ANNUAL REPORT

2024

भा.कृ.अनु.प.–भारतीय बागवानी अनुसंधान संस्थान

हेसरघट्टा लेक पोस्ट, बेंगलूरू – ५६००८९

ICAR- Indian Institute of Horticultural Research

Hessaraghatta Lake Post, Bengaluru – 560 089

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Annual Report 2024

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हेसरघट्टा लेक पोस्ट, बेंगलूरू – ५६००८९

ICAR - Indian Institute of Horticultural Research,
Hesarghatta Lake Post, Bengaluru – 560 089

High yielding, climate resilient and nutrient rich varieties (developed by ICAR-IIHR) dedicated to the Nation by Honourable Prime Minister of India on 11th August, 2024.

Arka Udaya

Arka Kiran

Arka Chandra

Arka Nikita

Arka Vistar

Arka Vaibhav

Arka Amar

Arka Aayush

Arka Shreeya

Arka Dhanvantari

Arka Daksha

Arka Prabhavi

Arka Ashwagandha

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PREFACE

The horticulture sector has established it's role with significant contribution to the Indian economy as well as in enhancing the nutritional, health, and economic well-being of our country's population despite persistent challenges due to changing climate and inadequate marketing and storage infrastructure. To meet the futuristic demands of horticultural produce, it is crucial to improve the productivity and quality of the produce and minimize post-harvest losses. Leading this endeavour is the ICAR-Indian Institute of Horticultural Research (ICAR-IIHR). The institute is striving continuously by conducting comprehensive and focussed research on fruit, vegetable, flower, medicinal crops, and mushrooms.

The ICAR-IIHR has introduced over 330 varieties/hybrids and developed 156 technologies, fostering entrepreneurship through licensing in horticulture. In 2024, the Institute identified four promising varieties and two technologies, with 9 varieties/hybrids notified by the Central Varietal Release Committee and 19 varieties identified for release by State Varietal Release Committee, Karnataka. On the commercialization front, about 43 technologies were licensed to 60 licensees. Additionally, two patents were granted in the year 2024. On the PG education front, the ICAR-IIHR has expanded its programs as a Hub of IARI and offered 74 courses to Ph.D. and M.Sc. students across 15 disciplines. For effective dissemination of IIHR technologies, the institute conducted over 112 on-campus and off-campus training sessions and numerous demonstrations including 203 on-farm trials and 4077 demonstrations. The special programs such as NEH, TSP, and SCSP were intensified to disseminate advanced technologies to the farmers and empower the stakeholders associated with horticulture sector. About 4 t seed of different varieties/hybrids of vegetable and flower crops, 8 lakhs of quality planting material of fruit and flower crops and 32.5 t of inputs (Microbial consortia and nutrient specials) were distributed for demonstrations in different states.

Prominent dignitaries Shri Arjun Munda Ex. Minister of Agriculture and Farmers Welfare, Govt. of India, Sushri Shobha Karandlaje then Minister of State in Ministry of Agriculture and Farmers Welfare and Dr C N Manjunath, Member of Parliament, Bengaluru Rural Loksabha Constituency visited the institute in 2024. The scientists of the institute were conferred with several prestigious awards and recognitions and published 220 research papers in peer-reviewed journals.

I express our sincere gratitude to Dr. Himanshu Pathak, Ex. Secretary of DARE & Director General of ICAR, and Dr. Sanjay Kumar Singh, Deputy Director General (Horticultural Science) for their timely support and invaluable guidance. The institute acknowledges the Chairman and members of RAC for their valuable suggestions and recommendations to the Council. We extend our appreciation to all Central and State Government agencies that have greatly helped us in various research and developmental endeavours. I congratulate the Chairperson and Members of the Publication Committee for bringing out this important document within the stipulated timeframe.

(Dr. T. K. Behera)
Director

1. Introduction

The ICAR-Indian Institute of Horticultural Research, an ISO 9001:2015 certified premier institute conducts basic, strategic, anticipatory and applied research on all aspects of fruit, vegetable and ornamental crops, medicinal and aromatic plants and mushrooms. The Institute was the first horticultural research institute in the country established by the Indian Council of Agricultural Research (ICAR), New Delhi, on September 5, 1967, it was initially established at the ICAR headquarters at New Delhi, and subsequently shifted to Bengaluru in Karnataka on February 1, 1968. Dr. G.S. Randhawa was the founder Director, whose vision and dynamism helped the institute to grow rapidly. The Institute took over the erstwhile National Hortorium of the Government of Karnataka, spread over an area of 24.7 ha at Hesaraghatta, and later on acquired an additional 238 ha of land from the surrounding village of Ivarkandapura. The Institute expanded the ambit of its research activities to the length and breadth of the country by establishing experimental stations at Lucknow, Nagpur, Ranchi, Godhra, Chettalli and Gonikoppal. Over the years, the experimental stations at Lucknow, Nagpur, Ranchi, and Godhra have attained the status of independent institutes. At present, the ICAR-IIHR, Bengaluru has two Central Horticultural Experiment Stations located at Bhubaneswar in Odisha and Chettalli in Karnataka, and two Krishi Vigyan Kendras located at Gonikoppal and Hirehalli. The institute houses the Project Coordinating Unit of the ICAR-All India Coordinated Research Project on Fruits at its main campus.

Vision

Increasing research efforts to reorient and refine approaches for developing eco-friendly sustainable and widely adoptable technologies contributing towards increased food and nutritional security, quality and higher output, so that horticulture can become an enterprise and the farmer an entrepreneur.

Objectives

To address the food and nutritional security, the following objectives are envisaged:

- To serve as a national repository of horticultural crop germplasm and horticultural database
- To develop improved varieties/ hybrids through conventional breeding and through Marker Assisted Selection for biotic and abiotic stress tolerance in various horticultural crops
- Effective utilization of natural resources and enhancement of input use efficiency and plant health management
- Production of quality seed and planting material of horticultural crops
- Post-harvest management, value addition and horticultural waste utilization
- Dissemination of the technologies for improving on-farm production and productivity and to act as a specialized center for HRD in horticulture Mandate
- Basic, strategic and applied research to enhance sustainable productivity, quality and utilization of horticultural crops
- Repository of horticultural genetic resources and scientific information
- Transfer of technology, capacity building and impact assessment of technologies
- Human resource development and education

Mission

To bring about improvement in fruit, vegetable, ornamental and medicinal crops through genetic manipulation, refinement in pre-and post-harvest technologies through precision horticulture, mechanization and other modern approaches.

Main Station, Hesaraghatta, Bengaluru

The main station is located in Hesaraghatta, 25 km North of Bengaluru city. The Institute houses laboratory complexes, experimental farms, administrative block and staff quarters at Hesaraghatta campus in about 263 ha land. The Institute has also taken over 24 acres of land of IVRI at Yelahanka, Bengaluru, and about 2 acres of the UHS, Bengaluru campus. The experimental farm located at Hirehalli is spread over 68 acres. The Hirehalli station is involved in planting material production and research work on fruit crops, particularly maintenance of jack fruit germplasm. It has Centre of Excellence (COE) on Kamalam..

Growth

The physical growth of the Institute can be viewed in two phases. In the initial years up to 1990, the emphasis was laid on development of land and infrastructure. The entire arable land was divided into well-defined experimental blocks for carrying out field experiments

and independent laboratory buildings for all the major scientific divisions. Currently, research activities are being carried out by eight divisions having State-of-the art equipment like electron microscope, ultracentrifuge, LC-MS/ MS, GC-MS/MS, ICP-OES, HPLC, GLC, SFE, AAS, Rapid microbial identification systems, RTPCR etc.. Field facilities, polyhouses, net houses, growth chambers, mist chambers, Gamma chamber, temperature gradient chambers and phenomics facility are available. Facilities like cold storage chambers, gene banks, seed processing, nursery units and communication channels like local area network with video conferencing facilities, etc. are available. The Institute has also created cryopreservation facilities for long-term preservation of germplasm of various crops. A referral laboratory for food safety has been established in the year 2017 for analysis and certification of food contaminants in horticultural produce of different stakeholders. Food Safety Referral Lab (FSRL) at ICAR-IIHR has been upgraded to National Reference Lab for Fruits and Vegetables by FSSAI. The Institute houses modern library, committee rooms, auditorium, food court, training hostel, bank, post office, dispensary, residential quarters and facilities for the students.

The main station at Hesaraghatta, Bengaluru, under the leadership of the Director, ICAR-IIHR, implements and monitors all the activities of the Institute. Considering the importance given to horticultural research and development in the country, ICAR-IIHR has the mandate to serve various stakeholders of the horticultural sector and for carrying out this mandate, the Institute has established various service-oriented units, namely, Prioritization, Monitoring and Evaluation Cell (PME); Institute Technology Management Unit (ITMU) and Consultancy and Processing Committee including Hortibusiness incubation facility; Agricultural Technology Information Centre (ATIC); Agricultural Knowledge Management Unit (AKMU); Regional Centre (South) of the ICAR-National Agricultural Education Accreditation Board (NAEAB); Vigilance Cell; P. G. Education, Publication Unit, Library and Women's Cell.

Central Horticultural Experiment Station (CHES), Chettalli, Kodagu, Karnataka

The CHES was established in 1972 at Chettalli along with Citrus Experiment Sub-station at Gonikoppal. In the year 1992, the Citrus Experiment Sub-station at Gonikoppal was converted into a full-fledged KVK and all the research work along with the research laboratories of the erstwhile sub-station were shifted to Chettalli. The station occupies an area of 92 ha. The mandate crop of the center is Coorg mandarin with major emphasis on citrus dieback disease. It also works on underutilized fruit crops like, pummelo, avocado, mangosteen, karonda, rambutan etc and is involved in production and distribution of true-to-the-type disease-free citrus and other planting materials and *Trichoderma* cultures.

Central Horticultural Experiment Station (CHES), Bhubaneswar, Odisha

The station was established on 6th November, 1992 to cater to the research and developmental needs in horticulture for the tribal and coastal belts of Odisha and the adjoining region. Transfer of Technology in NEH region and Tribal Sub-Plan are also being taken up by the station. The station is spread over an area of 40 ha housing a full-fledged laboratory and office building and the experimental farm. It has strong unit for production of disease-free planting materials of fruit crops for benefit of the farmers of Eastern region of the country.

Krishi Vigyan Kendra (KVK), Hirehalli, Tumkuru, Karnataka

The KVK, Hirehalli was sanctioned in the year 2009. Apart from the activities of Krishi Vigyan Kendra, it has taken up activities of popularization of ICAR-IIHR developed technologies, and production and distribution of seeds/planting material.

Krishi Vigyan Kendra (KVK), Gonikoppal, Kodagu, Karnataka

The KVK, situated in Kodagu district of Karnataka, was established in the year 1954 by the Karnataka State Government as Citrus Research Station and was transferred to ICAR-IIHR, Bengaluru on February 1, 1972 to be part of CHES, Chettalli with the objective of investigating the nature and causes of citrus die-back disease in Kodagu and nearby areas till 1991. In 1992, the Citrus Research Sub-station was converted into a full-fledged KVK occupying an area of 17.5 ha.

ICAR-AICRP on Fruits

The institute houses the Project Coordinating Cell of All India Coordinated Research Project (AICRP) on Fruits. The AICRP on Tropical Fruits and Sub-Tropical Fruits were amalgamated and named as AICRP on Fruits since August 21, 2013. The project has objective of collection, conservation and evaluation of germplasm along with standardization of production technologies, viz., rootstocks, population density, nutrition and water management and evolution of cost-effective, integrated insect pest and disease management practices under different agro-climatic conditions in citrus, banana,

grapes, guava, litchi, jackfruit, mango, papaya and sapota. There are 23 centres working on mango, 16 on guava, 13 on banana, 12 on citrus, 9 on papaya, 8 each on litchi and grapes, 5 on jackfruit, 4 on sapota. At present, there are 50 centres, including 30 SAU based centres, 14 ICAR-Institute-based centres, four CAU-based centre and one private unit and one under the Government of Arunachal Pradesh.

Accomplishments of ICAR-IIHR

The main research program of the institute in the initial years revolved around the improvement of the productivity by evolving high yielding varieties/ hybrids in fruits, vegetables, ornamentals, medicinal and aromatic plants and the development of advanced production technologies for yield enhancement. With the emergence of new challenges in horticulture, the emphasis was later shifted to breeding hybrids/varieties for biotic and abiotic stresses, developing integrated water and nutrient management protocols, pests and disease management technologies, efficient postharvest management practices and conducting research in frontier areas like hi-tech horticulture, precision farming, information technology and biotechnological interventions.

The institute conducts research on 54 major horticultural crops. ARKA is the trade mark of the varieties and technologies developed by ICAR-IIHR. The varieties and technologies are commercialized to encourage entrepreneurship. Entrepreneurship development through incubation of technologies and hand holding is done through BESST-HORT and Agri- Business Incubation (ABI) of the institute. The institute has developed over 330 high yielding and disease resistant varieties and hybrids in mandate crops and the refined production technology for these crops including those for high density planting in fruit crops and organic and protected cultivation practices for vegetables. More than 156 technology products have already been commercialised. Notably, 130 technologies of the institute have been picked up by licensees on non-exclusive basis through more than a fifteen hundred licences. The institute has been placing great emphasis on the promotion of entrepreneurship and there are three Technology Business Incubators (TBIs) in operation at the institute to hand hold and promote horticultural entrepreneurship. Recent initiation of online seed portal for the sale of the seeds of the institute released varieties and hybrids has been well received by the public.

The institute has sanctioned strength of 154 scientific and 205 technical staff for working on 54 horticultural crops. It houses the project coordination cell of the ICAR-AICRP on Fruits and is actively involved with other AICRPs on Arid Zone Fruits, Vegetables, Flowers, Medicinal plants, Mushroom and Energy in Agriculture for the Nationwide involvement in horticultural research and development. It has international linkages with World Vegetable Center (earlier Asian Vegetable Research and Development Centre), Taiwan and Bioversity International.

The facilities and sophisticated instruments besides being used for advanced research are also employed for rendering services and are accessible for other research agencies. The Services of NABL Accredited National Food Referral Lab & Pesticide Residue Lab, DNA finger printing of varieties, disease-free certification of plant material, leaf, soil and water analysis, contract research and consultancy services for horticultural research and development are available. It serves as a DUS testing centre for varietal protection of horticultural crops.

Technology products and publications are made available through the Agriculture Technology Information Center (ATIC) that serves the role of providing solutions to farmer's problems through appropriate interventions. On the educational front the institute has been functioning as an Outreach Campus of Indian Agriculture Research Institute, New Delhi since 2014 and is equipped with smart class rooms, centralized facilities for the students' research. ICAR-IIHR has Memorandum of Understanding with more than 50 institutions for research and education.

Transfer of the technologies/varieties is efficiently and effectively attempted through demonstrations in different agro-climatic regions of the country with the help of Krishi Vigyan Kendra's, National Horticultural Fairs, publications and the mobile app ARKA Bagwani. The institute has received "ISO 9001:2015" certification for its activities. The Institute had been adjudged as "The Best Institute" by Indian Council of Agricultural Research, New Delhi with the Sardar Patel Best Institute Award twice during 1999 and again in 2010. Recently, by recognizing the contributions of the ICAR-IIHR on various fronts, the Indian Council of Agricultural Research, New Delhi bestowed the institute with Top Rank among all ICAR institutes for the year 2019-20 and 2020-21 (combined).

* * * * * *

Staff position of ICAR-IIHR as on December 2024

Category	Sanctioned	In position
Scientific	153+1*(RMP)+2 KVK	129+1+1 KVK
Technical	194+11 (Including KVK)	134+7 KVK
Administrative	93+4 (Including KVK)	55
Supporting	91+4 (Including KVK)	17
Total	531+22	335+9

***Director**

Unified budget allocation 2024-25 (BE)

Rs. (Lakhs)

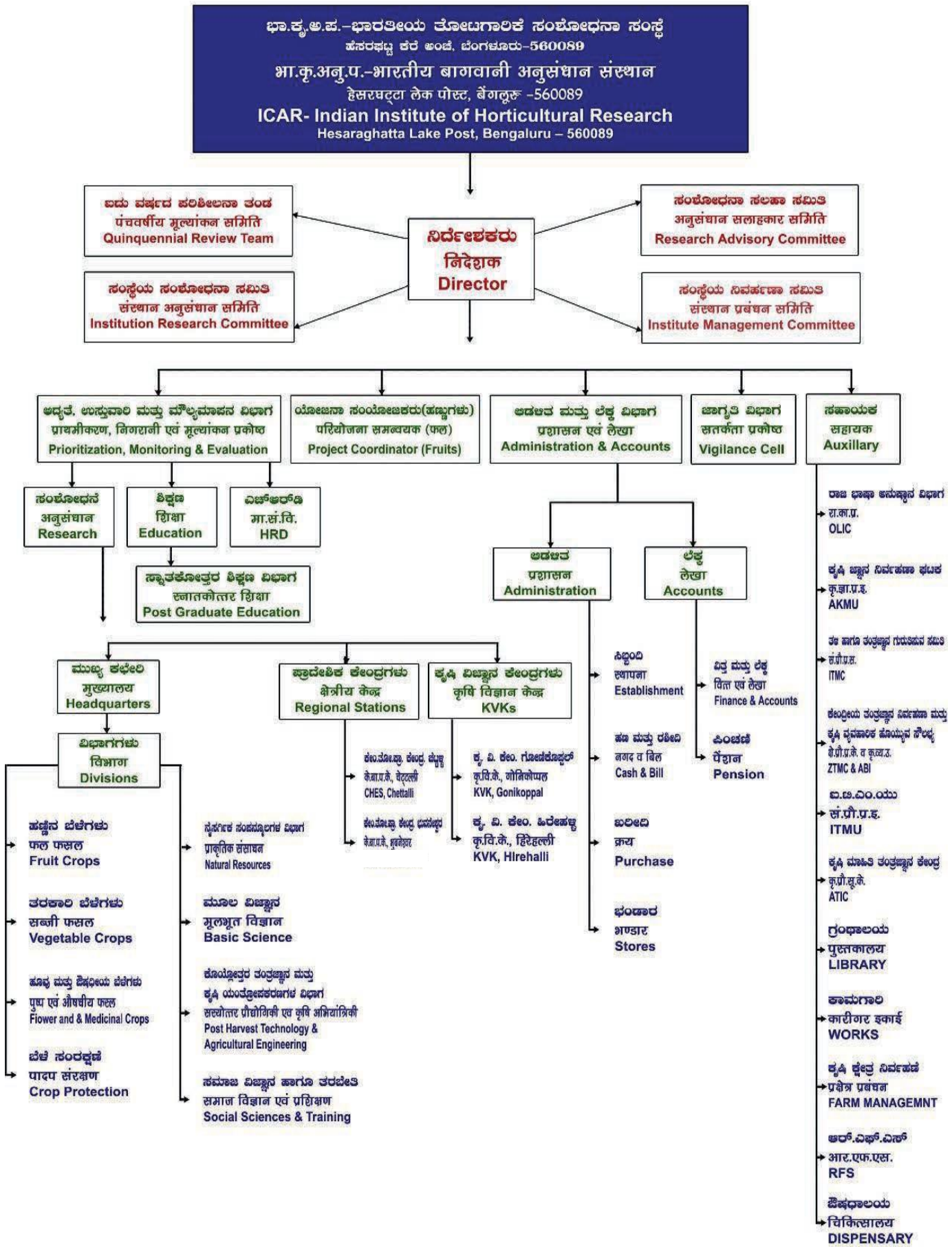
S. No	Head	Other than NEH & TSP	NEH	TSP	SCSP	Grand Total
1	2	3	4	5	6	7(3+4+5+6)
1	CAPITAL for creation of Capital Assets	350.00	0.00	0.00	0.00	350.00
2	Grant in Aid-Salaries	7084.00	0.00	0.00	0.00	7084.00
3	Grants in Aid-General					
	Pension&other retirement benefits	5444.00	0.00	0.00	0.00	5444.00
	Travelling allowance	60.00	0.00	0.00	0.00	60.00
	Research & Operational expenses	950.00	100.00	150.00	250.00	1450.00
	Administrative expenses	700.00	0.00	0.00	0.00	700.00
	Miscellaneous expenses	40.00	0.00	0.00	0.00	40.00
	Grand Total	**14628.00**	**100.00**	**150.00**	**250.00**	**15128.00**

Expenditure up to December 2024 (Unified budget)

Rs. (Lakhs)

S. No	Head	Other than NEH & TSP	NEH	TSP	SCSP	Grand Total
1	2	3	4	5	6	7(3+4+5+6)
1	CAPITAL for creation of Capital Assets	110.25	0.00	0.00	0.00	110.25
2	Grant in Aid-Salaries	6090.70	0.00	0.00	0.00	6090.70
3	Grants in Aid-General					
	Pension& other retirement benefits	4768.00	0.00	0.00	0.00	4768.00
	Travelling allowance	38.46	0.00	0.00	0.00	38.46
	Research & Operational expenses	741.57	48.76	112.50	126.15	1028.98
	Administrative expenses	520.92	0.00	0.00	0.00	520.92
	Miscellaneous expenses	11.64	0.00	0.00	0.00	11.64
	Grand Total	**12281.54**	**48.76**	**112.50**	**126.15**	**12568.95**

ORGANOGRAM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ಲೆಕ್ಕ
लेखा
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ತಂ ಹಾಗೂ ತಂತ್ರಜ್ಞಾನ ಗರುತಿಸುವ ಸಮಿತಿ
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ITMC
ಕೇಂದ್ರೀಯ ತಂತ್ರಜ್ಞಾನ ನಿರ್ವಹಣಾ ಮತ್ತು ಕೃಷಿ ವ್ಯವಹಾರಿಕ ಶಿಕ್ಷಣ ಕೇಂದ್ರ
केंप्रौ.प्र.के. व कृ.व्य.
ZTMC & ABI
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सं.प्रौ.प्र.इ.
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आर.एफ.एस.
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Divisions
ಹಣ್ಣಿನ ಬೆಳೆಗಳು
फल फसल
Fruit Crops
ತರಕಾರಿ ಬೆಳೆಗಳು
सब्जी फसल
Vegetable Crops
ಹೂವು ಮತ್ತು ಔಷಧೀಯ ಬೆಳೆಗಳು
पुष्प एवं औषधीय फसल
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ಬೆಳೆ ಸಂರಕ್ಷಣೆ
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Post Harvest Technology & Agricultural Engineering
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क्षेत्रीय केंद्र
Regional Stations
ಕೃಷಿ ವಿಜ್ಞಾನ ಕೇಂದ್ರಗಳು
कृषि विज्ञान केंद्र
KVKs
ಕೇಂ.ತೋಟ್ರಾ. ಕೇಂದ್ರ, ಚೆಟ್ಟಳ್ಳಿ
केंबा.प.के., चेट्टल्ली
CHES, Chettalli
ಕೃ. ವಿ. ಕೇಂ. ಗೋನಿಕೊಪ್ಪಲ್
कृ.वि.के., गोनिकोप्पल
KVK, Gonikoppal
ಕೇಂ.ತೋಟ್ರಾ. ಕೇಂದ್ರ ಭಾಸವಳ್ಳಿ
केंबा.प.के. भूवनेश्वर
ಕೃ. ವಿ. ಕೇಂ. ಹಿರೇಹಳ್ಳಿ
कृ.वि.के., हिरेहल्ली
KVK, Hirehalli
ಸಿಬ್ಬಂದಿ
स्थापना
Establishment
ಹಣ ಮತ್ತು ರಶೀದಿ
नगद व बिल
Cash & Bill
ಖರೀದಿ
क्रय
Purchase
ಭಂಡಾರ
भण्डार
Stores
ವಿತ್ತ ಮತ್ತು ಲೆಕ್ಕ
वित्त एवं लेखा
Finance & Accounts
ಪಿಂಚಣಿ
पेंशन
Pension

2.1. विशिष्ट सारांश

वर्ष 2024 के लिए भा.कृ.अनु.प.-भा.बा.अनु.सं. में विभिन्न शोध परियोजनाओं, विस्तार गतिविधियों और स्नातकोत्तर शिक्षा के महत्वपूर्ण निष्कर्षों को इस अध्याय में संक्षेप में प्रस्तुत किया गया है।

फसल आनुवंशिक संसाधन

भा.कृ.अनु.प.-भा.बा.अनु.सं. देश में कई बागवानी फसलों के प्रबंधन संयंत्र आनुवंशिक संसाधनों के लिए नोडल केंद्र है और फल, सब्जी और फूल फसलों के लिए मान्यता प्राप्त राष्ट्रीय सक्रिय जननद्रव्य स्थल (एनएजीएस) है। वर्ष 2024 के दौरान, जननद्रव्य संकलन में फलों में 78, सब्जी फसलों में 639, फूलों की फसलों में 108, औषधीय फसलों में 51 और मशरूम में 2 शामिल थे। वर्ष 2024 में संस्थान की विभिन्न अधिदेशित फसलों में एकत्रित कुल जननद्रव्य वंशक्रम 878 थीं। कुल मिलाकर, बेंगलुरु, चेट्टल्ली और भुवनेश्वर में लगभग 14,529 व्यवहार्य जननद्रव्य संरक्षित किए गए। फलों, सब्जियों, फूलों, औषधीय फसलें और मशरूम के कुल जननद्रव्य वंशक्रमों की संख्या 2582, 10583, 981, 276 और 107 है।

किसान की किस्म, निरंथरा कुमार जामुन (साल भर फल देने वाला जामुन, आरईजी/2023/0124), जो साल भर फल देती है, की पहचान की गई और जैव विविधता को आजीविका सुरक्षा से जोड़ने के लिए पीपीवी और एफआरए के साथ पंजीकृत किया गया। एक आशाजनक वैक्स एप्पल जीनप्ररुप, सीएचईएसएम-1 की पहचान की गई जिसे स्थानीय संकलन से प्राप्त किया गया है और इसे नियमित रूप से फल देने वाले और उच्च उपज (90 से 120 किलोग्राम/पौधा) पौध चयन के रूप में पहचाना गया। कूर्ग क्षेत्र के पांच अलग-अलग देशी फल, जिनमें *ज़िज़िफ़स ओनोप्लिया* (एल.) मिलर), *ग्लाइकोस्मिस मौरिटियाना* (लैम.) *एलियोकार्पस वेरिएबिलिस* ज़माज़र्टी, *कैन्थियम पार्विफ्लोरम* लैम, *रूबस निवेस* वॉल को सीएचईएस-चेट्टाली में एकत्र और संरक्षित किया गया। आशाजनक सोरसॉप प्रविष्टियों में बड़े आकार के फलों के लिए सीएचईएस-आर3पी3 (22.3 सेमी x 13.5 सेमी फल आकार, 1358.8 ग्राम फल भार, और 1007.6 ग्राम गूदा भार) और उच्च टीएसएस (14°ब्रिक्स), कम अम्लता (0.45%), कम बीज भार (14.6 ग्राम) और कम बीज संख्या (25.5) के लिए आईआईएचआर-आर6पी2 शामिल हैं।

ताजा खाने के प्रयोजन हेतु कटहल खंड में, तमिलनाडु के पनरुति से दो कृषक किस्मों हरिगोल्ड और थिरुमाला की पहचान की गई। दोनों किस्मों ने फल की गुणवत्ता और उपज विशेषताओं के संबंध में बेहतर प्रदर्शन दिखाया। कोमल कटहल के उद्देश्य से उपयुक्तता के मूल्यांकन हेतु कर्नाटक और तमिलनाडु से कोमल कटहल प्रविष्टियां (एन =10) एकत्र की गईं।

टमाटर में, विभिन्न राष्ट्रीय और अंतर्राष्ट्रीय संस्थानों/संगठनों से प्राप्त 84 विविध टमाटर किस्मों का पॉलीहाउस में पौध अवस्था में ऊष्मा सहनशीलता के लिए मूल्यांकन किया गया, जिसमें मार्च 2024 के दौरान 44.67° सेल्सियस औसत पर अधिकतम तापमान दर्ज किया गया। दो प्रविष्टियों एवीटीओ1822 और एवीटीओ1892 को प्ररोह की लंबाई, प्ररोह के भार, तने की परिधि, जड़ की लंबाई, जड़ के भार और पत्ती क्षेत्र के लिए बेहतर प्रदर्शन के आधार पर सहनशील के रूप में पहचाना गया। मिर्च में, 26 बैंगनी फल वाले प्रविष्टियों को एंथोसायनिन सामग्री के लिए चिह्नित किया गया था और कुल एंथोसायनिन सामग्री 30.2 से 59.7 मिलीग्राम/100 ग्राम (ताजा भार) तक थी। प्रविष्टि आईआईएचआर-बी-एचपी-81 में सबसे अधिक कुल एंथोसायनिन सामग्री 59.7 मि.ग्रा./100 और डेल्फिनिडिन का 32.2 मि.ग्रा./100 ताजा भार था। यह न्यूट्रास्यूटिकल्स से भरपूर मिर्च के प्रजनन के लिए संभावित दाता के रूप में काम कर सकता है। दक्षिण-पूर्व एशियाई थ्रिप्स प्रतिरोधी प्रविष्टियों में जीसी-एमएस प्रोफाइलिंग, आईआईएचआर 4550 में एक प्रमुख एपिक्यूटिकुलर वैक्स घटक के रूप में ट्रिट्रियाकोंटेन-16-वन और प्रतिरोधी प्रविष्टियों आईआईएचआर 4550 और आईआईएचआर-बी-एचपी-79 में हेक्स-3(जेड)-एनिल ब्यूटाइरेट, मिर्च में दक्षिण-पूर्व एशियाई थ्रिप्स प्रतिरोध के लिए प्रतिरोध प्रदान करने वाले थे और इसे घ्राणमापी अध्ययनों और पत्ती निमज्जन जैवमूल्यांकन के माध्यम से मान्य किया गया था।

बैंगन में, 270 प्रविष्टयों का एनबीपीजीआर के न्यूनतम विवरणक के अनुसार लक्षण वर्णन किया गया। आईआईएचआर-824, आईआईएचआर-803 (*एस. टोर्वम*) और आईआईएचआर- 792 (*एस. सीफोर्थियानम)* जैसे प्रविष्टियों को प्रतिरोधी के रूप में पहचाना गया और प्रति जड़ प्रणाली 10 गैल से कम दर्ज किया गया और प्रजनन कारक <1 है। अर्का हर्षिता को लवणता और जीवाणु मुर्झान रोग दोनों के लिए प्रतिरोधी पाया

गया । आईआईएचआर-629 (मट्टुगुल्ला फल प्रकार) ने *फ़ोमोप्सिस* फल सड़न के प्रति मध्यम प्रतिरोध दिखाया। तुरई में, आईआईएचआर-345 (52 टन/हेक्टेयर), आईआईएचआर-347 (48.25 टन/हेक्टेयर) और आईआईएचआर-346 (44.25 टन/हेक्टेयर) ने प्रति हेक्टेयर उच्च फल उपज और मृदुरोमिल फफूंद के प्रति प्रतिरोध दर्ज किया, जिसका पीडीआई 10 से कम था।

करेले में, उपज के संबंध में श्रेष्ठ जननद्रव्य आईआईएचआर-181 (14.19 टन/हेक्टेयर), आईआईएचआर-196 (13.94 टन/हेक्टेयर) और आईआईएचआर-189 (13.5 टन/हेक्टेयर) की दृष्टि से श्रेष्ठ थे। चौदह वंशक्रमों ने टमाटर पर्ण कुंचन न्यू दिल्ली वायरस के लिए पूर्ण प्रतिरोध दिखाया। खीरे में, 144 जननद्रव्य प्रविष्टयों का लक्ष्ण-वर्णन किया गया। बहु विशेषक जीनप्ररुप - समप्ररुप दूरी सूचकांक (एमजीआईडीआई), प्रधान घटक विश्लेषण और कारक विश्लेषण के आधार पर 21 सर्वश्रेष्ठ खीरे के जीनप्ररुप चुने गए। फ्रांसबीन में, आईआईएचआर-296 में सबसे अधिक एंथोसायनिन (35.7±9.55 मि.ग्रा./सीजीई 100 ग्रा. ताजा भार) सामग्री दर्ज की गई। प्याज में, चार वंशक्रमों एटीआर/आईआईएचआर-01, एटीआर/आईआईएचआर-02, एटीआर/आईआईएचआर-03 और एटीआर/आईआईएचआर-04 ने प्राकृतिक और कृत्रिम दोनों ही स्थितियों में एन्ट्राकनोज के प्रति उच्च स्तर का प्रतिरोध दिखाया। चित्रदुर्ग से एकत्रित भूप्रजातियों में एलएसआर/18/37 में ट्विस्टर रोग के प्रति उच्च स्तर का प्रतिरोध (पीडीआई: 5.5) प्रदर्शित हुआ। करी पत्ते में, कर्नाटक, ओडिशा और तमिलनाडु से प्राप्त 20 प्रविष्टियों का मूल्यांकन ताजी पत्ती में सगंधीय तेल की मात्रा के लिए किया गया और तेल की सबसे अधिक मात्रा एलएसआर/18/06 (0.60%) में पाई गई, जिसके बाद एलएसआर/18/07 (0.56%) का स्थान रहा।

चाइना एस्टर के सफ़ेद फूल वाले समूह में, फुले गणेश व्हाइट और अर्का अर्चना किस्मों में खुले पुष्पों की उच्च उपज दर्ज की, और गुलाबी रंग वाले समूह में, अर्का कामिनी और अर्का अद्विका कर्तित पुष्प के लिए आशाजनक पाया गया। बैंगनी रंग वाले समूह में, अर्का निराली को कर्तित पुष्प के लिए आशाजनक पाया गया।

क्रॉसेंड्रा में, उत्परिवर्तक-3 को उच्चतम रेकिस लंबाई (6.44 सेमी) के लिए आशाजनक पाया गया, और इसके पौधे में बौना वृद्धि होने के साथ दीर्घायु है और इसे गमलों में इस्तेमाल के लिए अनुशंसित किया जा सकता है। *बारलेरिया* जननद्रव्य (*एन* = 9) में, आईआईएचआर बीसी-एच-05 ने बैंगनी फूल रंग समूह में खुले पुष्प की सर्वोच्च उपज रिकॉर्ड की गई तथा गुलाबी रंग के समूह में आईआईएचआर बीसी-एच-06 की खुली पुष्प उपज थी। नए द्विरंगी पुष्प वाले आईआईएचआर बीसी-वी-02 और सफेद रंग के समूह में आईआईएचआर बीसी-वी-03 खुले पुष्प की दृष्टि से आशाजनक थे। लाल रंग समूह में, आईआईएचआर बीआर-वी-01 को आकर्षक भूआवरण किनारों पर रोपाई के रूप में आशाजनक पाया गया। पीले रंग के समूह में आईआईएचआर बीपी-वी-01 को आकर्षक उद्यान बाढ़ के पौधे के रूप में आशाजनक पाया गया।

फसल सुधार

छिलके के आकर्षक रंग, उच्च टीएसएस तथा गूदे की अधिक प्राप्ति के लिए आम के आम्रपाली x वनराज (आर3पी16, आर3पी22, आर5पी3 और आर5पी23) के चार संकर आशाजनक पाए गए। दशहरी की दो एफ$_1$ संततियों (आर1पी8 और आर1पी6) और एक अर्ध सहोदर (आर27पी28) को फलों की गुणवत्ता के लिए चुना गया। गोवा मनकुरद की छह उत्कृष्ट अर्धसहोदरों (आर2पी18, आर3पी24, आर1पी34, आर1पी29, आर5पी1 और आर1पी17) को श्रेष्ठ फल की गुणवत्ता, नियमित फलन और समय से पहले फलन के लिए का चयन किया गया। आम्रपाली x वनराज की 168 वंशक्रमों में क्यूटीएल अनुक्रम विश्लेषण से चार क्यूटीएल (मिपेक 1, मिपेक 14, मिपेक 19 और मिपेक 20) की पहचान की गई जो छिलके के लाल रंग से संबंधित थे, जबकि एक अन्य क्यूटीएल (मिपेक 14) नारंगी रंग के गूदे से संबंधित था। पुमेलो में, प्यूटेटिव मार्कर CiBE0246 में फल के भार और एस्कॉर्बिक अम्ल सामग्री के साथ संभावित संबंध देखा गया। फलों में कड़वाहट/मीठापन एकल न्यूक्लियोटाइड क्रम में होने वाले परिवर्तनों के कारण होती है जिसकी पुष्टि एलसीएमएस विश्लेषण से की गई। पपीता में, पीआरएसवी प्रतिरोध प्रजनन के अंतर्गत *वास्कोनसेलिया* की तीन अंतर-जेनेरिक संकर संतानें *कुंडिनामर्सेसिस* x रेड लेडी (29-12, 28-12, और 19-9); अर्का प्रभात x *वी. पार्विफ्लोरा* x अर्का प्रभात (43-5 और 44-15) की BC1F3 अंतरजातीय संतति; लाल गूदा प्रकार (27-14 और 27-22), और पीला गूदा प्रकार (27-26) और रेड लेडी x वास्कोनसेलेकाउलिफ्लोरा (4-9, 5-12, और 9-20) में पीआरएसवी सहनशीलता के गुण के संबंध में बेहतर प्रतिरोध प्रदर्शित हुआ। पपीता की अर्का प्रभात किस्म में रोपाई के 60 दिन बाद डिम्बों में पराग किरणन के माध्यम से तथा अपरिपक्व डिम्ब कल्चर के माध्यम से अगुणितों में अनिषेकजनन प्रेरित हुआ और बीएसए विश्लेषण से दो सूचनात्मक मार्करों की पहचान हुई। *कैरिका पपाया* की जीनोम-संपादित समष्टि में बीस टी0 वंशक्रमों की छंटाई की गई और शून्य की

पहचान की गई। चुनी हुई समष्टियों के लक्षण-वर्णन संपादन से यह स्पष्ट हुआ कि ईआईएफ4ई लक्ष्य जीन में अपेक्षित स्थल पर उत्परिवर्तन हुए।

चार अमरूद की संततियों अर्थात आईएसएच 12 (अर्का पूर्णा x *पी. कैटलियनम* किस्म कैटलियनम), आईएचएस 10 और आईएसएच 3 (अर्का पूर्णा x *पी. कैटलियनम* किस्म ल्यूसिडम), और आईएसएच 1 (एच 12-5 x *पी. कैटलियनम* किस्म कैटलियनम) को मुर्झान और सूत्रकृमि (एम. *एंटरोलोबी*) के संयुक्त प्रतिरोध के लिए चुना गया। मात्रात्क आकलनों के आधार पर दृश्टव्य स्कोरिंग और रंग पठन (सीआईईएलएबी) दोनों का उपयोग करके पांच एलजी में रंग संबंधी विशेषताओं के लिए कुल 16 क्यूटीएलएस की पहचान की गई। चीकू में संकरों और उत्परिवर्तक प्रविष्टियों के 11 श्रेष्ठ वंशक्रमों का बौनेपन और उच्च उपज के लिए मूल्यांकन किया गया। आईएचआर-63 और कुछ अन्य उत्परिवर्तक पौधे बौने पाए गए। शरीफा में, अर्का सहन x बालानगर की बाईस संततियों का उनके स्व-फलदायीपन और फल की गुणवत्ता के आधार पर चुना गया। अंगूर के मूलवृंत प्रजनन में, डोग्रिज उत्परिवर्तक (आर6पी25एम2, आर6पी27एम4, आर6पी36एम9, आर6पी39एम12, आर6पी44एम16) और डोग्रिज x 110आर संकर (आर6पी16एच16, आर6पी43एच28) में लवणता और क्षारीयता की जांच शुरू की गई। ड्रैगन फ्रूट चयन सीएचईएसएच-डी1 और उत्परिवर्तक सीएचईएसएच-डीई उच्च फल भार और उपज के लिए बेहतर पाए गए।

वर्गाकार गोल खंड और प्रसंस्करण प्रकार टमाटर संकर (*एन* =43) में, जल्दी पकने के लिए दो संकर (2023X114 और 2022X134) और 5 डिग्री ब्रिक्स से ऊपर टीएसएस के लिए चार संकरों (2022X078, 2022X134, 2023X199 और 2023X117) की पहचान की गई। उच्च पीएच वाले संकर 2023X140 और 2022X78 थे। हरे स्कंध प्रकार के संकरों (*एन* = 12) में, अगेती पुष्पन के लिए 2023X46 और 2023X04, 2023X11 और 2023X44 की अगेती पकने तथा 2023X46 की सर्वोच्च उपज के लिए पहचान की गई । चपटे और गोल प्रकार के संकरों (*n* =23) में 2023X89 व 2023X106 अगेती पुष्पन वाले तथा 2023X81 व 2023X74 अगेती पकने वाले पाए गए। अधिक उपज देने वाले संकर 2023X53, 2023X75 और 2023X74 थे। निधानी आयु बढ़ाने के लिए द्वितीय एक्सॉन क्षेत्र में *पेक्टेट लाइज़* जीन *(सोलिक03जी111690)* को लक्षित करने के लिए विशिष्ट दो गाइड आरएनए डिज़ाइन किए गए, कई गाइड आरएनए निर्माण को **pDIECT**_22C वेक्टर में क्लोन किया गया था और टमाटर की अर्का विकास किस्म में रूपांतरित किया गया, जिसके परिणामस्वरूप दो संपादित पौधे *पेक्टेट लाइज़* जीन में इनडेल्स प्रदर्शित हुए। विटामिन डी बायो-फोर्टिफिकेशन के लिए, **7** डीहाइड्रो कोलेस्ट्रॉल रिडक्टेस जीन के कोडिंग अनुक्रम को खत्म करने के लिए **CRSPR-Cas9** कांस्ट्रक्ट के साथ टमाटर की किस्म अर्का विकास का *एग्रोबैक्टीरियम* मध्यस्थता वाला रूपांतरण हेतु लक्षित किया गया और 3 वैयक्तिक गाइड आरएनए व 38 प्यूटेटिव ट्रांसफेर्मेंट विकसित किए गए।

मिर्च में, सूखा सहिष्णु जीनप्ररुपों का उपयोग करके विकसित समष्टियां, आईएचआर4517 को एफ$_4$ पीढ़ी तक अग्रेषित किया गया और उनके उपज व गुणवत्ता व उपज संबंधी प्राचलों के आधार पर आईएचआर4517 × देवनुर डीलक्स, आईएचआर4517 × आईएचआर 3448 और आईएचआर4517 × एटिगेरे डब्बी क्रॉस संकरों से 27 एफ$_4$ फूलों का चयन किया गया। *कैप्सिकम एनम* में *कैप्सिकम बैकेटम* से एंथ्रेक्नोज प्रतिरोधी स्थलों को समाहित करने के लिए दो प्रजातियों *सी. चिनेंस* और *सी. फ्रूटसेंस को* ब्रिज प्रजातियों के रूप में इस्तेमाल किया गया और [*सी. एन्नुम* × *सी. चिनेंस*) × *सी. बैकेटम*] की त्रीमार्गीय संततियों ने बेहतर बीज लगना और बीज अंकुरण दिखाया। *सी. ऐनम* के साथ प्रतीप संकरण और मार्कर-सहायी चयन (एमएएस) से लगभग 11 प्रगत प्रतीप संकर पौधों में उच्च स्तर की सहनशीलता देखी गई। बहु वायरस रोग सहिष्णुता के लिए, दो प्रगत प्रजनन वंशक्रमों (डीएफ4-32 और डीएफ4-171) जो संकर (एमएस3बी × आईएचआर 2451) × (एमएस3बी × आईएचआर 459) से उत्पन्न हुए थे, में सीएमवी -गुंटूर, सीएचएमएमवी- बेंगलुरु और सीएचएलसीवी रायचूर विलगकों के लिए संयुक्त सहिष्णुता देखी गई। मिर्च के नाड़ी चित्ती विषाणु प्रतिरोध के लिए eIF4E के जीनोम संपादन हेतु T_0 जीनोम संपादित वंशक्रमों से T_1 पीढ़ी के पौधे उगाए गए। जड़ के भार और वितान तापमान के लिए गुणसूत्र 1 और 7 पर दो क्यूटीएल पहचाने गए तथा और अधिक विश्लेषण के लिए जीनोमी क्षेत्रों को 100 केबी तक संकीर्ण किया गया।

शिमला मिर्च में, संकर आईआईएचआरबीपी013 X एचटी-9 और आईआईएचआरबीपी34 X एचT-7 को आईआईएचआर, बैंगलोर और एनआईएएसएम, बारामती में उनके प्रदर्शन के आधार पर स्थिर संकर के रूप में पहचाना गया। आईआईएचआरबीपी061 (पीला), आईआईएचआरबीपी062 (लाल), आईआईएचआरबीपी008-1 (हरा) और आईआईएचआरबीपी008-2 (हल्का हरा) को बेहतर फल विशेषताओं के साथ उच्च उपज के लिए पहचाना गया। बैंगन (*n*=90) में, संकर एच1 (पूसा क्रांति x पूसा भैरव 3.69 किग्रा/पौधा) को सबसे अधिक फल उपज दर्ज की,

उसके बाद एच2 (पीपीएज x पी. भैरव, 3.36 किग्रा/पौधा) का स्थान था। इन संकरों में आकर्षक और चमकदार फल का रंग होता है और आकार में आयताकार से लेकर लंबे होते हैं और जीवाणु मुर्झान के प्रति प्रतिरोधक (जीरो प्रतिशत जीवाणु मुर्झान प्रकोप) होता है। पांच अंतर-प्रजातीय संततियों ($एफ_9$) में बैंगन के प्ररोह और बेधक प्रतिरोध के लिए खेत में छंटाई के दौर चार अतिसंवेदनशील कृष्य किस्में और एक प्रतिरोधी वन्य प्रजाति *सोलेनम मैक्रोकार्पोन* (कुल 10 प्रविष्टियों में), पांच अंतर-विशिष्ट $एफ_9$ वंशक्रमों (9-17, 9-16, 9-8, 9-12, 9-6वी) में 6% से कम प्ररोह संक्रमण रिकॉर्ड किया गया (अत्यधिक प्रतिरोधी पैमाना) तथा 20% से कम फल छेदक संक्रमण (प्रतिरोधी) रिकार्ड किया गया, जिसकी पुष्टि $एफ_9$ पीढ़ी में की गई।

तरबूज में, *सिट्रुलस एमेरस* की पृष्ठभूमि से व्युत्पन्न बीसी1 एफ1 वंशक्रमों (एन =25),वंशक्रम 18 (टीएसएस-10.8 डिग्री ब्रिक्स), 20 (टीएसएस-10.5 डिग्री ब्रिक्स), 42 (टीएसएस 11.0 डिग्री ब्रिक्स) और 46 (टीएसएस 10.0 डिग्री ब्रिक्स) में गहरे लाल रंग के गूदे तथा बेहतर फल गुणवत्ता संबंधी विशेषताओं के साथ श्रेष्ठ फल उपज दर्ज की गई। सेल-4-30 और सेल-4-35 को नारंगी गूदे वाले तरबूज (जुबली प्रकार) के लिए नारंगी कुरकुरे गूदे तथा 11-13 डिग्री ब्रिक्स टीएसएस के साथ श्रेष्ठ पाया गया।

भिंडी (n=6) में, वाईवीएमवी रोग के प्रति प्रक्षेत्र सहनशीलता के साथ उच्च फल उपज और फलियों की श्रेष्ठ गुणवत्ता के लिए दो प्रगत प्रजनन वंशक्रमों आईआईएचआर-299-1-2-2 और आईआईएचआर-385-1-1-5 की पहचान की गई। निर्यात उद्देश्य (n=15) के लिए, हाइब्रिड 125 को उच्च उपज और छोटे, गहरे हरे फल के साथ बेहतर पाया गया। वाईवीएमवी और ईएलसीवी प्रतिरोधी जीएमएस और गैर-जीएमएस आधारित संकरों (n=160) की विल्लुपुरम, तमिलनाडु में हॉटस्पॉट पर छंटाई के लिए पहचान की गई। प्राकृतिक हॉटस्पॉट क्षेत्र में प्रगत वंशक्रमों की छंटाई में आईआईएचआर-385-1-1-5 और आईआईएचआर-386-1-1-26 को वाईवीएमवी के लिए 0% प्रकोप तथा ईएलसीवी के 2.87 से 4.83% संक्रमण के साथ प्रतिरोधी पाया गया।

फ्रांसबीन में, अर्का सुकोमल x अर्का अर्जुन (*एन* =80) के संकर दो स्तंभ प्रकार के फली प्रजनन वंशक्रम ($एफ_{11}$) नामत: आईआईएचपीआरपीबी-आईपीएस-3 और आईआईएचपीआरपीबी-आईपीएस-4 की श्रेष्ठ फली गुणवत्ता तथा रतुआ रोग के विरुद्ध प्रतिरोध के साथ उच्च फली उपज के लिए पहचान की गई। (अर्का सुकोमल x आईआईएचआर-79) x लक्ष्मी), (अर्का शरत x आईआईएचआर-79) x लक्ष्मी), (अर्का अर्जुन x आईआईएचआर-79) x लक्ष्मी) से व्युत्पन्न $बीसी_2$ $एफ_4$ संततियों से रतुआ प्रतिरोध से युक्त श्रेष्ठ फली गुणवत्ता के लिए कुल 50 श्रेष्ठ एकल पादप चयन पहचाने गए। बैंगनी फलियों के संदर्भ में आईआईएचआर-277-1 x आईआईएचपीआरपीबी-आईपीएस-3 के संकर से श्रेष्ठ फली गुणवत्ता (गोल या पेंसिल के आकार के फलों) से युक्त सात एकल पादप चयनों का चुनाव किया गया।

लोबिया में, अर्का समृद्धि × काशी कंचन के संकरण से सोलह निर्धारित/झाड़ी प्रकार के एकल पादप चयन किए गए, और उन्हें खरीफ 2024 के दौरान $एफ_3$ पीढ़ी तक उन्नत किया गया। अर्का समृद्धि, अर्का गरिमा, अर्का सुमन और अर्का मंगला में से प्रत्येक की पृष्ठभूमि से कुल 25 $बीसी_1$ $एफ_2$ संततियों का मूल्यांकन किया गया और बारह से पंद्रह वंध्य संततियों का चयन करके खरीफ 2024 के दौरान उनका उर्वर पौधों के साथ प्रतीप संकरण कराया गया। सेम में, खरीफ 2024 के दौरान प्रकाश - ताप सहनशीलता के लिए मूल्यांकित 34 वंशक्रमों में से 2 वंशक्रम 1.12 किलोग्राम पौधे की अनुमानित उपज के साथ सहनशीलता की दृष्टि से आशाजनक पाए गए।

तोरई में, अंत:प्रजनित वंशक्रम आईआईएचआर-137 की पहचान ToLCNDV रोग के प्रतिरोध के लिए की गई थी। सीजीएमएस प्रतीप संकर संततियां ($बीसी_5$, $बीसी_6$ पीढ़ी) विकसित की गई और विभिन्न आनुवंशिक पृष्ठभूमियों (हरा/लंबे/मध्यम/छोटे फल) में नौ प्रतीप संकर समष्टियां भी विकसित हुईं। सभी प्रतीप संकर संततियां 100% नर वंध्य थीं, जिससे वंध्यता के बने रहने का संकेत मिला। नर-वंध्य आधारित संकरों आरजीएमएसएच-24-44 (54.25 टन/हेक्टेयर), आरजीएमएसएच-24-31 (53.8 टन/हेक्टेयर) और आरजीएमएसएच-24-20 (53 टन/हेक्टेयर) की पहचान 66 नर वंध्य संकरों के मूल्यांकन के आधार पर बेहतर संकर के रूप में की गई। लंबे फलों वाले एंड्रोमोनोशियस वंशक्रमों को चुना गया और समष्टियों को आगे बढ़ाने के लिए उनका संबंधित मोनोशियस जनकों के साथ प्रतीप संकरण कराया गया। अर्का प्रसन्न फल गुणवत्ता से युक्त हरमेर्फोडाइट वंशक्रमों के विकास का प्रयास किया गया।

वंशक्रम आईआईएचआर 60 और आईआईएचआर 61 संवेदी तुलनीय अर्का सूरज की तुलना में चूर्णी फफूंद के हल्के प्रतिरोधी थे, इसकी पुष्टि हुई। गाजर में नॉन-बोल्टिंग/नॉन-पिथी वंशक्रमों (आईसी 347787, आईसी 43540, आईआईएचआर 62, आईआईएचआर 51, आईआईएचआर 89, आईआईएचआर 63, आईआईएचआर 77, आईआईएचआर 66 और आईआईएचआर 71) की पहचान की गई ।

लौकी में, सूखा सहनशीलता स्कोर के आधार पर, जीनप्ररुपों बीजी-64, बीजी-141 और बीजी-49 को शारीरिक और जैव रासायनिक लक्षणों के आधार पर सूखा सहनशील के रूप में वर्गीकृत किया गया। खेत की स्थिति के तहत मृदुरोमिल फफूंद के विरुद्ध प्रतिरोध के लिए पेठा के जिन 22 जीनप्ररुपों का मूल्यांकन किया गया उनमें से एजी-6-15-11-37, एजी- 3-25-2-48, एजी-3-54-39-59, एजी-21-3-16, एजी-3-54-39-55 और एजी-3-25-2-34 को मध्यम प्रतिरोधी (एमआर) के रूप में वर्गीकृत किया गया। खीरे में सूखा सहनशीलता के लिए जांचे गए जीनप्ररुपों में से, आईसी-429942 में नमी की कमी के प्रति उच्च सहनशीलता देखी गई। जिसके बाद आईसी398523 का स्थान था। जीनप्ररुपों आईसी-345635 और आईसी-429942 का उपयोग कलम लगाने संबंधी आगामी अध्ययनों में किया जा सकता है।

करेले में उपज, उपज से संबंधित विशेषताओं और विषाणु प्रतिरोध के लिए मूल्यांकित उन्नत प्रजनन वंशक्रमों में, आईआईएचआर आईपी-19-17-3 (10.17 टन/हेक्टेयर) का बेहतर प्रदर्शन रहा। चूर्णी फफूंद प्रतिरोध के लिए विकसित समष्टियों में से, चार एफ$_7$ समष्टियों (आईआईएचआर-पीएमआर-एफ$_7$ -19-11-8-4-2-6-1, आईआईएचआर-पीएमआर-एफ$_7$ -19-6-23-3-4-3-2, आईआईएचआर-पीएमआर-एफ$_7$ -19-11-1-1-3-4-1, और आईआईएचआर-पीएमआर-एफ$_7$ -19-11-1-1-3-4-2) में 0 पीडीआई के साथ पूर्ण प्रतिरोध प्रदर्शित हुआ। एन-हेक्सेन का उपयोग करके बारह प्रविष्टियों से मोरिंगा बीज का तेल निकाला गया जिसकी मात्रा 33 से 40% के बीच भिन्न थी। वसा अम्ल प्रोफाइल से पता चला कि ओलिक अम्ल प्रमुख वसा अम्ल है।

गुलाब में, 16 प्रगत प्रजनन वंशक्रमों में से आकर्षक लाल रंग के पुष्पों के साथ गुलाबों की उद्यान में उपयुक्तता के लिए आईआईएचआरआर 9-13 (अर्का वीरराघवन) की पहचान की गई। कर्तित पुष्प उत्पान के लिए मूल्यांकित अनेक वंशक्रमों में से, आईआईएचआरआर 3-18-2 खुले खेत में उगाने के लिए उपयुक्त पाया गया, क्योंकि इसमें कांटे कम होते हैं और संरक्षित खेती की किसी भी अतिरिक्त लागत के बिना लंबे डंठल पैदा करने में सक्षम है। आनुवंशिक अध्ययनों से एपेटालॉइड वंध्यता को नियंत्रित करने वाले अप्रभावी जीन (aa) की पुष्टि हुई, जबकि गेंदे में पेटालॉइड वंध्यता को एकल प्रभावी जीन (pp) के द्वारा नियंत्रित होने की पुष्टि हुई। कैरोटीनॉयड सामग्री के लिए एक दोहरा उर्वर वंशक्रम आईआईएचआरएमओ 2335, और एक एपेटालॉइड वंध्य वंशक्रम (आईआईएचआरएमओ2340) तथा और एक आनुवंशिक पेटालॉइड वंध्य वंशक्रम (आईआईएचआरएम 2-3) का चयन किया गया, जिनमें शुष्क पंखुड़ी आहार के आधार पर कैरोटीनॉयड सामग्री का >2% है।

