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JUST AGRICULTURE™

Magazine

FROM JOBNER TO ICAR:

Dr. M.L. JAT's

RISE IN INDIAN AGRICULTURE
NEW SECRETARY (DARE) & DG (ICAR), NEW DELHI

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From the Founder & Chief Editor's desk

Dear Readers,

Welcome to the latest issue of Just Agriculture—a publication dedicated to empowering, informing, and inspiring the agricultural community.

As we step into another year, the landscape of agriculture continues to evolve. We are witnessing significant advancements in technology, sustainability practices, and global trends that are reshaping the way we produce, consume, and think about food. From precision farming to the integration of AI in crop management, innovation is at the heart of the agricultural revolution. However, alongside these opportunities, challenges like climate change, supply chain disruptions, and labor shortages remain pressing concerns that require our collective action and resilience.

At Just Agriculture, we are committed to being a bridge between these emerging technologies and the farmers, agribusinesses, and stakeholders who will shape the future of agriculture. In this issue, we delve into topics that matter most: sustainable farming practices, the rise of ag-tech, and the crucial role of policy in ensuring a thriving agricultural ecosystem. We also highlight success stories from across the globe, demonstrating how adaptability and innovation are driving positive change.

I believe that the future of agriculture is bright, but it requires all of us—farmers, scientists, policymakers, and consumers—to work together toward a common goal: ensuring food security, environmental sustainability, and the well-being of future generations.

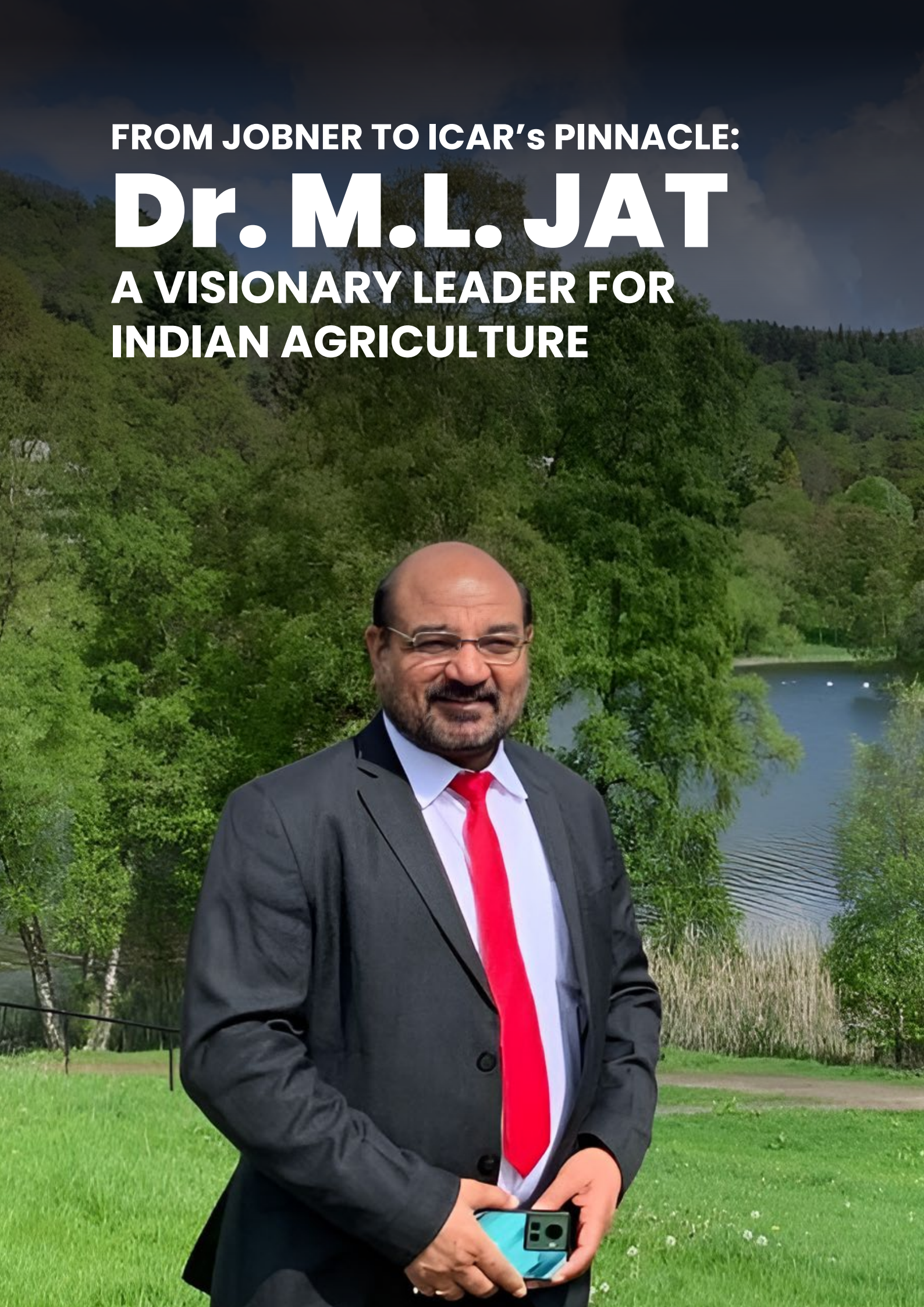
Thank you for your continued support and for being a part of this incredible journey. I hope this issue inspires you as much as it has inspired us to bring it to you.

Dr. D.P.S. BADWAL
Founder Editor,
Just Agriculture-the Magazine

FROM JOBNER TO ICAR's PINNACLE:

Dr. M.L. JAT

A VISIONARY LEADER FOR INDIAN AGRICULTURE



Dr. M.L. JAT

A SON OF JOBNER LEADING INDIAN AGRICULTURE

In a historic moment for Indian agriculture, Dr. Mangi Lal Jat, hailing from the modest village Pachkodiya of Jobner in Rajasthan, has been appointed as the Secretary, Department of Agricultural Research and Education (DARE) and Director General, Indian Council of Agricultural Research (ICAR), New Delhi on April 17, 2025. This remarkable achievement not only marks a personal triumph for Dr. Jat but also brings immense pride to the farming community, stakeholders of Jobner, and the state of Rajasthan. As a distinguished alumnus of Sri Karan Narendra Agriculture University (SKNAU), Jobner, Dr. Jat's journey from a small village to one of the highest posts in Indian agricultural research is a testament to his dedication, vision, and relentless pursuit of excellence.

FROM HUMBLE BEGINNINGS TO GLOBAL ACCLAIM

Born and raised in Jobner, a village in Jaipur district known for its agricultural heritage, Dr. Jat grew up amidst the challenges of arid farming. His early life was shaped by the realities of rural Rajasthan, where water scarcity and limited resources tested the resilience of farmers. Inspired by the need to transform agriculture, he pursued his academic journey with unwavering focus. Dr. M.L. Jat is a well-recognized Systems Agronomist with over 25 years of rich experience in Systems Science across the developing world. As a Global

Research Program Director for the Resilient Farm and Food Systems (RF & FS) program of at ICRISAT, Dr Jat leads and provides scientific, strategic and partnership guidance to dynamic and vibrant research teams of the program across five clusters – Climate Adaptation and Mitigation Science, Geo-spatial and Big Data Sciences, Digital Agriculture, Landscapes, Soil Health and Water Science and the ICRISAT Development Center.

Dr. Jat completed his **B.Sc. (Agriculture)** at SKN College of Agriculture, Jobner, laying the foundation for his illustrious career. He furthered his studies at the prestigious **Indian Agricultural Research Institute (IARI), New Delhi in Ph.D (Agronomy) with specialisation in Soil Moisture Conservation.** His doctoral research focused on resource-efficient farming systems, a theme that would define his career. His time at IARI honed his expertise in conservation agriculture, nutrient management, and climate-resilient farming, earning him recognition as an internationally acclaimed agronomist.

A TRAILBLAZING CAREER

Dr. Jat's professional journey is marked by significant contributions to agricultural science and policy. Before his appointment as ICAR Director General, he held several prestigious designations:

- Global Research Program Director, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad (until 2025): Led global initiatives in sustainable agriculture, focusing on dryland farming systems.
- Principal Scientist, International Maize and Wheat Improvement Center (CIMMYT), New Delhi:

Pioneered conservation agriculture practices in South Asia, impacting millions of farmers.

- Senior Scientist, ICAR institutes: Contributed to research on cropping systems and soil health.

His work at CIMMYT and ICRISAT earned him global recognition for promoting sustainable intensification and climate-smart agriculture. Dr. Jat's research has directly benefited farmers in Rajasthan, particularly through technologies like zero-tillage and precision nutrient management, which align with the state's arid conditions.

