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A Resonance in Agriculture

Monthly Agriculture E-Magazine

September-2024



MICROGREEN FARMING



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Times of Agriculture

A Resonance in Agriculture

From the Editor's Desk

Dear Readers,

We hope you will enjoy this **September** edition of the **Times of Agriculture magazine**. In this issue, we have discussed an innovative farming type that is gaining immense popularity in Western countries and is gradually becoming more in demand in India's metropolitan cities. It has been commonly observed that people are becoming more health-conscious, opting for healthier diets that include organic foods and nutritious vegetables.

In this edition, we have focused on **Microgreen Farming**. **Microgreens** is a new variety of edible vegetables, harvested before actual leaves appear, but before the first leaves are about to fully develop. The word Microgreen is a marketing term differentiating these plants from leafy greens and sprouts. Compared to sprouts, microgreens are more nutritious. The fundamental difference between sprouts and microgreens is that sprouts take 2-4 days to grow, while microgreens take 7-14 days. Microgreens contain five times more vitamins. Their use is increasingly common in major cities, with people purchasing and trying to incorporate it into their daily routines.

Microgreens are nutritious and help boost immunity, having the ability to fight various diseases. This practice is already highly prevalent in Western countries. In India, several startups have now begun cultivating microgreens and selling them in large retail stores. Microgreen farming has the potential to become a profitable venture for farmers. With the right information, proper seed selection, and effective marketing, it can serve as a significant source of income. Apart from microgreen farming, this issue includes other important articles and updates on recent agricultural developments. We hope you will enjoy reading this edition. Please feel free to send us your suggestions and feedback.

Thank you very much, and enjoy reading!

Editor-In-Chief

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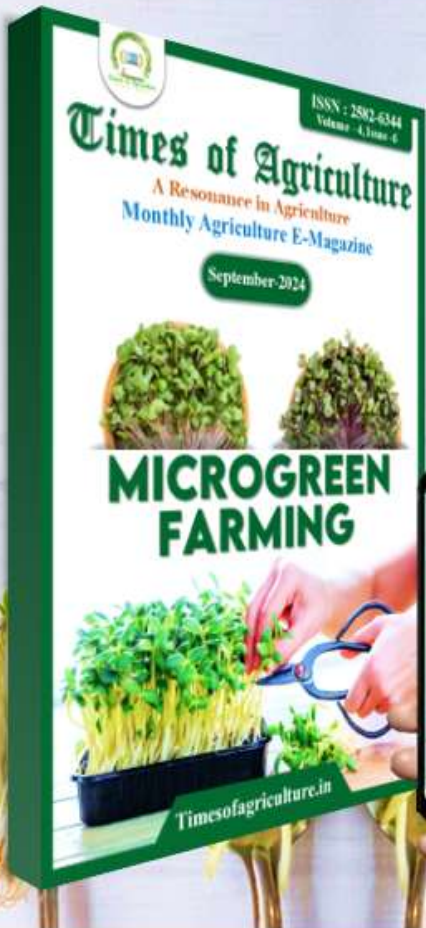
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MICROGREEN FARMING



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AGRICULTURE UPDATES



Government approved Rs 24,474.53 crore subsidies on P&K Fertilisers

The Union Cabinet, chaired by Prime Minister Narendra Modi, has approved the Nutrient Based Subsidy (NBS) rates for rabi season 2024 on P&K fertilizers. The decision is aimed at ensuring the availability of fertilizers to farmers at subsidized, affordable and reasonable prices. The government is making available 28 grades of P&K fertilizers to farmers at subsidized prices through fertilizer manufacturers/importers.

Briefing reporters, I&B Minister Anurag Thakur said, “A nutrient-based subsidy of Rs 24,420 crore on P&K fertilisers has been approved for the kharif season starting April 1 till September 30.” The minister said the subsidy on Nitrogen has been fixed at Rs 47.02 per kg, phosphatic at Rs 28.72 per g, potassic at Rs 2.38 per kg, and Sulphur at Rs 1.89 per kg for 2024 kharif season. In fact, the subsidy on phosphatic fertilisers has been increased to Rs 28.72 per kg for the 2024 kharif season from Rs 20.82 per kg in the 2023 rabi season. However, the subsidy on nitrogen, potassic and Sulphur has been kept unchanged for 2024 kharif season. With this subsidy, DAP which is sold currently at Rs 1,350 per bag (50 kg), will continue to be available at the same rate in the upcoming 2024 Kharif season. Muriate of Potash will also continue to be available at Rs 1,670 per bag, while NPK will be available at Rs 1,470 per bag.

In view of the recent trends in the international prices of fertilizers & inputs i.e. urea, DAP, MOP and sulphur, government has decided to approve the NBS rates for Rabi 2024 on P&K fertilizers. The subsidy would be provided to the fertilizer companies as per approved and notified rates of N (nitrogen), P (phosphorus) and K (potash) so that fertilizers are made available to farmers at affordable prices, it added.

Odisha CM, Mohan Charan Majhi, announced the launch of 'CM Kisan Yojana'

Odisha Chief Minister, Mohan Charan Majhi, announced the launch of 'CM Kisan Yojana' to benefit 46 lakh farmers, including the landless ones. The scheme was announced at an event at Gangadhar Meher University and will also benefit landless farmers who were excluded from the PM Kisan Yojana.. Under the scheme, the farmers will get the following benefits:

1. A total of Rs 925 crore will be transferred to the bank accounts of the small and marginal farmers through Direct Benefit Transfer (DBT).
2. The eligible beneficiaries will receive a total of Rs 4000 in two phases. The first installment of Rs 2000 will be disbursed on Nuakhai, the agriculture festival of Odisha, whereas the remaining amount will be transferred on Akshaya Tritiya.
3. The children of the beneficiaries of the scheme will receive scholarships for pursuing technical studies.
4. Under the scheme, the Odisha government will buy paddy from farmers at Rs 3,100 per quintal.

The Chief Minister also launched the Krushak Odisha Unified Portal of the Agriculture and Farmers Empowerment Department at the event. He said that going further, the state government also plans to launch the Balabhadra Yojana to promote organic farming in the state.



Nearly 12% of Indian-tested spices fail FSSAI quality and safety standards

Nearly 12 per cent of Indian-tested spices failed to meet the Food Safety and Standards Authority of India (FSSAI) quality and safety standards after many countries took measures over contamination risk in two popular spice exporting brands from the country, reported the news agency Reuters on Sunday, August 18, quoting data collected from a Right to Information (RTI) response.

