self-reliant not just in missiles (defence equipment) but also in meals (food). As the old proverb goes, no army can march on an empty stomach. "Jai jawan, jai kisan" (salutation to the soldier and salutation to the farmer) was the slogan given by Late Lal Bahadur Shastri, and Atal Bihari Vajpayee added "jai vigyan" (salutation to the scientist) to that. Focusing on science and scientists is critical for attaining self-reliance in meals to missiles.

What is the meaning of India becoming self-reliant in food?

Self-reliance in food does not mean that we have to produce everything ourselves at home, irrespective of the cost. Its true meaning lies in specialising in commodities in which we have a comparative advantage, exporting them, and importing those in which we don't have a significant comparative advantage. This is not an either/or situation - it is about the degree of self-reliance a country wants to have following the principles of comparative advantage. If some protection is needed for new areas to develop (infant industry argument), that may be okay. But one should not aspire to be self-sufficient behind high tariff walls. That would only breed inefficient and high-cost structures that cannot compete globally.

What is it that gives a country an edge over others in attaining comparative advantage?

In the area of agriculture and food, researches reveal that it is the efforts and resources that a country puts in agri-research and development (agri-R&D), its extension from lab to land, investing in irrigation to boost yields, efficiency in marketing and processing the produce, and taking it from farmers' fields to consumers' table or export destinations.

What are the challenges to self-reliance in food?

1. **High dependence on edible oil import:** India has achieved self-reliance in agriculture by producing a reasonably large amount of food, and also being a net exporter of agri-produce. The high dependence on imports for edible oils - hovering around 55 to 60% of consumption however, remains a concern. India's potential to emerge as a significant exporter of agri-produce remains untapped.
2. **Low-value exports:** Further, most processing in India can be classified as primary processing, which has lower value-addition compared to secondary processing. Due to this, despite India being one of the largest producers of agricultural commodities in the world, agricultural exports as a share of GDP are fairly low in India relative to the rest of the world. The same proportion is around 4% for Brazil, 7% for Argentina, 9% for Thailand, while for India it is just 2%.
3. **Lack of effective decentralised:** The real promise of a decentralised system of experimentation, of learning from each other, and the adoption of best-practices and policies has largely failed to materialise. Instead, Indian agriculture since Independence has remained highly fragmented.
4. **Low-value exports:** Further, most processing in India can be classified as primary processing, which has lower value-addition compared to secondary processing. Due to this, despite India being one of the largest producers of agricultural commodities in the world, agricultural exports as a share of GDP are fairly low in India relative to the rest of the world. The same proportion is around 4% for Brazil, 7% for Argentina, 9% for Thailand, while for India it is just 2%.

What is to should be done to make India self-reliant in meal ?

1. Focus on agri-R&D

There is ample literature to show that agri-R&D raises total factor productivity and makes agriculture more competitive globally. Sometimes, the basic R&D to develop "miracle seeds" is done outside the country, but those seeds can be imported and adapted to local conditions with in-country R&D and scaled up for adoption at farmers' fields. The Green Revolution was such a case. The Economic Survey (2021-22) explicitly highlighted the correlation between spending on agri-R&D and agricultural growth. Many research also shows that every rupee spent on agri-R&D yields much better returns (11.2), compared to returns on every rupee spent on say fertiliser subsidy (0.88), power subsidy (0.79), etc. Yet, the competitive populism in Indian democracy leads to suboptimal choices in the allocation of scarce resources. More on safety nets like food subsidy and MGNREGA or on income support and subsidies for farmers, but very little for agri-R&D.

2. Increase the investment in agri sector

If India wants to be fully self-reliant in food, it is generally agreed that it must invest at least 1% of its agri-GDP in agri-R&D. But the budgets of both the Union government and the states put together reveal that this expenditure on agri-R&D and education hovers around 0.6% of agri-GDP, with a roughly equal share of the Centre and all states put together. This is way below the minimum cut off point of 1% and government policy must urgently work towards raising this substantially.

3. Private sector involvement

In addition to this, the government should come out with policies that incentivise private companies to expand their R&D programmes and invest more financial resources on development projects, which have the potential to overcome the challenges of the current agrarian setup of India. There are some global and local companies like Bayer, Syngenta, MAHYCO, Jain Irrigation, and Mahindra and Mahindra that spend a considerable amount of their turnover on R&D programmes and developing high-tech inputs.

The USP of these companies is that they develop technology that increases productivity while addressing the current challenges of limited net sown area, depleting water resources, vulnerability to climate change, and the need to produce nutrient-rich food. India's budget allocations in the agri-food space should thrive on creating "more from less". The financing should focus on altering the current atmosphere of a high incidence of hunger and malnutrition, keep a check on the mismanagement of natural resources and mitigate climate change issues.

There is a need to work on building long-term sustainable solutions that have an aggressive approach to implementing relevant policies and developing new ones.

■■■

QUINOA SEED (*Chenopodium quinoa* Willd.)

A RESERVOIR OF NUTRITIONAL COMPONENTS

About Author

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Quinoa (*Chenopodium quinoa* Willd.) is an annually growing species belonging to the Andean region of Southern America. Quinoa is a staple food for the indigenous people of Andes and has been cultivated there for over 7000 years. Quinoa is a pseudo-cereal belonging to the family of "Chenopodiaceae" which is not a true grain but rather a fruit and the seeds can be milled to obtain flour. The beneficial bioactive compounds in quinoa seeds have recently caused interest in them such as polysaccharides, saponins, and phenolic compounds and their potential health benefits. Several studies demonstrate that these elements can be connected to different biological effects such as anti-cancer, anti-inflammatory, and antioxidant activities.

Nutritional composition of quinoa

Numerous studies have confirmed that quinoa contains high-quality protein. All types of essential

amino acids are present in quinoa protein, making it a complete protein. The protein composition of quinoa ranges from 12% to 23%, with the majority of the protein being albumins (35%) and globulins (37%). The protein in quinoa is highly digestible. Due to its excellent digestion, quinoa has a 73% biological value (BV). The relatively low concentration of trypsin inhibitors in quinoa seeds prevent the enzymatic

digestion and absorption of protein, contributing to the high protein bioavailability. Additionally, patients with celiac disease can safely consume quinoa, as it is a gluten-free pseudo-cereal. The bioactive peptides present in quinoa have many activities, including antioxidant, antimicrobial, immunomodulatory, and antihypertensive effects which are beneficial for human health.

The solubility and digestibility of quinoa starch are both very high. Quinoa is rich in fiber compared to other cereals. It contains 8–13% dietary fiber. Quinoa fiber comprises about 2.6%-10% of the total weight of the grain; about 78% of its fiber content is insoluble and 22% soluble**.** The majority of the insoluble quinoa fiber is made up of galacturonic acid, arabinose, galactose, xylose, and glucose whereas soluble quinoa fiber comprises glucose, galacturonic acid, and arabinose.

Quinoa's lipid profile is thought to be beneficial for human health. The lipid content of quinoa was reported to range from 5.3% to 14.5%, with a high level of unsaturation between 70% and 89.4%. Fatty acids Omega-3 and Omega-6 make up the majority of quinoa oil. It is well recognised that omega-3 and omega-6 fatty acids have positive impacts on health. It helps reduce the risk of cardiovascular disease (CSD), breast cancer, and gastrointestinal cancer. Fatty acid constituents of quinoa are mainly monounsaturated (27%) and polyunsaturated (55%), while saturated fatty acids represent 12% of the total fatty acids. Quinoa oil is relatively stable despite having a high level of unsaturation because it contains tocopherols, a natural antioxidant. Quinoa has a substantially greater vitamin E activity value that can protect fatty acids of cell membranes against oxidative damage.

Quinoa contains rich minerals in bioavailable forms. Quinoa has many vitamins, with 100 g of this grain containing: 0.4 mg of thiamine, 78.1 mg of folic acid, 1.4 mg of vitamin C, 0.20 mg of vitamin B6, and 0.61 mg of pantothenic acid. Quinoa has the sufficient amounts of minerals like calcium, magnesium, and potassium in accessible forms required for a balanced human diet. It has 874 mg of calcium per kilogramme (Ca), phosphorus (P) 2735.0 mg/kg, iron (Fe) 948.5 mg/kg, K 9562.2 mg/kg, and magnesium (Mg) kg-4543.3 mg/kg. Dietary minerals are necessary chemical substances that control the body's electrolyte balance, glucose homeostasis, nerve impulse transmission, and enzyme cofactors**.** Additionally, betaine (630.4 mg/100 g dry portion) and its precursor choline (70.2 mg/100 g dry portion) are both highly concentrated in quinoa. Betaine has been discovered to improve overall managing one's health and preventing diseases linked to low plasma levels. The phospholipids phosphatidylcholine and sphingomyelin, which are necessary for the operation of cell membranes, are made with the help of choline, a nutrient that resembles a vitamin.

Table 1 :- Nutritional composition of quinoa (uncooked). Data obtained from Food -Data Central USDA (2019) United States Department of Agriculture

Nutrients		Vitamins		Vitamins	
Water a	13.3	Thiamin (B1)b	0.36	Choline total b	70.2
Energy (kcal)	368	Riboflavin (B2)[b]	0.318	Vitamin E[b]	2.44
Total Protein[a]	14.1	Niacin (B3)[b]	1.52	Betaine[c]	630.4
Total Fat[a]	6.07	Pantothenic acid (B5)[b]	0.772	Folate[c]	184
Carbohydrate[a]	64.2	Pyridoxine (B6)[b]	0.487	β-carotene[c]	8.0
Dietary Fiber [a]	7	β-tocopherol[b]	0.08	β-cryptoxanthin[c]	1.0
Starch[a]	52.2	γ-tocopherol[b]	4.55	Vitamin K[c]	1.1
Ash[a]	2.38	δ-tocopherol[b]	0.35		

[a] g/100 g edible portion, [b] mg/100 g edible portion, [c] µg/100 g edible portion

Table 2:- Mineral Composition of uncooked quinoa. USDA 2019

Mineral Composition (mg/100 g edible portion)	
Calcium	47.0
Iron	4.6
Magnesium	197.0
Phosphorus	457.0
Potassium	563.0
Sodium	5.0
Zinc	3.1
Copper	0.6
Manganese	2.0

Conclusion

To conclude, Quinoa has good potential to be used as a functional food. Its seeds have high nutritional value and contain many bioactive compounds. It provides many health benefits including antioxidant, hypolipidemic, immunomodulatory and weight regulating effects. Incorporating quinoa into the diet may result as a successful way to consume high biological value proteins and all accessible essential amino acids, something that other grains rarely provide. Quinoa is an appealing, gluten-free alternative that is available to celiac sufferers and diabetic patients because of its low glycemic index. Additionally, in rural and marginal areas of some developing countries, where energy-protein malnutrition affects a larger portion of the population, quinoa may serve as a strategic crop used to supplement diets.

ONE NATION ONE FERTILIZER

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It has been agreed to execute One Nation One Fertilizer by creating a "Single Brand for Fertilizers and Logo" under the fertiliser subsidy programme known as the **"Pradhanmantri Bhartiya Janurvarak Pariyojna,"** according to a statement from the Ministry of Chemicals and Fertilizers (PMBJP). The launch of One Nation One Fertilizer is scheduled for October 2, 2022.

For all fertiliser companies, State Trading Entities (STEs), and Fertilizer Marketing Entities, the single brand name for UREA, Di-Ammonium Phosphate (DAP), Murate of Potash (MOP), and Nitrogen Phosphorus Potassium (NPK), etc. would be BHARAT UREA, BHARAT DAP, BHARAT MOP, and BHARAT NPK, etc.

According to the plan, all fertiliser businesses, State Trading Entities (STEs), and Fertilizer Marketing Entities (FMEs) will have to use the PMBJP's "Bharat" brand and logo.

The memo outlines the sspecifications of the new packaging for companies:

1. The PMBJP logo and the new "Bharat" brand name will take up two-thirds of the fertiliser packet's front.
2. The remaining one-third of the space can only be used by the manufacturing brands to show their name, logo, and other information.

Following is the government's justification for creating a single "Bharat" brand for all fertilisers sold at a subsidised price by businesses:

a) Currently, the government sets a maximum retail price for urea, which reimburses businesses for the greater manufacturing or import expenses they have to pay. On paper, the MRPs for non-urea fertilisers are uncontrolled. Companies cannot, however, receive subsidies if their MRPs are greater than those formally suggested by the government. Simply put, the government essentially sets the MRPs for approximately 26 fertilisers (including urea).

b) The government determines where businesses can sell in addition to subsidising them and setting the price at which they can sell. The Fertilizer (Movement) Control Order, 1973 facilitates this. In accordance with this, the department of fertilisers, in cooperation with producers and importers, develops an agreed-upon monthly supply plan for all fertilisers subject to subsidies. Each month, before the 25th, a supply plan is released for the following month. The agency also routinely monitors movement to make sure that fertiliser is available where it is needed, particularly in remote locations.

c) The government would obviously want to take credit and convey that message to farmers when it is spending enormous sums of money on fertiliser subsidies (the bill is anticipated to exceed Rs 200,000 crore in 2022-23) and determining where and at what price companies can sell.

A couple of issues are immediately apparent:

1. Companies that produce fertiliser will be discouraged from engaging in marketing and brand-promotion efforts. They will now only serve as the government's contracted importers and manufacturers. The main assets of any business are its brands and the long-standing farmer relationships.
2. Currently, the corporation is held accountable for any bags or batches of fertiliser that don't adhere to the necessary criteria. However, that might now be entirely transferred to the government. The plan may not work out politically in the ruling party's favour.

NANO UREA LOW COST AND HIGH YIELD FOR MEETING FUTURE FOOD REQUIREMENT

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Prills urea are not only costaly for the producer but may be harmful to humans and the environment. The nano urea consist of higher surface area because losses in size of the nano particle and have high reactivity, solubility in water.

Nano urea are the important tools in agriculture to improve crop efficiency, yield and quality parameter with increase nutrient use efficiency, reduce wastage of fertilizer and cost of cultivation. It fulfills crop nitrogen requirement, increase leaf photosynthesis effective tillers and branches comes out and reduce the requirement of conventional urea by 50% or more.

IFFCO has priced nano urea at Rs.240 per 500ml bottle for the farmers,which is 10% cheaper than the cost of a bag of conventional urea. Conventional urea is effective 30-40% in delivering nitrogen to plants, while the effectiveness of the nano urea liquid is over 80%. It will also have a huge positive impact on the quality of underground water, very significant reduction in the Global warming with an impact on climate change and sustainable development.

Introduction

Nano sized fertilizers are the new frontier of nanotechnology towords a sustainable agriculture. Nano urea (liquid) contains nano scale nitrogen particles which have more surface area (10000 times over 1mm urea prills) and number of particles (55000 nitrogen particles over 1mm urea prills).

In a breakthrough, the Indian Farmers Fertilizer Cooperative Limited (IFFCO) launched this nano urea liquid. "Worlds first nano urea liquid" was unveiled during its 50th annual general body meeting of IFFCO. Nano urea is developed to replace conventional urea and it can curtail the requirement of the some by at least 50%. It's a bottle of 500ml which contains 40000ppm of nitrogen and equivalent to one bag of conventional urea.

Dose and method

- Mix 2-4 ml of nano urea liquid in 1 litre of clean water and spray on crop leaves .
- For better result spray twice:
  1. At initial growth stage (tillering/branching).
  2. Before one week of flowering.

Component and content:

1. Quinhydrone 0.01-5%
2. Calcium cyanamide 0.01-10%
3. Urea 85-99.98%
4. Micro non-nitrogen plant nutrients.

How to use nano urea

Take IFFCO Nano Urea bottle to make a solution. According to crop age and condition choose a concentration per liter of water. For 30-40 days crop farmers can choose 4 ml nano urea per liter of water. Mix water and nano urea in a spray pump and spray it on crop leaves.

Advantages

1. Reduce excess use of urea.
2. Crops will stronger, healthier and protect them from lodging effect.
3. Improve physical and chemical condition of soil.
4. It will be balanced nutrition program.
5. Increase production with improved nutritional quality.
6. Reduce global warming and sustainable development.
7. India will be self reliant in nitrogen fertilizer.
8. Cheaper than granular urea.

Disadvantages of conventional urea

1. Environmental pollution.
2. Harm to soil health.
3. Makes plants more susceptible to disease.
4. Increase insect infestation.
5. Delayed maturity of the crop and production loss.
6. Loss of urea by runoff.

Conclusion

India now has a lead role in a new global green revolution. IFFCO nano urea is a huge step towerds sustainable agriculture and food system that includes presion and smart farming. It is capable of revolutionizing the entire agriculture sector all over the world. the nano fertilizer would be more sustainable than conventional urea for the environment and reduce input, logistics and storage cost. It is expected to replace the usage of urea granules, one of the most widely used fertilizers in farmlands across the world. Market participants believe the fertilizer could be a game changer in the long run, including in international markets, subject to how well farmers accept it. IFFCO has planned an enormous countrywide campaign exercise to demonstrate and train the farmers on how to use and apply it.