AWARDS AND RECOGNITIONS

Dr. Jat's contributions have been honored with numerous accolades, reflecting his impact on agricultural science:

Rafi Ahmed Kidwai Award-2018, CIMMYT Recognition Award-2020; ICRISAT Honour-2022; Gold Medal, Indian Society of Agronomy-2015, Certificate of Appreciation by Government of Cambodia; Prof. Mahatim Singh Memorial Award (2015), Society for Advancement of Wheat Research (SAWR), ICAR-IIWBR, Karnal, India; Plaque

of Appreciation (2014), APAARI-CIMMYT-FAO-DoA (Thailand); Award of Honour-2014 by Chief Minister of Government of Punjab, India; Award of Honour jointly by Indo-US Science and Technology Forum, Colorado State University and PAU for contribution in precision agriculture technologies; Recognition Award (2014), International Plant Nutrition Institute (IPNI), USA; The FAI Golden Jubilee Award for Excellence-2017; Dhiru Morarji Memorial Award, The Fertilizer Association of India, 2003; PS Deshmukh Young Agronomist Award, Indian Society of Agronomy, 2004; Young Soil Conservationist Award, Indian Association of Soil & Water Conservationists, 2006; Member, Regional Technical Coordination Committee (RTCC) of the Rice-Wheat Consortium for the Indo-Gangetic Plains, 2005-2009.

His publications, exceeding 200 peer-reviewed papers, and patented technologies have set benchmarks in agricultural research, particularly for semi-arid regions like Rajasthan.

ICAR UNDER HIS LEADERSHIP: WHAT LIES AHEAD

As Director General of ICAR, Dr. Jat is now at the helm of India's apex agricultural research body with 113 research institutes, 74 agricultural universities, and thousands of scientists across the country.

In his dual role as Secretary of DARE, he will be responsible for:

- Shaping India's agri-research policy and international collaborations
- Leading the innovation pipeline for farmer-centric technologies
- Strengthening extension, skill-building, and climate-ready agriculture
- Driving the digital and genomic transformation in Indian agri-science
- Transforming Agriculture & Transforming Education with Viksit Bharat @2047

"From the fields of Jobner to the halls of Krishi Bhawan, Dr. M.L. Jat is proof that India's agricultural future is in excellent hands."

— Dr. D.P.S Badwal

AROMATHERAPY– THE SCIENCE OF SCENT

Ms. Radhika Savaliya[1], Dr. Dhawani Patel[2], Ms. Bhargavi Savaliya and Mr. Mohit Dholariya

College of Horticulture, S. D. Agricultural University, Jagudan, Mehsana

Assistant Professor, College of Horticulture, S. D. Agricultural University, Jagudan, Mehsana

INTRODUCTION:

- Aromatherapy literally means a therapy using fragrances. It is the art of blending fragrances for a specific healing purpose. Aromatherapy uses the potent vital energy of the plant known as essential oils. Essential oils are extracted from a plant's flowers, leaves, needles, branches, berries, seeds, fruits, rind or roots.
- Aromatherapy is one of the most ancient healing arts and traces its origin to 4500 B.C., an era when Egyptians used aromatic substances in medicines. Greeks also used plant essences for aromatic baths and scented massages. In ayurveda, there is mention of scented baths (bhyanga). Prof. Gantle Fosse, a French cosmetic chemist coined the term aromatherapy and described properties of essential oils.
- As they evaporate when exposed to air at ordinary temperature, they have also been known as ethereal oils. They represent the essence or active constituent of plant; hence they are also known as essential oils. They are secreted in special structures such as ducts, cell schizogenous or lysigenous glands, trichomes etc. They are commonly found in species of labiatae, rutaceae, piperaceae, zingiberaceae, umbelliferae, myrtaceae and lauraceae.
- They are extracted from plant by different oil extracting methods like Steam distillation, Solvent extraction, Maceration, Enfleurage, Expression, Supercritical CO2 extraction etc.

SOME ESSENTIAL OILS WHICH USE FOR DIFFERENT PURPOSES:

1. **Lavender:** Calming, sleep aid, and stress relief.
2. **Peppermint:** Energizing, focus-enhancing, and relieves headaches.
3. **Eucalyptus:** Respiratory support, decongestant, and invigorating.
4. **Tea Tree:** Antimicrobial, immune support, and skin healing.
5. **Lemon:** Uplifting, purifying, and mood booster.
6. **Chamomile:** Relaxing, soothing, and promotes relaxation.
7. **Rosemary:** Improves memory, concentration, and mental clarity.
8. **Bergamot:** Mood enhancer, stress relief, and anxiety reduction.
9. **Geranium:** Balancing, calming, and promotes emotional well-being.
10. **Cedar wood:** Grounding, calming, and supports sleep.
11. **Orange:** Uplifting, energizing, and promotes positivity.
12. **Sandalwood:** Relaxing, centering, and supports meditation.

MATERIALS USED FOR AROMATHERAPY

1. **Essential oils:** Fragrant oils extracted from plants chiefly through steam distillation (e.g. eucalyptus oil) or expression (grapefruit oil). However, the term is also occasionally used to describe fragrant oils extracted from plant material by any solvent extraction.
2. **Absolutes:** Fragrant oils extracted primarily from flowers or delicate plant tissues through solvent or supercritical fluid extraction (e.g. rose absolute). The term is also used to describe oils extracted from fragrant butters, concretes, and enfleurage pommades using ethanol.
3. **Phytoncides:** Various volatile organic compounds from plants that kill microbes. Many terpene-based fragrant oils and sulphuric compounds from plants in the genus "Allium" are phytoncides, though the latter are likely less commonly used in aromatherapy due to their disagreeable odours.
4. **Herbal distillates or hydrosols:** The aqueous by-products of the distillation process (e.g. rosewater). There are many herbs that make herbal distillates and they have culinary uses, medicinal uses and skin care uses. Common herbal distillates are rose, lemon balm and chamomile.
5. **Infusions:** Aqueous extracts of various plant material (e.g. infusion of chamomile)
6. **Carrier oils:** Typically, oily plant base tri acyl glycerides that dilute essential oils for use on the skin (e.g. sweet almond oil)

BASIC METHODS OF AROMATHERAPY

- **Effleurage** – Gentle & firm massage stroke, always pushing towards heart. This promotes relaxation of muscular tissues and soothes nerve endings.
- **Petrissage** – Roll the flesh like kneading atta, on fatty areas. This stimulates circulation and accelerates lymphatic flow, thereby expelling the toxins.
- **Bathing** – Few drops of essence in hot water bathtub, to relieve colds, stress, headache, fatigue, flues and pains.
- **Inhalation** – Direct and rapid means of treating colds, aches, respiratory discomfort by inhaling the vapours from a bowl of steaming hot water.
- **Compresses** – For rheumatic pains, fever, and headache, bruises, abscesses, skin application. A piece of flannel is soaked in a bowl of water containing the oil, and pressed on the affected area.

BASE OILS AND BLENDING

Volatile oils are often mixed with milder carrier oil (usually vegetative oil) or are weakened (diluted) in alcohol. The essential oils should not be applied directly until diluted with base oils as they are in a concentrated form and can result in inflammation.

Essential oils are distilled from the leaves, bark, roots and other aromatic portions of a botanical. Essential oils evaporate and have a concentrated aroma. Carrier oils, on the other hand, are pressed from the fatty portions (seeds, nuts, kernels) and do not evaporate or impart their aroma as strongly as essential oils. Carrier oils can go rancid over time, but essential oils do not. Instead, essential oils "oxidize" and lose their therapeutic benefits, but they don't go rancid.

The only exception is lavender, which can be used directly on the skin for insect bites and stings. However, it is good to use any cold-pressed and micro filtered vegetable oil. Viscous and mineral oils do not permeate through skin, so as unfiltered oils as they block pores. Wheat germ oil or Vitamin - E may be added slightly to enhance the skin-care properties. Normally, 20 to 60 drops of essential oils is blended with 100 ml of the base oil, just prior to application. Blended oils are mixtures working in harmony, and they are known as synergistic blends. By rule, oils of the same botanical family will usually work efficiently. Blended and diluted oils cannot be stored for more than a month.

MODE OF ACTION

On inhalation, the useful volatile principles are transported by the lining of the nose and transmit signals to the brain, which is stimulated to release powerful neurochemicals in the blood stream. On topical use, these molecules permeate through the microscopic pores and hair follicles, which enter bloodstream of the capillaries. They act in harmony with the natural defences of the human body. Massage on the body tissues and the healing properties of the essential oils can combine to produce wonderful results. During massage, the blood circulation is stimulated and the toxic waste substances of tissue are carried to the - lymphatic system. Along with useful molecules, some oils contain powerful ketones, phenols and aldehydes also, and it should be carefully avoided by dilution.