The FSSAI data shows that 474 of 4,054 samples tested between May and early July failed to meet the quality and safety parameters, according to the RTI response quoted in the news report. The food and safety standard regulator told the news agency that it did not have a breakdown of the brands whose spices were tested, but the regulator was taking the required actions against the companies involved in the situation, according to the report.

"Action on non-conforming samples has been taken as stipulated," the regulator told the news agency, with reference to the penalty under the Indian law without further elaboration on the case.

Indian brands like MDH and Everest are amongst the most popular in India, which is also the world's biggest exporter, producer, and consumer of spices. Both brands told the news agency that their products are safe for consumption, reported the news agency. MDH and Everest sell their products in Europe, Asia, and North America. The food and safety standard regulator carried out inspections that covered sampling and testing mixed spice blends after Hon Kong suspended the sale of some of the blends of the brands MDH and Everest in April 2024 due to the high level of a pesticide, according to the report.



Himachal Pradesh to launch HIM-UNNATI scheme to boost natural farming

The Himachal Pradesh State Government has unveiled a new initiative, the HIM-UNNATI scheme, aimed at promoting natural farming across the state. With an allocation of ₹150 crore, this scheme will bolster the efforts of approximately 1.92 lakh farmers already practicing chemical-free farming on over 32,149 hectares of land. The programme will focus on making the agriculture sector economically viable through a cluster-based development model and promoting natural farming.

Under HIM-UNNATI, the government will consolidate smallholding farmers to enable bulk production, ensuring a sufficient marketable surplus. The initiative will also integrate various ongoing agricultural schemes and coordinate with departments such as animal husbandry, horticulture, fisheries, and rural development to maximise the scheme's impact.

The scheme would particularly benefit small and marginal farmers, women farmers, and those from weaker sections of society, including Scheduled Castes (SC), Scheduled Tribes (ST), and Below Poverty Line (BPL) families. The scheme is expected to generate self-employment opportunities for approximately 50,000 farmers through the creation of 2,600 focused agricultural clusters. Additionally, it is anticipated to increase productivity by 15-20 percent in vegetables and cereals in the State. The HIM-UNNATI scheme includes 100 percent soil test-based nutrient management to enhance soil productivity, the promotion of high-end product cultivation, and support for traditional crops and millet procurement.



Cabinet approves the continuation of schemes of PM-AASHA Scheme

The Union Cabinet chaired by the Prime Minister Shri Narendra Modi has approved the continuation of schemes of Pradhan Mantri Annadata Aay SanraksHan Abhiyan (PM-AASHA) to provide remunerative prices to farmers and to control price volatility of essential commodities for consumers. The total financial outgo will be Rs. 35,000 crore during 15th Finance Commission Cycle upto 2025-26.

The Government has converged the Price Support Scheme (PSS) & Price Stabilization Fund (PSF) schemes in PM AASHA to serve the farmers and consumers more efficiently. The Integrated scheme of PM-AASHA will bring-in more effectiveness in the implementation which would not only help in providing remunerative prices to the farmers for their produce but also control the price volatility of essential commodities by ensuring their availability at affordable prices to consumers. PM-AASHA will now have the components of Price Support scheme (PSS), Price Stabilization Fund (PSF) , Price Deficit Payment Scheme (POPS) and Market Intervention Scheme (MIS).

The procurement of notified pulses, oilseeds & copra at MSP under Price Support Scheme will be on 25% of national Production of these notified crops from 2024-25 season onwards which would enable States to procure more of these crops at MSP from farmers for ensuring remunerative prices and preventing distress sale. However, this ceiling will not be applicable in case of Tur, Urad & Masur for 2024-25 season as there will be a 100 % procurement of Tur, Urad & Masur during in 2024-25 season as decided earlier.



Amit shah launches white revolution 2.0 to boost dairy sector

Union Home and Cooperation Minister Amit Shah launched the standard operating procedure for 'White Revolution 2.0' stating that milk dairies will aid empowerment of women and the fight against malnutrition. Mr. Shah said that according to the western concept, a woman is considered unemployed even though she does all the work at home, adding that he disagrees with it. He said White Revolution 2.0 will help the inclusion of women engaged in procurement of milk in formal employment as the money will be deposited in their bank accounts. The scheme aims to increase procurement led by cooperatives from the present 660 lakh litres per day to 1,000 lakh litres.

Union Minister for Fisheries, Animal Husbandry and Dairying, and Panchayati Raj, Rajiv Ranjan Singh was also present at the launch. Mr. Shah said that in the past 70 years, necessary changes in cooperatives were not made due to which the bodies became very successful in some States and were left to the mercy of State governments in others. He said the government has prepared a joint proposal of two lakh primary agriculture cooperative societies (PACS), dairy and fishery cooperatives, and sent it across the country, and all the States have accepted it. He said that once these PACS are registered, there will not be a single panchayat without a PACS, dairy or fisheries cooperative society. The Minister said once this happens, co-operatives will be able to reach the whole country, which will lead to the creation of cooperative institutions at tehsil and district levels, and State institutions will gain strength and momentum. White Revolution 2.0 will “empower women and also give strength to the fight against malnutrition.