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NEXT GENERATION SEQUENCING A BOON

About Author

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DNA sequencing process utilizes biochemical methods in order to determine the correct order of nucleotide bases in a DNA macromolecule using sequencing machines. Ten years ago sequencing was based on a single type of sequencing that is Sanger Sequencing. Demand has never been greater for revolutionary technologies that deliver fast, inexpensive and accurate genome information. This challenge has catalysed the development of next generation sequencing (NGS) technologies. It have impacted enormously on the life sciences. The inexpensive production of large volumes of sequence data is the primary advantage over conventional methods. NGS platforms have changed the impact of sequencing on our knowledge of crop genomes and gene regulation. It provides the information about gene regulation on the cellular as well as whole-plant level through RNA sequencing and subsequent expression analyses of genes. NGS has facilitated the development of methods to genotype very large numbers of single nucleotide polymorphisms.

Genotyping by sequencing and whole-genome resequencing can lead to the development of molecular markers suited to studies of genetic relationships among breeding materials, creation of detailed genetic mapping of targeted genes and genome-wide association studies Plant genotyping can benefit plant breeding through selection of individuals resistant to climatic stress and to pathogens causing substantial losses in agriculture.

Introduction

Roche's 454 technology in 2005 was capable of producing sequences with very high throughput and at a much lower cost than the first sequencing technologies. These new sequencing technologies are generally known under the name of Next Generation Sequencing (NGS) Technologies or High Throughput Sequencing Technologies. NGS technologies produce a massively parallel analysis with a high throughput from multiple samples at much reduced cost. NGS technologies can be sequenced in parallel millions to billions of reads in a single run and the time required to generate the Giga Base sized reads is only a few days or hours making it better than the first generation sequencing such as Sanger sequencing. NGS technologies continue to improve and the number of sequencers have increased in the last few years.

Techniques in Next Generaton Sequencing:

SOLiD sequencing

Supported Oligonucleotide Ligation and Detection (SOLiD) is a NGS sequencer Marketed by Life Technologies. It consists of multiple sequencing rounds and starts by attaching adapters to the DNA fragments, fixed on beads and cloned by PCR emulsion. Beads are placed on a glass slide and the octamer with a fluorescent label at end are sequentially ligated to DNA fragments, and the color emitted by label is recorded. Output format is color space which is encoded form of the nucleotide where four fluorescent colors are used to represent 16 possible combinations of two bases. The sequencer repeats ligation cycle. Each cycle complementary strand is removed and a new sequencingcycle starts at the position n-1 of the template. The cycle is repeated until each base is sequenced twice. The recovered data from the color space can be translated to letters of DNA bases and the sequence of the DNA fragment can be deduced. The strength of ABI/SOLiD platform is high accuracy because each base is read twice while the drawback is the relatively short reads and long run times. The errors of sequencing in this technology is due to noise during the ligation cycle which causes error identification of bases. The main type of error is substitution.

Roche/ 454 sequencing

It is based on the detection of pyrophosphate released after each nucleotide incorporated in the new synthetic DNA strand. Here, DNA samples are randomly fragmented and each fragment is attached to a bead whose surface carries primers. It have oligonucleotides complementary to the DNA fragments so each bead associated with a single fragment. Each bead is isolated and amplified using PCR emulsion which produces about one million copies of each DNA fragment on the surface of the bead. The beads are then transferred to a plate containing many wells called picotiter plate (PTP).

The pyro sequencing technique is applied which consists in activating of a series of downstream reactions producing light at each incorporation of nucleotide. By detecting the light emission after each incorporation of nucleotide,sequence of the DNA fragment is deduced . Roche /454 is able to generate relatively long reads which are easier to map to a reference genome. The main errors detected of sequencing are insertions and deletions due to the presence of homopolymer regions. Identification of the size of homopolymers should be determined by the intensity of the light emitted by pyrosequencing.

Ion Torrent sequencing

It does not use fluorescent labeled nucleotides like other second-generation technologies. Based on detection of the hydrogen ion released during the sequencing process it uses a chip that contains a set of micro wells and each has a bead with several identical fragments. The incorporation of each nucleotide with a fragment in the pearl, a hydrogen ion is released which change the pH of the solution. This change is detected by a sensor attached to the bottom of the micro well and converted into a voltage signal which is proportional to the number of nucleotides incorporated. The Ion Torrent sequencers are capable of producing reads lengths of 200 bp, 400 bp and 600 bp with throughput that can reach 10 Gb for ion proton sequencer.

Heliscope Single Molecule sequencing

It Involves DNA library preparation based on DNA shearing followed by addition of a poly-A tail to the sheared DNA fragments. These poly-A tailed DNA fragments are attached to flow cells through poly-T anchors. The sheared DNA templates are hybridized to immobilized oligonucleotide primers. Then it is adhered to the solid surface or directly immobilized by covalent bonding to the solid surface. The change is detected by a sensor attached to the bottom of the micro well. It is converted into a voltage signal which is proportional to the number of nucleotides incorporated. DNA templates are then primed with a universal primer. Extension-based sequencing with cyclic washes of the flow cell with fluorescently-labeled nucleotides (one type of nucleotide added at a time, as applied in the Sanger method).The reads are performed by the Heliscope sequencer. It generates short reads of up to 28 Gb in a single sequencing run.

Conclusion

As NGS has developed over recent years, the time required to sequence DNA has reduced. Scientists can now sequence millions of DNA fragments at the same time. They can also sequence virtually anything, from specific target regions to the entire human genome, within 24 hours. After a laboratory receives a tumor specimen,it takes approximately 10 days to receive a whole-genome-sequencing report.

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VEGETABLES

AN IMPORTANT SOURCE OF HUMAN NUTRITION

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Vegetables can be any component of a plant that can be eaten, including leaves, roots, fruits, and seeds. In addition to being an integral aspect of contemporary farming, vegetables are a global staple food. Vegetables are highly recommended by medical professionals due to their low caloric content and high nutrient density. Vegetables are a good source of energy, vitamins, minerals, and fibre, and there is mounting evidence that they also supply a variety of phytonutrients, which have additional health advantages. Some vegetables contain a high concentration of carbohydrates and are therefore referred to as starchy vegetables. Typically, these are tubers and roots, including potatoes, sweet potatoes, yams, taro, and sweet corn. Because of their carbohydrate content, starchy vegetables contain more energy. Other vegetables are considered as non-starchy, typically, have a higher water content, are fewer calories, and contain more vitamins and minerals. One of the greatest methods to obtain nutrients from food is to eat a balanced, rotating diet of different types of vegetables beginning at a young age, as is supported by scientific research.

Why should we eat vegetables?

Indian Council of Medical Research (ICMR) has suggested that every individual consume at least 300 g of vegetables per day. Micronutrients and macronutrients are plentiful in fresh vegetables. The modern micronutrients include minerals and vitamins, while the macronutrients present are complex carbohydrates and fibres. They are rich in iron, calcium, vitamin C, folic acid, carotenoids, and phytochemicals. Some vegetables are extremely low in calories, whereas others, such as potato, sweet potato, tapioca, and yam, are high in starch and supply a substantial quantity of energy. Consequently, vegetables can be employed to add or subtract calories from our diet.

Which vegetables should be consumed?

Consuming vegetables that are fresh, readily available in our area, and ideally seasonal would be beneficial. They are delicious and contain a greater number of micronutrients. However, you cannot receive all the nutrients you require from a single type of vegetable. Consuming a wide variety of them, particularly those with a range of colours, is essential. Diets can be greatly improved by including vitamin C-rich citrus fruits in addition to the typically eaten leafy greens, tomatoes, and other vegetables. Add some variety to your meals by choosing some new vegetables to complement these.

Colour is the key

There is a strong correlation between the pigments that give fruits and vegetables their vibrant colours and the health benefits you will reap from eating them. Vegetables with a purple or blue colour (such as beets, kale, and eggplant) are especially beneficial because they contain antioxidants, which have been shown to lower cancer, stroke, and heart disease risks. Cancer and heart disease risk can be reduced by eating more foods that are red in colour, such as red peppers, radishes, tomatoes, and watermelons. Vegetables like carrots, pumpkins, and squash that are orange or yellow in colour contain carotenoids, which are beneficial to eye health. Green vegetables like asparagus, green beans, broccoli, cabbage, green capsicum, cucumber, lettuce, peas, and spinach have phytochemicals with anti-cancer properties, while brown and white vegetables (cauliflower, chives, garlic, ginger, leek, onion) are excellent sources of phytochemicals with antiviral and antibacterial properties.

How to prevent cooking losses?

Cooking and preparing meals in water also causes vitamin loss. These losses can, however, be greatly mitigated by employing correct cooking techniques. Vegetables lose a lot of nutrients when they are washed after being cut or when they are chopped up into small pieces for preparation. Raw, freshly harvested vegetables are always healthy to eat, provided they are washed well before consumption.

Health benefits

Fresh vegetables include nearly all the essential nutrients required by the human body. The nutritional value of vegetables is considerable. Vegetables are rich in critical vitamins, minerals, and antioxidants that supply your body with numerous key health benefits. Carrots, for example, are rich in vitamin A, which plays a crucial role in maintaining eye health as we grow older. Many vegetables are high in dietary fibre, a form of carbohydrate that aids in the digestion process and can be found in many different types of vegetables. Some research suggests that fibre can enhance the body's ability to absorb vitamins and minerals, giving you a boost of energy throughout the day. Numerous green leafy vegetables, including kale, spinach, and chard, are potassium-rich. Potassium improves the kidneys' ability to eliminate sodium from the body, hence lowering blood pressure. Vitamin K, which is found in green leafy vegetables, is believed to prevent calcium from accumulating in the arteries. This can reduce your risk of arterial damage and help you avoid future heart health complications including heart disease. Vegetables are a powerful source of folate, a B vitamin that aids in red blood cell production. Folate is particularly vital to the health of children and may help lessen the incidence of cancer and depression.

Focus areas

In order to develop cultivars rich in a variety of phytochemicals and to ensure that a mixture of phytochemicals enters the human diet, it is necessary to continue comparing the levels of phytonutriceuticals in older and newer major cultivars and to identify the genetic mechanisms that regulate the synthesis of their key phytochemicals, such as the glucosinolates, thiosulfides, and flavonoids. Studies have shown that the bioavailability of some of the phytochemicals increase dramatically after storage and processing, while others degrade rapidly; therefore, it is necessary to study the potential change in the balance of these compounds and to identify the optimum conditions for maintaining these phytochemicals after harvest and processing.

Conclusion

Vegetables in their various forms provide an adequate intake of most vitamins and nutrients, dietary fibres, and phytochemicals, restoring a measure of balance to diets and helping to alleviate many of the issues associated with poor nutrition. Regular consumption of a diet rich in vegetables has undeniably favourable benefits on health, since phytonutriceuticals in vegetables can protect the human body from a variety of chronic diseases. Increasing the use of vegetables may reduce the consumption of saturated fats, trans fats, and foods with a greater caloric density, all of which may be associated with a healthier overall diet.

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TECHNIQUES OF HERBICIDE APPLICATION

About Author ...

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Presently, throughout the globe approximately 2 million tonnes of pesticides are utilized, out of which 47.5% are herbicides, 29.5% are insecticides, 17.5% are fungicides and 5.5% are other pesticides. Chemicals that are used to kill or inhibit the growth of weeds are called herbicide. These chemicals are applied directly to weeds plants and soil, severs methods like injecting, incorporating the soil, by applying them as granules, by applying through irrigation systems and by applying them with sprayers. Uniform application of herbicide is crucial for good weed management; reduce the negative impact of herbicide in soil quality and better performances of crops.

Objective

1. To study the different methods of herbicide application.
2. Know the mode of action of herbicide.

Parameters to select the method of herbicide application

1. Crop - weed situation.
2. Herbicides type.
3. Mode of action and selectivity of herbicide.
4. Environmental situation.
5. Cost and convenience of herbicide application.

Different methods of herbicides application based on site of target.

A. Soil application of herbicides:

(i) Surface application

Herbicides are applied uniformly on the surface of the soil either by spraying or by broadcasting. The applied herbicides are either left undisturbed or incorporated in to the soil. Incorporation is done to prevent the volatilization and photo-decomposition of the herbicides. e.g. Fluchoralin.

(ii) Subsurface application

It is the application of herbicides in a concentrated band, about 7-10 cm below the soil surface for controlling perennial weeds. For this special type of nozzles introduced below the soil under the cover of a sweep hood.e.g. Carbamate herbicides to control Cyperus rotundus and Nitralin herbicides to control Convolvulus arvensis.

(iii) Band application

Pre-emergence herbicide are application to a restricted band along the crop rows leaving an untreated band in the inter-rows. Later inter-rows are cultivated to remove the weeds. Saving in cost is possible here. For example when a 30 cm wide band of a herbicide applied over a crop row that were spaced 90 cm apart, then two-third cost is saved.

(iv) Fumigation

Application of volatile chemicals in to confined spaces or in to the soil to produce gas that will destroy weed seeds is called fumigation. Herbicides used for fumigation are called as fumigants. These are good for killing perennial weeds and as well for eliminating weed seeds. e.g. Methyl bromide, Metham.

(v) Herbigation

It is the application of herbicides with irigation water both by surface and sprinkler systems. In India farmers apply fluchloralin for chillies and tomato, while in western countries application of EPTC with sprinkler irrigation water is very common in Lucerne.

B. Foliar application

(i) Blanket spray

It is the uniform application of post emergence herbicides to standing crops without considering the location of the crop (entire area). Only highly selective herbicides are used here e.g. Spraying 2,4-Ethyl Ester to rice three weeks after transplanting.

(ii) Directed spray

It is the application of partially selective herbicides on weeds in between rows of crops by directing the spray only on weeds avoiding the crop. This could be possible by use of protective shield or hood. eg. spraying of glyphosate in between rows of tapioca using hood to control *Cyperus rotundus*.

(iii) Protected spray

It is a method of applying non-selective herbicides on weeds by covering the crops which are wide spaced with polyethylene covers etc. This is expensive and laborious. However, farmers are using this technique for spraying glyphosate to control weeds in jasmine, cassava, banana.

(iv)Spot treatment

It is usually done on small patches having serious weeds infestation to kill it and to prevent its spread. Rope wick applicator and Herbicide glove are useful here.

(v) Lay by application

Application of soil acting herbicide after the last cultivation in crops for example after ridging in sugarcane or cotton, after earthing- up in potato. Which will prevent further emergence of weeds.

■■■

BIOSENSOR IN AGRICULTURE
AN OVERVIEW

About Author ...

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Growing human population, preservation of clean resources and food quality, and climate and environmental protection all provide significant difficulties to current food production. The development of technologies to ensure the sustainability of food is largely a collaborative endeavor backed by both businesses and governments. There have been numerous initiatives aimed at overcoming obstacles and improving factors that influence food production. The key difficulties in food production and sustainability are being widely addressed through the use of biosensors and bio sensing technologies and their applications. These difficulties are caused by a variety of factors, some of which are tied to the food manufacturing industry itself. Several things may influence the world's food production. Economic infrastructure, such as information technology, electricity, irrigation, and transportation, is prerequisite in agriculture development.

Bio sensing technologies and food sustainability

A biosensor is defined as a small, portable analytical equipment with a biological or biomimetic sensing component that is either directly connected to or integrated into a transducer system. Enzyme/substrate, antibody/antigen, and nucleic acids/complementary sequences couples are the primary biological components employed in biosensor technology. The signal is then transformed into a quantifiable quantity by the transducer. Signals can be shown in electrical (voltammetry, impedance, capacitance), optical (colorimetric, fluorescence, chemo-luminescence, and surface plasmon resonance), or any other chosen format. Agricultural biosensors can be classified based on type of bio-recognition system used. Agricultural

biosensors are now dealing with the in-situ analysis of crop pollutants, pathogens and ultimately contributing to decision control system in precision agriculture. Animal physiological studies are now conducted via use of wearable biosensors in modern dairies. For developing highly sensitive agricultural biosensors, specifically those working in liquid-solutions, stability is also an important aspect foodomics, or the food fingerprint, is about the nutritional values, quality and authenticity, and safety and security of foods.

Microfluidics in bio-sensing technology

Microfluidics represents a techno-logical system integrating multiple technologies including bio sensing, nanotechnology, and microsystems with microscale volumes and micro sized channels. The combination of electro-chemical microfluidic and cell culture technologies represents a novel analytical technique in food analysis.

Nutrients and qualities detection

The measures in food security can be divided into two categories: postharvest loss and food biosecurity. Food biosecurity indicates food contamination and destruction by natural, political, unfair economic gain, warfare, or exacting revenge.

Biosensors for detection and identification of infectious disease in crops

Some microorganisms, particularly certain bacteria and fungi, are pathogens that attack crops and cause disease, sometimes in epidemic proportions. Fungal infection and aflatoxin production can occur at any stage of plant growth, harvesting, drying, processing and storage.

Toxin detection

Electrochemical biosensors for fast detection and assessment of food toxins belong to the main stream of development in food safety.