BENEFITS OF AROMATHERAPY

Aromatherapy is often used for relaxation, stress relief, and mood enhancement. Some potential benefits include:

1. Stress Reduction: Certain essential oils may help promote relaxation and reduce stress levels when inhaled.
2. Improved Sleep: Lavender and chamomile oils, for example, are thought to have calming effects that may aid in improving sleep quality.
3. Mood Enhancement: Citrus or peppermint scents are believed to have invigorating properties and can uplift mood.
4. Pain Relief: Some essential oils, like eucalyptus or peppermint, are used topically and may have analgesic (pain-relieving) properties.
5. Headache Relief: Peppermint and lavender oils are sometimes used to alleviate tension headaches.
6. Antimicrobial Effects: Certain essential oils possess antimicrobial properties that may help combat bacteria or fungi.
7. It's important to note that while aromatherapy is widely used for these

purposes, scientific evidence supporting its effectiveness varies, and individual responses may vary as well. Always consult with a qualified healthcare professional for personalized advice.

SOME USEFUL TIPS FOR THE AROMATHERAPIST

- Avoid using essential oils during pregnancy.
- Use citrus oil (lime, orange oils) only after exposure to sunlight
- Do not use sage, thyme & cypress oils on subjects suffering hypertension.
- Wait for a minimum of the hour after meal for the treatment.
- Your clothing should not obstruct the movements and ensure clean warm hands and nails short.
- The subject is comfortably positioned, partly dressed or covered with towels.
- Unless you are a qualified

physiotherapist, do not use deep pressure. Use whole palm with gentle & firm movement always pushing towards the direction of the heart.

- The room should be warm with subdued lighting. Avoid disturbances except, optionally, a soft musical background.
- Chenopodium oil is contraindicated in pregnancy and in patients with impaired kidney or liver.
- Aromatherapy administered during radiotherapy was not beneficial.
- Avoid use of clove bud, clove leaf, nutmeg and cinnamon oils unless expert professional treatment is required.
- Two common oils, lavender and tea tree, have been implicated in causing gynaecomastia, an abnormal breast tissue growth, in prepubescent boys.
- Some very common oils like Eucalyptus are extremely toxic when taken internally. Doses as low as one teaspoon has been reported to cause clinically significant symptoms and severe poisoning can occur after ingestion of 4 to 5 ml.
- Toxic reactions like liver damage and seizures have occurred after ingestion of sage, hyssop, thuja, and cedar.
- The topical use of methyl salicylate heavy oils like sweet birch and wintergreen may cause hemorrhaging in users taking the anticoagulant warfarin.
- Keep all essential oils out of the reach of children.
- Keep flammable oils away from fire.
- Use small quantities for babies, children and the elderly.

STORAGE OF VOLATILE OILS

Volatile oils are liable to deteriorate on keeping. The deterioration is accompanied by change in colour, or increase in viscosity of the oil, or change in odour of the oil. Therefore, volatile oils should be preserved properly in well closed, well filled containers away from light and in cool place.

FARMING IN THE FACE OF CLIMATE CHANGE: HOW ASSAM'S FARMERS ARE ADAPTING

Debasmita Baruah[1*], Pompi Dutta[1] and Bidisha Hazarika[2]
[1] Department of Agricultural Economics and Farm Management
[2] Department of Tea Husbandry and Technology
Assam Agricultural University, Jorhat, Assam, India

The agricultural sector of Assam is significantly threatened by climate change, that has emerged as an undeniable and stark reality, having profound implications on the livelihood of farmers. Frequent occurrence of floods, erratic rainfall patterns, elevating temperatures and prolonged droughts have intensified the struggles faced by rural communities. Despite these adversities, remarkable resilience has been exhibited by the agricultural sector of Assam, by adopting innovative climate adaptation and mitigation strategies, indigenous traditional knowledge to sustain the productivity of crops.

CULTIVATING CLIMATE-RESILIENT VARIETIES

With unpredictable rainfall and frequent flooding affecting productivity, Assam's farmers are turning to climate-resilient crop varieties. Flood-tolerant rice strains such as Ranjit Sub1, Bahadur Sub1, and Swarna Sub1, developed specifically for regions prone to submergence, are now widely adopted in flood-prone districts like Dhemaji, Majuli, and Barpeta. Farmers have also begun diversifying their crops, increasingly cultivating drought-resistant millets, pulses, and indigenous vegetables, ensuring food and nutritional security under changing climatic conditions. Krishi Vigyan Kendras play an instrumental role in imparting dissemination of climate adaptation strategies to the farmers. In addition to that Assam Agricultural University plays a pivotal role in developing new climate-resilient crop varieties specifically suited to the state's unique agro-climatic zones.

EFFECTIVE FLOOD MANAGEMENT AND RAINWATER HARVESTING

Flood management has become critical in Assam's agriculture. Raised-bed cultivation, elevated granaries, and community-managed shelters for livestock have emerged as essential strategies, especially in vulnerable areas like Majuli and Lakhimpur. Additionally, rainwater harvesting practices, including farm ponds, small reservoirs, and check dams, are gaining popularity in hilly and drought-prone regions such as Karbi Anglong and Dima Hasao, significantly improving water availability for irrigation during dry spells. Government initiatives such as MNREGA scheme is playing a crucial role in supporting rural communities in building and maintain rainwater harvesting structures. Moreover, the establishment of early-warning systems and flood shelters, is being facilitated by the Assam State Disaster Management Authority (ASDMA).thereby enhancing preparedness among farmers and local communities.

ADOPTION OF TECHNOLOGY AND INNOVATION

Technological advancements are transforming Assam's agricultural landscape. Farmers increasingly rely on mobile applications that offer real-time weather forecasts, pest and disease alerts, market price information, and crop advisories. Government initiatives have introduced drone technology for precise crop monitoring and pesticide application, soil health cards for optimized fertilizer use, and Geographic Information System (GIS) mapping to better manage land resources and reduce risk. Numerous technology driven projects have been initiated by Krishi Vigyan Kendras (KVKs) and the North-Eastern Space Applications Centre (NESAC) that have significantly enhanced agricultural productivity and risk mitigation. Furthermore, farmers' access to market and transparency in pricing is facilitated by platforms like e-NAM (Electronic National Agriculture Market).

ORGANIC FARMING AND INTEGRATED AGRICULTURE

Assam has seen a remarkable shift toward organic and integrated farming systems. Farmers in districts like Jorhat, Kamrup, and Sonitpur have embraced practices such as vermicomposting, biofertilizers, organic mulching, and crop rotation, significantly improving soil fertility, water retention, and crop resilience. Integrated farming models combining agriculture, livestock, fisheries, and poultry are enhancing farm productivity, reducing dependency on single crops, and providing stable, diversified sources of income.

STRENGTHENING COMMUNITY PARTICIPATION

Community engagement and collective action have become cornerstones in Assam's adaptation strategy. Farmer Producer Organizations (FPOs), cooperatives, and self-help groups actively collaborate on sharing knowledge, pooling resources, and collectively marketing produce, thus achieving better bargaining power and market access. Programs like Assam State Rural Livelihood Mission (ASRLM) and various non-governmental organizations have supported training, capacity-building, and awareness campaigns to enhance community resilience. Women-led cooperatives, particularly active in districts like Lakhimpur and Golaghat, have significantly empowered communities, driving adoption of sustainable agricultural practices and diversification. Initiatives such as participatory plant breeding and seed banks also help farmers access high-quality, resilient seeds.

GOVERNMENT AND INSTITUTIONAL INITIATIVES

The Assam government has initiated several schemes to strengthen farmers' capacity to cope with climate change impacts. Key schemes include Rashtriya Krishi Vikas Yojana (RKVY), promoting infrastructure development and resource management; Pradhan Mantri Fasal Bima Yojana (PMFBY), providing crop insurance against climate risks; and Chief Minister Samagra Gramya Unnayan Yojana (CMSGUY), aiming at rural infrastructure enhancement. Institutional support from Assam Agricultural University (AAU), Krishi Vigyan Kendras (KVKs), and regional agricultural research stations are crucial for extending climate-smart technologies and comprehensive training to farmers. Moreover, international collaborations with organizations like the International Rice Research Institute (IRRI) and the International Centre for Integrated Mountain Development (ICIMOD) have also significantly contributed to enhancing farmers' resilience by bringing global expertise and technologies to Assam.