MICROGREEN FARMING



About the Author

Pragti Negi

Assistant Professor

SBS University,

Dehradun, Uttarakhand

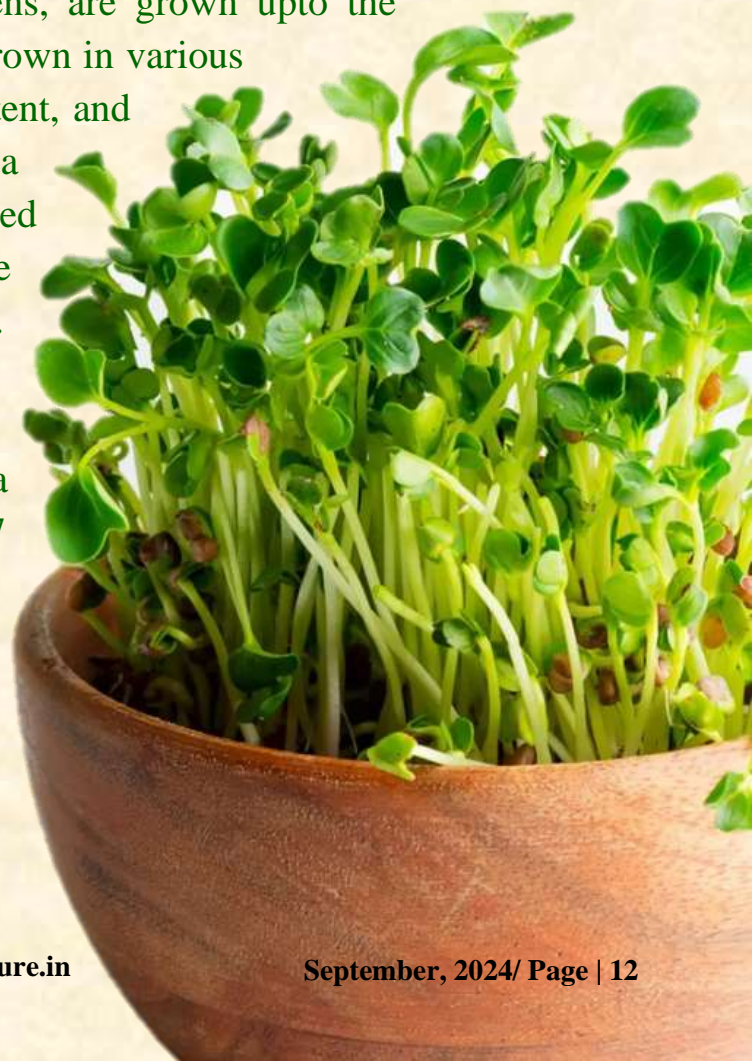


Microgreens were widely known in the 1980s when they first started appearing in Californian restaurants. They are known by several names, such as vegetable confetti or micro herbs, these flavorful greens are an excellent splash of color to a range of savory dishes. Even though they are tiny, they are rich in protein (up to 9 times), and frequently have higher nutrient contents than mature vegetable greens. They are therefore an advantageous supplement to any diet and hence are gaining popularity among the young and old generations, these days. Due to this factor, people from diverse backgrounds are opting for the farming of these tiny plants as a most suitable choice over their traditional 9 to 5 jobs. Microgreen farming can be done by anyone with a low time investment (with minimal effort of around 8 hours per week). Along with the possible positive health effects of microgreens, this article contains a comprehensive production guide for microgreen farming along with some successful case studies and startups of these tiny plants.

What are Microgreens?

Microgreens is a new variety of edible vegetables, harvested before actual leaves appear, but before first leaves about to full develop. The word Microgreen is a marketing term differentiating these plants from leafy greens and sprouts. All over the world, there are approximately 25 types of microgreens that are cultivated commercially.

Young vegetable greens, or microgreens, are grown upto the height of 1-3 inches (2.5-7.5 cm). They are grown in various colors and textures, have a high nutrient content, and an aromatic flavor. Microgreens lies between a sprout and a baby green, and are often called baby plants. However, they should not be confused with sprouts, which lack leaves. Microgreens are harvested 7–21 days after germination, once the plant's first real leaves have emerged. Conversely, sprouts have a significantly shorter growing cycle of 2–7 days. Because the stems and leaves of microgreens are deemed edible, they resemble baby greens more closely. They can be sold before they're harvested, but they are far smaller than baby greens.



Advantages of Microgreen Farming

Consumers all over the world are increasingly recognizing the advantages of including leafy greens or microgreens in their diets, which will ensure that demand continues to increase. Also, there is future for farming within the homes because the country is witnessing many issues related to crop failures when crops are cultivated outdoors.

The following are some of the key benefits of microgreen cultivation:

- Microgreens need 7 to 14 days from seed to harvest. Picking doesn't require a farmer to wait a whole year or longer.
- It is possible to grow microgreens all around the year which also allow farmers to diversify farming business as they grow and increase revenue by using microgreens as an extra source of income.
- Farmers may establish their businesses with relatively little capital by growing enough microgreens to sell at a weekly farmer's market or by supplying enough greens to one restaurant, subsequently increasing output in response to demand.
- Microgreens are described as “*functional*” foods because they contain a comprehensive set of various vitamins that help in nourishment. In comparison to the mature plants, these microgreens have nine times higher nutrition along with some beneficial nutrients like potassium, iron, zinc and copper.
- To earn better profits and recognition, a farmer also sells their microgreens to upscale restaurants and food retailers.

How to Grow Microgreens?

Depending on the abilities and objectives, these microgreens can be produced in systems of various complexity. Microgreens are easy to cultivate and maintain in small areas. Microgreens should be cultivated in soil or soilless media, inside or outdoors, and under artificial or natural light. Growers may grow microgreens on a small scale within their kitchens or on a larger scale in industrial production systems for profit. The process of cultivating, gathering, and preserving microgreens by the growers has an important effect on the accumulation and breakdown of phytonutrients.

WHAT ARE MICROGREENS?

Microgreens are tiny plants that are usually harvested after only 7 to 14 days of growth.



Sprout
1-7 Days



Microgreen
7-14 Days



Baby Green
2-3 Weeks

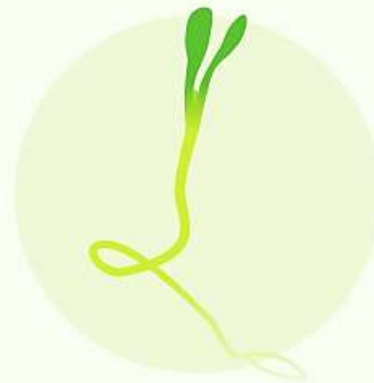


Adult Green
1-2 Months



Microgreens

- ✓ Grown in soil or hydroponic
- ✓ Harvested within 1-2 weeks
- ✓ Leaves and stems can be eaten



Sprout


- ✓ Sprouts germinate in water
- ✓ Harvested within 5-7 days
- ✓ We consume the entire sprout



Level of
Vitamins

x5

Microgreens have on average five times¹ the level of vitamins than their mature plant counterparts.



The following are some of the basic steps that are required for cultivation of microgreens:

1. Seed selection: Start with seeds that grow specifically to produce microgreens. Seeds are free of fungicides and other pesticides, and their non-plant matter content is low. This is particularly important if one intends to grow microgreens of maize, peas, or spinach crops whose seeds are usually plated with fungicide. Some other kinds of microgreens have mucilaginous seeds, which, when submerged, create a thick, jelly-like covering that holds moisture. Mucilaginous seeds include basil and cress. Before planting, they need no soaking before sowing.

2. Planting and germination: The microgreen seeds need light and nutrition as soon as they sprout to yield the best possible outcome. At this stage, propagation bulbs work perfectly as long as they refrain from producing too much heat, which might harm the delicate leaves.