रजनीगंधा में, तीन एकल प्रकार के वंशक्रम आईआईएचआर 15-5-16, आईआईएचआर 15-22-एचएस-1, और आईआईएचआर 15-7-13 को माला उद्देश्य के लिए आशाजनक पाए गए। रजनीगंधा के आईआईएचआर-15-7-13 (0.106%), अर्का कीर्तना (0.102%), आईआईएचआर-17 23एचएस-9 (0.094%), और आईआईएचआर-17-5-2 (0.09%) जीनप्ररुपों में सर्वाधिक कंक्रीट सामग्री दर्ज की गई। गुलदाउदी में मूल्यांकित 10 अर्ध-सहोदर वंशक्रमों में से दो वंशक्रम आईआईएचआर 5-11 और आईआईएचआर 9-9 कर्तित पुष्प के लिए आशाजनक पाए गए और आईआईएचआर2-11बी और आईआईएचआर2-42 शैय्या के उद्देश्य के लिए आशाजनक थे, क्योंकि इनके पुष्प का रंग अनोखा स्वरूप विशेष होता है तथा बड़ी मात्रा में पुष्प लगते हैं। पीले रंग का प्राकृतिक उत्परिवर्ती (बड स्पोर्ट) जो एचवाईसीडी14 से प्राप्त किए गए तथा कैंडर पिंक से प्राप्त दो प्रेरित उत्परिवर्ती (15 और 20 गीगा विकिरण) और शैम्पेन येलो से प्राप्त एक उत्परिवर्ती को स्व पात्रे दशाओं के अंतर्गत सफलतापूर्वक विलगित किया गया और पुष्प गुणवत्ता संबंधी विशेषताओं के लिए उन्हें मूल्यांकित किया गया। खुले खेत में मूल्यांकन किए गए जरबेरा के जीनप्ररुपों में से अर्का कृषिका, अर्का रेड और आईआईएचआर जी-2 की फूलदान आयु अधिक थी। प्रजनन वंशक्रमों में आईआईएचआर जी-2 भी उच्च उपज देने वाला पाया गया।

ब्रह्मी में, चयन आईआईएचआरबीएम07 और आईआईएचआरबीएम05 बैकोसाइड उपज (क्रमशः 198.40 और 176.84 किग्रा/हेक्टेयर) के मामले में बेहतर पाया गया। अश्वगंधा में लगभग 21 एफ संकरों में से छह संकर (डीडब्ल्यूएस -420 जीए-3, आरवीए-100 x जीए-3, आरवीए 100 x डीब्ल्यूएस-420, वीए-2 x आरवी-100, वीए-2 x सीआईएमएस और आरवीए-100 x जीएए-1) शुष्क जड़ उपज की दृष्टि से आशाजनक पाए गए। शुष्क जड़ उपज प्रति पौधा 10-25 ग्राम तथा जड़ की लंबाई >20 सेमी थी। *सेलेसिया* की नौ प्रजातियों का जीनोम अनुक्रमण एनजीएस द्वारा डेनोवो बायोइनफॉरमैटिक्स के साथ मिलकर किया गया। अनुक्रमित जीनोम से, प्रजाति-विशिष्ट एसएसआर और प्रजाति-विशिष्ट जीन की पहचान की गई।

फ़सल उत्पादन

आम के संकर अर्का उदय में, उच्च घनत्व वाली तीन रोपण प्रणालियों (एचडीपी) में से 2 मीटर x 2.5 मीटर

रोपण की एचडीपी प्रणाली में प्रति पौधे उच्चतम फल उपज (7.19 किग्रा) प्राप्त की गई। आम की किस्म रसपुरी में प्रति पौधा 100 ग्राम की दर से मृदा में कैल्सियम का उपयोग करने तथा आम के एक अन्य संकर अर्का उदय में 0.5% की दर से कैल्शियम का पत्तियों पर छिड़काव करने (मासिक अंतराल पर फल आने की अवस्था के दौरान) से फल की उपज में वृद्धि हुई। *एनोना* संकर अर्का सहान में, अकार्बनिक उर्वरकों के माध्यम से नाइट्रोजन, फास्फोरस और पोटाश की पूरक खुराक देने के साथ-साथ स्वस्थाने वर्मी कम्पोस्ट का उपयोग करना फल उपज तथा औसत पलवार की दृष्टि से बेहतर पाया गया। जब अर्का सहान की *एनोना स्क्वैमोसा* (वाशिंगटन) पर कलम लगाई गई तो मूलवृंत और कलम का अनुपात लगभग एक रहा, जब कि अन्य सभी मूलवृंतों के मामले में यह एक से अधिक था। अमरुद में एक वर्ष में दो बार मिट्टी में 100 ग्रा. चूने का उपयोग करना उच्च फल उपज तथा फलों की संख्या की दृष्टि से बेहतर पाया गया। अमरूद में एचडीपी प्रणाली (3 मी x 2.5 मी.) के लिए, 340:70:260 ग्राम एन:पी:के फर्टिगेशन खुराक इष्टतम पाई गई। अर्का पूर्णा के एयर लेयर्ड पौधों से आरडीएफ + 2.5 किलोग्राम गोबर की खाद+ 150 ग्राम एएमसी पौधा की खुराक के कलम लगे पौधों की तुलना में उच्चतर उपज मिली।

ड्रैगन फल (किस्म लाल) में, 40% वाष्पीकरण प्रतिस्थापन पर सिंचाई का समय निर्धारित करने से बारानी दशा की तुलना में उल्लेखनीय उच्चतर फल उपज (44.67 टन/हेक्टेयर) प्राप्त हुई। मंगुष्ट में नारियल जट के साथ अर्ध कठोर काष्ठ कलमों में सर्वाधिक अंकुरण (40%) और जीवंतता प्रतिशत (53.3%) देखा गया। रूट पल्सिंग और गमला माध्यम के संयोजनों, निर्जर्मीकृत अर्का किण्वित कोकोपीट के साथ 250 पीपीएम की दर से आईबीए + वर्मीक्यूलाइट + परलाइट (1:1:1) का पपीते में जड़ प्रेरण की दृष्टि से प्रभावी पाया गया । प्यूमेलो किस्म अर्का अनंथा में, 250 पीपीएम आईबीए के साथ उपचारित पत्ती कलमों को एएफसी+वर्मीक्यूलाइट+परलाइट (1:1:1) माध्यम में स्थानांतरित करने के परिणामस्वरूप ऊतक संवर्धित रैक में 40% तथा निचली बहु सुरंगों में 60% जड़ निर्माण हुआ।

जामुन में इसकी तीन किस्मों नामत: धूपधल, कोंकण भधोली और गोमा प्रिया की फेनोलॉजी का अध्ययन किया गया। कोंकण भधोली में सबसे अधिक फूल और फल दिखाई दिए । बीबीसीएच पैमाने के अनुसार, करोंदा (किस्म कोंकण बोल्ड) में सात प्रमुख वृद्धि चरणों की पहचान की गई। कूर्ग मेंडारिन में, कलम लगे पौधों में अंकुरित पौधों की तुलना में बेहतर प्रदर्शन किया और पोषक तत्वों (20 किग्रा गोबर की खाद + आरडीएफ + मैग्नीशियम, गंधक, ज़िंक का मृदा में उपयोग और जैव-उर्वरकों (एएमसी और वीएएम) + सिट्रस स्पेशल + हरी खाद (सनई) के पत्तियों पर प्रयोग करने से पौधे के वृद्धि और उपज प्राचलों में उल्लेखनीय सुधार हुआ।

खेती की तीन प्रणालियों जैसे फलों पर आधारित फसल प्रणालियों में प्राकृतिक खेती, आधुनिक खेती और जैविक खेती में से अंतर फसलों (फ्रांसबीन, टमाटर, चाइना ऐस्टर) की उपज आधुनिक प्रणाली में उल्लेखनीय रूप से उच्चतर थी। टमाटर में प्राकृतिक खेती के अंतर्गत अन्य जैविक खेती प्रणालियों (3.71°ब्रिक्स) की तुलना में काफी अधिक टीएसएस (5.62°ब्रिक्स) और अम्लता (0.55%) दर्ज की और आधुनिक खेती (11.5 मि.ग्रा./100 ग्रा. ताजा भार) की तुलना में उल्लेखनीय रूप से उच्चतर विटामिन सी (27.8 मि.ग्रा./100 ताजा भार) प्राप्त हुए।

लौकी मूलवृंत में रोपाई के 52 दिनों बाद खेत दशा के अंतर्गत जीएसबी और *फ्यूजेरियम* मुर्झान के विरुद्ध किए गए अध्ययनों में मूलवृंत बीजी बीजी-77-6-1 से 76.92% सर्वोच्च फसल संख्या और 18.67 पीडीआई (फ्यूजेरियम मुर्झान) खीरे में रिकॉर्ड किया गया जबकि लौकी (बीजी-24) में यह 80% और पीडीआई 26.67 प्रतिशत था।

चार माह में मातृ बल्बों से प्राप्त रजनीगंधा की किस्म अर्का प्रज्वल के गुणवत्तापूर्ण रोपण स्टॉक के लिए चार प्रगुणन प्रोटोकॉल मानकीकृत किए गए। ग्लेडियोलस किस्मों अर्का अमर और अर्का आयुष में उच्चतर प्रवर्धन गुणांक प्राप्त किया गया जिसके लिए इनका क्रमशः 150 पीपीएम बेंज़िल एडेनिन और 150 पीपीएम सैलिसिलिक अम्ल से उपचार किया गया। गुलाब में, मूलवृंत के रूप में नेटल ब्रायर से 72.7% की बेहतर कलिका जीवंतता दर्ज की गई और कलम किस्म अर्का सावी में कलिका जीवंतता के लिए बेहतर निष्पादन पाया गया, जबकि अर्का स्वदेश में अगेती अंकुरण देखा गया। पोषक तत्वों की 120:80:240 किग्रा नाइट्रोजन:फास्फोरस:पोटाश प्रति हेक्टेयर/वर्ष + 25 टन गोबर की खाद +12.5 प्रतिशत की दर से एएमसी का उपयोग तथा एकल छिद्रण के साथ-साथ 45 x 45 सेमी का अंतराल रखते हुए मातृ पौधा खंड से क्रॉसेंड्रा से अर्का चन्ना की अंतस्थ कलमों की सर्वोच्च जीवंतता दर तथा अंकुरों/कलमों की सर्वाधिक संख्या रिकॉर्ड की गई।

दीर्घावधि (16 घंटे प्रकाश, 8 घंटे अंधकार) से युक्त प्रकाशवधि मॉड्यूल में उल्लेखनीय रूप से बेहतर पुष्प गुणवत्ता संबंधी प्राचल देखे गए, जिसके बाद कर्तित गुलदाउदी की विभिन्न किस्मों में पुष्प कलिका निकलने

की अवस्था तक अल्प दिवसों (8 घंटे प्रकाश-16 घंटे अंधकार) का स्थान था। गुलाब पर लवणता संबंधी अध्ययन से स्पष्ट हुआ कि अर्का परिमला में प्रति पौधा पुष्पों की संख्या 69 से 53, अर्का सावी में 53 से 44 तथा *आर. म्ल्टीफलोरा* पर अर्का सुकन्या में 50 से 33 तक कम हो जाती है, जबकि लवणता में 7.5 डीएसएम$^{-1}$ वृद्धि होती है।

पाइपर लोंगम की खेती में 10% कुनापजाला के साथ जैविक उपचार में शाखाओं की संख्या, फलने वाली शाखाओं और सूखी जड़ की उपज में वृद्धि हुई। इसके साथ ही रोपाई के 240 दिन बाद 50% गोबर की खाद और 50% वर्मीकम्पोस्ट के माध्यम से आरडीएफ में उच्चतर पिपेरिन सामग्री (2.7%) देखी गई।

केले के सम्पूर्ण फल तथा केले के गूदे में बीटासाइफ्लुथ्रिन और इमिडाक्लोप्रिड के अवशेष और दृढ़ता के अध्ययन ने संकेत दिया कि इमिडाक्लोप्रिड और बीटासाइफ्लुथ्रिन अवशेष अनुशंसित खुराक पर क्रमशः 20.28 दिन व 16.75 के अर्ध-जीवन मूल्यों के साथ विघटित हो गए। अंगूर के फलों में, यह पाया गया कि फॉसेटाइल-एल्यूमीनियम और फॉस्फोनिक अम्ल के अवशेष 7.57 दिनों के अर्ध-जीवन मूल्यों के साथ विघटित हो जाते हैं, ट्राइफ्लोक्सीस्ट्रोबिन अवशेष 10.9 दिनों के अर्ध-जीवन मूल्यों के साथ विघटित होते हैं, फ्लूपायराम अवशेष 8.68 दिनों के अर्ध-जीवन मानों के साथ विघटित होते हैं तथा डिफेनोकोनाज़ोल अनुशंसित खुराक पर 7.51 दिनों के अर्ध-जीवन मानों के साथ विघटित होते हैं। अनार में आइसोटियानिल और फोसेटाइल-एल्यूमीनियम के अवशेष अनुशंसित खुराक पर क्रमश: 6.07 और 0.61 दिनों के अर्ध जीवन मानों के साथ विघटित होते हैं। खीरा में, फ्लूपाइरोम और टेबुकोनाज़ोल के अवशेष अनुशंसित खुराक पर क्रमशः 2.20 और 1.97 दिनों के अर्ध-जीवन मानों के साथ विघटित होते हैं।

फसल सुरक्षा

फ्यूजेरियम ऑक्सीस्पोरम एफ. एसपी. *प्सिडाई और लाभकारी माइक्रोबियल इनोक्युलेंट* के बीच की अंतःक्रियाओं ने *फ्यूजेरियम* को रोकने में *ट्राइकोडर्मा* प्रजाति (जीजे16बी और जेएल-5 क्रमशः 36.1 और 40.8% अवरोध के साथ) की प्रभावशीलता का संकेत दिया। एएमसी 0.78% अवरोध के साथ कम प्रभावी था। उच्च सांद्रता में पामिटिक अम्ल अंगूरों की दिलकुश किस्म के निधानी आयु बढ़ाने में प्रभावी था। अंगूरों को 20 और 10% पामिटिक अम्ल के संपर्क में रखने से उनकी गुच्छों में 12 दिनों तक बिक्री योग्य गुणवत्ता बनाए रखी। अंगूर की किस्मों में वाष्पशील कार्बनिक यौगिकों के उत्पादन के लिए जैवएजेंट के छिड़काव की पूर्व-कटाई के संबंध में, *हैन्सेनियोस्पोरा ओपंटिया* (एमवाई) और *बैसिलस एमाइलोलिकेफैशियन* (गोल-2) को आम और अंगूर के फलों की सतहों से अलग किए गए संभावित अधिपादपों के रूप में पहचाना गया, जो वीओसी का उत्पादन करते थे और अंगूर के रोगजनकों के खिलाफ प्रभावी पाए गए। दिलकुश में *एच. ओपंटिया* और *बी. एमाइलोलिकेफैशियन* प्रभावी थे, लेकिन बैंगलोर ब्लू में प्रभावी नहीं थे। सफेद गूदा वाले ड्रैगन फ्रूट पौधों में, यह पहचाना गया कि लाल-काले रंग के तने के धब्बे *एपिकोकम सोरघिनम* (ईएसएच14 विलगम) के कारण होते हैं ।

टमाटर में जीवाण्विक पत्ती धब्बा उत्पन्न करने वाली *ज़ैंथोमोनस* प्रजातियों के बीच आनुवंशिक विविधता का अध्ययन करने के लिए चार जीनों, *यानी, GyrB*, gap1, glt1और lepa का उपयोग करके बहु स्थल अनुक्रम मूल्यांकन (एमएलएसए) को नियोजित किया गया है। "GyrB" और "Lep" जीनों में अधिक भिन्नता दिखाई, जिससे वे प्रजातियों के भीतर अंतर को पहचानने के लिए बेहतर मार्कर सिद्ध हुए। सीटीएबी विधि के संशोधित प्रोटोकॉल का उपयोग करके टमाटर के 303 पर्ण कुंचन नमूनों के कूल जीनोमी डीएनए विलगित किए गए। इसी प्रकार RNeasy पादप मिनी किट (क्यूजेन, वेलेंसिया, सीए) द्वारा एकत्र किए गए 144 खेत नमूनों से कुल आरएनए निष्कर्षित किए गए । डीएनए विषाणुओं के लिए उन विषाणुओं के सीपी जीन के प्रति विशिष्ट विभिन्न प्राइमरों का उपयोग करके पीसीआर आवर्धन किया गया।

टमाटर में समेकित प्रबंधन के लिए इमिडाक्लोप्रिड 60 एफएस (5 ग्राम प्रति किग्रा बीज) + एएमसी का पत्तियों पर उपयोग (20 मिली प्रति लिटर) 30 दिन बाद तथा इसके 30 दिन बाद 0.4 ग्राम थायामेथोक्सम का पत्तियों पर छिड़काव, 30 दिन के बाद समुद्री खरपतवार के सत इमामेक्टिन बेंजोएट (0.2 ग्राम प्रति लीटर) का पत्तियों पर छिड़काव और 45 दिनों के बाद उपरोक्त के पत्तियों पर छिड़काव के साथ-साथ 60 दिनों पर एएमसी (20 मिलि प्रति लिटर) का पत्तियों पर छिड़काव जैसे उपचार अत्यधिक प्रभावी पाए गए और इनसे रोग के प्रकोप में 20.2% की कमी आई।

फलीदार सब्जियों में *कोलेटोट्रीकम लिंडेमुथिएनम* के नियंत्रण के लिए जिन कवकनाशियों का परीक्षण किया गया उनमें से कार्बेन्डाजिम, थियोफैनेट मिथाइल, टेबुको नाजोल+ट्राइफ्लोक्सीस्ट्रोबिन और कार्बेन्डाजिम+मैन्कोजेब में स्वपात्रे दशाओं के अंतर्गत 10 से 150 पीपीएम पर *सी. लिंडेमुथिएनम* का पूर्ण निषेध प्रदर्शित हुआ।

इसके अतिरिक्त, *ट्राइकोडर्मा विरिडी* के एक पृथक्करण ने भी स्व पात्रे में *सी.* लिंडेमुथिएनम का प्रभाशीलता प्रदर्शित की। कुकरबिटेसी कुल की सब्जियों फली वाली सब्जियों और सोलेनेसी कुल की सब्जियों में बीज वाहित विषाणुओं का पता लगाने और उनका लक्षण-वर्णन करने के लिए टीईएम और पीसीआर जैसी उन्नत नैदानिक तकनीकों का उपयोग किया गया जिनका उन्नत रोग प्रबंधन कार्यनीतियों में योगदान रहा। कद्दूवर्गीय फसलों में चिपचिपे तना अंगमारी के प्रबंधन के लिए *ट्राइकोडर्मा एस्परेलम* प्रभेद आईआईएचआर टीवी5 और *बैसिलस सबटिलिस* इन फसलों में चिपचिपा तना अंगमारी के कारक एजेंट, *स्टैगैनोस्पोरोप्सिस कुकुरबिटेसिरम* के विरुद्ध प्रभावी पाए गए।

अल्टरनेरिया पोलिएंथी के लिए रजनीगंधा के लगभग 134 वंशों की जांच की गई, जिनमें से चार संकर मध्यम रूप से प्रतिरोधी पाए गए। गेंदे में पत्ती और पुष्प अंगमारी उत्पन्न करने वाले *अल्टरनेरिया टेजेटिका* के विरुद्ध जिन 191 जीनप्ररुपों का मूल्यांकन किया गया उनमें से पांच मध्यम रूप से प्रतिरोधी जीनोटाइप पूसा अर्पिता, आईसी-250332, आईसी-250323, केएयू-एम2 और सीजीएफएम-रायचूर पाए गए। फ्यूजेरियम विल्ट के लिए 2 मौसमों के लिए ग्लेडियोलस जननद्रव्य (*एन* =75) की खेत में की गई छंटाई के आधार पर लगभग 36 अत्यधिक प्रतिरोधी (0-10%) और 34 प्रतिरोधी (10-25%) पाए गए। कृत्रिम संरोपण में 4 जीनप्ररुप (गोल्ड, पंजाब ग्लैड-3, जेवी गोल्ड और येलो स्टार) अत्यधिक प्रतिरोधी पाए गए और 5 जीनप्ररुप (ईसी येलो, डीएफआर-1, नोवालक्स, आयुष और संजीवनी) प्रतिरोधी पाए गए।

कीटरोगजनक सूत्रकृमि का एक प्रभेद, *हेटेरोरहैबडाइटिस इंडिका* आम के तना बेधक के विरुद्ध प्रभावी पाया गया। तने बेधकों द्वारा वृक्ष में किए गए छिद्रों में पांच दिनों के अंतराल पर तीन बार प्रति छिद्र 10 मि.लि. की दर से ईपीएन के घोल को सुई द्वारा छिद्रों में डालने से तना बेधक के प्रकोप में लगभग 80 प्रतिशत की कमी देखी गई। पिछले कुछ वर्षों में संवेदनशीलता के स्तर के आधार पर, आम की चुनी हुई किस्मों को अलग-अलग संवेदनशीलता समूहों में वर्गीकृत किया गया। तोतापुरी और लंगड़ा: संवेदनशील (15-20%); अल्फांसो और बंगनापल्ली: मध्यम रूप से संवेदनशील (5-10%); मल्लिका और नीलम: सबसे कम संवेदनशील (<5%) पाए गए।

एजाडिरेक्टिन 1% को 2.5 मि.लि./लि. की दर से पुष्प कलिका निकलने पर उसका प्रथम छिड़काव करने और उसके दो सप्ताह बाद 10 ग्रा. प्रति लिटर की दर से पोंगामिया साबुन का दूसरा छिड़काव करने तथा फल निकलने की अवस्था पर 10 ग्रा./लिटर की से नीम साबुन का तीसरा छिड़काव करने वाला प्रबंधन मॉड्यूल आम में फुदकों (*इडियोस्कोपस* प्रजातियां) और थ्रिप्स (*स्किरोथ्रिप्स डोरसैलिस* और अन्य प्रजातियाँ) के नियंत्रण के लिए सबसे प्रभावी था। फुदकों (*इडियोस्कोपस* प्रजातियां) और थ्रिप्स (*स्किरोथ्रिप्स डोरसैलिस* और अन्य प्रजातियाँ) की समष्टि में 80% से अधिक की कमी आई।

अमरूद की अर्का किरण किस्म में, प्रति पौधा 0.5 मिली की दर से फ्लूपायराम का उपयोग और रोपाई के पूर्व गोबर की खाद से समृद्ध *बेसिलस एमिलोलिकेफेसिएंस* आईआईएचआर बीए-2 का उपयोग तथा तिमाही अंतराल पर प्रति पौधा 2 लिटर की दर से नीम की खली के सस्पेंशन से युक्त जैव एजेंट का मिट्टी में भ्राव करने से जड़गांठ सूत्रकृमियो की समष्टि में 71.3 प्रतिशत की सर्वाधिक कमी हुई और उपज में 18.6 प्रतिशत तक की वृद्धि हुई। अमरूद में सूत्रकृमिमुक्त रोपण सामग्री उत्पन्न करने के लिए निर्वात चूषण उपकरण के माध्यम से *बेसिलस* आईआईएचआर बीए2 के उपचार से पिटिकाओं की संख्या में न्यूनतम कमी हुई (0.03) और मिट्टी में भी सूत्रकृमियों की समष्टि कम हुई (48.00 प्रति 100 घन सें.मी. मृदा) और इसके साथ ही वृद्धि संबंधी प्राचल भी उच्चतर हुए। एवोकैडो में, जापानी भृंग के संक्रमण के कारण उपज में होने वाली हानि 20% से 40% तक आंकी गई जो संक्रमण की गहनता पर निर्भर था।

टमाटर में, *ट्रैकिसपर्मम एम्मी* के सगंधित तेल में *प्थोरिमिया एब्सोल्यूटा* के विरुद्ध सर्वोच्च मृत्यु दर प्रदर्शित हुई (100%), उसके बाद *सिज़ीगियम एरोमैटिकम* का स्थान रहा (97.5% मृत्यु दर)। *एफिस क्रैकसिवोरा* के लिए, सबसे अधिक मृत्यु दर *जर्मेनियम डिसेक्टम* (100%) के साथ दर्ज की गई, उसके बाद *टी. एम्मी* (95% मृत्यु दर) का स्थान रहा। द्विपदीय यौगिकों में से, थाइमोल और सिट्रोनेलोल से क्रमशः *प्थोरिमिया एब्सोल्यूटा* की क्रमश: *100% और 90%* मृत्यु दर दर्ज की गई। *जिरानियोल* और *डी-लिमोनीन* से *ए. क्रैकसिवोरा* की क्रमश: 92.5% और 90% मृत्यु दर दर्ज की गई ।

संरक्षित परिस्थितियों में उगाए गए टमाटर में जड़ गाँठ सूत्रकृमि के प्रबंधन के लिए, प्रति एकड़ 500 मि.लि. की दर से फ्लूओपिरम 400 एससी का उपयोग और उसके पश्चात खड़ी फसल में 30 दिन में एक बार जैव पीड़कनाशियों के सस्पेंशन से समृद्ध नीम की खली के घोल का मिट्टी में भराव करने से सूत्रकृमियों की समष्टि में कमी आई और उपज में वृद्धि हुई। विभिन्न ब्रैसिका

प्रजातियों में से सरसों की फसल में से 1 प्रतिशत की दर पर सरसों की फसल के अवशेषों का उपयोग करना टमाटर में *एम. इनकॉग्निटा* का उपयोग करने में सर्वाधिक प्रभावी पाया गया।

कैप्सिकम की 11 वन्य प्रजातियों के अत्यधिक पादप वाष्पशील यौगिकों (एचपीवी) में *थ्रिप्स पार्विसपिनस* और *स्किर्टोथ्रिप्स डोर्सालिस,* दोनों के लिए महत्वपूर्ण प्रतिकर्षण दिखाया था। मिर्च में थ्रिप्स (*थ्रिप्स पार्विसपिनस*) के आईपीएम के लिए सफेद और नीले रंग के चिपचिपे ट्रैप का उपयोग किया जा सकता है । *टी. पार्विसपिनस* के विरुद्ध मूल्यांकित जैविक निवेशों में से नीम तेल + पोंगामिया तेल + लहसुन + मिर्च + 5 मि.लि. प्रति लिटर की दर से एफओआरएस का सम्मिलित उपयोग तुलनीय उपचारों की अपेक्षा थ्रिप्स की मृत्यु दर को 67.0% कम करने में प्रभावी पाया गया, जबकि 4 मि.लि./लिटर की दर से एज़ाडिरेक्टिन 10000 पीपीएम के परिणामस्वरूप 63.4% मृत्यु दर हुई। व्यापक क्षेत्र सर्वेक्षण किए गए और कैप्सिकम पारिस्थितिकी प्रणाली से *टी. पार्विसपिनस* से संबंधित चार जैवएजेंट प्राप्त किए गए।

प्राकृतिक खेत दशाओं के अंतर्गत जड़गांठ सूत्रकृमियों *एम. इनकॉग्निटा* के प्रति प्रतिक्रिया के लिए रजनीगंधा के जिन 13 वंशक्रमों का अवलोकन किया गया, उनमें से अर्का कीर्तना (जीआई - 1.3) में न्यूनतम पिटिका सूचकांक (जीआई) पाया गया, उसके पश्चाम क्रमश: आईआईएचआर-17-5-2 (जीआई: 1.60), आईआईएचआर-15-5-16 (जीआई; 1.73) और आईआईएचआर 17-22एचएस-83 (जीआई 2.00) का स्थान रहा। रजनीगंधा में सूत्रकृमि रोपण सामग्री के उत्पादन के लिए, रोपण सामग्री का मूल्यांकन निर्वात चूषण उपचारित उपकरणों के साथ और बिना कई जैवएजेंट और रसायनों की प्रभावकारिता का मूल्यांकन किया गया। निर्वात चूषण उपकरण से उपचारित *बैसिलस एमाइलोलिकेफेसिएन्स* आईआईएचआर बीओ-2 में पिटिकाओं की सबसे कम संख्या (0.33) दर्ज की गई, मृदा में सूत्रकृमियों की समष्टि भी सबसे कम (60.00 प्रति 100 घन सें.मी. मृदा) थी और इसके साथ ही रजनीगंधा में वृद्धि संबंधी प्राचल भी उच्चतर थे। जड़गांठ सूत्रकृमियों के विरुद्ध प्रतिक्रिया के लिए ग्लेडियोलस के संकर चयनों का खेत मूल्यांकन किया गया, जिसमें *मेलाइडोगाइने इन्कोग्निटा* का पिटिका सूचकांक (जीआई) 0.73 से 3.73 (0 से 5 के पैमाने पर) था, और सबसे कम जीआई आईआईएचआर 15-1-105 में दर्ज किया गया था जबकि सबसे अधिक जीआई आईआईएचआर 15-1-212 में दर्ज किया गया था।

फसल उपयोग और फार्म यंत्रीकरण

शरीफा में, गामा विकिरण से अर्का सहान संख्या के फलों में सतह का गहन कालापन उत्पन्न हुआ। यदापि 400 और 800 ग्रे की उच्चतर खुराकों के माध्यम से फल मक्खी के संक्रमण का प्रभावी नियंत्रण हुआ। न्यूनतम संसाधित प्यूमेलो और अनार की निधानी आयु बढ़ाने वाली विधियों का मानकीकरण किया गया। परिपक्वता की विभिन्न अवस्थाओं में तोड़े गए फलों की निधानी आयु संबंधी अध्ययनों से यह स्पष्ट हुआ कि जिन फलों को 70 प्रतिशत रंग विकसित होने की अवस्था पर तोड़ा गया, उनकी निधानी आयु सर्वाधिक थी। सूक्ष्म छिद्रित (0.005%) से युक्त गैर-वातायित पुनेट बक्सों में पैकबंद किए गए रंबूटान के फल 9 डिग्री सेल्यियस $\pm$1 पर 21 दिनों तक भंडारित किए जा सकें, जबकि इसकी तुलना में गैर पैकबंद फल 9 दिनों तक ही भंडारित किए जा सके। मलायन सेब के फलों को कलिका निकलने से तुड़ाई की अवस्था तक लगभग 97 दिनों की आवश्कयता होती है और फसल के उचित पुष्पन व फलन के लिए लगभग 282.96 ताप इकाइयों की आवश्यकता होती है।

कई अन्य खाद्य योजकों के साथ ड्रैगन फल के छिलकों का उपयोग करके तैयार किए गए जैम में 10 प्रतिशत सूक्रोज भी था और इसे लोगों ने स्वीकार भी किया। अर्का कमलम आरटीएस पेय में आजमाए गए विभिन्न प्राकृतिक फ्लेवर में अदरक, इलायची और तुलसी के बीजों के फ्लेवर स्वीकारे थे। लाल ड्रैगन फल से तैयार प्रोबायोटिक पेय को मानकीकृत करने के प्रोटोकॉल निर्धारित किए गए। कैबिनेट ड्रायर में एवोकाडो पाउडर तैयार करने के लिए उचित फार्मूलेशन भी मानकीकृत किया गया है। कृत्रिम रंगों के विकल्प के रूप में जामुन, बार्बाडोस चेरी, ड्रैगन फल और टमाटर से प्राप्त किए गए प्राकृतिक फल रंगों के परत चढ़े कंगनी, सोयाबीन और मटर के आटे से तत्काल खाने के लिए तैयार फुलिल्त स्वल्पाआहार के विकास के लिए प्रक्रिया प्रोटोकॉल भी तैयार किए गए। फुल्लित स्वल्पाआहार बनाने के लिए कंगनी के आटे और एवोकाडो के चूर्ण को मिलाकर तैयार किए गए उत्पाद कैल्सियम (0.24%), मैग्नीशियम (0.43%), लौह (26.1 पीपीएम) और जस्ते (10.3 पीपीएम) से समृद्ध थे।

विभिन्न विलायकों और निष्कर्षण विधि का उपयोग करके बेल के गूदे से मर्मेलोसिन प्राप्त करने की प्रक्रिया मानकीकृत की गई। कैबिनेट शुष्कक का उपयोग करके हरी मिर्च को सुखाने के लिए शुष्कन प्राचल उपयुक्तम बनाए गए और हरी मिर्च का पाउडर तैयार करने के लिए उसे पीसेन के प्रोटोकॉल स्थापित किए गए। करेले में विभिन्न जीनप्ररुपों को सुखाने या निर्जलीकरण करने का

प्रयास किया गया। पुष्पों के कचरे से तत्काल उपयोग के लिए तैयार ठोस कम्पोस्ट ब्लॉक तैयार करने की प्रक्रिया का प्रोटोकॉल मानकीकृत किया गया। स्क्वाश पेय में *सैंट्रेला एशियाटिका* की पत्तियों का उपयोग किया गया है। सैंट्रेला स्क्वेश को आदर्श तापमान पर 6 माह के लिए भंडारित किया जा सकता है। *मैक्रोसाइबे गिर्गेंटिया* से डी-मैनोसाइल विशिष्ट लैक्टिन विलगित और शुद्ध किए गए जिनमें अर्बुद्ध रोगी/कैंसर रोधी क्रिया प्रदर्शित हुई। धान के गीले पुआल में *प्लुरोटस पल्मोनेरियस* में पंजीकृत गीले धान के भूसे में 212.6 ग्राम प्रति किलोग्राम की उच्चतम जैविक दक्षता (उपज) *प्लूरोटस प्ल्मोनेरियस* में दर्ज की गई। 450 जीवाई पर रखे गए *एग्रोसाइबी गिरैटा* में अन्य खुराकों और तुलनीयों की अपेक्षा सर्वोच्च उपज दर्ज की गई।

उत्पादन, विपणन और व्यापार का अर्थशास्त्र

निम्न लागत परिपक्वन (एलसीआर) प्रौद्योगिकी जिसमें 1.93 रुपये प्रति किलोग्राम लागत वाले एफएसएसएआई द्वारा स्वीकृत परिपक्वन घोल का उपयोग किया जाता है, उसे सुरक्षित श्विसनीय और प्राधिकृत विकल्प के रूप में पाया गया है। कर्नाटक में इस प्रौद्योगिकी को 90 अपनाने वाले हैं जो कुल उपयोगकर्ताओं का 62.9% है जबकि केरल में 18 उपयोगकर्ता हैं। अधिकांश (52.83%) ने इस प्रौद्योगिकी दर 5 रेटिंग दी है, जिससे यह पता चला कि वे इससे अत्यधिक संतुष्ट थे। बयाडगी एपीएमसी में मिर्च की फसल पर एपीएमसी डीरेग्यूलेशन (कर्नाटक सरकार की मई 2020 की नीति) के प्रभाव से स्पष्ट हुआ कि यदापि आरंभ में मूल्यों में कमी आई, लेकिन बाद में सकारात्मक प्रवृत्ति देखी गई। इससे यह स्पष्ट हुआ कि समय के साथ मूल्यों में सकल वृद्धि हुई। बयाडगी एपीएमसी का औसत वार्षिक राजस्व बाजार में निम्न वसूली के कारण कमी आई यदापि बाजार में पहुंचने वाले उत्पाद और मूल्यों में, दोनों में वृद्धि दर्ज की गई। मिर्च की खेती करने वाले किसानों में एपीएमसी बिक्री (7921 रुपये/क्विंटल) और बाहर की जाने वाली बिक्री (7897 रुपये/क्विंटल) से होने वाली निवल आय में अंतर नगण्य था। अध्ययन से छह विपणन चैनलों की पहचान हुई और पाया गया कि 92 प्रतिशत उपज का व्यापार एपीएमसी के माध्यम से किया जा रहा है।

बागवानी जिंसों में मांग और आपूर्ति अनुमानों के संबंध में, फलों और सब्जियों में उल्लेखनीय वृद्धि होने की आशा है, जो क्रमशः 109.53 मिलियन टन से लगभग दोगुनी होकर 225.17 मिलियन टन और 213.88 मिलियन टन से 417.53 मिलियन टन हो जाएगी। पुष्पों और मसालों में उल्लेखनीय वृद्धि देखी गई है, जिसमें पुष्पों में लगभग चार गुना वृद्धि हुई और मसालों में छह गुना से अधिक (11.26 मीलियन टन से 69.61 मिलियन) वृद्धि हुई। हालांकि, सुगंधित और औषधीय पौधों और रोपण फसलों में स्थिरता या गिरावट देखी गई।

ड्रैगन फल के बाग स्थापित करने की अनुमानित लागत 9.80 लाख रुपये प्रति एकड़ थी, जिसमें से अचल लागत और परिवर्तनशील लागत क्रमश: 5,91,840 रुपये और 3,89,070 रुपये थी।

ड्रैगन फल की औसत उपज 4.5 टन प्रति एकड़ थी। ड्रैगन फल की खेती से प्राप्त होने वाला सकल अनुमानित लाभ 6,75,000 रुपये होने का अनुमान लगाया गया था। बाधा विश्लेषण से पता चला है कि ड्रैगन फल के बाग लगाने के लिए आवश्यक उच्च प्रारंभिक लागत प्रमुख बाधा (93%) है, इसके बाद समय पर गुणवत्ता वाले रोपण सामग्री की अनुपलब्धता (88%) और उपज के विपणन की समस्या (85%) है।

सांख्यिकीय अनुसंधान

अखिल भारतीय समन्वित अनुसंधान परियोजना (फल) के पांच स्थानों पर मेंडारिन के 7 वंशक्रमों की स्थिरता के मूल्यांकन के लिए बहुचरीय (मल्टीवेरियट) विधि अपनाई गई। उपज और वृद्धि संबंधी सात गुणों के लिए अपनाए गए सात स्थिरता उपायों पर आधारित परिणामों के आधार पर तीन अनूठे समूहों की पहचान की गई (समूह 1: मेंडारिन और नागपुर सीडलेस, समूह 2: दार्जिलिंग मेंडारिन और मुदखेड सीडलेस, समूह 3: खासी मेंडारिन, कूर्ग मेंडारिन और किन्नू मेंडारिन)। फलों की उपज के लिए लुधियाना, उसके पश्चात अकोला, श्रीगंगानगर और नागपुर सर्वोत्तम स्थान हैं।

चाइना एस्टर और जरबेरा के स्थिरता विश्लेषण के लिए बहुआयामी स्केलिंग दृष्टिकोण को अपनाया गया, जिसके तहत चाइना एस्टर 36 वंशों और जरबेरा के 16 वंशों की स्थिरता का वृद्धि पुष्प गुणवत्ता और पहचाने गए तीन समूहों के आधार पर मूल्यांकन किया जा सके।

कृषि में कंप्यूटर अनुप्रयोग

चीकू की खेती के लिए तेलुगु में और अनार की खेती के लिए हिंदी में मोबाइल ऐप डिजाइन और विकसित किए गए।

कृषि विस्तार अनुसंधान

चयनित बागवानी फसलों के उत्पादन और निर्यात को बढ़ावा देने में अनुसंधान और विस्तार अंतराल के संबंध में, अधिकांश किसानों (70%) ने व्यक्त किया कि

अनेक फसलों के मामले में सस्योत्तर साज संभाल से संबंधित समरूप मानक प्रोटोकॉल की कमी है। किसानों (73.33%) ने ऑन लाइन खरीद प्लेटफार्म की की आवश्यकता पर बल दिया। अर्का मीली मेल्ट के अपनाने और इसके अनुप्रयोग संबंधी अध्ययनों से यह स्पष्ट हुआ कि विभिन्न फसलों में मीली मतकुड़ के प्रबंधन के मामले में यह प्रभावी है। प्रमुख फसलों में प्रतिभागिता संबंधी प्रदर्शनों के मामले में 53 प्रतिशत किसानों ने संतोष व्यक्त किया और 93 प्रतिशत किसानों ने 70-100 मि.लि./लिटर की वर्तमान खुराक को कम करने के लिए इसकी सांद्रता को बढ़ाने का सुझाव दिया, ताकि यह और अधिक सस्ती तथा उपयोगकर्ताओं के लिए अनुकूल बन सके। विषाणु प्रतिरोधी मिर्च की किस्मों के मामले में किसानों ने यह बताया कि भा.बा.अनु.सं. की अर्का तेजस्वी किस्म विद्यमान बाजार के लिए बहुत उपयुक्त है तथा अर्का सानवी और अर्का यशस्वी ने भी उपज, उत्पादकता तथा उपभोक्ताओं की पसंद के संदर्भ में बहुत अच्छा निष्पादन दिया है।

मशरूम उगाने वाली महिला किसानों की पोषणिक तथा आय सुरक्षा में सुधार के स्तर के मूल्यांकन से यह प्रदर्शित हुआ कि लाभ-लागत के 1.8 से 5.1 अनुपात के साथ आजीविका सुरक्षा (एलआई) स्कोर के आधार पर महिलाओं की पोषणिक सुरक्षा में उल्लेखनीय सुधार हुआ है तथा आय में 100-200 प्रतिशत की वृद्धि हुई है। अर्का सब्जी बीज किट के माध्यम से खेतिहर महिलाओं की पोषणिक और आजीविका सुरक्षा के संबंध में यह स्पष्ट हुआ कि आमदनी में 15 से 18 प्रतिशत की उल्लेखनीय वृद्धि हुई है। प्रति 0.1 एक एकड़ 738.9 कि.ग्रा. की उपज वृद्धि के साथ अर्का हर्षिता से लाभ प्राप्त हुआ है और खेतिहर महिलाओं की औसत निवल आय 24,015 रुपये प्रति वर्ष रही है। इसके बाद मिर्च की अर्का मेघना और टमाटर में अर्का रक्षक का स्थान था।

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2.2. Executive Summary

The important findings from various research projects, extension activities and PG education in ICAR-IIHR for the year 2024 are summarized in this chapter

CROP GENETIC RESOURCES

The ICAR-IIHR is the nodal centre for management plant genetic resources of several horticultural crops in the country and is the recognized National Active Germplasm Site (NAGS) for fruit, vegetable and flower crops. In the year 2024, the germplasm collections included 78 in fruit crops, 639 in vegetable crops, 108 in flower crops, 51 in medicinal crops and 2 in mushrooms. The total germplasm lines collected in different mandate crops of the institute in 2024 were 878. Overall, about 14,529 viable germplasm were conserved at Bengaluru, Chettalli and Bhubaneswar. The fruit crops, vegetable crops, flower crops, medicinal crops and mushrooms account for 2582, 10583, 981, 276 and 107 of total germplasm lines, respectively.

The farmer's variety, Niranthara Kumar Jamun (Round the Year Jamun, REG/2023/0124), that bears fruits year-round, was identified and registered with PPV & FRA for linking biodiversity to livelihood security. A promising wax apple genotype, CHESM-1, was identified as a regular-bearing and high-yielding (90 to 120 kg plant^{-1}) seedling selection from the local collection. The five different native fruits of the Coorg region, including *Ziziphus oenoplia* (L.) Miller), *Glycosmis mauritiana* (Lam.) *Elaeocarpus variabilis* Zmarzty, *Canthium parviflorum* Lam, *Rubus niveus* Wall were collected and conserved at CHES-Chettalli. The promising soursop accessions include CHES-R3P3 for big size fruits (22.3 cm x 13.5 cm fruit size, 1358.8 g fruit weight, and 1007.6 g pulp weight) and IIHR-R6P2 for higher TSS (14°Brix), lower acidity (0.45%), lower seed weight (14.6 g) and lower seed number (25.5)

In jackfruit segment for table purpose, two farmers varieties such as Harigold and Thirumala, from Panruti, Tamil Nadu were identified. Both the varieties showed superior performance with respect to fruit quality and yield traits. Tender jackfruit accessions (n=10) were collected from Karnataka and Tamil Nadu for assessing suitability for tender jack purpose.

In tomato, 84 diverse tomato accessions sourced from different National and International institutes/ organizations were evaluated for seedling stage heat tolerance in polyhouse with average maximum temperature recorded was 44.67°C during March 2024. The two accession AVTO 1822 and AVTO1892 were identified as tolerant based on superior performance for shoot length, shoot weight, stem girth, root length, root weight and leaf area. In chilli, 26 purple fruited accessions were characterized for anthocyanin content and the total anthocyanin content was ranged from 30.2 to 59.7 mg 100 g^{-1} (Fresh weight). The accession IIHR-B-HP-81 had highest total anthocyanin content of 59.7 mg 100 g^{-1}and 32.2 mg 100 g^{-1} FW of delphinidin and could serve as a potential donor for breeding peppers rich in nutraceuticals. The GC-MS profiling in Southeast Asian thrips resistant accessions, tritriacontan-16-one as a key epicuticular wax component in IIHR 4550 and Hex-3(Z)-enyl butyrate in resistant accessions IIHR 4550 and IIHR-B-HP-79 were conferring resistance to southeast Asian thrips resistance in chilli and same was validated through olfactometer studies and leaf dip bioassay.

In brinjal, 270 accessions were characterized as per minimal descriptor of NBPGR. Accession such as IIHR-824, IIHR-803 (*S. torvum*) and IIHR- 792 (*S. seaforthianum*) were identified as resistant and recorded less than 10 galls per root system and reproduction factor is <1. Arka Harshitha was found resistant to both salinity and bacterial wilt disease. IIHR-629 (Mattugulla fruit type) showed moderate resistance to *Phomopsis* fruit rot. In ridge gourd, the accessions IIHR-345 (52 t ha^{-1}), IIHR-347 (48.25 t ha^{-1}) and IIHR-346 (44.25 t ha^{-1}) recorded the higher fruit yield per hectare and resistance to downy mildew with the PDI of less than 10.

In bitter gourd, superior germplasm with respect to yield were IIHR-181 (14.19 t ha^{-1}), IIHR-196 (13.94 t ha^{-1}) and IIHR-189 (13.5 t ha^{-1}). Fourteen lines showed complete resistance for tomato leaf curl New Delhi Virus. In cucumber, 144 germplasm accessions were characterized. Based on multi-trait genotype-ideotypes distance index (MGIDI), principal component analysis and factor analysis, 21 best cucumber genotypes were selected. In French bean, IIHR-296 recorded highest anthocyanin content (35.7±9.55 mg CGE 100 g^{-1} FW). In onion, four lines ATR/IIHR-01, ATR/IIHR-02, ATR/IIHR-03 and ATR/IIHR-04 showed high level of resistance to antracnose both in natural and artificial inoculated conditions. The landrace collected from Chitradurga, LSR/18/37 showed high level of resistance (PDI: 5.5) to twister disease. In curry leaf, 20 accessions from Karnataka, Odisha and Tamil Nadu were evaluated for fresh leaf essential oil content and the maximum oil

content was noticed in LSR/18/06 (0.60%) followed by LSR/18/07 (0.56%).

In white flower colour group of China aster, cultivars Phule Ganesh White and Arka Archana recorded high loose flower yield, and in pink colour group, Arka Kamini and Arka Advika found promising for cut flower. In violet colour group, Arka Nirali with novel flower found promising for cut flower.

In crossandra, the Mutant-3 was found to be promising for highest rachis length (6.44 cm), and has dwarf growing habit and more longevity of flower in the plant and can be recommended for use in potted plants. Among *Barleria* germplasm (*n*=9), IIHR BC-H-05 recorded maximum loose flower yield in purple flower colour group and IIHR BC-H-06 in pink colour group. IIHR BC-V-02 with novel bi-coloured flower and IIHR BC-V-03 in white colour group were promising for loose flower. In red colour group, IIHR BR-V-01 was found promising as an attractive ground cover / edging plant. IIHR BP-V-01 in yellow coloured group was found promising as an attractive garden hedge plant.

CROP IMPROVEMENT

Four promising hybrids of Amrapali x Vanraj (R3P16, R3P22, R5P3, and R5P23) have been selected in mango for attractive peel color, high TSS, and high pulp recovery. Two F1 progenies (R1P8 and R1P6) and one half-sib of Dashehari (R27 P28) have been selected for their fruit quality. Six elite half-sibs of Goa Mankurad (R2P18, R3P24, R1P34, R1P29, R5P1, and R1P17) were selected for superior fruit quality, regular bearing and precocity in bearing. QTL seq analysis in 168 Amrapali x Vanraj progenies identified four QTLs (mipec 1, mipec 14, mipec 19, and mipec 20) associated with red peel color and a QTL (mipuc 14) associated with orange pulp color. In pumello, a putative marker CiBE0246 showed possible linkage with fruit weight and ascorbic acid content. The variation in the fruit's bitterness/sweetness is due to changes in a single nucleotide sequence, confirmed by LCMS analysis.

In papaya PRSV resistance breeding, three inter-generic hybrid progenies of Arka Prabhath x *Vasconcellea cundinamarcensis* x Red Lady (29-12, 28-12, and 19-9); BC1F3 intergeneric progenies of Arka Prabhath x *V. parviflora* x Arka Prabhath (43-5 and 44-15); red pulp type (27-14 and 27-22), and yellow pulp type (27-26) and intergeneric progenies of Red Lady x *Vasconcelleacauliflora* (4-9, 5-12, and 9-20) showed better fruit traits with PRSV tolerance. In papaya variety Arka Prabhath, parthenogenetic induction of haploids through immature ovule culture route through pollen irradiation showed 60 DAP ovules as responsive, and BSA analysis identified two informative markers. In the genome-edited population of *Carica papaya*, 20 T0 lines were screened and nulls were identified. Edit characterization of the selected populations revealed that the eIF4E target gene had mutations at the expected locus.

Four guava progenies *viz*., ISH 12 (Arka Poorna x *P. cattleianum* var cattleianum), ISH 10 and ISH 3 (Arka Poorna x *P. cattleianum* var lucidum), and ISH 1 (H 12-5 x *P. cattleianum* var cattleianum) were selected for combined resistance to wilt and nematode (*M. enterolobii*). A total of 16 QTLs were identified for colour traits across five LGs using both visual scoring and colour reader (CIELAB) based quantitative estimations. In sapota, out of eleven elite lines of hybrids and mutant populations were evaluated for dwarfness and high yield. The IHR-63 and some mutant plants were also found to be dwarf. In custard apple, twenty-two progenies of Arka Sahan x Balanagar have been selected based on their self-fruitfulness and fruit quality. In grape rootstock breeding, screening for salinity and sodicity was initiated in Dogridge mutants (R6P25M2, R6P27M4, R6P36M9, R6P39M12, R6P44M16) and Dogridge x 110R hybrids (R6P16H16, R6P43H28). Dragon fruit selection CHESH-D1 and mutant CHESH-DE were found superior for high fruit weight and yield.

In square round segment and processing type tomato hybrids (*n*=43), two hybrids (2023X114 and 2022X134) for early ripening and four hybrids (2022X078, 2022X134, 2023X199 and 2023X117) for TSS above 5°Brix were identified. The hybrids with higher pH were 2023X140 and 2022X78. In green shoulder type hybrids (*n*=12), 2023X46 and 2023X04 were identified for early flowering, 2023X11 and 2023X44 for early ripening and 2023X46 for highest yield. In flat and round type hybrids (*n*=23), early flowering hybrids were 2023X89 and 2023X106 and early ripening were 2023X81 and 2023X74. Higher yielding hybrids were 2023X53, 2023X75 and 2023X74. To enhance the shelf life, two guide RNA's specific for targeting the pectate lyase gene (Solyc03g111690) in the second exon region were designed, multiple guide RNA construct was cloned into pDIRECT_22C vector and transformation of tomato var. Arka Vikas resulted in two edited plants showing indels in pectate lyase gene. For Vitamin D bio-fortification, *Agrobacterium* mediated transformation of tomato cultivar Arka Vikas with CRISPR-Cas9 construct to knock out coding sequence of 7 dehydro cholesterol reductase gene was targeted with 3 individual guide RNA and 38 putative transformants were developed.

In chilli, populations developed using drought tolerant genotype, IHR4517 were forwarded to F_4 generation and 27 F_4 families were selected from crosses IHR4517 × Devnur Delux, IHR4517 × IHR 3448 and IHR4517 × Attigere Dabbi based on their yield and fruit quality parameters. To introgress anthracnose resistant loci from *Capsicum baccatum* into *C. annuum*, two species *C. chinense* and *C. frutescens* were used as bridge species and three-way cross progenies of [*C. annuum* × *C. chinense*) × *C. baccatum*] showed improved seed set and seed germination. From backcrossing with *C. annuum* and marker-assisted selection (MAS), about eleven advanced backcross plants showed good level of tolerance. For multiple virus disease tolerance, two advanced breeding lines (DF4-32 and DF4-171) derived from the cross ((MS3B × IHR 2451) × (MS3B × IHR 459) showed the combined tolerance to CMV-Guntur, ChVMV- Bengaluru and ChLCV Raichur isolates. The genome editing of the eIF4E genes for resistance to Chilli veinal mottle virus resistance, T_1 generation plants were raised from T_0 genome edited lines. Two QTLs on Chromosome 1 and 7 were identified for root weight and canopy temperature and genomic regions were narrowed down to 100 kb for further analysis.

In bell pepper, hybrids IIHRBP013 X HT-9 and IIHRBP34 X HT-7 were identified as stable hybrids based their performance at IIHR, Bangalore and NIASM, Baramati. IIHRBP061 (yellow), IIHRBP062 (red), IIHRBP008-1 (green) and IIHRBP008-2 (light green) were identified for high yielding with better fruit characters. In brinjal (*n*=90), hybrid H1 (Pusa Kranti x Pusa Bhairav 3.69 kg plant^{-1}) registered highest fruit yield followed by H2 (PPL x P. Bhairav, 3.36 kg plant^{-1}). These hybrids have attractive and shiny fruit colour and oblong to long in shape combined with resistance to bacterial wilt (with zero per cent bacterial wilt incidence). In field screening for brinjal shoot and fruit borer resistance in five interspecific progenies (F_9), four susceptible cultivated varieties and one resistant wild species *Solanum macrocarpon*, (in total of 10 entries) five interspecific F_9 lines (9-17, 9-16, 9-8, 9-12, 9-6v) recorded less than 6% shoot infestation (highly resistant scale) and less than 20% fruit borer infestation (resistant) which was confirmed in F9 generation.

In water melon, BC_1F_1 advanced breeding lines (n=25) derived from the background of *Citrulus amarus* for WBNV resistance, the line 18 (TSS-10.8°Brix), 20 (TSS-10.5°Brix), 42 (TSS of 11.0°Brix) and 46 (TSS of 10.0°Brix) recorded superior fruit yield with dark red flesh with better fruit quality traits. Sel-4-30 and Sel-4-35 were found to be superior with orange crispy flesh and TSS ranging from 11-13°Brix for orange fleshed watermelon (Jubilee type).

In okra (*n*=6), two advanced breeding lines IIHR-299-1-2-2 and IIHR-385-1-1-5 were identified for high fruit yield with superior pod quality and field tolerance to the YVMV disease. For export purpose (*n*=15), the Hybrid 125 was found superior with high yield and short, dark green fruit. The combined resistance to YVMV and ELCV resistant GMS & non-GMS based hybrids (*n*=160) were identified by screening at hotspots in Villupuram, Tamil Nadu. Among advance lines screened at natural hotspot area, IIHR-385-1-1-5 and IIHR-386-1-1-26 found to be resistant to YVMV with 0% incidence and 2.87 to 4.83% incidence of ELCV.

In French bean, two advanced pole bean breeding lines (F_{11}) *viz.*, IIHPRPB-IPS-3 and IIHPRPB-IPS-4 derived from the cross Arka Sukumol x Arka Arjun (*n*=80) were identified for high pod yield with superior pod quality and resistance to rust disease. A total of 50 superior single plant selection for superior pod quality and combined with rust resistance were made from BC_2F_4 progenies derived from the crosses ((Arka Sukumol x IIHR-79) x Lakshmi), (Arka Sharath x IIHR-79) x Lakshmi), (Arka Arjun x IIHR-79) x Lakshmi). With regards to the purple pods, seven single plant selections with superior pod quality (round or pencil fruits) were selected from the cross IIHR-277-1 x IIHPRPB-IPS-3.

In cowpea, sixteen determinate/bush type single plant selections were made from the cross Arka Samruddi × Kashi Kanchan, and advanced to F_3 generation during Kharif 2024. A total of 25 BC_1F_2 progenies from background of each of Arka Samruddi, Arka Garima, Arka Suman and Arka Mangala were evaluated and twelve to fifteen sterile progenies were selected and backcrossed with their fertile plants during *Kharif*, 2024. In Dolichos, among 34 lines evaluated for photo-thermo tolerance during *Kharif* 2024, two lines were found promising for tolerance with an estimated yield of 1.12 kg plant^{-1}.