Biosensors for pre-harvest agriculture

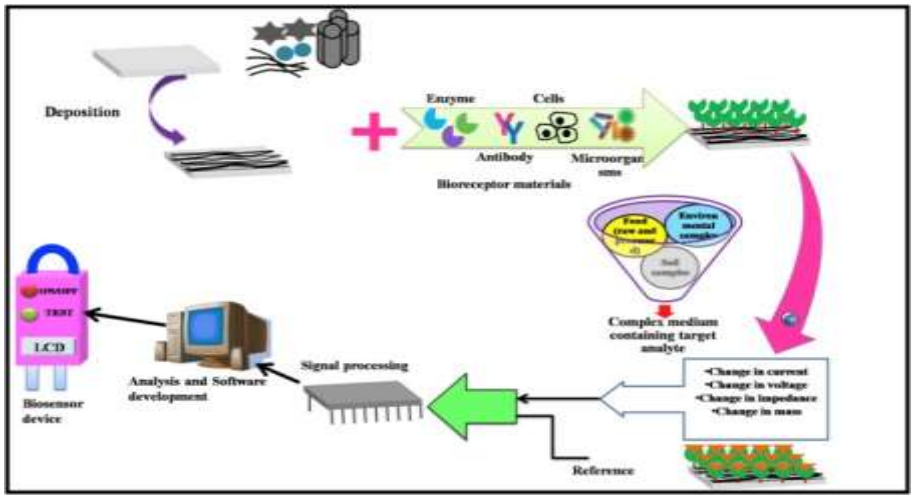
During pre-harvest stage, the crop is affected by afflation contamination, deficiency of nutrients, phytohormone imbalance, diseases, extreme weather conditions (drought and floods), irrigation scheduling and lodging. Presently laboratory-based techniques including polymerase chain reaction (PCR), immune-fluorescence (IF), enzyme-linked immune sorbent assay (ELISA) and gas chromatography-mass spectrometry (GC-MS) are being used for the detection of plant disease.

Biosensors for post-harvest agriculture

Post-harvest agriculture is a complex aggregate of operations consisting of harvesting, sorting, storage, processing and packaging. In agriculture the food quality is evaluated based on internal and external quality both.

Future challenges

Application and commercialization of biosensor technology has lagged behind the output of research laboratories. One of the future challenges is to develop cost effective methods for sequencing, interpreting and storing deoxyribonucleic acid (DNA) sequences. The development of DNA probes is a promising area of research in biosensors. So far, molecular imprinted polymers have been prepared with affinities for proteins, amino acid derivatives, sugars, vitamins, pesticides, and pharmaceuticals. Biosensor advancement in the commercial world could also be accelerated by the use of intelligent instrumentation, electronics, and multivariate signal processing methods such as chemo metrics and artificial neural networks.



Recent development in biosensors to combat agricultural challenges and their future prospects

Conclusion

Biosensors could play an important role in providing powerful analytical tools to the agricultural diagnosis sector, particularly where rapid, low cost, high sensitivity and specificity measurements in field situations are required. This review summarized on-going developments in this field. There are many different ways to combine biology, chemistry, physics, mathematics and engineering in order to develop new biosensors with applications in agriculture. The promise shown by biosensor technology is very real. The advancements in micro-fabrication technology, material science and Nano engineering have an enormous and profitable impact in the agricultural biosensor market.

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Bacillus subtilis

A POTENTIAL BIOCONTROL AGENT (ANTAGONIST) IN MANAGEMENT OF PLANT DISEASES

About Author ...

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Beneficial bacteria are exploited as biopesticides to control the diseases in plants. They are gram positive, rod shaped bacteria that can form a protective endospores. It is a facultative anaerobe, heavily flagellated. Optimal temperature range for this bacteria is 25-35˚C. They produce colonies which are dry, flat with lobate margins. They can tolerate extreme environmental conditions by forming endospores. The most known species hosting biocontrol agents are *Bacillus subtilis* and *B. amyloliquefasciens*.

Mode of action

Bacillus spp. can control fungal pathogens by competition, antibiosis and induced resistance. Competition takes place for space at the root surface and for nutrients in the rhizosphere, mainly those released as seed or root exudates. Competitive colonisation of the rhizosphere and successful establishment in the root zone is a prerequisite for effective biocontrol, regardless of the mechanisms involved. Direct antagonism involves the production of several microbial metabolites among which lipopeptides play the major role.

Uses

The peat-based formulation of *Bacillus subtilis* is mainly used as seed

treatment for the control of root rots and wilt diseases of crop plants. The method of application and the precautions to be followed are mentioned below:

- ✓ *Bacillus* strains are effective against a broad spectrum of plant pathogens and they can be used either as foliar application or root application before transplanting.
- ✓ In case of soil or root application the ability of the specific strain to colonize and permanently establish on the roots of the specific crop is crucial. Sometime the colonization is not simply crop-specific, but cultivar-specific.
- ✓ Root application of *Bacillus spp.* should be done to improve resistance of the plant or to protect the early stage of seed germination, rather to directly control soil-borne inoculum of pathogens.
- ✓ 600 grams of peat based *Bacillus subtilis* product is required to treat the seeds required for sowing in one hectare.

Trade names of *Bacillus subtilis* :

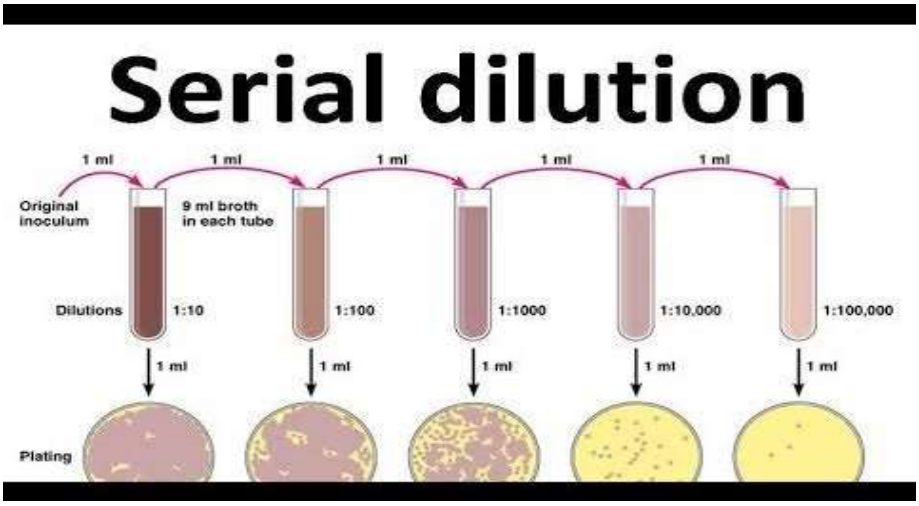
- Bio- Mate
- Mildown
- Florabacibs
- Subweln
- Bio Downking
- Leaf Care
- Bacilin
- Green Dual.

Collection of soil sample:

The soil samples are taken from depth of 5 cm. A zigzag sampling of soil format is used.

Isolation by serial dilution technique

Isolated in Nutrient Agar medium (NA) medium by serial dilution technique. 10 g of soil sample is diluted in 90 ml of distilled water in 250 ml conical flask and kept in an orbital shaker at 150 rpm to get a homogenized soil suspension. Serial dilutions are made. Dilution of 10^{-7} is isolated into nutrient agar plates and incubated at 37˚C for 24 hours. Isolated colonies



growing on each diluted plates are transferred into freshly prepared nutrient agar slants. The bacterial strains isolated on nutrient agar slants are kept at in refrigerator for further study.

Identification and characterization of the isolate

The strain was isolated and found Gram positive based on the Gram Staining Technique. Rod-shaped bacterium which stains dark purple in colour are arranged in chains when viewed under microscope.

Mass multiplication of *Bacillus subtilis*

Preparation of mother culture

The nutrient broth medium is prepared as mentioned below. The medium is taken in conical flasks. Autoclaved at 15 lbs psi pressure for 15 minutes. A loopful of *B. subtilis* is inoculated into the medium and incubated for 2 days. This serves as mother culture.

- Glucose : 5.0 g
- Peptone : 5.0 g
- Beef extract : 3.0 g
- Sodium chloride : 3.0 g
- Distilled water : 1000 ml

Mass multiplication

Nutrient broth is prepared in fermentor and sterilized at 15 lbs psi pressure for 15 minutes. The mother culture is added @ 1L/100 L of the medium and incubated at room temperature for 2 days. The medium containing the bacterial growth of *B. subtilis* is mixed with talc powder.

Formulation of *Bacillus subtilis*

- ✓ Serenade (WP, aqueous suspension) - Primary target is fungi, bacteria infecting on various fruits and vegetables.
- ✓ Kodiak [WP (Conc.), flowable]– target fungi infecting cotton, large seeded legumes, soybeans.
- ✓ Subtilex [WP (Conc.)]- target fungi infecting cotton, large seeded legumes, soybeans.
- ✓ Hi Stick L + Subtilex (Flowable)– target fungi infecting soybean, peanuts.

Conclusion

Food and money are at higher risk due to the severity of the plant diseases. Biocontrol agents played crucial role in the control of plant diseases through various mechanisms. Emphasis must be given on the use of biocontrol agents (antagonists) for control of various plant diseases rather than solely dependant on harsh chemical fungicides which causes loss of microflora and microfauna of soil. *Bacillus spp.* like *Bacillus subtilis* and others are an attractive alternative to synthetic chemical fungicides as these bacteria are environmental friendly and non-toxic to plants, beneficial microorganisms and humans and they are potential source for managing various plant diseases.

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GENDER ISSUES
IN FAMILY AND SOCIETY

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Gender is a word used in social and cultural context. Gender refers to *"socially constructed roles, behaviours, activities and attributes that a given society considers appropriate for women and men.*" According to World Health Organization "Gender refers to the characteristics of women, men, girls and boys that are socially constructed which includes norms, behaviours and roles associated with being a woman, man, girl or boy, as well as relationships with each other." Gender issues are deeply rooted in the family and society as the male members think that they are superior to female.

Gender issues in families

Family is the basic unit/backbone of our society. In the family and societies, gendered characteristics are ascribed as per their sex whether they are male or female. These gender norms by upholding the roles that were assigned to them during the early stage of life. Male members are assigned work outside the house and female are allowed to do only households work. However, it should be noted that not all parents set gender roles for their children and want them to participate in both household and extra-domestic activities, thus its application is not universal. They actually reject teaching their kids that gender norms or preferences should be respected since doing so can breed prejudice or stereotyping.

Gender issues in societies

A group of people that share a common culture and shared criteria that determine their customs and lifestyle and that are related to each other within the framework of a community are called as a society. In the society, the distribution of gender roles could be surprising. There are people who restrict the female gender to domestic chores specifically cleaning and cooking. People do not agree that men should perform these domestic tasks equally; instead, they prefer that men perform exterior household tasks like cleaning the compound and fixing damaged facilities. This starts at early stage of a child where girls are taught how to make food and make sure the house and clothes are clean, and take care of the laundry. The male gender is viewed as the breadwinner or provider, and as such, they are expected to work hard and meet the primary and secondary requirements of the family.

Socialization

During the process of socialization, girls tend to play separately from their male counterparts whether in school or at home. During and after adolescent stage, there is tendency for both genders to reject gender segregation throughout and after the adolescent stage and become attracted to the other. This is a problem that is heavily influenced by one's socialisation, peer pressure, parental guidance, and personal desire. The isolation and reintegration of gender at various stages of life may affect a growing child to adopt their colleagues' ways of life.

Conclusion

However, gender abilities are also surprising because females have always been treated weaker than males. The majority of women tend to hate demanding tasks and those that demand a lot of energy. Despite all difficulties, there are women who have defied the stereotypes and are today employed in technical jobs, construction companies, and the military. Some of the women have also demonstrated incredible strength, particularly those who compete in world boxing championships; as a result, they don't want to live up to society expectations regarding their physical prowess. Everyone tends to be independent and pursue their hobbies in whichever way is most practical for them. This indicates that certain sociological standards become less and less important in society as people become more dynamic.

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VENTILATION OF CALF HOUSING DURING WINTER

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Dairy farmers often see an increase in respiratory illnesses in calves during winter months. Understanding the physical needs of calves goes a long way in determining how to properly care for them, especially in cold weather. One of the most important issues directly associated with the health of calves is proper ventilation. Ensuring that calf barns and hutches are not completely closed and that calves are housed in a draft-free environment are two key elements to proper ventilation. After one month of age, dairy calves are most comfortable between 50°F to 80°F. As temperatures fall below 50°F calves can experience cold stress and must begin to use energy to maintain an optimal body temperature. When this happens, calves are putting energy into simply maintaining a core body temperature instead of using energy for growth. It is especially important during these colder conditions that calves are housed in an environment where there are no drafts or direct winds reaching them.

Many calves tend to be housed in naturally ventilated shelters such as individual calf hutches, open-front, and curtain sided calf buildings. When the weather turns cold, caretakers will close curtains and hutch vents to try to create a warm environment for those calves, but doing so can drastically decrease the air quality within those shelters. According to Cobb *et. Al.*, (2016), indoor environments that do not have appropriate ventilation or drainage can have greater humidity, airborne noxious gases and dust, and bacterial growth in moist bedding. When there is more than a five-degree temperature difference inside a calf shelter from the outside temperature, this is indicative of a ventilation problem. Although a calf's environment needs to remain draft-free, there must be a way for fresh air to circulate. Fresh airflow through pens removes stale air, harmful ammonia odors, and helps to control humidity levels in the calf's environment. In an article focusing on ventilating calf barns in winter months, it was stated that naturally ventilated calf barns present a different set of problems that include draft-free pens that prevent ventilation of the pen itself, resulting in highly polluted microenvironments within well-ventilated barns. However, positive-pressure ventilation systems to supplement natural or negative-pressure ventilation systems seem to be effective in overcoming these problems (Nordlund, 2008). To improve ventilation, individual calf hutches should be oriented to promote steady air movement but not allow drafts. More permanent buildings should control airflow with curtains, removable panels, pressure tube ventilation, or fans.

Positive pressure systems within barns can help to regulate air exchange and increase ventilation.

Because the young calf lacks the ability to produce large amounts of body heat, we must also look at other ways to keep that calf warm in the winter months. Calf jackets can provide additional protection for calves housed both indoors and outdoors. However, jackets must be managed properly to maximize their benefits to the calf. This includes removing jackets during unusually high temperatures, increasing strap length as the calf grows, and ensuring calves are still housed on dry bedding. Calf bedding is a critical part of helping calves maintain body heat and stay comfortable in the harsh winter

Generous amounts of dry bedding help to keep calves comfortable and warm

months. Providing calves with enough clean, dry bedding to allow that animal to nestle into will help insulate that calf and keep it comfortable in cold weather. The potential for the calf to nest deeply seems to reduce the risk for chilling and allows for colder and better-ventilated spaces (Nordlund, 2008). Keep in mind that fresh, dry air is key to a calf's overall health.

As the seasonal temperatures fluctuate, ventilation needs may vary daily. Barns may need to be closed tighter due to wind and temperature changes overnight, but as temperatures climb during the day, ventilation requirements need to be increased. Such factors should be taken into consideration especially when installing panels or materials that are not easily removed when temperatures reach unseasonal highs. Fans and positive pressure ventilation systems are an easier way to maintain proper ventilation.

A calf's needs will vary with seasonal changes, so understanding these needs will help to raise healthier calves. Respiratory setbacks, often caused by poor ventilation, not only increase treatment costs but can also negatively affect performance even into the first few lactations of that animal. Therefore, proper management of calf housing is critical to the health of growing calves. Calves are the future of your dairy operation which makes caring for their needs critical to the success and profitability of the farm.

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SUGARCANE GROWN USING AGRICULTURAL EQUIPMENTS BOOST FARMERS' INCOME & LOWER COSTS

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When compared to other nations, India is the leader in sugarcane growing. A lot of sugarcane is grown in this area. Sugarcane can be grown by farmers for a considerable profit. In terms of sugarcane production, Brazil leads the world. The second-Place is India. Many regions of India, Uttar Pradesh, Haryana, and other states, are home to sugarcane farms. The same is being used for special training exercises in sugarcane farming. India is a significant and extremely large country again for export of agriculture.

Planting methods & techniques

The optimum temperature for sugarcane germination is between 25 and 32°C. Under North Indian conditions, this temperature need is twice met: in October and in February-March. In October, sugarcane is sown for the fall. For autumn planting to produce higher yields, the sowing process should be finished in October. Low summer temperatures can cause planting to be postponed since they hinder sugarcane germination. February and March are the months when spring sugarcane is planted. Haryana and March, Uttar Pradesh in February and March, and Punjab in January and February are the ideal seasons for sugarcane cultivation. As we move east, planting season comes earlier. Sugarcane is sown in Tamil Nadu, Andhra Pradesh, Maharashtra, and Karnataka between December and February. In Maharashtra, planting takes place in July and August and the harvest takes 15 to 18 months to complete. In South India, single planting is typical. The crop is planted in January and February, and after a year, it is subtracted.

Agricultural machinery for planting sugarcane

1. Cane node sugarcane planter:

The tractor-driven cane node pointer device for planting sugarcane

moves ICAR-IISR, Lucknow, developed this agricultural device. These farming tools There are 4 boxes, out of which two are used to store sugarcane bud sets and two are used to store manure. The rear pair of sugarcane buds receive manure. Power for this agricultural machine comes from the ground wheel, which allows for the deployment of manure composters and sugarcane bud positioned in the front and the back, respectively. These farming tools With this cultivator, planting is simple. This cultivator requires the use of two cultivators. The node pointer is 90 cm long. Planting is done at a 20–25 cm distance and a 20–25 cm depth. horizontally positions the sugarcane bud, often using an end-to-end technique. The eye system of this agricultural machine was adapted from the eye of the plant. It saves about 70% of the cost of planting material and can plant a hectare in 4 to 5 hours.