3. Fertilization requirements: For the growing of microgreens, a seedling nutrition solution for vegetative growth is usually sufficient. After applying the nutrient solution, there is a drying period during which the growth surface maintains enough moisture to keep the roots moist between the watering.

4. Harvesting of microgreens: After planting, the microgreens are ready to harvest in 2-3 weeks, depending on the kind of seeds the grower planted. Always have a check of the first “true leaves” as a sign of readiness. Then, with the help of scissors cut the greens slightly above the soil's surface.

Wash the microgreens under running water and dry them with paper towels or a salad spinner before serving. One can serve them directly too. or add them to main courses, salads, soups, and sandwiches for better culinary purposes. The rest of the microgreens can also be stored in a refrigerator in plastic bags.

Challenges in Microgreen Farming

- 1. High Initial Investment:** Equipment, infrastructure, and technology must be purchased in large quantities to start up an indoor microgreen farming business. For certain gardeners, especially hobbyists or small-scale producers, the initial costs associated with hydroponic or aeroponic setups, grow lights, and climate control systems are expensive.
- 2. Maintenance of Energy:** To mimic ideal growing conditions, indoor farming primarily depends on artificial lighting and climate control equipment. Because of this, energy use can be an important operational expense, which creates the cost of production and creates issues with electricity use and the environment.
- 3. Disease and pest control:** Although there is a regulated atmosphere in indoor farming but pests and illnesses are always there to negatively impact the microgreens. Hence, to avoid infestations and other problems, it's crucial to put up strict hygiene standards, implement integrated pest management procedures into effect, and maintain a check on the health and nutrient application of the plants.
- 4. More Requirement of Light:** In comparison to other mature plants, microgreens requires more amount of light in the absence of which they are not able to grow properly and becomes weak and skinny in structure.
- 5. Sensitive to Overcrowding:** If the grower grows these plants in a densely populated way, it will result in damping off . One always prevents this case, by treating the media with *trichoderma*.

Startups/Case Studies in India

A few years ago, it would have been thought impossible to cultivate crops in a city. However modern technologies like hydroponics and vertical gardening have made growing food in small urban spaces feasible. Here are the 6 urban farming companies that are going above and beyond to introduce environmentally friendly farming techniques in India and are involved in cultivating microgreens too.

1.UGF Farms:

Urban Green Fate (UGF) Farms was established in 2017 by Linesh Narayan Pillai who converts vacant lands into flourishing food gardens. The layout of live food gardens avoids physical damage to nearby structures. The Mumbai-based company provides residents with planted microgreens—vegetable greens that have developed leaves—so they can grow them in organic peat moss rather than heavy soil. Simply picking the greens from the live plant when necessary is all that needs to be done by the consumer.



2. Farm2Fam:

Keya Salot started the Mumbai-based firm Farm2Fam in January 2019, which grows microgreens that are delivered right to customers' doorsteps without the use of chemicals, pesticides, or herbicides. Farm2Fam took the vegetable confetti concept from the west to Mumbai and exposed the population to fresh, nutrient-dense living microgreens. A few of the forty different microgreen flavors that Farm2Fam offers are Swiss chard, Alfalfa, Nasturtium, Purple Kohlrabi, Sango Radish, and Sunflower.



3. Living Food Company:

It was founded by Akash K. Sajith in 2018 and is changing the food scenario of India although in a small way. They are growing fresh microgreens of different vegetables along with some fresh vegetables for consumption.



Benefits of MICROGREENS

HIGH IN NUTRIENTS:

Contain 4-40 times more nutrients by weight than their fully-grown counterparts.

(Source: NCBI)

CONTAIN POLYPHENOLS

Prevent the buildup of harmful free radicals Associated with a reduced risk of heart disease, cancer & Alzheimer's disease

(Source: NCBI)

IMPROVE HEART HEALTH

Animal studies have shown microgreens may help reduce heart disease risk factors, such as weight, bad LDL cholesterol & triglycerides.

(Source: FASEB)

REDUCE CHRONIC DISEASE RISK

Veggie consumption is associated with lower risk of certain cancers, inflammation, heart disease, diabetes & obesity. (Source: NCBI)

GROWN YEAR-ROUND

Because microgreens can be grown indoors, there's no need to wait for warm weather to roll around in order to break out the gardening gloves.



Case Study of a Kerala Resident: Ajay Gopinath

He began growing Microgreens on a modest scale as an experiment in 2017 or 2018. After two years of study and experimenting, he finally figured out the proper procedures, even though he wasn't sure what they were. After that, he began cultivating them on a commercial scale for an existence.



In 2022, he was successful in growing 50 different varieties of microgreens in an area of 80 sq. feet in his house and harvested around 5kg of greens every day. Thus, by selling these he made a profit of Rs. 2 to 3 lakh per month.

Conclusion:

Microgreens are classified as a unique kind of functional food with many nutrients that help to increase the lifespan and overall health of consumers all over the world. They are very affordable and easy to grow at home which also makes them a desirable addition to food. Microgreens are known for the unique and enriching culinary experience that they provide to the consumer owing to their high nutrition rich in potassium, iron, zinc and visual characteristics.

Overall, microgreen farming has acquired a top spot in the urban cities and rural farm production avenues. Microgreens have the potential to act as a nutritional powerhouse.



Previous Issues



Website Statistics (August 2024)

201K

Monthly
Pageview

81K

Monthly
Visitor

2.1M

Monthly
Impression

Social Stats



6.5K



5.3K



7.4K



1.7K



2K





HONEY BEE AS AN EXPLOSIVE DETECTOR

UNVEILING NATURE'S SENSITIVE SNIFFERS

About Author



Awaneesh Kumar*

Raffles University
Neemrana, Rajasthan

Promish Kumar

SHUATS, Prayagraj

Explosives pose a significant threat in a variety of settings, from national security and law enforcement to military operations. Traditionally, detecting these dangers has relied on expensive equipment and specialized personnel. However, in an unexpected twist, nature has given us an unlikely partner in the form of honey bees. These remarkable insects, known for their exceptional sense of smell, have become the focus of research for their potential in detecting explosives. This article explores the idea of using honey bees as explosive detectors, examining their unique abilities and how

advancements are being made to harness their skills for improved security.

Sensitivity to odour

Honey bees have an extraordinary sense of smell, capable of detecting and distinguishing even the faintest traces of volatile compounds. Their olfactory receptors are incredibly sensitive, which makes them highly effective at identifying explosive materials. Through a process of classical conditioning, bees can be trained to associate the scent of specific explosives with a reward, such as sugar water. Once trained, they expand their natural



foraging behaviour to include the detection of explosives, proving that they can be just as adept at finding dangerous materials as they are at locating flowers.