In ridge gourd, the inbred line IIHR-137 was identified for resistance to ToLCNDV disease. CGMS backcross progenies (BC_5, BC_6 generation) were developed and nine backcross populations in different genetic backgrounds (green / long / medium / short fruits). All backcross progenies were 100% male sterile, indicating sterility maintenance. The male-sterility based hybrids RGMSH-24-44 (54.25 t ha^{-1}), RGMSH-24-31 (53.8 t ha^{-1}) and RGMSH-24-20 (53 t ha^{-1}) were identified as superior hybrids based on evaluation of 66 male sterility hybrids. Andromonoecious lines with longer fruits were

selected and backcrossed with respective monoecious parents to advance the populations. Development of hermaphrodite lines with Arka Prasan fruit quality was attempted.

In carrot, the lines IIHR 60 and IIHR 61 were confirmed as moderately resistant powdery mildew compared to susceptible check Arka Suraj. In radish, non-bolting/ non-pithy lines at high temperature were identified (IC 347787, IC 43540, IIHR 62, IIHR 51, IIHR 89, IIHR 63, IIHR 77, IIHR 66 and IIHR 71).

In bottle gourd, based on the drought tolerance score, genotypes BG-64, BG-141 and BG-49 were categorized as drought tolerant based on physiological and biochemical traits. Among 22 ash gourd genotypes evaluated for resistance against downy mildew under field condition, six genotypes viz., AG-6-15-11-37, Ag-3-25-2-48, AG-3-54-39-59, Ag-21-3-16, AG-3-54-39-55 and AG-3-25-2-34 were categorized as moderately resistant (MR). Among genotypes screened for drought tolerance in cucumber, IC-429942 showed high tolerance to deficit moisture stress followed by IC398523. The genotypes IC-345635 and IC-429942 can be used for further grafting studies.

Among advanced breeding lines evaluated for yield, yield related traits and virus resistance in bitter gourd, IIHR IP-19-17-3 (10.17 t ha^{-1}) performed better. Among populations developed for powdery mildew resistance, four F_7 populations (IIHR-PMR-F_7-19-11-8-4-2-6-1, IIHR-PMR-F_7-19-6-23-3-4-3-2, IIHR-PMR-F_7-19-11-1-1-3-4-1, and IIHR-PMR-F_7-19-11-1-1-3-4-2) exhibited complete resistance, with a PDI of 0. Moringa seed oil was extracted from twelve accessions using n-hexane and it varied from 33 to 40%. Fatty acid profile showed that oleic acid is the predominant fatty acid.

In rose, IIHRR 9-13 (Arka Viraraghavan) has been identified for suitability as garden rose with attractive red colour among sixteen advanced rose breeding lines. Among multiple lines evaluated for cut flower production, IIHRR 3-18-2 is found suitable for production under open field cultivation with less number of prickles and able to produce long stalks without any additional cost of protected cultivation. Genetic studies confirmed single recessive gene (aa) governing apetaloid sterility while petaloid sterility was confirmed to be governed by single dominant gene (PP) in marigold. For carotenoid content one double fertile line IIHRMO 2335, and an apetaloid sterile line (IIHRMO2340) and a genetic petaloid sterile line (IIHRM 2-3) were selected that are having with >2 % of carotenoid content based on dry petal meal.

In tuberose, three single type lines IIHR 15-5-16, IIHR 15-22-HS-1, and IIHR 15-7-13 were found promising for garland purpose. The tuberose genotype IIHR-15-7-13 (0.106%), Arka Keerthana (0.102%), IIHR-17 23HS-9 (0.094%), and IIHR-17-5-2 (0.09%) recorded the highest concrete content. Out of 10 half-sib lines evaluated in chrysanthemum, two lines IIHR5-11 and IIHR9-9 were found promising for cut flower and IIHR2-11B and IIHR2-42 for bedding purpose with unique flower colour, flower form and floriferousness. Yellow coloured natural mutant (bud sport) from HYCD14, two induced mutant (15 and 20 Gy irradiation) from Candor Pink and one mutant from Champagne Yellow were successfully isolated under *in vitro* conditions and evaluated for flower quality traits. Among gerbera genotypes evaluated in open field, Arka Krishika, Arka Red and IIHR G-2 resulted higher vase life. IIHR G-2 was also found to be high yielding among the breeding lines.

In *Brahmi*, the selections IIHRBM07 and IIHRBM05 were found superior in terms of bacoside yield (198.40 and 176.84 kg ha^{-1}, respectively). About 21 F_1 hybrids in Ashwagandha, six crosses (DWS-420 x GA-3, RVA-100 X GA-3, RVA100 x DWS-420, VA-2x RVA-100, VA-2x CIMS and RVA-100 x GAA-1) were found promising in terms of dry root yield ranging from 10-25 g per plant and root length of >20 cm. Genome sequencing of nine *Salacia* species was done by NGS with Denovo Bioinformatics. From the sequenced genome, species specific SSRs and species-specific genes were identified.

CROP PRODUCTION

Among three high density planting systems (HDP) in mango hybrid Arka Udaya, highest fruit yield per plant (7.19 kg) was obtained in HDP system of 5 m x 2.5 m during 4th year after planting. Soil application of calcium @ 100 g per plant in mango variety Raspuri and foliar spray of 0.5% Ca (during fruiting stage at monthly intervals) in mango hybrid Arka Udaya resulted in higher fruit yield. In *Annona* hybrid Arka Sahan, integration of *in situ* vermicomposting along with supplementing NPK through inorganic fertilizers was better in terms of fruit yield and average fruit weight. The stock scion ratio was near to one when Arka Sahan was grafted on *Annona squamosa* (Washington) while it was more than one on all other rootstocks. In guava, soil application of 100 g lime twice in a year was found better in terms of higher fruit yield and fruit number. For HDP system (3 m x 2.5 m) in guava, fertigation dose of 340: 70: 260 g N: P_2O_5:K_2O was found optimum. Air layered plants of Arka Poorna yielded higher at 50 and 75% of RDF + 2.5 kg FYM + 150 g AMC per plant than approach grafted ones.

In dragon fruit (variety Red), scheduling irrigation at 40% evaporation replacement yielded significantly higher fruit yield (44.67 t ha^{-1}) than rainfed condition. Semi hardwood cuttings treated with coconut water showed maximum sprouting (40%) and higher survival per cent (53.3%) in mangosteen. Combinations of root pulsing and potting media, IBA @ 250 ppm with sterilized Arka Fermented Cocopeat + Vermiculite+perlite (1:1:1) found effective in root induction in papaya. In pummelo variety Arka Anantha, leaf cuttings treated with 250 ppm IBA and transferring to AFC+Vermiculite+perlite (1:1:1) media resulted in 40% rooting in tissue cultured rack and 60% rooting in low poly tunnels.

In jamun, the phenology of 3 jamun varieties *viz*., Dhupdhal, Konkan Bhadholi and Goma Priya was studied. Highest flowering and fruit set was observed in Konkan Bhadholi. As per the BBCH scale, seven principal growth stages were identified in karonda (cv. Konkan Bold). In Coorg mandarin, grafted plants performed better than seedling plants and integrated and balanced supply of nutrients (20 kg FYM+ RDF + soil application of Mg, S, Zn, and bio-fertilizers (AMC and VAM) + Foliar application of Citrus Special+ Green manuring (Sunhemp)] significantly improved plant growth and yield parameters.

Among three systems of cultivation viz., natural farming, modern farming and organic farming in fruit-based cropping system, the yields of intercrops *viz*., French bean, tomato, China aster and marigold were significantly higher in modern farming. In tomato, natural farming recorded significantly higher TSS (5.62°Brix) and acidity (0.55%) over organic farming (3.71°Brix) and significantly higher vitamin C (27.8mg 100 g^{-1} FW) over modern farming (11.5mg 100 g^{-1} FW).

In studies on identification of bottle gourd rootstock against GSB and *Fusarium* wilt, under field condition at 52 days after transplanting, rootstock BG-77-6-1 recorded the highest crop stand of 76.92% & PDI (Fusarium wilt) 18.67 in Cucumber and 80% & PDI 26.67 in bottle gourd (BG-24).

Rapid multiplication protocol of quality planting stock of tuberose var. Arka Prajwal from mother bulbs in four months was standardized. Higher propagation coefficient was achieved in gladiolus varieties Arka Amar and Arka Ayush by treating with 150 ppm Benzyl Adenine and 150 ppm salicylic acid respectively. In rose, Natal Briar as rootstock recorded superior bud survival of 72.7% and among scion varieties Arka Savi performed better in bud survival whereas Arka Swadesh exhibited earlier sprouting. Terminal cuttings of crossandra var. Arka Chenna from the mother plant block with nutrient dose of 120:80:240 kg N:P_2O_5:K_2O ha^{-1} yr^{-1} + 25 t FYM ha^{-1} + AMC @ 12.5 kg ha^{-1} and spacing of 45 x 45 cm with single pinching recorded highest survival rate of cuttings and number of sprouts/cutting.

Significantly better flower quality parameters were observed in the photoperiodic module consisting of long days (16 h light,8 h dark) followed by short days (8 h light16 h dark) up to flower bud initiation across different varieties of cut chrysanthemum. Studies on salinity effect on rose revealed that number of flowers per plant decreased from 69 to 53 in Arka Parimala, 53 to 44 in Arka Savi, 50 to 33 in Arka Sukanya on *R. multiflora* with increase in salinity from control to 7.5 dSm^{-1}.

Field cultivation of *Piper longum*, resulted in higher number of branches, fruiting branches and dry root yield in organic treatment with 10% Kunapajala. Higher piperine content (2.7%) was noticed in RDF through 50% FYM and 50% Vermicompost at 240 DAP. The tomato + French bean cropping system was most profitable and sustainable due to soil incorporation of velvet bean. Application of 2 t ha^{-1} of bio-enriched organic manure along with 80% RDF resulted in maximum yield in okra hybrid Arka Nikita and French bean var. Arka Komal. The profiling of Volatile Organic Compounds (VOC's) produced by eight elite methylobacterial isolates and putative functions of dominant VOC's were detected. The isolate *Bacillus* sp. 36 was found to be most promising for siderophore production. Mass production and spore extraction of mycorrhiza from the cocopeat substrate was standardized. Size of Nano-P synthesized from methanol extract of stevia (70.1 nm) and banana leaf (61.4 nm) was lesser than from water extract. nanofiber based multi-nutrient sachet was developed.

Residue and persistence study of Betacyfluthrin and imidacloprid in banana whole fruits and banana pulp indicated that Imidacloprid and Betacyfluthrin residues dissipated with half-life values of 20.28 days 16.75, respectively at the recommended dose. In grape berries, it was found that residues of fosetyl-Al and phosphonic acid dissipated with half-life values of 7.57 days, Trifloxystrobin residues dissipated with half-life values of 10.9 days, Fluopyram residues dissipated with half-life values of 8.68 days and difenoconazole dissipated with half-life values of 7.51 days at the recommended dose. In pomegranate, residues of Isotianil and Fosetyl-Al were found to be dissipated with half-life values of 6.07 and 0.61 days respectively at recommended dose. In cucumber, residues of Fluopyram and Tebuconazole dissipated with half-life values of 2.20 and 1.97 days respectively at the recommended dose.

CROP PROTECTION

The interactions between guava wilt pathogen *Fusarium oxysporum* f. sp. *psidii* and beneficial microbial inoculants indicated the effectiveness of *Trichoderma* sp. (GJ16B and JL-5 with inhibition of 36.1 and 40.8%, respectively) in inhibiting *Fusarium*. AMC was less effective with an inhibition of 0.78%. The palmitic acid at higher concentration was effective in extending the shelf life of Dilkush variety of grapes. The bunches maintained marketable quality up to 12 days in case of grapes exposed to 20 and 10% palmitic acid. With respect to pre-harvest of spray of bioagents for production of volatile organic compounds in grape varieties, *Hanseniospora opuntiae (*MY) and *Bacillus amyloliquefaciens* (Gol-2) were identified as potential epiphytes isolated from mango and grape fruit surfaces that produced VOCs and found effective against grapes pathogens. *H. opuntiae* and *B. amyloliquefaciens* were effective in Dilkush, but not effective in Bangalore Blue. In white-fleshed dragon fruit plants, it was identified that reddish-black stem spots are caused by *Epicoccum sorghinum* (ESH14 isolate).

Multi Locus Sequence Assay (MLSA) has been employed using four genes *viz.*, gyrB, gap1, glt1and lepA to study the genetic diversity among *Xanthomonas* species causing bacterial leaf spot in tomato. The gyrB" and "lepA" genes showed more variation, making them better markers for distinguishing within-species differences. Total genomic DNA of 303 tomato leaf curl samples was isolated by following modified protocol of CTAB method. Similarly total RNAs was extracted from 144 field collected samples by RNeasy Plant Mini kit (Qiagen, Valencia, CA). For DNA viruses, PCR amplification was performed using different primers specific to CP gene of different viruses.

For integrated management of tomato diseases, the management module consisting of seed treatment with Imidacloprid 60 FS (5 g kg^{-1} seed) + foliar application of AMC (20 ml per litre) at 30 days+ foliar application Thiamethoxam 0.4 g per litre at 30 days+spraying Sea weed extract at 35 days+foliar application of Emamectin Benzoate (0.2 g per litre) at 45 days+foliar application of AMC (20 ml per litre) at 60 days was found highly effective in reducing the disease incidence at 20.2%.

Among various fungicides tested for control of *Colletotrichum lindemuthianum* in legume vegetables, Carbendazim, Thiophanate Methyl, Tebuconazole +Trifloxystrobin and Carbendazim+Mancozeb demonstrated complete inhibition of *C. lindemuthianum* at 10 to 150 ppm under *in vitro* conditions. Furthermore, one isolate of *Trichoderma viride* also showed effective suppression of *C. lindemuthianum in vitro*. Advanced diagnostic techniques such as TEM and PCR were to detect and characterize seed-borne viruses in in cucurbitaceous, legume, and solanaceous crops, contributing to improved disease management strategies. For management of gummy stem blight in cucurbits, *Trichoderma asperellum* strain IIHR TV5 and *Bacillus subtilis* were found effective against *Staganosporopsis cucurbitacearum*, the causal agent of gummy stem blight in cucurbits.

About 134 tuberose lines screened for *Alternaria polianthi*, four crosses were found to be moderately resistant. Out of 191 genotypes were evaluated against *Alternaria tagetica* causing leaf and flower blight in marigold, five moderately resistant genotypes were found Pusa Arpita, IC-250332, IC-250323, KAU-M2 and CGFM- Raichur. Based on field screening of gladiolus germplasm (*n*=75) for *Fusarium* wilt for 2 seasons, about 36 were found highly resistant (0-10%) and 34 were resistant (10-25%). In artificial inoculation, only 4 genotypes (Gold, Punjab Glad-3, JV Gold and Yellow Star) were highly resistant and 5 genotypes (EC Yellow, DFR-1, Novalux, Aayush and Sanjeevani) were resistant.

A strain of entomopathogenic nematode, *Heterorhabditis indica* was found effective against mango stem borer, *Batocera rufomaculata*. About 80% reduction in infestation of stem borer was noticed with injection of EPN solution into borer holes @ 10 ml per hole three times at 5-day interval. Based on susceptibility levels over the years, the selected varieties of mango were classified into different susceptibility groups. Totapuri and Langra: Susceptible (15-20%); Alphonso and Banganapalli: Moderately Susceptible (5-10%); Mallika and Neelam: Least Susceptible (< 5%).

Management module consisting of first spray at flower bud initiation with azadirachtin 1% @ 2.5 ml L^{-1} followed by second spray of Pongamia soap @ 10 g L^{-1} after two weeks and third spray of neem soap (@ 10 g L^{-1} at fruit setting stage was most effective for control of hoppers (Idioscopus spp.) and thrips (Scirtothrips dorsalis and other species) in mango. The population of hoppers (Idioscopus spp.) and thrips (Scirtothrips dorsalis and other species) was reduced by more than 80%.

In guava cv. Arka Kiran, application of Fluopyram @ 0.5 ml per plant and *Bacillus amyloliquefaciens* IIHR Ba-2 enriched FYM before planting followed by soil drenching of bioagent enriched neem cake suspension at quarterly intervals @ 2 L per plant showed maximum decrease in nematode population of root knot nematodes

up to 71.3% and increase in yield by 18.6%. For production of nematode free planting material in guava, *Bacillus amyloliquefaciens* IIHR Ba-2 treated through vacuum suction equipment recorded the minimum number of galls (0.03) and nematode population in soil (48.00 per 100 cc soil) and higher growth parameters in guava. In avocado, the yield losses due to Japanese beetle infestation were estimated to range from 20% to 40%, depending on infestation severity.

In tomato, the essential oil of *Trachyspermum ammi* exhibited highest mortality (100%) against *Phthorimaea absoluta* followed by *Syzygium aromaticum* (97.5% mortality). For *Aphis craccivora*, highest mortality (100%) was recorded with *Geranium dissectum* followed by *T. ammi* (95% mortality). Among binary compounds, Thymol and Citronellol recorded 100% and 90% mortality of *Phthorimaea absoluta*, respectively. Geraniol and D-Limonene registered 92.5% and 90% mortality of *A. craccivora*, respectively.

For managing root knot nematodes in tomato grown under protected conditions, integrated nematode management module comprising soil application of Fluopyram 400 SC at 500 ml per acre combined with soil drenching of neem cake enriched biopesticides suspension once in 30 days in standing crop decreased the nematode population and increased the yield. Among different *Brassica* species, mustard crop residues at 1% was found most effective for suppression of *M. incognita* in tomato.

Healthy plant volatiles (HPV) of eleven *Capsicum* wild species had shown significant repellency to both *Thrips parvispinus* and *Scirtothrips dorsalis*. White and blue sticky traps can be used for IPM of thrips (*Thrips parvispinus*) in chilli. Among organic inputs evaluated against *T. parvispinus*, combination of Neem oil + Pongamia oil + Garlic + Chilli + FORS @ 5 ml per litre resulted in 67.0% thrips mortality over control whereas Azadirachtin 10000 ppm @ 4 ml per litre resulted in 63.4% mortality. Extensive field surveys were conducted and four bioagents associated with *T. parvispinus* were recovered from capsicum ecosystem.

Out of 13 tuberose lines observed for reaction towards root knot nematodes *M. incognita* under natural field conditions, the minimum gall index (GI) was observed in Arka Keerthana (GI – 1.3) followed by IIHR-17-5-2 (GI: 1.60), IIHR-15-5-16 (GI; 1.73) and IIHR 17-22HS-83 (GI 2.00). For production of nematode free planting materials in tuberose, the planting materials were evaluated for efficacy of several bioagents and chemicals with and without using vacuum suction treating equipment. *Bacillus amyloliquefaciens* IIHR Ba-2 treated through vacuum suction equipment recorded the lowest number of galls (0.33) and nematode population in soil (60.00 per 100 cc soil) and higher growth parameters in tuberose. Field evaluation of gladiolus hybrid selections for reaction to root knot nematodes, *Meloidogyne incognita* revealed gall index (GI) from 0.73 to 3.73 (on a 0 to 5 scale), the least GI was recorded in IIHR 15-1-105 and the highest GI was recorded in IIHR 15-1-212.

CROP UTILIZATION AND FARM MECHANIZATION

In custard apple, gamma irradiation caused severe surface blackening in Arka Sahan hybrid fruits though higher doses of 400 and 800 Gray effectively controlled fruit fly infestation. Methods for extending shelf life of minimally processed pummelo and pomegranate was standardized. Shelf-life studies of fruits harvested at different stages of maturity revealed that those harvested at 70% color development exhibited maximum shelf life. Rambutan fruits packed in non-ventilated punnet boxes with micro-perforation (0.005%) could be stored for 21 days at 9°C±1 compared to 9 days in non-packed control. Malayan apple fruits required approximately 97 days from bud initiation till harvest and requires about 282.96 heat units for proper flowering and fruiting.

Jam was prepared Using dragon fruit peel along with other food additives and the jam with 10% sucrose was accepted well. Among natural flavours tried in Arka Kamalam RTS beverage, flavours of ginger, cardamom and basil seeds were found acceptable. The preparation protocol was standardized for red dragon fruit probiotic beverage. Suitable formulation had been standardized for preparation of avocado powder in cabinet dryer.

Process protocol for the development of Ready to Eat Extruded Snacks of finger millet, soyabean and peas flour, coated with natural fruit colourant from jamun, Barbados cherry, dragon fruit and tomato as an alternative to synthetic colorant was optimized. Avocado powder incorporated with Finger Millet flour for making extrudates was rich in calcium (0.24%), magnesium (0.43%), iron (26.1 ppm) and zinc (10.3 ppm).

Extraction procedure for marmelosin from bael pulp using different solvents and extraction method was standardized. The drying parameters were optimized for green chilli dehydration using a cabinet drier and established a pulverization protocol for the preparation of green chilli powder. Dehydration of bitter gourd was attempted in different genotypes**.** The process protocol for the preparation of compact ready to use compost blocks from floral waste was standardized. *Centella asiatica* leaves has been used to develop a squash beverage. *Centella* squash

can be stored for six months at ambient temperature. D-mannosyl Specific lectins were isolated and purified from *Macrocybe gigantea* mushroom that showed anti-tumor/anti-cancer activity. *Pleurotus pulmonarius* registered highest biological efficiency (yield) of 212.6 g per kg in wet paddy straw. *Agrocybeae girata* exposed at 450Gy has recorded highest yield in comparison to the other doses and control.

ECONOMICS OF PRODUCTION, MARKETING & TRADE

The impact assessment of low-cost ripening (LCR) technology which uses FSSAI-approved ripening solution costing Rs. 1.93 per kilogram, stands out as a safe, reliable, and authorized alternative. Karnataka accounts for 90 adopters, representing 62.9% of total users and Kerala for 18 adopters. Majority (52.83%) rated the technology as 5, indicating high satisfaction and endorsement. The impact of APMC deregulation (GoK policy dated May 2020) on the chilli crop at the Byadgi APMC revealed that the prices initially declined, but the trend shifted positively thereafter, leading to an overall increase in prices over time. The average annual revenue of Byadgi APMC declined due to lower cess despite increases in both market arrivals and prices, The net income difference between APMC sales (Rs.7,921 q^{-1}) and outside sales (Rs.7,897 q^{-1}) was negligible for chilli farmers. The study identified six marketing channels, with 92% of the produce being traded through the APMC.

With respect to demand and supply projections of horticultural commodities, fruits and vegetables are expected to see substantial increases, nearly doubling from 109.53 million tonnes to 225.17 m t and 213.88 m t to 417.53 m t, respectively. Flowers and spices show remarkable growth, with flowers increasing nearly fourfold and spices growing more than sixfold (from 11.26 m t to 69.61 m t). However, aromatic and medicinal plants and plantation crops show stagnation or decline.

The estimated cost for establishing dragon fruit orchard was Rs. 9.80 lakhs per acre, in which fixed cost and variable cost accounts to Rs. 5,91,840 and RS. 3,89,070, respectively.

The average yield of dragon fruit was 4.5 t $acre^{-1}$. The per acre gross returns obtained from dragon fruit cultivation was estimated to be Rs. 6.75,000 The Constraint analysis revealed that higher initial cost required for establishing Dragon fruit orchard is the major constraint (93%) followed by non- availability of quality planting material in time (88%) and the problem of marketing the produce (85%).

STATISTICAL RESEARCH

Multivariate approach was adopted for assessing the stability of 7 Mandarin lines across five AICRP (F) locations Results based on 7 stability measures for seven different yield and growth attributes three unique groupings were identified (group 1: Mandarin and Nagpur Seedless, group 2: Darjeeling mandarin and Mudkhed seedless, group 3: Khasi mandarin, Coorg mandarin and Kinnow mandarin).. For fruit yield, Ludhiana followed by Akola Sriganganagar and Nagpur as best locations.

Multi-dimensional scaling approach for stability analysis in China aster and gerbera was adopted for assessing the stability of 36 China aster lines and 16 gerbera lines based on growth flower quality and identified three groupings.

COMPUTER APPLICATIONS IN AGRICULTURE

The mobile app for Sapota cultivation in Telugu and Pomegranate cultivation in Hindi has been designed and developed.

AGRICULTURAL EXTENSION RESEARCH

With regard to research and extension gaps in production and promotion of export of selected horticultural crops, majority of the farmers (70%) expressed that there was lack of uniform standard protocol on post-harvest handling of many crops. Farmers emphasized the need for an online purchasing platform (73.33%). A study on adoption and utilization of Arka Mealy Melt revealed its effectiveness in managing mealy bugs across diverse crops. Participatory demonstrations across key crops provided 53% farmers expressed satisfaction and 93.3% suggested increasing its concentration to reduce the dosage from current 70-100 ml per litre, making it more cost-effective and user-friendly. Regarding virus resistant chilli varieties, farmers expressed Arka Tejaswi variety of IIHR suits well to prevailing market and Arka Sanvi and Arka Yashasvi are also performed very well in terms of yield, productivity and consumer preference.

The assessment of level of improvement in nutritional and income security of women mushroom growers showed a significant improvement in nutritional security of women and 100-200% income increase based Livelihood Improvement (LI) Scores with a Benefit-Cost ratio of 1.8 to 5.1. Nutritional and income security of farm women through Arka Vegetable seed kit revealed that the earnings increased significantly from 15% to 18%. Arka Harshitha emerged as profitable with average yield of 738.9 kg per 0.1 acre and average net income of Rs. 24,015/- per yr. It was followed by Arka Meghana in chilli and Arka Rakshak in tomato.

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3.1. CROP GENETIC RESOURCES

3.1.1 Germplasm Exploration and Collection

Crop	Germplasm collected	Areas explored	Total viable germplasm as on 31.12.2024	No of germplasm characterized	Germplasm registered with NBPGR
FRUIT CROPS					
ICAR-IIHR, Bengaluru					
Mango	09	Karnataka (5) A &N Island (2) Manipur (2)	781	10	02 (IC Nos received for Arka Udaya and Arka Suprabath
Guava	-		74		
Papaya	-		54		
Annona	-		29	04	03
Sapota			52		
Grapes			20		
Pomegranate			269		
Jamun	-	-	109	70	1
Jackfruit	11	Sirumalai and Pudukottai Panruti	192		2
	Monkey jack	Gonikoppa, Karnataka			
	Hebbalasu	Wayanad, Kerala			
Dragon fruit	6	Gujarat and Assam Wayanad, Kerala	41		
Avocado	-		91	58	1
Pummelo	-		35		
Tamarind	-		90		
Rose apple	16	Mudigere and Sringeri, Karnataka	06	16	-
Soursop	10	Kodagu, Karnataka	04	10	
Wood Apple			18	18	-
Minor fruits			40		Malayan apple IC-0648522
CHES Chettalli, ICAR-IIHR					
Wild fruits	5	Kodagu, Karnataka		5	-

Avocado	4	Kodagu, Karnataka	120	20	0
Passion fruit	15	Kodagu, Karnataka, Waynad, Kerala and Kodaikanal, Tamil Nadu	40	15	-
Citrus	-		35	-	
Rambutan			10	-	
Malabar tamarind			40	25	-
Kokum			30	-	
Longon			15	-	
Other fruit crops			130		-
VEGETABLE CROPS					
Tomato			700		
Chilli			2010		
Brinjal	3	UP and Karnataka	372	270	-
	450	NBPGR	450	310	-
Bell pepper	2	Private seed industry	83	15	-
Watermelon			382	-	-
Muskmelon			158	-	-
Oriental melon			80	-	-
Okra	53	ICAR-IIVR, Varanasi	1799	60	
	08	Salem (secondary collection from local areas)			
	11	Secondary collection from Kerala			
French bean			276		-
Cow pea			263		-
Garden Pea			512		
Dolichos bean			276		
Cluster bean	2	Coimbatore, Tamil Nadu	54	18	1
Vegetable Soybean			88		
Onion	81	Secondary collection ICAR-DOGR	150	100	
Carrot	5 tropical	Mysore, Karnataka	193	-	
Radish	5 accessions, (3 Red round, 1 green round and 1 yellow round)	New Delhi and Meerut	103	-	

Ridge gourd	13	Odisha and Karnataka	338	160	1
Bitter gourd	8	Sikkim and Karnataka	163	24	-
Ash gourd			75	20	
Bottle gourd			159		1
Pumpkin			133		
Cucumber			617		-
Drumstick			222		
Curry leaf	03	Western Ghats, North Karnataka and Surroundings of Bengaluru, Karnataka	125	-	80
FLOWER CROPS					
ICAR-IIHR, Bengaluru					
Rose	67	Breeding lines from IIHR with NBPGR IC Nos and Secondary collection from Karnataka	477	60	-
Marigold	6	Breeding lines from IIHR, with NBPGR IC Nos	81	81	-
Tuberose	3	DFR, Pune, BCKV, Kolkatta, AAU, Assam	42	5	-
Gladiolus	5	IARI, New Delhi, DFR, Pune, BCKV, Kolkatta,	90	5	-
Carnation	-	-	50	6	-
Crossandra	5	Karnataka (Mandya, Hesaraghatta, Dibbur), Goa, Tamil Nadu (Cuddalore)	15	15	-
Barleria	20	Tamil Nadu (Hosur, Cuddalore), Madhya Pradesh (Bhopal), Maharashtra (Pune), Karnataka (Dibbur, Shivakote, Kakolu, Mavallipura, Hesaraghatta)	9	9	-
Jasmine	2	TNAU, Coimbatore	47	47	-
Dahlia			20		
Chrysanthemum	-	-	122	60	-
China aster	-	-	28	28	-

MEDICINAL CROPS AND MUSHROOM					
Brahmi (*Bacopa monnieri* L.)	11	Karnataka, Odisha and Jharkhand	115	115	IC numbers obtained for all collections-
Centella asiatica			28		
Gymnema sylvestre			53	53	
Clitorea ternatea	40	Gujarat, Pune, Rajasthan, AP, Kerala, Orissa, ICAR-NBPGR	50	30	
Salacia spp			30	13	
Mushroom	2	Bengaluru and B R Hills, Karnataka	107		

3.1.2. Germplasm Conservation and Domestication

Fruit Crops

***Annona*:** An impressive collection in *Annona* has been maintained in the field gene bank (FGB) for preserving genetic diversity and supporting breeding programs. Sixteen varieties of custard apple (Balanagar, Raidurg, APK-1, Red Sitaphal, Mammoth, Barbados, Washington 07005, Washington 98797, Taiwan, NMK-1, Arka Neelachal Vikram, Phule Janki, Hyderabad Selection, Phule Purandar, Purandar Gold and Arka Sahan), three varieties of Atemoya (Island Gem, Pink's Mammoth and Bullock's Heart) and eight species of Annona - *Annona squamosa*, *Annona atemoya*, *Annona reticulata*, *Annona cherimola* , *Annona glabra* , *Annona muricata*, *Annona mucosa* and *Annona montana* have been maintained in the field gene bank. Two more *Annona squamosa* from Udaipur, Rajasthan also included in the field germplasm.

Soursop collected from Kodagu region

Jamun: A unique farmer's variety, Niranthara Kumar Jamun (Round the Year Jamun, REG/2023/0124) that bears fruits year round has been identified from the field of the custodian farmer Sri N. Kumar, Ajjihalli village, Tumkuru district of Karnataka and registered with PPV & FRA and MOU was exchanged with Farmer and KVK, Hirehalli.

Round the year Jamun

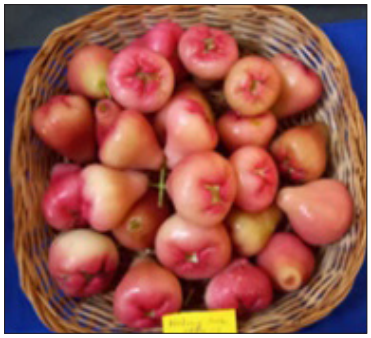
Wax apple: A promising genotype, CHESM-1 was identified as a regular-bearing and high-yielding seedling selection from local collection. It has spreading growth habit and bears bell-shaped fruits in clusters with an attractive pink peel color. The fruits are 100% edible without seeds. The average fruit yield varies from 90 to120 kg per plant with fruit weight of 35-40 g. The fruits contain more than 90% moisture with TSS of 6.4 to 7.6 ^{0}Brix.

Cluster Bearing in CHESM-1

Closer view of CHESM-1 fruits

Malayan apple (IC-0648522): A promising germplasm accession, IIHR-III-R3R7 was identified for high yield (over 50 kg from 20-yr old tree). The fruits are bell-

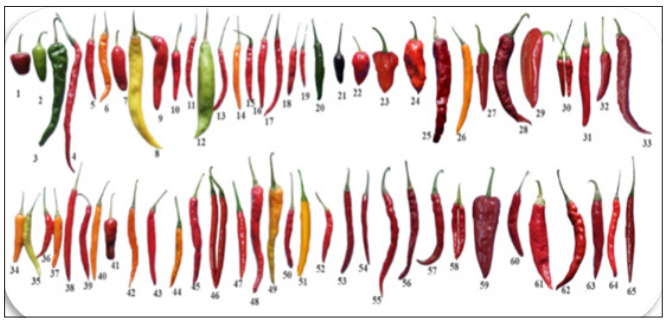
shaped with length exceeding 5.5 cm and maximum breadth of 5 cm. Each fruit weighs more than 55 g. The pulp is 1.5 cm thick, with TSS of over 5.5°Brix, acidity of 0.35% and vitamin C content of 20 mg per 100 g.



CHES (ICAR-IIHR), Bhubaneswar: Germplasm of mango (103), pineapple (17), jackfruit (24), tamarind (41), bael (12), custard apple (3), dragon fruit (06), Jamun (27) and underutilized fruit crops (24) such as wax apple, rose apple, tamarind, jamun, longan, rambutan, egg fruit, avocado, karonda, star gooseberry, star apple, Barbados cherry, carambola, kokum are being maintained

Vegetable Crops

Chilli: A total of 2020 Capsicum accessions were maintained and 96 accessions were characterized for minimal descriptor of NBPGR, New Delhi.



Diversity in fruit colour of germplasm accessions in chilli

Brinjal: A total of 3 germplasm lines (two accessions of Kashmiri pink brinjal and West Bengal Malda local, fruit looks like bottle gourd and also has resistance to bacterial wilt) were collected and seeds multiplied.

Okra: Six existing wild species namely *Abelomschus tetraphyllus* var. *tetraphyullus, A. cailleei, A. tuberculatus, A. moschatus, A. ficulnius, A. manihot* and three new wild relatives *viz., A. enbeepeegeearensis* (IC417446, IC-582757), *A.pungens* var. *mizoramensis* (IC-624235,IC-624236), *A. angulosus* var. *grandiflorus* (IC-599701) were conserved.

***Abelmoschus pungens* var. *mizoramensis* (IC-624235)**

***Abelmoschus enbeepeegeerensis* (IC-417446)**

Musk Melon

Eleven species *viz., Cucumis melo var momordica, Cucumis trigonus, Cucumis dispsaeus, Cucumis madrasipatnus, Cucumis prophetarun, Cucumis metuliferus, Cucumis callous, Cucumis melo var agrestis, Cucumis sagittatus, Cucumis sativus var hardwicki, Cucumis hystrix* were collected in 2023. About 4 species were regenerated. Characterization for agronomical traits was done for *Cucumis metuliferus, Cucumis melo* var *agrestis, Cucumis sagittatus, Cucumis sativus var hardwicki* and *Cucumis metuliferus*. A total of 35 accession of melon germplasm were regenerated.

Field view and morphological traits of regenerated 35 accessions of melon

Onion: A total of 65 onion germplasm was regenerated and conserved in medium seed gene bank module at ICAR-IIHR.

Curry leaf: Three new germplasm were collected and the total germplasm strength stands at 225.

Radish: Seed conservation of 103 accessions has been done.

Carrot: About 193 accessions have been conserved.

Bell pepper: Two new germplasm were collected from private seed companies and the total bell pepper germplasm is 83.

Ridge gourd

Registration of germplasm/genetic stock: Downy mildew moderately resistant genetic stock of ridge gourd [IIHR DMR 18-4-4 (INGR24027)] has been registered by Plant Germplasm Registration Committee (PGRC) of ICAR in May, 2024. Its fruits are medium long and green in colour. It is a slow mildewing type with moderate resistance (PDI=24.4, AUDPC=1171.87) and high yield (12.5 t ha^{-1}) compared to susceptible check variety, Pusa Nutan (2.1 t ha^{-1}, PDI=73.4, AUDPC=3648). Artificial screening of IIHR-DMR 18-4-4 also showed moderate resistance (16.67 PDI) and can be used for developing downy mildew resistant ridge gourd varieties/hybrids.

Downy mildew moderately resistant IIHRDMR18-4-4 (*left*) and susceptible line, IIHRDMS-30-1(*right*)

IIHRDMR18-4-4

CHES (ICAR-IIHR), Bhubaneswar: Among vegetables, germplasm of chili (140), brinjal (42), legume vegetable (175), amaranthus (285), drumstick (86), edible leafy vegetables (26), pointed gourd (41), underutilized cucurbits (Solena-6), edible fern (*Diplazium esculentum*) are being maintained.

Flower Crops

Rose: Four hundred and seventy seven genotypes are being maintained. Germplasm collection consists of sixteen rose species of which *Rosa clinophylla* and *R. centifolia* flower regularly. *R. chinensis viridiflora* is an unique collection with green flower, where in petals are more like leaves. Germplasm collection includes six rootstocks of which IIHRRs-1 and Arka Nishkant (IIHRRs-2) are registered for their powdery mildew resistance.

Marigold: Marigold germplasm consists of 41 genotypes belonging to species of *Tagetes erecta* and *T. patula*

Tuberose: A total of 42 germplasm was conserved in FGB.

Gladiolus: A total of 90 germplasm was conserved in cold room, multiplied and maintained in FGB.

Carnation: A total of 50 germplasm was conserved in the polyhouse.

Crossandra: A total of 20 genotypes have been conserved, multiplied and maintained in the field gene bank.

***Barleria*:** About 29 genotypes have been conserved, multiplied and maintained in FGB.

Chrysanthemum: About 122 germplasm have been conserved and multiplied in FGB.

China aster: About 28 germplasm have been conserved in cold room, multiplied and maintained.

Lotus (*Nelumbo nucifera*): Total of 74 different lotus accessions were collected from different secondary sources.

Medicinal crops

In medicinal crops, 115 accessions of *Bacopa monnieri*, 54 accessions of *Andrographis paniculata*, 37 accessions of *Aloe vera*, 28 accessions of *Centella asiatica* and 53 of *Gymnemasylvestre*are conserved and being maintained in FGB. About 50 accessions of *Clitorea ternatea* germplasm collected and maintained as seeds. In addition, 200 species of medicinal trees and 30 species of RET medicinal shrubs and trees conserved in herbal garden and RET field gene bank, respectively.

3.1.3. Germplasm Characterization

Fruit Crops

Mango: Ten mango genotypes were characterized as per the Bioversity International descriptors.

Papaya: Twelve accessions were characterized as per the DUS descriptor.

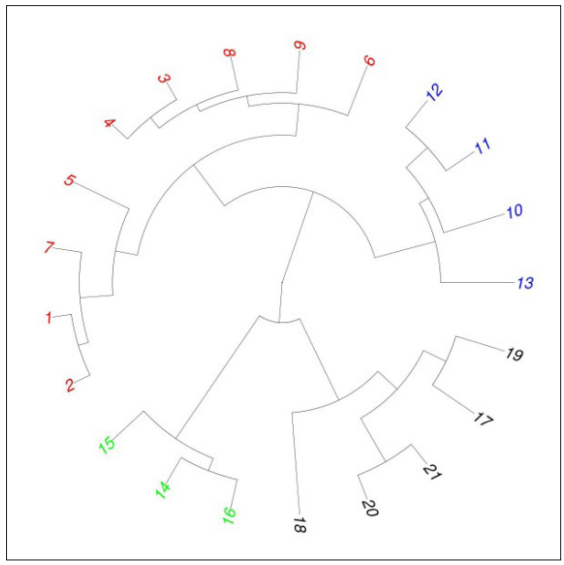
Guava: Fifteen accessions were characterized as per the DUS descriptor.

Jamun: A study on 21 jamun genotypes sourced from Bengaluru Rural, Shivamogga and Chikmagaluru districts in Karnataka revealed significant morphological variability. Notable variability was observed in fruit weight (0.74-15.41 g), pulp percentage (44.8-100) and seed/pulp ratio with seedless genotypes J13, J14, and J16 showing highest pulp percentage. Principal component analysis accounted for 97.45% of total variation highlighting diversity among genotypes. This variability provides a basis for selecting superior parental material for breeding program with focus on enhanced fruit quality and yield.

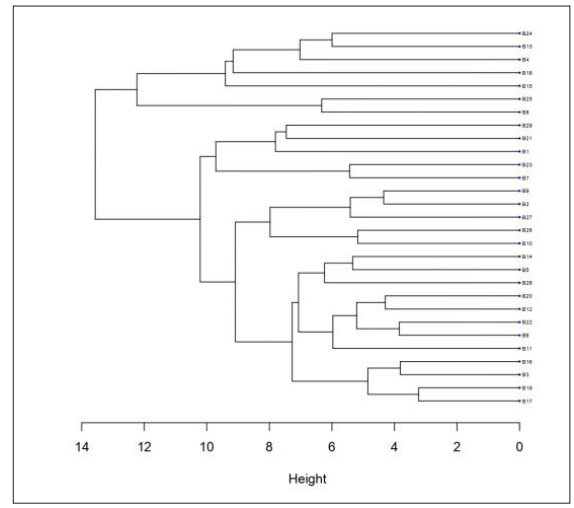
In-situ evaluation of 10 jamun germplasm from Mayurbhanj district of Odisha indicated wide variability in fruit weight (2.30-9.70 g), pulp content (73-85%) and TSS (14.20-24.43°Brix). Total phenols and flavonoids ranged between 24.52-79.62 mg GAE 100 g^{-1} and 23.98-46.72 mg QE 100 g^{-1}, respectively, while antioxidant capacity in terms of FRAP varied from 3 to 10.93 mM Fe(II) 100 g^{-1}. The evaluation of ten jamun accessions collected from Dhenkanal district in 2022 at CHES, Bhubaneswar showed considerable variations in plant height (2.83-3.88 m), trunk girth (22.36-29.20 cm), primary girth (14.45-20.48 cm), and canopy spread (EW: 2.20-4.80 m, NS: 2.50-3.20 m).

Jamun germplasm block at CHES, Bhubaneswar

Tamarind: Analysis of 29 tamarind accessions from Bastar region in Chhattisgarh revealed significant genetic variability in morphological, biochemical and mineral traits. Pod weight ranged from 91.1 to 528.3 g, pulp weight from 32.88 to 275.68 g, vitamin C content from 54.5 to 92 mg 100 g^{-1} and iron content from 26.6 to 25.7 ppm. Five accessions (B21, B26, B15, B25, and B7) were identified as the most promising based on desirable fruit traits, while five sweet accessions (B26, B21, B15, B12, and B11) had acidity levels below 6%. Principal component analysis (PCA) explained 86.73% of variability, and correlation analysis revealed strong relationships among pod weight, pulp weight, and seed traits.



Colour coded circular dendrogram constructed using Ward's cluster analysis for 21 genotypes of jamun. Red: Bangalore Rural; Blue: Bangalore Rural; Green: seedless genotypes from Shivamogga; Black: Chikmangaluru



Hierarchal clustering of 29 tamarind accessions based on quantitative characters

At CHES Bhubaneswar, twenty three tamarind accessions collected from Koraput and Rayagada Districts in 2021 were evaluated for morphological parameters. Variability was observed in plant height (1.46-4.34 m), trunk girth (17.0-45.4 cm), primary girth (11.0-31.6 cm) and canopy spread (EW: 2.20-4.65 m, NS: 2.20-4.76 m). Of these, 11 accessions had purple/red pigmentation on newly emerging shoots. Six accessions were identified for their precocious and off-season (October-December) flowering.

Germplasm block of tamarind and accession with off-season flowering at CHES, Bhubaneswar

Avocado: The characterization of twenty accessions showed wide range of variation for both qualitative and quantitative characteristics. Fruit weight was maximum in PAH-026 (778.33 g) and lowest in Acc-22 (198.7 g). Fruit length was maximum in PA-111 (17.43 cm) and minimum in Acc-22 (7.65 cm). Pulp weight ranged from 115.7 g in Acc-22 to 590.0 g in PAH-026. The pulp percentage was highest in PAH-004 (89.2) and lowest in Acc-22 (58.1). Moisture content was minimum in Acc-22 (70.2%) and maximum in PA-120 (90.2%). Peel

weight was highest in PAH-026 (95.67 g) and lowest in PAH-006 (25.13 g). Peel thickness ranged from 0.17 mm (PAH-006) to 1.30 mm (PA-008).

Soursop (*Annona muricata*): Twenty-one accessions maintained at Bengaluru, Chettalli and Hirehalli were evaluated for morphological parameters. The promising soursop accessions include CHES-R3P3 for big size fruits (22.3 cm x 13.5 cm fruit size, 1358.8 g fruit weight, and 1007.6 g pulp weight) and IIHR-R6P2 for higher TSS (14°Brix), lower acidity (0.45%), lower seed weight (14.6 g) and lower seed number (25.5)

Wood apple (*Feronia limonia*): Evaluation of 18 accessions in the field gene bank for fruit quality indicated that the Accession VI-R1P1 registered highest pulp recovery (71.95%), high TSS (14.8°Brix), low acidity (1.76%), and fruit weight of 325 g when compared to farmer's variety (fruit weight of 413 g and fruit size of 9.83 cm x 9.54 cm) and released variety (fruit weight of 301 g and fruit size of 7.47 cm x 8.57 cm).

Wood apple accession, VI-R1P1

Wood apple variety, PKM-1

Aonla (*Emblica officinalis*): Among 12 varieties, highest yield (75 kg plant^{-1}) with bold fruits (> 60 g) and high pulp recovery (90%) was noticed in NA-7 and is best suited for growing in mild subtropical regions. Anand-2 had a greater vitamin C level (507.7 mg 100 g-1 FW).

Lasoda (*Cordia myxa* L.): Genotypes from southern Karnataka were evaluated for a range of qualitative and quantitative traits to assess phenotypic diversity. The analysis revealed significant variation (P<0.05) in most of the traits indicating their potential for distinguishing germplasm diversity. The fruit weight (1.40–3.11 g, with an average of 2.22 g) showed wide variation. Additionally, the traits such as number of fruits per tree, fruit yield, total soluble solids (TSS), as well as qualitative traits like fruit peel color and taste, exhibited substantial variability, with CV exceeding 20%. Principal component analysis (PCA) and hierarchical cluster analysis effectively grouped genotypes based on their phenotypic profiles. Genotypes from diverse geographic regions were widely distributed across the first two principal components (PC1 and PC2), highlighting the broad range of phenotypic diversity within the collection. A subset of traits accounted for 94% of the total variance in the PCA, suggesting their utility in *Cordia myxa* breeding programs.

Wild fruits: The five different native fruits of the Coorg region, including jackal jujube (*Ziziphus oenoplia* (L.) Miller), Orange berry (*Glycosmis mauritiana* (Lam.) Tanaka), South Indian Marble tree (*Elaeocarpus variabilis* Zmarzty), Coromandel Canthium (*Canthium parviflorum* Lam), Mysore raspberry (*Rubus niveus* Wall) were collected and conserved at CHES-Chettalli. All five collected fruits were characterized for morphological and biochemical traits. The wide variability was observed among the different crops for morpho-biochemical traits. The average fruit weight was 0.33 g in *Z. oenoplia*, 0.93 g in *G. mauritiana*, 20.34 g in *E. variabilis*, 0.82 g in *C. parviflorum* and 0.802 g in *R. niveus*.

Zizypus oenoplea

Glycosmis mauritiana

Elaeocarpus variabilis

Canthium parviflorum

Rubus niveus

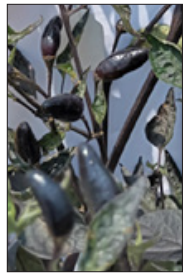
Vegetable crops

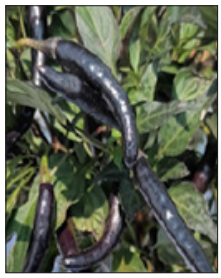
Chilli: Twenty-six purple fruited accessions were evaluated for anthocyanin content for two seasons. The total anthocyanin levels varied from 30.2 to 59.7 mg 100g^{-1} (Fresh weight). Profiling through Liquid Chromatography-Mass Spectrometry revealed that delphinidin and cyanidin content ranged from 8.19 to 32.6 mg 100g^{-1} FW and 0 to 16.5 mg 100g^{-1} FW, respectively. The IIHR-B-HP-81 accession had highest total anthocyanin content of 59.7 mg100g^{-1}and 32.2 mg100g^{-1}FW of delphinidin. Stability analysis revealed that accessions IHR-B-HP-81, IHR-B-HP- 129, IHR-B-

HP- 53 IHR-B-HP-18, IHR-B-HP-56 and IHR-B-HP-137 ranked high in the simultaneous selection index. These accessions with high anthocyanin could serve as potential donors for breeding peppers rich in nutraceuticals.

IIHR-B-HP-81

IIHR-B-HP-53


IIHR-B-HP-129


IIHR-B-HP-18

IIHR-B-HP-56

Chilli accessions with high anthocynin content

Brinjal: A total of 270 germplasm lined were raised for seed multiplication and characterized as per minimal descriptor of NBPGR. The yield per plant ranged between 1.20 kg in Kashmiri local - 2.75 kg in Malda local. Malda local is found to be resistant to bacterial wilt.

Maintenance of brinjal wild species: Seeds of wild species namely *Solanum torvum, S. gilo, S. indicum, S. macrocarpon, S. mammosum, S. viarum, S. nigrum, S. seaforthianum* and *S. sisymbriifolium* were produced and maintained.

S. torvum

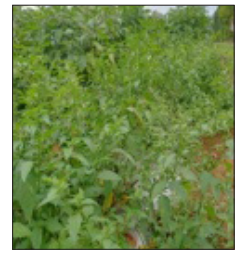
S. gilo

S. indicum

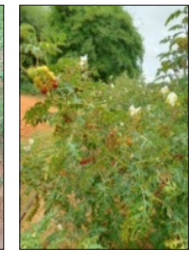
S. macrocarpon

S. mammosum

S.torvum


S. nigrum

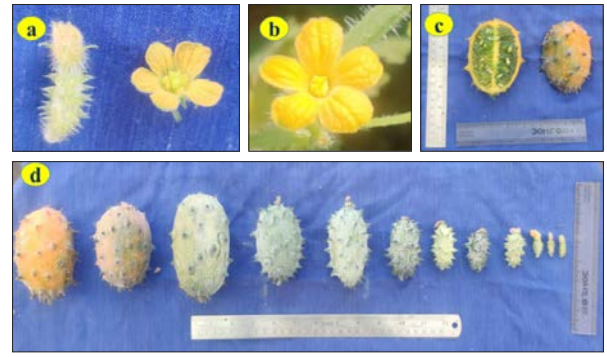
S. seaforthianum


S. sisymbriifolium

Wild germplasm in brinjal

Musk melon: The *Cucumis metuliferus* was characterized for morphological and nutritional traits.

Plant part	Nutrient concentration (%)					Nutrient concentration (ppm)		
	N	P	K	Ca	Mg	Cu	Zn	Fe
Pulp	2.31	0.58	0.44	0.53	0.40	9.10	9.10	**539.40**
Seed	3.64	0.77	0.83	0.47	0.29	25.50	25.50	166.10



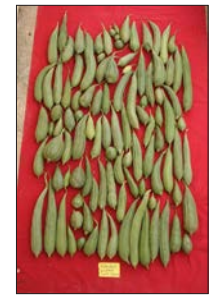
Characterization of horned melon (*Cucumis metuliferus*)

Okra: Six wild species were characterized for 25 important morphological traits.

Radish: A total 48 accessions were characterized for 25 characters (plant characters. leaf characters, root characters) using minimal descriptors of NBPGR

Carrot: A total of 110 accessions were characterized for plant, leaf and root characters.

Ridge gourd: The characterization of 160 germplasm lines along with two checks Arka Vikram and IIHR-6 indicated significant differences for quantitative traits except for peduncle length, yield and vulnerability index for tomato leaf curl New Delhi virus. Days to first female flower appearance varied from 38.0 (IIHR-6) to 71.4 (IIHR-233), fruit length from 3.88 (IIHR-241) to 36.56 cm


Fruit diversity in Ridge gourd germplasm

(IIHR -200), number of fruits per plant from 0.6 (IIHR-242) to 50.0 (IIHR -241) and fruit weight from 24.28 kg (IIHR- 232) to 476.19 kg (IIHR-221). The marketable fruit yield per plant ranged between 0.08 kg (IIHR-242) - 4.45 (IIHR-345). Two lines were completely resistant to ToLCNDV with zero vulnerability index.

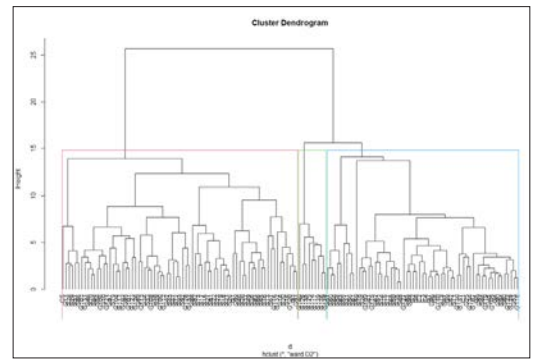
Superior ridge gourd germplasm and yield contributing traits

Trait	Mean	Min.	Max.	Superior genotypes
Node at first female flower appearance	9.31	2.25	21.70	IIHR-224 (2.25), IIHR-234 (2.40) IIHR-244 (2.50)
Days to first female flower appearance	49.53	38.00	71.44	IIHR-6 (38), IIHR-244 (39.6), IIHR-214 (39.67)
Fruit length (cm)	19.46	3.88	36.56	IIHR-200 (36.56), Arka Vikram (36.5), IIHR-218 (33.5)
Day to first fruit harvest	58.86	49	100	IIHR-6 (49), IIHR-214 (49), IIHR-234 (49)
No. of fruits per plant	7.97	0.60	50	IIHR-241 (50.00), IIHR-345 (28.00) IIHR-231 (25.50)
Average fruit weight (g)	136.2	24.3	476.2	IIHR-221(476.2), IIHR-205 (231.3), IIHR-210 (226.8)
Yield of marketable fruits per plant (kg)	0.98	0.08	4.45	IIHR-345 (4.45), IIHR-241 (3.57) IIHR-221 (3.00)
Yield of marketable fruits per ha (t)	19.77	1.60	89.00	IIHR-345 (89.00), IIHR-241 (71.40) IIHR-221 (60.00)
Vulnerability index (ToLCNDV)	46.59	0.00	87.00	IIHR-334 (0.00), IIHR-334-1 (0.00) IIHR-285 (0.50)' IIHR-268 (7.50) IIHR-330-1 (8.89)

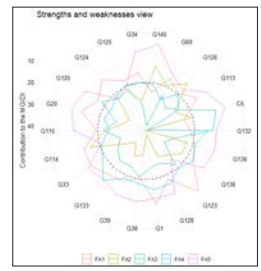
Cucumber

Characterization and multiplication of germplasm:

One hundred and forty-four cucumber germplasm accessions were characterized according to the minimal descriptor of NBPGR, New Delhi, for 44 characteristics. At the marketable stage, fruit color varied from cream, light green, green, dark green, to brown, while flesh color ranged from white, green, to yellow. Significant variations were observed for fruit length, size, number of fruits per plant and yield per plant. The dendrogram based on cluster analysis has grouped 144 cucumber germplasm lines into three major clusters. Based on multi-trait genotype-ideotypes distance index (MGIDI), principal component analysis and factor analysis, the 21 best cucumber genotypes were selected (IC 541391, IC297982, IC354828, IC634877, IC613458, IC354790, IC523692, IC634887, IC572024, IC264828, IC613467, IC613468, IC527400, IC613461, IC634878, IC634879, IC606240, IC634884, IC256248, PI197085 and IC613462). About 70 crosses were made using these selected genotypes.



Dendrogram of cucumber germplasm from quantitative traits



Strengths and weaknesses of the selected cucumber genotypes

Fruit variability in cucumber germplasm

Cluster bean: Two new germplasm of cluster bean were collected from Coimbatore, Tamil Nadu. With this total cluster bean germplasm strength of IIHR is 54. Registered one cluster bean advance breeding line IIHRCB 22-1-1 (INGR24064) with NBPGR, New Delhi for long, string less pods in cluster at each node.

Onion

Evaluation of onion germplasm resistance to anthracnose

A total of eleven onion genotypes (4 improved resistant and 7 susceptible lines) were evaluated for onion twister resistance caused by *Colletotrichum gloeosporioides* in field as well as in artificial inoculated conditions during *Kharif*, 2024. All four lines namely ATR/IIHR-01, ATR/IIHR-02, ATR/IIHR-03 and ATR/IIHR-04 showed high level of resistance both in natural and artificial inoculated conditions. Further selection was performed for higher resistance among these resistant lines to onion twister and advanced to next generations.