2. Trench sugarcane planter:

Farm machinery for sowing sugarcane in deep furrows in pairs is a device for planting sugarcane. Running on a tractor ICAR-IISR, Lucknow, created this agricultural device. This agricultural tool was created to cut sugarcane from the tractor's PTO and open pits. It continues to apply manure while performing the harvesting work. This agricultural device contains a tank that applies medicine concurrently with the sowing, lowering the cost to the farmer. 3 in this agricultural tool A tractor must be driven by the farmer. On the agricultural equipment, two farmers must sit, and In front of the agricultural tool, a box filled with sugarcane is positioned, and a hole is created by standing the box on its side. Beginning with sugarcane, Please. In that hole, blades are put in place to continue cutting the sugarcane at intervals of 20 to 25 cm. The sugarcane being cut continues to move in the furrow, which has two linked tyres, and is driven by the tractor's PTO. They continue to cover the soil on the sugarcane from the side, and a roller behind them separates the soil from the sugarcane. This agricultural machine has a 30 cm-deep hole in it. Which continuously pours into the furrows and evenly blends the soil in the trenches with the PK fertilisers It mixes very well with the Trend-Pointer Cultivator. In an hour, it has the equivalent planting effect of 0.20 hectares and pays for almost half the cost of running the plantation. An agricultural tool costs 76000 Farmers Planting Guide and takes less time to use.

3. Deep furrow sugarcane planter:

Two rows of deep furrow sugarcane are sown with this agricultural equipment. This agricultural machine, which is run by ICAR-IISR, Lucknow, has been designed and is used for the task of opening deep furrows. The distance between furrows can also be programmed into this agricultural tool. You can adjust the time at the top if necessary. 30, 75, 90, and 120 cm deep It is fed by this device, which only needs to be planted once, and has two holes. Three cultivators are needed for agricultural tools. Two cultivators are driven by a tractor using pointed agricultural tools in deep furrows. Standing the sugarcane up straight makes two holes in the farming tools. The sugarcane was placed into the hole by the farmer. Because it has blades, it is expensive that removed 20 to 25 cm. Two ties are attached to the side of the furrow to hold the earth in place once the sugarcane has been dug into the furrow. It cuts and works to cover the dirt in the sugarcane furrow with the help of rollers in behind of it. It works by pressing the sugarcane and dirt together. This agricultural implement is attached to four crates. Tanki may fit into two boxes. Two crates are used to store sugarcane for tillers. Trend-Pointer 3 to 4 agricultural implementation The effective planting area for Ghote is one hectare, and 60–70% of the plantation is now being farmed. Barta agriculture equipment costs 100,000. Farmers can plant in a convenient and simple method. And the pace quickens.

4. Ridger type sugarcane cutter-planter:

The agricultural device used for sugarcane planting is known as a Ridger type sugarcane cutter-planter and is driven by the tractor's PTO. The ICAR-IISR in Lucknow developed this agricultural tool that can plant sugarcane between a distance of 75 cm and 90 cm. the main tasks related to planting. In this machine, the tines can be adjusted. The farmer can position the tines at the desired planting distance for the sugarcane. This equipment can effectively plant one hectare of sugarcane in 4-5 hours, saving roughly 60% of the cost of running a sugarcane plantation.

5. Three row multipurpose sugarcane cutter-planter:

For sugarcane plantations that are driven by tractors, a three-row ground-wheel-driven multipurpose sugarcane cutter planter was developed. Four cultivators are needed in this agricultural apparatus, three of which must be mounted on the tractor. Continues to function performs all planting-related tasks from a distance of 75 cm. It can efficiently plant one hectare in 3.5 to 4 hours and reduces planting operating costs by about 70 percent.

Conclusion

Farmers will not have to spend as much time sowing sugarcane due to this agricultural machine, which will also enhance sugarcane production. Work will be simpler and there won't be as many workers, which will lower costs and raise income. With this agricultural device, fertilizers and weed treatment were applied at the same time of sowing.

TECHNOLOGICAL ADVANCEMENTS CAN CHANGE THE FISHING INDUSTRY

About Author

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New information and monitoring technologies are potential game-changers for fisheries management and can be of help in achieving green growth of the sector. Application of new technologies has allowed governments to collect more data on fish stocks, better monitor, enforce and evaluate the environmental impacts of fisheries activities and improve the effectiveness of policies to sustainably manage fisheries.

Introduction

"Technology empowers small-scale fishers generating information not just on fisheries, but on markets, which allows them to demonstrate their commitment to ocean conservation."

Technology can assist consumers in making better choices about what they eat and how those decisions affect the environment and the people involved in its production. Small-scale fishermen can now use technology to generate information on markets as well as fisheries, enabling them to make smarter business decisions and show their support for ocean conservation.

World's fisheries face two major concerns: climate change, which causes fish species to depart from their historical ranges, and providing millions of people with a sustainable source of protein. A new era of technical advancements, however, offers excellent prospects to safeguard our seas, sustain robust fish populations, feed 3 billion people, safeguard the livelihoods of more than 260 million people, and adapt to the effects of climate change.

Technology can be a catalyst for the transformation of fisheries practises and regulations, even though it cannot alone resolve the worldwide fishing dilemma. Technological advancements present an opportunity to enhance fisheries management strategies and the seafood industry under a sustainable approach, where we meet the needs of the present without depleting resources for future generations. We can also empower fishers and give consumers more information so they can make more informed seafood choices. The cod fishery in Alaska is one illustration of how new technologies are assisting the fishing industry in becoming more effective and sustainable. To help prevent overfishing of Pacific halibut, a valuable species in the area that is frequently found with cod, the cod fishery is testing an electronic surveillance system in conjunction with computer vision technology and machine learning. Businesses like Bumble Bee Foods, for instance, are able to inform their customers about the origins of the Fair Trade tuna they are consuming. Customers may track their tuna from the boat to the plate by using a bumble bee blockchain service that uses tuna collected in the Western and Central Pacific Ocean. Then, customers may use their smart phones to scan QR codes to learn more about the origins of their tuna and the ethical standards established by this fishery, enabling them to make smarter purchasing decisions.

International organisations involved in IUU and related fish crimes issues:

Technological and digital advances these days allow innovative monitoring equipment to be attached to traditional sampling gear and collect more data such as ecosystem information, in order to better manage fish stocks and tackle IUU fishing.

Conclusion

"The possibilities are as endless as the ocean."

Fishery monitors can rapidly and precisely register fishermen using Web Control Pesca, as well as keep track of where and when they fish, how much fish they catch, who they sell it to, and how much they charge. Authorities and fishermen are automatically informed of the information collected. We will keep collaborating on our Smart Boat Initiative with fishermen, traders, fishing communities, scientists, and fishing officials to find ways that new technologies might help to advance the way that we fish today.■

RECIRCULATORY AQUACULTURE SYSTEM (RAS)
START-UP OF ZERO-DISCHARGE WATER

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Aquaculture is the fastest growing agri-food sectors in the world. According to Food and Agriculture Organization, a record 214 million tonnes of fisheries and aquaculture products were produced in 2020, including 178 million tonnes of aquatic animals and 36 million tonnes of algae, largely as a result of the expansion of aquaculture. These productions are helps in provide food, nutrition, income and job to millions of people in the world. In fisheries and aquaculture sectors, the advancement of technology innovation of recirculating systems has been driven by strong environmental standards in the world to reduce pollution from hatcheries and aquaculture facilities. Recirculation, however, also ensures a higher and more consistent aquaculture production with fewer infections and better ways of controlling the hatchery factors that affect growth.

Introduction

In Recirculatory Aquaculture System, Less cost, less space, less time, more fish production and profits in zero water exchange is a modern aquaculture technology. The constant innovation of new production technology is required since aquaculture production is increasingly focused on sustainability, consumer needs, food safety, and cost effectiveness. Aquaculture production generally has an impact on the environment, but modern recirculation techniques greatly mitigate this impact when compared to conventional fish farming techniques. Thus, recirculation systems have two right away benefits: cost effectiveness and minimal environmental impact.

Aquaculture utilizing recirculation is essentially the practice of culturing fish or other aquatic animals while recycling the water used in the process. The system, which is based on the employment of mechanical and biological filters, can theoretically be used to any aquaculture species, including fish, shrimp, clams, and others. However, fish farming is the primary use of recirculation technology. According on the amount of water is recycled or recycled back, different levels of recirculation can be used. Some farms use as little as 300 litres of fresh water, and sometimes even less, every kilo of fish produced annually. These farming methods are installed inside closed, insulated buildings. For every kg of fish produced annually, traditional outdoor farms that have been converted into recirculated systems use about 3 m^3 of fresh water. For trout, a standard flow-through system typically uses 30 m^3 per kilo of fish produced annually. For examples, the consumption of new water in the examples given will be 17 m^3 per hour (h), 171 m^3 per hour, and 1712 m^3 per hour, respectively, for an aquaculture farm that produces 500 tonnes of fish annually.

Zero-discharge of water

Given that water has become a scarce resource in many areas, the small amount of water utilized in recirculation is undoubtedly advantageous from an environmental standpoint. Additionally, because less water is used than would typically be the case in a fish farm, it is considerably simpler and less expensive to extract the nutrients the fish excrete. Therefore, recirculation aquaculture can be viewed as the most environmentally beneficial method of fish production that is also economically feasible. The nutrients from the farmed fish can be used as a base for the generation of biogas or as fertilizer on agricultural land. Although it is feasible to prevent all sludge and water from the farm from being discharged, the waste water treatment of the very lowest concentrations is frequently a costly operation to entirely clean off. The term "zero-discharge" is sometimes used in relation to fish farming. As a result, a request for permission to discharge nutrients and water should always be included.

Controlling of Fish growth Parameters

Fish are cold-blooded animals, making water temperature one of the most crucial factors when assessing the viability of fish farming. Recirculation gives the fish farmer entire control over all production parameters, and his ability to manage the recirculation system effectively takes on equal weight to his capacity to care for the fish. Controlling variables like water temperature, oxygen content, or lighting, for example, provides fish with steady and ideal settings, which again reduces stress and promotes greater growth. The constant growth pattern that results from these predictable conditions gives the farmer

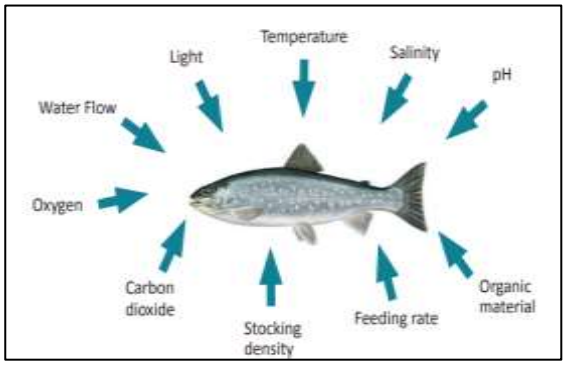

Figure1. Important parameters influencing health and growth of fish (Source: FAO)

the ability to know with absolute certainty when the fish will have reached a specific stage or size.

Principle of Recirculatory Aquaculture System

In a recirculation system, it's important to continuously cleanse the water to eliminate the waste the fish excrete and to give oxygen to keep the fish healthy. Recirculation systems are actually pretty straightforward. The water from the fish tanks passes through a mechanical filter, then a biological filter, before being aerated, carbon dioxide-drained, and returned to the fish tanks. The fundamental idea behind recirculation is this. Depending on the precise needs, additional facilities can be incorporated such pure oxygen oxygenation, ultraviolet or ozone disinfection, automatic pH adjustment, heat transferring, denitrification, etc.

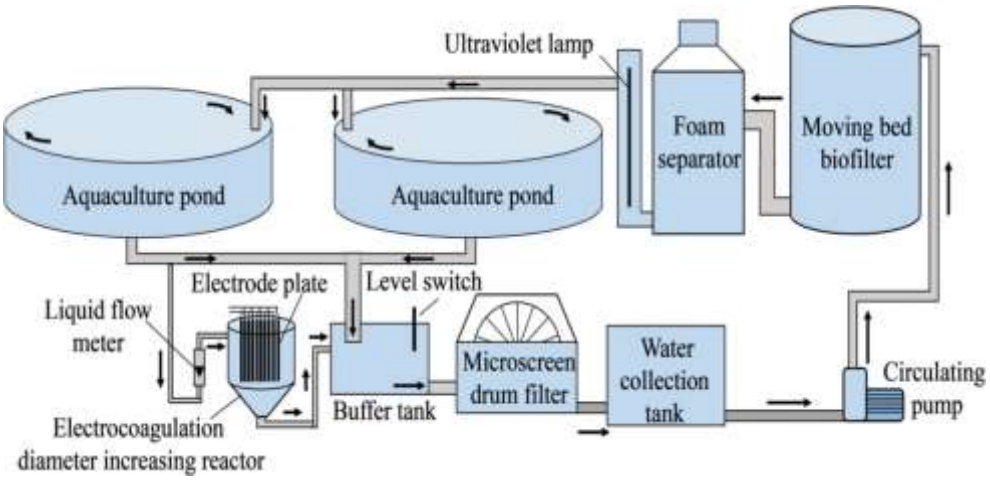

Figure2. Principle drawing of the Recirculation Aquaculture System
(Source: https://www.sciencedirect.com/science/article/abs/pii/S2214714421004669)

Advantage of Recirculatory Aquaculture System

- Less time, high growth of fish.
- Fully controlled environmental parameters.
- Less water use for culture and water is recycled.
- Require less surface area and energy use.
- Best feeding plan and Disease prevention.
- Easy harvesting and grading of fish.
- Safety from the environment and unwanted predators.

■■■

BENEFITS OF MODERN CROP CUTTING EXPERIMENT METHOD

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Technology is slowly but surely encroaching on every sector and discipline. It is gradually expanding into the agricultural sector as well. India is a primarily agricultural-based country, so its economy is highly dependent on agriculture. Planning and resource allocation for the development of the agricultural sector heavily depends on data on crop acreage, yield, and production. Using technology, we can obtain accurate information, which could lead to a higher yield and quicker processing of claims. This will significantly reduce the farmers' burden. According to world population predictions, India's population will gradually increase. For that government to determine if its agricultural areas can sustainably generate food for its population in that situation. The fact that the majority of farms still engage in conventional farming and are untracked makes the situation much more challenging. In such cases, modern Crop cutting experiments were performed to gather more exact data on crop yield.

Definition

Crop Cutting Experiments (CCE) are coming to the rescue of authorities to estimate crop damage and determine the yield of a particular crop in an area.

Objectives of crop cutting experiment:

1) It is used to calculate the yield of a cropped area, which represents the simple yield for the specific crop in that year of the entire area.
2) It helps the government by predicting produce shortage or excess in a certain year.
3) It assists the government in deciding if the export or import of a certain crop is important for the nation.

Methods of CCE:

Crop cutting experiments are becoming more and more common, and they go by many names in various places. Essentially, there are two types of CCE methods: traditional and modern.

1) Traditional CCE method

The basis of the traditional yield component method is that specific locations are chosen and random

samples are selected for study from the whole area. Following the selection of the plot, the harvest from that region is assessed based on many criteria, including grain weight, biomass weight, moisture, and other pertinent factors. A rough estimate is created from the yield of the state or region and is generalized for the entire region based on the data collection.

The Pradhan Mantri Fasal Bima Yojana (PMFBY), is a national crop insurance scheme recently introduced in India. For each crop, each state is required by PMFBY to conduct four CCEs in each *Gram Panchayat* and submit a yield report within a month of harvest. The traditional CCE approach, however, is not without flaws. The dependence on factors including the administrative system, size and type of field employees, harvesting conditions, and farmer's cooperation continues to be the major problem.

2) Modern CCE method

Due to the short harvest period, it is highly challenging to carry out so many CCEs with minimal staff using traditional techniques. Furthermore, the government has started to use modern technologies. It will help the government to be able to do the most CCE experiments possible within the limited harvest period with limited manpower and more accurate reports. Besides, they can offer to customize crop insurance schemes for farmers and execute timely claim settlements in a just manner. These impartial and timely claims come as a blessing for the farmers.

This approach estimates the yield from a productivity efficiency model (PEM) using several, multi-resolution satellite data sources, weather data, and CCE data from the previous year as a proxy for the yield. To make the yield proxy more representative, high resolution crop maps and crop sowing date maps created from satellite data are also employed. The agritech platforms that use AI and ML can identify plots that are perfect for such studies using ground-level data and satellite imaging.

Conclusion

Crop cutting experiments are a kind of sample survey. It is conducted regularly by the agriculture departments for different Kharif and Rabi crops each year at the national level. Based on the results of this practice, expected crop-wise yield estimates are worked out for different states, and then the data is pooled to know the national status. However, the traditional method requires a significant number of workers to carry out such tests. Therefore, by employing modern technology, we may carry out the largest number of CCE experiments during the short harvest window with fewer workers and more accurate reports.

Fig. 1: Traditional method

Fig. 2: Modern method

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INSECTICIDES ARE MORE DANGEROUS THAN INSECT IN LIFE

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Significance of insects

Numerous bugs are viewed as irritations by people. Notwith-standing, bugs are likewise vital for various reasons. In the climate, a few bugs fertilize blossoming plants. Bugs produce valuable substances, like honey, wax, veneer, and silk. Bugs are food sources in certain regions of the planet.