Portability and mobility

One of the most significant advantages of using honey bees for explosive detection is their natural portability and mobility. Bees instinctively cover large areas in their search for food, making them ideal for deployment across wide regions where explosives may be hidden. Not only can they be easily transported to different



locations, but once released, they swiftly survey the area. This ability to quickly cover ground allows for fast and efficient detection, which is crucial in high-stakes security operations.

Cost-Effectiveness

Compared to conventional explosive detection methods, utilizing honey bees offers a much more cost-effective solution. The necessary equipment is minimal, and the training process taps into the bees' natural behaviours. This eliminates the need for expensive machinery, routine maintenance, and frequent recalibration. Furthermore, bees are relatively easy to breed and maintain, making them a sustainable, low-cost resource that can be used repeatedly in explosive detection scenarios.



Versatility and adaptability

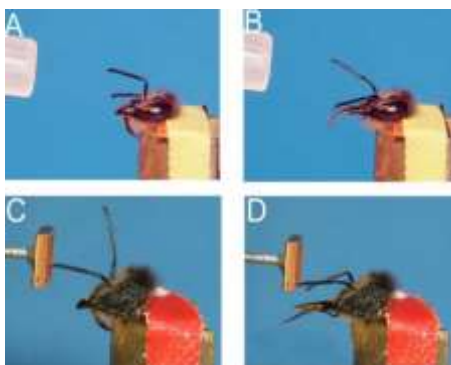
Honey bees are versatile in their ability to detect different types of explosive compounds. Once trained on a particular explosive, they can also identify similar substances with related odour profiles, broadening their range of detection. This makes them particularly valuable in detecting a variety of explosives, including those used in improvised explosive devices (IEDs). By



leveraging their remarkable ability to differentiate odours, honey bees add an extra layer of security across multiple sectors.

Integration with technology

The effectiveness of honey bees as explosive detectors can be further enhanced through the integration of modern technology. For instance, researchers have explored attaching small electronic sensors or microchips to individual bees. These devices can monitor the bees' movements and behaviours, transmitting data in real-time. This blend of nature and technology allows for more accurate and



immediate detection of explosives, making the process faster and more reliable. Through advanced systems that combine bee behaviour with data analytics, we can achieve even greater security capabilities.

Conclusion

Honey bees' incredible sense of smell has positioned them as a valuable tool in explosive detection. Their sensitivity to odours, coupled with their natural mobility, cost-effectiveness, and adaptability, makes them an excellent alternative to traditional methods. By training honey bees to detect explosives, we tap into their unique abilities, enhancing our capacity to safeguard against threats. The integration of technology further amplifies their potential, enabling real-time monitoring and analysis. As we continue to explore innovative, nature-based solutions, honey bees offer a promising and unconventional approach to ensuring public safety and security.





GROWING GREEN

REVOLUTIONIZING INDOOR FARMING OF VEGETABLES WITH LED LIGHTING

About Author



Sandeep Indurthi

Ph.D. Vegetable Science
Punjab Agricultural University
Punjab

As the global population continues to grow and urban areas expand, the demand for fresh, high-quality produce is reaching unprecedented levels. Traditional agriculture is facing mounting pressures due to limited land and climate change, prompting a shift to indoor farming. Utilizing LED (Light emitting diode) lighting, which replaces less efficient traditional systems, indoor farming offers year-round, high-quality vegetable production with precise control and lower environmental impact. This technology is essential for sustainable, efficient agriculture, ensuring a resilient food system for the future.

The science behind LED lighting: Light spectrum and plant growth

LED lighting technology allows for precise control over the wavelengths of light emitted, which plays a crucial role in optimizing plant growth. Plants utilize light for photosynthesis, which converts light energy into chemical energy to support their growth. Red light (around 660-680 nm) is essential for photosynthesis and affects the flowering and fruiting stages of plant development. This light promotes chlorophyll production, which is critical for the photosynthesis process, and can enhance the overall growth and yield of plants. Moreover, blue light (around 450-470 nm) supports seedling growth with strong root development and healthy

foliage, and during the vegetative phase, it is crucial for increasing chlorophyll content, leaf size, and overall plant structure.

Specific light regimens for different vegetables

Vegetable type	Light spectrum requirements	Purpose	Examples
Leafy greens	High in blue light, balanced red light	Encourages lush, tender leaves; improves growth rates and nutritional content	Lettuce, Spinach
Fruit-bearing vegetables	Higher proportion of red light, essential blue light	Enhances the fruit development and yield; supports robust plant structure	Tomato, Peppers
Root vegetables	Balanced combination of blue and red light	Supports healthy foliage and strong root growth	Carrots, Beets



Energy efficiency and cost savings

LEDs are significantly more energy-efficient than traditional HPS (High pressure sodium) lamps, using 150-600 watts versus 400-1000 watts. Switching from a 600-watt HPS to a 300-watt LED can reduce energy consumption by around 50%, lowering bills and environmental impact. Case studies showed LEDs can reduce costs substantially: one indoor farm reduced electricity bills by 40%, while a vertical farm saved over \$100,000 annually.

Additionally, LEDs last 50,000 to 100,000 hours, compared to HPS lamps' 10,000 to 20,000 hours. The extended lifespan of LEDs leads to fewer replacements and reduced maintenance expenses, making LEDs a more cost-effective choice for indoor farming.

Enhancements in vegetable quality and yield

LED lighting can greatly enhance vegetable crop growth and yields. Research showed lettuce growth rates increased by 25% and spinach yields by up to 30% under LED lights. Custom LED lighting settings also boost tomato fruit production by 20. Additionally, customized LED spectra can enhance nutritional content. For instance, lettuce under balanced red and blue light has higher vitamin C and antioxidants, while tomatoes showed increased lycopene levels. These nutritional enhancements contribute to the overall quality and health benefits of the produce, making it more beneficial for consumers.

Environmental benefits of LED lighting in indoor vegetable farming

LEDs significantly reduce the carbon footprint of indoor vegetable farming by consuming less electricity

than traditional HPS lamps, resulting in fewer greenhouse gas emissions and promoting sustainable practices. Additionally, LEDs produce much less heat, decreasing the need for extensive cooling systems. This reduction in heat lowers water use for cooling, conserving resources and reducing operational costs. The energy and water efficiency of LEDs make them a more environmentally friendly and resource-efficient choice for indoor farming, contributing to both sustainability and cost savings.