Besides, a total of 150 germplasm was screened under natural condition to identify diverse resistance sources to onion twister disease. Among them, genotype LSR/18/37 a landrace collected from Chitradurga, Karnataka found highly resistant (PDI: 5.5) followed by Sanagham Selection which was moderately resistance (PDI: 18.0). Remaining germplasm showed variable reactions to anthracnose with most of them found highly susceptible (>20.0 PDI).

Disease reaction of four improved lines of onion for twister disease

Genotype	Disease reaction under natural conditions (PDI)	Disease reaction under challenge inoculation conditions (PDI)	Reaction type
ATR/IIHR-01	5.3	6.5	Resistant
ATR/IIHR-02	6.7	10.3	Resistant
ATR/IIHR-03	7.2	9.7	Resistant
ATR/IIHR-04	8.3	8.7	Resistant
Arka Bheem	100	100	Susceptible
Arka Kalyan	60	100	Susceptible
AN-360	100	100	Susceptible
PBR-429	100	100	Susceptible
Arka Niketan	100	100	Susceptible
Arka Bindu	40	100	Susceptible
Arka Vishwas	60	100	Susceptible

Curry leaf

Characterization of curry leaf germplasm for essential oil: Out of total of 125 curry leaf germplasm, 20 accessions from Karnataka, Odisha and Tamil Nadu were evaluated for fresh leaf essential oil content and the maximum oil content was noticed in LSR/18/06 (0.60%) followed by LSR/18/07 (0.56%). The essential oil content varied from 0.11 to 0.60% in cultivated germplasm collection and 0.21-0.27% in wild germplasm collection.

Nutritional profiling of curry leaf germplasm

Nutritional profiling of 80 curry leaf germplasm was carried out for 10 micro-nutrients such as phosphorous, potash, calcium, magnesium, sulphur, iron, copper, manganese, zinc and boron present in leaves. The elite genotypes identified for different nutrients were presented in the table

Curry leaf germplasm with better nutrient profile

Genotype	Nutrient concentration (%)					Nutrient concentration (ppm)				
	P	K	Ca	Mg	S	Cu	Zn	Fe	Mn	B
IC652402	0.53	0.09	4.12	0.41	0.16	31.1	29.4	348.9	79.9	42.3
IC652403	0.21	0.09	5.97	0.63	0.25	13.2	22.9	181.0	24.3	93.9
IC652404	0.23	1.19	5.94	0.37	0.12	19.1	21.7	157.1	81.6	48.7

IC652419	0.16	0.99	5.66	0.48	0.23	16.8	23.3	315.6	92.5	69.3
IC652456	0.17	0.20	2.05	0.78	0.19	18.1	14.5	164.5	26.4	143.4
IC652459	0.13	0.20	4.81	0.73	0.28	18.2	40.6	285.4	35.1	40.1
IC652502	0.77	0.10	2.08	0.77	0.06	33.0	16.5	257.9	46.9	88.7
IC652518	0.18	3.42	1.42	0.30	0.17	38.3	29.8	319.8	33.5	49.1
IC652519	0.22	3.52	1.52	0.26	0.21	47.4	42.6	314.1	36.3	47.6
IC652520	0.21	3.42	1.80	0.10	0.23	15.4	31.9	401.3	14.2	57.8
IC652521	0.21	1.42	0.30	0.18	0.41	20.0	16.8	439.2	24.9	62.9

Drumstick

The drumstick germplasm maintained at CHES, IIHR Bhubaneswar have been subjected to leaf nutritional characterization. The leaf Nitrogen content varied from 3.02 to 4.17 per cent among the various germplasm. Similarly, the leaf P content ranged between 0.28-0.50 %, leaf K ranged between 2.05-3.12 %, leaf Ca ranged between 0.67-1.76 %, Leaf Mg ranged between 0.25-0.65 per cent and leaf S ranged between 1.8-2.67 %. Micronutrient content showed a wide variation among the leaves of moringa germaplasm. The total Fe, Mn, Zn, Cu and total Boron ranged between, 363.0-583.5 ppm, 60.6-111.0 ppm, 14.4-24.1 ppm, 1.23-2.70 ppm and 230.4-515.2 ppm, respectively.

Some germplasm of moringa maintained at CHES, IIHR Bhubaneswar have been subjected to pod (at edible stage) nutritional characterization. The pod Nitrogen content varied from 1.76 to 2.67 per cent among the various germplasm. Similarly, the pod P content ranged between 0.30-0.43 %, pod K ranged between 1.41-2.52 %, calcium content in the pod ranged between 0.40-0.74 % , Mg and sulphur content in the moringa pods ranged from 0.2.0 to 0.41 % and 1.40 to 1.82 per cent, respectively. Micronutrient content showed a wide variation among the pods of moringa germaplasm. The total Fe, Mn, Zn, Cu and total Boron ranged between, 60.2-76.6 ppm, 20.02-32.50 ppm, 11.16-16.89 ppm, 1.20-1.80 ppm and 345.6-681.6 ppm, respectively.

Edible fern

Nutritional and biochemical analysis of an edible fern, *Diplazium esculentum* was carried out. It was found that the leaves contain 5.46% total N, 0.92 % total P, 3.10% total K, 186.60 ppm total Fe, 15.58 ppm total Mn, 61.21 ppm of total Zinc on dry weight basis. Apart from that the leaves contain, 750.67, 629.17, 620.83 FRAP Antioxidant activity mg/ 100 g DW, DPPH Antioxidant activity mg/ 100 g DW, Total Flavonoid mg/100 g DW, respectively.

Flower crops

Rose: Green rose commonly known as *R. chinensis* cv. viridiflora was profusely flowering. It is a shrub rose growing to a height of 40-50 cm with profuse branching. The plant can be easily multiplied by cuttings and flowers round the year. The green flowers remain fresh for a long time. The genotype has the potential to be explored as filler or as novelty in flower arrangements.

Tuberose: Five germplasm were characterized as per standard descriptors.

Gladiolus: Five germplasm were characterized as per standard descriptors.

Carnation: Six germplasm were characterized as per standard descriptors.

Crossandra: Fifteen genotypes were characterized based on standard morphological descriptors.

Barleria: Nine genotypes belonging to four commercially cultivated species *viz*., *Barleria cristata*, *Barleria prionitis*, *Barleria repens* and *Barleria prionitioides* are being maintained in the field gene bank and were characterized based on the morphological descriptors.

Jasmine: Thirty-nine genotypes of jasmine belonging to four commercially cultivated species *viz*., *Jasminum sambac*, *Jasminum auriculatum*, *Jasminum grandiflorum*, *Jasminum multiflorum,* and eight other lesser-known species (*Jasminum rigidum*, *Jasminum nitidum*, *Jasminum flexile*, *Jasminum malabaricum*, *Jasminum humile*, *Jasminum calophyllum* and *Jasminum arborescence*) are being maintained in

the field gene bank and characterized based on the morphological descriptors.

Chrysanthemum: A total of 60 genotypes were characterized for 77 traits as per DUS test guidelines.

China aster: A total of 28 genotypes for 21 traits were characterized as per DUS test guidelines.

Lotus: The morphological evaluation revealed that that plant height of the accessions ranged from 10 to 58 cm. Minimum plant height was observed in IIHR-NN-S-52 (10 cm) and maximum was in IIHR-NN-S-4 (58 cm). The number of leaves on water surface per pot was in the range of 2-50, and the number of leaves above the water surface per pot was in the range of 1 to 28.

Medicinal crops

Morphological variability in *Brahmi* germplasm

About 115 germplasm lines of *Brahmi* are characterized for different morphological traits as per the guidelines of DUS testing. Germplasm exhibited creeping (n=67), semi creeping (n=32) and erect (n=16) growth habits. The stem had pigmentation of light brown in 65 germplasm lines, dark brown in 16 lines and light green in 34 lines. Majority of the genotypes showed cuneate leaf shape (n=101) whereas only fourteen genotypes had expressed ovate leaf shape. About 69 genotypes showed green colour leaf whereas 35 genotypes showed dark green leaf, the remaining eleven genotypes exhibited yellowish green leaf. Flower color varied among the germplasm. Bluish purple coloured flowers were noticed in 70 genotypes. About 28 genotypes showed purple colour, and 70 genotypes had white flower colour.

The number of primary branches per plant varied from 11.33 (IIHR BM 01) to 25.33 (IIHR BM 55) with a mean of 16.82. Leaf length ranged between 1.08 cm in IIHR BM 01 - 2.06 cm in CIM Jagriti with a mean of 1.51 cm. Leaf width varied from 0.41 cm (IIHR BM 01 and IC 392242) to 0.75 cm (IIHR BM 09) with a mean of 0.51 cm. Flower diameter ranged from 0.93 cm (IIHR BM 26) to 1.23 cm (IIHR BM 55) with a mean of 1.05 cm.

Light green Light brown Dark brown

Anthocyanin pigmentation on stem in *Brahmi* genotypes

Ovate Cuneate

Variability of leaf shape in *Brahmi* genotypes

Bluish purple Purple White

Variability of flower colour in *Brahmi* genotypes

Gymnema sylvestre (Gudmar)

About 53 accessions of *Gymnema sylvestre* were characterized for five quantitative (leaf length, leaf breadth, leaf area, petiole length and internodal content) and seven qualitative traits (leaf texture, leaf colour, leaf shape, leaf tip shape, leaf base shape, flower colour and stem colour). Leaf length ranged between 3.02-5.76 cm and leaf width between 1.58-4.08 cm. Maximum leaf area was observed in IIHR-GS-41 (22.52 cm^2) followed by IIHR-GS-42(19.43 cm^2), while minimum leaf area was recorded in IIHR-GS-44(5.38 cm^2). Unique morphotypes identified included IIHR-GS-18 for late flowering, IIHR-GS-15 with maximum number of capsules and IIHR-GS-24 for velvety broad leaves.

Clitorea ternatea (Shankh pushpi)

A total of thirty germplasm accessions of *Clitorea ternatea* were characterized for 5 qualitative and 10 quantitative traits and the variation was noticed for plant height, leaf colour, flower colour, flower size, flower weight, pod size, seed colour and seed weight.

Flower colour variability in *Clitorea ternatea*

Salacia chinensis (Saptarangi)

Thirteen accessions of *Salacia chinensis* were characterized for 10 quantitative and 6 qualitative plant, leaf and fruit parameters. Quantitative parameters included plant height, plant spread (N-S and E-W), leaf length, leaf width, stem girth, leaf area, fruit length and fruit width and qualitative parameters observed were leaf shape, leaf apex shape, leaf base shape, leaf colour, leaf glossiness and fruit shape.

3.1.4. Evaluation of Germplasm for Yield and Quality

Fruit Crops

Papaya: A total of 34 accessions were field planted and selfing /sib-mating is being carried out for maintaining the genetic purity.

Jackfruit: In jackfruit segment for table purpose, two farmers varieties such as Harigold and Thirumala, from Panruti, Tamil Nadu were identified after **o**n-site evaluation. Both the varieties showed superior performance with respect to fruit quality and yield traits.

Harigold (JK 2/24): Fruits are oblong to ellipsoid with blunt spikes, bears in clusters of 2-3 with 50-55 fruits per tree. It has crispy flakes with an attractive golden yellow color, lesser latex and good shelf life, It has high flake recovery of 40-45% and fruit yield (300-350 kg per tree) with TSS of >30°Brix, acidity of 0.34% and carotenoid content of 2.83 mg 100 g^{-1}. Fruits are suitable for table and processing purposes.

Cross section view of Harigold jackfruit

Crispy flakes of Harigold jackfruit

Thirumala (JK 12/24): Fruits are oblong in shape. Flakes are crunchy and have attractive turmeric yellow color. Fruit has more than 45% bulb recovery, bulb weight ranged between 44-46 g, and flake thickness 6-8 mm. Flakes have TSS of 25.1 to 27.5°Brix and carotenoid content of 2.5-3.0 mg 100 g^{-1}. A fully grown tree yields about 450–500 kg fruits per plant with an average fruit weight of 10-12 kg.

Cross section view of Thirumala jackfruit

Crunchy turmeric yellow flakes of Thirumala

Tender jackfruit accessions (*n*=10) were collected from Karnataka and Tamil Nadu for assessing suitability for tender jack purpose. Among accessions, fruits harvested at 60 and 90 days old weighed 0.62 to 2.13 kg with dietary fibre ranging between 8-12%, and total phenol content ranging between 150-797 mg 100 g^{-1}. The accessions VE-1, Palur-1, Hemachandra, JAP-1, NSP-1 and Tubugere were found rich in dietary fibre of more than 11 to 12%. The accessions JAP-1 and VE-1 needed less time of about 30 minutes to achieve palatability and JAP-1 resulted in less water uptake ratio (1.26) compared to other accessions

VE-1

Hemachandra

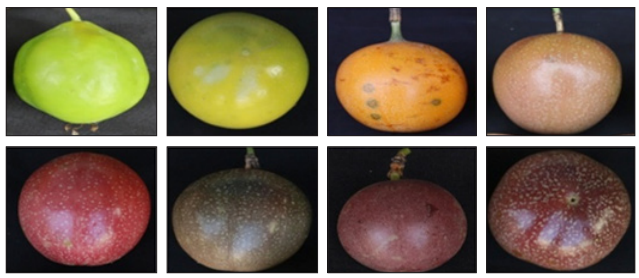
Palur-1

Rose apple (*Syzygium jambos*): From the survey and *in situ* evaluation of germplasm in Mudigere and Sringeri areas of Chikmagaluru in Karnataka, sixteen accessions were identified and assessed for characteristics in their natural habitat. Fruiting occurred primarily from May to June, with off-season fruiting in November and December. Variability was observed for several fruit characteristics. Fruit length ranged between 3.4-4.58 cm; fruit width 3.15-4.17 cm; fruit weight from 15 to 24.60 g; pulp thickness from 0.35 to 0.50 cm; and pulp recovery from 70.35 to 84.96%. TSS varied from 11.2 to 15.2◦B and acidity from 0.12-0.24 %. Among rose apple accessions, ASSG-11 stands out for its large fruit size (fruit width 4.12 cm, fruit weight (24.6 g) and high pulp recovery (84.96%) with pulp thickness of 0.5 cm. The ASSG-7 registered highest TSS (15.2°Brix) and smaller cavity size inside the fruit (1.67 x 1.47 cm). ASMG-1 had higher pulp thickness (0.7 cm). Fruit colour was yellow (10C) to yellow orange group (19C). Seed weight and fruit cavity registered higher CV compared to other traits.

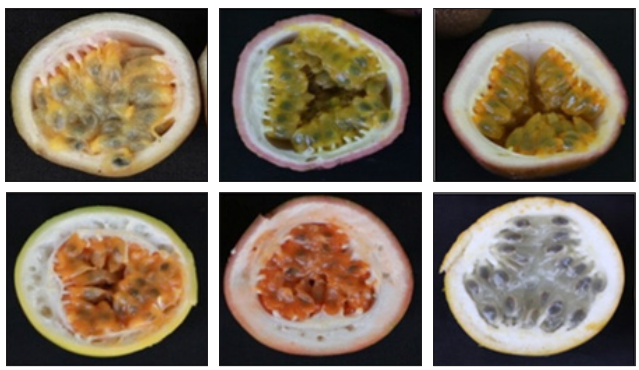
Variability in fruit shape and size in rose apple

The analysed biochemical parameters in rose apple collections included total phenols (53.98-156.01 mg 100 g^{-1} FW), total flavonoids (9.78- 20.29 mg 100 g^{-1} FW), anti-oxidant activity (FRAP 53.74-100.88 mg 100 g^{-1} FW) and DPPH (91.69 -120.79 mg 100 g^{-1} FW). Total sugars varied from 72.56 to 108.9 mg and the reducing sugars was highest in ASSR-16 (43.68 mg) and non-reducing sugar in ASMG-6 (70.82 mg). Promising accessions include ASMG-2 for total phenols and anti-oxidants, ASMG-6 for total sugars and ASSG-11 for total flavonoids. Based on nutrient profile, the promising accessions were ASSG-15 (high potassium 0.78% and zinc 10.37 ppm) and ASMG-4 (high Fe, 74 ppm), ASMG-1 (high Ca, 3.44% and Mg, 2.17%).

Passion fruit: The passion fruit germplasm was evaluated for morpho-biochemical traits. The accessions showed wide variations for fruit weight (23.19-197.54 g), fruit length (43.2-97.1 mm), fruit breadth (39.74-84.18 mm), rind weight (14.72-108.3 g), rind thickness (1.92-6.16 mm), seed number (24.6-389.8) and TSS (12.2-19.8 ^{0} B). Maximum fruit weight and length were recorded in PF-29 and fruit breadth in PF-30. Minimum fruit weight and length were observed in PF-42 and fruit breadth in PF-30. The germplasm PF-51, PF-54, and PF-53 had higher aroma and flavor content.



Variation in peel colour of passion fruit germplasm



Variation in pulp colour of passion fruit germplasm

Rambutan: Out of 200 rambutan accessions characterized for morphological and biochemical traits, wide variations were observed and the accession R4P11 was found superior. The fruit weight in R4P11 ranged between 36-46 g with an average fruit weight of 40 g. It is a regular bearer and high-yielding (25 kg per tree). The pulp recovery is more than 50% with good TSS (18-21^{o}Brix), ascorbic acid (40-46 mg 100 g^{-1}) and total phenols (156-188.34 mg GAE 100 g^{-1}).

Mother plant of R4P11 and closer view of fruits

Vegetable crops

Tomato

TODVAR4-1 LA1920

Evaluation of genotypes for resistance to bacterial wilt disease: Around 22 diverse lines were evaluated in bacteria wilt sick plot. A fairly good number of lines (10 out of 22) survived at the end of 12th week after planting. Highest percentage of plant survival was observed in Arka Abha and 20-3-1-B followed by 2021/TODVAR4-1and 2021/TODVAR4-2. The lowest percentage of plants survived in 2021/TOINDVAR-1 and LA-1994 followed by AVTO1920 and Arka Vikas.

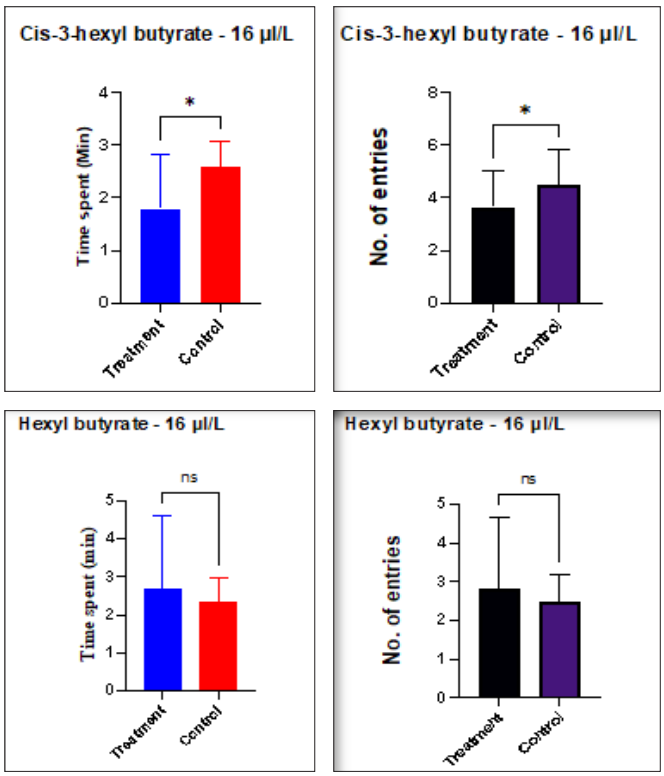
Seedling stage heat tolerance: A total of 84 diverse tomato accessions sourced from different National and International institutes/organizations were evaluated for seedling stage heat tolerance in polyhouse during March 2024. The average maximum temperature recorded was 44.67^{o}C. The genotypes were sown in seedling trays filled with cocopeat. The observations for six seedling related traits (shoot length, shoot weight, stem girth, root length, root weight and leaf area) on five randomly selected 30-day old seedlings. The results revealed that 13 genotypes exhibited superior performance with respect to all six traits, demonstrating heat tolerance at the seedling stage. The lines AVTO 1822 and AVTO1892 showed superior performance for majority of these seedling traits.

Resistance to *Phthorimaea absoluta* in wild relatives: Experiment was carried out to know the oviposition preference of female moths of tomato leaf miner on cultivated tomato and wild species of tomato under choice and no-choice conditions. Considering the both

choice and no-choice assays, cultivated tomato was found to be consistently preferred by the female *P. absoluta* moths for egg laying.

Chilli

Metabolite analysis for Southeast Asian thrips resistance: GC-MS profiling identified Tritriacontan-16-one as a key epicuticular wax component in the resistant accession IIHR 4550, while Hex-3(Z)-enyl butyrate was recognized as a significant volatile compound in resistant accessions IIHR 4550 and IIHR-B-HP-79. The both compounds exhibit non-preference effects on Asian thrips as a synthetic volatile. The validation through bioassays and olfactometer studies showed the reduced scraping damage (%) at 8 µl/L and 16 µl/L of Hex-3(Z)-enyl butyrate in the leaf dip bioassay. Four-arm olfactometer studies revealed that Hex-3(Z)-enyl butyrate significantly influenced the time spent and the number of entries compared to the control.

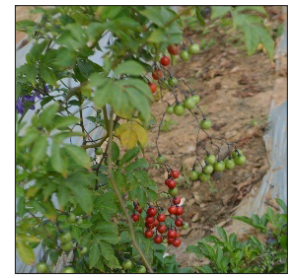


Validation of synthetic compound Hex-3(Z)-enyl butyrate and Hexyl butyrate16 µl/L concentration

Brinjal

Screening for resistance to nematode, salinity and bacterial wilt: The resistance to nematode confirmed in IIHR-824, IIHR-803 (*Solanum torvum)* and IIHR-792 (*S. seaforthianum*) and recorded less than 10 galls per root system with reproduction factor is <1. Arka Harshitha was found resistance to both salinity and bacterial wilt disease.

Arka Harshitha



S. seaforthianum

S. torvum

Screening germplasm for resistance to *Phomopsis* fruit rot

A total of 150 germplasm accessions were screened for *Phomopsis* fruit rot and the moderate resistant reaction was observed IIHR-629 (Mattugulla fruit type).

Evaluation of germplasm for drought and heat stress: A set of 120 diverse germplasm accessions of brinjal were characterized in CTGC and field conditions for phenotypic and morphological traits associated with drought and heat stress. The analysis showed *Solanum acculiatissimum*, *Solanum incanum*, *Solanum macrocarpon*, KS-224 and IIHR-766 as tolerant to drought stress, while Kateri Brinjal, Black Beauty, BRLVAR-4, *Solanum capricoides*, and Goa Brinjal-3 were found to be susceptible. Additionally, *Solanum seaforthianum*, Arka Avinash, SKT - Shri Baigan, Goa Brinjal-3, Arka Neelanchal Shyama, and Mattigulla were identified as heat stress-tolerant genotypes. In contrast, IIHR-586, CO-2, Kateri Brinjal, Dommeru Vanga, WCGR (West Coast Green Round), and Rampur Local were found to be susceptible to heat stress.

Muskmelon

Evaluation of muskmelon for yield and quality traits

Among 9 muskmelon lines evaluated, the lines IIHR653-1, IIHR628-6, IIHR628-8 differed significantly for yield and yield attributing traits.

IIHR623-1 **IIHR624-5** **IIHR628-6**

IIHR628-8 IIHR653-1 IIHR653-2

IIHR796-3 IIHR802-5 IIHR802-7

Morphological view for fruit traits of muskmelon advanced breeding elite accessions

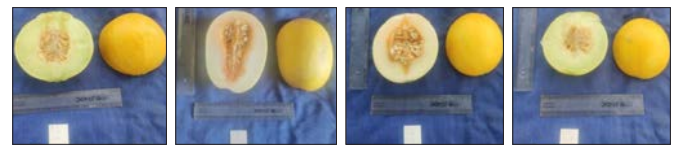
Canary melon

Characterization of eight canary melon lines for yield and quality traits indicated that the lines IIHR-818-2, IIHR-818-3, IIHR-818-4 differed significantly for yield and yield attributing traits

Performance of Canary melon for yield and quality traits

Treatment	Fruit Weight (g)	Flesh Thickness (cm)	TSS (°B)
IIHR-797-1	645	2.10	10.75
IIHR-818-2	985	2.85	12.65
IIHR-818-3	925	2.85	10.90
IIHR-818-4	770	2.00	11.70
IIHR-818-5 (G)	720	2.25	13.25
IIHR-818-7	680	2.20	11.55
IIHR-820-1	750	2.95	11.25
IIHR-825-2 (G)	710	2.20	12.15
CD (p<0.05)	156.40	0.21	1.34
SEm±	45.97	0.06	0.39
CV(%)	8.41	3.73	4.74

IIHR-797-1 IIHR-818-2 IIHR-818-3 IIHR-818-4

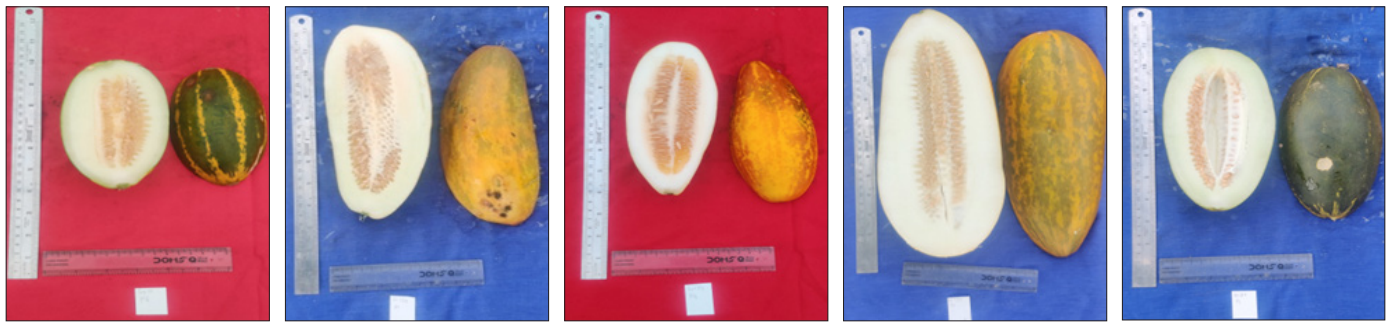


IIHR-818-5 IIHR-818-7 IIHR-820-1 IIHR-825-2

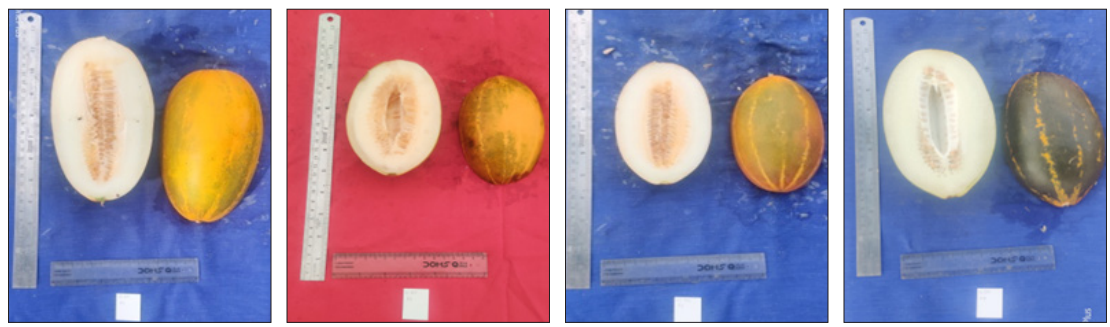
Morphological view for fruit traits of canary melon

Oriental pickling melon (*Cucumis melo* var *conomon*)

Among 9 lines, the lines IIHR618-2, IIHR617-4 differed significantly for yield and yield attributing traits



IIHR-603 IIHR-617-1 IIHR-617-2 IIHR-617-4 IIHR-618-1



IIHR-618-2 IIHR-618-3 IIHR-618-4 IIHR-618-7

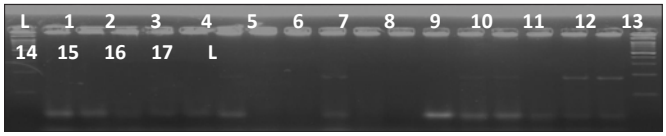
Morphological view for fruit traits of oriental pickling melon

Performance of oriental pickling melon (*Cucumis melo* var *conomon*) for yield and quality traits

Treatment	Fruit weight (g)	Fruit length (cm)	Fruit width (cm)	Flesh thickness (cm)	Rind thickness (cm)	TSS (°B)
IIHR603	590.00	15.00	8.60	1.40	0.30	3.07
IIHR617-1	966.67	21.67	9.80	3.27	0.30	3.00
IIHR617-3	586.67	17.67	8.30	1.67	0.23	2.00
IIHR617-4	1243.33	31.50	13.27	3.77	0.37	3.80
IIHR618-1	866.67	16.77	11.00	2.45	0.30	3.33
IIHR618-2	1180.00	17.93	10.20	3.10	0.38	3.17
IIHR618-3	580.00	13.27	9.33	2.20	0.20	5.17
IIHR618-4	568.33	13.37	8.70	2.10	0.27	5.50
IIHR618-7	946.67	17.03	10.40	3.13	0.47	5.17
CD (p<0.05)	35.71	1.00	0.48	0.20	0.07	0.45
SEm±	16.70	0.47	0.23	0.10	0.03	0.21
CV (%)	2.45	3.13	2.76	4.55	12.30	6.70

Downy mildew resistance: Among 17 musk melon lines evaluated, the lines IIHR818-2, IIHR818-3, IIHR820-1, IIHR796-3 and IIHR796-4 were found slow mildew types

Identification of *Fom* 2-mediated *Fusarium* wilt resistance using functional marker: AS-PCR amplification (2-3F3 and 2-3R2) yield 183-bp fragment in R genotype, no amplification in S genotype. Among 17 muskmelon lines, the lines such as IIHR818-6, IIHR796-3, IIHR624-1, IIHR628-6, IIHR653-1 and IIHR653-2 are found be conferred with *Fom*-2 resistant allele.



Marker assisted validation of muskmelon for *Fon*-2 race resistance

Okra: A total of ten newly collected germplasm from Salem from an organic village Sandy during October and the same set of germplasm were evaluated during *Rabi* 2024. Among them, IIHR-1768 found superior for yield (260 g plant^{-1}) with round purple fruits with no ridges. Fruit length was 14 cm and single fruit weight was around 22 g at marketable stage. It is suitable for fresh market and processing. The fruit yield in IIHR-1774 (Star okra) was 180 g plant^{-1}, fully ridge type, lush green, two branches and suitable for fresh market.

French bean

A total of 86 French bean germplasm, which includes accessions of both common bean and string bean with determinate growth habits were evaluated for three seasons during *Rabi* (2022-2023), summer (2022-23) and *Kharif* (2023-24) seasons. The diversity for pod quality traits was observed in the germplasm. IIHR-155 and IIHR-11 were identified as the promising genotypes based on three seasons mean and their position on AMMI biplots, stability indices combined, estimates of best linear unbiased prediction (BLUP) and minimal crossover interaction.

Diversity for pod quality related traits in germplasm of French bean

Anthocyanin content and antioxidant potentials: The anthocyanin content varied significantly among French bean varieties, with purple-podded varieties showing markedly higher levels than green-podded ones. IIHR-296 had the highest anthocyanin content (35.7±9.55 mg CGE100 g^{-1} FW) followed by IIHR-277-1 (28.5±2.69 mg CGE100 g^{-1} FW) and IIHR-252 (29.6±6.66 mg CGE100 g^{-1} FW). In contrast, green-podded varieties such as IIHRPB-IPS-2 (5.45±0.62 mg CGE100 g^{-1}FW), IIHR-17 (3.92±0.77 mg CGE100 g^{-1}FW), IIHR-51 (3.64±0.22 mg CGE100 g^{-1}FW) and IIHR-61 (3.52±0.00 mg CGE

100 g^{-1} FW) had significantly lower anthocyanin levels. These findings highlight the potential of purple-podded French bean varieties for nutritional enhancement and functional food applications.

Characterization for rust resistant *Ur* gene using SCAR markers: The screening of 86 bush type accessions and 42 pole type accessions of French bean results with rust disease resistant '*Ur*' gene diagnostic SCAR Marker 'SK'14 for *UR*-3 found that SCAR marker assay was positive for 23 accessions namely, IIHR-11, IIHR-50, GC-918, IIHR-31, IIHR-31-1, IIHR-34-2, IIHR-43, IIHR-203, IIHR-213, IIHR-214, IIHR-218, IIHR-219, IIHR-231, IIHR-266-1, IIHR-104, IIHR-153, IIHR-191, IIHR-197, IIHR-198, IIHR-201-2, IIHR-266-2 and IIHR-274-2.

Cowpea

A total of 252 accessions of cowpea were evaluated for virus diseases under natural epiphytic condition. The field evaluation and ELISA test showed that KVTSA-2 was identified as resistant and IIHR-58, KVTSA-67 were moderate resistant types for cowpea aphid borne mosaic disease.

Garden pea

A total of 361 garden pea accessions (Germplasm: 118, Breeding lines: 152 and varieties and other lines: 91) were sown for evaluation during November, 2024. Morphological observations as well as yield and other contributing traits are being recorded for short listing promising genotypes for quality improvement.

Field view and variability in garden pea morphological traits

Radish

Evaluation of germplasm: With regard to root length and root weight, IIHR 77, IIHR 63, IIHR 15, IIHR 7, IIHR 86, IIHR 65, IIHR 64 and IIHR 51 recorded highest root length (>51 cm), root weight (> 150 g) compared to Arka Nishant (17.06 cm and 60 g) in summer.

Biochemical and nutritional profiling: Among 24 accessions, high TSS was observed in IIHR 63 (4.6ºBrix) and IIHR 77 (4.4ºBrix) compared to Arka Nishant (3.5ºBrix). IIHR 85 recorded highest Vitamin C of 24.39 mg 100 g^{-1} compared to Arka Nishant (7.89 mg 100 g^{-1}) with highest anthocyanin of 8.21 mg 100 g^{-1}.

Screening for heat tolerance: Among 24 accessions screened for heat tolerance (polyhouse) 39-24ºC, 20 accessions were found heat tolerant with higher root yield (<150 g). Membrane stability index was highest in IIHR 77 (85.6%) followed by IIHR 62 (83.6%) and IIHR 66 (83.0%) and IIHR 15 (80.5%) compared to Arka Nishant (71.1%). In open-field condition (37ºC), among 24 accessions, IIHR 77, IIHR 15, IIHR 87, IIHR 7 and IIHR 51 were superior heat tolerant entries with non-bolting, higher root weight and marketable yield per ha consistently for the last 3 years compared to Arka Nishant and Pusa Chetki. This was also confirmed in artificial screening for heat tolerance in polyhouse at 39-42ºC in summer.

Carrot

Evaluation for root yield, high carotene content and quality traits

Among 29 lines evaluated, superior accessions AS 9 (156 g), IIHR 200 (149.33 g), IIHR 88 (143 g), IIHR 129 (139 g), IIHR 113 (131 g), IIHR 61(130 g) and IIHR201(120 g) recorded higher root weight, self-core compared to Arka Suraj (80 g). Among 29 lines tested for carotenoids, 5 lines *viz*., IIHR 60 (19.1 mg 100 g^{-1}), IIHR 36 (18.5 mg 100 g^{-1}), IIHR 190 (17.3 mg 100 g^{-1}) and IIHR 61 (17.8 mg 100 g^{-1}) and IIHR 88 (16.6 mg 100 g^{-1}) had higher carotenoids than Arka Suraj (10.0 mg 100 g^{-1}).

IIHR 60 IIHR 88

Evaluation for male sterility: 10 Petaloid CMS and 6 brown anther CMS were identified**.**

Evaluation of lines for powdery mildew resistance: Among 13 lines evaluated for powdery mildew resistance through artificial and field screening, IIHR 60 and IIHR 61 were confirmed as moderately resistant (PDI 11.11 and 19.26, respectively) and IIHR 72 as highly resistant (0 scale) compared to Arka Suraj which was susceptible.

Hybridization of accessions for powdery mildew resistance: About 10 hybrids involving lines with powdery mildew resistance were developed.

Evaluation of lines for nematode resistance: Among 13 accessions screened artificially for root knot nematode resistance, one-line IIHR 88 was identified and confirmed as moderately resistant (consistent for three years) compared to Arka Suraj (susceptible).

Ridge gourd

Screening ridge gourd germplasm for fruit fly resistance: A total of 42 ridge gourd genotypes were screened for their resistance to fruit fly, *Bactrocera cucurbitae* under natural epiphytotic conditions during *Kharif* 2024. Based on percent fruit infestation, among the screened genotypes, IIHR-346 showed resistance to fruit fly with a relatively low percentage of fruit damage (17.65%) and a moderate reduction in fruit yield (38.83%), whereas 26 other germplasm accessions showed moderate resistance to fruit fly.

Evaluation of new germplasm for yield, related traits and downy mildew resistance: Thirteen new ridge gourd germplasm collected from Odisha and Karnataka were evaluated for yield, yield related traits and downy mildew resistance during *Kharif* 2024. Data has been recorded on eight quantitative traits and two qualitative traits like fruit colour and ridge type. The lines IIHR-345 (52 t ha^{-1}), IIHR-347 (48.25 t ha^{-1}) and IIHR-346 (44.25 t ha^{-1}) were found to be superior with respect to yield per hectare and all the lines showed resistance to downy mildew with the PDI of less than 10.

Bitter gourd

Evaluation of germplasm for yield, related traits and LCV resistance: Twenty-four germplasm lines were evaluated for yield and yield related traits during summer. Data has been recorded on. Significant differences were observed among germplasm two qualitative traits like fruit colour and ridge and for twelve quantitative traits except for days to first female flower appearance, days to first picking and Cowpea aphid borne mosaic virus and. Fruit length ranged from 6.35 cm (Arka Harit) to 17cm (IIHR-93). Superior germplasm with respect to yield were IIHR-181 (14.19 t ha^{-1}), IIHR-196 (13.94 t ha^{-1}) and IIHR-189 (13.5 t ha^{-1}). Fourteen lines showed complete resistance for tomato leaf curl New Delhi Virus.

Evaluation of new germplasm for yield and virus resistance during Summer: Out of nine new bitter gourd germplasm evaluated, the accession IIHR-203 (31.6 q), IIHR-210 (29 q) and IIHR-209 (26 q) were found superior with respect to yield per hectare. All the lines except IIHR-202 and IIHR-203 showed complete resistance to ToLCNDV.

Evaluation of new germplasm for yield traits and downy mildew resistance during *Kharif*: Among **f**ive bitter gourd germplasm, the accessions IIHR-205 (77.14 q) and IIHR-204 (62.43 q) were found to be superior with respect to yield per hectare and all the lines except IIHR-203 showed resistance to downy mildew with the less PDI (15.87).

Fuit yield parameters and PDI in new germplasm of bitter gourd

Genotype	Node to first female flower appearance	Days to first female flower	Fruit length (cm)	Days to first picking	Fruit weight (g)	No. of fruits/ plant	Yield per ha (q)	Downy mildew PDI	Fruit characters
IIHR-203	9.67	41.33	4.40	60.00	7.55	17.00	25.67	15.87	LG,DCR,SF
IIHR-204	8.57	38.43	7.44	60.00	12.70	24.57	62.43	26.98	G,DCR,SF
IIHR-205	8.29	40.86	6.12	60.00	13.57	28.43	77.14	26.98	LG,DCR,SF
IIHR-207	17.50	47.25	6.12	60.00	6.75	19.14	25.86	34.92	LG,DCR,SF
IIHR-203-1	11.40	42.20	5.10	60.00	14.76	10.50	31.00	24.69	G,DCR,SF
Mean	11.08	42.01	5.84	60.00	11.07	19.93	44.42	25.89	
SEm±	1.69	1.45	0.52	0.00	1.64	3.10	10.66	3.05	

Screening germplasm for fruit fly resistance during *Kharif*: A total of 43 bitter gourd genotypes were screened for their resistance to fruit fly, *Bactrocera cucurbitae* under natural epiphytotic conditions. Based on percent fruit infestation, 33 germplasm accessions showed moderate resistance to fruit fly and rest of the lines were susceptible.

Ash gourd

Evaluation of germplasm for fruit yield and quality attributes: Among 22 germplasm accessions, maximum fruit yield was recorded in AG-3-54-39-55 (6.55 fruits plant^{-1}) followed by AG-1-73-10 (5.50 fruits plant^{-1}). Average fruit weight varied from 2.04 kg (AG-3-54-39-55) to 7.24 kg (AG-21-3-16).

Nutritional and biochemical profiling: Among 22 ash gourd genotypes, the nutrient concentrations were in the ranges of 0.81-1.62% for N, 0.25-0.66% for P, 1.61-3.35% for K, 0.26-0.84% for Ca, 0.25-0.49% for Mg, 0.08-0.15% for S, 13.3-74.4 ppm for Fe, 16.25-24.5 ppm for Mn, 5.57-16.71 ppm for Zn and 4.4-11.75 ppm for Cu. The vitamin C varied from 3.63 to 7.13 mg 100 g^{-1}.

Summer squash

Evaluation of thirty-five summer squash accessions for yield related traits showed significant differences for fruit morphological traits such as fruit length (11.22-52.5 cm), fruit girth (24.3-52.8 cm), flesh thickness (1.2-4.8 cm), TSS (3.0-5.4°Brix) and fruit weight (0.316-1.56 kg with mean value of 0.625 kg). The seed yield per fruit varied from 0 to 126.9 g fruit^{-1}. Three accessions recorded the seed yield of >100 g per fruit. IIHR-SSQ-6 recorded the highest ratio of seed on single fruit basis.

Pumpkin

Thirty-nine pumpkin accessions were evaluated for nine quality traits and wider variation was observed for TSS (3.43-11.83°Brix), vitamin C (6.10-48.78 mg 100 g^{-1}), acidity (0.03-0.17 mg 100 g^{-1}), total carotenoids (2.93-21.95 mg 100 g^{-1}), lycopene (0.09-3.82 mg 100 g^{-1}), phenols (8.45-64.95 mg GAE 100 g^{-1}) and antioxidants activity (9.57-21.56 mg AEAC 100 g^{-1}). The Accession 27-2 and Accession-92 recorded higher values for total carotenoids, lycopene content and antioxidant activity. Five accessions recorded TSS more than 10.0°Brix.

Twenty-one *C. maxima* types were evaluated and found that the average fruit weight (0.33-2.32 kg), fruits per plant (0.56-7.22), yield (3.73-48.1 t ha^{-1}), flesh thickness (1.55-4.35), TSS (4.0-10.0°Brix), seed weight per fruit (15.9-122.1 g) and seed length (0.90-1.81cm). RJ-4 recorded highest yield compared to Arka Suryamukhi (36.23 t ha^{-1}).

Drumstick

Among 53 superior accessions, the variation was large for fresh whole leaf weight per shoot (156.1-745.1g) and yield per plant (1.93-17.25kg). The edible leaf yield per shoot was 93.76-375.43 g and edible leaf yield per plant ranged between 0.99-8.69 kg plant^{-1}. A purple podded accession was identified with higher pod yield at very low height from the ground level.

Flower Crops

Chrysanthemum: Out of 20 germplasm evaluated for yield and flower quality, Arka Yellow Gold recorded high loose flower yield.

China aster: A total of 28 germplasm were evaluated for yield and quality traits. In white flower colour group, cultivars Phule Ganesh White and Arka Archana recorded high loose flower yield, and pink colour group, Arka Kamini and Arka Advika found promising for cut flower. In violet colour group, Arka Nirali with novel flower found promising for cut flower.

Crossandra: The Mutant-3 was found to be promising for highest rachis length (6.44 cm), peduncle length (10.95 cm), freshness of flowers in plant (4.14 days) and minimum plant height (49.5 cm). This has dwarf growing habit and more longevity of flower in the plant can be recommended for use in potted plants. The Mutant-2 has maximum shelf life (3.57 days) and minimum peduncle length (7.78 cm) and flower diameter (2.99 cm), respectively. This is a valuable trait for loose flower and suggests its suitability for use as a loose flower.

***Barleria*:** Among nine germplasm, IIHR BC-H-05 recorded maximum loose flower yield in purple flower colour group and IIHR BC-H-06 in pink colour group. IIHR BC-V-02 with novel bi-coloured flower and

IIHR BC-V-03 in white colour group were promising for loose flower. In red colour group, IIHR BR-V-01 was found promising as an attractive ground cover / edging plant. IIHR BP-V-01 in yellow coloured group was found promising as an attractive garden hedge plant.

Medicinal crops

Brahmi (*Bacopa monnieri*)

Evaluation of germplasm for yield and bacoside A content: Fresh herbage yield varied from 687.1 g m^{-2} (IIHR BM 27) to 3820.2 g m^{-2} (IIHR BM 45) with a mean of 2169.2 g m^{-2}. Dry herbage yield ranged from 76.83 g m^{-2} (IIHR BM 01) to 575.28 g m^{-2} (IIHR BM 49) with a mean of 108.75. Bacoside A3 content varied from 0.16% (IC 426442) to 1.27% (IIHR BM 27) with a mean of 0.62%, respectively. Bacopaside-II content varied from 0.43 % (IIHR BM 35) to 1.39 % (CIM Jagriti) with a mean of 0.81%, respectively. Jujubogenin content varied from 0.05 % (IIHR BM 57) to 1.19% (IC 554585) with a mean of 0.49% respectively. Bacopasaponin C content varied from 0.03% (IC 353203) to 1.19% (IIHR BM 06) with a mean of 0.36%, respectively. Bacoside A content varied from 1.27% (IIHR BM 68) to 4.12% (IC 565466) with a mean of 2.28%, respectively.

Content of active ingredients in *Bacopa monnieri* germplasm

Biochemical parameters	Range (%)	Mean (%)
Bacoside A3	0.16-1.27	0.62
Bacopaside-II	0.43-1.39	0.81
Jujubogenin	0.05-1.19	0.49
Bacopasaponin C	0.03-1.19	0.36
Bacoside A (%)	1.27-4.12	2.28

Mineral nutrient profile in germplasm

In germplasm collections, the leaf nutrient concentration (%) varied from 2.66 to 5.63% for N, 0.24 to 0.35% for P and 0.85 to 1.22% for K. Significant variation was observed in copper (13.5-19.7 ppm), zinc (33.7-62.9 ppm) and manganese (36.9-95.4 ppm) concentrations. Higher variation among different lines was noticed for iron content (288-1073 ppm). IC-554588 recorded higher Ca (0.43%), Mg (0.25 ppm) and Cu (19.7 ppm). Similarly, IC 284992 exhibited higher Fe (1073 ppm) and Zn (62.9 ppm).

Gymnema sylvestre (Gudmar)

Among fifty-three accessions, the fresh leaf yield varied significantly and ranged from 1.08 kg to 7.05 kg per plant. The accession IHR-GS-9 recorded maximum yield (7.05 kg) followed by IIHR-GS-25 (6.85 kg), IIHR-GS-27 (6.80 kg) and IIHR-GS-1 (6.33 kg). IIHR-GS-45, IIHR-GS-5, IIHR-GS-43, IIHR-GS-49 and IIHR-GS-53 are other promising lines with leaf yield above 5.5 kg per plant.

Among 25 genotypes, bioactive content (gymnemagenin) during vegetative and flowering stages showed significant variation ranging from 0.01 to 2%. The bioactive content was higher in vegetative stage than in flowering stage. IIHR-GS-44 exhibited maximum gymnemagenin content of 2% in vegetative stage and 1.92% in flowering stage. The same was reported with other tested accessions. There was more than 20% increase in gymnemagenin content during vegetative stage in 8 accessions *viz.*, IIHR-GS-5, IIHR-GS-6, IIHR-GS-15, IIHR-GS-23, IIHR-GS-24, IIHR-GS-25, IIHR-GS-41 and IIHR-GS-45.

Salacia chinensis (Saptarangi)

Thirteen accessions of *Salacia chinensis* were evaluated for mineral nutrient profile. Among them, Accession-2

had the highest content of Calcium (3.77 %) and Accession-3 had the highest iron content (176 ppm). The Accession-1 had better Phosphorus (1.5%).

3.2. CROP IMPROVEMENT

Fruit Crops

Mango

Promising hybrids developed

Mango hybrid R3P16 (Amrapali x Vanraj): This hybrid has a yellow-green orange colour pulp with a high TSS of 20.55ºBrix. The peel colour is attractive yellow-green with red blush. The average weight of a single fruit is 301.9 g with a high pulp recovery of 72.84%. The average fruit length is 10.83 cm and the fruit width is 7 cm.

Mango hybrid R3P22 (Amrapali x Vanraj): This hybrid has a yellow-green peel colour with a red tinge. The pulp colour is orange and with a TSS of 23.04ºB. The average weight of a single fruit is 219.7 g with a fruit length of 8.22 cm and fruit width of 6.88 cm. The pulp recovery is 69.35%.

Mango hybrid R5P3 (Amrapali x Vanraj): This hybrid has an attractive yellow-orange peel colour with red tinge. The pulp colour is yellow-orange with an average fruit weight of 380.7 g. The fruits showed high TSS (23.44ºB) with 73.12 % pulp recovery. The fruit is medium-sized with fruit length of 9.56 cm and width of 7.70 cm.

Mango hybrid R5P23 (Amrapali x Vanraj): This hybrid has medium-sized fruits with an average fruit weight of 282.48 g. The fruits showed yellow-green peel colour with orange pulp. The pulp recovery percentage is high (73.12%) with high TSS (23.44ºB).

R3P16 (Amrapalli x Vanraj)

R3P16 (Amrapalli x Vanraj)

R5P3 (Amrapalli x Vanraj)

R5P23 (Amrapalli x Vanraj)

Crossing work was carried out in 6 different combinations *viz.*, Alphonso x *Mangifera camptosperma*, Mallika x Peddaneelum, Totapuri x Pedda Neelum, Alphonso x Pedda Neelum, Amrapali x Pedda Neelum, Amrapali x EC95862 and raised 58 F_1 progenies for primary evaluation. One hundred and ten mango hybrids were evaluated for fruit quality parameters of which 2 F1 progenies (R1P8 and R1P6) have been selected for secondary evaluation. About 154 mango half-sibs were evaluated for fruit quality parameters of which R27P28 half-sib of Dashehari variety has been selected for further evaluation.

Quality traits of selected mango hybrids and half sib

Hybrid	Fruit weight (g)	Fruit length (cm)	Fruit width (cm)	Fruit thickness (cm)	TSS (ºBrix)	Pulp (%)	Skin colour	Pulp colour
R1P8 (Amrapali x Vanraj)	282.30	9.96	6.34	6.86	20.60	75.9	Yellow-green	Yellow-orange
R1P6 (Amrapali x *Mangifera odorata*)	208.68	9.20	6.42	5.66	20.28	71.9	Yellow-green	Orange
R27P28 (half sib of Dashehari variety)	319.6	11.74	7.40	6.52	20.86	66.5	Yellow-green	Yellow-orange

Half sibs of Goa Mankurad variety: Among 266 half-sibs of Goa Mankurad evaluated, fruiting was observed in 41 progenies which were evaluated for qualitative (Fruit shape, fruit attractiveness, fruit skin and pulp color, pulp texture, and fiber content) and quantitative traits (fruit weight, pulp%, pulp thickness, TSS, acidity,

total sugar content, carotenoid content in pulp and peel). Significant variability was observed across all quantitative and qualitative fruit morphological and biochemical traits. Based on superior fruit quality traits the progenies R2P18, R3P24, R1P34, R1P29, R5P1 and R1P17 are selected for further observations such as regular bearing and precocity in bearing.

Mutation breeding in polyembryonic varieties: For broadening the genetic base of polyembryonic mango varieties, the kernels of Kurukkan, Mylepelian, Peach, Moreh, and Muvandan varieties were treated with different doses of gamma irradiation from 15 to 35 Gy. Irradiation created significant variations in plant height, stem girth, number of nodes and number of leaves. Maximum germination percentage was observed in 20 Gy and 25 Gy, irradiation irrespective of the varieties. However, the LD 50 for each of the polyembryonic variety will be standardized by increasing the sample size for the treatment in the ensuing season.

QTL seq analysis: QTL seq analysis was done for peel and pulp colour in mango by analyzing 168 Amrapali x Vanraj progenies. The study led to the identification of four QTLs (*mipec 1, mipec 14, mipec 19 and mipec 20*) associated with red peel colour and a QTL (*mipuc 14*) associated with orange pulp colour.

Pummelo

Molecular characterization of hybrids: Molecular characterization of 102 hybrids was attempted using 10 SSR markers. The SSR markers were used for hybridity confirmation, diversity analysis, and DNA fingerprinting. The putative marker CiBE0246 showed possible linkage with fruit weight and ascorbic acid content in the studied 102 pummelo hybrids. Pairwise sequence alignment using gene-specific markers for naringin and limonin revealed that the changes in single nucleotide sequence were responsible for variation in fruit's bitterness/sweetness, which was again confirmed by LCMS analysis.

Papaya

PRSV resistance breeding: Three intergeneric hybrid (IGH) progenies of the three-way cross (Arka Prabhath x *V. cundinamarcensis* x Red lady) namely 29-12, 28-12 and 19-9 were found good in terms of morphological traits and fruit quality. The fruit weight varied from 1200 to 1800 g, pulp thickness from 3.5 to 3.7 cm and TSS from 11.5 to 13.0ºBrix with orange-red pulp 32 A coupled with PRSV tolerance. These progenies were advanced further for next generation. In the BC_1F_3 intergeneric progenies (Arka Prabhath x *V. parviflora* x Arka Prabhath), based on morphological and fruit traits (Fruit weight of 900 to 1500 g , pulp thickness of 2.1 to 3.0 cm, TSS of 10.0 to 12.2ºBrix) the progenies 43-5 and 44-15 for red pulp type and 27-14 and 27-22 and 27-26 for yellow pulp type were advanced further. In the intergeneric progenies of Red Lady x *Vasconcellea cauliflora*, the progenies 4-9, 5-12, and 9-20 were advanced for the next generation for better fruit traits (Fruit weight of 1000 to 1500 g, pulp thickness of 1.8 to 2.5 cm, and TSS of 10.0 to 12.2ºBrix)

Enhancing yield through doubled haploid technology: Parthenogenetic induction of haploids through immature ovule culture route by pollen irradiation showed 60 DAP ovules as responsive. Globular, embryogenic calli typical of embryo response, were obtained during the *in vitro* germination of unfertilized immature seeds on medium with high 2,4-D (1 mg L^{-1}) levels. Shoot bud induction was noticed on calli on MS media supplemented with a BAP (2 mg L^{-1}) and NAA (0.5 mg L^{-1}) levels. After studying the papaya genome sequence information and literature, four genes were shortlisted which potentially can discriminate female and hermaphrodite plants. BSA analysis has so far identified two informative markers.

Embryonic induction of immature haploid ovules in papaya cv. Arka Prabhath

Genome edited population of *Carica papaya*: T_1 generation plants were screened for the T-DNA segregation to identify the T-DNA null plants. Over 1200 plants derived from 20 T_0 lines were screened and nulls were identified for further screening for Papaya Ringspot Spot Virus resistance. Edit characterization of the selected populations was carried out and the eIF4E target gene had mutations at the expected locus.

Guava

Breeding for nematode resistance: Screening of wild species of guava for nematode (*M.enterolobii)*, resistance resulted in the identification of *Psidium cattleianum* as resistant source. Screening of interspecific progenies (Arka Poorna x *Psidium cattleianum* and H 12-5 x *P. cattleianum*) for combined resistance to wilt *(Fusarium oxysporum* fsp. *psidii;* GW-10) and nematode (*M. enterolobii)* has resulted in identification of four resistant progenies *viz.*, Arka Poorna x *P. cattleianum* var *cattleianum* (ISH 12),

Arka Poorna x *P. cattleianum* var *lucidum (*ISH 10 and ISH.3) and H 12-5 x *P. cattleianum* var *cattleianum (*ISH 1) based on nine months of challenge inoculation. A confirmatory trial involving air-layered plants of the identified progenies is in progress. Backcrossing of the interspecific progenies (with *Psidium cattleianum*) has resulted in 0.63% fruit set. Initial fruit evaluation of the interspecific progenies revealed that the fruit weight ranged between 220 to 260 g, pulp thickness from 1.7 to 2.0 cm with a TSS 11 to 12°Brix and medium seed hardiness (5.0-5.5 kfg).