CONCLUSION

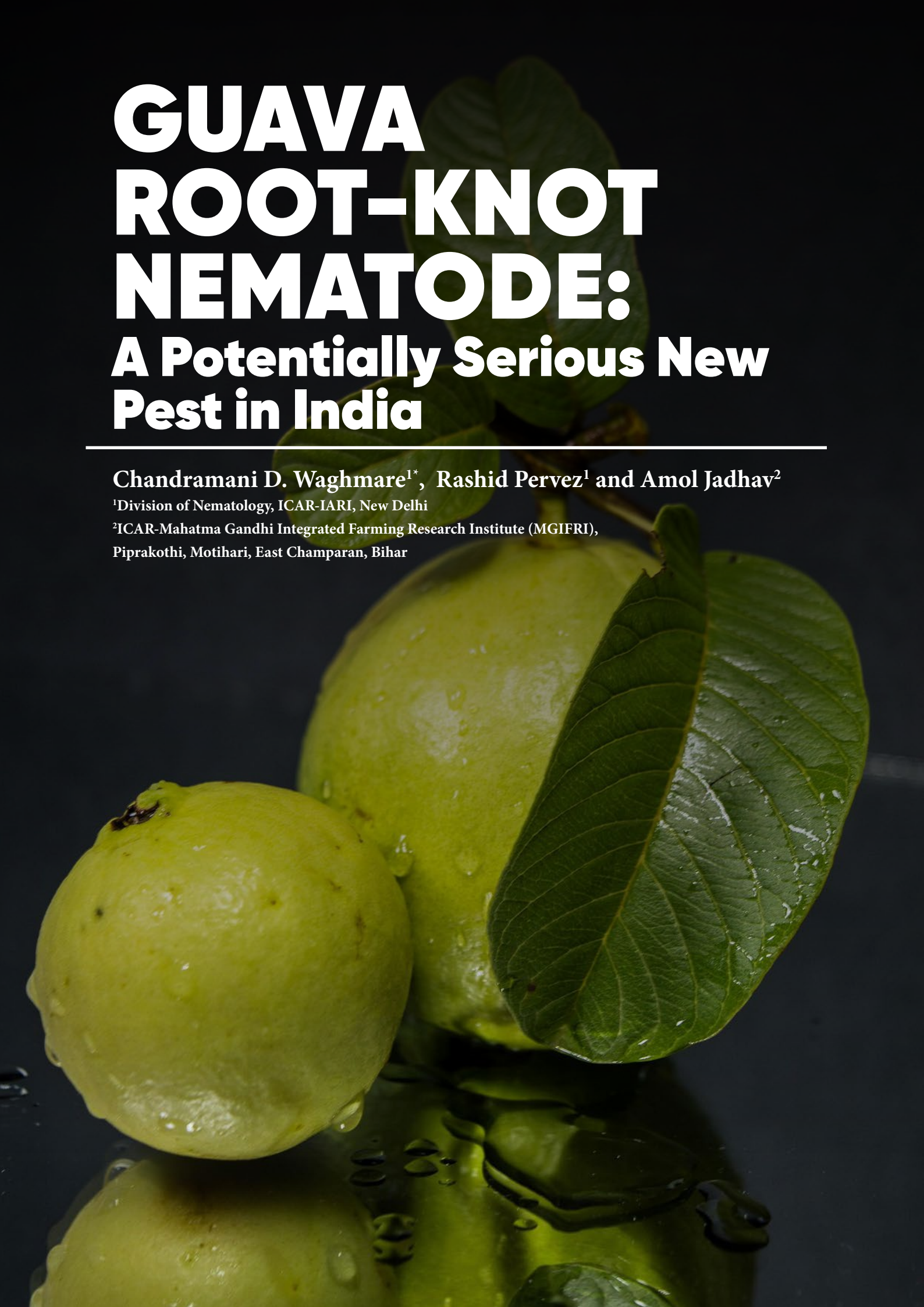
Climate change poses substantial challenges, yet Assam's farmers are adapting through innovation, community collaboration, and supportive government initiatives. Combining traditional agricultural wisdom with modern technological advancements and policy support, Assam is progressively building a climate-resilient farming future, ensuring sustainable livelihoods for future generations.

GUAVA ROOT-KNOT NEMATODE: A Potentially Serious New Pest in India

Chandramani D. Waghmare[1*], Rashid Pervez[1] and Amol Jadhav[2]

[1]Division of Nematology, ICAR-IARI, New Delhi

[2]ICAR-Mahatma Gandhi Integrated Farming Research Institute (MGIFRI), Piprakothi, Motihari, East Champaran, Bihar



Meloidogyne enterolobii, commonly known as the guava root-knot nematode, has recently been identified as a significant threat to Indian agriculture. First recorded in India in guava, this nematode is now recognized for its highly pathogenic nature, causing severe yield losses and contributing to guava orchard decline. Its presence has been reported across major guava-growing regions, particularly in Tamil Nadu, where it has been linked to devastating economic losses.

PEST STATUS AND IMPACT

The guava root-knot nematode was inadvertently introduced into India, with public and private nurseries playing a key role in its interstate spread through infected guava planting materials. Efforts have been made to contain its spread, but its establishment across different regions remains a growing concern. Unlike other root-knot nematodes, *M. enterolobii* is highly virulent and capable of overcoming nematode-resistant genes in crops, making it particularly challenging to manage.

This nematode is one of the most destructive root-knot species globally, attacking several major crops, including guava, tomatoes, cotton, soybeans, peppers, and sweet potatoes. Its rapid reproduction rate allows it to multiply quickly, reaching high population densities in the soil within a short period. One of its defining features is the ability to cause extensive gall formation on plant roots, much larger than those induced by the common Southern root-knot nematode (*M. incognita*). This ability to parasitize resistant crops exacerbates its impact, making control measures even more difficult.

SURVEY FINDINGS AND ECONOMIC IMPACT

Studies conducted in major guava-growing districts of Tamil Nadu have confirmed the presence of M. enterolobii in several orchards, leading to widespread guava decline. The nematode is often found in association with Fusarium spp., collectively causing a complex disease that results in yellowing, wilting, leaf scorching, defoliation, significant yield reduction, and plant mortality within months. Similar symptoms were observed during extensive surveys, highlighting the urgency of addressing this issue.

In Brazil, where *M. enterolobii* (previously referred to as *M. mayaguensis*) has been extensively studied, it has been documented as a polyphagous plant-parasitic nematode inflicting severe damage on a wide variety of crops. Its ability to parasitize multiple host plants, including those with built-in nematode resistance, poses a significant challenge for sustainable agricultural practices in India and beyond.

FIRST RECORDS IN INDIA

The root-knot nematode *M. enterolobii* has been newly recorded in India, particularly affecting guava orchards. It has been responsible for a drastic decline in guava production across India and other regions of the world. Studies have confirmed that the association of *M. enterolobii* with guava is highly pathogenic, severely affecting plant health and productivity.

In Tamil Nadu, *M. enterolobii* has been identified as a major factor behind significant yield losses in guava orchards. This was the first recorded instance of its impact on guava in India. Previously, reports from Brazil highlighted its polyphagous nature, as it inflicted severe damage on multiple plant species. Surveys conducted in major guava-growing districts of Tamil Nadu confirmed the presence of *M. enterolobii* across all these regions, reinforcing its widespread and destructive nature.

SYMPTOMS AND DAMAGE

Guava decline, a complex disease, has been closely linked to the parasitic activity of *M. enterolobii*. Affected trees exhibit symptoms such as:

- Formation of large, irregular galls on the roots
- Yellowing and wilting of leaves
- Scorching of leaf margins
- Premature leaf drop
- Significant yield reduction
- Plant death within months
- Severe yield reduction, leading to plant death in advanced stages

Figure 1. Galling on soybean roots from the Southern root knot nematode

Figure 2. Galling on tomato roots from the guava root-knot nematode.

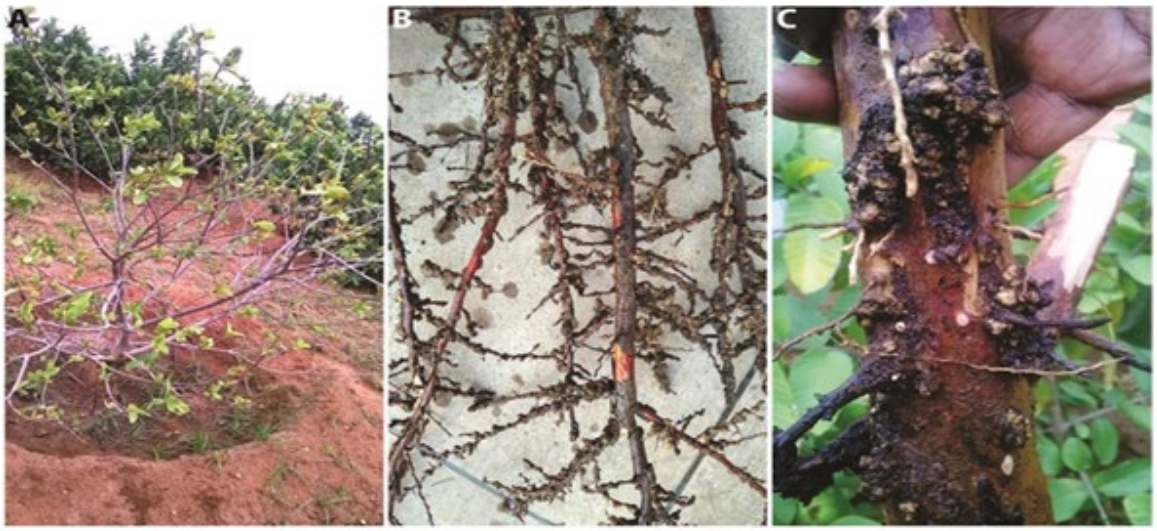


Figure 3. Symptoms of damage due to guava root-knot nematode, M. enterolobii on guava shoots and roots. A, Yellowing of leaves and defoliation on a young guava tree; B, profuse galling on the roots (Courtesy: Dr. M.R. Khan and Dr. R.K. Walia), C, Compound galls on stem and collar region of guava (Courtesy: Dr. S. Nakkeeran)

These symptoms were consistently observed during surveys conducted in guava-growing districts. The rapid and severe impact of the nematode underscores the urgent need for effective management strategies to mitigate its spread and safeguard agricultural productivity.