Biological importance

Bugs can be tracked down in each climate on Earth. While a chosen handful of bugs, for example, the Arctic Wooly Bear Moth, live in the brutal Arctic environment, most bugs are tracked down in the warm and sodden jungles. Bugs have adjusted to a wide scope of natural surroundings, effectively tracking down their specialty, since they will eat practically any substance that has a health benefit.

As decomposers, bugs assist with making topsoil, the supplement-rich layer of soil that assists plants with developing. Tunneling bugs, for example, subterranean insects and creepy crawlies, dig burrows that give channels to water, helping plants. Honey bees, wasps, butterflies, and subterranean insects fertilize blossoming plants. Nursery workers love the huge look at the bug and imploring mantis since they control the size of specific bug populaces, for example, aphids and caterpillars, which feed on new plant

development. At last, all bugs treat the dirt with the supplements from their droppings.

Financial importance

Bugs have huge financial significance. A few bugs produce helpful substances, like honey, wax, finish, and silk. Bumble bees have been raised by people for millennia for honey. The silkworm enormously impacted mankind's set of experiences. At the point when the Chinese utilized worms to foster silk, the silk exchange associated China with the remainder of the world. Grown-up bugs, like crickets, as well as bug hatchlings, are additionally usually utilized as a fishing trap.

Bugs as food

Bugs are not simply eaten by individuals. Bugs are the sole food hotspot for some creatures of land and water, reptiles, birds, and warm-blooded animals, making their parts in pecking orders and food networks critical. It is conceivable that food networks could fall assuming bug populaces decline.

It is hard to track down a bug that isn't eaten in some structure by individuals. Among the most well-known are cicadas, insects, mantises, grubs, caterpillars, crickets, insects, and wasps.

Bugs in medicine

Bugs have likewise been utilized in medication. Previously, fly hatchlings (parasites) were utilized to get wounds to forestall or stop gangrene. Gangrene is brought about by the disease of dead tissue. Slimy parasites just eat dead tissue, so when they are put on the dead tissue of people, they clean the injury and can forestall disease. A few medical clinics utilize this kind of therapy.

Adverse consequences of pesti-cides on soil wellbeing

Kills helpful living beings. Increase in nitrate levels of soils. Damage to normal makeup of the soil. Alters the pH. Decrease soil quality. Kills soil-living beings. Toxic to organisms. Toxicity accessibility of supplements. Kills worms. Residual impact. Toxic to soil living beings.

Impact on water

The spillover of agrochemicals into streams, lakes, and other surface waters can build the development of green growth. Eutrophication-Change in quality and structure of amphibian biological systems by aggregation of exorbitant synthetic compounds in water bodies. Water becomes ill-suited for drinking. Dirtied water prompted the passing of fish and other sea-going creatures. Excessive utilization of agrochemicals has prompted the pollution of groundwater.

Impact on air

Pesticide Pollution-Pesticides can add to air contamination. Pesticide float happens when pesticides are suspended in the air as particles are conveyed by the wind to different regions. Weather circumstances at the hour of utilization as well as temperature and relative moistness change the spread of the pesticide in the air.

Bhopal Gas Tragedy

Bhopal's pesticide plant was worked in 1969 to fabricate Sevin-Asia to kill scarabs, weevils, and worms. The plant was worked by Union Carbide India, Limited, yet an American organization, Union Carbide Corporation, held > ½ of the stock. The hole started on December 2, 1984, when water entered a tank that was utilized to store methyl isocyanate, harmful gas and a vital fixing in Sevin. The water responded with the gas, prompting outrageous strain and intensity that perhaps made the tank detonate. The tank heaved 40 tons of noxious gas high up. The poisonous cloud was generally methyl isocyanate, a compound that can bother the throat and eyes, cause chest torment and windedness, and, in enormous dosages trigger spasms, lung disappointment and heart failure. Pesticides enter the human body. Pesticides can enter the body through the inward breath of sprayers, residue and fume that contain pesticides; Enters through, oral openness by polishing off food/water. skin openness by direct contact.

Consequences for pollinators

Consequences for supplement cycling in a biological system. Effects on soil disintegration, construction and fruitfulness. Effects on water quality. Effects on people. Effects on birds. Contaminate the food. Effects on fish and other oceanic creatures. Pesticides upset the regular harmony among nuisance and hunter bugs. Pesticides cause bother to bounce back and auxiliary bug flare-ups. Pesticides might cause bug resistance Change in populace development rate Increase in no. of ages Gene change.

The decrease of normal adversaries

Overall place of conversation. Impact of pesticides on non-targets and Led to a flood in bug levels pollinators in the new years. and Pesticides influence the two spineless creatures (earthworms) to use additional pesticides to control the irritation destroying ruin. and vertebrates (people).

Impact of pesticides on worms

Organophosphates lessen night crawler populations. Carbamate bug sprays are exceptionally harmful to night crawlers. Studies have shown pesticide application leads to its downfall. 80% of the earthly spineless creatures break down soil natural matter in humus. Physiological harm i.e cell disfunction. The use of neonicotinoid bug sprays, for example, imidacloprid prompts the above consequences for pollinators. Dust gathering productivity. Province mortality. Searching way of behaving. Pesticides application influences their exercises.

Effect of pesticides on pollinators

Impact of pesticides on regular adversaries. Predators-pivotal job in monitoring bug populaces. These incorporate coccinellids, braconid wasps and savage bugs. E.g. cypermethrin and imidacloprid when contrasted with bio-pesticides are utilized such neem.

Impact of pesticides on fish

The important piece of marine environment cooperates with physical, natural and substance climate. Provide food hotspots for different creatures, for example, ocean birds and marine warm-blooded animals - an essential piece of the marine food web. Pesticides have been straightforwardly connected to causing fish mortality around the world.

Assume an exceptionally basic part in natural pecking orders

Impacts of pesticides on birds and Ingestion of pesticide granules, treated seeds. Pesticide openness causes

birds mortality, by networks and Cabamates, OP, OC propagation. taking care of conduct. Numerous land and water-proficient species are near the very edge of eradication. The worldwide decrease in the land and water proficient populace has turned into a natural concern around the world.

Impact of pesticides on creatures of land and water

Out of 36 species gathered from three pools of northeastern Louisiana (USA) that were found to contain deposits of 13 organochlorines. Creatures at the more significant levels of pecking order experience more noteworthy mischief when contrasted with those at lower levels. Biomagnification is the increment of a portion of the pesticides because of its diligent and non-biodegradable nature in the tissue of the organ at each progressive degree of the pecking order.

■■■

THE ENTOMOLOGY
FROM PROTECTION TO PRODUCTION

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The future production of enough protein from livestock, poultry, and fish constitutes a significant problem due to a growing global population and more demanding consumers for meat. Since the existing land space is insufficient to meet the rising demand, new protein sources are urgently needed. Insects have a significant potential for growth in the food and feed industry, due to their numerous environmental advantages over the production of meat. The practice of eating insects is a known as "entomophagy", and inclusion of edible insects in the diet has been followed by humans from many years, especially among some of the ethnic groups of South America, Mexico, Africa, and Asia.

The word "Entomology" means the study of insects and their relationship to humans, the environment, and other organisms. Human health, local and global economies, and sustainable food and water supplies all depend on state-of-the-art knowledge about insects, their integral roles in ecosystems, and their *effective management*. However, with a growing world population and increasingly demanding consumers for meat, the present entomology moving from protection to production and consumption areas.

Importance of insects as food & feed

High grade protein, vitamins, and amino acids are found in edible insects for human consumption. Insects have a high rate of food conversion; for example, to generate the same amount of protein, crickets require six times less feed than cattle, four times less feed than sheep, and twice as little feed as pigs and broiler chickens. Additionally, compared to conventional livestock, they produce less ammonia and greenhouse gases. Organic waste can be used to grow insects. Insects are therefore a possible source of protein for traditional production (mini-livestock), either directly for human consumption or indirectly in recomposed meals (with extracted protein from insects); and as a source of protein into feedstock combinations.

Which insect species are eaten?

More than 2000 edible insect species are available for human consumption. They belonging to Coleoptera (beetles, often the grubs) (31%), Lepidoptera (caterpillars) (17%), Hymenoptera (wasp, bees, ants) (15%), Orthoptera (crickets, grasshoppers,

Source- USDA

locusts) (14%), Hemiptera (true bugs) (11%), Isoptera (termites) (3%), Odonata (Dragonflies), Diptera (true flies) and others (9%) (Jongema, 2017). The habit of eating insects called entomophagy, extensively documented all over the world. Some of those were eaten throughout the tropics, such as termites and grubs of *Rhychophorous* spp. In central Africa, several caterpillars are eaten and whereas in southern Africa, *Imbrasia belina* is a common seasonal food item. In the Sahelian region of Africa, many grasshopper species are used as food. In Southeast Asia, *Lethocerus indicus* and *Oecophylla smaragdina* are popular ones. In Australia, *Endoxyla leucomochla* is well known food. In Mexico, Chapulines, *Sphenarium* are popular food, while in Columbia the queen of ant, *Atta laevigata* have been eaten for hundreds of years.

Conclusion

Edible insects can diversify diets, improve livelihoods, contribute to food and nutrition security and have a lower ecological footprint as compared to other sources of protein. These potential benefits combined with a heightened interest in exploring alternative sources of food that are both nutritious and environmentally sustainable are spurring commercial production of insects as food and animal feed.■

ENTOMOPATHOGENS

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Plant pathogens like bacteria, oomycetes, fungi, nematodes and viruses) weeds, arthropods (mainly mites and insects), molluscs (snails and slugs), and a few vertebrates are among the agricultural pests. By feed on crops, they corrupt the production and quality of a produce. Pest species are supposed to number in the millions internationally. They have a main impact on a restriction on agricultural production that has resulted in a 40% decrease in potential globe produce. Insect pests are consider vital deterrents, office for an estimated 10.80 per cent of global farming losses in the post-green revolution age. In addition, an estimated 18–26% decline in world yearly agricultural output, worth $470 billion, was recently recorded. Insecticides are used to reduce these losses and, as a consequence, have become an important method for managing insect pest infestations due to their small application effort, elevated usefulness, and expediency. Though, concentrated purpose of chemicals has resulted in the improvement of resistance to one or extra programme of insecticides in as much as 80% of cases. As a result, entomopathogens, which contain viruses, fungi, protozoa and bacteria are seen as authoritarian operators of pest infestations.

Entomopathogens

Microbes infect order arthropods are usually called as Entomopathogens. In Greek word ***Entomo***- arthropods includes mites, insects, spider and scopion, ***Pathogen***- is microbe which cause sickness. Entomopathogens are germs that are pathogenic to six leg insect such as insects, ticks, and mites. Some species of obviously happening nematodes, viruses, fungi and bacteria infect a more of pest arthropod and occupy an significant position in their control. Some entomopathogens be cultured in vitro (nematodes, fungi, and bacteria) or in vivo (viruses and nematodes) and sell commercially. In some cases, they are also bent on diminutive scale for non-commercial narrow use. Using entomopathogens as biopesticides in insect control is called microbial control, which can be a critical part of integrated pest management (IPM) against several pests.

Entomopathogens are used in a traditional microbial control approach where mysterious microorganisms are import and at large for supervision of persistent insect for long-term control. The discharge of exotic germs is extremely keeping pace and is done by administration agency only after wide and accurate tests. In difference, commercially obtainable entomo-pathogens are free through inundative submission method as biopesticides and are frequently used by Agriculturist, government agencies, and home-owners. considerate their action, environmental adaptation, host variety, and dynamics of germs-pest-plant interactions is necessary for fruitfully utilize entomopathogen-based biopesticides for pest control in turf grass, landscape, orchard, horticulture, agriculture and urban environments.

History of entomopatho-gens

Entomopathogenic bacterial use for the killing of insects starts in the 1960s. Discovered the pathogenic effect of *B. thuringiensis* against the larvae of dipterans. In 1800s, the existence of EPF has been studied in silkworm industries of France. Agostino Bassi reported in silkworms, muscardine disease is caused by *Botrytis bassiana* (*Beauveria bassiana*). The idea of using fungus for the management of insects strikes from the study of diseases in silkworm industry. During this study, it was observed that fungus is not only killing silkworms but also virulent to other insects. Elie Metchnikoff reported *Entomopthora anisopliae* (*Metarhizium anisopliae*) as disease-causing agent in wheat cockchafers in Russia. This fungus is also used for the control of weevils in sugarbeet**.** The insecticidal properties of fungus. Steiner found the first insect-killing nematode *Aplectana kraussei* in 1923, which is now regarded as *Steinernema kraussei*. These discoveries are not gaining people's attention toward the pathogenicity in insects until *Neoaplectana carpocapsae* and DD-136 strain were isolated from the larvae of codling moth. Nematodes have a symbiotic association with bacteria, families Steinernematidae are symbiotically associated with Xenorhabdus genus of bacteria and bacterial genus Photorhabdus is symbiotically associated with family Heterorhabditidae. Due to this mutualistic association, nematodes are regarded as effective biocontrol agents.■

Important Entomopathogenic microorganisms

Entomopatho-genic group	Entomopathogen species
Bacteria	*Paenibacillus popilliae*
	Bacillus sphaericus
	Bacillus thuringenesis
Viruses	Nucleopolyhedrovirus (NPV)
	Granulovirus (GV)
Fungi	*Verticillium lecani*
	Metarhizium anisopliae
	Hirsutella thompsonii
	Beauveria bassiana
	Nomuraea rileyi
	Isaria fumosorosea
Nematodes	*Steinernema carpocapsae*
	Heterorhabditis heliothidis

CURRENT ISSUES IN PLANT DISEASE CONTROL

BIOTECHNOLOGY AND PLANT DISEASE

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According to Agrios biotechnology is the genetic manipulation, and multiplication of any living organism through novel techniques and technologies such as tissue culture and genetic engineering resulting in the production of improved or new organism and products that can be used in variety of ways. Traditional plant breeding methods have been used to develop cultivars resistant to various diseases. But this process is time consuming and limited availability of genetic resources for most of the crops are available and has left little room to continued improvement by this means. Development of crop varieties which are resistant against many economically important diseases is a major challenge for plant biotechnologists, worldwide. Plant diseases are a threat to world agriculture and general food security. Significant yield losses due to the attack of pathogen occur in most of the agricultural and horticultural crop species. Two most important reasons for limited genetic resources available for breeding are that many of the natural gene traits that may be beneficial in one plant tissue may be deleterious in other plant tissue and that loss of genes pools recurring during the domestication and breeding of crop plant. Modern technologies such as transcriptomics, proteomics and metabolics are now proved to be useful in understanding plant metabolic pathways and the role of key genes associated with their regulation. This can facilitate new insights into the complex metabolite neighborhoods that give rise to a given phenotype and may allow discovery of new target genes to modify a given pathway. Such genes can then be subject to new metabolic engineering efforts and applications. It has become routine to transfer genes from one organism to another, genes conferring disease resistance to crop plants have been introduced. Such gene transfers could be accomplished by direct methods: e.g. the gene or biolistic method and agrobacterium mediated method.

Role of biotechnology in plant disease control

Recent advances in plant genetic engineering strategies for the management of bacterial diseases of plants are now available. Genetic engineering for plant disease resistance has been discussed by many workers.

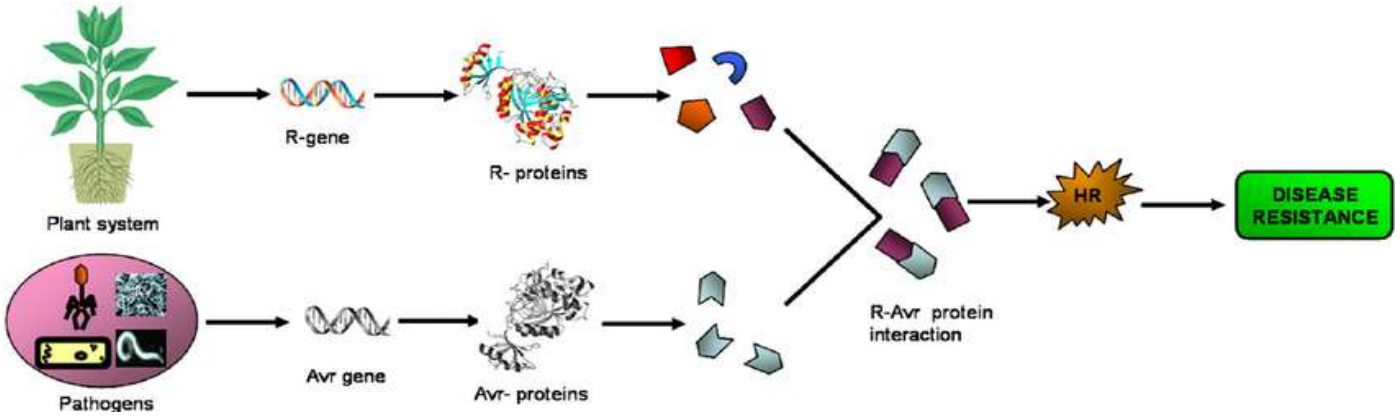
1. To obtain pathogen-free mother plants through rapid clonal propagation.
2. New plants to which genes have been incorporated through genetic engineering are likely to show instability towards environmental conditions and towards the pathogenic microflora of their habitats. Here, pathology plays its part.
3. The main vehicle for transferring genes from donor to recipient, in plant pathogens, particularly the bacterium *Agrobacterium tumefaciens* and the cauliflower mosaic virus.
4. Control of plant diseases by inserting resistance genes into plants by genetic engineering techniques.
5. The study of plants genes for resistance to disease and of pathogen genes for virulence to pathogen has already added considerably by genetic engineering techniques.