Mutation breeding: Guava varieties of IIHR like Arka Kiran, Arka Reshmi, and Arka Poorna were treated with 100-300 Gy Gamma rays to induce variability and sown in the field. Similarly, Guava scions of Arka Reshmi were irradiated with a dose range of 20 to 82 Gy and grafted in the field.

QTL identification for leaf, peel and pulp color in guava: QTL analysis for leaf, peel and pulp color traits was done in guava using intervarietal mapping population from the cross 'Arka Poorna' x 'Purple Local'. A total of 16 QTLs were identified for these color traits across five LGs using both visual scoring and color reader (CIELAB) based quantitative estimations. Visual leaf color and peel color harboured a QTL in LG1 at position 49.66 cM. The QTL explained 10.2% phenotypic variation with a marker LOD of 3.53. The results indicate that leaf and peel color traits are tightly linked in guava. For visual pulp color, a QTL (qPC2.1) at position 52.05 cM was identified in LG2 that explained a phenotypic variation of 43.2%. The QTL had a high LOD score of 18.41. For CIELAB values, twelve major QTLs and two minor QTLs were identified for leaf, peel and pulp color. Overall, for both the visual color scores and CIELAB color values, two QTL clusters identified: one in LG1 for leaf and peel color (23.35 cM to 32.88 cM) and the other in LG2 for pulp color (41.25 cM to 61.70 cM).

Sapota

Breeding for dwarfness: Eleven elite lines of hybrids and mutant populations, which were planted in 2020, were evaluated for growth and yield character along with fruit qualities. The plants are observed for dwarfness and high yield. IIHR-63 was found to be dwarf and mutant plants also were found dwarf.

Annona

Breeding for self-fruitfulness: The segregating populations of about 1600 progenies of Arka Sahan x Balanagar have been evaluated for self-fruitfulness.

28/14

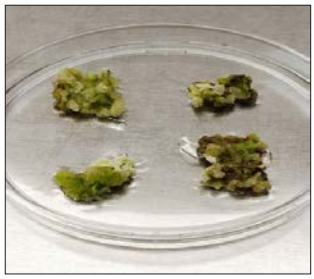
Twenty-two progenies of Arka Sahan x Balanagar have been selected based on the self-fruitfulness and quality of fruits. These progenies (1/1, 1/23, 4/15, 6/3, 10/3, 18/6, 22/19, 24/4, 26/15, 27/15, 28/14, 30/2, 31/10, 32/16, 36/3, 49/16, 50/10, 50/13, 50/16, 50/17, 51/16, 51/17) were propagated vegetatively and will be planted for secondary evaluation in the field to confirm their self-fruitfulness. Additionally, six progenies (1/1, 10/3, 13/11, 28/5, 31/5, and 31/11) in progeny row trial have established well.

Grapes

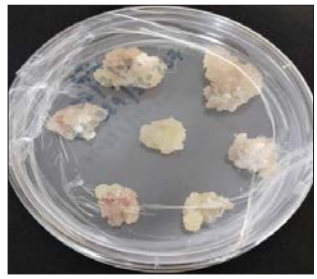
Rootstock breeding: In grape rootstock breeding aimed at improving Dogridge for sodicity tolerance, 96 hybrid progenies were developed from the cross between Dogridge and 110R. Additionally, 200 bunches of Dogridge were crossed with 110R following pruning in the second fortnight of September and the first fortnight of October. About 116 hybrids of Dogridge × 110R and 187 Dogridge mutants were successfully established in the field and propagated for sodicity screening. Screening for salinity and sodicity was initiated in Dogridge mutants such as $R_6P_{25}M_2$, $R_6P_{27}M_4$, $R_6P_{36}M_9$, $R_6P_{39}M_{12}$, $R_6P_{44}M_{16}$, and Dogridge x 110R hybrids viz., $R_6P_{16}H_{16}$, $R_6P_{43}H_{28}$.

Scion breeding for mildew resistance: In grape scion breeding for mildew resistance, 54 hybrids were developed from 2,715 seeds of the *Red* Globe × Amber Queen cross and 13 hybrids from 3,183 seeds of the Red Globe × James cross. Embryo rescue was performed for seedless crosses, resulting in the successful rescue of 14 plants from Flame Seedless × Amber Queen and 5 plants from Flame Seedless × Bianca.

Genome editing for powdery mildew resistance: Towards editing of Mlo 7 gene, which is a key susceptibility gene for powdery mildew resistance in grapes, target for sgRNA were designed and chemically synthesized. The synthesized sgRNA were ligated to pKSE401 with cas9 cassette binary vector for further transformation into grapes cv Thompson seedless. The surface sterilized leaf bits were inoculated onto MS media containing various concentrations of BAP and 2,4-D. The calli were kept under callus maturation medium for further conversion into somatic embryos. The embryogenic calli were co-cultivated with Agrobacterium carrying cas9 and sgRNA cassette binary vector for further transformation.



Callus initiation after 20 days



Callus proliferation

Pomegranate

Bacterial blight resistance breeding: About 6,864 mutants were generated to introduce variability in pomegranate (*Punica granatum*) cv. Bhagwa for blight tolerance/ resistance. Initial screening conditions for *Xanthomonas axonopodis pv. punicae* were found to be ineffective. Consequently, an optimized indigenous screening facility was established for evaluating six month old mutants. The plants were defoliated using ethrel (0.2%), followed by application of Bavistin (0.2%) to prevent fungal infections. Virulent *Xanthomonas axonopodis pv. punicae* (Xap) strains were inoculated by spraying on 22 to 25 day old leaves. To ensure optimal infection conditions, the plants were exposed to 80–85% RH and temperature of 28–30°C for 24 hrs before inoculation. A controlled environment was maintained using a 10 × 8 × 6 ft dome-shaped polyhouse, covered with coconut fronds and a 50% shade green net.

To introgress the blight resistance gene from 99A (USDA collection) into a commercial cultivar, experiment on flowering induction in 99A was conducted. Natural flowering was observed during December 2024 and January 2025, associating with a maximum temperature of 26.6°C and a minimum of 17.7°C in December, and a maximum of 27.9°C and a minimum of 13.5°C in January. Additionally, 99A plants were field-established at NRC Pomegranate, Solapur; CITH, Srinagar; and CIAH, Bikaner to evaluate their flowering performance under conditions similar to their native climatic environment.

Wilt resistance breeding: As part of the pomegranate wilt resistance hybridization program, 35 *Nana* × *Bhagwa* crosses were successfully made, and open-pollinated (*OP*) *Nana* seeds were sown. A total of 78 OP progenies have been developed and are currently under evaluation for resistance to wilt.

Dragon fruit

Irradiation was carried out in seeds (*n*=6000) with gamma radiation. A mutant population of 2500 progenies was raised in nursery.

Among dragon fruit genotypes, Selection CHESH- D1 and mutant CHESH-DE were superior for highest fruit weight and yield based on three assessments.

CHESH D1: Selection was made from the open-pollinated progeny of Hiryur Red cultivar. Fruits are round with red pulp, having dense bracts with medium apical bract length (5.70 cm). The average individual fruit weight was 507.71 g with a pulp weight of 404.52 g, TSS 14.50ºBrix, and betalain content of 20.4 mg BCE

CHESH – DE: It is a mutant progeny resulting from EMS (2.5 %) of M_2 generation. Fruits have low to medium number of bracts with smooth surface, and round shape. It bears fruits of pale pulp with pink blush. The average fruit weight is 379.18 g with a pulp weight of 260.11 g and TSS of 14.80ºBrix. The total sugar content is 5.75 g and the reducing sugar is 4.66 g.

CHES-D1

CHES-DE

Avocado

Hybridization: The hybridization work to improve fruit quality traits was attempted in different parental combinations **(**CHES N-1 × Arka Coorg Ravi, Arka Coorg Ravi × Pinkerton Pinkerton × Arka Supreme, Maluma Hass × Arka Coorg, Ravi Arka Coorg Ravi × PA-026 (Y), Arka Supreme × Pinkerton, Arka Supreme × Seedless, Arka Supreme × PA-026 (Y), Acc. 22 × Arka Coorg Ravi, Arka Coorg Ravi × Seedless, Arka Coorg Ravi × Maluma Hass, Arka Coorg Ravi × Acc. 22, Arka Supreme × Acc. 22, PA- 026 × Acc. 22 and PA- 026 × Seedless. About 10,133 flowers were crossed and initial fruit set was observed in 208 flowers and fruit retention was only 39. Arka Coorg Ravi × PA-026 (Y) combination was found better.

Rose apple

The OP progenies (168) of rose apple (Farmer's variety, SJRP8) were raised. Criteria is big size fruits>40g, thick rind- > 7 mm.

Vegetable crops

Tomato

Evaluation of hybrids for square round segment and processing: A set of 43 hybrids selected in 2023 and 2024

were evaluated along with seven commercial checks. The hybrids such as 2023X114 and 2022X134 ripened early. The hybrids 2022X110 and 2023X186 matured late. The hybrids 2022X078 recorded highest TSS followed by 2022X134, 2023X199 and 2023X117 (TSS of above 5°Brix). As many as 5 hybrids recorded higher TSS of more than 5.0°Brix and 4 hybrids recorded TSS in the range of 4.8-5°Brix. Maximum yield per hectare was observed in 2023X117 followed by 2023X133 and 2023X127. The pH value of the hybrids was in the range from 3.8 to 4.03, highest pH was observed in 2023X140 followed by 2022X78 and lowest in 2023X186.

Performance of high yielding hybrids 2023X117 and 2023X 186

Evaluation of hybrids for green shoulder segment: A set of 12 hybrids were evaluated along with two commercial checks. The hybrids such as 2023X46 and 2023X04 flowered early, whereas the hybrids 2023X11 and 2023X44 ripened early. The hybrids 2023X10 and 2023X08 matured late. The highest yield was observed in 2023X46 followed by 2023X12 and 2023X07.

Performance of high yielding green shoulder segment hybrids 2023X46, 2023X12 and 2023X07

Evaluation of hybrids for flat and round segment: A total of 23 hybrids along with nine commercial checks were evaluated. Among flat and round segment hybrids, hybrids 2023X89 and 2023X106 flowered early, while the hybrids 2023X81 and 2023X74 ripened early. The hybrids 2023X70 and 2023X93 matured late. The highest yield per hectare was observed in 2023X53 followed by 2023X75 and 2023X74.

Performance of high yielding flat and round segment hybrids 2023X53, 2023X 75 and 2023X74

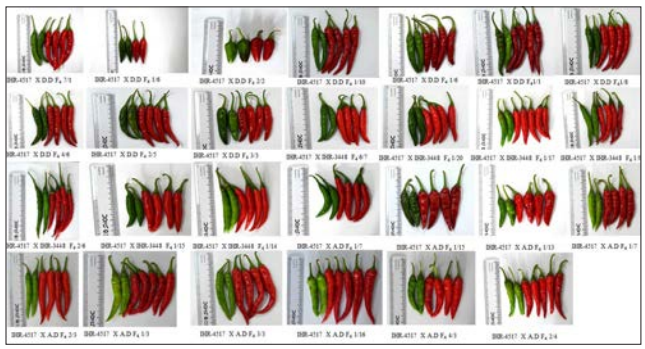
Evaluation of genotypes for nitrogen (N) and phosphorus (P) use efficiency: Under deficit N supply, the tomato genotypes showed overall reduction in total dry matter production by 21.36% and considerable reduction in root volume (19.25%) and chlorophyll content (SPAD values by 22.73%). Under P deficit conditions, the reduction in total dry matter production was only 3.36% and chlorophyll content (SPAD values by 0.47%). There was increase in root volume by 2.95% under deficit P supply. Among 42 selected tomato genotypes, Arka Abhed, IIHR 2853, Arka Abha and IIHR 2833 recorded higher photosynthesis rate under deficit N supply. The genotypes IIHR 2901, IIHR 2897, LA 1609 and Arka Sourabh recorded higher photosynthesis rate under deficit P supply.

Genome editing for shelf life enhancement: Two guide RNA's specific for targeting the pectate lyase (PL) gene (Solyc03g111690) in the second exon region were designed. The multiple guide RNA construct was cloned into pDIRECT_22C vector and transformation of tomato var. Arka Vikas resulted in two edited plants showing indels in PL gene.

Genome editing for Vitamin D bio-fortification: Agrobacterium mediated transformation of tomato cultivar Arka Vikas with CRISPR- Cas9 construct to knock out coding sequence of 7 dehydro cholesterol reductase gene for accumulation of 7 dehydrocholesterol in fruits was targeted with 3 individual guide RNA and 38 putative transformants were developed.

Chilli

Breeding for drought tolerance: The populations developed using drought tolerant genotype, IHR4517 were forwarded to F_4 generation. A total of 27 F_4 families were selected of crosses IHR4517 × Devnur Delux, IHR4517 × IHR 3448 and IHR4517 × Attigere Dabbi based on their yield and fruit quality parameters and advanced to further evaluate for morphological, physiological and molecular traits related to drought tolerance conferring traits in chilli



Variability in fruit quality parameters in advanced F_4 families developed for drought tolerance in chilli

Breeding for anthracnose fruit rot resistance: The introgression of anthracnose resistant loci from *Capsicum baccatum* into *C. annuum* was attempted through genetic bridge-cross strategy using C. *chinense* and C. *frutescens* as bridge species. The three-way cross hybrids [C. *annuum* × C. *chinense*) × C. *baccatum*] showed improved seed set and seed germination. The Cross-Compatibility Index (CCI) ranged from 0 (*C. annuum* × *C. frutescens*) and (*C. annuum* × *C. baccatum*) to 84% (IHR-BHP-51 × PBC81). The three-way cross hybrid population exhibited unique traits such as varied throat color intensity and parthenocarpy upon open pollination and no fruit set up on selfing. Backcrossing with C. *annuum* and marker-assisted selection (MAS) was attempted to develop advanced backcross populations and eleven advanced backcross plants showing good level of tolerance were identified to further evaluation.

Three way hybrid backcross population ((IHR4700 x IHR4652) x PBC81) x IHR4700)) showing varied level of tolerance to anthracnose fruit rot resistance

Breeding for multiple viruses tolerance: Two advanced breeding lines (DF4-32 and DF4-171) derived from the cross ((MS3B × IHR 2451) × (MS3B × IHR 459) showed the combined tolerance to CMV-Guntur Isolate, ChVMV- Bengaluru Isolate, and ChLCV Raichur isolate.

DF4 - 32 **DF4 - 171**

Advanced F4 families developed having combined tolerance to CMV, ChVMV and ChLCV

Studies on growth and gas exchange parameters: In moisture deficit stress tolerant chilli cv Arka Lohit**,** moisture deficit stress (50% FC) reduced all the gas exchange parameters (Transpiration rate, Membrane Stability Index, Relative water content.) with larger impact on RWC and membrane stability. Further, stress affected dry matter accumulation and number of fruits per plant. Seed priming (Chemo priming (10^{-3} M and in Glycine Betaine 20mM) + Bio priming (P72, *Bacillus amyloliquefaciens*) mitigated the ill effects of the stress and improved fresh and dry weight of stem and leaves, stem girth and root volume.

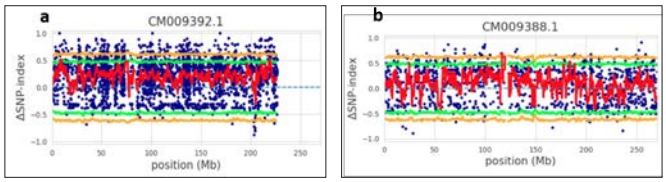
High temperature stress tolerance in Chilli cv Arka Lohit- metabolite content: Seedlings raised from chemo and bio-primed seeds exhibited high temperature tolerance compared to unprimed as they accumulated higher amount of amino acid contents. The amino acids such as tryptophan, phenyl alanine, leucine, histidine, proline and serine accumulated in higher levels due to seed priming. In unprimed treatment under high temperature stress, higher accumulation of glutamicacid and tryptophan was noticed. In case of sugars, under high temperature stress, significantly higher accumulation of inositol and ribose was noticed in primed seeds compared to unprimed, indicating these sugars play a major role as a osmolytes in relation to tolerance.

Genome editing of the eIF4E genes: T_1 generation population was raised from a T_0 genome edited line, the line is being screened for resistance to Chilli veinal mottle virus resistance.

Genome editing of the CaERF28 gene: The four gRNAs for the editing of CaERF28 gene were cloned into Plasmid vector pKSE401. *A. tumefaciens* strain GV3101 were transformed with the confirmed CRISPR/Cas9 construct using the freeze-thaw method. The first two leaves and the hypocotyl from the germinated seeds under controlled conditions were selected as explants for genetic transformation.

Molecular mapping of powdery mildew resistance loci: Total of 624 SSRs were screened to identify the polymorphism between PMR-14 (resistance) and ICPN-2b (susceptible parent). 124 SSRs were polymorphic between parents.

QTL-Bulk segregant analysis: QTL Bulk segregant analysis was performed to identify QTLs associated to root weight and canopy temperature in chilli. Two QTLs have been identified in the chromosomes 1 and 7 for tolerant parent versus root weight bulks and three QTLs have been identified in the chromosomes 3, 7 and 8 for tolerant Parent versus canopy temperature bulks. The genes corresponding to these QTLs surrounding 100kb have been identified for further analysis.



QTL-Bulk Segregant analysis in Chilli (a). Tolerant parent vs Root weight bulks (b).Tolerant parent vs canopy temperature bulks

Brinjal

Mutation breeding: The M_5 seeds (Selfed) of two lines such as CARI-1 and Dongar bhati were (irradiated with 160 GY gamma rays and 3% colchicin) advanced to M_6 generation that had less seeds when compared the check variety (untreated)

Mutant lines

Evaluation of advanced breeding lines for resistance to bacterial wilt disease: Advanced breeding lines derived from crosses between Arka Keshav x IIHR-104-2-5 (3.50 kg plant^{-1}), yield 3.50 kg plant^{-1} with zero per cent Arka Neelakant x IIHR-104-3-4 (3.25 kg plant^{-1}) and Arka Nidhi x IIHR-586-1-5 (2.92 kg plant^{-1}) were promising for yield and resistance to bacterial wilt whereas check variety Kurume completely succumbed to bacterial wilt.

Arka Keshav x IIHR-104-2-5 **Arka Neelakant x IIHR-104-3-4**

Hybrids for yield and bacterial wilt resistance in different genetic background: A total of 20 hybrids were evaluated for yield and bacterial wilt. Three hybrids such as Hybrid-1 (3.84 kg plant^{-1}) Hybrid-2 (3.05 kg plant^{-1}) and Hybrid-3 (2.91 kg plant^{-1}) had high potential yield with zero percent bacterial wilt incidence with superior fruit quality traits.

Hybrid-1 **Hybrid-2** **Hybrid-3**

Evaluation of new F_1 hybrids: A total of 90 hybrids were evaluated for yield and resistance to bacterial wilt of hybrids namely H1 (Pusa Kranti x Pusa Bhairav 3.69 kg plant^{-1}) followed by H2 (PPL x P. Bhairav, 3.36 kg plant^{-1}) and H3 (KS-224 x Pusa Bhairav, 3.33 kg plant^{-1}) were promising for yield and resistance to bacterial wilt (with zero per cent bacterial wilt incidence) with attractive and shiny fruit colour and oblong to long in shape. The average fruit weight ranged from 80 to 100 g, 90 to 110 g and 50 to 70 g respectively.

Pusa Kranti x Pusa Bhairav **PPL x Pusa Bhairav** **KS-224 x Pusa Bhairav**

Screening of inter-specific progenies of *Solanum macrocarpon* x *Solanum melongena* (F_9 generation) for shoot and fruit borer resistance: In field screening for brinjal shoot and fruit borer resistance in five interspecific progenies (F_9), four susceptible cultivated varieties and one resistant wild species *Solanum macrocarpon*, (in total of 10 entries) five interspecific F_9 lines (9-17, 9-16, 9-8, 9-12, 9-6v) recorded less than 6% shoot infestation (highly resistant scale) and less than 20% fruit borer infestation (resistant) which was confirmed in F9 generation. BFSB resistance with high yield was consistently observed for three years in these five F_9 lines. *S. macrocarpon* recorded zero incidence of shoot and fruit infestation.

The lowest shoot and fruit infestation was observed in ISH 17 (9-17) of 1.98% (shoot borer) and 15.71% (fruit borer) followed by 9-8 (2.5%) shoot borer and 20.01% fruit borer, 9-6 (3.41% shoot borer and 19.22% fruit borer, 9-12 (4.97% shoot borer and 19.25% fruit borer and 9-16 (5.95% shoot borer and 20.86% fruit borer)

which is categorized as highly resistant for shoot borer and resistant to fruit borer compared to susceptible check Arka Kusumakar (34.71% shoot borer and 73.48% fruit borer) under open field conditions. The scale of resistance to BSFB for assessing resistance was followed as per AVRDC. The resistance was also confirmed by artificial challenging of *Leucinodes* moths / larvae in these F_9 lines.

ISH 9-17 **ISH 9-16** **ISH 9-12**

Artificial challenging of shoot and fruit borer

Oviposition preference: Under no choice conditions, artificial challenging of *Leucinodes* moths on leaves of wild species *S. macrocarpon* showed least preference (1 egg female^{-1}) as against 124.67 eggs female^{-1} in susceptible check (Arka Kusumakar). Among five F_9 interspecific lines, egg laying was least in 9-12 (5.33 eggs female^{-1}), followed by 9-6v (12 eggs), 9-17 (11.33 eggs), 9-8 (26 eggs) and 9-16 (36.33 eggs female^{-1}) compared to 124.67 eggs female^{-1} in susceptible check (Arka Kusumakar). This confirmed antixenosis mechanism of resistance to BSFB in the leaves of five interspecific lines and wild species *S. macrocarpon.*

Larval mortality and adult emergence: In no choice conditions**,** artificial challenging of neonate (1st instar larvae) on fruits of wild species *S. macrocarpon* recorded 0% emergence of adults while Arka Kusumakar, susceptible check recorded 100 % adult emergence. F9 Interspecific line 9-17 recorded minimum adult emergence of 7.84 % and this was followed by 9-6v (12.04%), 9-8(13.15%), 9-12(16.48%) and 9-16(16.52%). This confirmed antibiosis resistance mechanism due to reduced reproduction of the pest in F9 interspecific lines as compared to cultivated susceptible check.

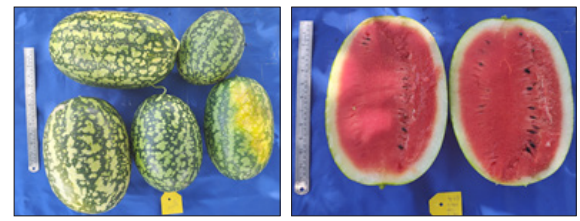
Evaluation of F_9 interspecific lines (*S. macrocarpon* x *S. melongena*) for yield: Marketable yield (healthy fruits) in F_9 interspecific lines was highest in 9-17 (46.08 t ha^{-1}) followed by 9-6v (43.38 t ha^{-1}), 9-16 (43.00 t ha^{-1}), 9-12(35.33 t ha^{-1}) and 9-8 (33.55 t ha^{-1}) compared to 8.30 t ha^{-1} in susceptible check, Arka Kusumakar.

Watermelon

Breeding for resistance to WBNV disease: A total of 25 BC_1F_7 lines resistant to WBNV derived from the *C. amarus* background were evaluated for yield and quality traits. Among them, Line 18 (TSS-10.8°Brix), 20 (TSS-10.5°Brix), 42 (TSS of 11.0°Brix) and 46 (TSS of 10.0°Brix) with dark red flesh were found to possess better quality traits.

Line-18

Line-20



Line-46

Line-42

Breeding for orange fleshed watermelon (Jubilee type) for yield and quality traits

A total of 8 carotene rich biofortified watermelon genotypes were evaluated for yield and quality during summer 2024. Sel-4-30 and Sel-4-35 were found to be superior with orange crispy flesh and TSS ranging from 11-13°Brix. The line was proposed for ITMC identification and MLT trials.

Sel-4

Okra

Evaluation of advance lines for yield and quality parameters : Six advanced lines and four commercial checks were evaluated during *Rabi* 2024. Based on pooled analysis for 2022-2024, IIHR-299-1-2-2 was idented as superior for fruit yield (19.87 t ha^{-1}) and statistically on par with IIHR-385-1-1-5 (19.84 t ha^{-1}). The entry IIHR 385-1-1-5 showed field tolerance to YVMV and IIHR-299-1-2-2 showed intermediate tolerance under natural field condition.

Plant stature and fruits of IIHR-299-1-2-2 (160.79qtl/ha)

Plant stature and fruits of IIHR385-1-1-5 (97-102 qtl/ha) tolerant to YVMV at hotspot area and artificial screening

Evaluation of purple okra advance for yield and quality parameters: Out of five line evaluated, IIHR-700 found to be superior for yield (14.45 t/ha), dark purple fruit , thin 5 ribs rich in anthocyanin content (in terms of cyanidin -3-glucosides) 8.48 mg $100g^{-1}$ FW and 1.12 % mucilage content. This was followed by IIHR 1658, which is having short fruit, light purple colour, 5 ribs and yield 12.5 t/ha, anthocyanin content 7.5 mg $100g^{-1}$ FW and 1.5% mucilage content

Evaluation of okra hybrid for export potential: A total 15 hybrid evaluated under ORT at IIHR during summer 2024 and among them, Hybrid 125 was found to be promising for high yield (23 t ha^{-1}) and significantly superior among the hybrid tested. Fruits are short, dark green fruit and suitable for export potential.

Hybrid 125

Development of New F_1 hybrids for yield, quality and resistant to YVMV and ELCV: A total of 160 both GMS and non-GMS based F_1 hybrids were developed during *Kharif* season 2024 at ICAR-IIHR, Bengaluru. These hybrids will be being evaluated for yield and quality parameter at IIHR during summer 2025, the same hybrids will be screened for YVMV and ELCV virus at hotspot areas of CHES, Bhubaneshwar and ADH office, Villupuram, Tamil Nadu

Development of Interspecific hybridization of okra using wild and cultivated species: A total twenty interspecific hybrids were developed using wild species as (maternal) and cultivated as male and vice versa also for transfer YVMV and ELCV resistant genes to cultivated lines and also identify sterile cytoplasm during summer 2025 ant ICAR, IIHR, Bengaluru.

Estimation of biochemical content of selected lines in okra: A total of three advance lines were estimated for biochemical contents namely moistre,total phenol, antioxidant activity (FRAP), DPPH, total flavonids, crude fibre and anthocynine content in okra, Among the line estimated IIHR-385-1-1-5 recorded the highesst conent of mositure (90.20%), phenol (1260 mg 100 g^{-1} DW), FRAP (11.37 mg 100 g^{-1} DW) and crude fibre (9.87%) However, the purple poded line IIHR-700-1-2 had highest content of DPPH(1631 mg 100 g^{-1} DW) among all the lines estimated during 2024.

Biochemical parameters in selected lines of okra

Parameters	IIHR-385-1-1-5	IIHR-386-1-1-26	IIHR-700-2
Moisture (%)	90.02	89.85	88.80
Total phenols (mg 100 g^{-1} DW)	1260	1245	1189
Antioxidant activity like FRAP (mg 100 g^{-1} DW)	1137	1036	1033
DPPH (mg 100 g^{-1} DW)	1545	1515	1631
Total flavonoids mg 100 g^{-1} DW	307.50	330	380.9
Crude fibre content (%)	9.87	9.25	7.68
Anthocyanin content (mg 100 g^{-1} FW)	-	-	7.50

Breeding for YVMV resistance: Natural screening of okra advance line in hotspot area: A total of nine

advance lines including susceptible check (Acc 1685) in Villupuram, Tamil Nadu during summer 2024. Among advance lines screened at natural hotspot area, IIHR-385-1-1-5 and IIHR-386-1-1-26 found to be resistant to YVMV with 0% incidence and 2.87 to 4.83% incidence of ELCV. This was followed by IIHR -299-1-2-2 and IIHR 700-2-9 found resistant ELCV (0% incidence and tolerant to YVMV (5.16 to 9.82%). However, susceptible checks like Pusa Sawani recorded 93% and Acc 1685 recorded 91.5% incidence of YVMV at natural hotspot area.

Screening of okra advance lines for resistance to YVMV and ELCV in Villupuram (TN)

Advance lines	YVMV incidence at 90 DAS (%)	ELCV incidence at 90 DAS (%)
IIHR-385-1-1-5	0.00 (0.55*)	2.87 (8.15*)
IIHR-386-1-1-26	0.00 (0.55)	4.83(10.52)
IIHR-299-1-2-2	5.16 (10.85)	0.0(0.55)
IIHR-700-2 -9	9.82 (17.94)	0.0(0.55)
IIHR-285X Ac 1685 F $_{8}^{-}$ $_{9}$	29.27 (32.34)	21.54 (27.39)
Pusa Sawani	93.00 (77.21)	7.10 (15.43)
Arka Anamika (RC)	34.77 (36.13)	14.94 (22.33)
Parbhani Kranti	87.89 (69.78)	27.52 (31.63)
Acc 1685 (SC)	91.50 (75.89)	0.0 (0.55)
CD ($p< 0.05$)	6.79	8.35
CV (%)	10.05	37.12

Acc 1685
Susceptible check

IIHR-385-1-1-5
Resistant line

Pusa Sawani IIHR-299-1-2-2 View of the experimental plot

Okra YVMV and ELCV screening plot at Villupuram

Screening of okra new accessions for YVMV resistance at hotspot area: A total 53 okra accessions along with two YVMV susceptible checks Pusa Sawani and Ac 1685) were screened (Without single insecticide sprays) during entire cropping periods (observations were recorded after 75 DAS). The eight accessions found to be resistant to YVMV under natural field condition are given below.

IIHR-1720 Pusa Sawani Acc 1685 IIHR-1735

YVMV resistant Okra lines

Okra accessions resistant to YVMV in open-field condition

Accession (IIHR. No)	YVMV incidence (%)	Disease Reaction
1720, 1730, 1731, 1734, 1735, 1749, 1756 (7)	0	HR
8	0-10	R
6	11-25	MR
4	25-50	S
28	>50	HS

Whole genome sequence analysis: Whole genome sequencing of okra variety, IIHR 299 was performed through Illumina, Nanopore (ONT) and HiC sequencing. A total of 64.7 Gb filtered reads were obtained from ONT platform. The Nanopore reads were analysed using Flye software with default parameters. Finally, contigs of 1.2 GB obtained were mapped with Illumina paired end reads using BWA-MEM tool to improve the accuracy of the contigs. Two rounds of polishing were performed to improve the draft genome assembly. The reads obtained from HI-C sequencing were aligned to draft assembly using BWA tool. Scaffolding of final contigs has been performed using JUICER tool and visualizated by 3D-DNA tool. Final draft genome assembly is in progress.

French bean

From trials on advanced breeding lines of pole bean derived from the cross Arka Sukumol × Arka Arjun for three seasons (*Rabi* 2022, *Kharif* 2023 and *Rabi* 2023), IIHPRPB-IPS-3 [Pedigree: (Arka Sukumol × Arka Arjun)-7-7-2-4-2-82] and IIHPRPB-IPS-4 [Pedigree: (Arka Sukumol × Arka Arjun)-8-6-1-1-66] were identified as superior lines with respect to pod quality parameters. IIHPRPB-IPS-3 is characterized by medium green, smooth, stringless, oval or pencil-shaped pods, high yielding, field tolerance to the rust disease and IIHPRPB-IPS-4 is characterized by medium green, smooth, stringless, flat/oval-shaped pods, high yielding and resistant to the rust disease.

IIHPRPB-IPS-3

IIHPRPB-IPS-4

Growth habit and pod quality parameters

The three-way cross BC_1F_1 progenies involving rust-resistant accession IIHR-79 [(Arka Sukumol x IIHR-79) x Lakshmi), (Arka Sharath x IIHR-79) x Lakshmi), (Arka Arjun x IIHR-79) x Lakshmi) were backcrossed with superior pod quality variety Lakshmi mainly to improve pod quality traits. The three-way cross BC_2F_1 progenies were developed during *Kharif* 2023-24 and about 22 high yielding single plant selection with superior pod quality combined with rust resistance in BC_2F_2 progenies were selected during *Rabi* season, 2023-24. These progenies were advanced to BC_2F_3 by evaluating in polyhouse during *Summer* 2024. A total of 50 single plant selection (BC_2F_4) were made during *Kharif* 2024-25 and being evaluated during *Rabi* 2025.

Promising single plant selection for superior pod quality traits from three-way cross BC_2F_3 of ((Arka Sukumol × IIHR-79) × Lakshmi) × Lakshmi

The F_2 progenies for purple pod segment involving the cross between purple pod accession IIHR-277-1 and advanced breeding line IIHR-PB-IPS-3 (an advanced breeding lines from cross Arka Sukumol × Arka Arjun) were evaluated and ten single plant selection with superior single plant selection with purple pods were made during *Rabi* 2023-24. These progenies were advanced to F_3 generation during *Kharif* 2024 and a total of seven single plant selection with superior pod quality with round/pencil shaped pods were made.

Superior F_3 progenies selected from the cross involving purple pod accession IIHR-277-1 and advanced breeding line IIHR-PB-IPS-3

Cowpea

Evaluation of F_2 progenies: The F_2 progenies derived from the crosses such as Arka Samruddi × Kashi Kanchan, Kashi Kanchan × TSA-32, TSA32 × TSA38A, Arka Suman × Arka Mangala, Arka Suman × TSA-35, Arka Suman × IIHR17B and Arka Suman × TSA-28

were evaluated during Summer, 2024. The F_2 population from all the crosses except Arka Samruddi × Kashi Kanchan were showing the susceptible reaction to the virus diseases. Hence, all crosses were rejected and only sixteen determinate/bush type single plant selection were made from the cross Arka Samruddi × Kashi Kanchan, and advanced to F_3 generation during *Kharif* 2024.

Genetic male sterility lines: The genetic male sterility BC_1F_1 progenies in the background of Arka Samruddi, Arka Garima, Arka Suman and Arka Mangala were evaluated during *Kharif* 2023 and all plants were fertile. The 25 BC_1F_2 progenies from background of each of Arka Samruddi, Arka Garima, Arka Suman and Arka Mangala were evaluated fertility and twelve to fifteen sterile progenies were selected and backcrossed with their fertile plants during *Kharif* 2024.

Dolichos

Breeding for photo-thermo tolerant lines for year round cultivation: Among 34 lines evaluated for photo-thermo tolerance during *Kharif* 2024, two lines were found promising for tolerance with an estimated yield of 1.12 kg plant^{-1}.

Photo-thermo tolerant Dolichos lines

Carrot

Breeding for powdery mildew resistance: 10 lines were screened for powdery mildew resistance along with three checks viz., Arka Suraj, KSP135 and KSP123 by artificial screening in Rabi, 2023 .Among these ,IIHR 60 and IIHR 61 were confirmed as moderately resistant (PDI 12.59 , 14.07 respectively) compared to Arka Suraj which was susceptible (PDI 40.74)consecutively for 3 years

Development of hybrids with powdery mildew resistance: 10 hybrids involving CMS lines and powdery mildew resistant lines were developed which would be screened further for powdery mildew resistance.

Evaluation of lines for nematode resistance: In artificial screening for root knot resistance in polyhouse during summer for stability of nematode resistance at high temperature >35 ˚C summer, IIHR 88 was identified and confirmed as resistant (consistent for three years) compared to Arka Suraj susceptible).

IIHR 88 (nematode resistant)

Radish

Non-bolting/non-pithy lines at high temperature are IC 347787, IC 43540, IIHR 62, IIHR 51, IIHR 89, IIHR 63, IIHR 77, IIHR 66 and IIHR 71. Hybridization of radish accessions between susceptible and heat tolerant lines was done and.15 hybrid combinations were developed involving heat tolerant lines

Evaluation of hybrids for heat tolerance and yield: Among 15 hybrids evaluated for heat tolerance in polyhouse condition (42c), 6 hybrids were found superior (IIHR 66 x Arka Nishant, IIHR 56 x Arka Nishant, IIHR 79 x Arka Nishant, IIHR 15 x A. Nishant, IIHR 62 x Arka Nishant, IIHR 64 x Arka Nishant) with root weight more than 150 g. IIHR 66 x Arka Nishant recorded highest root weight of 480 g per plant with root length of 38 cm.

Bottle gourd

Screening and identification of bottle gourd genotypes having tolerance to deficit moisture stress: About 38 bottle gourd genotypes that were earlier screened for deficit moisture tolerance at -0.40 MPa and based on germination and seedling growth characteristics were genotypes were classified based on membership function value (MFV). The same genotypes were screened for drought tolerance under field conditions by imposing moisture stress at flowering stage. Various physiological and biochemical parameters were recorded and drought tolerance index was calculated for the various parameters studied. Based on the drought tolerance score, genotypes BG-64, BG-141 and BG-49 were categorised as drought tolerant and BG-62-1 and BG-49(A) as susceptible genotypes based on physiological and biochemical traits.

Ash gourd

Field evaluation of genotypes against cucurbit downy mildew (*Pseudoperonospora cubensis*) in Rabi 2023-24: Among the 22 ash gourd genotypes evaluated for resistance against downy mildew under field condition, six genotypes viz., AG-6-15-11-37, Ag- 3-25-2-48, AG-3-54-39-59, Ag-21-3-16, AG-3-54-39-55 and AG-3-25-2-34 were categorized under moderately resistant (MR).

Cucumber

Delineation of stress tolerance mechanism: Contrasting genotypes of cucumber with respect to drought tolerance (5 tolerant - IC-345635, IC-526627, IC-398523, IC-429942, IC-432020 and 5 susceptible - IC-354128, IC-350229, IC-317883, IC-427631, IC-400675) were subjected to moisture stress 20 days after sowing under pot experiments. IC-429942 showed high tolerance to deficit moisture stress followed by IC398523 with higher photosynthetic rate (4.90 and 3.96 respectively), RWC (54.65% and 52.33%), MSI, total chlorophyll, MDA, catalase and peroxidase activity. The genotypes IC-345635 and IC-429942 can be used for further grafting studies.

Cumulative water use by cucumber genotypes under 100% and 50% FC conditions

Genotype	Cumulative water use (Litre/plant)			
	100% FC	50% FC	Mean	% Reduction
IC-432020	23.47	9.96	16.72^{ba}	57.56
IC-398523	21.89	11.74	16.81^{ba}	46.39
IC-345635	25.09	11.71	18.39^{a}	53.35
IC-429942	23.82	11.41	17.62^{a}	52.11
IC-526627	18.61	8.05	13.33^{dc}	56.74
IC-354128	22.62	13.14	17.88^{a}	41.92
IC-400675	18.75	10.75	14.75^{bc}	42.63
IC-427631	18.66	9.47	14.06^{dc}	49.25
IC-350229	16.65	8.39	12.52^{d}	49.60
IC-317883	18.22	8.71	13.46^{dc}	52.20
Mean	20.777	10.332		
	T	**G**	**T*G**	
CD (p=0.05)	0.939	2.101	2.971	
CV (%)	15.174			

Ridge gourd

Breeding for ToLCNDV resistance

ToLCNDV resistant inbred lines: Four ToLCNDV resistant inbred lines along with eight resistant germplasm (five ridge gourd and three sponge gourd) and two checks Arka Prasan and Arka Vikram were evaluated for yield & yield parameters and ToLCNDV incidence during summer season of 2024. Significant differences were observed among the genotypes for all the traits. Except IIHR-137 (VI=0), none of the lines showed resistance to ToLCNDV. Among the ridge gourd lines, highest fruit yield was recorded by IIHR 6 (44.01 t/ha; VI=20.0) followed by and IIHR-RV-23-4 (38.50t/ha; VI=38.37) and IIHR-RV-20-3 (35.17t/ha; VI=31.04).

Advancing the BC_3F_1 populations developed for transferring ToLCNDV resistance: Seven BC_3F_1 populations of the Arka Prasan background crossed with IIHR.Sel.1 were raised for advancement. Overall the ToLCNDV incidence was less this year, mean score ranged from 1-2.61. Best IPs with less LCV incidence having medium long and long fruits were selected and advanced by selfing.

Selection in the BC_1F_2, BC_2F_2 and BC_2F_3 segregating populations: Two BC_1F_2, three BC_2F_2 and four BC_3F_2 populations were raised during summer. ToLCNDV incidence was recorded on all the segregating populations on 0-5 scale. Though the incidence was less this year, best five IPs were selected in each population based on ToLCNDV score (ranging from 0-2) and fruit length and were advanced by selfing as well as backcrossing to the recurrent parent, Arka Prasan.

Fruits of Segregating populations developed for ToLCNDV resistance

Breeding for downy mildew resistance:

Screening of susceptible, resistant parents and F_2's of R X R crosses during *Kharif*: Twenty two parents (8 susceptible, 14 resistant) and 4F_2 population of resistant x resistant crosses with IIHR-61, IIHR-147, IIHR-160, IIHR-183, IIHR-117 and IIHR-183 back ground were screened for downy mildew resistance. Downy mildew mean score ranged from 4.9 to 7.2 in the susceptible parents, and from 1.63-3.00 in F_2s. In resistant parents PDI ranged from 18.78-52.3. Nineteen F_2s showed resistance with the mean score less than 3. All these F_2 s were advanced by selfing. Highest fruit length was recorded by (IIHR-147 X IIHR-117) F_2 (35.75cm) followed by (IIHR-160 X IIHR-61) F_2 (30.25cm) among the resistant F_2 population.

Screening of double cross hybrids for downy mildew during *Kharif*: Seventeen double cross hybrids, including Arka Prasan, Arka Sumeet, Arka Sujat, IIHR-6, IIHR-IP-18-50, IIHR-IP-18-55, IIHR-IP-18-13, IIHR-DMR-18-4-4, IIHR-DMR-18-65-1,

IIHR-DMR-18-65-2, IIHR-DMR-18-4-3, and IIHR-DMR-22-4-2, were evaluated for resistance to downy mildew. The mean downy mildew score ranged from 2.38 to 4.88, with six plants showing resistance (mean score < 3). The hybrid (Arka Sumeet x IIHR-DMR-18-4-4) P-35 x (Arka Sumeet x IIHR-DMR-18-65-1) P-26 exhibited highest fruit length and demonstrated resistance to downy mildew.

Screening of backcross F_1s for downy mildew during *Kharif*: Fourteen backcross progenies, including 11 (BC_1F_1s) crossed with susceptible (female) parents and 3 (BC_2F_1s) crossed with resistant male parents, were developed using eight downy mildew-susceptible lines (Arka Sumeet, Arka Sujat, IIHR RGIP-18-13, IIHR RGIP-18-50, IIHR RGIP-18-55, IIHR-6-1-1, Jaipur Long) and four downy mildew-resistant lines (IIHR DMR 18-4-3, IIHR DMR-18-4-4, IIHR DMR 18-65-1, IIHR DMR-18-65-2). These progenies were screened for downy mildew resistance during the Kharif season. The mean scores ranged from 2 to 5, seven resistant plants exhibiting mean score ≤ 3 were advanced.

Screening of segregating (F_2 and backcross F_2s) population for downy mildew during *Kharif*: Three F_2 populations, 6 BC_1F_2 populations and 1 BC_2F_2 populations developed using 4 downy mildew susceptible released varieties, 4 advanced breeding lines and 4 resistant lines were raised. Downy mildew mean score ranged from 2-4.5 and 13 resistant plants were advanced with the mean score ≤ 3. (IIHR-IP-18-50 X IIHR-DMR-18-4-4) BC_2F_2 population recorded highest fruit length (27-29.25 cm).

Screening of population pollinated with mixed pollen of downy mildew resistant parents *Kharif*: Three resistant lines IIHR-160-1, IIHR-DMR-18-4-4 and IIHR-DMR-18-65-1 were pollinated with mixed pollen of the resistant plants within these lines and the resulted progenies were screened for downy mildew resistance during *kharif*. Individual plants were screened and mean downy mildew score ranged from 1-4. Six plants showing resistance with the mean score ≤ 3 were advanced.

Incorporation of male sterility (CGMS):

Advancing male sterile lines (Backcrossing of BC_5, BC_6 generation): Nine back cross populations viz., IIHR-37-4-1-2-5 BC_6, IIHR-23-5 BC_7, IIHR-26-4 BC_7, IIHR-5-1BC_7, IIHR-6-2 BC_7, IIHR-49-3 BC_7, IIHR-70-1-3 BC_7, DM-22-4-2 BC_7 and IIHR-34-2 BC_7 were raised for maintenance of male sterility in different genetic backgrounds (green / long / medium / short fruits). All of the backcross progenies were 100% male sterile, indicating sterility maintenance. In all 9 back cross populations, IPs with fruits similar to their male parent were selected and backcrossed with respective male parents to maintain sterility. Fruit length ranged from 8.17cm (IIHR-37-4-1-2-5 BC_6) – 39.98 cm (IIHR-70-1-3 BC_7) in these advanced back cross populations. Seven male sterile lines were crossed with various reference varieties and advanced breeding lines to generate the *ms-based* hybrids.

Evaluation of *ms* based F_1 hybrids for yield and disease resistance: Sixty-six male sterility based hybrids developed using five *ms* lines and nine male parents in different combinations were evaluated in preliminary row trial for yield and yield related traits. Wide variability was observed for all the fruit related traits. Among these, three *ms* based hybrids viz., **RGMSH-24-44** (54.25 t ha^{-1}), **RGMSH-24-31** (53.8 t ha^{-1}) and **RGMSH-24-20** (53 t ha^{-1}) have recorded maximum fruit yield/hectare.

RGMSH-24-20

RGMSH-24-31

RGMSH-24-44

Advancing the androe-monoecious lines: Four BC6 F_1 population IIHR-6 and IIHR 51 background and three BC_2 F_1 Arka Prasan background were raised, and all the progenies were monoecious due to the dominant gene action of monoecy. Two BC_6 F_1 populations in IIHR-51 background were segregated into both monoecious and andromonoecious plants in 3:1 ratio as per the recessive gene control of Andromonoecy. Four BC1F2 populations of Arka Sumeet (IIHR-174 was AM source), Arka Prasan, Pusa Nutan (IIHR-174 was AM source), background and two BC_5 F_2 in the Phule Sucheta and IIHR 51 background were raised and all the progenies were segregated into both monoecious and andromonoecious plants in 3:1 ratio as per the recessive gene control of Andromonoecy. AM plants with longer fruits were selected and backcrossed with respective monoecious parents to advance the populations.

Development of Hermaphrodite Lines with Arka Prasan quality: In the last year, eight hermaphrodite ridge gourd lines viz., IIHR-230, IIHR -232, IIHR -234, IIHR -241, IIHR -244, IIHR -257, IIHR -263, and IIHR -270 were crossed with Arka Prasan to develop hermaphrodite hybrids possessing the quality traits of

Arka Prasan. Reciprocal crosses were also performed. The resulting crosses which were monoecious, were sown in 2024, and the generation was advanced through selfing.

Bitter gourd

Breeding for high yield and quality:

Evaluation of advanced breeding lines for yield, related traits and virus resistance: Nine advanced breeding lines (ABL) along with 3 checks viz., VNR-28, Palee and Pragathi were evaluated for yield, yield related traits and virus resistance during summer season in RBD with two replications. Data has been recorded on 12 quantitative traits viz., and two qualitative traits like fruit color and ridge type. Significant differences were observed among the germplasm for almost all the traits studied except days to first female flower appearance, days to first picking and Cucurbit aphid borne mosaic virus. Among the ABLs, fruit length ranged from 6.19cm (IIHR IP-19-104-2) to 17.33cm (IIHR GP-184-7). Among the advanced breeding lines IIHR IP-19-17-3 (10.17t) performed better. Seven advanced breeding lines along with the check Pragati showed complete resistance for ToLCNDV.

Evaluation of advanced breeding lines for yield, related traits and downy mildew resistance: Ten advanced breeding lines (ABL) along with four checks viz., Arka Harit, VNR-28, Palee and Pragati were evaluated for yield, related traits and downy mildew resistance during *kharif* season in RBD with two replications. Data has been recorded on 11 quantitative traits and two qualitative traits like fruit color and ridge type. Significant differences were observed among the advanced breeding lines and checks for all the traits. Among the ABLs, fruit length ranged from 12.15 cm (IIHR IP-20-184) to 26.35 cm (Palee). Among the advanced breeding lines IIHR GP-177-1 (21.91 t), IIHR PDGY-8 (19.65 tonnes) and IIHR IP-GP 148-10 (19.35 tonnes) were on par with the checks VNR-28 (25.11 tonnes) and Palee (21.27 tonnes). With respect to downy mildew resistance none of the lines showed resistance, although IIHR GP-177-1 (26.82) showed least percent disease index (PDI).

Transferring Gynoecy:

Advancing the back cross populations for transferring Gynoecy: In order to transfer the gynoecy, 8 BC_2F_1, 3 BC3F1, 25 BC_5F_1, 1 BC1F1, 15 BC_2F_2, 7 BC_4F_2, along with respective parents in different genetic back grounds depending on various fruit traits viz., fruit color (green/dark green/very dark green), fruit length (long/medium long), fruit ridge type (continuous/discontinuous), number of tubercles (less/many), tubercular prominence (prominent/non-prominent), white tip (present/absent) were raised for advancement. Progeny of all the 37 F_1 crosses were monoecious indicating the recessive gene nature of gynoecy. Selfing of these lines was done to advance the generations for further evaluation. Twenty-two segregating populations have segregated into both monoecious and gynoecious plants. Gynoecious plants of these populations were back crossed with the respective male parents to increase the fruit length. With respect to improvement of fruit length in the advanced gynoecious backcross progenies, longest fruit length recorded in gynoecious plants of various segregating populations is about 25-30 cm compared to 8-10cm fruit length found in the original gynoecy source, IIHRGy-491.

Breeding for powdery mildew resistance:

Advancing of powdery mildew resistant breeding lines (uniform): During the rabi season, eleven F_7 populations and one F_3 population derived from a biparental cross, exhibiting uniformity in powdery mildew resistance and fruit characteristics, were evaluated. Key traits assessed included fruit color (green/dark green/very dark green), fruit length (long/medium long), and ridge type (continuous/discontinuous). Screening for powdery mildew resistance was conducted phenotypically in the field using a 0–9 disease scoring scale. Among all populations, ten displayed resistance to powdery mildew, with a Percent Disease Index (PDI) below 20. From these populations, 29 individual plants (IPs) were selected based on their resistance to powdery mildew and superior fruit quality. These selected plants were further advanced through selfing. Notably, four F_7 populations (IIHR-PMR-F_7-19-11-8-4-2-6-1, IIHR-PMR-F_7-19-6-23-3-4-3-2, IIHR-PMR-F_7-19-11-1-1-3-4-1, and IIHR-PMR-F_7-19-11-1-1-3-4-2) exhibited complete resistance, with a PDI of 0.

Advancing of powdery mildew resistant breeding lines (segregating): Nineteen F_7 population, 2 BC_2F_6 and four germplasm segregating for powdery mildew resistance and fruit characters were evaluated for powdery mildew resistance in the Rabi season. Mean score ranged from 0-5.42. Out of all the segregating population 34 IPs were found to be resistant with the mean powdery mildew score less than 3.

Bell pepper

GMS based hybrids: Developed GMS based hybrids in bell pepper and evaluated them for yield traits and suitability under playhouse cultivation and identified 5 high yielding GMS based hybrids as shown below.

IIHRBP 049 X IIHRBP 030
Yield per plant: 1030.4 g
Single fruit wt.: 107 g

IIHRBP 049 X IIHRBP 048
Yield per plant: 987.8 g
Single fruit wt.: 63 g

IIHRBP 049 X IIHRBP 034
Yield per plant: 1073.2 g
Single fruit wt.: 115 g

IIHRBP 049 X IIHRBP 052
Yield per plant: 977.53 g
Single fruit wt.: 100 g

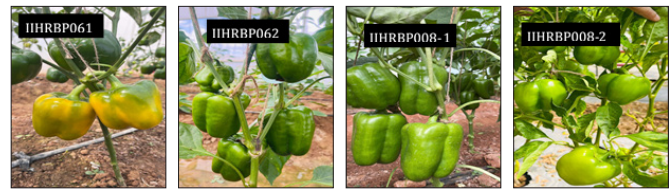
IIHRBP 049 X IIHRBP 013
Yield per plant: 1073.2 g
Single fruit wt.: 115 g

Previously identified heat tolerant and susceptible Capsicum lines were used to make crosses and evaluated them under 3 environments (IIHR, Bangalore (poly tunnel (47°C and 50% RH) and open field (36.5 °C and 27% RH) and NIASM, Baramati (39°C and 35% RH) along with parents for yield and attributing traits under heat stress condition. Identified IIHRBP013 X HT-9 and IIHRBP34 X HT-7 as the best performing hybrids for fruit and yield traits in all the environment. Backcrossing to desired bell pepper background is in progress to transfer heat tolerance and to improve fruit size and to study the genetics of important traits through generation mean analysis

IIHRBP013 X HT-9

IIHRBP034 X HT-7

Evaluated 15 inbred lines in different colour background and identified IIHRBP061(Y), IIHRBP062(R), IIHRBP008-1(G) and IIHRBP008-2 (LG) as high yielding with better fruit characters.



Cluster bean

Development of non- lodging type plants: For developing nonlodging type cluster bean line, crossed the contrasting parents and 18 selected lines were selected for lodging tolerance and pod traits and further evaluated for yield traits

IIHRCB2-28-1M

IIHRCB2-27-5M

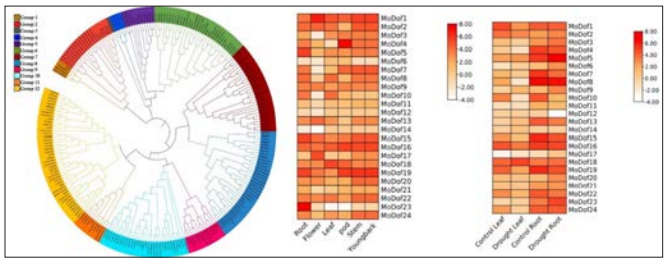
Mutation studies: Selected mutant lines in M_5 generation were evaluated and IIHRCB-M-2-27-5 was identified as the best mutant line among all for *kharif* season and IIHRCB-M-2-28-1 for summer season.

Drumstick

The moringa germplasm maintained at CHES, IIHR Bhubaneswar have been subjected to leaf nutritional characterization. The leaf Nitrogen content varied from 3.02 to 4.17 per cent among the various germplasm. Similarly, the leaf P content ranged between 0.28-0.50%, leaf K ranged between 2.05-3.12%, leaf Ca ranged between 0.67-1.76%, Leaf Mg ranged between 0.25-0.65 per cent and leaf S ranged between 1.8-2.67%. Micronutrient content showed a wide variation among the leaves of moringa germplasm. The total Fe, Mn, Zn, Cu and total Boron ranged between, 363.0-583.5 ppm, 60.6-111.0 ppm, 14.4-24.1 ppm, 1.23-2.70 ppm and 230.4-515.2 ppm, respectively.

Some germplasm of moringa maintained at CHES, IIHR Bhubaneswar have been subjected to pod (at edible stage) nutritional characterization. The pod Nitrogen content varied from 1.76 to 2.67 per cent among the various germplasm. Similarly, the pod P content ranged between 0.30-0.43 %, pod K ranged between 1.41-2.52%, calcium content in the pod ranged between 0.40-0.74%, Mg and sulphur content in the moringa pods ranged from 0.2.0 to 0.41% and 1.40 to 1.82 percent, respectively. Micronutrient content showed a wide variation among the pods of moringa germplasm. The total Fe, Mn, Zn, Cu and total Boron ranged between, 60.2-76.6 ppm, 20.02-32.50 ppm, 11.16-16.89 ppm, 1.20-1.80 ppm and 345.6-681.6 ppm, respectively.

Identification of Dof gene family in *Moringa oleifera*: About 24 Dof genes were identified along with its chromosomal locations. Further, phylogenetic analysis of 236 Dof protein sequences grouped them into twelve major groups. Synteny and interspecies collinearity analyses identified gene duplication events and provided insights into the evolutionary relationships among MoDof genes. Analysis of gene expression data showed the involvement of different MoDofs in various plant parts of *M. oleifera* under drought stress conditions.



Phylogenetic and expression analysis of Dof gene family in Moringa

Biochemical profiling of moringa seed oil: Moringa seed oil was extracted from twelve accessions using n-hexane and it varied from 33 to 40%. Fatty acid profile showed that oleic acid is the predominant fatty acid.