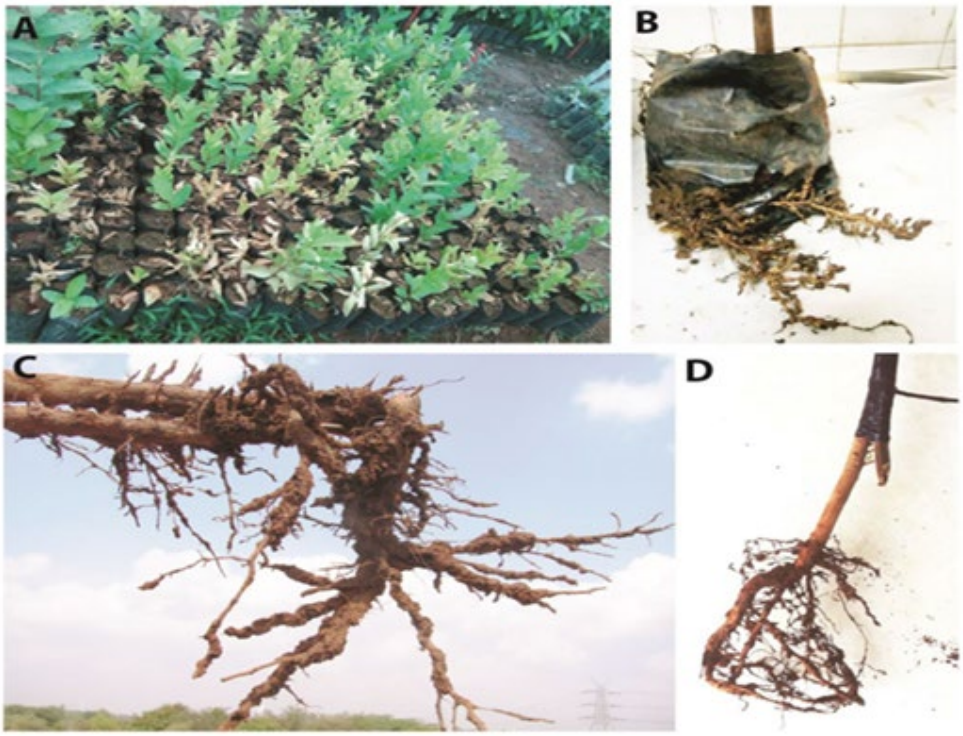


Figure 4. Symptoms of damage due to guava root-knot nematode, M. enterolobii on guava nursery plantlets. A, nematode-infested guava rootstocks after grafting showing yellowing and drying; B, seedling in polybag revealing galled roots, C, galled roots in guava seedling; D, root galls in a guava graft (A-D).

LIFECYCLE AND BIOLOGY

The lifecycle of *M. enterolobii* progresses swiftly, with eggs hatching into juvenile nematodes that move toward plant roots. Once inside, they establish feeding sites, leading to the formation of characteristic galls. Each female nematode can lay between 400 to 600 eggs, completing its life cycle within approximately four weeks under warm conditions (Fig. 5). This rapid reproduction rate exacerbates the nematode's impact, allowing infestations to expand quickly and intensify crop losses.

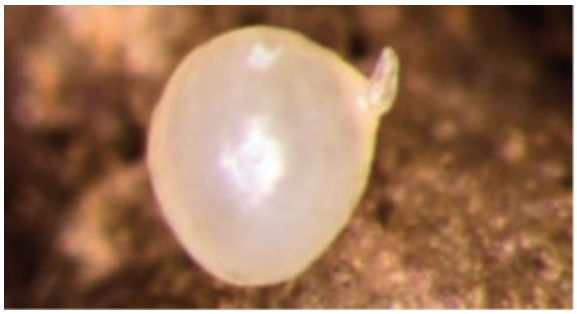


Figure 5. A mature female of the guava root-knot nema¬tode

HOST RANGE AND SPREAD

This nematode has a broad host range, including several agronomic crops (such as, cotton, soybean, and tobacco), vegetable crops (including tomato, pepper, and cucumber), and fruit crops (notably guava, banana, and grape). Many ornamental plants and weed species also act as hosts, making control efforts more complex. It spreads easily through infected soil, plant material, irrigation, and farm machinery, further increasing its risk to agriculture.

MANAGEMENT STRATEGIES

Given its adaptability and ability to overcome resistance in crops, M. enterolobii requires an integrated management approach:

- Crop rotation: Alternating with non-host crops to reduce nematode populations.
- Resistant varieties: While resistance options are limited, ongoing research aims to develop more tolerant plant varieties.
- Soil treatment: Nematicides may be used cautiously, but sustainable alternatives are preferable.
- Sanitation practices: Cleaning farm equipment and using certified planting material to prevent spread.
- Biological control: Beneficial nematodes and soil microbes offer an eco-friendly management alternative.

CONCLUSION

The guava root-knot nematode presents a serious challenge to Indian agriculture, particularly affecting guava orchards. Its rapid spread, ability to infect resistant crops, and severe impact on yield make it a formidable pest. Early detection, strict quarantine measures, and sustainable pest management strategies are essential to controlling its spread and mitigating its impact on food security and agricultural livelihoods. Continued research and farmer awareness will play a crucial role in managing this emerging threat.

SENSOR-ENHANCED SUSTAINABILITY:

Pioneering Precision Weed Management in Conservation Agriculture

Puspa Parameswari[1*], Sohan Singh Walia[2], and Pratahbidya Nayak[3]

[1*]Senior Research Fellow, Division of Agronomy, ICAR-IARI- New Delhi

[2]Director-cum-Principal Agronomist, School of Organic Farming, Punjab Agricultural University, Ludhiana

[3]PhD Scholar, Division of Agricultural Physics, ICAR-IARI, New Delhi

WHAT IS CONSERVATION AGRICULTURE?

Conservation agriculture is a farming system that prioritizes soil health, water conservation, and biodiversity. It emphasizes minimal soil disturbance, permanent soil cover, and crop rotation to enhance sustainability. The core principles of CA aim to reduce soil erosion, improve water retention, and preserve the health of ecosystems. Weed control in conservation agriculture, however, presents a unique challenge due to the reduced use of chemical herbicides and the increased reliance on non-invasive methods that align with the sustainability goals of CA.

THE CHALLENGE OF WEED MANAGEMENT IN CONSERVATION AGRICULTURE

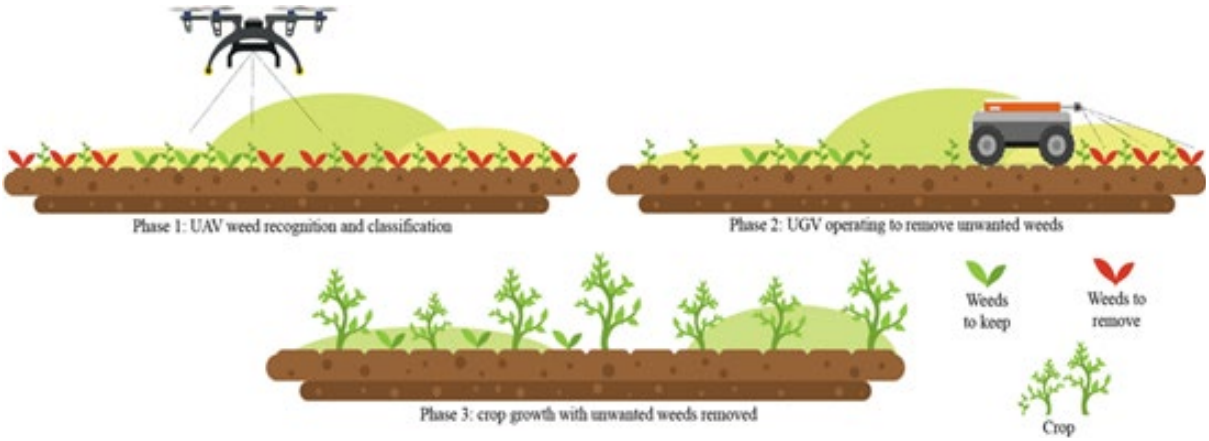
Weeds are a significant problem for farmers worldwide, as they compete with crops for essential resources such as water, nutrients, and light. In conservation agriculture, where the use of herbicides is limited or avoided altogether, the need for alternative, effective weed management strategies is crucial. Traditional weed management methods like mechanical tilling, manual weeding, or selective herbicide application are often labour-intensive, inefficient, or not always sustainable in the long term.