Innovations and future trends in LED lighting for indoor vegetable farming

Smart LED systems

Smart LED systems use sensors and data analytics to create adaptive lighting environments for plants. They automatically adjust light intensity, spectrum, and duration based on real-time monitoring of plant needs and environmental conditions, optimizing both plant health and energy efficiency throughout the growth cycle.

Integration with other technologies

LED lighting is increasingly integrated with vertical farming and urban agriculture, enabling crops to be grown in stacked layers within controlled indoor spaces. This compact and energy-efficient approach maximizes space use, reduces land requirements, and supports sustainable urban farming, making fresh produce more accessible and lowering the carbon footprint of food transportation.

Challenges and considerations in adopting LED lighting for indoor vegetable farming

Adopting LED lighting presents challenges such as high initial costs,

with LEDs being more expensive to purchase and install than traditional HPS lamps. However, this upfront investment can be offset by long-term savings from lower energy usage, decreased maintenance expenses, and increased crop productivity, leading to a favourable return on investment. Additionally, effectively implementing LED systems requires understanding how to optimize light spectra, intensity, and timing for different crops and growth stages. This learning curve can be steep, making ongoing education and technical support essential for maximizing the benefits of LEDs in indoor farming.

Conclusion

Advanced LED lighting is revolutionizing indoor vegetable farming by enhancing plant growth, increasing energy efficiency, and promoting sustainability. The ability to customize light spectra for different growth stages and crop types has led to improved yields and better crop quality. Additionally, the lower energy usage and extended lifespan of LEDs lead to substantial cost savings and a lower environmental footprint.

Vision for the future

As LED technology continues to evolve, it holds the potential to further transform agriculture by enabling more precise control over growing conditions. This innovation will not only optimize indoor farming practices but also playing a key role in tackling global food security issues, making sustainable and efficient food production accessible to communities around the world.

■ ■ ■





KANJI: A HEALTHY FUNCTIONAL BEVERAGE

About Author



Prerna Nath*

ICAR-RCER, FSRCHPR
Ranchi, Jharkhand

S.J. Kale

ICAR-NISA
Ranchi, Jharkhand

Black carrots (BCs) in India are grossly underutilized and are mainly used to prepare salad, juice and pickles. In Northern India, carrots, especially a variety that is deep purple or black in colour, are fermented to make a traditional ready to serve drink known as 'Kanji'. The tuberous roots of black carrots, the main ingredient of *Kanji*, possess diuretic, digestive tract soothing, hepatoprotective and uterine stimulating properties. *Kanji* is a red colored lactic acid fermented carrot based spiced drink, mainly prepared for the purpose of combating heat stroke and process of preserving food items. It is a quite popular remedy for the treatment of indigestion, loss of appetite

and liver disorders. These are also reported to have menstruation delaying and uterine contraction inducing effects. The decoction of roots is efficacious in removing urinary tract stones. It is prepared and used extensively as an appetizer in early summer season. It is made traditionally at home scale with least inputs. Since long, it is being prepared both in homes as a house-hold remedy and on a small industrial scale by road-side vendors. However, its commercial production is still at a meagre stage.

Kanji is a functional probiotic beverage because it retains all the nutrients and viable microbiota till the time of consumption. Fresh black carrots and *kanji* are shown in Fig. 1. *Kanji* is a popular drink possessing cooling and soothing effects alongwith high nutritional value. Naturally produced CO₂ during fermentation adds effervescence, sparkle, tangy taste to the beverage. CO₂ had antimicrobial properties and shelf life of beverage was three months. The drink is an excellent source of anthocyanins and total phenolic compounds with known antioxidant activity. It is effective in the treatment of diarrhoea, lactose indigestion, constipation, colonic

disorders and food allergy. Probiotics are the microorganisms naturally present in food which stimulates the growth of beneficial microflora within the gastrointestinal tract thus helping in assisting digestion. Probiotics are known to possess anti-microbial, anti-mutagenic, anti-carcinogenic, reduces serum cholesterol levels and stimulate immune system. Probiotic beverages have been reported to be effective in various stomach related disorders such as; diarrhoea, lactose intolerance, constipation, colon infections etc.

Kanji production typically relies on spontaneous natural fermentation. Natural fermentation mainly comprises of Lactic acid fermentation which helps in providing economic means of producing microbiologically safe food products consequently resulting in minimum loss of nutritive value. Fermentation is one of the oldest food processing technologies that helps in extending the shelf life of perishable foods. Most of the fermentation in *Kanji* is carried out by hetero-fermentative LAB's like *Leuconostoc mesenteroides*, *Lactobacillus plantarum* and *Lactobacillus brevis*. Fermentation of vegetables plays an important role in