Pumpkin

Interspecific hybridisation in *Cucurbita* spp: Eleven interspecific crosses were tested for its yield potential, where *C. maxima x C. moschata* (1) and its reciprocal cross (1) along with eight interspecific cross between *C. moschata x C. pepo* was attempted. Fruit length (14.35-32.88 cm), fruit girth (13.80-59.87 cm), flesh thickness (1.25-4.15 cm), TSS (5.5-12.0°Brix) and fruit weight (0.35-3.12 kg with mean value of 0.625 kg). Fruit yield varied from 3.11 to 31.23 t ha^{-1}. RJ-4 x Arka Chandan (*C. maxima x C. moschata*) recorded highest yield having potential for use as rootstock.

Mutant population induced from PKM-1 (10) and IIHR-D-28 (6) was assessed for floral traits. The mutant 14, 15 and 34 recorded early flowering height (< 75.0 cm) than PKM-1(200.2 cm). Similarly, the mutant 46 (20.0 cm) and 9 (128.6 cm) recorded wider range for flowering in IIHR-D-28 (64.0 cm).

Biochemical profiling of genotypes: Thirty six accessions of pumpkin were evaluated for quality parameters. TSS varied from 3.43 to 11.83ºBrix. Total phenols from 8.45-64.95 mg GAE 100 g^{-1}. Antioxidant activity varied from 1.41 to 37.33 mg 100 g^{-1}. Some accessions have very high total carotenoid content which varied from 2.93-21.95 mg 100 g^{-1}.

Flower Crops

Rose

Breeding for Garden Roses: Sixteen advanced rose breeding lines (IIHRR 9-13, IIHRR 2-9-8-1, IIHRR 2-9-8-2, IIHRR 4-4-2, IIHRR 7-4 , IIHRP 3-18-2, IIHRR 3-7-12, IIHRR 4-5-12, IIHRR 4-5-12-1, IIHRR 13-16, IIHRR 13-24, IIHRR 15, IIHRR 13-4, IIHRR 11-3, IIHRP 21, IIHRR 13-39) were evaluated for their suitability as garden roses. Among them, IIHRR 9-13 was identified by the Institute Technology Management Committee with the name 'Arka Viraraghavan'. It is an environmentally friendly rose that can be managed with minimal pesticide usage. Being a perennial climber Árka Viraraghavan' contribute to environmental sustainability with carbon stock accumulation and nutrient recycling ability. As a climber plant it is well suited for multiple landscape features in urban area, helping to regulate urban heat island effect, altering the aesthetic surroundings and contributing for psychological well-being of people. It has attractive red colour (RHS Red Purple group N66-A) flowers, larger in size (10-12cm) with multiple petals (50-60) having yellow basal spot (RHS yellow group 3-C).

Arka Viraraghavan

IIHRR 4-5-12-1

Breeding for cut flower: Of the multiple lines evaluated for cut flower production, IIHRR 3-18-2 is found suitable for production under open field cultivation with less number of prickles and able to produce long stalks without any additional cost of protected cultivation. IIHRR 7-1 recorded larger bud size (6-7cm) with long vase life (7-8 days). With red colour flowers it has potential for production of loose flowers in open field and cut flowers under protected cultivation. IIHRR 7-7 was found to be having larger flower size (10cm) with longer flower stalk (70cm). IIHRR 13-3-1 has more number of petals (65-70) with attractive yellow colour and it was selected for cut flower production under protected cultivation. IIHRR 204 had attractive flower shape with novel colour and ability to produce long flower stalks both in open and under protected cultivation. IIHRR 7-9 with red colour flowers was multiplied for further evaluation in both open field and under protected cultivation.

IIHRR 7-9

Breeding for fragrant roses: Among 54 rose genotypes screened, estimation of anthocyanin (87.67 - 1868.2 mg 100 g^{-1} DW of petals and antioxidants (5572 - 34701 mg 100 g^{-1} DW of petals) indicated wide variability in availability of the phytochemicals. IIHRP-7 was found to be rich in anthocyanin content. Anthocyanins (1868 mg 100 g^{-1} DW of petals) has the commercial potential for food colour and flavor. Interms of oil content Arka Parimala had the maximum compared to all the lines evaluated.

IIHRP-7

Resistance breeding for biotic stress: Among several rose progeny populations evaluated over the years for powdery mildew, IIHRR 13-4 remained immune to infestation by powdery mildew (*Podosophera pannosa* (Wallr.Fr.) de Bary). It is a shrub type plant with semi-upright growth habit. Flowers are small, semi-double type and purple in colour. In field screening for resistance against black spot disease caused by *Diplocarpon rosae*, IIHRR 3-7-12 was found to be resistant with <10 Percentage of disease Index (PDI). Further, response to artificial inoculation of *D. rosae* in detached leaf assay (DLA) method across the selected genotypes with varied levels of resistance, confirmed the resistance to be in accordance with the field screening.

IIHRR 13-4 IIHRR 3-7-12

IIHRR 3-7-12 is a seedling selection from *R.clinophylla.* It produces single type white flowers with 2-3 days keeping quality. IIHRR 3-7-12 is environmental friendly, floriferous in nature and has demonstrated resistance to black spot disease. It helps in conserving urban biodiversity by attracting bees.

Screening for resistance to black spot: Standard procedures were followed for testing and screening of the rose genotype IIHRR 3-7-12 against black spot caused by *Diplocarpon rosae*. In field screening for resistance against black spot disease caused by *Diplocarpon rosae*, IIHRR 3-7-12 was found to be resistant with <10 Percentage of disease Index (PDI).

Marigold

Male sterility: Genetic studies confirmed single recessive gene (aa) governing apetaloid sterility while petaloid sterility was confirmed to be governed by single dominant gene (PP). Recessive epistasis was found to govern the interaction between apetaloid and petaloid male sterility. Cytoplasmic male sterile lines are being maintained in both yellow and orange background. IIHRMYs-1 and IIHRMOs-1 are the cytoplasmic male sterile lines being maintained in yellow and orange colour respectively. Rf gene in homozygous condition could restore the fertility in Sterile cytolplasm (S).

Pre-breeding lines for developing hybrids: In an attempt to enhance heterosis vigor for flower yield and carotenoid content, 137 pre-breeding lines were evaluated and based on the evaluation twelve were selected for future breeding program. For carotenoid content one double fertile line IIHRMO 2335, and an apetaloid sterile line (IIHRMO2340) and a genetic petaloid sterile line (IIHRM 2-3) were selected that are having with >2 % of carotenoid content based on dry petal meal. Among the three, IIHRMO 2335 and IIHRMO 2340 lines were registered with NBPGR. IIHRMO 2340 and IIHRM 2-3 are genetic male sterile lines maintained by intercrossing between fertile and sterile flowers of the same line.

IIHRMO 2340 (INGR 24080)

IIHRMO 2335 (INGR 24079)

Breeding for disease resistance: Repeated field evaluation combined with detached leaf assay resulted in confirmation of IIHRFM-332 as moderately resistant genotype for *Alternaria* leaf spot and flower blight caused by *Alternaria tagetica*. Genotypes were found to have differential response to the disease infection, with moderately resistant genotypes could resist the spread of disease even at congenial condition of high rainfall and humidity. Besides being resistant, the flowers of IIHRFM-332 were attractive and can be evaluated further for flower production and for their suitability to landscape.

IIHRFM-332

Tuberose

Breeding for garland purpose: Three single type lines IIHR 15-5-16, IIHR 15-22-HS-1, and IIHR 15-7-13 are promising for garland purpose. IIHR 15-5-16 produces 58.1 number of florets per spike, bold buds (1.26 g) and florets (1.50 g) with the bud length of 5.45 cm and yields 7.0 spikes per plant per year with long shelf life (3.0 days). IIHR 15-22-HS-1 (IC0642160) bears 56.3 number of florets per spike with the bold buds (1.37 g), florets (1.43 g), floret size (4.50 cm), bud length (6.42 cm) and yields 5.7 spikes per plant per year. IIHR 15-7-13 produces 58.3 number of florets per spike, small buds (1.11 g) and florets (1.35 g) with the bud length of 5.71 cm and yields 6.3 spikes plant^{-1} yr^{-1}.

IIHR 15-22-HS-1 **IIHR 15-5-16** **IIHR-15-7-13**

Tuberose lines suitable for loose flower

Evaluation of genotypes for concrete content: Out of eight advance lines (IIHR-15-7-13, IIHR-17 23HS-9, IIHR 15-22-HS-1, IIHR 17-1-16, IIHR 15-5-16, IIHR 17-5-2, IIHR 17-4-23, IIHR 17-4-10) and three varieties (Mexican Single, Arka Prajwal and Arka Keerthana) evaluated, tuberose genotype IIHR-15-7-13 (0.106%), Arka Keerthana (0.102%), IIHR-17 23HS-9 (0.094%), and IIHR-17-5-2 (0.09%) recorded the highest concrete content as compared to other lines.

Breeding for *Alternaria* leaf blight disease resistance: Twelve tuberose lines were screened for resistance to leaf blight disease caused by *Alternaria polianthi* through artificial inoculation. Three tuberose lines IIHR 20-8-16, IIHR 20-8-72, and IIHR 20-2-67 were found to be moderately resistant *Alternaria* leaf blight disease with the PDI of 20.00 to 24.00.

Quantification of pigment in pink tuberose: Forty-one colour tuberose lines were quantified for total anthocyanin content (mg 100 g^{-1} FW) at bud and flower stages. Highest total anthocyanin content was noticed in 20-2-10 (5.81) and 20-5-29 (5.51) at bud stage and 20-5-29 (4.31) and 20-1-74 (3.98) at flower stage. Anthocyanin profiling of selected tuberose genotypes using LC-MS revealed that Cyanidin and Delphinidin are the major anthocyanin components. Highest Cyanidin content was observed in 20-29HS-39 (579.15 µg 100 g^{-1}), highest Delphinidin content was noticed in 20-2-10 (1024.55 µg 100 g^{-1}).

Gladiolus

Breeding for cut flower with *Fusarium* wilt resistance: Seventeen hybrid selections were evaluated for two consecutive years and pooled analysis revealed that IIHR-15-1-48, IIHR-15-1-212 and IIHR-15-1-215 were found promising for cut flower purpose. IIHR-15-1-48 (RHS colour: Red 53B middle, having red 53A margin) bears 15 florets per spike, florets are thick, wavy and arranged in zig zag pattern on spikes and produces 2.53 spikes per plant. IIHR-15-1-212 (RHS colour: Red purple 67B, red purple 67A hairy streaks with yellow 2C blotch) florets are attractive with frills and arranged in double row pattern on spikes, produces 14 florets per spike and 2.63 spikes per plant. IIHR-15-1-215 (RHS colour: Red purple N 74 A, red purple 60 A blotch having white yellow 3C on lower lip) florets are thick, frilled, attractive and arranged in zig zag pattern on spikes with 14 florets per spike and produces 2.35 spikes/plant. Three advance lines were found to be resistant to *Fusarium* wilt disease.

Gladiolus hybrid selection IIHR 15-1-215

Evaluation of hybrid progenies of white gladiolus: A total of 341 progenies of ten different cross combinations were evaluated for growth and flowering parameters, and 50 white flower gladiolus lines are found promising with high flower yield, quality and multiplication potential, were advanced for further evaluation.

Gladiolus progenies with white flower

Chrysanthemum

Breeding for cut flower and bedding: Out of 10 half-sib lines evaluated, two lines IIHR5-11 and IIHR9-9 were found promising for cut flower and IIHR2-11B and IIHR2-42 for bedding purpose with unique flower colour, flower form and floriferousness.

Mutation breeding: Yellow coloured natural mutant (bud sport) from HYCD14, two induced mutant (15 and 20 Gy irradiation) from Candor Pink and one mutant from Champagne Yellow were successfully isolated under *in vitro* conditions and evaluated for flower quality traits.

Resistance breeding for biotic stress: Among 180 genotypes/lines screened for white rust disease (*Puccinia horiana*) in field condition, 77 lines were highly resistant (PDI 1-10) and 27 were resistant (PDI 11-20).

China aster

Breeding for cut flower and loose flower: Among 36 F_9 erect type lines evaluated for cut flower traits, the promising lens were pink (15-41-3, 15-41-5 and 15-57-2A), purple/violet (15-32-1A, 15-41-5A, 15-41-7 and IIHRM15) and white (15-42-3, 15-52-1B, 15-57-7 and CC5-1(23)) flowered lines in terms of attractive unique flower colour, long sturdy flower stalk, more number of ray florets and vase life. The lines 15-16-1 (light pink) and 15-14-1 (white) was found promising in terms of dwarf plant stature and attractive flower colour. Among 47 F_9 lines evaluated for loose flower yield, 10 F_9 lines recorded more than 50 flowers per plant and high loose flower yield.

Breeding for bedding and pot culture: The pink flowered lines (15-2-1, 15-16-4, 15-19-2, 15-30-1 and 15-57-2), purple/violet (15-14-3 and 15-27-1) and white (15-14-2, 15-15-1 and 15-16-3) were found promising for early flowering, attractive flower colour and floriferousness.

Crossandra

Promising lines: Fifteen Crossandra genotypes were collected and conserved in the germplasm block. The collected genotypes were characterized and evaluated for their suitability for loose flower and pot culture. Crossandra Mutant-3 with dwarf growing habit, highest rachis length, peduncle length, highly floriferous, more longevity of flowers in the plant and attractive flower colour (Orange - Red group 32A of RHS colour chart) was found promising for pot culture. Crossandra Mutant-2 was found promising for loose flower purpose with medium sized flowers, thicker petals, strong petal stalk, higher yield and higher shelf life.

Gerbera

Germplasm consisting of 11 commercial varieties and 12 breeding lines are being maintained and are evaluated in separate experiments. Among commercial varieties of gerbera evaluated under polyhouse (naturally

ventilated), Torro Rosso variety performed best with respect to flower yield (3.23 flowers/plant/month) and quality. Due to their novel flower colour all varieties were found promising for commercial cultivation. In another experiment, a total of 12 numbers of gerbera genotypes were evaluated under open field among these, among these Arka Krishika, Arka Red and IIHR G-2 resulted higher vase life (6.20 days, 6.17 days & 6.15 days, respectively). IIHR G-2 was also found to be high yielding among the breeding lines.

Evaluation of gerbera germplasm under open filed conditions at IIHR (2024)

Genotype	Plant spread (cm)		Flower diameter (cm)	Disc diameter (cm)	Flower stalk length (cm)	Flower stalk diameter (cm)	No. of flower stalks per plant per month	Vase life (days)
	E-W	(N-S)						
Arka Krishika	40.60	39.79	8.54	1.50	36.90	4.16	3.75	6.20
Arka Red	38.17	39.50	7.02	1.00	32.15	4.01	3.50	6.17
IIHR G-1	43.99	44.52	11.40	2.78	41.51	4.01	2.36	5.87
IIHR G-2	46.17	47.70	8.60	1.22	43.90	3.90	3.15	6.15
IIHR G-3	39.30	36.29	9.51	1.33	36.30	1.36	2.00	5.12
IIHR G-4	38.21	38.32	9.11	1.52	38.33	4.37	1.85	4.50
IIHR G-5	46.53	49.08	8.66	0.97	46.00	4.29	2.15	5.33
IIHR G-6	45.47	42.30	10.12	1.07	37.47	3.71	2.85	4.94
IIHR G-7	54.21	52.90	10.60	0.91	41.02	4.13	2.33	4.25
IIHR G-8	66.20	62.36	9.30	1.55	58.83	5.68	2.87	5.75
IIHR G-9	38.17	40.32	8.55	1.24	36.23	3.93	2.50	5.50
IIHR G-10	35.08	39.29	9.58	3.00	31.42	2.75	1.85	5.84

Dahlia

Germplasm consisting of 09 varieties were maintained and evaluated in field. Among these V5 variety is best suited for pot culture with dwarf nature (51.33 cm, plant height) and more flowering duration (10.29 days). V2, V5, V6 are suitable for loose flower purpose due to its smaller flower diameter (8.31 cm, 8.54 cm & 9.61 cm, respectively) and flower compactness. From the evaluation of open pollinated (OP) population, fourteen selections were made (14 nos.) based on flower quality (flower colour, size & form) and suitability for pot plant, bed and border plants.

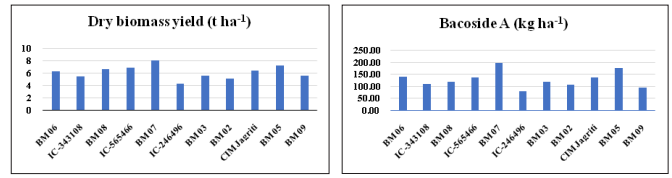
V1 V2 V3

Dahlia varieties at ICAR-IIHR

Medicinal Crops

Brahmi (*Bacopa monnieri*)

Evaluation of elite lines for herbage yield and Bacoside A content: Evaluation of eleven elite lines for yield and bacoside content along with check CIM Jagriti (over three harvests) showed total dry biomass yield ranged from 4.25 to 8.11 t ha^{-1}. Highest biomass was recorded in BM07 (8.11 t ha^{-1}) followed by BM05 (7.24 t ha^{-1}) and IC 565466 (6.96 t ha^{-1}) compared to check CIM Jagriti (6.41 t ha^{-1}). Bacoside content in 11 lines were estimated over three seasons (summer, rainy and winter) where mean bacoside content was highest in BM07 (2.40%) followed by BM05 (2.38%) and BM03 (2.17%) whereas check CIM Jagriti recorded 2.14%. The selections IIHRBM07 and IIHRBM05 were found superior in terms of bacoside yield (198.40 and 176.84 kg ha^{-1}, respectively) compared to check (137.76 kg ha^{-1}).



Dry biomass yield (t ha^{-1}) and Bacoside yield (kg ha^{-1}) in elite lines of *Bacopa monnieri*

Antioxidant activity in elite lines

Field view of elite lines of *B. monnieri*

Among eleven elite selections of *Brahmi*, highest DPPH (1, 1-diphenyl-2- picrylhydrazyl) activity was recorded in IC-3535203 (19.7 mg g^{-1} AAE) followed by IC- 246496 (18.05 mg g^{-1} AAE). Free radical scavenging activity showed a variation of 14.8 to 19.7 mg g^{-1} AAE (ascorbic acid equivalent). Further, IC-324777 also recorded higher flavonoid content (28.0 mg g^{-1} catechin equivalent) and higher phenolic and tannin content (40.29 mg g^{-1} and 17.71 mg g^{-1} gallic acid equivalent, respectively).

Polyploid induction, confirmation and evaluation: Terminal shoot cuttings were immersed in different colchicine (0.50, 1.00, 1.50 and 2.00%) solutions for 24 and 48 h to induce polyploidy in IIHRBM06. Ploidy status has been confirmed through flow cytometry using *Pisum sativum* var Trinidad as standard for estimating the genome size. The genome size of IIHRBM06 is estimated to be 0.68 pg and genome size varied from 0.71 to 1.77 pg among the tested putative polyploids. Polyploids showed different ploidy status. Among the confirmed polyploids, three were pentaploid, two were tetraploids and one showed triploid condition. Initial analysis shows that there was no significant increase in Bacoside A content in the confirmed polyploids. Bacoside A content of BM6P1 and BM6P2 (1.89 and 1.91%, respectively) is on par with the control BM 6 (1.97%). The polyploids with higher biomass yield and bacoside content on par with the check will be evaluated further.

***In-vitro* propagation:** Embryogenic callus cultures were successfully established using leaves as explants on MS media supplemented with 2.5 mg per l of NAA. Establishment of embryogenesis derived plantlets is in progress. Direct organogenesis from meristems as explants on MS media supplemented with zeatin (2 mg per l) and IAA (0.1 mg per l) resulted in large number of *Brahmi* plantlets.

Tissue regeneration culture/direct organogenesis from meristems of *Brahmi*

Mutation studies through gamma irradiation and Ethyl Methane Sulphonate: Studies conducted to induce mutations in the BM6 genotype of *Brahmi* using gamma irradiation and EMS (Ethyl Methane Sulfonate) in order to increase both herbage yield and Bacoside content. Soft terminal stem cuttings of 10-15 cm were subjected to gamma irradiation at doses of 20, 40, 60, 80, 100, and 120 Gray (Gy). Significant differences in growth and survivability were observed between treated plants and control group, particularly within the 20-80 Gy range. Plants exposed to 20 Gy exhibited best growth and survivability. However, higher doses from 80 to 120 Gy caused severe growth retardation and ultimately resulted in complete plant mortality.

Response of Brahmi (IIHR BM 06) genotype to gamma irradiation at 20 to 120Gy

EMS Treatment: Soft stem cuttings of the BM 06 genotype of *Brahmi* were treated with Ethyl Methane Sulfonate (EMS) at concentrations of 0.5% and 0.8% for varying duration control (0 min), 30 minutes, 1 hour, 1.5 hours, 2 hours and 2.5 hours to induce beneficial point mutations aimed at improving herbage yield and bacoside content. At 0.5% EMS, no significant differences were observed in terms of survivability. However, minor variations were noted in growth traits, such as growth rate, stem length, stem size, and leaf size, particularly at 2 and 2.5 hours of exposure when compared to the control. In contrast, at 0.8% EMS, growth retardation was gradual from 30 minutes to 2 hours of exposure, with severe retardation observed at 2.5 hours. Although EMS treatments would not create detectable growth retardation, EMS known to cause point mutations in genes leading to desirable trait improvements. Further experiments are planned to refine and narrow down the effects of EMS treatment to identify optimal exposure durations and concentrations for inducing desirable mutations.

Effect of EMS at 0.5% (A) & 0.8% (B) concentrations on morphological traits of Brahmi (IIHR BM 06) genotype

Ashwagandha

Evaluation of F_1 hybrids: About 21 F1 hybrids were evaluated with seven parental lines for growth and yield traits. Among them, six crosses (DWS-420 x GA-3, RVA-100 X GA-3, RVA100 x DWS-420, VA-2x RVA-100, VA-2x CIMS and RVA-100 x GAA-1) were found promising in terms of dry root yield ranging from 10-25 g per plant and root length of >20 cm.

Salacia spp

Genome sequencing and identification of Species-Specific Markers: Genome sequencing of nine *Salacia* species (*S. fruticosa, S. chinensis, S. oblonga, S. macrosperma, S. vellaniana, S. beddomei, S. malabarica, S. wayanadica and S. brunoniana)* was done by NGS with denovo bioinformatics. From the sequenced genome, species specific SSRs and species-specific genes were identified.

3.3. CROP PRODUCTION

Fruit Crops

Mango

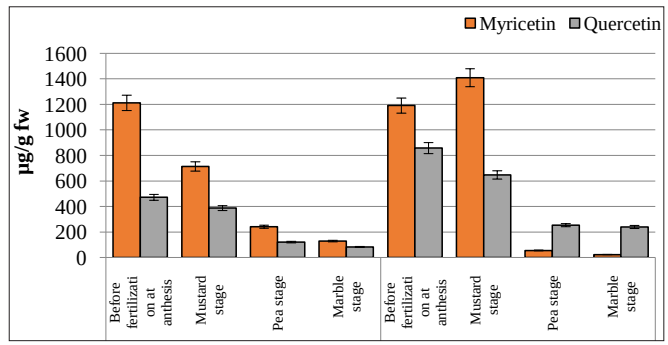
Integrated resource management module for high density planting (HDP) systems: The effects of three high-density planting (HDP) systems (5 m x 5 m, 5 m x 3.75 m and 5 m x 2.5 m) as main treatments and 3 drip-fertigation levels (Incremental increase of 55:14:51, 73:18:68 (RDF) and 91:22:85 g $N:P_2O_5:K_2O$ per plant per yr up to 5th yr) as sub treatments were studied in two mango hybrids Arka Udaya and Arka Suprabhath since 2020. During 4th year after planting, the average fruit yield was 6.60 kg per plant in Arka Udaya with 31.8 fruits per plant and average fruit weight of 207.8 g. The per-plant fruit yield was highest in HDP system of 5 m x 2.5 m (7.19 kg) followed by HDP system of 5 m x 3.75 m (6.87 kg) and 5 m x 5 m (5.75 kg). The average TSS was 24±0.32^{o}Brix in fruits of Arka Udaya. In Arka Suprabhath, the flowering and fruit set was observed in only 50% of the plants and the average fruit yield per plant was 4.79 kg. The average fruit number per plant and fruit weight was 23 and 208 g, respectively.

Arka Udaya

Arka Suprabhath

Secondary nutrient requirement: In Raspuri variety, soil application of calcium @ 100 g per plant recorded relatively higher fruit number (252 per plant) and fruit yield (13.63 t ha^{-1}) followed by foliar spray of 0.5% Ca (217 fruits per plant and fruit yield of 10.23 t ha^{-1}). In mango hybrid Arka Udaya, higher fruit number (237 per plant) and fruit yield (4.38 t ha^{-1}) were recorded with foliar spray of 0.5% Ca during fruiting stage at monthly intervals. Physiological parameters were unaffected by secondary nutrient treatments.

Metabolites in ovary and at different stages of fruit set in Alphonso and Amrapali: Major sugars like fructose, glucose and galactose were higher in Amrapali variety than in Alphonso. Among flavonoids quercetin was more in Amrapali in ovary and at different stages of fruit growth.



Quercetin and myricetin in the ovary and at different stages of fruit development

Bisexual flower production and temperature: In mango variety Alphonso, bisexual flower production was significantly higher in the year 2023-24 compared to 2022-23. Comparison of weather parameters indicated significantly lower minimum temperature during flower bud initiation period during November -February in 2022-23 than in 2023-24. The differences might be due to temperature during flower bud differentiation time that plays an important role in flower sex ratio.

Flowering genes in Royal Special in off-season and regular season: The mango variety Royal Special bears twice a year with off-season during June-August and regular season during November-January. Leaves and buds of Royal Special were sampled during pre- & post-differentiation from vegetative to reproductive stages in June and January. Relative gene expression (RE) of the flowering inducer genes (*CO-C, MiFt, SOC, LFY-B, MiAP1*) was less in 2024, correlating with lower flowering. RE in leaves of the flowering inducer genes was higher in the regular bearing season compared to off-season, the flowering repressor *SVP1* also increased but to a lesser extent. The RE of all flowering genes was

lesser in the sink, apical bud, and notably expression of *SVP1* was more in the buds during off-season. To characterize the *Ft* gene in the mango variety Totapuri, the full length *Ft* gene was cloned and sequenced.

Sugars, starch and C:N ratio in Royal Special variety: Greater accumulation of soluble sugars was observed in buds (>3 times than leaves during off-season, and >2 times during regular flowering) and higher starch accumulation was observed in leaves and buds during regular flowering periods. The C:N ratio in bud was 2.5 times higher than in leaf indicating metabolite assimilation to the sink. The abscisic acid was higher in buds, and salicylic acid in leaves.

Crop load: Leaf N, K, and Ca content decreased with the increase in crop load. Reductions were significant with the crop load of 1.0 fruit cm^2 TCSA and above at Bhubaneswar. A crop load of 0.75 fruits cm^2 is ideal for getting quality harvest of big sized fruits.

Annona

***In situ* organic matter recycling in *Annona* hybrid Arka Sahan:** The work on *in situ* organic matter recycling as vermicomposting, microbial composting and direct recycling was initiated in 2022 for making the production system self-sustainable. The fruit yield varied from 12.7 to 14.5 kg per tree in different treatments. Integration of *in situ* vermicomposting along with supplementing NPK through inorganic fertilizers was better in terms of fruit yield (14.5 kg per tree) and average fruit weight (428 g).

Nutrient requirement of *Annona* hybrid Arka Sahan: Nutrient treatments (*n*=11) included 100% (225:50:125 g N:P_2O_5:K_2O) and 75% of nutrient removal equivalent dose along with soil application of lime and dolomite, and foliar application of 0.5% Ca and/or 0.5% Mg during fruiting stage at monthly interval. Present recommendation is 250:125:125 g N:P_2O_5:K_2O +10 kg FYM. In the year 2024, the fruit yield (16.3-17.1 kg per tree) and fruit number (37.0-41.2) were similar in both nutrient doses equivalent to 100% and 75% nutrient removal along with soil application of 100 g dolomite and 5 kg FYM. However, the TSS was maximum in nutrient removal equivalent dose along with soil application of 100 g lime (34.7°Brix) compared to other treatments (30.1-33.3°Brix).

Evaluation of rootstocks for *Annona* hybrid Arka Sahan

Arka Sahan grafted on seven different *Annona* spp was evaluated for 7th year and the growth and fruit quality parameters of Arka Sahan were unaffected on seven different rootstocks during the seventh orchard year. The stock scion ratio was near to one when Arka Sahan was grafted on *Annona squamosal* (Washington) while it was more than one on all other rootstocks. Minimum tree height was recorded on *A. reticulata* which also had less tree spread. Fruit yield was highest on *Annona squamosa* (Washington) and least on *A. cherimola*.

Guava

Secondary nutrient requirement: Soil application of 100 g lime twice in a year was better in terms of higher fruit yield (30.72 t ha^{-1} in one crop) in 13-yr old guava and fruit number (467 per plant). The fruit yield was 72.8% higher than control. Leaf nutrient concentrations in guava indicated that Ca and Mg contents were above the optimum range across the treatments. However, the sulphur content of the leaf was below the optimum range for guava (0.29-0.47%). Among the soil microbial population, except fungi, population of bacteria, actinomycetes, N fixers, P solubilizers and zinc solubilizers were found higher when calcium was applied to soil @ 100 g per plant twice in a year either with or without magnesium.

Development of fertigation modules for high density planting: In HDP system of 3 m x 2.5 m, higher fruit number of 147.8 per tree and fruit yield of 24.9 kg per tree was obtained at fertigation dose of 340: 70: 260 g N: P_2O_5:K_2O. At higher planting density (2 m x 1.5 m), the fruit number (111.5) and fruit yield (17 kg per tree) were higher at 210: 40: 160 g N: P_2O_5 : K_2O indicating lesser nutrient requirement. Fruit setting and fruit retention were higher by 9.56% and 11.13%, respectively in 3 m x 2.5 m HDP over 2 m x 1.5 m HDP. Insect damage was significantly higher under high density planting at 2 m x 1.5 m than in HDP of 3 m x 2.5 m. The average marketable fruits were 82% under 3 m x 2.5 m plots while it was 75% under 2 m x 1.5 m plots.

Evaluation of propagules under HDP: Fourth year of evaluation of approach grafts and air layers of Arka Poorna in response to mineral and organic nutrient sources with 50, 75 and 100% of RDF + 2.5 kg FYM + 150 g AMC and 100% RDF through either organic manures or inorganic fertilizers showed no significant difference in yield per plant. However, air layered plants yielded higher with 50 and 75% of RDF + 2.5 kg FYM + 150 g AMC per plant (8.67 kg and 8.22 kg

fruits, respectively) than approach grafted ones (7.9 kg). Vegetative growth parameters *viz*., plant height, canopy spread and pruned biomass were significantly higher in air layers as compared to the approach grafts.

Air layered guava

Approach grafted guava

Canopy architecture management: Guava variety Arka Poorna planted at 3 m x 2 m and 3 m x 1 m spacing were trained and pruned to establish the framework in palmette, Y, espalier, and open centre training systems. In 3-yr old plants, the fruit yield was higher in Y trellis system at 3.0 m x 1.0 m (4.97 kg per plant) than in other systems (2.14-2.73 kg plant^{-1}) The open centre system recorded higher number of vegetative and flowering shoots and fruits per plant. Minimum fruit yields were noticed in Palmette (1.55 kg plant^{-1}) and Espalier systems (1.63 kg plant^{-1}). After back pruning, the number flowering shoots and fruits per plant was higher in Espalier system of training which presented lesser number of days for sprouting after pruning.

Crop load: At Bhubaneswar, crop load of 1.5-2 fruits cm^{-2} TCSA was found ideal for getting quality harvest of big sized fruits. A crop load beyond 2.00 fruits cm^{-2} TCSA leads to significant reduction in fruit weight, TSS, sugar content, and vitamin C.

Papaya

Secondary nutrient requirement: The growth parameters were unaffected by different treatments. Soil application of 100 g dolomite twice in a year recorded higher fruit number (31.7 per plant) and fruit yield (35.2 t ha^{-1}) followed by soil application of 100 g lime twice in a year (27.7 per plant) and fruit yield (43.2 t ha^{-1}). Significantly higher photosynthesis (14.3 µ mol m^{-2} s^{-1}), stomatal conductance (0.252 m mol m^{-2} s^{-1}) and transpiration rate (5.13 m mol m^{-2} s^{-1}), were recorded with foliar spray of 0.5% Ca at monthly intervals during fruiting stage and also with soil application of 100 g dolomite twice in a year.

Field view of the papaya showing response to applied secondary nutrients

Sapota

Fruit-based cropping system: The growth performance of acid lime var. Balaji in the interspaces of 22-yr old sapota hybrid DHS-2 was similar among different spacing and planting geometries in 3-yr old plants in terms of plant height, canopy spread (E-W and N-S), and stem girth. Flowering and fruit setting in acid lime plants was observed in double row square system of planting, with an initial yield of 0.5 to 6.0 kg per plant.

Acid lime mixed cropped in Sapota

Fruiting in 3-yr old acid lime

Pomegranate

Canopy architecture management: Pomegranate variety Bhagwa planted at a spacing of 4 m x 3 m and 4 m x 1.5 m were trained to establish the framework in palmette, Y, parallel-T and bush training systems. During third year i.e., first year of cropping, the growth parameters *viz*., number of primary and secondary shoots, number of fruits per plant (50.4), and initial yield per plant (6.18 kg) were higher in the bush system of training at 4.0 m x 3.0 m.

Bush system

Y-Trellis system

Grapes

Induction of rooting in green cuttings of rootstock hybrids and mutants: An attempt was made to standardize the faster methodology for multiplying hybrids and mutants of Dogridge rootstock using semi-hardwood /green cuttings. Quick dipping of green cuttings in 3000 ppm IBA induced rooting in 20 days period with plantlet survival of 80%. Quick dipping of green cuttings in 2000 ppm IBA was comparable to 3000 ppm IBA.

Screening hybrids and mutants of Dogridge rootstock for salinity tolerance: Three different hybrids and mutants *viz*., 12 Gy, 22 Gy, hybrid (H16-R6-P16) and rootstock 110 R were screened for salinity tolerance by imposing four levels of salinity (using sodium chloride and calcium chloride in the ratio of 1:1) *viz*., 2.5 dS m^{-1}, 5.0 dS m^{-1} and 7.5 dS m^{-1} and compared with control. Out of four accessions screened, hybrid H16-R6-P16 exhibited salinity tolerance at morphological, physiological and biochemical levels with highest root to shoot ratio, chlorophyll content, MDA, total soluble protein, total sugars, membrane stability index (MSI). while minimum chlorophyll content, MDA, total soluble proteins, total sugars and MSI were recorded in the mutant (12 Gy) which was more susceptible at all the levels of salinity.

Dragon fruit

Drip irrigation requirement: In dragon fruit (variety Red), irrigation water requirement varied during different months in a year and the water requirement was maximum during March to May (2056 m^3 ha^{-1}). Irrigation at 100% evaporation replacement registered relatively better growth, canopy volume (27.7 m^3) and branching (126.3 cladodes per pillar) although there were no statistical differences. Scheduling irrigation at 40% ER yielded significantly more number of fruits (79.7 per pillar) and also resulted in higher fruit yield (44.67 t ha^{-1}). Rainfed condition resulted in 12.5% lower yield and relatively smaller fruit size (460 g) compared to irrigation at 40% ER (496 g) suggesting the need for moisture to get good marketable sized fruits. Further, scheduling irrigation at 40% ER also recorded higher water use efficiency (4.23 kg m^3) indicating it's practical utility under scarce water situations.

Field view of experimental plot and harvested produce

Crop load: At Bhubaneswar, significant increase in fruit size, pulp, and proportion of A grade fruit was observed with the reduction in number of fruits, whereas, TSS remained unaffected. A crop load of 2-3 fruits/flush is ideal for getting quality harvest of big sized fruits.

Propagation of fruit crops

Mangosteen: Different types of cuttings (softwood, semi hardwood and hard wood cuttings) and growth hormones were tried to assess the effects on sprouting and survival percent. Semi hardwood cuttings treated with coconut water showed maximum sprouting (40%) and higher survival per cent (53.3%) followed by semi hardwood cuttings treated with IBA 2000 ppm (46.7% and 33.3%, respectively). The sprout initiation was observed early in semi hardwood and hard wood cuttings and there was no sprouting in softwood cuttings.

Planting of mangosteen cuttings and successful plants

***Flacourtia enermis*:** For seed propagation, soaking seeds overnight in 500 ppm GA_3 solution resulted in higher germination (56%), followed by 2.5% KNO_3.

Manila tamarind (*Pithecellobium dulce*): For seed propagation, soaking seeds in 100 ppm GA_3 and 0.5% KNO_3 overnight resulted in germination of >90%.

Vegetative propagation: Soft wood grafting was attempted in Egg fruit (*Pouteria* sp,), Loquat, Malayan apple and Barbados cherry. The success rate varied from 20% in Malayan apple to 100% in wood apple.

Propagation through Semi Sterile Tissue Culture (SSTC) Technique

Papaya: Nodal cuttings were taken from seedlings raised in the nursery and were given root pulsing treatments in different concentrations of IBA. Among different combinations of root pulsing and potting media, IBA @ 250 ppm with sterilized Arka Fermented Cocopeat + Vermiculite+perlite (1:1:1) found effective in root induction. The success of about 81.33% could be achieved during the reporting period and the plants are ready for field transplanting.

Papaya plants raised through SSTC technique – Ready for field transplanting

Pummelo

Propagation by leaf and nodal cuttings: In pummelo variety Arka Anantha, 40% rooting was observed in leaves treated with 250 ppm IBA and transferring to AFC+Vermiculite+perlite (1:1:1) media in tissue cultured rack at room temperature after 45 days. In low poly tunnels, 60% rooting was observed at 250 ppm IBA in AFC+Vermiculite+Perlite media after 45 days. Rooted leaves are transferred and treated with different concentration of 6 BAP for shoot induction.

Induction of rooting from leaves of pummelo variety Arka Anantha

In case of single nodal explants of pummelo variety Arka Ananta were treated with 300 ppm IBA in AFC + Vermiculite + Perlite (1:1:1) media, 30% rooting was observed. Rooted cuttings are transferred for hardening.

Induction of rooting from single node cuttings of pummelo variety Arka Anantha

Jamun

Phenological stages of jamun using BBCH scale were identified for three varieties Dhupdhal, Konkan Bhadholi and Goma Priyanka for the second year. Highest flowering and fruit set percentage was observed in Konkan Bhadholi. High precipitation and low temperature led to increased vegetative growth that suppressed reproductive flush in the year 2023. In contrast during 2024, less precipitation during September- October months resulted in lesser vegetative growth. In both the years, the days taken for ripening was same for each varieties but the time of harvest advanced in 2023-24 due to higher temperature. Konkan Bahadhauli was early (75-84 days); while Dhupdal was late (95-105 days). Goma Priyanka took 90-95 days for harvesting from flower bud initiation.

Biochemical basis of flowering: Biochemical composition of both vegetative and reproductive buds of five jamun varieties *viz.*, Dhupdhal, Selection -45, Selction-58, Savadatti and AJG-85 were along with growth parameters. The results revealed that phenols (60.26 mg g^{-1}), protein (508.43 mg g^{-1}) and total sugars (5.05 mg $100g^{-1}$) were significantly higher in reproductive buds. Similarly phosphorous (0.0891%) and C/N ratio (60.14) were significantly higher in reproductive shoots. Carbohydrates (51.34 mg g^{-1}), chlorophyll (0.909 mg g^{-1}) and nitrogen content were significantly higher in vegetative shoots. Internodal length was maximum in reproductive shoots and shoot length and shoot thickness was maximum in vegetative shoots. Total sugar content shows that carbohydrates reserve that are essential for flowering, hydrolyzing of these carbohydrates into sugars at the flower bud formation is a crucial step for panicle development hence reserve of carbohydrates is less in reproductive buds than the vegetative buds. Higher phenolic content accumulation in reproductive buds and lower phenol content in vegetative buds has significant role in bud formation. Phenolic content has positive role in reproductive bud morphogenesis. High Phosphorous content and high C/N ratio in shoots helps to induce flowering.

Karonda

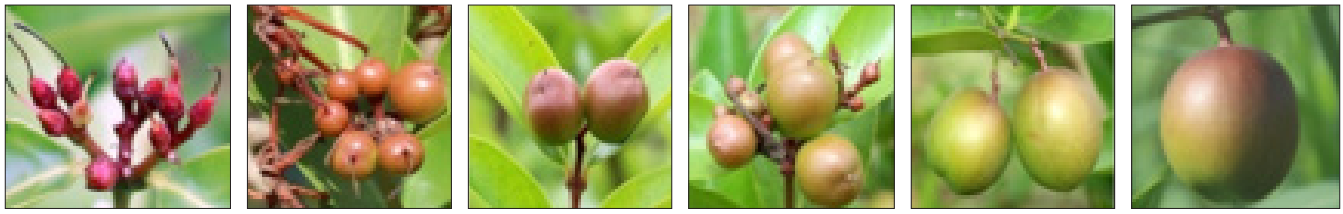
Phenological studies: Important phenological growth stages of Karonda (cv. Konkan Bold) occurring during an annual growth cycle were identified and described using a three-digits extended BBCH scale. A total of 38 secondary growth stages encompassing the 7 principal growth stages were identified and described as per the BBCH scale. The seven principal growth stages identified include three vegetative stages (bud, leaf and shoot development), two flowering stages (inflorescence emergence and flower development) and two fruiting stages (fruit development and maturity).

511 513 515 517 518 519

Principal growth stage 5: Inflorescence emergence

610 611 613 615 617 618 619

Principal growth stage 6: Flower Development



710 711 713 715 717 719

Principal growth stage 7: Fruit Development

810 811

815 819

Principal growth stage 8: Fruit Maturity

Inflorescence, flowering and fruit development stages of karonda according to BBCH Scale

Natural farming approaches in horticulture-based cropping system

Natural farming, modern farming and the organic farming are being assessed in three major fruit crops *viz*., mango (Arka Udaya and Raspuri), custard apple (Arka Sahan and Balanagar) and guava (Arka Poorna and Allahabad Safeda). In natural farming system, forage grass hybrid napier (BH-18), *Glyricidia*, *Sesbania*, Neem, *Pongamia*, *Cassia toria*, *Calotropis*, *Lantana*, Castor and *Hibiscus* are maintained as border crops. Mulching, Jeevamrita application and plant protection with herbal concoctions were practiced.

Natural farming model in fruit based cropping systems

Performance of main and intercrops: The canopy volume in main crops *viz*., mango and guava were found better in Modern Farming, while custard apple growth was better Organic Farming irrespective of the varieties. The growth and canopy volume were lower in Natural Farming than in other two systems. French bean and China aster were grown as an intercrop during *Kharif*, while tomato and marigold were grown as intercrops in *Rabi* season in all systems.

French bean: The pod yield in French bean in modern farming was significantly higher (7.82 t ha^{-1}) than in natural farming (4.29 t ha^{-1}). In China aster, the flower diameter (4.43 cm) was significantly higher in modern farming over natural farming (3.46 cm). Similarly, the flower yield was higher in modern farming (1.45 t ha^{-1}) as compared to natural farming (0.72 t ha^{-1}).

Tomato: Tomato yield was significantly higher in modern farming (109.9 t ha^{-1}) than in natural farming (30.1 t/ha). Natural farming recorded significantly higher TSS (5.62°Brix) and acidity (0.55%) over organic farming (3.71°Brix) and significantly higher vitamin C (27.8 mg 100 g^{-1} FW) over modern farming (11.5 mg 100 g^{-1} FW) although it was moderate in total carotenoids and lycopene contents. Significantly higher total carotenoids (9372 mg 100 g^{-1} FW) and lycopene content (8268 mg 100 g^{-1} FW) was observed in organic farming. The pooled data of two years revealed higher yield with modern farming with organic farming registering 70% and natural farming 20% of the yield level in modern farming. In tomato modern farming resulted in highest marketable yield (90%) followed by Natural Farming (81%) and organic farming (76%).

Comparison of single harvest yield

Comparison of single harvest yield

Comparison of second harvest of tomato yield in 50 m^2

Marigold: The marigold yield was significantly higher in modern farming (24.4 t ha^{-1}) than in natural farming (14.8 t ha^{-1}). There were no significant differences in total carotenoids and the lycopene among different systems. However, total carotenoids were marginally higher (25.53 mg 100 g^{-1} FW) in natural farming compared to modern farming (23.95 mg 100 g^{-1} FW). The pooled mean of two years indicated significant yield improvement from 6.0 t ha^{-1} in 2023 to 14.8 t ha^{-1} in 2024 in Natural Farming.

Comparison of one time harvest yield in marigold (50 m^2)

Economics of intercrops: The economic analysis of French bean production indicated that the cost of cultivation in Organic Farming was 14.5% higher over Modern Farming. In contrast, Natural Farming system recorded 40% and 47.5 % lower cost of production over Modern and Organic Farming systems, respectively leading to similar net returns (Rs.1,23,410 ha^{-1}) as that of Modern Farming (Rs. 1,25,120 ha^{-1}) with relatively higher benefit cost ratio (1: 2.1).

Soil fertility variations: In 2-yr period, Modern Farming (5.97) and Organic Farming (5.89) showed slight decrease in soil pH. The EC increased significantly in Modern Farming (0.58 dS m^{-1}). Organic Farming showed highest increase in organic carbon (1.15%). Modern Farming (51.1 kg ha^{-1}) and organic farming (54.1 kg ha^{-1}) significantly increased the soil test P, while Natural Farming (44.5 kg ha^{-1}) also showed an increase. Same trend was observed with soil test K. Organic Farming showed maximum counts of bacteria, fungi, and actinomycetes per gram of soil, followed by Natural Farming indicating a richer microbial environment compared to Modern Farming.

Pest and disease reaction: The impact of leaf curl disease in tomato was seen more in organic and natural farming systems without much effect on the yield. Infestation of South American Tomato moth, *Phthorimaea absoluta* on leaves (12.5%) and fruits (32.5%) was highest in Natural Farming. Least damage by the pest was observed in the Modern treatments, where insecticides were included.

Pesticide residues: The harvested produce was analyzed for pesticide residue both in tomato and marigold and it was observed that only modern farming resulted in pesticide residue while the produce from both the organic farming and the natural farming were residue free.

Vegetable crops

Water productivity and nutrient management:

Dolichos: In pole type dolichos bean (Arka Vistar), bi-weekly application of (fertilizer dose of 25:40:50 kg N:P_2O_5:K_2O ha^{-1}) through water soluble fertilizers resulted in significantly higher yield (46.68 t ha^{-1}) than other treatments except weekly application of same amount of fertilizers (46.12 t ha^{-1}),bi -weekly and weekly application of 75% dosage through water soluble fertilizers (44.19 and 45.65 t ha^{-1}). All the fertigation treatments recorded higher yields to the tune of 17.86 to 33.86% than the soil application of fertilizers (334.87 t ha^{-1}). The maximum fertilizer use efficiency recorded with bi-weekly application of 75% fertilizer dose through water soluble fertilizers (507.24 kg kg^{-1}), while soil application of nutrients recorded the minimum (290.58kg kg^{-1}).

In bush type dolichos bean (Arka Amogh), bi-weekly application of 100% fertilizer dose of N:P_2O_5:K_2O (25:40:50 kg ha^{-1}) through water soluble fertilizers recorded higher yield (30.85 t ha^{-1}) than other treatments followed by weekly application of same amount of water soluble fertilizers (29.45 t ha^{-1}). Application of 75% of the fertilizer dose through fertigation using water soluble fertilizers at weekly and bi-weekly intervals also produced higher yields (26.45 and 27.57 t ha^{-1}). All the fertigation treatments, where water soluble fertilizers or in combination with common fertilizers was applied recorded higher yields to the tune of 11.6 to 42.9% than the soil application of fertilizers (21.58 t ha^{-1}). The maximum fertilizer use efficiency recorded with bi-weekly application of 75 per cent fertilizer dose through water soluble fertilizers (306.3 kg kg^{-1}), while soil application of normal fertilizers recorded the minimum (179.8 kg kg^{-1}).

Pole bean: The experiment was conducted to study the effect of different doses of nutrients applied through fertigation and its effect of yield and shape of the pods. There was significant interaction effect between fertigation treatments and varieties. Application of nutrients @ 94:100:94 kg N:P_2O_5:K_2O ha^{-1} produced significantly higher yield (29.57 t/ha) than others except fertigation @ 75:100:75 kg N:P_2O_5:K_2O per ha (25% NPK as basal application +75% NPK fertigation) where the yield was 28.17 t ha^{-1}. Among the varieties, Moraleda recorded significantly higher yield (30.45 t ha^{-1}) than Arka Sukomal (24.30 t ha^{-1}) and Belli (21.90 t ha^{-1}). Combination of @ 94:100:94 kg N:P_2O_5:K_2O ha^{-1} and Moraleda recorded maximum yield of 33.41 t ha^{-1}.

Chilli: Application of nutrients @ 225:157:225 kg N:P_2O_5:K_2O ha^{-1} (25% basal + 75% fertigation) through water soluble fertilizers has resulted in significantly higher yield (35.75 t ha^{-1}) than other treatments. Among the varieties, Saanvi produced significantly higher yield (34.83 t ha^{-1}) than Tanvi and Gagan. Fertigation @ 135:112:135 kg N:P_2O_5:K_2O per ha (25% as basal + 75% fertigation) recorded the lowest yield of 28.9 t ha^{-1}.The interaction effect shows that application of nutrient dose of 225:187:225 kg N: P_2O_5: K_2O per hectare (25% basal and remaining 75% through fertigation) resulted in significantly higher yields in Arka Tanvi (33.92 t ha^{-1}), Arka Saanvi (40.37 t ha^{-1}) and Arka Gagan (32.98 t ha^{-1}) than other treatments.

Organic Farming

Cucumber: The integrated nutrient management treatment (FYM, chemical fertilizers and PP chemicals) recorded significantly higher yield (32.5 t ha^{-1}) than most of the treatments except organic treatment where 100% N of recommended dose was substitute with farm yard manure (30.6 t ha^{-1}), safe vegetable production methods (30.30) and 75% N of recommended dose was substitute with farm yard manure (29.6 t ha^{-1}). Application of FYM @ 25 t ha^{-1} resulted in minimum yield of 16.2 t ha^{-1} and inorganic nutrient application produced 21.2 t ha^{-1}.

Musk melon: The integrated nutrient management (FYM, chemical fertilizers and PP chemicals) treatment produced significantly higher yield (27.2 t ha^{-1}) among all the treatments except organic treatment where 100% N was substituted with farm yard manure (26.1 t ha^{-1}). Among other organic treatments, application of 75% and 50 % N through FYM recorded the yield of 22.9 and 22.0 t ha^{-1}, respectively. Application of only FYM @ 25.0 t ha^{-1}resulted in minimum yield of 18.2 t ha^{-1}.

Bottle Gourd

Identification of bottle gourd rootstock against GSB and *Fusarium* wilt: Under controlled condition, pinhole grafting method recorded highest average success rate in comparison to approach grafting. Among the six rootstocks, BG-114-3 showed the highest success rate (Cucumber: 70.83% and Watermelon: 83.33%).

Watermelon on bottle gourd

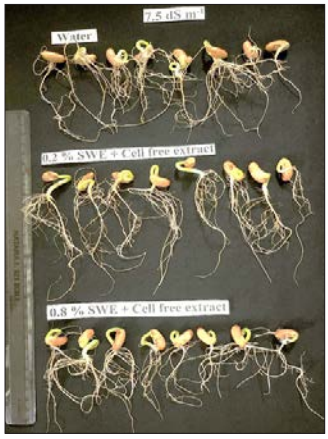
Cucumber on bottle gourd

Under field condition at 52DAT, rootstock BG-77-6-1 recorded the highest crop stand of 76.92% & PDI (Fusarium wilt) 18.67 in Cucumber and 80% & PDI 26.67 in bottle gourd (BG-24)

Cucumber on BG-77-6-1

Bio-stimulatory effect of *Streptomyces roseofulvus* and seaweed liquid extracts on seed germination of French bean and onion under salinity stress

Based on germination in French bean variety Arka Suvidha, bio-stimulatory effect of *Streptomyces roseofulvus* and seaweed liquid extracts were assessed under salinity stress. Lower sodium accumulation (Na/K 0.32) and electrolyte leakage (30.5%), higher root length (8.0 cm), hypocotyl length (2.7 cm) and fresh weight of seedlings (3.43 g) were recorded in french bean seeds soaked in 0.8 % seaweed extracts+ with cells culture at higher salinity level of 10.5 dS m^{-1}.



Seaweed extracts (0.2 and 0.8%) and *Streptomyces roseofulvus* (cellfree extract)

Seaweed extracts (0.2 and 0.8%) and *Streptomyces roseofulvus* (with cells culture)

Germination of french bean seeds soaked in biostimulants under salinity stress

In onion variety Arka Bheem, seeds soaked in 0.8 % seaweed extracts + cellfree extract recorded lower sodium/potassium ratio (1.4), sodium/calcium ratio (3.3), lower electrolyte leakage (45.8 %), significantly higher root length (1.37 cm) and hypocotyl length (2.85 cm) at higher salinity level of 10.5 dS m^{-1}.

Flower Crops

Rapid multiplication of quality planting material in vegetatively propagated flower crops

Tuberose: Rapid multiplication protocol of quality planting stock of tuberose var. Arka Prajwal from mother bulbs in four months was standardized. Sectioned mother bulbs weighing 40 to 50 g when planted on the substrate combination of Arka Fermented cocopeat + soil + FYM (1:1:1 v/v) along with the application of 150:75:125 kg ha^{-1} NPK (50 % RDF) produced 2.43 spindle-shaped bulbs per plant with bulb weight (31.83 g) and bulb diameter of 2.60 cm in a propagation cycle of four months. The root-knot nematode gall index was 1.15. In tuberose genotype IIHR-4, whole mother bulbs planted on substrate combination of Arka Fermented cocopeat + soil + FYM (1:1:1 v/v) along with the application of 225:112.5:187.5 kg ha^{-1} NPK (75% RDF) produced 3.04 spindle-shaped bulbs per plant with bulb diameter of 2.57 cm in a rapid propagation cycle of four months Root-knot nematode gall index was 1.03.

Gladiolus: Gladiolus corms undergo a 3-month dormancy phase post-harvest. Freshly harvested gladiolus corms were treated with plant growth regulators to shorten the dormancy and achieve rapid multiplication cycles. Freshly harvested corms of Arka Amar soaked for 24 hours in 150 ppm Benzyl Adenine, resulted in 68.6% higher production of planting stock over control. Treated corms sprouted in 48.0 days and produced 4.25 corms/plant. The propagation coefficient was 171.9%. Freshly harvested corms of Arka Ayush soaked for 24 hours in 150 ppm Salicylic acid, resulted in 28.8% higher production of planting stock over control. Corms sprouted in 41.05 days and produced 3.35 corms/plant. The propagation coefficient was 187.7%.

Cormels of gladiolus undergo a dormancy phase of 6 months and cannot be used as planting stock during the subsequent season. In an attempt to reduce the dormancy phase and produce planting stock from cormels, freshly harvested cormels of gladiolus vars. Arka Amar and Arka Ayush with and without the tunic, were soaked for 24 hours in various concentrations of plant growth regulators. Freshly harvested cormels of Arka Amar with tunic soaked in 150 ppm BA produced the maximum number of corms per cormel (1.29 of 2.52 cm diameter). The sprouting time for cormels was 56.3 days.Soaking cormels of Arka Ayush without tunic in 50 ppm BA, resulted in the production of the maximum number of corms per cormel (1.13 of 2.23 cm diameter). Days taken for sprouting of cormels was 45.8.

Rose: Natal Briar as rootstock recorded superior bud survival of 72.7% compared to *Rosa multiflora*. Among scion varieties, Arka Savi performed better in bud survival and sprout length, whereas Arka Swadesh exhibited earlier sprouting. Cuttings of rootstock and the scion from the mother plants receiving 400:200:200 kg $N:P_2O_5:K_2O$ ha^{-1} yr^{-1} performed better registering

excellent results across multiple metrics. In budded plants with Natal Briar as the rootstock and Arka Swadesh as scion, spraying 150 ppm Kinetin resulted in highest bud sprout (79.0%), earliest sprouting (17.1 days), maximum length (5.42 cm), girth (4.43 mm) and number of leaves (12.22).