This is where precision weed management powered by sensor technology comes into play.

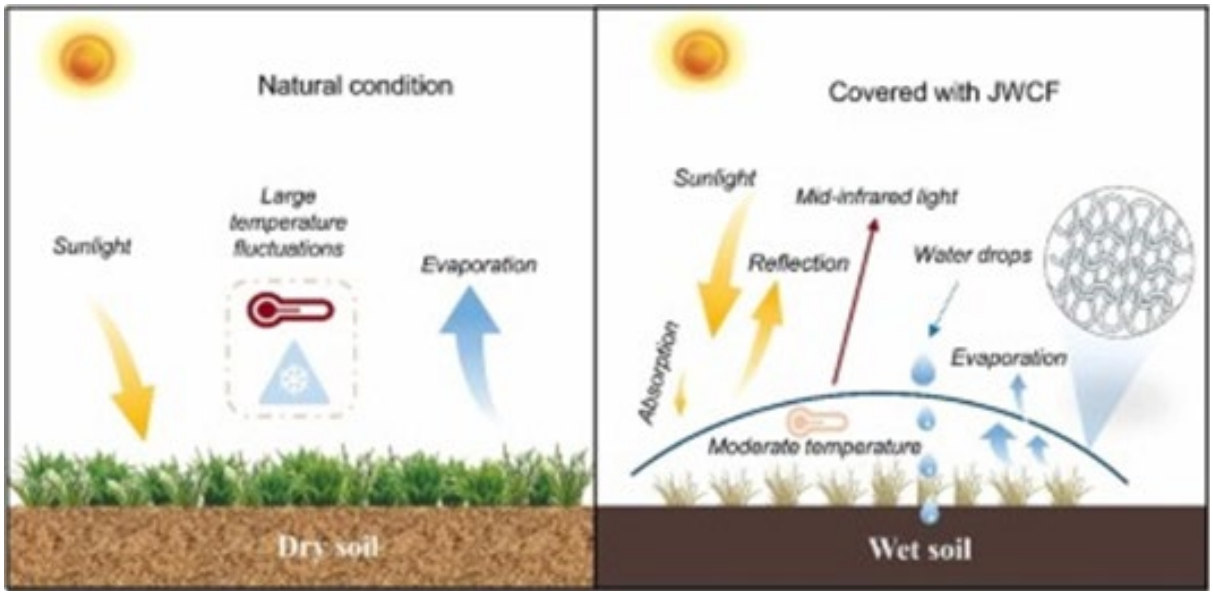
SENSOR TECHNOLOGY IN PRECISION WEED MANAGEMENT

Precision agriculture (PA) refers to the application of advanced technologies to monitor and manage field variability. Sensors are integral to precision agriculture systems, providing real-time data to inform decision-making. In the context of weed management, sensors are used to detect and identify weed species, monitor weed growth patterns, and apply targeted interventions with remarkable accuracy. Several types of sensors play a role in precision weed management:

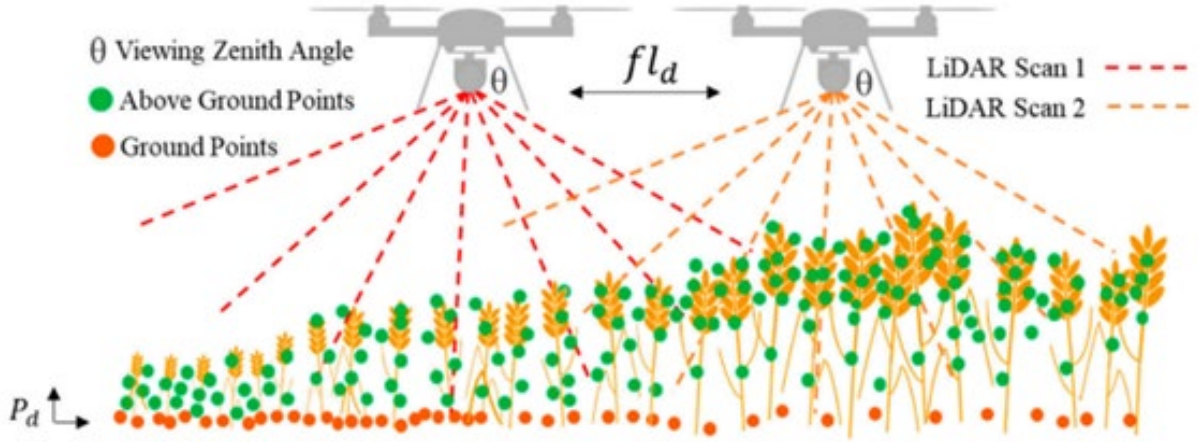
1. Optical Sensors: Optical sensors, including cameras and spectrometers, capture images of the field and analyze light reflected from plants. These sensors can distinguish between crops and weeds based on differences in colour, shape, and reflectance spectra. By identifying weed species early, farmers can target them with precision, avoiding unnecessary interventions in areas where crops are not threatened.



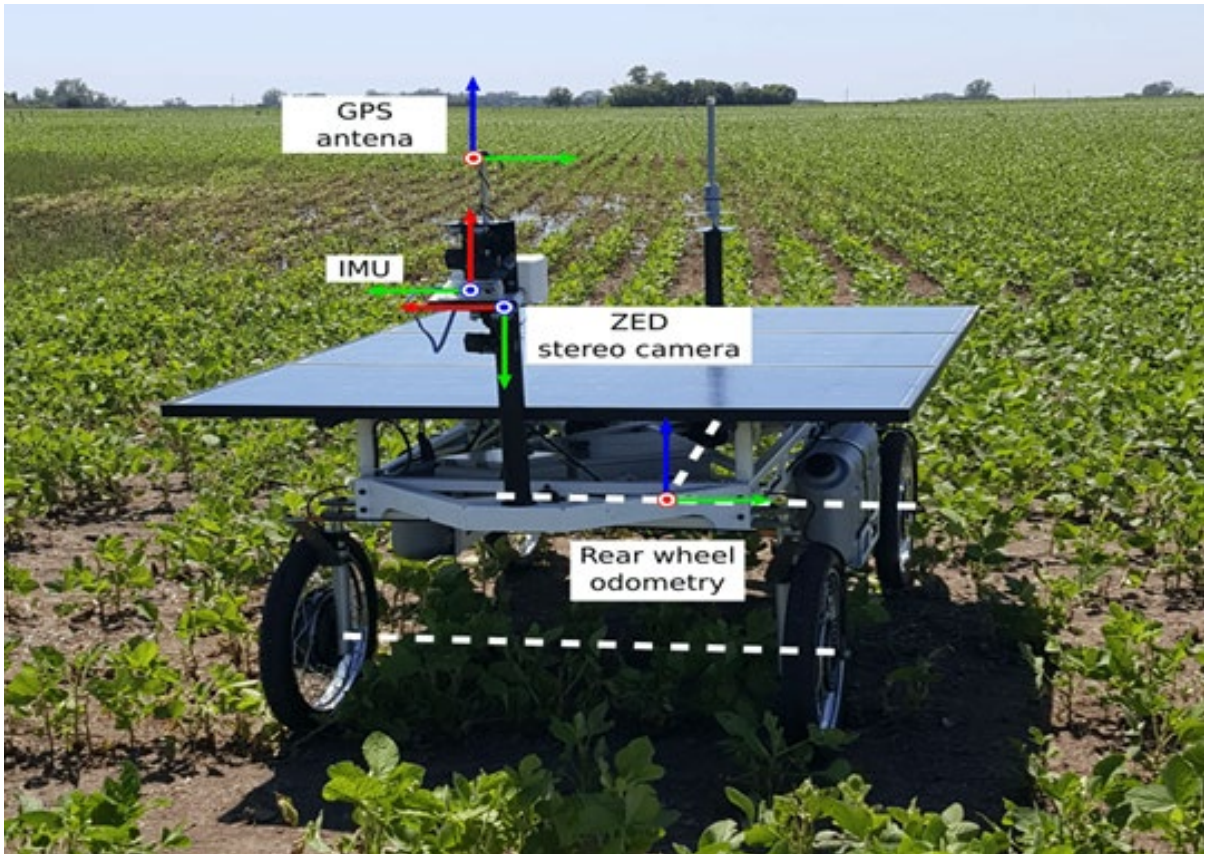
2. Multispectral and Hyperspectral Sensors: Multispectral and hyperspectral sensors capture light across various wavelengths, providing detailed insights into plant health and composition. These sensors are highly effective for detecting weeds in the early stages of growth, even before they become visible to the naked eye. By analyzing the spectral signatures of crops and weeds, farmers can develop more precise weed management strategies that reduce herbicide usage and minimize crop damage.