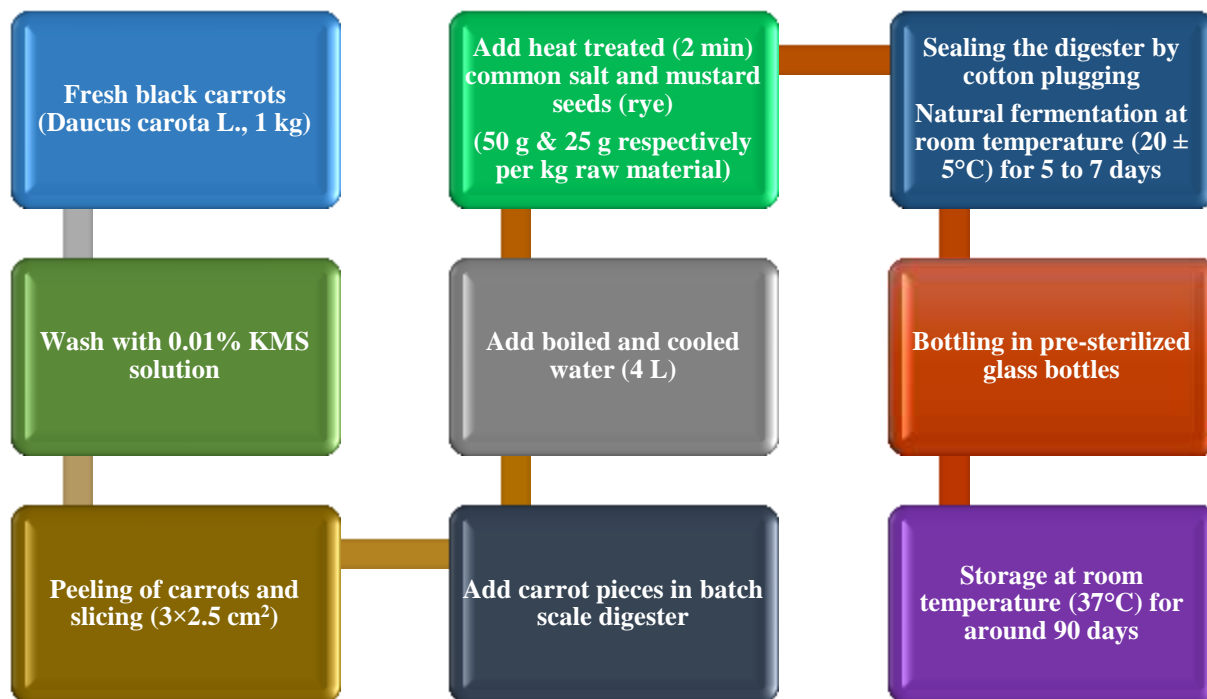


Fig. 2 Process for preparation of *Kanji* from shredded black carrots

preservation, production of wholesome nutritious foods in a wide variety of flavors, aromas, and textures which enrich the human diet and remove anti-nutritional factors to make the food safe to eat. In India many vegetable fermentations are carried out which include preparation of mixed vegetable pickles and fermented spiced beverages.

Method of preparation

There are various methods of preparing *kanji*, one of the method is to use peeled and sliced carrots along with the addition of water and other minor ingredients (Fig. 2). To set up the fermentation process, 1 Ltr sterilized distilled water was added to 1Kg sliced carrots along with 3% NaCl and 4% mustard powder. The above mixture in bottles should be cotton plugged and allow for natural lactic acid fermentation by natural microflora of carrots. The spontaneous fermentation takes 4 to 5 days for completion at around 35°C.

Composition, packing, storage and shelf life

The fermented juice is packed in clean, pre-sterilized dry glass bottles followed by sealing and storage at room temperature. *Kanji* is a shelf stable product with a shelf life of 6 months at room temperature retaining good color,



nutrition, flavor and taste. Pasteurization and/or the addition of preservatives can extend the shelf life up to 2 years, but the sensory properties may change with due course of time. *Kanji* is an acidic product with pH 3.2–3.5 consequently helping it in enhancing its shelf life. Yeasts may have access to this acidic environment and cause spoilage by formation of film over the surface leading to many physical and chemical changes such as; change in color, change in taste and flavor, change in aroma. Some of the spoilage yeasts associated with *kanji* are *Candida krusei*, *Candida pelliculosa* and *Candida lipolytica*.

Application and importance

The beverage is a refreshing drink for hot summers. It gives cool and soothing feeling along with boost of antioxidants and other nutrients. The beverage is a low-priced healthy option for summer soft drinks available commercially with added synthetic chemicals and colors. The fermented black carrot functional beverage can

further be spiced by the addition of chilli powder, rock salt, sugar and other ground spices followed by dilution with 3 to 4 times chilled water before serving

Health benefits

Processing of vegetables through fermentation techniques helps in preserving them with high nutritional value. Besides this, it also leads to production of beneficial enzymes, B-vitamins, Omega-3 fatty acids, and various strains of probiotics in various fermented foods. The eating of fermented food offers numerous health benefits such as prevention of cancer, obesity, constipation and health promotion. Fermented foods also have cholesterol lowering properties, fibrolytic effect, antioxidative and anti-ageing properties, brain health promotion, immunity promotion, skin health promotion activity, probiotic effect, Flatulence reducing activity, hyper-cholesteremic effect, anti-carcinogenic effect. ■

MEDICINAL PLANTS

INDIA'S POTENTIAL FUTURE IN EXPORT

About Author



K. Ajan Neela Aravindhan

Researcher (Independent)

Tamil Nadu

India is the country with innumerable resources which could be utilized for human benefit, one such treasure of the subcontinent is its rich diversity of medicinal plants. People in India has deep knowledge about the usage and properties of thousands of plant species since ancient times. Various precious texts related to ayurveda, siddha and sowa-rigpa provides valuable insights about the therapeutic effects of the many herbs. Despite having extensive information related to the medicinal and aromatic plants, proper cultivation practices are not yet well established in the country.

Demand for medicinal plants:

According to National Medicinal Plants Board (NMPB), the gap between the supply and demand of the medicinal floral materials is increasing. Its also estimated that the market value of the medicinal plants could increase up to 14 billion in 2026. According to World health organization (WHO), 80% of the population in the developing countries depends predominantly upon folklore systems of medicine. Even the people in developed countries began to make use of the traditional systems of medicine. Most of the big pharmaceutical industries which uses crude drugs for their products in the developed foreign countries primarily rely upon major exports from other countries. Apart from the pharmaceutical industries, other sectors like cosmetic, food, perfumery, beverage and even pesticide industries utilize and demand the natural herbal medicines. The gradual increase in demand for the medicinal herbs both inside and outside India, gives us the best chance to increase the supply of the raw materials and thus intensifying the income of the farmers.

Current marketing trends & export:

Consistent global acceptance of traditional medicines paves the way for international trade of Medicinal and Aromatic Plants (MAP). Currently these medicinal plants play a pivotal role in the livelihood of many farmers, foragers, herbalists, micro-entrepreneurs and other herbal industries. Parts of the plants like leaves, barks, roots, and flowers are extensively collected and used according to the types and species. India even has large consumers of herbal medicine thus the herbal products are most important for inland trade too. Several startups in India now utilize and depends upon the medicinal plants for their skin care, cosmetics, hair oil, nutraceutical, beverage, infused salts, perfumes and other supplements. Major exporting destinations comprises of United States, United Arab Emirates, United Kingdom, Singapore, Myanmar, Iran, Bangladesh, Sri-Lanka, and several European countries. The medicinal plants are exported mostly in the form raw herbs, powdered form, extracts, herbal formulations & mixtures, essential oils and ayurvedic compounds. In spite of India's salient role in major global



export of Medicinal plants is well established, un-availability of good manufacturing process, relatively low level of research and development process & non exploration of the full potential of the herbs curbs the growth of cultivation and exportation of the plants till now. Presence of Export Promotion Zones (EPZ) in Gujarat, Tamil Nadu, Maharashtra, Uttar Pradesh, Kerala, West Bengal, Andhra Pradesh could support to increase the export of Medicinal plants to other countries thus boosting the economy. The two major Agri Export Zones for medicinal and aromatic plants in India are Kerala and Uttarakhand.