Tissue culture techniques

Almost all tissue culture techniques are used in plant pathology. Some of the importance tissue culture techniques and their importance to plant pathology.

Protoplast fusion

Disease resistance in breeding program may come either from closely related species or from more distantly related species. Problems are generally encountered if an effort is made in crossing distantly related species. Protoplast fusion is one of the methods



that can be used to circumvent problems in introgression genes for resistance.

Chemically induced fusion

Isolated protoplasts are sticky, tend to aggregate in suspension and show fusion spontaneously during incubation. Chemicals tend to increase the fusion frequency. Fusion can occur in the presence of high CA2+ and high pH (9-10) but a commonly used chemical (Fusogen) is polyethylene-glycol (PEG). Due to the addition of PEG there is adhesion of protoplast to their neighbors which can be assessed by microscope.

Selection for disease resistance

In-vitro selection has a distinct advantage over other selection systems since it allows significant saving of space, time and money. For plant diseases that cause damage through toxins, cell selection for toxin resistance in cultures and regeneration of plants from descendants of the selected cell lines can give disease-resistant genotype. For example, disease resistant crop plants have been produced through in vitro selection in potato against *Phytophtora infestans* (late blight of potato), in tobacco, (*Nicotiana tabacum*) against *Pseudomonas tabli*.

RNA-interference technique

During the last decade, RNA-mediated functions has been greatly increased with the discovery of small non-coding RNAs which play a central part in process called RNA silencing. Ironically, the very important phenomenon of co-suppression has recently been recognized as a manifestation of RNA interference (RNAi), an endogenous pathway for negative posttranscriptional regulation. RNAi has revolutionalized the possibilities for creating custom "Knock down" of the gene activity. RNAi operates in both plants and animals, and use double stranded RNAi (dsRNA) as a trigger that targets homologous mRNAs for degradation or inhibiting its transcription translation.

Monoclonal antibodie technique

The hybridoma technique was developed by George Kohler and Cesar Milstein in 1975 at the Medical Resident Council Laboratory in Cambridge, England. This technique was never patented but its commercial applications were recognized immediately. This discovery led to the production of monoclonal antibodies. In this technique there is the fusion of mycloma cells (cancer cells) with antibody-body producing while blood cell (B-lymphocytes). The resulting hybrid celled is called a hybridoma.

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ROLE OF VERMICOMPOST IN SUSTAINABLE AGRICULTURE

About Author ...

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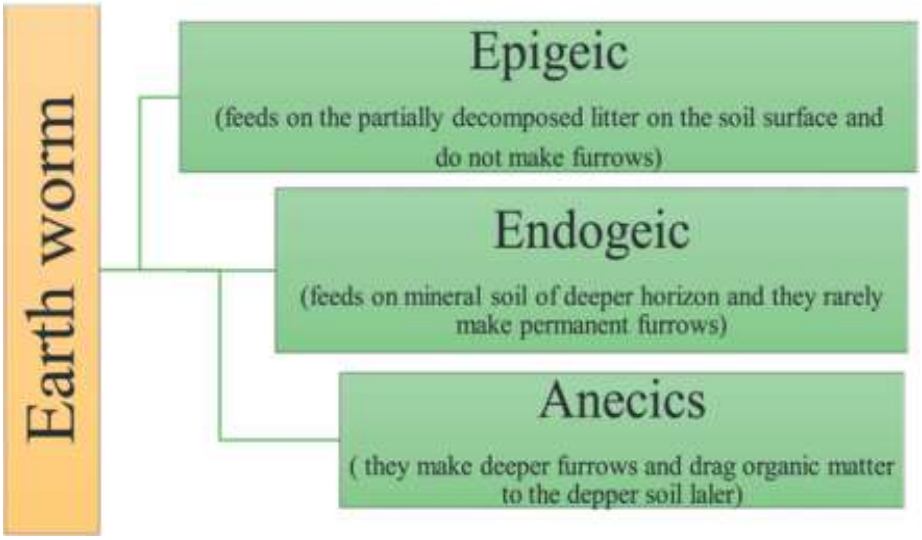
In present day changing situation of soil degradation and reduction in crop yields, soil fertility and crop production maintenance year after year is main concern of sustainable agriculture. Sustainable agriculture practices include benefits of soil restorative measures that are more than overall negative effects of soil degradation processes. Use of organic

manures for crop production is a good management practice of soil restoration. Vermicomposting is good alternative among other; consider a way to transformation of wastes into useful compost for plant and soil, while reducing their negative environmental impacts.

Earthworm and vermicompost

Earthworm comes under bio-reactor and their activity increased the decomposition rate of organic wastes by stimulating both surface area and aeration of substrate. Earthworms helps in aeration, mixer and chemically degrader and biologically increase rate of decomposition. Micro-organism along with earthworm play key role in degrading organic residues and thus, balance the nutrient flux in the system. These micro-organism in gut secret mucus from gut epithelium as an energy source, may fix atmospheric nitrogen. Plant residues, dung, rural and urban waste material crush and mixed in worm gut. Temperature, rate of bio process and enzyme inactivation all are maintained by earthworms in high temperature condition.



General characteristics of vermicompost

- Vermicompost have well decomposed, economically compatible, eco friendly and always found not toxic.
- We can used any type of wastes like industrial waste, municipal waste, agro wastes, sewage and sludge, municipal wastes can be transformed into beneficial compost by earthworm.
- It required turning in regular way, aerobic condition essential for it to produce normal smell after preparation. If improper aerobic condition available that time it will generate foul odor.
- It play key role as a "soil conditioner" by enhancing soil properties like porosity, drainage and water holding capacity.
- Vermi-conversion helpful in reduction of heavy metal present in feeding materials due to earthworm cast owing to accumulation of worm tissue.

Vermicompost effects on soil properties

Effects on soil physiochemical properties

The important role of vermicompost in formation of aggregate, porosity, bulk density and hydraulic conductivity, penetration resistance, soil organic carbon ,nutrient content etc. It reduces the bulk density of the soil, penetration resistance as wet aggregation stability improved. Vermicompost is rich source of humic acid and biological active compounds like plant growth regulators.

Effects on soil biological properties

Soil biological properties consider soil microbial biomass, enzymatic activity, beneficial micro-organism population, hormones etc. It increase activity of dehydrogenase enzymes, nitrogen status due to increase rate of beneficial micro-organism growth in rhizosphere of plant, resulted the enhanced activity of nitrogenase in soil, which is mainly improve nitrogen fixation.

Effects on the soil fertility

In recent year, inorganic fertilizer application reduce and giving more importance to organic amendments and sustainable crop production. Soil organic carbon is increase with the vermicompost application as well as some plant nutrients as compared to mineral fertilizers. Thus, vermicompost application enhances overall soil fertility.

Effects on plant growth

Vermicompost application improve soil fertility that help in growth and development of plant and nutrient uptake by plant serve as a naturally available and it is slow released source of plant nutrient.

Effects on bioremediation and detoxification of industrial wastes

Earthworm has the potential to bioconversion and detoxification of heavy metal of industrial wastes due to intestinal micro biota, enzymes and chloragocyte cells that reduce hazardous forms of benign forms.

Effects on plant diseases

Vermicompost is very important for bio remediation of different diseases of plant. Soil borne, foliar disease and pests have been reducing with application of vermicompost that is effective as organic fertilizers and biological control agents. Vermicompost application reduces tomato late blight caused by *phytophthora brassicae*, *phytophthora nicotiana*e and tomato fusarium wilt produced by *fusarium lycopersici.*

Conclusion

Vermicompost is organic in nature and a complex mixture of earthworm fasces, humic organic matter and micro-organisms. Although, vermicompost application in agriculture will not fulfill the demand of food but its application with inorganic fertilizer through integrated manner could be able to achieve sustainability in food production. Vermicomposting is a good solution of enhanced food production demand at the time of environmental degradation and maintenance of sustainability.

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SEED OXYGEN MAPPING USING SENSORS

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Aerobic metabolism by definition requires the presence of oxygen. In the mitochondria, oxygen serves as the terminal electron acceptor for oxidative phosphorylation, a fundamental component of respiration. In plants, oxygen is a by-product of photosynthesis. As both respiration and photosynthesis represent the basis of life on earth, an understanding of the mechanisms directing oxygen consumption, production and homeostasis has long been a primary research goal in biology and biotechnology. An essential prerequisite for making progress in this field is the means to precisely quantify local concentrations of oxygen at the tissue and cellular levels.

Conventional method and their limitations

Conventional measurement systems such as polarography can only provide mean values which lack spatial resolution and are thus blind to any compartmentation present within the sample. This limitation has been partially overcome by the use of needle-type microsensors, which have been applied to quantify oxygen concentration across a sample transect, delivering a resolution level of a few µm However, as these devices can only measure the oxygen concentration prevailing at a discrete point at any given time, they cannot image the two-dimensional distribution of oxygen within the sample.

Measurement of single seed oxygen and bulk seed oxygen consumption during imbibition

The FireSting®-GO2 is a hand-held fiber-optic oxygen meter based on the established FireSting® technology featuring:

- broad oxygen sensor portfolio (micro- and minisensors, robust probes, sensor spots, flow-through cells, respiration vials),
- sensors for the full and the trace oxygen range,
- measurements in water as well as in the gas phase,
- automatic temperature and pressure compensation and
- proven REDFLASH technology.

Procedure to log data in oxygen sensor probes for seeds

- Carefully place the sensor inside a seed (in case of single seed oxygen mapping) or inside the box where seeds are placed (in case of measuring oxygen consumption of bulk seeds.)
- Open Start Logging in the Main Menu. Choose the appropriate mode: Manual for manual logging, *i.e.* data points are logged each time the OK button (SAMPLE) is pressed; Continuous for automatized logging with adjustable Logging Interval and Logging Duration.
- The logged data are displayed numerically and graphically on several sub-screens. If the data logging is finished, EXIT the Logging Mode with the BACK button.

Fig. 1: The photograph of Oxygen sensor (Firesting) used for oxygen measurement. The left photo shows the data logger along with the oxygen sensing probe and the right photo shows the the display unit.

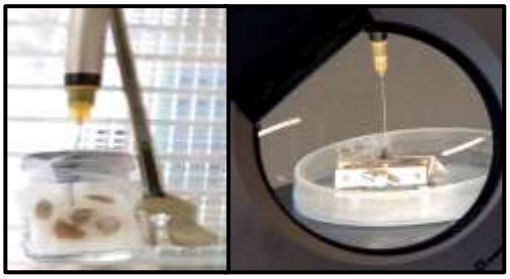

Fig. 2: The oxygen sensor probe inserted into samples for oxygen measurement. The left image show the insertion of probe into pericarp of single seed while the right image shows the insertion of probe into bottle with 5 seeds witout pericarp to measure oxygen consumption during imbibition.

- The entire set up is placed at 20°C in the dark.

Conclusion

The development of oxygen-sensitive microsensors now offers the capability to determine the localized oxygen status within a seed and to study its dynamic adjustment both to changes in the ambient environment and to the seed's developmental stage. Oxygen maps, both static and dynamic, should serve to increase our basic understanding of seed physiology, as well as to facilitate upcoming breeding and biotechnology-based approaches for crop improvement.■

BOTANICAL PESTICIDE

PREPARATION AND THEIR USES

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Pesticides are the major technology used in the management of field and postharvest losses due to pests. But the misuse and overuse of synthetic pesticides has resulted in massive destruction of advantageous organisms as well as negative effects on the ecosystem. The use of biopesticides including microbial agents, biochemical pesticides, and botanicals is considered as a more effective strategy for the operation and control of colorful nonentity pests. Botanical pesticides are derivations of plants that repel, inhibit growth or kill pests. Maximum botanical pesticides are used to manage insect pests and many studies have focused majorly on insect pest management.

Plants with pesticidal properties also retain compounds that have effects on plant pathogens similar as bacteria, fungi, viruses as well as nematodes. The importance of botanical fungicides is attributed to their efficacy, biodegradability, varied modes of action, low toxicity as well as availability of source materials. They also have shortpre-harvest andre-entry intervals. Generally used botanical pesticides are popular in organic agriculture where organically produced food fetches premium prices. thus botanical pesticides are gaining popularity because they are safe to use on crops produced for human consumption and recently there's a lucrative market among consumers willing to pay further for organically produced food. There are many studies involving the known and yet to be exploited plant species with pesticidal properties.

Source of botanical pesticide

1. Nicotine

It is extracted from the leaves of tobacco plants,Nicotiana tobacum and related spp.has a long history as insecticide.Nicotine sulphate contain 40% nicotine it is contain two intimately related alkaloids, nornicotine and anabasine it is contact stomach and fumigant insecticide. As such they cause symptoms of poisoning similar to those seen with organophosphate and carbamate insecticides this insecticide mostly use against Thrips,Aphids and jassids. Nicotine constitutes approximately 0.6-3.0% of the dry weight of tobacco nicotine is also present at ppb-concentrations in edible plants in the family Solanaceae, including potatoes,tomatoes,and eggplants.

2. Rotenone

It is exracted from the roots of Derris elliptica . it is commonly used as fish poisan and also used against leaf eating catterpiller. Rotenone is commonly sold as a dust containg 1 to 5 % active ingreadient for home and garden use, but liquid formulations used in organic agriculture can contains as much as 8% rotenone and total 15% total roteniods.

3. Sabadilla

- It is a alkaloid found in seeds of tropical lily schoenocaulon officinale (Liliaceae).
- The alkaloid mainly cevadin and veratridine act as nerve poisons.
- It is the primary contact poisons.
- Sabadila is harmful to pollinator (honey bees).

4. Ryanodine

- It is a alkaloid derived from woody stem of south American shrub Ryoania speciosa.
- Activity: Ryanodine acts as muscular poison by blocking the conversion of ADP to ATP in striated muscles.
- It acts as a slow acting stomach poison and cause insects to stop feeding after they eat it.
- It is reportedly effective against thrips and worms.
- It is used as dust (20-40%).

5. Nicotine

- Nicotine is obtain from tobacco palnts, Nicotiana tobaccum and N.rustica (Solanaceae) to the extent of 2-8%.
- Activity: mimics acetycholine in the nerve synapse, causing tremors, loss of coordination and eventually death.
- It is extremely fast acting causing severe disruption and failure of nervous system.
- It is used as fumigant in green houses
- It act as contact posion.
- It is effective against sucking insects (thrips, leaf hopprs mealy bugs) and leaf miners.
- It is commercially available as nicotine sulphate 40% (Black leaf 40) and manufactured in india only for export purpose.

6. Pyrethrum

- “Pyrethrum” refers to powdered dried flowers of Chrysanthemum cinerariifolium.
- “Pyrethrins” are all the toxic constituents of the pyretherum flowers and “Pyrethroids” are the syenthetic analogue of pyrethrins.
- Pyrethrins mode of action is similar to DDT and has fast acting knock down effect.
- It breaks down quickly from sunlight
- The commonly used synergist to synergise pyrethrins is piperonyl butoxide (POB).
- Kenya is the largest producer of pyrethrum.

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BIOFERTILIZER & ITS APPLICATION

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Biofertilizer are substances that contain microorganism, which when added to the soil increases its fertility and promotes plant growth. Biofertilizers are living microbes that improve soil nutrient availability or mobilize nutrients for plants. Since many microbial taxa, including helpful bacteria and fungi, successfully colonies the rhizosphere, rhizoplane, or root interior, they are currently used as biofertilizers.

What is bio-fertilizer?

- Biofertilizers are organic fertilizers that contain bacteria, algae, and fungi as microbial inoculants (separately or in combination).
- which may help biological nitrogen fixation for the useful of plants.
- They help increase the soil micro-flora and there by the soil health.
- Biofertilizer also incorporate organic fertilizers (manure, etc.).
- Use of bio-fertilizer is recommended for improving the soil fertility in organic farming by the fixation of atmospheric nitrogen solubilizing phosphorus, and stimulating plant growth through the synthesis of growth promoting substances.

Types of bio-fertilizers

1. Bacterial Biofertilizer.
2. Fungal Biofertilizer.
3. Algal Biofertilizer.
4. Aquatic fern biofertilizer earthworms biofertilizer.

Bacterial bio-fertilizer:

These are two types-

Fig.1 Rhizobium nods

Fig.2 BGA in association with Azolla

Symbiotic nitrogen fixers: Close associa-tion between legumes and rhizobial bacteria. Exp. Rhizobium, *Azospirillum spp.*

Free living nitrogen fixers: Bacteria live within the soil and connect good significant levels of nitrogen without the direct interaction with another organism. Ex. Azotobacter, Klebsiella etc.,

Fungal biofertilizer:

It's required the use of fungal agent (mycorrhiza) are formulated to provide nutrients to the host plant and safeguard crops against pathogens. Ex. V.A.M.

Algal biofertilizers:

The alga provides nitrogen to the fern and the fern provides a habitat for the alga. Exp. Anabena, Nostoc, Ocillatoria.