3. Thermal Sensors: Thermal infrared sensors detect temperature differences between weeds and crops. Weeds, due to their different water content and transpiration rates, often have a distinct thermal signature compared to crops. These sensors can help identify weeds in real-time, particularly during stress conditions or dry spells, enabling targeted, time-sensitive interventions.
4. LIDAR (Light Detection and Ranging) Sensors: LIDAR technology uses laser light to measure the distance between the sensor and objects, creating high-resolution 3D maps of the field. LIDAR can detect weed density, growth stage, and location, providing detailed spatial data that allows for highly accurate weed management. This technology is particularly useful in large fields, where traditional monitoring methods may be inefficient.
5. Ground-based Sensors: Ground-based sensors, such as those integrated into autonomous vehicles or robotic weeders, can provide real-time data on weed location and density. These sensors are often paired with GPS and



machine learning algorithms, enabling the automation of weed control processes. Ground-based systems can precisely target weeds without disturbing the surrounding soil, aligning perfectly with the principles of conservation agriculture.



BENEFITS OF SENSOR-BASED PRECISION WEED MANAGEMENT

Reduced Herbicide Usage: One of the most significant benefits of sensor technology in weed management is the reduction in herbicide usage. By precisely targeting weeds, sensors enable the application of herbicides only where necessary, reducing chemical runoff and minimizing environmental harm. This is particularly important in conservation agriculture, where reducing reliance on chemicals is a central goal.

Improved Weed Detection and Control: Sensors allow for early detection of weed

species, enabling timely intervention. Early intervention is key to preventing weed growth from becoming problematic and helps prevent competition with crops for resources. By accurately identifying weeds and applying treatments only when necessary, farmers can improve weed control efficiency and crop yield.

Cost Savings and Increased Efficiency: With sensor technology, farmers can optimize resource use, including water, fertilizers, and labour. Targeted weed control reduces the need for frequent manual weeding or indiscriminate herbicide spraying, lowering operational costs. Furthermore, precision applications are more efficient, reducing the time spent on weed management tasks.

Enhanced Environmental Sustainability: Sensor technology allows for precise and controlled application of herbicides, minimizing chemical exposure to the environment. By reducing the frequency and volume of chemical applications, sensor-based weed management aligns with the sustainability goals of conservation agriculture, supporting healthier ecosystems and reducing soil and water contamination.

Adaptation to Climate Variability: Sensors provide real-time data that can be used to adjust weed management practices in response to changing environmental conditions. For example, during dry spells, sensors can detect changes in weed behaviour or crop stress, allowing farmers to adapt their approach to weed management in line with current weather conditions.

THE FUTURE OF SENSOR-BASED WEED MANAGEMENT IN CONSERVATION AGRICULTURE

The future of sensor-based weed management is promising. As sensor technology continues to advance, its integration with artificial intelligence (AI), machine learning (ML), and big data will further enhance weed management systems. AI and ML can process large amounts of sensor data to predict weed growth patterns, identify emerging weed species, and automate decision-making processes.

Additionally, the development of autonomous vehicles and robotic weeders equipped with sensors is expected to revolutionize the physical application of weed control methods. These machines will be able to identify and target weeds autonomously, reducing the need for human labour while minimizing the impact on surrounding crops. Another exciting development is the integration of sensors with drones. Drones equipped with advanced imaging and spectral sensors can provide high-resolution aerial monitoring of fields, allowing for more precise and timely identification of weed problems across large agricultural areas.

CONCLUSION

Sensor technology has the potential to transform weed management in conservation agriculture, offering a more efficient, cost-effective, and environmentally sustainable approach to weed control. By leveraging sensors to detect, monitor, and manage weeds with precision, farmers can reduce herbicide use, improve crop yields, and maintain the integrity of ecosystems. As the technology continues to evolve, its role in conservation agriculture will become increasingly vital, driving innovation and ensuring the future of sustainable farming practices.

With the rise of precision agriculture, sensor technology represents a critical step towards a more sustainable, efficient, and resilient agricultural system. It is an exciting time for the industry, as the fusion of technology and ecology paves the way for smarter, more sustainable farming practices.

Press Release

DHANUKA QUOTE ON US 27% TARIFF, IMPACT ON INDIAN AGRICULTURE SECTOR

US Announces 27% Tariff on Indian Exports, Impact on Indian agriculture sector

Here is the view from M.K Dhanuka, Chairman, Dhanuka Agritech Limited, one of India's leading crop protection companies, listed on BSE and NSE.

"The effect of American tariffs on India's agricultural sector is mixed. While costs of production increased because of more expensive imported inputs and machinery, fresh export markets have opened up. Industries such as rice and cashews came under initial strain, but India's tariffs being lower than the other Asian countries allow us to maintain its share in the market. Meanwhile, exporters also started diversifying into Southeast Asia and the Middle East, mitigating the shock. The current tension highlights the need to diversify trade relations and build up our domestic agri-value chain. For Dhanuka, we do not see any substantial effect from U.S. tariffs. Indeed, U.S. pressure on China may improve India's long-term cost competitiveness. To effectively avoid tariff risks, India needs to diversify export markets, invest in value-added agri products, and cut input costs through GST and duty reforms. Facilitating MSMEs with credit availability, easing compliance, and developing cold-chain infrastructure will be crucial to rendering Indian agriculture globally competitive and robust."

Press Release

LEXUS INDIA REPORTS ROBUST 19% GROWTH IN FY 2024-25

Lexus India is pleased to announce an impressive 19% growth in the fiscal year 2024-25 compared to fiscal year 2023-24, reinforcing the brand's growing presence in India's luxury automotive sector. This strong performance is a testament to Lexus' commitment to delivering exceptional vehicles and superior customer experiences.

The first quarter of 2025 also saw continued momentum, with Lexus India recording a 17 % increase in sales compared to first quarter 2024. Leading this growth was the NX model in the quarter, highlighting its popularity among Indian consumers seeking luxury SUVs. The LM model also demonstrated outstanding demand, solidifying its appeal in the luxury mobility segment.

In March 2025, Lexus India has clocked highest-ever monthly sales to date. The brand registered 61% growth as compared to March 2024. The NX model experienced exceptional growth, while the RX maintained stable performance. The combined SUV lineup of NX and RX models rose by 63% compared to March 2024. The LM continued to thrive, reflecting sustained customer interest, and the recently announced bookings for the LX witnessed strong positive demand.

Commenting on the robust performance, Hikaru Ikeuchi, President of Lexus India, stated, "We are deeply grateful to our guests for their unwavering trust and enthusiasm for Lexus vehicles in India. Achieving an impressive 19% growth in FY 2024–25, along with a strong start to 2025 marked by a 17% first quarter growth, is a testament to our commitment to delivering unparalleled luxury and exceptional guest experiences. These milestones inspire us to push boundaries and continuously enhance our offerings. As we move forward, we remain dedicated to redefining luxury mobility, embracing sustainability, and exceeding guest expectations."

Lexus has embraced the Japanese philosophy of Omotenashi, ensuring every action reflects deep respect and guest care. To reinforce this and provide absolute peace of mind, Lexus India has recently introduced flexible and unique Lexus Luxury Care service package which includes Comfort, Relax and Premiere options that are available in 3 years / 60,000 Km or 5 years / 100,000 Km or 8 years / 160,000 Km. This service package provides guest with multiple offerings further delighting them.

Marking eight years of operations in India, with an overall robust growth, Lexus India remains optimistic about sustaining this positive momentum throughout 2025, reinforcing its position in the luxury automotive market and delivering memorable experiences to its valued guests.