Crossandra: Terminal cuttings of crossandra var. Arka Chenna from the mother plant block with nutrient dose of 120:80:240 kg $N:P_2O_5:K_2O$ ha^{-1} yr^{-1} + 25 t FYM ha^{-1} + AMC @ 12.5 kg ha^{-1} (NK application in six split doses to the substrate at bimonthly intervals) recorded maximum rooting (88.28%), number of sprouts per cutting (4.26), number of leaves per cutting (10.36), root length (5.97 cm), and root spread (3.11 cm). Terminal cuttings of crossandra var. Arka Chenna from the mother plants at a spacing of 45 x 45 cm and with single pinching resulted in the highest survival rate of cuttings (93.75%), number of sprouts/cutting (4.26), number of leaves/cutting (4.26), longest root (6.05 cm) and root spread (4.58 cm).

Vertical farming of orchids

Potting medium and container type were evaluated for vertical farming of *Dendrobium* orchid. *Dendrobium* cv. Emma White grown on charcoal medium in netted pots on vertical structures, recorded the maximum number of spikes/ plant (2.78), spike length (48.49cm), number of florets (7.70), floret width (6.24 cm) and floret length (5.23 cm). Optimum planting geometry and planting density for *Dendrobium* cv. Emma White on vertigrow structures was quincunx system of planting with a spacing of 30 x 30 cm, which produced the maximum number of spikes/ plant (2.82), spike length (44.70 cm), number of florets (7.99), floret width (6.06 cm), floret length (5.70 cm).

Suitability of chrysanthemum varieties for protected condition

Significantly better flower quality parameters were observed in the photoperiodic module consisting of long days (16 h light,8 h dark) followed by short days (8 h light16 h dark) up to flower bud initiation across different varieties of cut chrysanthemum. The variety Arctic Queen registered maximum flower diameter followed by IIHR 5-14. Number of branches were significantly higher in IIHR 5-14 and IIHR 9-9. Bud diameter, stalk girth, no. of flowers per plant and fresh weight of flower bunch was maximum in IIHR 5 -14 followed by IIHR 9-9.

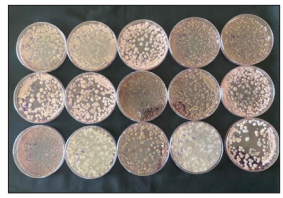
Growth and yield characteristics of African Marigold in different hydroponic systems: Performance of four different varieties of African Marigold (*Tagetes erecta) viz*., Arka Bhanu, Arka Abhi, Siri and Bhairavi was evaluated in two hydroponic systems Deep Flow Technique (DFT) - A type, and Linear NFT (Nutrient Film Technique) – Linear/ Flatbed system in comparison with conventional soil-based cultivation. Higher growth rate and yield of marigold was observed in Linear NFT system. The evaluated hydroponic systems performed better than the soil-based systems and evolved as the most water-efficient cultivation technique.

Evaluation of floral-waste based composts for microbial parameters

The microbial load of composts prepared using different wastes revealed that the flower waste with agricultural waste has a comparatively higher number of fungal colonies (21.35*105 CFU/g), whereas, highest number of bacterial colonies (25.4*109 CFU/g) was recorded in temple waste treated with 2.5 kg/t of Arka Decomposer. Significantly high number of *Pseudomonas fluorescens* (129*106 CFU/g) was found in temple waste. Flower waste treated with 2.5 kg of Arka decomposer per tonne of waste (34.8*106 CFU/g) recorded higher count of nitrogen fixing bacteria.

Arka Decomposer and microbial dynamics in floral-waste based compost starter bricks

The initial microbial analysis of the floral-waste based compost starter bricks revealed fungi as the predominant microorganism, with bacteria and actinomycetes being almost negligible or absent in all treatment groups. Fungal populations showed varied responses to different concentrations of Arka Decomposer over a 60-day observation period. Higher concentration of Arka Decomposer (0.9%) inhibited the fungal growth or altered the microbial dynamics unfavorably for fungi. This pattern highlights the importance of optimizing decomposer concentrations for effective microbial activity in composting processes.



Effect of salinity and alkalinity on flower yield of different varieties budded on different rootstocks

Number of flowers per plant decreased from 69 to 53 in Arka Parimala, 53 to 44 in Arka Savi, 50 to 33 in Arka Sukanya on *R. multiflora* with increase in salinity increased from control to 7.5 dSm^{-1}. In alkalinity condition, reduction in number of flowers in Arka Parimala, Arka Savi and Arka Sukanya was 55%, 48% and 62%, respectively). The reduction in flower number on *R. indica* was 54 % in Arka Parimala, 32% in Arka Savi and 52% in Arka Sukanya under saline conditions. Under alkaline condition, it was 72, 70 and 69%, respectively. Number of flowers was lowest in all the varieties when budded on Natal Briar.

Identification of micronutrient related constraints in flower crops: Survey work was carried out in Challakere region of Chitradurga district to identify micronutrients related constraints and to assess micronutrient management practices adopted by farmers in major flower crops of the region China Aster, Chrysanthemums, Marigold and Tuberose. Soil pH is near to alkaline in 50% of samples, potassium and iron were found to be below optimum levels in 50% of samples and low organic carbon in 25% of samples. Soil nutrient imbalances and high pH were identified as reasons that hinder micronutrient absorption in flower crops. Irrigation water quality analysed from same fields showed high salt content and unsafe levels of residual sodium carbonate.

Standardization of micronutrient foliar formulations: Field efficacy trials to standardize the dose and frequency of application of micronutrient foliar formulations (one control and 4 formulations) were continued in China aster (Arka Kamini) and chrysanthemum (Cent Yellow). For China aster and chrysanthemum, optimum dose was found to be 2.5 g per litre and three to five sprays at fortnightly intervals. In gladiolus (Arka Ayush), optimum dose was 4 g of micronutrient formulation per litre at fortnightly interval of sprays.

Medicinal crops

Evaluation of field and soilless cultivation of *Piper longum* and *Uraria picta* (Prishnaparni)

In *Piper longum*, higher number of branches (25.93), fruiting branches (3) and dry root yield (28.33 g $plant^{-1}$) were observed in organic treatment with 10% Kunapajala. Higher piperine content (2.7%) was noticed in RDF through 50% FYM and 50% Vermicompost at 240 DAP. It is comparable to RDF with root yield of 17.33 g and piperine content of 2.4%. In soilless cultivation in polyhouse, higher number of branches (8.2), number of fruiting branches (1.2) recorded in AFC:Vermicompost:Compost substrate and Sasya Poshakras @ 5 ml per litre, whereas higher number of leaves (145.6) and dry root yield (22.24 g $plant^{-1}$) was recorded in AFC:Vermicompost substrate with Sasya Poshakras @ 5 ml per litre.

***Piper longum* in field** ***Piper longum* in soilless cultivation**

Soil health management

Fruit crops

INM in Coorg mandarin: Among treatment combinations such as Coorg mandarin seedlings and grafted plants as one factor, cover cropping as second factor and nutrients, grafted plants performed better than the seedling plants and integrated and balanced supply of nutrients (20 kg FYM+ RDF + soil application of Mg, S, Zn, and bio-fertilizers (AMC and VAM) + Foliar application of Citrus Special+ Green manuring (Sunhemp)] significantly improved plant growth parameters, fruit number, fruit weight, juice volume and fruit yield compared to other treatments. Total soluble solids increased, while the acidity and vitamin C decreased in this treatment.

Coorg mandarin with sunhemp as green manure crop and cowpea as cover crop

Effect of micronutrient spray on yield and quality parameters of Coorg mandarin: Micronutrient spray on 4-yr old Coorg mandarin indicated that application of Citrus Special and Zn and Mg Sulfate at bimonthly interval resulted in significantly higher yield and number of fruits than control, monthly and quarterly applications. There was no significant difference in respect to fruit weight among different frequencies of application. Juice volume was more in Zn and Mg Sulfate in bimonthly and quarterly treatments followed by Citrus Special treatments.

Avocado

Delineation of sufficiency levels of NPK: Sand culture experiments for a period of four months were conducted to delineate N, P and K for avocado var. Arka Supreme using Hoagland Solution (0.5 C). Hoagland solution (200 mL) was applied in alternate days. Based on growth response in terms of plant height, number of leaves, root length, root volume and dry matter yield, the sufficiency level was was 200 ppm of N, 15 ppm of P and 150 ppm of K in soil solution for avocado.

Assessment of NPK requirement in field condition: In 3-yr old avocado (var. Arka Supreme), there was significant improvement in fruit number due to application of 400:300:800 g $N:P_2O_5:K_2O$ per plant + 20 kg FYM followed by 400:300:400 g $N:P_2O_5:K_2O$ per plant. There was variation in plant growth parameters among treatments.

Vegetable crops

Screening for moisture deficit tolerance in tomato: A RIL population of 113 from a cross between parents 3125A (sensitive) and RF4A (tolerant), was screened for moisture deficit tolerance using 18% PEG8000. Tolerant and sensitive RIL genotypes identified from the *in vitro* PEG experiment were selected for pot experiments. Tolerant genotypes exhibited lower percent reduction of shoot biomass, root biomass, photosynthetic rate, and fruit weight when compared to control under water stress. The tolerant genotypes also had better water use efficiency and relatively moderate increase in canopy temperature. The sensitive RILS B9 and K2 had performed poorer in all these aspects. There was significant increase in peroxidase, superoxide dismutase, malondialdehyde, proline, phenols and flavonoids under moisture deficit stress in tolerant genotypes. The RIL population was also subjected to a priming experiment where the RILs and the parents were subjected to a lower concentration of PEG-8000 (10%) for 24h post which, they were subjected to 18% PEG.

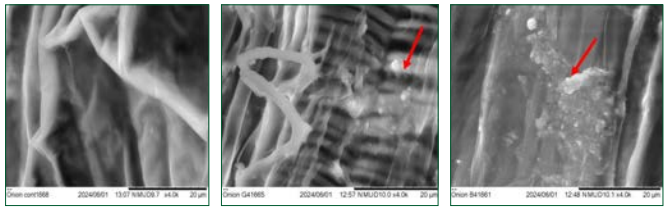
Effective cropping system in velvet bean incorporated soil: Among tomato + French bean, chilli + pea and okra + *Dolichos* bean cropping systems, tomato + French bean emerged as the most profitable and sustainable option with soil incorporation of mucuna.

Optimizing bio-enriched organic manure and fertilizer use in okra and French bean: Application of 2 t ha^{-1} of bio-enriched organic manure along with 80% recommended fertilizer dose resulted in maximum yield (47.6 fruits $plant^{-1}$ and 27.9 t ha^{-1}) in okra hybrid Arka Nikita and French bean var. Arka Komal (36.6 pods $plant^{-1}$ and fruit yield 20.9 t ha^{-1}). Leaf nutrient content was also higher in the same treatment in Arka Nikita.

Okra and French bean cropping system

Field evaluation of selected strain for water deficit stress management in onion: Plants were treated with a B4 strain and maintained at different field capacities (100%, 60%, and 40%). In B4 strain treated plants, about 10.2% yield increase was observed at 60% FC.

Colonizing ability of bioagent in onion: Colonizing ability was studied by inoculation, followed by assessment of microscopic images. Electron microscopic images indicate heavy colonization of B4 and G4 strains in onion roots.



Control G4 strain B4 strain

Colonization of bioagents in onion

Determination of the shelf life of methylobacterial formulations: Four experimental consortia of eight promising methylotrophic bacterial isolates formulated in Methanol Mineral Salts (MMS) medium were stored in the presence of two levels of glycerol viz., 5 and 10 %, under ambient conditions. After twelve months of storage at ambient condition, it was observed that use of 10% glycerol (v/v) as a cell protectant sustained higher cell populations across the consortia formulations compared to 5%.

Volatile organic compounds and traits of methylobacterial isolates: The profiling of Volatile Organic Compounds **(**VOC's) produced by eight elite methylobacterial isolates and putative functions of dominant VOC's were detected. Except *Bacillus sp.* 49 and *Pseudomonas sp.* 25 all the isolates formed biofilms on Congo Red Agar. Highest production of exopolysaccharide was observed in the isolate *Bacillus* sp. M9. Biosurfactant production was observed in isolate *Bacillus* sp. M9 (21.34 µg mL^{-1}) by both blue agar and drop collapse assay. All the eight isolates produced siderophores. The isolate *Bacillus* sp. 36 was found to be most promising for siderophore production.

Mycorrhiza and Mycorrhiza Helper Bacteria from extreme environment: Mycorrhiza spores isolated from rhizosphere samples from harsh environment belonged to *Glomus, Aculospora, Scutelospora and Gigaspora* genera. Five isolates increased biomass and showed root colonization up to 90 -100% in finger millet. Potential 20 mycorrhizal isolates based on production of infective propagules and 28 Mycorrhiza Helper Bacterial (MHB) isolates based on nutrient solubilisation were identified. Phosphate solubilisation index of the MHB isolates ranged from 2.71 to 8.16, two isolates recorded highest solubilisation potential of 180 µg ml^{-1} medium. About 18 isolates solubilized zinc phosphate, 12 isolates solubilized zinc oxide, 13 isolates solubilized zinc carbonate and 9 isolates solubilized all zinc sources. Mass production and spore extraction of mycorrhiza from the cocopeat substrate was standardized.

Preparation of nano-P fabrication by green synthesis: Nanoscale-Phosphorus was successfully synthesized using extracts from banana and stevia leaf. Recovery of nano-P by methanolic extract (79.8%) was high as compared to water extract (75.8%). Phosphorus nanoparticles obtained from water extract of stevia and banana leaves showed particle size of 79.4 nm and 72.1 nm, respectively. Size of Nano-P synthesized from methanol extract of stevia (70.1 nm) and banana leaf (61.4 nm) was lesser than from water extract.

Nanofiber based multi-nutrient sachet using electrospun nanofiber mat: Nanofiber developed by electro spinning was encapsulated with micronutrients (Zn, Fe and B) and nanofiber based multi-nutrient sachet was developed. These sachets provide more controlled release of the material, with a high influence in the diffusion and degradation mechanisms of the polymer, as well as its hydrophobicity. Nutrient loading efficiency was 89-93% in Zn, whereas in Iron the loading efficiency was 71 to 88%.

Pesticide residue analysis

Banana: The residue and persistence study of Betacyfluthrin and Imidacloprid in banana whole fruits, and banana pulp was studied following the application of Betacyfluthrin (90 g/L) and Imidacloprid (210 g/L) OD as a foliar spray on banana plants. Imidacloprid residues dissipated with half-life values of 20.28 days at the recommended dose and 21.93 days at 1.25 times the recommended dose. For Betacyfluthrin, the half-life values were 16.75 and 13.60 days respectively.

Grape berries: The residue and persistence study of fosetyl-Al and its metabolite (phosphonic acid) in grape berries was studied following the application of fosetyl-Al 80% WP as a foliar spray on grape vines. The residues of fosetyl-Al and Phosphonic acid dissipated with half-life values of 7.57 days at the recommended dose and 7.61 days at 1.25 times the recommended dose, 6.78 days and 7.61days, respectively. The residue and persistence study of Trifloxystrobin and its metabolite in grape berries was conducted following the application of Trifloxystrobin 500 g/L SC as a foliar spray on grape vines. The residues of Trifloxystrobin dissipated with half-life values of 10.9 days at the recommended dose and 7.2 days at 1.25 times the recommended dose. In

a similar study, the residues of Fluopyram were found dissipated with half-life values of 8.68 days at the recommended dose and 11.53 days at 1.25 times the recommended dose and for difenoconazole, the half-life values were 7.51 and 8.99 days, respectively.

Pomegranate fruits: In the study on Glyphosate and its metabolite, Aminomethyl phosphonic acid (AMPA) in immature pomegranate fruits, mature pomegranate fruits, edible aril and juice, the half-life of glyphosate residues were found below limit of quantification (LOQ) from the 0-day in both the doses. In residue and persistence study on Isotianil, its metabolite (DCIT acid), fosetyl-Al, and its metabolite (phosphonic acid) in pomegranate fruits, the residues of Isotianil were found dissipated with half-life values of 6.07 days at recommended dose and 13.51 days at 1.25 times the recommended dose. For fosetyl-Al, the half-life values were 0.61 and 0.58 days, respectively.

The evaluation of Chlorantraniliprole and Abamectin in pomegranate whole fruit, seeds, juice was conducted following the foliar spray application of Chlorantraniliprole 4.3% w/w + Abamectin 1.7% w/w SC. The residues of Abamectin dissipated with half-life values of 3.72 days at the recommended dose and 3.23 days at 1.25 times the recommended dose and that of chlorantraniliprole were 4.83 and 5.43 days, respectively. In a similar study on Spirotetramat and its metabolites, the residues of Spirotetramat dissipated with half-life values of 2.87 days at the recommended dose and 8.65 days at 1.25 times the recommended dose.

The residue and persistence study of Betacyfluthrin, Imidacloprid, and the total residue of Imidacloprid in immature pomegranate fruits, mature pomegranate fruits, edible aril, and juice was conducted following the application of Betacyfluthrin 90 g/L and Imidacloprid 210 g/L OD as a foliar spray on pomegranate trees. Imidacloprid residues were dissipated with half-life values of 27.27 days at the recommended dose and 28.37 days at 1.25 times the recommended dose. For Betacyfluthrin, the half-life values were 8.53 and 9.24 days, respectively.

Cucumber: The residues of Fluopyram dissipated in cucumber with half-life values of 2.20 days at the recommended dose and 2.88 days at 1.25 times the recommended dose. For Tebuconazole, the half-life values were 1.97 and 0.98 days, respectively.

Pesticide decontamination from Milli-Q and lake-water: A total of 88 pesticides were tested and pesticides remediation was 30-100 % at 0.01, 0.05, 0.1, 0.5, and 1 ppm concentration levels

Heavy metal decontamination from Milli-Q and lake-water: A decontamination study of Pb, Cd, Hg and As were carried out in the lake water using the adsorbents, RSBC, Cu-BTC@BC, MWCNT@Cu-BTC, and ZIF-8@BC. The results suggested ZIF-8@BC held the best potential for the removal of the afore-mentioned heavy metals (61-94%).

Pesticide dynamics during processing of *Brahmi* (*Bacopa monnieri*) and basil (*Ocimum basilicum*): An analytical method was developed for 79 pesticides in dried *B. monnieri* and *O. basilicum* with recovery of acceptable range following SANTE guideline. The fresh *Brahmi* samples collected from farmers' field were processed to dry powder and analysed by validated method. The Processing Factors, which are required to fix MRLs, were evaluated for fenobucarb, pyridalyl, triazophos, carbofuran, chlorpyriphos, cyhalothrin, and cypermethrin. The commercial samples of *Brahmi* powder were found contaminated with high concentration of synthetic pyrethroid insecticides like cypermethrin, deltamethrin and cyfluthrin. The dry powder of Ocimum was prepared from pesticide-contaminated fresh samples. After analysis, Processing Factors were evaluated for chlorpyrifos, cyfluthrin, imidacloprid, fluopyram, tebuconazole, and fenazaquine. Out of five market samples, two were found contaminated with cyhalothrin and fenvalerate.

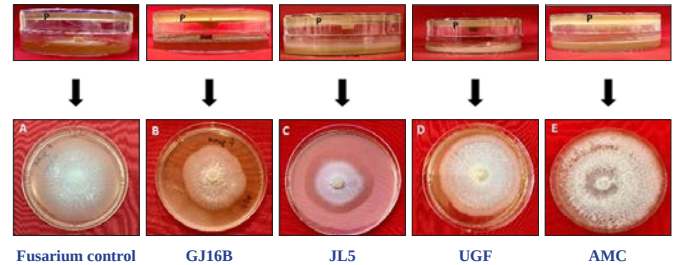
3.4. CROP PROTECTION

3.4.1. Diseases

Fruit Crops

Guava

Interaction of *Fusarium oxysporum* (guava wilt) with bioagents: Double plate assay was conducted to investigate the interaction between guava wilt pathogen *Fusarium oxysporum* f. sp. *psidii* and beneficial microbial inoculants like Arka Microbial Consortium (AMC), *Bacillus* sp. (UGF), and *Trichoderma* sp. (GJ16B and JL5). The antagonistic effects were recorded in terms of per cent inhibition of mycelial growth of *Fusarium oxysporum*. Among beneficial microbes tested, GJ16B and JL-5 were found most effective in inhibiting *Fusarium* with inhibition of 36.1 and 40.8%, respectively. AMC was found to be less effective with an inhibition of 0.78%.



Double Plate assay of *Fusarium oxysporum* f. sp. *psidii* against beneficial microbial inoculants

Postharvest disease management in grapes

Inhibition of growth of post-harvest pathogens by palmitic acid: Dilkush variety of grape bunches were exposed to different concentrations of palmitic acid (VOC), metabolites of bacteria and yeast immediately after harvest and kept at 20^0C in the cold chamber. It was observed that palmitic acid at higher concentration was favourable in extending the shelf life of grapes. The minimum shelf life of 7 days was observed in the control postharvest pathogens inoculated and uninoculated grapes and also in grapes exposed to different concentration of palmitic acid. The bunches retained marketable quality up to 12 days in case of grapes exposed to 20 and 10% palmitic acid. However, grapes exposed to 5% of palmitic acid or metabolites of IIHR_MIFY01 and IIHR_GSPB02 were having marketable quality only up to 10 days. The fruit quality parameters such as total and reducing sugars (TSS), berry colour, firmness, ascorbic acid and titratable acidity were also maintained potentially by VOC even in the presence of postharvest pathogens. The storage test showed that biofumigation had no negative effects on fruit quality and extended the shelf life of fruits.

Growth inhibition of post-harvest pathogens due to different treatments in grapes

Treatments	*A. alternata*	*C. gloeosporioides*	*P. citrinum*	Mean growth inhibition category
1% Palmitic acid	2	2	3	2.33
5% Palmitic acid	2	2	4	2.67
10% Palmitic acid	3	3	4	3.33
20% Palmitic acid	3	3	4	3.33
99% Alcohol	1	1	2	1.33
95% Alcohol	1	1	1	1.00
90% Alcohol	1	1	1	1.00
80% Alcohol	1	1	1	1.00
IIHR_GSPB02 -Metabolite	2	2	4	2.67
IIHR_MIFY01-Metaboilte	2	2	3	2.33

Values were categorized on a scale from 0 to 4, where 0 = No growth inhibition; 1=1 to 25%; 2 = 26 to 50 %; 3 = 51 to 75 % and 4 =76 to 100%

Effect of pre-harvest of spray of bioagents for VOC production on post-harvest decay: Dilkush, Bangalore Blue and Fantasy were included in the experiment. *Hanseniospora opuntiae (*MY) and *Bacillus amyloliquefaciens* (Gol-2) were identified as potential epiphytes isolated from mango and grape fruit surfaces that produced VOCs and found effective against grapes pathogens. Two sprays of these isolates at 1 x 10^8 CFU ml^{-1} were given at weekly intervals before harvest. The shattering of berries, cracking of fruits and browning/ rotting were recorded on 3, 6 and 9 days. Berry shattering was high in Bangalore Blue (30-43%). *H. opuntiae* and *B. amyloliquefaciens* were effective in Dilkush up to 9 days, but not effective in Bangalore Blue.

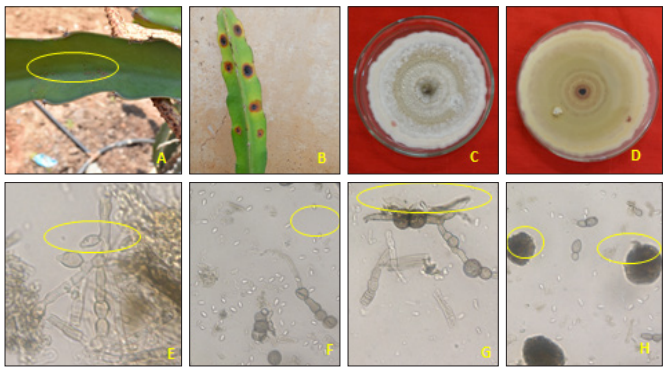
Effect of pre-harvest spray of bioagents identified for VOC production on post-harvest decay in grapes

Bioagent	Shattered berries (%)	Cracked berries (%)	Brown/ rot berries (%)
Dilkush			
PRE-9	3.45	0.43	0.87
GOL-2	2.25	0.00	1.69
MY	5.65	1.88	1.88
Control	**29.63**	1.28	16.72
Bangalore Blue			
PRE-9	30.22	0.00	1.33

GOL-2	49.69	0.00	1.84
MY	31.15	0.00	0.00
Control	43.04	0.00	0.21
Fantasy			
PRE-9	6.70	5.51	13.55
GOL-2	0.00	6.52	11.41
MY	3.87	8.38	13.55
Control	4.55	10.91	18.19

Dragon fruit

Etiology of stem spot: During flowering and fruit initiation, white-fleshed dragon fruit plants exhibited reddish-black stem spots caused by *Epicoccum sorghinum* (ESH14 isolate), identified through pathological, morphological, and molecular analyses. Pathogenicity trials on red- and white-fleshed varieties confirmed the virulence of fungus, with significant lesions forming within five days and yellowing by 7th day after inoculation with a 10^5 conidia per ml spore suspension. Koch's postulates were satisfied through re-isolation of the pathogen. Molecular identification via ITS, β-Tubulin, and Actin gene sequencing revealed 99–100% similarity to known *E. sorghinum* sequences in GenBank, supported by phylogenetic analysis. The findings confirmed the close genetic relationship of ESH14 with *E. sorghinum*



Dragon fruit stem exhibiting brown spot symptoms in field (A) and symptoms under artificial inoculation (B), colony morphology (C, D), mycelial and conidial morphology of the fungus *Epicoccum sorghinum* (E), conidia (F), chlamydospores (G) and pycnidia (H) @40X

Molecular characterization of pathogens involved in avocado wilt: Based on multigene characterization (ITS, beta-tubulin and COX1) four species *Phytophthora* and other oomycetes pathogens like *Phytopythium vexans* (7 isolates) and two isolates of *Phytopythium chaemehyphon* were identified. *P. cinnamomi* is highly dominating organism, followed by *Phytopythium vexans*. *Lasiodiplodia* species have been associated with severe symptoms of stem canker and dieback. Concatenated analysis of the ITS, tef-1α, and β-tub genes identified ten isolates of *Lasiodiplodia pseudotheobromae*, two isolates of *Lasiodiplodia brasiliensis*, and two isolates of *Lasiodiplodia iraniensis* (syn: L. iranensis). Further pathogenicity tests confirmed that these *Lasiodiplodia* isolates could induce disease in various plant parts of avocado.

Vegetable crops

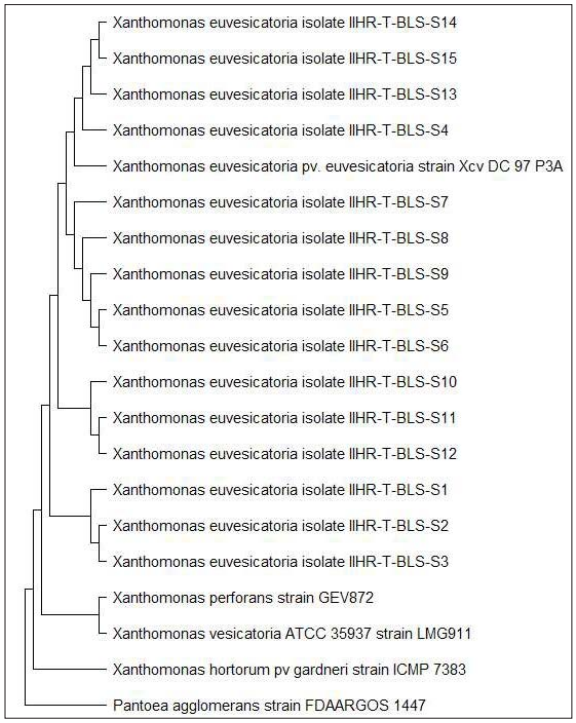
Tomato

Characterization of *Xanthomonas* species causing bacterial leaf spot: Bacterial leaf spot (BLS) remains as one of the major threats to tomato production, primarily caused by diverse *Xanthomonas* species. Bacterial spot of tomato is reported to be caused by *Xanthomonas vesicatoria*, *Xanthomonas euvesicatoria*, *Xanthomonas gardneri*, and *Xanthomonas perforans*. Understanding the prevailing population dynamics and genetic diversity of *Xanthomonas* species causing bacterial leaf spot of tomato is crucial for quarantine purpose and effective disease management.

Bacterial spot of tomato on leaves and fruits

Totally 15 isolates have been taken for study. Among the species-specific markers employed the marker Bs-XeF and Bs-XeR could give amplification in all 15 isolates, while Bs-XvF and Bs-XvRBs-XpF and Bs-XpR could not give amplification for any of the isolates confirming all isolates belonged to *X. euvesicatoria*. Multi Locus Sequence Assay (MLSA) has been performed using four genes *viz.*, gyrB, gap1, glt1and lepA to study the

genetic diversity among *Xanthomonas* species. *Pantoea agglomerans* strain FDAARGOS 1447 was taken as outgroup, with respective reference genomes of all four *Xanthomonas* species from the NCBI database. All the isolates clustered based on where they were isolated, suggesting geographical factors play a role in their evolution. The "gltA" gene was very similar across all isolates, even those from different species like *X. euvesicatoria* and *X. perforans*, "gap1" gene was also similar across most isolates. However, the "gyrB" and "lepA" genes showed more variation, making them better markers for distinguishing within-species differences.



MLSA analysis of four housekeeping gene sequences (gyrB, gap1, glt1and lepA) 15 *Xanthomonas* isolates from tomato compared with reference genomes of *X. euvesicatoria* - Xcv DC 97 P3A, *X. vesicatoria* - ATCC 35937 strain LMG911, *X. gardneri* - strain ICMP 7383 and *X. perforans* - strain GEV872 from the NCBI database).

Diagnosis and management of emerging viruses: Roving survey was conducted during 2023-24 for collection of viral infected tomato samples from Karnataka, Tamil Nadu and Telangana. The incidence of mosaic and mottling and leaf curl disease (percentage of plants with symptoms) was recorded in each field (425 fields) visually by counting the number of symptomatic over asymptomatic plants by randomly selecting 10 m x 10 m plots at each location. Total 447 samples showing various kinds of symptoms include mosaic and mottling and leaf curl were collected.

Incidence of viruses in tomato

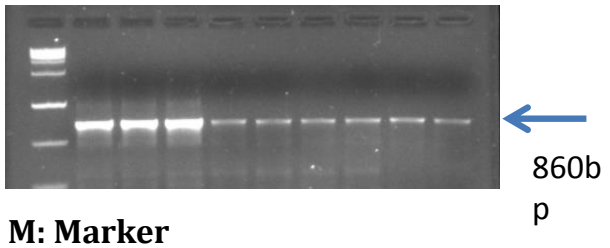
State	No. of Field surveyed in each location	Stage of the crop	Disease incidence			
			Leaf curl On leaves	Tospovirus On leaves	Mosaic Complex	Fruit Bloch symptoms
Karnataka	339	Reproductive	35 to 95 %	2 to 10 %	10 to 15	75% to 95
Tamil Nadu	4 0	Reproductive	80 to 95 %	10-12%	2 to 10 %	75% to 85%
Telangana	46		50 to 60%	9 to 15%	2 to 4%	30 to 55%

Detection of virus association with tomato plants by DAC-ELISA: To know the status of viruses associated with mosaic disease of tomato, the infected samples collected from the three states were subjected to Direct Antigen Coating Assay (DAC-ELISA). Polyclonal antisera of chilli veinal mottle virus (ChiVMV), cucumber mosaic virus (CMV), tobacco mosaic virus (TMV), tomato mosaic virus (ToMV), tomato mottle mosaic virus (ToMMV), tomato brown rugose fruit virus (ToBRFV), and groundnut bud necrosis virus (GBNV) (DMSZ, Germany), as well as PCR using begomoviral-specific primers. The ELISA and PCR results showed that in Tamil Nadu, 27% of samples were infected with begomoviruses, followed by cucumoviruses (17%) and potyviruses (10%), with tobamo viruses being the least common. In Telangana, 24% of samples were infected with begomo viruses, followed by mixed infections of cucumoviruses and potyviruses (17%), and tobamoviruses (11%). Similarly, in Karnataka, 29% of samples were infected with begomoviruses, followed by mixed infections of cucumoviruses and potyviruses (18%), with tobamoviruses being the least common. Furthermore, mixed infections of DNA and RNA viruses were detected in tomato samples collected from different locations in Karnataka, Telangana, and Tamil Nadu.

PCR and RT-PCR detection of different viruses: Total genomic DNA of 303 tomato leaf curl samples was isolated by following modified protocol of CTAB method. Similarly total RNAs was extracted from 144 field collected samples by RNeasy Plant Mini kit (Qiagen, Valencia, CA). For DNA viruses, PCR amplification was performed using different primers specific to CP gene of different viruses. The resulted PCR amplicon of 770 bp sequencing is under progress. Similarly for RNA viruses, PCR amplification was performed using different primers specific to CP gene. The amplified PCR products of ChiVMV (860bp) were sequenced by automated DNA sequencer ABI PRISM 3730 (Applied Biosystems).

PCR and RT-PCR detection of different viruses infecting tomato

State	Districts	DNA	PCR	RNA	RT-PCR			
			BGV		ChiVMV	CMV	Tobmo	-Ve
Karnataka	Kolar	84	+	11	5	6	-	
	Mandya	21	+	20	4	4	2	10
	Mysuru	20	+	22	6	3	3	12
	Chikkaballapur	48	+	10	4	3	3	-
	Bangaluru rural	35	+	11	4	4	3	-
	Hassan	25	+	21	8	8	4	-
Tamil Nadu	Hosur	8	+	7	2	3	3	-
	Salem	20	+	8	4	2	2	-
Telangana	Hyderabad	7	+	6	3	2	1	-
	Warangal (R)	8	+	4	1	1	-	-
	Sangareddy	9	+	6	2	2	2	-
	Siddipet	10	+	10	3	5	2	-
	Vikarabad	8	+	8	2	4	2	-
		303		144	48	47	27	-



M: Marker
Lane 1,2, 3 Tomato, Datura and tobacco positive plants
Lane 4 Mysore
Lane 5 Mandya
Lane 6 Hassan
Lane 7 Kolar
Lane 8 Salem
Lane 9 BLR

PCR amplification of ChiVMV infected tomato samples

Phylogentic analysis of CP gene of ChiVMV infected with tomato: Maximum Likelihood method phylogenetic analysis of ChiVMV tomato isolate, with earlier reported ChiVMV isolates, CP gene sequences from India and other parts of the world showed genetically distinct from other isolates. The phylogenetic tree divides isolates into two different groups. The first clade containing five isolates from Karnataka and second clade contain one isolate from Tamil Nadu along with ChiVMV infecting diverse crops form different countries.

Integrated management of viruses: Integrated management of tomato diseases was assessed with three modules and one control during 2023-24. The disease progress was recorded at 15 days intervals. Among different modules, Module 1 [Seed treatment Imidacloprid 60 FS (5 g kg^{-1} seed) + foliar application of AMC (20 ml per litre) at 30 days+ foliar application Thiamethoxam 0.4 g per litre at 30 days+spraying Sea weed extract at 35 days+foliar application of Emamectin Benzoate (0.2 g per litre) at 45 days+foliar application of AMC (20 ml per litre) at 60 days] and Module 2 [Foliar application of Neem soap (10 g per litre) at 15days+foliar application of *Bacillus amyloliquefaciens* (5 ml per litre)+ Ponagamia oil (3 ml per litre) at 30 days+foliar application of sea weed extract (2 ml per litre) at 35days+foliar application of Fish oil (ml per litre)+AMC (20 ml per litre) at 45 days+ foliar application of Neem Seed Kernel Extract (40 g per litre) at 60 days] was found highly effective in reducing the disease incidence at 20.2 and 52.0% compared to control (70.4%).

Integrated management of viruses infecting Tomato

Module	15 DAS		30 DAS		45 DAS		60 DAS		75 DAS		90 DAS		105 DAS	
	M	LC	M	LC	M	LC	M	LC	M	LC	M	LC	M	LC
Module 1	0	0	5.5	10.5	7.5	15.8	12.5	17.8	15.2	25.2	18.2	35.5	20.2	40.0
Module 2	0	0	5.7	12.1	8.9	15.0	14.5	25.9	17.3	35.3	19.3	40.3	25.6	52.2
Module 3	0	0	8.2	15.6	8.9	20.6	15.2	25.5	19.5	30.9	20.3	40.5	27.3	52.3
Module 4	0	0	10.2	18.3	15.2	25.6	20.0	35.3	22.3	45.0	30.5	48.9	50.0	70.4
SE	0.0	0.0	1.6	2.5	2.4	3.5	2.2	5.1	2.2	5.9	4.0	3.9	9.3	8.9
CD (p=0.05)	0.0	0.0	2.7	4.2	4.1	5.9	3.8	8.6	3.6	10.0	6.8	6.7	15.8	15.0

M-Mosaic and mottling, LC- Leaf curl

Different types of vectors were observed during crop growing period. The Module No 1 and Module No 2 were found highly effective and recorded low whitefly population (10 insects per plant) and (13 insects per plant) compared control (16.4 insects per plant).

Host range studies: Seedlings of 11 host species were raised under controlled condition and mechanical inoculation of pure culture of the virus was done at 3-4 leaf stage. The host species tested for this study were Tomato, Chilli, Capsicum, Tobacco, Datura, *Physalis minima*, *Chenopodium amaranticolar*, *Chenopodium quinoa*, *Solanum nigrum*, *Beans and Cucumber*. All plants were observed for symptoms of Mosaic and mottling, except beans. This was further confirmed by DAS-ELISA.

Host range of Chilli Veinal Mottle Virus

Hosts	Symptoms expression	ELISA
Tomato	Mosaic and mottling	++
Chilli	Mosaic and mottling	++
Capsicum	Mosaic and mottling	++
Tobacco	Mosaic and mottling	++
Datura	Mosaic and mottling	++
Physalis minima	Moasic	++
Chenopodium amaranticolar	Mosaic	++
Chenopodium quinoa	Mosaic	++
Solanum nigrum	Mosaic and mottling	++
Beans	No	-
Cucumber	Mosaic	++

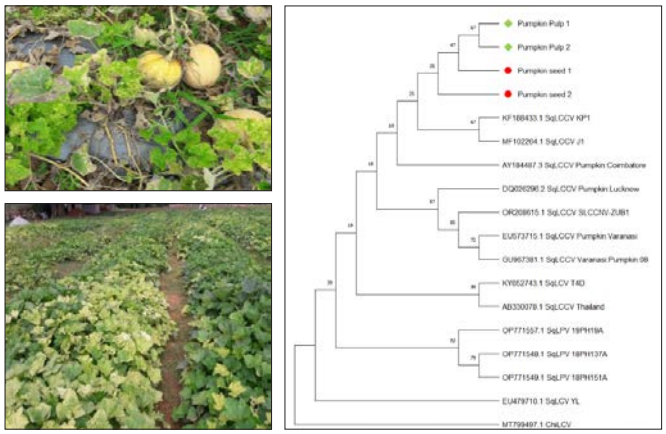
Legume vegetables

Management of Bean antracnose pathogen: Among various fungicides tested for control of *Colletotrichum lindemuthianum*, Carbendazim, Thiophanate Methyl, Tebuconazole+Trifloxystrobin and Carbendazim+Mancozeb demonstrated complete inhibition of *C. lindemuthianum* at concentrations ranging from 10 to 150 ppm under *in vitro* conditions. Furthermore, one isolate of *Trichoderma viride* also showed effective suppression of *C. lindemuthianum in vitro*.

Cucurbitaceous vegetables

A comprehensive field survey was conducted in Karnataka and Maharashtra, to identify major seed-borne virus isolates affecting cucurbitaceous crops (bottle gourd, bitter gourd, cucumber, watermelon, ridge gourd, pumpkin, and muskmelon), legumes (French bean), and solanaceous hosts (tomato, brinjal, and chili). Transmission Electron Microscopy (TEM) was used to detect tobamovirus infections in bottle gourd and tomato, as well as begomovirus infections in French bean, chilli, and ridge gourd, while seed-borne virus infections were examined using the blotting paper and water-soaked methods in cucurbitaceous, legume, and solanaceous crops. None of the samples were tested positive for viral infections under TEM. RT-PCR-based diagnostics were developed for detecting seed-borne viruses in bottle gourd, ridge gourd, and bitter gourd, while PCR-based diagnostics confirmed the presence of Tomato Leaf Curl Palampur Virus in cucumber. Furthermore, Watermelon Bud Necrosis Virus (WBNV) infections were diagnosed and characterized in watermelon samples collected from Nagpur. Overall, the study effectively utilized advanced diagnostic techniques such as TEM and PCR to detect and characterize seed-borne viruses in major horticultural crops, contributing to improved disease management strategies.

Detection of CGMMV and ToLCPV in cucumber



Detection ofToLCNDV in pumpkin seeds

Sporulation induction and management of gummy stem blight of cucurbits: To standardize sporulation induction for developing gummy stem blight screening protocol twelve cereals and millets were evaluated as medium for sporulation of *Staganosporopsis cucurbitacearum*. Sparse sporulation was observed on maize and rice grains. Among ten media evaluated for growth and sporulation of *Staganosporopsis cucurbitacearum*, cornmeal media and quarter strength potato dextrose agar media supported good growth of the pathogen. For management of gummy stem blight in cucurbits, nineteen bioagents were evaluated under *in vitro* conditions. *Trichoderma asperellum* strain IIHR TV5 and *Bacillus subtilis* were found effective against *Staganosporopsis cucurbitacearum*, the causal agent of gummy stem blight in cucurbits.

Flower crops

Tuberose

Evaluation of germplasm against *Alternaria polianthi*: About 134 lines were screened for *Alternaria polianthi* in tuberose during 2023-24 (*Kharif* season) and four crosses were found to be moderately resistant.

Chrysanthemum

***Phytophthora* associated with root rot:** Samples infected with *Phytophthora* were collected from chrysanthemum cultivated areas to assess the prevalence of *Phytophthora* species causing root rot in chrysanthemums. The disease has led to significant losses in susceptible varieties such as Scent Yellow and Scent White, which are grown for loose flowers. Samples were collected from Bangalore Rural, Davanagere, Chitradurga, and Kolar districts. Out of 93 samples, 48 tested positive for *Phytophthora* species, with disease severity ranging from 35-50 per cent. Morphological characteristics were recorded for these 48 *Phytophthora* isolates, 30 of which exhibited cottony colony growth. Most isolates showed papillated sporangia.

***Phytophthora* sp. infection in chrysanthemum**

Marigold

Evaluation of germplasm against *Alternaria tagetica*: Out of 191 genotypes were evaluated against *Alternaria tagetica* causing leaf and flower blight in marigold,, 170 were found to be highly susceptible, 16 susceptible and 5 moderately resistant. Moderately resistant genotypes are Pusa Arpita, IC-250332, IC-250323, KAU-M2 and CGFM- Raichur.

Gladiolus

Evaluation of germplasm against *Fusarium* wilt: Field screening for *Fusarium* wilt was conducted in gladiolus germplasm for 2 seasons. Among 75 genotypes, 36 were found highly resistant (0-10%), 34 were resistant (10-25%), 20 were moderately susceptible (25-50%) and 3 were susceptible (50-75%). In artificial inoculation 4 genotypes (Gold, Punjab Glad-3, JV Gold and Yellow Star) were highly resistant and 5 genotypes (EC Yellow, DFR-1, Novalux, Aayush and Sanjeevani) were resistant.

3.4.2. Insect pests

Fruit crops

Mango

Efficacy of entomopathogenic nematode (EPN) strain for control of stem borer: A strain of entomopathogenic nematode, *Heterorhabditis indica* was found effective against mango stem borer, *Batocera rufomaculata*. Continuous field evaluation indicated 80% reduction in stem borer infestation with injection of EPN solution into borer holes @ 10 ml per hole three times at 5-day interval. Efficacy was at par with standard check insecticide. This could be an environment friendly approach of stem borer management in mango and other fruit crops.

Larvae of mango stem borer infected with EPN

Varietal preference of fruit borer, *Citripestis eutraphera*: Among six major commercial varieties, the infestation of fruit borer was lowest in Neelam (2%) and highest in Totapuri (20.54%). The infestation ranged between 8.40-8.67% in Alphonso, Banganapalli and Mallika varieties. Based on susceptibility levels over the years, the varieties were classified into different susceptibility groups. Totapuri and Langra: Susceptible (15-20%); Alphonso and Banganapalli: Moderately Susceptible (5-10%); Mallika and Neelam: Least Susceptible (< 5%).

Infestation of mango fruit borer, *Citripestis eutraphera* on different varieties

Management of hoppers and thrips using botanicals and entomopathogens: The module consisting of first spray at flower bud initiation with azadirachtin 1% @ 2.5 ml L^{-1} followed by second spray of Pongamia soap @ 10 g L^{-1} after two weeks and third spray of neem soap (@ 10 g L^{-1} at fruit setting stage was most effective for control of hoppers and thrips. The module consisting of three sprays of IIHR formulation of *Metarhizium anisopliae* @ 0.5 ml L^{-1} (first two sprays at flower bud initiation to flowering stage) and third spray at fruit setting stage was also found better. The population of hoppers and thrips was reduced by more than 80% in the two modules indicating the scope for use of botanicals and entomopathogens for management of hoppers and thrips in mango.

Guava

Seasonal infestation of tea mosquito bug in guava and drumstick: The infestation of tea mosquito bug, *Helopeltis antonii* in guava and drumstick was studied at weekly interval from July 2024 to January 2025 in the experimental fields at ICAR-IIHR**.** The highest number and activity of tea mosquito bug was higher on drum stick than on guava. In drumstick, the highest number of *H. antonii* was recorded during 36th Standard week (70.0 per plant). There was no activity of *H. antonii* on drumstick during 44- 48th standard week, but there was a slight increase in the population from 49th standard week. In guava, the highest activity of *H. antonii* was recorded during 36th standard with 23.0 number per plant. However, the activity of *H. antonii* was not observed from 44 -50th standard week on guava. Temperature maximum (T_{max}) (*r*=0.31) and Temperature minimum (T_{min}) (*r*= 0.36), Evaporation (*r* =0.46) and wind speed (*r*= 0.48) showed moderate positive correlation with *H. antonii* population. The rainfall (*r*=-0.19) showed weak negative correlation with *H. antonii* population.

Management modules for nematodes in guava cv. Arka Kiran: Application of Fluopyram @ 0.5 ml per plant and *Bacillus amyloliquefaciens* IIHR Ba-2 enriched FYM before planting followed by soil drenching of bioagent enriched neem cake suspension at quarterly intervals @ 2 L per plant showed maximum decrease in nematode population of root knot nematodes up to 71.3% and increase in yield by 18.6%.

Management strategies for production of nematode free planting materials: Efficacy of several bioagents and chemicals was evaluated with and without using vacuum suction treating equipment developed by ICAR–SBI, Coimbatore. Among treatments, *Bacillus amyloliquefaciens* IIHR Ba-2 treated through vacuum suction equipment recorded the minimum number of galls (0.03) and nematode population in soil (48.00 per 100 cc soil) and higher growth parameters in guava.

Litchi

Insect pollinators and foraging behaviour in off-season: At CHES, Chettalli, off-season litchi flowers were visited by *Apis* bees such as *Apis cerana, A. florea, A. dorsata*, non-*Apis* bees such as Anthophorid bees, various hymenopteran wasps belonging to Vespidae, Scoliidae, dipteran flies belonging to Syrphidae,

Calliphoridae, Hemipteran bugs, lepidopteran moths and coleopteran beetles. The results showed that *Tetragonula irridipennis* is the major pollinator species accounting 58% of total pollinators found visiting the off-season litchi flowers followed by 6 % and 3 % abundance of *Apis cerana* and *Apis florae,* respectively. Peak foraging activity of *T. irridipennis* on off-season litchi flowers was 8 a.m. -5 p.m.

Avocado

Seasonal infestation and damage due to Japanese beetle: The Japanese beetle, *Popillia* spp. (Coleoptera: Scarabaeidae) is an invasive pest known for its destructive feeding habits on a variety of plants. Recently, its infestation on avocado (*Persea americana*) inflorescence has raised concerns due to potential threats to avocado production. Beetle densities peaked during October month, coinciding with the avocado flowering period at ICAR-IIHR Bengaluru. The adult beetles were seen feeding on the opened and unopened flower buds in clusters causing the flowers to wither and complete drying up of inflorescence**.** Heavily infested orchards exhibited up to 70% damage, with a corresponding 40 % reduction in fruit set. Higher beetle densities resulted in significantly increased flower damage ($p < 0.05$). Fruit set declined proportionally with the extent of flower damage, confirming the direct impact of beetle feeding on avocado yield. Yield losses due to Japanese beetle infestation ranged from 20% to 40%, depending on infestation severity.

Vegetable crops

Tomato

Effect of essential oils on *Phthorimaea absoluta* and *Aphis craccivora*: Essential oil of *Trachyspermum ammi* caused highest mortality (100%), with LC_{50} 3.23 (LCL-2.32, UCL-4.39) of *Phthorimaea absoluta* followed by *Syzygium aromaticum* (97.5% mortality) with LC_{50} 3.96 (LCL=2.93, UCL=5.32). For *Aphis craccivora,* highest mortality (100%) was recorded with *Geranium dissectum* with LC_{50}= 1.32 (LCL=0.92, UCL=1.69) followed by *T. ammi* (95% mortality) with LC_{50}=4.21 (LCL=2.90, UCL5.97). Among binary compounds, Thymol and Citronellol recorded 100% and 90% mortality of *P. absoluta*, respectively. Geraniol and D-Limonene registered 92.5% and 90% mortality of *A. craccivora*, respectively. The present study suggests that EOs would be the best alternative to chemical insecticides for the management of *P. absoluta* and *A. craccivora*.

Repellency of herbivore induced plant volatiles of wild tomato species to mites: Herbivore Induced Plant Volatiles (HIPVs) of 16 wild tomato species (*Solanum pimpinellifolium* LA2934; *S. galapagense* LA0530; *S. arcanum* LA2172; *S. corneliomulleri* LA1910; *S. peruvianum* LA0372; *S. chilense* LA1970; *Solanum sp.* LA2934; *S. chmielewskii* LA2695; *S. neorickii* LA0735; *S. pennellii* LA1940; *S. habrochaites* LA1718*; S. habrochaites* LA1777; *S. peruvianum* LA1955; *S. cerasiforme* LA1994; *S. peruvianum* LA0462; *S. huaylasense* LA2808) were evaluated for behavioural response of two spotted spider mites, *Tetranychus urticae* Koch (Tetranychidae: Arachnida) through four arm olfactometer bioassay. Among 16 HIPVs, 7 HIPVs viz., *Solanum chilen*se, *S. neorickii, S. pervuianum, S. habrochities, S. chimielewerieden, Solanum sp.,* and *S. aracanum* had shown significant repellence.

Integrated nematode management under protected condition: For managing root knot nematodes in tomato grown under protected conditions, integrated nematode management module comprising soil application of Fluopyram 400 SC at 500 ml per acre combined with soil drenching of neem cake enriched biopesticides suspension once in 30 days in standing crop recorded the maximum decrease in nematode population (74.45 to 80.74%) and increase in yield (+25.28%) compared to untreated control.

Effect of biofumigation on root knot nematodes: Different *Brassica* species were evaluated for bio-fumigation against *Meloidogyne incognita* infection in tomato under pot conditions. Results exhibited that among the *Brassica* species, mustard crop residues at 1% was found most effective for suppression of *M. incognita* in tomato.

Chilli

Repellency of healthy/herbivore induced plant volatiles to thrips: Evaluation of repellency/attraction of healthy plant volatiles (HPV) of eleven capsicum wild species through four arm olfactmeter bioassay had shown significant repellency to both *Thrips parvispinus* and *Scirtothrips dorsalis* by *Capsicum frutacense*IIHR-B-H-79 volatiles only, Similarly, the repellency of herbivore induced plant volatiles (HIPV) had also shown significant repellency to both *Thrips parvispinus* and *Scirtothrips dorsalis* by *Capsicum frutacense*.

Remaining 10 wild species did not show any significant repellency to both HPV and HIPV.

Management of *Thrips parvispinus*

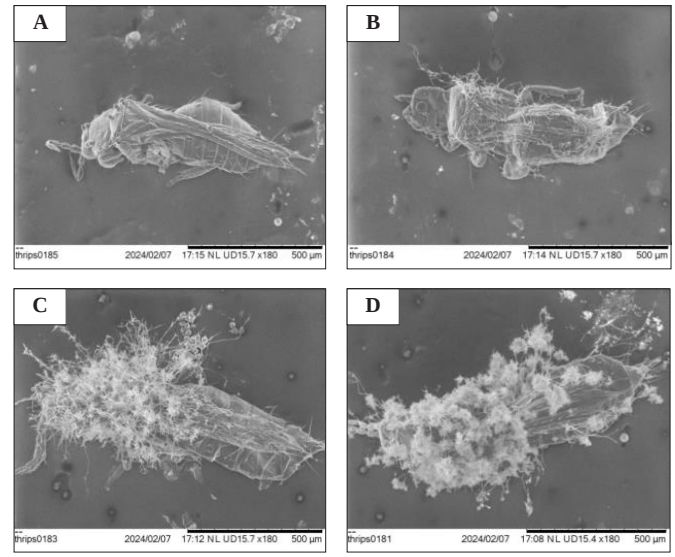
Colour Sticky traps: Among colour sticky traps evaluated for their efficacy in attracting South East Asian Thrips, *P. parvispinus*, white sticky traps attracted maximum number of adults (39%) followed by blue (36%) and yellow (25%). These observations indicate that white and blue sticky traps can be used for IPM of this thrips in chilli.

Efficacy of Botanicals and Fish Oil Rosin Soap: Among organic inputs evaluated against *T. parvispinus*, combination of Neem oil + Pongamia oil + Garlic + Chilli + FORS @ 5 ml per litre resulted in 67.0% thrips mortality over control whereas Azadirachtin 10000 ppm @ 4 ml per litre resulted in 63.4% mortality. Individually, Neem oil and Pongamia oil resulted in 47.5 and 59.0% mortality of thrips, respectively over control.

Capsicum

Exploration and evaluation of different bioagents associated with whitefly and thrips: Extensive field surveys were conducted and four bioagents associated with *T. parvispinus* were recovered from capsicum ecosystem. The biological and reproductive parameters of *T. parvispinus* were analyzed. The egg incubation period was 4.57±0.92 days on chilli and 4.8±0.77 days on capsicum. Nymphal durations (I and II instars) were longer on capsicum (2.71±0.61 and 4.29±0.73 days) than on chilli (1.93±0.46 and 3.07±0.73 days), with significant differences. Age-stage-specific survival rate (S_{xj}) of *T. parvispinus*on chilli and capsicum shown that the values varied across developmental stages, and the survival curves overlapped, which can be attributed to the fact that different individuals grew at different rates. the V_{xj}curve showed an upward trend and the highest value on each host was 13.16 (chilli) and 11.70 (capsicum) recorded at 17th and 19th days, respectively.

T. parvispinus infected with entomopathogenic fungi was collected and efforts were characterized. The morphological and molecular characterization shows that the fungi belong to *Cladosporium* sp. The laboratory bioassay at different concentration shows that the adult mortality of *T. parvispinus* varied significantly across *Cladosporium spp.* concentrations (F3,8: 7.862–23.096) compared to control. The highest mortality (69.10%) occurred at 1×10□ conidia/mL, while the lowest was at 1×10□ after seven days. SEM imaging revealed conidia adherence to *T. parvispinus* within 24 h post-infection. By 168 hpi, extensive mycelial colonization and sporulation were noted, with mycelia plugging the oral opening and spores forming in the head region.



SEM images of *Thrips parvispinus* adult infected with *Cladosporium*spp

Teasel gourd

Foraging behaviour of prominent insect pollinators: *Apis cerana* is the major pollinator species accounting 89% of total pollinators found visiting the teasel gourd male flowers followed by 8 % and 3 % abundance of *Halictus* sp. and *Tetragonula irridipennis*, respectively.

Flower crops

Tuberose

Screening tuberose lines for resistance to root knot nematodes, *M. incognita*: Out of 13 tuberose lines observed for reaction towards root knot nematodes under natural field conditions, the minimum gall index (GI) was observed in Arka Keerthana (GI – 1.3) which was at par with IIHR-17-5-2 (GI – 1.60) and IIHR-15-5-16 (GI – 1.73) and IIHR 17-22HS-83 (GI 2.00) which showed resistant reaction. IIHR-17-5-14 (GI- 2.37), Mexican Single (GI 2.43) and IIHR 15 22HS-1 (GI 2.50) revealed tolerant reaction. Maximum gall index was recorded in IIHR 17-1-16 (4.17).