Phosphate solubilising bacteria:

Ex. *Pseudomonas*, *Bacillus megaterium*.

Earthworms:

Ex. *Eisenia fetida*.

Bio-fertilizers application methods

There are three ways of using these N-fixing/P.S.M. bacteria.

Seed treatment:

Seed treatment is a most common method. Seed treatment with Rhizobium, Azotobacter, Azospirillum along with P.S.M. Seed treatment can be done with any of two or more bacteria. no side effect. Important thing is that the seeds must be coated first with Rhizobium or Azotobacter or Azospirillum when each seeds get a layer of above bacteria then the P.S.M. inoculant has to be treated on outer layer of the seeds.

Root dipping:

Application of Azospirillum with the paddy/vegetable plants this method is required. The required quantity of Azospirillum has to be mixed with 5-10 ltr of water at one corner of the field and all the plants have to retain for minimum 30min before sowing.

Soil application:

P.S.M. has to be used as a soil application use 2 kgs of P.S.M. per acre. Mix P.S.M. with 400 to 600 kgs of cow dung along with ½ bag of rock phosphate if available. The mixture of P.S.M., Cow dung and rock phosphate have to be kept under any tree shade or celling for over-night and maintain 50% moisture.

Precautions:

- Keep biofertilizer packets in cool and dry location for from direct sunlight and heat.
- Use proper combination of biofertilizers.
- Rhizobium is crop specific, so use in specified crop.
- Don't mix with chemicals.
- Use the packet before expiry, only on the specified crop, by the recommended method.

Advantage of biofertilizers:

- Do not pollute environment and don't have toxic effect on the product.
- Renewable source of nutrients and vitamins and maintain soil fitness.
- Complement chemical fertilizers.
- Update 25 to 30% fertilizers.
- Enhance the grain yields by 10-40%.
- Deteriorate plant residues, and stabilize C:N ratio of soil.
- Improve texture, structure and water holding capacity of soil.
- No adverse effect on plant growth and soil fertility.
- Stimulates plant growth though secreting growth hormones.
- Produce fungistatic and antibiotic like substances.
- Solubilize and mobilize nutrients.
- Eco-friendly, non-pollutants and cost-effective method. ■

COLD WAVE WARNING SERVICES OF IMD

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Similar to the heat wave during summer the country India also suffers from severe winter and associated cold wave because of very low minimum temperature. Like the humidity in the heat wave case the wind speed in case of cold wave further compounded the effect of wind chill. Many parts of northern & central India generally experiences cold wave conditions during winter season. The winter season from January to February (JF) is the winter time in almost all over India. However, the minimum temperatures (T min) drop below 8^0C over many parts of northern India during the month of November to February as seen from the normal Tmin during the period 1981 to 2010. December and January are the coldest months over northern India with normal T min less than 8^0C over its many parts. This region also experiences cold wave during these months. Normally winters are dry in northern India, although it gets rainfall associated with western disturbances. After the passage of western disturbances, dry cold north westerly winds penetrated into northern & central India. As a result, minimum temperatures drop over the regions and sometimes cause cold wave conditions. In southern parts, the temperature difference is not so marked due to moderating effect of Indian Ocean, Bay of Bengal and Arabian Sea.The average numbers of cold waves are highest over plains of northwest & adjoining central India with annual average numbers 6-8 days.

Criterion for declaring cold wave

It should be based on the actual minimum temperature of a station. Cold Wave is considered when minimum temperature of a station is 10.0^0 C or less for plains and 0°C or less for Hilly regions.

Based on departure:

Cold Wave: -ve departure from normal is 4.5°C to 6.4°C.
Severe Cold Wave: -ve departure from normal is more than 6.4°C.

Based on actual minimum Temperature (For plain stations only)

Cold Wave: When minimum temperature is ≤ 04°C.

Severe Cold Wave: When minimum temperature is ≤ 02°C.

Cold Day It should be considered when minimum temperature is 10.0°C or less for plains and 0°C or less for Hilly regions.

Cold day: Maximum Temperature Departure is -4.5°C to -6.4°C.

Severe Cold day: Maximum Temperature Departure is < -6.4°C.

Cold Wave conditions for coastal stations When departure is -4.5°C or minimum temperature less over a station, "Cold Wave" may be described if the minimum temperature is 15.0 ^{0}C or less.

Meteorological favourable conditions for cold wave

As cold wave conditions are associated with fall in minimum temperatures during the winter season. In this season, generally cold north westerly winds prevail over the Indo-Gangetic Plains (IGPs). These winds come from colder regions of Central Asia/ Hindukush region and fall the temperatures over the IGP, as results, cold wave conditions prevail over the region. In general,

- Whenever a Western Disturbance (WD) approaches IGP, clouds develop over the region, maximum temperature fall and minimum temperature rise over the region. Thus, Cold Wave conditions over IGP get abated at the approach of a WD.
- When a WD moves away from the Indian region, clear skies start appearing over the IGP leading to rise in maximum and fall in minimum temperatures.
- Whenever a WD approaches north India, winds in lower levels over the region are either from Arabian Sea or from both Bay of Bengal & Arabian Sea. As both types of these winds are the moist, as a result, minimum temperatures rise over the region. At the same time, clouding over the region leads to lesser penetration of solar insolation into the earth and hence falls in maximum temperatures.
- Formation of an anticyclone in lower & mid tropospheric levels is also a driver of cold waves. Such an anticyclone gives rise to sinking motion over the IGP leading to fall in minimum temperatures.
- Left entrance and right exit of a Jet core belong to upper level convergence which in turn causes sinking motion over the surface hence cause cold wave conditions.

Impact based colour coded alert & warning for cold wave

Colour code	Warnings	Impact	Suggested Action
Green (No action)	Minimum temperatures are near normal.	Comfortable temperature.	No precautionary action required.
Yellow Alert (Be Updated)	Cold wave conditions in isolated areas persist for Two days.	Moderate temperature. Chilly winds may aggravate cold at time. Cold is tolerable but mild health concern for vulnerable people. (Infants, pregnant women, elderly, people with chronic diseases etc.).	• Avoid prolonged exposure to cold. • Wear several layers of loose fitting, light weight; warm woolen clothing rather than one layer of heavy cloth. • Cover your head, neck, hands and toes adequately as majority of heat loss occurs through these body parts.
Orange Alert (Be Prepared)	1. Severe cold wave conditions persist for two days. **2.** Though not severe, but cold wave conditions persist for Four days or more.	• An increased likelihood of various illnesses like flu, running/ stuffy nose or nosebleed, which usually set in or get aggravated due to prolonged exposure to cold. • Do not ignore shivering. It is the first sign that the body is losing heat. Get Indoors. • Frostbite can occur due to prolonged exposure to cold. The skin turns pale, hard and numb and eventually black blisters appear on exposed body parts such as fingers, toes, nose and or earlobes. • Severe frostbite needs immediate medical attention and treatment.	• Listen to radio; watch TV, read newspaper for weather updates/ forecasts. • Wear insulated/ water proof shoes. • Moisturize your skin regularly with oil, petroleum jelly or body cream. • Eat healthy fruits and vegetables rich vitamin-C and drink lots of fluids to maintain adequate immunity. • Avoid or limit outdoor activities. • Keep dry, if wet, change cloths immediately to prevent loss of body heat. • Warm the affected area of the body slowly with lukewarm water; do not rub the skin vigorously. • If the affected skin area turns black, immediately consult a doctor. • Maintain ventilation while using Heaters to avoid inhaling toxic fumes. • Take safety measures while using electrical and gas heating devices. • Don't drink alcohol. It reduces your body temperature. • Drink hot drinks regularly
Red Alert (Take Action)	1. Severe cold wave conditions persist for more than two days. 2. Total number of cold wave/severe cold wave/days exceeding Six days.	• Severe exposure to cold wave can lead to Hypothermia; a decrease in body temperature which cause confusion, shivering, difficulty in speaking, sleepiness, stiff muscles, heavy breathing, weakness and/or loss of consciousness. Hypothermia is a medical emergency that needs immediate medical attention. • Frost and cold wave affect pulse crops and livestock.	• Along with suggested action for orange alert, extreme care needed for vulnerable people. • Regularly check on elderly neighbours, especially those who live alone. Stay Indoors, if possible. Avoid unnecessary exertion. • Locate designated public shelter nearby. • In case of electricity or heating mechanism failure, take the affected person to such designated shelters. • Seek medical attention as soon as possible for someone suffering from frostbite/ Hypothermia. • Do not give the affected person any fluids unless fully alert. • Store adequate water as pipes may freeze. • Move pets indoors. Likewise, protect livestock or other big animals from cold weather by moving them to an enclosure.

Methodolgy of prediction of cold waves:

Cold wave is predicted based on:

- Synoptic analysis.
- Climatological analysis.
- The consensus guidance from various regional and global numerical prediction models including WRF, GFS, GEFS, NCUM, UMEPS, UM Regional etc.
- Dynamic statistical techniques.

Temporal & spatial scales of cold wave warnings:

Seasonal outlooks: Meteorological sub-division wise maximum (T max) and minimum temperatures (T min) as well as cold wave probability for next 3 months issues in beginning of December.

Extended range forecasts: Meteorological sub-division wise spatial maps for bias corrected T max & T min and their anomalies are issued every Thursday with validity of 2 weeks.

Medium range forecasts: Colour coded warnings for 36 Meteorological sub-divisions and ~ 739 districts issued 4 times a day by National Weather Forecasting Centre and twice a day by Regional Meteorological Centre/ Meteorological Centre for upto 5 days.

City forecasts for ~ 470 cities/ towns: Quantitative forecast for T max & T min and cold waves is issued with validity upto 5 days.

Warning dissemination:

- Warnings are disseminated to Ministries of Home Affairs, Health, National, State & District Disaster Managemenet Authorities, Chief Secretaries/ Health Secretaries of States, Health Officers at State & districts, Indian Railway, Road transport etc. by email.
- National IMD website (https://mausam.imd.gov.in) and different regional IMD offices websites.
- Disseminated by Social Media: Facebook (www.facebiik.com/ India. Meteorological. Department) & Twitter handles of IMD (@ Indiametdept), NDMA & whats app groups.
- Electronic and print media warnings are disseminated.
- Multi-media messages every Thursday (www. Youtube.com/channel/ucqxTreoqo 07UVA Rm87 cuy QW).■

IMORTANCE OF AMRUTPANI AND JEEVAMRIT IN AGRICULTURE

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What is Amrutpani ?

Amrut is the heavenly beverage that can both revive the dead and rehydrate the gods. In a similar way, Amrutpani revitalises living soil and changes dead soil into living soil. Amrutpani is liquid manure that has been made using the Ahimsak Rishi-Krishi Despande method. Amrutpani is employed to increase soil fertility, just like Panchagavya.

Preparation of Amrutpani

- Combine a half a liter of honey and one liter of ghee and stir it well.
- Add and stir a handful of soil under the Banyan tree.
- Mix 3 liters of cow urine and 3 kg of cow dung in it and mix well.
- Now add this mixture in 10 to 20 liters of water.
- Your Amrutpani liquid organic fertilizer is ready to use.
- Use Amrutpani when planting seedlings or when seedlings are ready or if seedlings are drying.
- Amrutpani is more effective than organic fertilizer jeevamrut.
- If Amrutpani is used and seedlings did not get water for 21 days they will sustain.
- Jeevamrut and Amrutpani increase the immunity of the crop and also increase water tolerance.

How to use Amrutpani ?

After dipping into Amrutpani, sugarcane, turmeric, ginger, and other plants should be planted. Before planting, the roots of crops where seedlings are transplanted can be dipped in Amrutpani. Amrutpani can be mixed in the main watering channel while continuously mixing the crops being irrigated, such as sugarcane and other crops, with canal or well water. The seeds need to be treated for crops grown under rain or monsoons. Amrutpani should be applied to the soil while it is still wet. not directly on the plants, but rather in between the rows.

Amrutpani, or a small amount of water, should be used while planting seedlings of crops like fruit trees, tobacco, or crops like chillies and tomatoes. Excess of amrutpani is usually advantageous and won't affect the young plants.

Significant role of Amritpani in plant

Amritpani contribute significantly to organic farming by increasing agricultural productivity and quality in a sustainable manner. Amritpani application in agriculture is a time-honored method for achieving excellent and long-lasting agricultural output. It contains a variety of minerals, helpful microbes, hormones that promote development, enzymes, vitamins, bio-pesticidal chemicals, and other substances that can increase crop output and protect the crop against pests by enhancing the plant's defence mechanisms.

What is Jeevamrit ?

An excellent alternative to chemical fertilisers is Jeevamrit, an organic fertiliser. In addition to other minerals necessary for plant growth and development, it is a very good source of biomass, natural carbon, nitrogen, phosphorus, calcium, and other nutrients. The microorganisms that are found in the soil are what make it more fertile and increase crop output. Jeevamrit is used to enhance the amount of microorganisms in the soil. Jeevamrit improves soil fertility by increasing microbial activity in the soil.

Jeevamrit preparation

- Take 100 liters of water in the barrel.
- Add 10 kg Indian/Desi Breed Cow Dung and stir well for 5 minutes.
- 5 liters to 8 liters of Indian/Desi Breed Cow urine, and stir well.
- 1 kg black jaggery (used for winemaking), then stir the solution for 5 minutes.
- 1 kg Gram Flour (Besan), and stir well for 5 minutes.
- 1 kg Soil taken from the roots of Banyan Tree.
- Generally, this soil is free from chemical fertilizers.
- Then stir the solution for 15 minutes.
- Add another 100 liters of water in it and stir well.
- The above ingredients should be stored in a cool place and away from sunlight for 6-7 days.
- The mixture needs to be stirred a couple of times (10 mins every time) in a day.

Jeevamrit has a very foul smell. Also, it is difficult to handle liquid fertilizer with a shelf life of 10-12 days.

Significant role of Jeevamrit in plant

The application of Jeevamrit will improve soil quality. More than 700 million microorganisms can be found in just one gram of Jeevamrit. They use uncooked nutrients to prepare meals for the plants. Jeevamrit is prepared using a simple, quick, and efficient approach as opposed to composts and vermicompost.

Conclusion

Both are helps in maintaining the fertility and health of the soil. It provides a variety of advantages to use, including lower costs, simplicity of use for unfamiliar farmers, increased crop output, environmental safety, and effective crop production. Although farmers are unaware of the shelf life of liquid organic formulations, they often only utilize the freshest preparations of these products. We are able to keep jeevamrit for several days or even weeks. The advantages of stored material include a rise in nitrogen content, micronutrients, EC, etc. We must use this organic fertilizer if we want to have a decent yield and healthy crop quality.

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NUTRIENT BASED SUBSIDY & REFORMS IN FERTILIZER SECTOR

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Its aim is to ensure the balanced use of fertilizers, improving agricultural productivity, encouraging the growth of the local fertilizers industry and also reducing the load of subsidies. It aims ensuring sufficient quantity of P&K is at the farmer's disposal at statutory controlled price. Currently, NBS is applicable on 22 fertilizer products, including di-ammonium phosphate, muriate of potash, mono ammonium phosphate, triple super phosphate, SSP, various grades of complex fertilizer and ammonium sulphate. Urea is not covered under NBS. The government fixes the subsidy annually based on the weight of the different macro/micronutrient contained in the fertilizer. Farmers are provided fertilizers at a subsidized rate based on nutrient content (N, P, K, S, etc.) contained in the fertilizers.

The subsidy on phosphatic and potassic fertilizers are announced by the government on annual basis for each nutrient on per kg basis. Under the NBS regime, MRP of P&K fertilizers has been left open and fertilizer manufacturers/marketers are allowed to fix the MRP at reasonable rates. NBS on P and K fertilizers have removed the fiscal concerns of the government and subsidy on P and K fertilizers is no more open-ended. It is a fixed amount determined at the beginning of the year. How-ever, the partial implementation of NBS without bringing urea under its

ambit has led to imbalance in price ratio between urea and P and K fertilizers and consequent NPK use ratio. NBS has also lead to worsening of soil nutrient quality, along with shortages and price increase in all three types of urea namely nitrogenous, phosphoric and potassic. The worsening of the NPK ratio at the all-India level is a matter of concern. For example, NPK ratio in 2013 in Punjab was 61.7:19.2:1; in Haryana, it was 61.4:18.7:1. This fertilizer mix have an adverse impact on the productivity of crops as well as long-term soil health.

New Urea Policy 2015

It seeks to increase indigenous urea production, promote energy efficiency in urea production, and reduce subsidy burden on the central government. The policy ensures timely supply of urea to farmers at same Maximum Retail Price (MRP) with lesser financial burden on the exchequer.

Its feature are:

Incentivisation of urea production: Subsidy on production costs is provided to 25 urea units when their production is beyond a certain production limit. The computation of this subsidy is based on International Pricing Policy (IPP).

Disbursement of subsidy on production costs: The policy recommended that subsidy on production costs and special reimbursement to vintage plants (older than 30 years) should be paid without any delay.

Energy efficiency: Urea units would adopt best available technology and different measure to reduce energy consumption. It will make the urea manufacturing unit globally more competitive. The energy efficient units would be able to compete against imports and produce more. The policy also tighten the energy consumption norms based on the actual consumption levels of respective units.