ABOUT LEXUS INDIA:

Lexus launched globally in 1989 with a flagship sedan and a guest experience that helped define the premium automotive industry. In 1998, Lexus introduced the luxury crossover category with the launch of the Lexus RX. The luxury hybrid sales leader, Lexus delivered the world's first luxury hybrid and has since sold over 2 million hybrid vehicles. A global luxury automotive brand with an unwavering commitment to bold, uncompromising design, exceptional craftsmanship, and exhilarating performance, Lexus has developed its lineup to meet the needs of the next generation of global luxury guests and is currently available in over 90 countries worldwide. Lexus associates/team members across the world are dedicated to crafting amazing experiences that are uniquely Lexus, and that excite and change the world, reinforcing its core values of being Authentic, Refined, Omotenashi, Engaging, and Imaginative under its vision of 'Making Luxury Personal'. Ever since its debut in India in March 2017, Lexus has aimed to craft a better tomorrow and redefine luxury in the world's fastest-growing major economy. The brand strives to consistently deliver exceptional design and quality to the discerning Indian guest with a portfolio of 5 vehicles, 4 of which are self-charging hybrid electric vehicles. In 2020, Lexus' presence in the Indian market was further strengthened with the introduction of its first locally produced model, ES 300h and it continues to be the most popular model amidst Lexus' India line-up.

Press Release

ARYA.AG'S NBFC CROSSES ₹2000 CRORE MILESTONE IN COMMODITY FINANCE, A FIRST IN INDIA

~ Leading Grain Commerce Platform Transforms Rural Financial Inclusion Through Post-Harvest Commodity-Based Lending

Arya.ag, India's largest and only profitable grain commerce platform, today announced that its Non-Banking Financial Company (NBFC) arm has crossed the landmark figure of **₹2000 crore in commodity finance,** becoming the first in the country to achieve this scale in agri-based lending of this kind. This achievement marks a significant advancement in rural finance, challenging conventional wisdom that commodity finance at the farmgate level is too risky, fragmented, and unscalable. Unlike traditional lending models, Arya.ag's approach is anchored in financing against actual grain stored across India's heartland, supported by its robust technology infrastructure and decentralised storage network.

Anand Chandra, Co-founder of Arya.ag, commented: "*Reaching ₹2000 crore in commodity finance through our NBFC validates our integrated approach to post-harvest solutions. This milestone positions us as the largest NBFC in India's commodity collateral funding space, effectively doubling the scale of other players in this segment. We've developed a model where farmers receive loans in under 30 minutes based solely on KYC, changing the dynamics of rural finance. The virtually nil NPAs we've maintained while serving approximately 8 lakh farmers shows that when financial products align with real commodities and farmer needs, scale and sustainability naturally follow. Beyond our NBFC's direct lending, we've facilitated an additional ₹10,000 crore through partner banks against our warehouse receipts, bringing the total financing enabled this year to ₹12,000 crore.*"

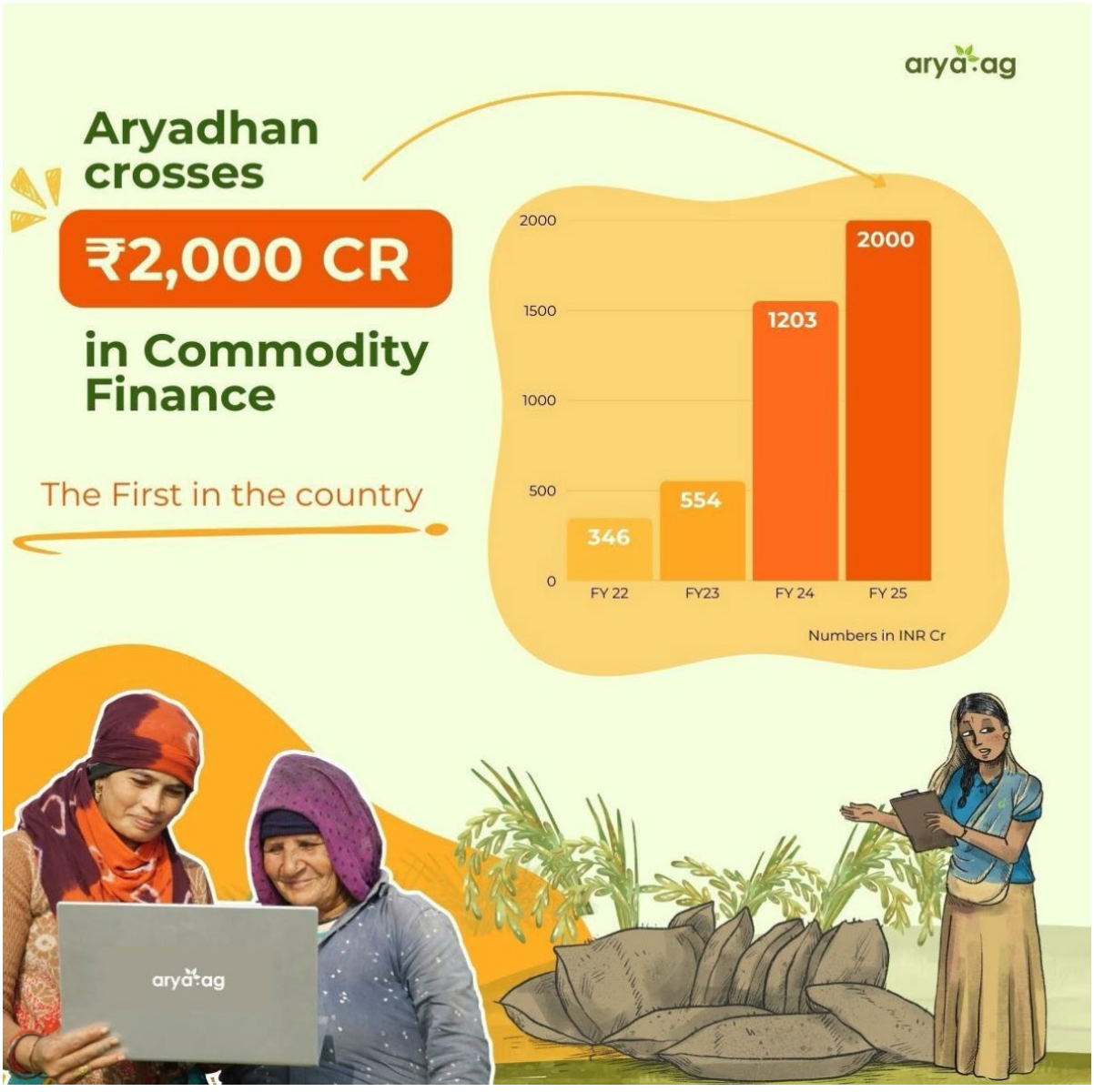
The company reports that its NBFC has become the largest in India in the commodity collateral funding space, effectively doubling the scale of other players in this segment. This achievement is part of a larger financing ecosystem, where partner banks have additionally disbursed over ₹10,000 crore against warehouse receipts issued by Arya.ag, bringing the total facilitated financing to ₹12,000 crore this financial year.

This achievement follows Arya.ag's recent recognition with the 2025 Forward Faster Sustainability Award in the Climate Action category by the UN Global Compact Network India, and its securing of an INR 2.5 billion loan facility backed by GuarantCo and HSBC

India. Operating across 21 states and covering 60% of Indian districts, Arya.ag manages over 4 million metric tons of commodities across 3,500+ warehouses with a total value exceeding ₹10,000 crore. Its success in commodity finance demonstrates that post-harvest solutions may be the key to unlocking the next frontier in agricultural financial inclusion.

About Arya.ag

Arya.ag is India's largest and only profitable grain commerce platform. It enables freedom of choice for farmers and their organisations to decide 'when' and 'to whom' they would want to sell their produce post-harvest by offering access to farmgate-level storage, seamless finance and transparent commerce. It eliminates the trust deficit in grain commerce through its exponentially growing layer of visibility and control, currently stretching across 60% of Indian districts, covering over 11,000 agri-warehouses. Arya.ag aggregates and stores USD 3 billion of grain annually while enabling disbursement of over USD 1.5 billion of loans to small-holder farmers, their organisations and other stakeholders. Arya.ag works towards creating equitable value chains in agriculture, assuring inclusive growth and greater transparency.



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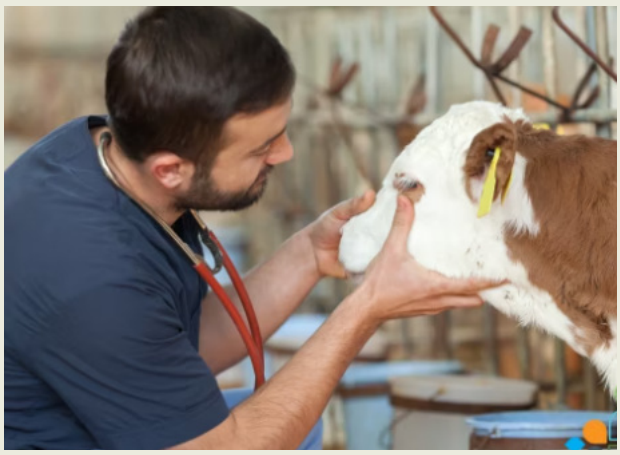

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