Future potential:

Since most of the medicinal plants are hardy in nature and does not require very much attention for the cultivation, it might act as popular export material in the near future. Trading of medicinal & aromatic plants may also help in the upliftment of tribals, foragers, forest dwellers and rural women. Ancestral knowledge of ethnobotany could be learned from rural

household people. The rapid increase in demand for MAP's could pave the way for opening of several commercial enterprises and industries thus the various biodiversity resources can be conserved, managed and properly utilized. Many of the known medicinal plants can be planted and harvested within a shorter duration as less as 3 to 4 months which could be utilized as additional form of income by farmers. Growing of MAP's could bring upliftment for poor section of people and unemployed youth since the period of harvesting and post harvesting requires intense labour force. Overall Medicinal plants industry might become future blooming area in the future and upliftment of many.

Government supports:

Several kinds of schemes and subsidies were implemented by both central government and several state governments for the farmers cultivating medicinal and aromatic plants thus encouraging the cultivation practices. The ministry of AYUSH also aims to increase the trade and export of MAPs,

several associations and organizations were setup by them for promoting the industry. The ministry of AYUSH is a centrally sponsored scheme of the National Ayush Mission. Some subsidies were given for cultivation of 140 prioritized medicinal plants at the rate of 30 to 75 percent.

Conclusion:

In-spite of several supports from the government, the medicinal plants industry requires many research and development plans. Increase in consumer demands and interest by the government may make a way for expanding the export and trade for medicinal plants, still many improvements and encouragement for cultivation should be done. Many affordable marketing and transporting facilities should be provided for the people. Good Agricultural & Collection Practices with sustainable cultivation techniques needs to be developed. Thus, boosting the export of MAPs in future.



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AN UNVEILS KRISHI-DECISION SUPPORT SYSTEM A MILESTONE IN AGRICULTURAL INNOVATION

About Author ...

Arumugam Nithyanandam*
Assistant Professor
Vanavarayar Institute of
Agriculture, Manakkadavu,
Pollachi, Tamilnadu
Nitish Kumar Jena
Sneha Leela Garnepudi
Research Scholar
Deptt. of Vegetable Science,
Horticultural College & Research
Institute, TNAU, Coimbatore

The Union Ministry of Agriculture on August 16, 2024, introduced the Krishi-Decision Support System (DSS) in a high-profile event held in New Delhi. The launch was attended by Minister of State for Agriculture Bhagirath Choudhary and

Union Agriculture Secretary Devesh Chaturvedi, who highlighted the platform's potential to revolutionize agricultural practices across India. This state-of-the-art geospatial platform represents a ground-breaking development in the country's agricultural technology landscape.

Comprehensive geospatial data integration

Krishi-DSS is designed as a comprehensive geospatial data hub, bringing together a vast array of information critical for effective agricultural management. It integrates satellite imagery, real-time weather updates, reservoir storage levels, groundwater measurements, and soil health data into a unified system. This holistic data integration allows stakeholders to access crucial information from any location, at any time, thereby enhancing the ability to make informed decisions.

The platform's advanced modules support a variety of agricultural functions:

- Crop mapping and monitoring:** By analyzing parcel-level crop maps over multiple years, Krishi-DSS facilitates the understanding of crop rotation patterns and seasonal variations. This information is vital for optimizing crop productivity and promoting sustainable agricultural practices. The ability to monitor and map crops at such a granular level helps in assessing the effectiveness of crop rotation and in identifying trends that can lead to improved soil health and higher yields.
- Drought monitoring:** Krishi-DSS is equipped with sophisticated tools to monitor and manage drought conditions. It provides near real-time data on soil moisture, water storage,



and crop health, enabling early detection of drought impacts. This feature helps stakeholders understand how dry spells affect agricultural outputs and supports proactive measures to mitigate drought-related risks. The system's drought monitoring capabilities include alerts and recommendations for water conservation and drought-resistant crop varieties.

- **Flood impact assessment:** The platform also assists in evaluating the impact of floods on agriculture. It offers tools for analyzing flood data and its effects on crops and soil, helping in the development of targeted flood management strategies. This functionality is crucial for regions prone to flooding, providing timely information to aid in disaster response and recovery efforts.
- **Crop insurance solutions:** Krishi-DSS supports the development of tailored crop insurance solutions by integrating data on crop health, weather patterns, and historical yield information. This helps in assessing risk and designing insurance products that better meet the needs of farmers, thus enhancing financial security in agriculture.

Enhanced user experience and data accessibility

Krishi-DSS boasts a streamlined user management system that ensures efficient access to data. The platform's

design prioritizes simplicity and ease of use, allowing stakeholders- from farmers to policymakers- to navigate through a centralized repository of agricultural information without complex access barriers. This user-friendly interface supports informed decision-making and fosters greater engagement within the agricultural community.

The platform also encourages collaboration through various interactive features:

- **Closed-group interactions:** Users can engage in discussions and share insights within secure, closed groups. This promotes knowledge exchange and collaborative problem-solving among agricultural experts and stakeholders.
- **Blog posting and news updates:** Regular updates and blog posts provide users with the latest developments in agricultural research, policy changes, and technological advancements. This feature ensures that all stakeholders remain informed about relevant trends and innovations.
- **Polls and surveys:** Krishi-DSS includes tools for conducting polls and surveys, allowing users to gather feedback and gauge opinions on agricultural issues. This functionality supports evidence-based policymaking and fosters a participatory approach to agricultural development.

Future prospects and vision

Krishi-DSS is more than a technological innovation, it is a catalyst for transformative change in Indian agriculture. By integrating diverse data sources and providing actionable insights, the platform aims to address key challenges in agriculture, from enhancing productivity to ensuring sustainability. Union Agriculture Minister Shivraj Singh Chouhan, during a recent meeting with officials from the Ministries of Agriculture and Farmers Welfare and Rural Development, underscored the importance of Krishi-DSS in realizing Prime Minister Narendra Modi's vision for agriculture and rural development. Chouhan emphasized the need for collective effort and dedication to achieve the roadmap for 2047, aiming for a developed and prosperous India.

In summary, Krishi-DSS represents a significant milestone in the evolution of agricultural technology in India. Its comprehensive data integration, advanced modules, and user-centric design collectively contribute to a more resilient, efficient, and sustainable agricultural sector. As India moves towards a future of innovation and sustainability, Krishi-DSS stands as a testament to the country's commitment to advancing agricultural practices and improving the livelihoods of its farmers.



Bharatagri: Revolutionizing Indian agriculture



From Tea Stall to Farming Frontiers: The Journey of Gramik's Founder





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