Supply of gas to urea units: Urea units are mingled to a national grid to ensure storehouse supply of gas at a uniform price. The policy recommended that at least 31.5 million metric standard cubic meters per day should be supplied to the urea units. The central power will cover the entire cost of natural gas, which is the main feedstock of urea. The policy have a positive impact on the fertilizer industry as it focuses on maximizing domestic Production and help reduce reliance on imports

Neem Coated Urea Policy, 2015

Department of Fertilizers (DOF) has made it compulsory for all the domestic producers to produce 100% urea as Neem Coated Urea (NCU). Neem coated urea is not fit for industrial use, so chances of its illegal diversion to industries will also be lesser. It is required less in quantity with same plot size and gives higher crop yield. It aims to improve soil health, reduce usage of plant protection chemicals, and prevent pests and disease attack, increase yield of crops. Due to slow release of Nitrogen, Nitrogen Use Efficiency (NUE) of Neem Coated Urea increases resulting in reduced consumption of NCU as compared to normal urea.

Problems in fertilizer sectors

Like any other sector, the fertilizer sector also faces a three-faced problem. Supply side problems; demand side problems and; systemic problems. It can be said without argument that domestic production has been increasing since the era of the Green Revolution to achieve self-sufficiency in the fertilizer sector. Though this progress has been slow, there has been consistent progress with its own ups and downs over the years. This means that some institutions had tried and achieved in solving some problems but not all. Over the years these problems have also evolved with the successive successes of the fertilizer sector. The widespread adoption of chemical fertilizers during the period of 1970s (the Green Revolution) along with other modern inputs became possible because of specific policies that were introduced in the wake of the Green Revolution. Fertilizer policies following the Green Revolution were designed to meet the dual objectives of expanding domestic capacity for fertilizer production and making fertilizers available to farmers at affordable prices.

Reforms in fertilizer sector

New Pricing Scheme (NPS) 2003: It is a concession Scheme for urea units based on the prices feedstock used and the vintage of plants. It had various phases like NPS-1 (2003-2004), NPS-11 (2004 2006), and NPS-III (2006 onwards). The difference between the cost of production and the selling price/MRP is paid as a subsidy/concession to manufacturers. Urea is the only controlled fertilizer which is sold at the statutory notified uniform sale price. It aims to help the urea units to achieve internationally competitive levels of efficiency, greater transparency, and simplification in subsidy administration.

Gas Pooling Policy 2015: All urea units would get gas at a uniform price. It seeks to change the industry dynamics in the Urea sector by levelling gas costs for all players.

Market Development Assistance (MDA): It aimed to promote the use of alternative fertilizers This policy was earlier limited to city compost only. There were demands to expand this policy by Incorporating organic waste like Biogas, Green Manure, organic compost of rural areas, solid/liquid slurry, etc.

Implementation of Direct Benefit Transfer (DBT) in Fertilizer Subsidy (2016): Under the fertilizer DBT system, 100% subsidy on various fertilizer grades is released to the fertilizer companies on the basis of actual sales made by the retailer to the beneficiaries. Beneficiaries are identified through Aadhaar Card, Kisan Credit Card, and Voter ID Card.

New Investment Policy (NIP) 2012: It was announced to facilitate fresh investment in the urea sector and to make India self-sufficient in the urea sector. Under this Matrix Fertilizers & Chemicals Limited (Matrix) has set up a Coal Bed Methane (CBM) based Greenfield Ammonia Urea complex at Paragraph, West Bengal.

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PHYTOREMEDIATION OF CONTAMINATED SOIL

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The release of heavy metals and metalloids into the environment from anthropogenic activities such as automobile use, agricultural pesticides, and untreated municipal /industrial effluent/ solid is wreaking havoc on the environment and contaminating soil. Heavy metal pollution is one of the world's most serious concerns, necessitating successful and cost-effective remediation.

Phytoremediation defines as the use of the plant to render the soil and water harmless by adsorbing or degrading the contaminants. A Greek word, '*phyto'* (plants) and a Latin word 'remedium' (to correct a problem) are put together and the term specifies an emerging technology to clean contaminated sites. Phytoremediation (or *phytotechnologies*) are a set of technologies using plants to remediate contaminants in soil, water and sediments. Although, phytoremediation is believed to be a novel approach, it is an ancient concept as over 200 years ago, Roman civilization reportedly used *Eucalyptus* trees to de-water the saturated soils.

Techniques of phtoremediation

Phytotechnologies have been increasingly recognized and applied both in-situ (right where the contamination has taken place) and ex-situ (excavation of contaminated soil, followed by phytoremediation). This remediation technique is a biological remediation technique as the plant is the biological component used to treat the contaminated environment.

Phytoextraction

Phytoextraction, a common process of phytoremediation, involves uptake of the contaminant by plant roots with subsequent accumulation in the aerial plant parts, followed generally by harvest and then disposal of plant biomass. The metal accumulating plants are seeded or transplanted into the metal-contaminated soil and then cultivated with established agricultural practices. The roots of these plants absorb metal elements from the soil and translocation them to the aerial shoots, where they accumulate.

Phytostabilization

Phytostabilization is the process of limiting the movement of pollutants in the soil by absorbing heavy metals through the roots or precipitating heavy metals inside the rhizosphere. The plant that is employed to carry out phytostabilization changes the soil chemistry, which allows heavy metal absorption and precipitation in the soil. Furthermore, during the phytostabilization process, specific redox enzymes secreted by plants transform heavy metals in soil into a less harmful condition. At the contaminated metal mining site, this procedure was well-practiced.

Phytodegradation

Phytodegradation which is also known as phyto-transformation is the breakdown of contaminants taken up by plants through metabolic processes within the plant, or the breakdown of contaminants surrounding the plant through the effect of enzymes produced by the plants. Plants are able to produce enzymes that catalyze and accelerate degradation.

Phytostimulation

Phytostimulation in the process where root released compounds enhance microbial activity in the rhizosphere. This process is critical for the applied technology of rhizoremediation that combines phytoremediation and bioaugmentation. This type of rhizosphere phytoremediation can be used as a low-cost approach to remove organic pollutants from the soil.

Phytovolatilization

Phytovolatilization is the process by which pollutants are absorbed from the soil, transported through the xylem, converted into a less harmful and volatile form, and released into the atmosphere. Because metals like mercury and selenium are highly volatile, phytovolatilization has been routinely employed to remove them. However, pollutants may be present in the plant's edible product, such as fruit, as a result of buildup and translocation during phytovolatilization.

Rhizofiltration

Rhizofiltration is the process by which plants adsorb and precipitate organic and inorganic contaminants on their roots in order to remove them from contaminated wastewater, groundwater, and surface water.

Rhizodegradation

Rhizodegradation occurs when soil organic pollutants are degraded by microorganisms in the rhizosphere. Fungi, bacteria, and yeasts are examples of microorganisms that carry out rhizodegradation. In the rhizosphere, there are more microorganisms than on the ground surface. Amino acids, carbohydrates, and flavonoids are found in the exudates released by plants.

Factors affect phytoremediation

Phytostabilization, phytoextraction, and phytovolatilization are the three primary methods of phytoremediation for heavy metal removal. Phytostabilization prevents heavy metals

from entering the food chain; phytoextraction adsorbs heavy metals from the soil and stores them in plant tissues; and phytovolatilization volatilizes heavy metals from the soil and releases them in a less toxic or non-hazardous form into the atmosphere.

Thus, phytoremediation technique relies on the use of plant interactions in polluted sites to mitigate the toxic effects of pollutants. Depending on pollutant type there are several mechanisms involved in phytoremediation. Plants have a more direct effect on contaminant levels. Phytoremediation is a set of ecological strategies. Various soil and plant factors such as the physical and chemical properties of the soil, the plant and microbial exudates, bioavailability of metals, and the availability of plant uptake, accumulate, trans locate, sequester and detoxify metals account for phytoremediation efficiency.

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SOILLESS CULTIVATION IN VEGETABLE PRODUCTION

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Soil is usually the most accessible medium for growing plants. It provides support, nutrients, air and water for successful growth of plants. However, the soil sometimes severely limits plant growth. Soil less agriculture is a method of growing plants using mineral nutrient solutions, in water and in other mediums, without soil. Ground plants can only grow with roots in mineral nutrient solutions or in an inert medium such as perlite, gravel, rock wool or coconut husks. According to the United Nations, the world's population is projected to rise from 7.6 billion in 2011 to approximately 8.6 billion in 2030 and 9.8 billion in 2050 (UN 2011). World's total agricultural land has been increased by 3% in 1958 to 2005 mainly in tropical countries but decrease in 0.19% of agriculture land was recorded between 2005 to 2011. Extreme population growth is accompanied by ecological destruction, resource scarcity, unequal distribution of food and, in many cases, malnutrition. To feed this growing population at least 6000 tons of food is required which is mostly imported from other sources out of which most of them are non-trusted source in term of quality standers. Soil-based agriculture faces several challenges, most notably a drop in per-capital land availability. With rapid urbanization and industrialization and the melting of the iceberg, the area of arable land will shrink further. Soilless techniques such as hydroponics, aerophonics and aquaponics are designed to combat these issues.

Classification of soilless culture

1. Solid media culture.
2. Solution culture.
3. Aero phonics.

Solid media culture

Soilless media can be in the form of substrates originated from peat moss, bark, coir, compost, rice hulls, vermiculite and perlite. This soilless culture is a mainstream practice in developing countries as normal ground soils are typically discontented in usage for crop production. Hence, the rudimentary characteristics of good soilless media would be easy to acquire, economical, abundant in nature, light weight, possess upright chemical properties and has a satisfactory water retention capability. The quality of the growing media must also be greatly maintained to ensure good growth of seedlings. This was because sustainable production of ornamental flower and other crops would need to compensate decent growing media with sufficient water holding capacity and aeration. The most common incorporated soilless media are coir-dust based substrates and sphagnum peat. This was because it is occasionally acknowledged as substrates or growth media with the most prominent crop production mechanisms for containerized or raised beds with restricted volumes and was appropriate for continuous supply of nutrients through fertilization.

Vertical farming

Vertical farming is one such solution that's been implemented around the world. By Vertical Farming, food crops can be cultivated easily in urban areas by planting in vertically stacked layers in order to save space and use minimal energy and water for irrigation. In India, Vertical Farming is at nascent stages, however, there are few startups and agri-tech companies working to revolutionise the field.

Techniques of vertical farming

1. Hydrophonics
2. Aerophonics
3. Aquaphonics.

Hydrophonics

Hydroponics' word has its origin from Greek language where 'hydro' refers to water and 'ponos' refers to labour. In hydroponic system it is assumed that soil is not necessary for

plant growth actually it acts as a source of essential macro and micronutrients that regulate the plant growth and development. Thus, if soil is replaced with a solution having appropriate combination of macro and micro nutrients it is possible to raise a crop to its full maturity.

Nutrient solutions

A nutrient solution for hydroponic systems is an aqueous solution containing mainly inorganic ions from soluble salts of essential elements for higher plants. Eventually, some organic compounds such as iron chelates may be present. An essential element has a clear physiological role and its absence prevents the complete plant life cycle. Currently 17 elements are considered essential for most plants, these are carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, iron, copper, zinc, manganese, molybdenum, boron, chlorine and nickel. With the exception of carbon (C) and oxygen (O), which are supplied from the atmosphere, the essential elements are obtained from the growth medium. Other elements such as sodium, silicon, vanadium, selenium, cobalt, aluminum and iodine among others, are considered beneficial because some of them can stimulate the growth, or can compensate the toxic effects of other elements, or may replace essential nutrients in a less specific role. The most basic nutrient solutions consider in its composition only nitrogen, phosphorus, potassium, calcium, magnesium and sulphur; and they are supplemented with micronutrients. The nutrient composition determines electrical conductivity and osmotic potential of the solution. Moreover, there are other parameters that define a nutrient solution as discussed below in detail. The nutrient composition determines electrical conductivity and osmotic potential of the solution.

Aerophonics

A plant-cultivation technique in which the roots hang suspended in the air while nutrient solution is delivered to them in the form of a fine mist. Aeroponic systems are a specialized version of hydroponics where the roots of the plant extend only in air and the roots are directly sprayed with a nutrient water mix (the recipe). In aeroponics, oxygen is surrounding the roots at all times. Surplus oxygen accelerates nutrient absorption at the root surface.

Hydroponics manages to grow crops up to 50% faster than in soil, it still has a major drawback. Since, the roots are always submerged in water, only crops that are more tolerant to waterlogging such as cabbages, lettuce and tomatoes are favored for growth. To overcome this demerit, the basic hydroponics setup was modified to use a high-pressure pump to blast freely hanging roots with a fine mist of the nutrient solution at regular intervals. This way the roots didn't face any water logging issues and it turned out that this method ended up in saving more water and nutrients than most hydroponics setups.

Resendiz-melgar *et al*., (2017) conducted a experiment in greenhouse type tunnel with skirt and zenithal ventilation located in San Pablo Tepetzingo Tehuacan, Puebla and given that the Amount of nutrients applied and saved throughout the production cycle in bell pepper for the three treatments of hydroponic systems. The amount of nutrient applied for the three treatments was similar because of the way the irrigations were controlled and the reused solutions adjusted. The percentage of nutrients saved was between 6% and 12% individually. Other works with pepper report higher savings with 78% or more than 80% with other crops nutrient savings in closed hydroponic systems are also relevant, in tomatoes, savings of 20-50% of fertilizer and 25% for cucumber have been obtained. The low nutrient reused may was due to the absorption by the plant and possibly to its being left in the substrate, as has been reported in other studies (Pineda *et al*., 2011).

Conclusion

Soilless farming is considered a newly developed technique for agricultural development, but it is not a simple technique. However, growers and gardeners in many countries lack knowledge of the new technique and require well-trained staff. Also, most of the substrates are international market, so they are expensive. So, you're better off looking for good, inexpensive substrates locally. Initially, terrestrial production systems were implemented by imitating traditional methods based on terrestrial production or land-based systems. Soilless culture can be the effective tool to increase the crop yield and the water-use efficiency, also reduce the environmental impact of greenhouses and nurseries. In hydrophonics method a more efficient use of water could be made and nutrient can be saved as well as it also avoids the fertilizers from direct disposal to the environment. By implementing a soilless farming system, better quality of agricultural products can be met to satisfy consumer preferences.

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MECHANIZATION IN FRUIT PRODUCTION

AN OVERVIEW

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Mechanization plays an important role in achieving sustainable food production. food sustainability can be achieved through production of sufficient quantity of nutrient enriched fruits, vegetables, medicinal plants and their processed products. Due to rising population demand for food is growing while land and water resources are becoming scarce, if the societies are to flourish in the long term they must increase Productivity growth through mechanization. India is second largest producer of fruit and vegetable in the world and India ranks first in productivity of grapes, banana, papaya, cassava and peas. To obtain maximum productivity and utilize the resources the demand for mechanization is also increasing. adoption of farm mechanization techniques such as sowing, spraying, inter cultural operations, application of fertilizers and harvesting will enhance horticulture production, productivity and quality in a long term, In order to provide sufficient food and nutrition to the population farm mechanization is essential.

Need of farm mechanization

1. Decrease in area of cultivation due to urbanization.
2. Labor costs are increasing.
3. Availability of skilled labor is reducing.
4. To meet the food safety standard.
5. Beating competition among international market.
6. Reduce crop losses by harvesting at proper stage.
7. Production of sufficient off season fruits and vegetables.

Cultivation practices in fruit orchard and adoption of mechanization:

1. **Land preparation:** Land preparation plays a major role in crop establishment. The land preparation includes ploughing, planking, FYM application and clod breaking., disc harrow, Mould board plough, disc harrow-cum-Puddler, peg tooth harrow, spring tine harrow, rotavator and patella harrow operated by tractor can be used for land preparations.
2. **Planting/sowing:** Planting of almost all crops are mainly done by hand. For vegetables, small spade is used to assist in making holes, the use of machinery is limited due to small land holding, undulating topography and fragmentation of land. For precise application of seed and fertilizer, mechanically metered seed drills and seedcum- fertilizer drills operated by tractors have been developed and pit hole digger used for orchard establishment (fig 01).
3. **Weeding/ Intercultural operation:** Weeds compete with the crop plants for soil nutrients, moisture, light and space, Khurpi is the most popular tool used for removal of weeds but it takes 300-700 man-hours to cover one hectare. Weeding can be done by wheel hoe, Conoweeder, peg type weeder, and star type weeder.
4. **Harvesting:** Farmers use plain and serrated sickles for harvesting of crops and grasses, which are locally available at a low cost. The output of these sickles is low and effort required is high. Harvesting of tuber crops are done by manually digging with local spades, which is a time consuming and tiresome method of harvesting. Mechanical harvesters such as limb shaker, canopy shaker, trunk shaker, and air blast can be used for harvesting of fruits (fig 02).

Fig. 1 Pit digger

Fig. 2 Canopy Shaker

Conclusion

The adaption of mechanization in Indian horticulture for various operations *viz.* seeding, weeding, spraying and harvesting will reduce the time taken for actual operation in comparison to manual operation which results in good rate of output. Government has started several schemes such as National Mission on Agricultural Mechanization (NMAM), Sub-Mission on Agricultural Mechanization (SMAM) to promote farm mechanization for speedy growth of agriculture sector.

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