Management strategies for production of nematode free planting materials in tuberose: Effect of vaccum suction treatment with equipment developed by ICAR – SBI, Coimbatore on bioagents was studied. Among all the treatments, *Bacillus amyloliquefaciens* IIHR Ba-2 treated through vacuum suction equipment recorded the lowest number of galls (0.33) and nematode population in soil (60.00 per 100 cc soil) and higher growth parameters in tuberose.

Gladiolus

Screening gladiolus lines for resistance to root knot nematodes, *M. incognita:* Field evaluation of gladiolus hybrid selections for reaction to root knot nematodes,

Meloidogyne incognita revealed gall index (GI) from 0.73 to 3.73 (on a 0 to 5 scale), the least GI was recorded in IIHR 15-1-105 and the highest GI was recorded in IIHR 15-1-212.

Interaction of bioagents with *Fusarium oxysporum* sp. *gladioli* in plate assay: Dual plate assay was conducted to investigate the antagonistic effects of beneficial microbial inoculants like Arka Microbial Consortium (AMC), *Bacillus* sp. (UGF), and *Trichoderma* sp. (GJ16B and JL5) against the gladiolus wilt pathogen *Fusarium oxysporum* sp. *gladioli*. The antagonistic effects in the dual plate assay were recorded in terms of percent inhibition of mycelial growth of *Fusarium oxysporum*. GJ16B, LA and RSL were found highly antagonistic against *Fusarium oxysporum* f. sp. gladioli. Double plate assay was conducted to investigate the interaction between gladiolus wilt pathogen *Fusarium oxysporum* sp. *gladioli* with beneficial microbial inoculants like AMC, UGF, GJ16B, JL5, RSL and LA. Among the beneficial microbes, JL-5 and LA were found most effective in inhibiting Fusarium pathogen with the percent inhibition at 42.48 and 41.29 % respectively.

Effect of microbial inoculants against Fusarium wilt: Based on dual culture assays it was found that *Trichoderma* species (GJ16B, JL-5) were found most effective in inhibiting *Fusarium* pathogens followed by bacterial inoculants UGF and AMC. Further double plate assays and GC-MS profiling indicated that the VOC's (Volatile organic compounds) released from *Trichoderma* sp *viz*; α-Copaeneα-gurjunene, muurolene, Cadinene, Germacrene B, Nerolidol, Phenethyl alcohol, beta-Patchoulene, α–Duprezianene, Tetrapentacontaneare etc could be involved in efficient inhibition of *Fusarium* pathogens. Pot culture pathogenecity tests with *Fusarium oxysporum* f. sp. *gladioli* confirmed the disease occurrence and GJ16B treated plants showed positive response as compared to other microbial inoculants tested, but gradually complete wilting of all the pathogen treated plants was observed.

T1: Control (Without Pathogen, T2: Pathogen control, T3: GJ16B, T4: LA, T5: UGF, T6: AMC, T7: GJ16B + Fusarium, T8: LA + Fusarium, T9: UGF + Fusarium, T10: AMC + Fusarium

Effect of various bio-inoculants against *Fusarium oxysporum* f.sp. *gladioli*

3.5 CROP UTILIZATION AND FARM MECHANIZATION

3.5.1. Crop Utilization (Post-Harvest Management & Value Addition)

Fruit crops

Post-harvest management

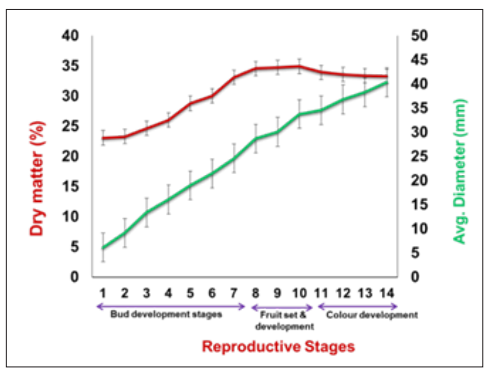
Mango: Hot water treatment of Alphonso variety at 52°C for 40 min or 55°C for 20 min controlled fruit fly infestation without causing internal breakdown.

Custard apple: Gamma irradiation (100, 200, 400,800 Gray) caused severe surface blackening of custard apple (Arka Sahan) fruits though higher doses of 400 and 800 Gray effectively controlled fruit fly infestation

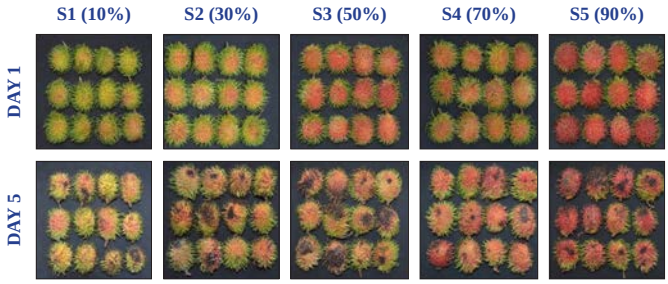
Minimal processing of pummelo and pomegranate: Methods for extending the shelf life of minimally processed pummelo and pomegranate was standardized. These products possessed fourteen days shelf life at 5□ storage.

Rambutan

Harvest indices, storage and packaging: The rambutan fruits (N-18, red type) took approximately 190 days to complete reproductive phase cycle from bud initiation to fruit harvest. The dry matter content in the buds and fruits increased till fruit development phase and consistency in dry matter was maintained during colour development phase while the fruit diameter increased linearly till harvest. Shelf-life studies of the fruits harvested at different stages of maturity (10, 30, 50, 70 and 90% color development) revealed that those harvested at 70% color development exhibited maximum shelf life compared to other stages, showing no significant variance in biochemical and sensory qualities. The rambutan fruits packed in non-ventilated punnet boxes with micro-perforation (0.005%) could be stored for 21 days at 9°C ± 1 compared to 9 days in non-packed control



Changes in the dry matter content (%) and fruit diameter (mm) during different stages of growth and development



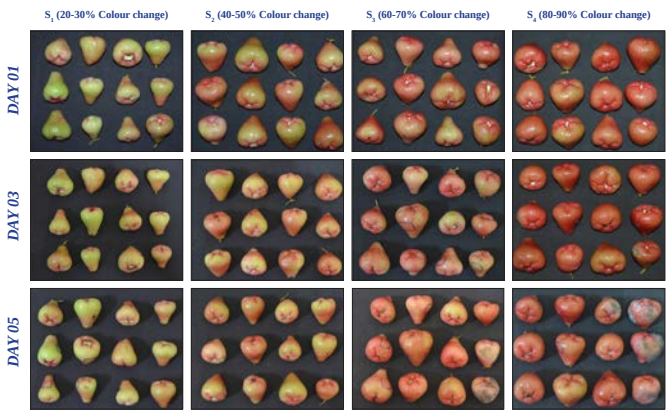
Storage studies of rambutan fruits harvested at different stages of maturity

Malayan apple (*Syzygium malaccense*)

Harvest indices: The Malayan apple fruits required approximately 97 days from bud initiation till harvest and requires about 282.96 heat units for proper flowering and fruiting. Shelf-life studies of the fruits harvested at different stages of maturity (20-30, 40-50, 60-70 and 80-90% color development) revealed that those harvested at 60-70% color development exhibited maximum shelf life compared to other stages, showing no significant variance in biochemical and sensory qualities

Days taken and heat unit requirements for different stages of development in Malay apple fruits

Stage of development	Days taken (Days)	Heat units
Bud stage	39.81 ± 5.97	140.21 ± 24.83
Flower stage	30.78 ± 6.88	82.92 ± 36.14
Fruit development	17.35 ± 5.96	36.27 ± 15.38
FD & colour development	9.87 ± 3.97	23.57 ± 12.04
Total	**97.80**	**282.96**

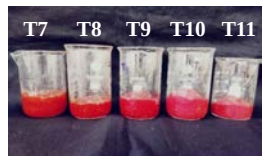


Malayan apple fruits harvested at different maturity stages and stored at room temperature

Value Addition

Dragon fruit

Preparation of jam from peel



Dragon fruit peel jam prepared using different treatments

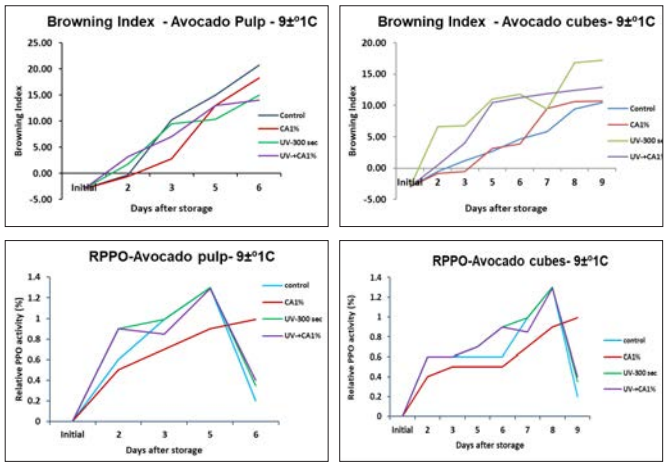
A jam was prepared from dragon fruit peel. Different enzymes were used at different concentrations to obtain the dragon fruit peel puree for jam preparation with high retention of betalains content. Jam with 30, 20, 10 and 0% sucrose were prepared along with other food additives (T7-T11). Physico-chemical, nutritional and sensory quality was analyzed in the prepared jams. It was found that the total polyphenols content ranged from 201.12 to 785.51 mg GAE 100 g^{-1} of jam whereas ascorbic acid content ranged between 59.2 and 62.9 mg 100 g^{-1} in jams. Organoleptically, the jam with 10% sucrose was accepted well. The dragon fruit peel had TSS of 6°Brix, 5.56 pH, 0.32% acidity, 90.92% moisture, 70.83 mg ascorbic acid 100 g^{-1}, 5.94% protein, 4.24% crude fiber, total polyphenols (32.31 mg GAE 100 g^{-1}), radical scavenging activity (8.12 mg AEAC 100 g^{-1}), total flavonoids (18.74 mg CE 100 g^{-1}), total betalains content (508.2 mg 100 g^{-1}).

Flavoured RTS beverage: Among natural flavours tried at different concentrations in Arka Kamalm RTS beverage, the flavors of ginger, cardamom and basil seeds were found acceptable compared to lemon, orange and passion fruit flavours. The ginger flavoured Arka Kamalam RTS beverage (8.4) scored maximum on 9 point hedonic scale even after 180 days of storage compared to cardamom (7.7) and basil seed flavoured (7.6) RTS beverages.

Probiotic beverage: The preparation protocol was standardized for red dragon fruit probiotic beverage.

Avocado

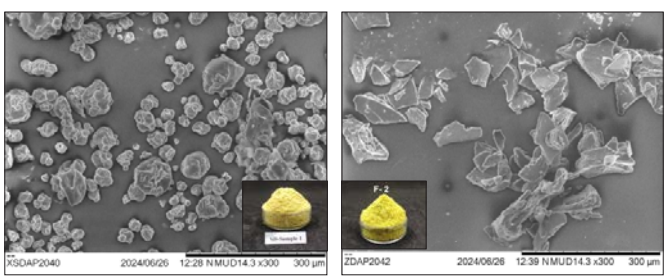
Pulp storage: Different treatments were imposed to avocado pulp and cubes to study their browning pattern during storage. The cubes treated with 1% citric acid has better storability of 8 days with lesser browning index (4.14) and polyphenoloxidase (PPO) activity (1.01%) than treated or untreated pulp at 9±1°C. Since, the browning is faster in cut avocado upon light exposure, the illumination of different packaging materials has been done. The illumination of poly propylene lined aluminum pouches is less (3.51) and was used to extend the storage of treated cubes upto 32 days under low temperature storage conditions (9±1°C)



Browning index and Relative Polyphenoloxidase (RPPO) activity of treated and untreated avocado cubes and pulp

Treated and control avocado pulp and cubes after 9 days of storage

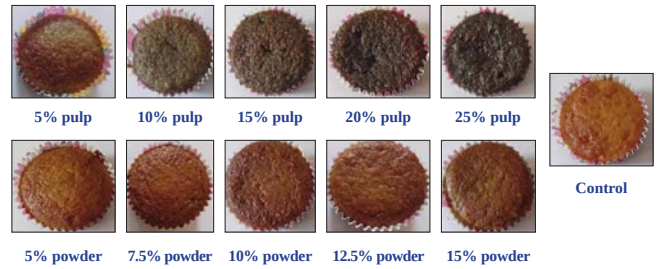
Powder: Suitable formulation had been standardized for preparation of avocado powder in cabinet dryer. This avocado powder was significantly higher in fat (26%), fibre (2.26%), colour and secured on par status with respect to flowability, moisture content and other physical properties compared with spray dried avocado powder. The cabinet dried powder scored high sensory scores. The SEM images showed that the spray dried powder particles are having blend edges and cabinet dried powders are amorphous in shape

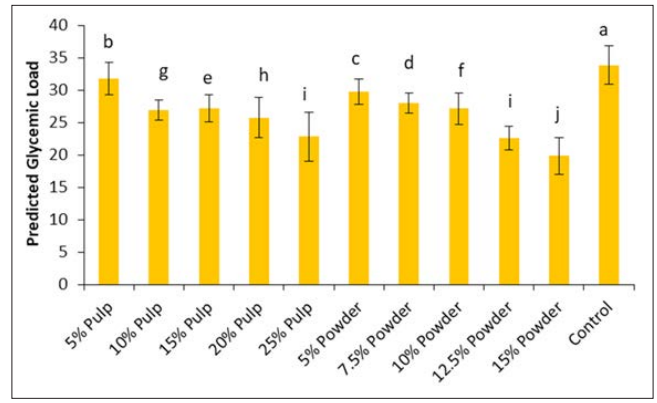


Scanning Electron Microscopic images of spray and cabinet dried avocado powder

Egg fruit

Muffins: Incorporation of 15% egg fruit powder in the batter formulation increased the minerals, phenols, flavonoids, radical scavenging activity of muffins. These muffins were classified as medium glycemic load food and received the highest sensory scores of 6.89 to 7.44 and were the most preferred by the panelists





Pouteria muffins of different formulations and their glycemic load predictions

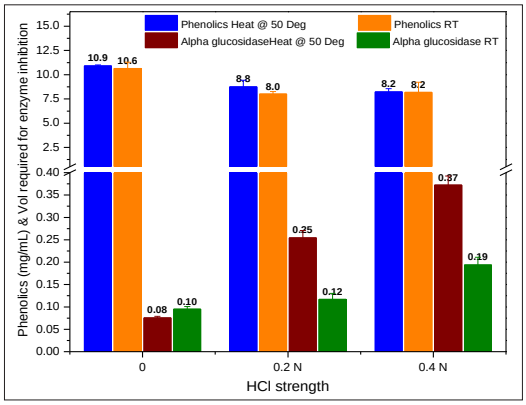
Probiotic fruit beverages: Probiotic beverage preparation process was standardized from dragon fruit and grapes.

Millet based extrudates coated with natural colourant

Fruit powders and millet incorporated Ready to Eat Extruded Snacks: Process protocol for the development of Ready to Eat Extruded Snacks of finger millet, soyabean and peas flour, coated with natural fruit colourant from Jamun, Barbados Cherry, Kamalam and Tomato as an alternative to synthetic colorant was optimized. Foxtail millet based extrudates with fruit colourant had lower water activity, lower water absorption index than finger millet based extrudates with fruit colourant. Incorporation of Jamun, Barbados Cherry powder increased the antioxidants, iron and zinc content in the millet based extrudates. Sensory scores revealed that fruit-finger millet based extrudates had better acceptance that fruit-foxtail millet based extrudates during storage.

Avocado powder incorporated with Finger Millet flour for making extrudates was rich in calcium (0.24%), magnesium (0.43%), iron (26.10 ppm), and zinc (10.30 ppm).

Effect of acidic medium and temperature on alpha glucosidase inhibitory activity of jamun seeds: Polyphenolic content in both acid treated and untreated samples did not vary significantly at room temperature and 50°C boiling, except slight reduction in samples treated with 0.4N HCl. But in the case of alpha glucosidase enzyme inhibition, significant differences were observed. Heating coupled with increased strength of HCL drastically reduced the enzyme inhibitory potential, indicating need for proper encapsulation of samples before consumption to prevent the gastric degradation.



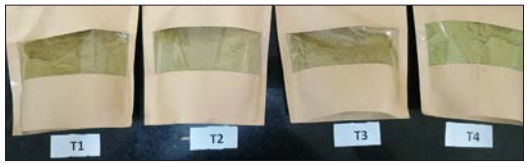
Effect of acidic medium and temperature on alpha glucosidase inhibitory activity of jamun seeds

Bael

Estimation of marmelosin: Extraction procedure for marmelosin from bael pulp using different solvents and extraction method was standardized. Among three extraction techniques (soxhlet, sonication and microwave), microwave was found most efficient method for marmelosin extraction from bael fruits. Marmelosin content in bael varied from 9.4 to 707.15 µg g^{-1}. Cultivated types have higher marmelosin content than wild types.

Vegetable crops

Green chilli powder: Optimized the drying parameters for green chilli dehydration using a cabinet drier, and established a pulverization protocol for the preparation of green chilli powder. The yield of green chilli powder ranged from 14-16%. The water activity of green chilli powder from various treatments ranged from 0.36-0.45. Green chilli powder obtained from treatment 4 showed better retention of color and ascorbic acid content.



Green chilli powder

Carrot and Beetroot

Drying characters of carrot and beetroot: The drying rate of different sizes of carrot and beetroot slices andf shreds was studied and the better drying rate was recorded in carrot shreds dried at cabinet dryer 55□ (1.06 g per min). The powdering ability of the shreds obtained by the same method is also very high 49.24% (<250 mm size). Similarly, the drying rate of beetroot shred under the same drying conditions (cabinet dryer 55□) is comparatively higher (2.58 g per min) with equivalent moisture content of 0.47%

Drying characters and powder properties of carrot and beetroot samples

Drying method	Carrot					Beetroot		
	Sample	Drying rate (g per min)	Dry matter recovery (%)	MC (%)	Particle size (<250mm)	Drying rate (g per min)	Dry matter recovery (%)	MC (%)
HPD-55°C	Shreds	1.06	11.12	5.57	49.24	1.43	14.29	3.2
	Slices (3mm)	0.56	9.39	9.38	18.10	-	-	-
	Slices (1mm)	1.01	8.80	3.25	26.75	1.07	14.67	3.5
CD-55°C	Shreds	0.84	11.14	0.14	47.96	2.58	11.43	0.47
	Slices (3mm)	0.66	8.47	1.41	17.06	-	-	-
	Slices (1mm)	1.02	8.60	0.67	32.44	1.81	13.33	0.45

HDP-Heat Pump dryer; CD-Cabinet dryer

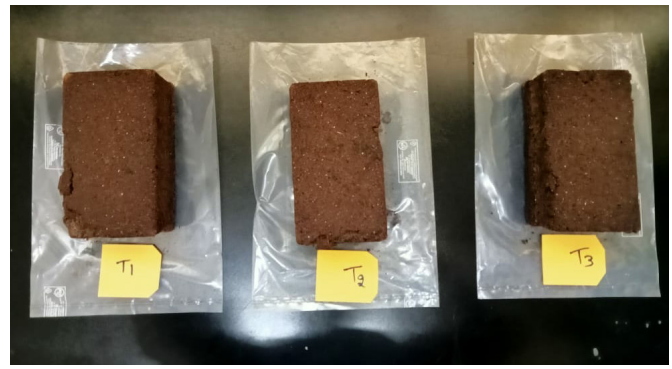
Dehydration of carrot: Eleven carrot genotypes were dried under cabinet drier and analyzed for total carotenoids content. Among the temperate carrot genotypes, highest total carotenoids content was observed in CARTEHYB-3 (178.08 mg 100 g^{-1} DW) whereas least was found in CARTEHYB-2 (90.56 mg 100 g^{-1} DW). Among the tropical carrot genotypes, CARTEHYB-4 (239.73 mg 100 g^{-1}) showed high carotenoids content and least was found in CARTEHYB-5 (116.29 mg 100 g^{-1}).

Dehydrated carrot slices

Dehydration of bitter gourd: Seven genotypes of bitter gourd were evaluated after processing in to dried slices. Among the bitter gourd genotypes, BIGHYB-3 had high moisture content and least was found in BIGHYB-4. High ascorbic acid content was found in BIGHYB-3 and least was found in BIGHYB-5. Total chlorophyll content ranged between 5.67 and 11.68 mg/g.

Flower crops

Compost blocks from flower waste: Standardized the process protocol for the preparation of compact ready to use compost blocks from floral waste. The compost blocks were tested for its compression and shear strength in texture analyser using load cell 50 and test speed of 2mm/sec. The compression strength of the compost blocks of these treatment combinations ranged from 130-190 kPa and shear strength of the blocks ranged from 33.41-46.37kPa.



Compost block from floral waste

Medicinal crops

***Centella* Squash:** *Centella asiatica* leaves has been used to develop a squash beverage. The squash was prepared using food additives in a combination that provides an organoleptically acceptable *Centella* beverage with good mouth feel and without or unrecognizable bitterness after dilution with water. *Centella* squash can be stored for six months at ambient temperature. The content of ascorbic acid, polyphenols, flavonoids and total triterpenoids in the diluted beverage was 208.80 mg 100 ml^{-1}, 139.30 mg GAE 100 ml^{-1}, 64.31 mg CE per 100 ml and 5.45 g 100 g^{-1}, respectively. After storage period of 180 days, the ascorbic acid, polyphenols, flavonoids and total triterpenoids content in the beverage was found to be 183.33 mg 100 ml^{-1}, 186.69 mg GAE 100 ml^{-1}, 9.79 mg 100 ml^{-1} and 1.68 g 100 g^{-1}, respectively.

***Centella* Squash**

Mushroom

Calcium fortified mushroom: Sensory evaluation was carried out for Calcium fortified mushroom. More than 65% people scored very good.

Anticancer properties from *Macrocybe gigantea*: Identified Anticancer properties from *Macrocybe gigantea* D-mannosyl Specific lectins that were isolated and purified from *Macrocybe gigantea* showed anti-tumor /anti-cancer activity as evident from cell line studies. Significant inhibition of cell line activity was observed even at low concentration (0.0025mg ml^{-1}) of purified lectin, when tested.

Pleurotus pulmonarius was evaluated on different agro-wastes like paddy straw, paddy straw powder, Corn cob powder, Saw dust and Coir pith. The highest biological efficiency (yield) of 212.6g / kg was reported in wet paddy straw.

Gamma irradiation was carried out for *Agrocybeae girata* at different doses. *Agrocybeae girata* exposed at 450Gy has recorded highest yield in comparison to the other doses and control.

High yielding mushroom produced through Gamma Irradiation

The protein bioavailability in 15 spp of oyster mushrooms were compared using *in vitro* pepsin-pancreatin/ gastric-ileal protein digestibility assay. The biological value ranged between 45.31% and 84.47%. The mean protein bioavailability was 62.39%. Sugar profile was analyzed in indigenous mushrooms species. The predominant sugars were sorbitol, glucose and ribose. Button mushrooms contained the highest amount of sorbitol (1274.9 mg 100 g^{-1} DW) and ribose (1881.1 mg 100 g^{-1} DW), glucose was the highest in the oyster mushroom *Pleurotus djamor* (348.4 mg 100 g^{-1} DW).

3.5.2 Farm Mechanization

Target-oriented fertilizer drill for high density guava orchard: The target-oriented fertilizer drill consisted of i) main frame, ii) hopper, iii) metering mechanism, iv) mechatronic system, v) pair of electric batteries and vi) furrow opener. The mechatronic system was designed to precisely apply fertilizer to target-oriented areas, thus effectively controlling the wastage of fertilizer. The ultrasonic sensor was placed one side of ferti drill to sense the guava plants and rotary encoder was placed along with pneumatic ground wheel, so that rotary encoder rotated when the ferti drill was in action and sent the signals to PLC board. The PLC board sent signals to stepper motor, to rotate. The metering mechanism of ferti drill was operated by stepper motor. The entire mechatronic system was operated by a pair of electric batteries of 12 V (165 Ah) each. The actual field capacity of the ferti drill was determined to be 0.186 ± 0.001 ha/h, while the theoretical field capacity was found to be 0.216 ± 0 ha/h. The field efficiency of the ferti drill was calculated to be 86.204 ± 0.575%. The fertilizer discharge quantity, length of fertilizer application and distance between tree trunk to furrow of developed machine were 423.5 ± 3.30 g, 109 ± 4.062 cm and 64.40 ± 3.043 cm, respectively. The fuel consumption, depth of application and speed of operation of target oriented ferti drill were 3.780 ± 0.058 l h^{-1}, 12.20 ± 0.800 cm and 0.976 ± 0.008 km h^{-1}, respectively.

3.6. ECONOMICS OF PRODUCTION, MARKETING & TRADE, STATISTICAL RESEARCH & COMPUTER APPLICATIONS IN AGRICULTURE

3.6.1. Economics of Production, Marketing & Trade

Impact assessment of low-cost ripening (LCR) technology

The LCR technology, developed and commercialized in 2011, has been evaluated for its impact using data from 60 mango traders (30 adopters and 30 non-adopters). The ripening practices among non-adopters included use of sachets/masala *(*21), ethylene dipping (4), ethylene spraying (2) and use of rented ripening chambers (3).

Ripening practices among non-adopters: The most prevalent ripening method among non-adopters is the use of sachets or masala, primarily due to its affordability at Rs.1.23 per kg, despite its non-approval by FSSAI. This technique involves placing 4-6 water-dipped ethylene sachets (such as the FYK brand) in a 15-20 kg tray, which is then sealed with newspaper. Another widely practiced method entails dipping mangoes in an ethylene solution, prepared at a concentration of 7–10 ml per liter of water, for 2–3 minutes before packing. Although slightly costlier at Rs.1.60 per kilogram, this approach also lacks FSSAI approval. Similarly, ethylene solution spraying, applied layer by layer on fruits, is practiced at a cost of Rs.1.30 per kg but remains unauthorized by FSSAI. A less common yet FSSAI-approved practice involves exposing fruits to ethylene gas in certified ripening chambers maintained by the Mango Board. However, this method incurs the highest cost at Rs.5.00 per kg, limiting its widespread adoption.

Performance of LCR Technology: The LCR technology, an FSSAI-approved ripening solution costing Rs. 1.93 per kilogram, stands out as a safe, reliable, and authorized alternative. Although slightly

more expensive than methods like sachets, dipping, and spraying, it ensures full compliance with food safety standards while maintaining cost-effectiveness. Unlike the costly rented ripening chambers, LCR technology bridges the gap between affordability and regulation, offering a practical and compliant solution. The average ripening period under this method is 5.7 days, with a shelf life of 6.7 days for ripened fruits and minimal spoilage of just 2.7%. Notably, 64.7% of users reported that the ripened fruits display a uniform and appealing yellow color, while 35.3% observed a yellow appearance with greenish patches. Additionally, 83.78% of users highlighted that the firmness of ripened fruits is well-preserved, with only 16.2% noting a slight reduction in firmness.

Spread of LCR Technology: The adoption of LCR technology has been most prominent in Karnataka, which accounts for 90 adopters, representing 62.9% of total users. This dominance is attributed to early awareness initiatives and proximity to the technology's development center. Maharashtra follows with moderate adoption, comprising 29 users, driven by the presence of significant mango-growing regions and increasing awareness. Kerala also shows a notable uptake with 18 adopters. In contrast, adoption rates are significantly lower in other states, with Andhra Pradesh, Telangana and Bihar each recording just two users.

Monetary gains to the society: The total monetary benefit from the LCR is Rs.13.85 crores, with Rs.7.76 crores benefiting consumers and Rs. 6.1 crores benefiting producers, indicating a positive impact on both sides of the market. The method innovatively accounts the intangible benefits of the use of the technology in terms of health costs.

Reasons for adopting LCR technology: The order of reasons for its adoption starting with its Locally Manufacturable, Low Investment Requirements, User-Friendly, Increased Consumer Acceptance, Safety in Consumption and Faster Ripening Compared to Natural Methods.

SOP Compliance: A significant 89% of users adhere to the SOP guidelines for maintaining the standard spacing in ripening crates and chambers. However, compliance drops to 55% when it comes to using the correct concentrations of Ethrel and Sodium hydroxide during the ripening process. Additionally, 67% of users follow the recommended treatment duration as specified in the SOP, indicating room for increasing awareness in adherence to critical procedural standards.

Suggestions for improving and adopting LCR technology include developing foldable and portable versions, increasing awareness among farmers, FPOs and stakeholders, and coordinating with mango boards facilitating direct marketing in major growing areas.

User ratings of LCR technology: Majority (52.83%) rated the technology as 5, indicating high satisfaction and endorsement. About 35.85% awarded a rating of 4, acknowledging good performance with minor areas for improvement. A smaller segment (7.55%) provided a neutral rating of 3, while only 3.77% expressed mild dissatisfaction with a rating of 2, suggesting areas for refinement but no major shortcomings.

Impact of APMC Deregulation: A Case Study of Chilli Growers and the Byadgi APMC

The impact of APMC deregulation (GoK policy dated May 2020) on market arrivals, pricing, farmers' incomes, and overall market performance was examined with a particular emphasis on the chilli crop at the Byadgi APMC.

Impact on chilli (dry) prices at Byadgi market: The Byadgi market primarily trades in varieties such as Byadgi Dabbi, Byadgi Kaddi and Guntur chillies. Intervention analysis and Difference-in-Differences analysis revealed a significant negative coefficient for the intervention variable across all three segments, indicating a substantial immediate drop in chilli prices following the market deregulation. However, the positive coefficient for the interaction variable in all segments suggested that the rate of price change increased significantly post-intervention. This indicates that while prices initially declined, the trend shifted positively thereafter, leading to an overall increase in prices over time.

Impact on chilli (dry) arrivals at Byadgi market: The average annual arrivals of dry chilli at the Byadgi market increased from 108,748 tonnes (TE 2019-20) to 115,995 tonnes (TE 2022-23), indicating no adverse impact of deregulation on dry chilli arrivals. This stability, despite deregulation is attributed to Byadgi's status as a specialized single-commodity market, with over 2000 traders, including commission agents and buyers, actively involved in the trade.

Impact of deregulation on Byadgi APMC revenue: The average annual revenue of Byadgi APMC declined from Rs. 16.91 crore (TE 2019-20) to Rs. 13.50 crore (TE 2022-23). This decrease is attributed to the indirect effects of deregulation, particularly the reduction in the market cess from 1.5 to 0.6% in July 2020. Despite

increases in both market arrivals and prices, the lower cess resulted in reduced market fee collections, contributing to the overall decline in revenue. Additionally, reduction in penalties collected under column 70, further impacted the market's financial performance.

Impact of deregulation on income of chilli farmers: Data collected from farmers selling dry chillies at Byadgi APMC yard and outside the yard revealed that the net income difference between APMC sales (Rs.7,921 q^{-1}) and outside sales (Rs.7,897 q^{-1}) was negligible, despite lower marketing costs for outside sales. The study identified six marketing channels, with 92% of the produce being traded through the APMC.

Demand and supply projections of horticultural commodities

The supply projections are derived using the average production of triennium ending (TE) 2022-23 and the annual growth rate of production during the past decade. The projections are based on past trends, and the model warns that long-term forecasts (beyond 10 years) may not fully account for emerging factors such as climate change, policy changes, market dynamics, and technological disruptions. The production of horticulture crops is projected to show significant growth across most categories by 2047-48, driven by expanding areas and improved productivity. Fruits and vegetables are expected to see substantial increases, nearly doubling from 109.53 million tonnes to 225.17 m t and 213.88 m t to 417.53 m t, respectively. Flowers and spices show remarkable growth, with flowers increasing nearly fourfold (from 2.99 m t to 11.22 m t) and spices growing more than sixfold (from 11.26 m t to 69.61 m t). However, aromatic and medicinal plants and plantation crops show stagnation or decline, with production decreasing from 0.61 m t to 0.45 m t and remaining nearly constant at 16.3 m t, respectively.

For the demand projections, an absorption function was used to project the future demand of horticultural commodities where absorption is the summation of actual production and net import after deducting post-harvest losses.

Actual Absorption = Production + Imports – Exports –Post-harvest losses

Per capita Absorption = (Production + Imports – Exports −PHL)/Population

$A_t = A_0 * N_t (1 + y * \eta_t)^t$

A_t= Projected Absorption in period t

A_0= Per capita absorption of commodity in base year (TE 2022-23)

N_t = Population in period t

y = Growth in Per Capita Income (@ 5.1 %)

η_t = Elasticity of the commodity

t = Time period

The projected demand for horticulture crops indicates consistent growth across all categories, driven by population increase, income growth, and changing dietary preferences. Fruits and vegetables, the largest contributors to horticultural demand, are expected to rise from 97.74 million tonnes and 192.31 m t in 2022-23 to 176.71 m t and 306.44 m t by 2047-48, respectively. Spices and flowers show substantial growth, with spices increasing from 9.92 m t to 21.90 m t and flowers nearly tripling from 2.68 m t to 7.86 m t over the period, reflecting their expanding utility in culinary, decorative, and industrial applications. Plantation crops experience a significant surge, growing from 16.15 m t to 47.27 m t, while aromatic and medicinal plants and honey also see steady demand increases, rising to 1.90 m t and 0.38 m t, respectively by 2047-48.

The demand-supply gap shows surpluses in fruits, vegetables, spices, and flowers, presenting opportunities for exports and value addition. Aromatic and medicinal plants, along with plantation crops, face growing deficits, highlighting production challenges.

Economics of production of dragon fruit

The estimated cost from establishing dragon fruit orchard was Rs. 9.80 lakhs per acre, in which fixed cost and variable cost accounts to Rs. 5,91,840 and RS. 3,89,070, respectively. The proportion of fixed and variable costs for dragon fruit orchard are approximately 60% and 40%, respectively. The initial establishment (fixed cost) was higher for dragon fruit than annual maintenance cost (variable cost).

The average yield of dragon fruit was 4.5 t $acre^{-1}$. The per acre gross and net returns obtained from dragon fruit cultivation was estimated to be Rs. 6.75,000 and Rs. 2.85,930, respectively. The economic feasibility of dragon fruit orchard was worked out considering the economic life of 20 years and discount rate of 8%. The study revealed that the dragon fruit orchard provides NPV of Rs. 81.59 lakhs, with a B-C ratio of 2.87, with 65% IRR and a payback period of 3.5 years. Hence, the cultivation of dragon fruit is economically feasible. The Constraint analysis revealed that higher initial cost required for establishing Dragon fruit orchard is the major constraint (93%) followed by non- availability of quality planting material in time (88%) and the problem of marketing the produce (85%).

3.6.2. Statistics Research

Multi-dimensional scaling approach for stability analysis in Mandarin multi-location trials:

Multivariate approach was adopted for assessing the stability of 7 Mandarin lines (Mudkhed seedless, Nagpur seedless, Nagpur mandarin, Kinnow mandarin, Coorge mandarin, Khasi mandarin and Darjeeling mandarin) based on trials conducted during years 2021-2023, across five AICRP (F) locations (Akola, Ludhiana, Nagpur, Sriganganagar, Tinsukia). Results based on 7 stability measures for seven different yield and growth attributes (no. of fruits per tree, fruit weight, fruit yield per tree, fruit yield per ha, canopy volume, stem girth and plant height three unique groupings were identified (group 1: Mandarin and Nagpur Seedless, group 2: Darjeeling mandarin and Mudkhed seedless, group 3: Khasi mandarin, Coorg mandarin and Kinnow mandarin).

Further analysis revealed that for fruit weight, Mudkhed Seedless (154.6 g), Nagpur Mandarin (144.1 g), Kinnow mandarin (165.9g) and Coorg Mandarin (155.8 g) were found to be stable and ideal for all locations. Based on fruit yield per tree, Mudkhed Seedless (48.1 kg), Nagpur Seedless(47.3kg), Nagpur Mandarin(47.3kg), Kinnow mandarin (62kg), Coorg Mandarin(44.6 kg) and Darjeeling mandarin(37.9 kg) were found to be stable and ideal for all locations. Based on number of fruits per tree, Nagpur Seedless (343), Kinnow mandarin (301) and Coorg Mandarin (285) were found to be stable and ideal for all locations. Based on the values of environmental indices, Akola followed by Ludhiana and Nagpur as best locations for fruit weight. For fruit yield, Ludhiana followed by Akola Sriganganagar and Nagpur as best locations and for number of fruits per tree, Sriganganagar followed by Ludhiana and Akola as best locations, as they possess least values of environmental indices.

Multi-dimensional scaling approach for stability analysis in China aster: Multivariate approach was adopted for assessing the stability of 36 China aster lines from the trials conducted during 2021-2023 at ICAR-IIHR, Bengaluru. Results based on 7 stability measures for seven different yield and attributing traits (plant height (cm), plant spread (cm), no. of branches per plant (cm), flower diameter (cm), no. of flowers per plant, stalk length (cm) and vase life (days)) identified three groupings (group 1: 15-41-3, 15-41-7,15-41-18,15-57-3,15-57-3,15-41-21, and 15-41-12; group 2: 15-41-16, 15-41-1,15-36-1,15-41-3,15-57-6,15-57-7, and 15-41-10; group 3: 15-32-1, 15-39-11B, 15-40-1, 15-39-14,15-31-1, 15-39-3 and 15-39-4).

Multi-dimensional scaling approach for stability analysis in gerbera: Multivariate approach was adopted for assessing the stability of 16 gerbera lines (Natan, Solange, Susan, GJ 0336, Beverly, Levi, Danaellen, Rosalin, Balance, Goliath, Stanza, Basics, Faith, Kalina, Alcatraz, Terra) for trials conducted during 2020-2023 at ICAR-IIHR, Bengaluru. Results based on 7 stability measures for six different yield and attributing traits (Flower diameter (cm), flower stalk diameter (mm), disc diameter (mm), flower stalk length (cm), flower number plant^{-1} month^{-1} and vase life identified three groupings (group 1: Basics, Natan, Solange, Balance and GJ 0336; group 2: Beverly, Terra, Rosaline and Danaellen and group 3: Alcatraz, Faith, Kalina and Levi).

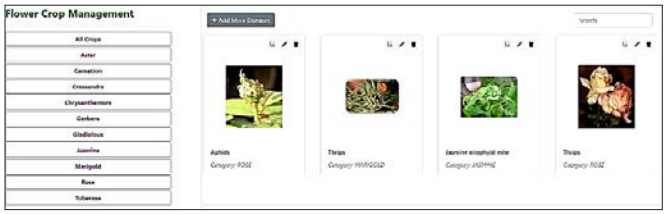
3.6.3. Computer Applications

Mobile application developed in Regional Languages (Sapota and Pomegranate)

The mobile app for Sapota cultivation in Telugu and Pomegranate cultivation in Hindi has been designed and developed. These applications, created in regional languages, are catered to meet the needs of local farmers. The apps can be downloaded from the Google Play Store or the IIHR website and accessible through any smart phone or compatible browsers, the application are hosted on Google's firebase cloud-based servers being a fast, secure, and scalable hosting solution provided by Google for deploying the application for static and dynamic content, and serverless backends. Firebase having several features that make it a popular choice for Static and Dynamic Content, it supports hosting static assets like HTML, CSS, and JavaScript, as well as dynamic content.

The app having a query submission forms for farmers to post their cultivation-related queries in native language. Further, IPM and IDM strategies are also provided for efficient crop management. The app offers a variety of features, including crop cultivation methods, disease and pest management, FAQs, and Contact Us section, and more. The disease and pest management module provides detailed information on various crop diseases, including symptoms, control measures, and management strategies to improve crop health. These modules developed using jQuery, which incorporates dynamic sliders, allowing users to scroll manually/automatically for detailed control measures.

Web application: The front-end web interface for flower crop management is designed with different menus and web pages using the server-side scripting language PHP. The application's design framework is structured to highlight important flower crops on the main page. This layout facilitates easy browsing and access to relevant management information for each flower crop. Users can select a specific flower crop from the list, and with subsequent clicks on the images of major pests and diseases affecting the selected crop, additional management details are displayed. The database structure is designed using MySQL storing structured data, integrated with tables for flower crop names, diseases and pests names along with images, symptoms, control measures and recommendations, enabling the retrieval of specified data at the time of crop data selection by the user providing them with detailed information. To further enhance usability, the application includes a search box, allowing users to quickly find specific flower crop management data. On the main page, users can easily navigate to other options like 'View', 'Update', 'Delete' and 'Add More' which are designed to perform data management operations to view, modify, remove, or add new records.



3.7. AGRICULTURAL EXTENSION RESEARCH

Research and extension gaps in production and promotion of export of selected horticultural crops

In 2024, major export-oriented crops such as Mango, Grapes and Pomegranate in fruit crops, Onion, Chilli and Gourds in vegetable crops and Rose and Jasmine in flower crops were selected for the study. Crop specific and group specific (Farmers and Exporters) schedules were prepared and data were collected from the 78 Grapes, Pomegranate and Mango growers/export farmers.

Majority of the farmers (70%) expressed that there was lack of uniform standard protocol on post-harvest handling of many crops followed by 69 percent of farmers said that there is a yield gap of 55 to 70% of export quality produce, which makes export economically inefficient. Other constraints faced by the farmers were non-availability of varieties, production package for field level adoption of export quality produce, poor financial support and difficulty in obtaining the financial assistance from agencies, non-availability of storage and transportation facilities from the production site to airport, particularly cost effective refer facilities, etc.

Major constraints faced by the exporters in export of horticultural produce

1 Quality Standards (Stringent international quality and safety standards) and Compliance regulations related to pesticide residues, sanitary, and phytosanitary measures)

2 Infrastructure issues (Inadequate cold storage, poor logistics and transportation infrastructure) and

3 Financial constraints (difficulty in getting investments and delay in release of assistance for export, etc.)

Approaches or suggestions given by farmers to promote export of horticultural crops

1 Strict Enforcement of Standards (meeting the food quality standards such as ISO9001, HACCP)

2 Changes in orchard management – with extensive availability and accessibility for export oriented production package

3 Complete guidance for effective management of the export quality production of different fruit and vegetable crops at grass root level (farmers field)

4 The potential states should be targeted for specific crops to enhance the export potential of the country, may be under ODOP programme or GI crops of different states

Approaches to promote export of horticultural crops expressed by exporters

1 Improvements in infrastructure – for pre and post-harvest management, cost-effective, good quality packaging and transport services and for processing of different produce

2 Contract farming under the supervision of exporters, with full package

3 Increase the investment in research and adoption of innovative technologies suitable for export quality production and processing of different horticultural produce

4 Providing timely and sufficient financial assistance for production and processing of horticultural crops.

Holistic village development in horticulture-based farming system

Apart from the eight existing FFP villages, four new cluster villages were selected for demonstration of improved varieties and technologies for the current year. The newly selected villages are Halasuru, Dunturu,

Bhoohalli and Kadalli in Sathnur hobli, Kanakapura taluk of Ramanagara district.

Crop based module: Based on the demand of farmers and the production system of the area, improved variety of Ragi (ML-365) was introduced for demonstration. Similarly, other field crops such as Redgram (BRG-4), Field bean (HA-3) and Foxtail millet (GPUF-3) were also introduced as intercrops for demonstration. In total, crop-based module covered nearly 370 families covering an area of 430 acres.

Horticulture crop module: This module covered in total of 13 families with an area of 12 acres. ICAR-IIHR hybrids of tomato (Arka Abhed), chilli (Arka Sanvi) and cucumber (Arka Veera) were demonstrated in farmer's fields.

Arka Mango Special: Arka Mango Special, a nutrient formulation developed to enhance mango yields and quality, has gained significant popularity among farmers, particularly in Karnataka, which accounted for 67.98% of purchases in 2023–24. Andhra Pradesh (14.19%), Tamil Nadu (6.06%), Kerala (3.77%), and Telangana (3.14%). A total of 8,544 kg of the product was sold during the year. Participatory demonstrations in key mango-growing regions revealed that 57% of farmers used the recommended foliar spray application method. Most farmers applied the product in an unstructured manner, highlighting the need for improved training and awareness to maximize its benefits. Feedback from demonstrations suggested key refinements to enhance the product's accessibility and ease of use. Farmers emphasized the need for an online purchasing platform (73.33%), a liquid formulation for easier application (63.33%), and a pH-neutralizing additive to replace lemon juice (50%) due to issues with availability and cost.

Arka Mealy Melt: A study on adoption and utilization of Arka Mealy Melt revealed its effectiveness in managing mealy bugs across diverse crops. In 2023–24, 242 litres of the product were sold through the ATIC of IIHR, with Karnataka leading in adoption at 73%, followed by Kerala (15.29%), Andhra Pradesh (3.93%), and others. Among fruit crops, 27% of farmers used it for pest control in grapes, while guava, custard apple, and papaya saw 13% adoption each. Kitchen garden growers accounted for 27% of usage among flower and vegetable crops, highlighting its versatility for small-scale and commercial farming. Participatory demonstrations across key crops provided valuable feedback for refinement. While 53% of farmers expressed satisfaction and 18% were highly satisfied with its performance, 93.3% suggested increasing its concentration to reduce the dosage from the current 70–100 ml per litre, making it more cost-effective and user-friendly.

Virus resistant chilli varieties: Farmers expressed that the major challenges in chilli cultivation are black thrips, viral diseases, and cost and availability of labor. As part of special schemes of the institute like SCSP and TSP, participatory demonstrations were taken up in major chili growing regions (Guntur district in Andhra Pradesh and Mahboobdabad district in Telanagana). Interaction with stakeholders of chilli crop *viz*., farmers, line department staff, traders of Guntur Chillli market expressed that, 'Teja" segment with its special attributes like slender, medium sized and pungent was prevailing and ruling the market. But due to increasing labor cost and the number of man-days to harvest operations of this segment incurs more labour compared to a variety like Arka Tejaswi which is slightly longer than the regular teja segment coupled with bit bigger fruits. In our demonstrations, the stakeholders expressed that Arka Tejaswi variety of IIHR suits well to be prevailing market sentiments and has great scope for further expansion in this region. Arka Sanvi and Arka Yashasvi were aslo performed very well in terms of yield, productivity and consumer preference.

Women empowerment and ICAR-IIHR technologies

The level of improvement in nutritional and income security of women mushroom growers through the developed index on nutritional and income security for farm women was assessed in 2024. The public-private interface between ICAR-IIHR, Bengaluru, and women farmers in Karnataka has significantly improved livelihood security and micro-enterprise development through skill development and extension trainings in mushroom technology. This study examined the impact of mushroom cultivation on livelihood, dietary diversity, food accessibility, and income levels of 30 women mushroom growers, aged 34 to 45 years, with 1 to 5 years of experience.

Cultivation areas range from 144 sq ft to 4000 sq ft. All participants received formal training at ICAR-IIHR on mushroom production technologies and few were supported through initiatives such as Arka Ready-to-Fruit Mushroom growing bags and Arka Mushroom outdoor growing units under various schemes like SC-SP and TSP.

The findings show a significant improvement in nutritional security of women, with 43% consuming more than nine food groups per week, 37% consuming 7-8 food groups, and 20% consuming 5-6 groups, as

per the Dietary Diversity Score (DDS). In terms of food accessibility and availability index, 43% of the respondents reported moderate access without shortages, 33% experienced easy access, while 24% had occasional shortages. Livelihood Improvement (LI) Scores indicated a 100-200% income increase, with a Benefit-Cost ratio of 1.8 to 5.1, resulting in a 50-100% reduction in food expenditure making them sustainable micro enterprises for farm women though better marketing avenues. Additionally, 77% of participants achieved a high nutritional security score while none fell into low nutritional security category.

Mushroom consumption out of total production: Mushroom consumption levels among 30 women farmers indicated that majority (43.3%) consume 20–30% of their total production, while 26.7% consume 30–40%. A smaller portion (13.3%) consumes 40–50%, and very few (10% and 6.7%) consume 10–20% and 0–10%, respectively. This indicates that most farmers reserve a moderate portion of their produce for personal use or local needs.

Income security of women mushroom growers: The results present a comprehensive analysis of mushroom cultivation across various plot sizes, from 6 ft x 6 ft to 4000 sq ft, focusing on financial outcomes such as yield, income, and expenditure. Gross income per year ranges from Rs. 14,400 for a 144 sq. ft area to Rs. 723,600 for a 1200 sq. ft area. The net income after expenses is notably improved by mushroom interventions, with baseline incomes increased by 110% to 262% post-intervention. For example, in a 1200 sqft area, income rose from Rs. 250,000 to Rs. 829,600 (232% increase). Overall, results highlight economic benefits of mushroom farming across different land sizes.

Innovative technologies adopted by women farmers in mushroom: Arka Ready-to-fruit Mushroom Growing Bags is the most popular practice (29%), followed by the use of credible online platforms and innovative branding (21% each) emphasizing convenience and digital marketing in mushroom farming. Sustainable practices like composting (12%) and diversification through cultivating multiple mushroom types (10%) are moderately adopted. Value-added product creation (9%) and customer-friendly packaging (8%) show a growing interest in enhancing product appeal. However, low-cost cultivation units (5%) and outdoor growing units (4%) have limited adoption, indicating potential areas for improvement.

Documenting the technology gaps & constraints: Important constraints and technology gaps perceived by women mushroom growers are limited access to quality spawn (100%), poor market information and access (83.33%), lack of awareness on standardized practices & pest and disease management (76.67%), less access to technical support and consultancy (76.67%), use of ICT & applications on mushroom (73.3%).

Improvement in nutritional and income security of farm women through Arka Vegetable seed kit

The data compared the adoption of ICAR-IIHR technologies among 40 women farmers (Chilli var. Arka Meghana, Tomato var. Arka Rakshak and Brinjal var. Arka Harshitha) that has brought about a transformative impact on income of women farmers from Doddaballapura taluk. It was evident from the primary data gathered by the growers in the year 2024. After adoption of IIHR varieties, the earnings increased significantly from 15% to 18% in many cases. Based on average yield, price per kg and net income from an area of 0.1 acre (4 guntas), Arka Harshitha emerged as profitable with average yield of 738.9 kg and average net income of Rs. 24,015/- per yr. Arka Meghana with average yield of 116.84 kg, @ Rs. 130 per kg, resulted in average net income of Rs. 15,188/-. Arka Rakshak with a moderate yield of 623.5 kg @ Rs. 22 per kg, resulted in lowest average net income at Rs. 13,716/-. The increase in income is largely attributed to the superior performance of improved seeds/ hybrids, which have resulted in higher yields.

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4.1 Tropical fruits

The identified work of AICRP (Fruits) is carried out at ICAR-IIHR, Bengaluru and its regional centres at CHES, Bhubaneswar and CHES, Chettalli.

ICAR-IIHR, Bengaluru

Mango: IC numbers were obtained for two mango varieties, Arka Udaya and Arka Suprabath. IC numbers were obtained for 3 accessions of Imphal centre. In mango rootstock breeding trial, about 2552 flowers of Vellaikolumban were crossed with Turpentine and raised 1 F_1 progeny. About 1167 flowers of Olour were crossed with Turpentine and raised 5 F_1 progenies. In a mango scion breeding trial, a total of 3322 flowers of Amrapali were crossed with Vanraj, raised 26 F_1 progenies. In the MLT trial of mango, all the varieties included for the trial (Pusa Deepshika, Pusa Manohari, Pusa Lalima, Arka Suprabath, R3P16, R3P22, R5P3, R5P23 along with check varieties (Amrapali, Mallika and Alphonso) are planted for evaluation.

Papaya: In the experiment entitled 'Multilocation testing of new papaya hybrids (MLT-II)', the shortest period to flowering was observed in PH4 (89 days) followed by PH2 (96 days). PH5 (121 days) required longest period for flowering. The shortest plant height at first flowering was observed in PH3 (125.88 cm), while the tallest plants were recorded in PH5 (171.56 cm). The lowest plant height was noted in PH3 (68.54 cm), which was on par with PH2 (81.98 cm) and PH1 (82.99 cm). Stem diameter at first flowering showed no significant variation among hybrids. Regarding PRSV (Papaya Ringspot Virus) severity at first flowering, PH4 recorded lowest incidence.

CHES Chettalli

At CHES Chettalli, there are six ongoing experiments (four on litchi and two on Citrus) in AICRP-Fruits.

Improving bearing potential of litchi through girdling of branches: Maximum flowering was observed in trees girdled with 4 mm in 50% branches (71.3%) which was on par 2 mm girdling of 50 % branches (68.3 %). Minimum flowering was noticed in control (38.3%). There were no significant differences in fruit drop among treatments at clove stage. Highest fruit yield (52.9 kg tree^{-1}) was observed in trees girdled with 4 mm in 50% branches which was on par with girdling of 2 mm 50% branches and 6 mm in 25% branches. Fruit yield was minimum in control (25.0 kg tree^{-1}). There were no significant differences among the treatments for fruit cracking, TSS content, fruit size, pulp recovery and fruit drop at colour break stage.

Survey and surveillance of emerging pests and natural enemies in litchi: During vegetative stage, maximum infestation was recorded for leaf rollers (38.9%), shoot and midrib borers *Conopomorpha* spp (26.6% and 33.3%), chrysomelid beetles (43.4%), weevils (25.8%) and stink bugs (28.8%). At flowering stage, flower webbers (32%), leaf rollers (60%), midrib borers (35%), chrysomelid beetles (51.4%), and stink bugs (38.8%) showed peak infestations. Fruit damage up to 17.5% by *Deudorix* spp and 35% by *Conopomorpha sinensis* was observed. Leaf rollers, loopers, shoot and midrib borers, and chrysomelid beetles were present throughout the year. Natural enemies in litchi ecosystem included *Coccinella septempunctata* L., praying mantises, predatory bugs, spiders, and various larval and pupal parasitoids.

Evaluation of promising clones of citrus (Grapefruit): Among seven varieties, there were significant differences in all the growth, fruit and biochemical parameters. Marsh Seedless variety recorded maximum plant height (3.22 m), plant girth (13.79 cm), plant spread N-S (3.57 m) and canopy volume (6.13 m^3), while minimum was noticed in the variety NRCC grape fruit. Marsh Seedless recorded maximum number of fruits (58), fruit weight (452 g), fruit length (9.66 cm), fruit diameter (10.0 cm), rind weight (155.5 g), TSS (8.67 °B), juice (43.2%) and fruit yield (26.3 kg plant^{-1}).

CHES Bhubaneswar

Mango: Soil application of RDF + 100 g Zinc sulphate + 50 g Copper sulphate + 50 g Borax (Soil application) after harvest and foliar spraying of 0.2% Zinc sulphate + 0.1% Copper sulphate + 0.1% Boric acid (2 sprays at just before flowering and marble stage) resulted in maximum yield (14.59 t ha^{-1}) with 115% increase over control. This treatment also recorded minimum number of fruits with jelly seeds and fruit cracking.

Assessing the effect of climatic variability on mango flowering and yield: The days taken for 50% flowering was lowest (13.16 days) in Arka Neelachal Kesari followed by Amrapalli (16.95 days) and Dushehari (17.21 days). The flowering intensity was highest in Neelachal Kesari (63.0%) Amrapalli (61.5%) followed by Dusheheri (35.4%). Maximum flowering duration (45.1 days) was observed in "Dashehari" and minimum duration of flowering (33.1 days) was recorded for "Arka Neelachal Kesari". The number of male flowers

per panicle was the lowest in "Dushehari" (220) and was highest (481) in "Amrapalli". Similarly, number of perfect flowers per panicle was observed maximum (225) in Amrapalli and minimum number of perfect flowers per panicle (111.5) was recorded in "Dusheheri".

4.2 Arid zone fruits (AICRP-AZF)

Three ongoing trials at ICAR-IIHR, Bengaluru are on germplasm introduction and evaluation in pomegranate, annona and fig, and cultivar improvement in pomegranate. About twenty-nine germplasm in Annona have been maintained in the field gene bank which is mostly used for breeding program and identification of resistant/ tolerant sources for Annona fruit fly. MLT trial on Anardana Pomegranate varieties is also conducted. USDA pomegranate genotypes were characterized for growth and yield traits, showing high variability across different traits such as the number of fruits per tree, yield, fruit cracking percentage and wilt incidence. Evaluation of sweet types pomegranate revealed that number of fruits was highest in Solapur Lal (59.00) followed by Bhagwa and Super Bhagwa. The yield was also highest in Solapur Lal and was on par with Bhagwa and Super Bhagwa. In the varietal trial of sour-type hybrid pomegranate, IC 1181 did not flower at the Bengaluru and also has collected scions of male parents (Nayana and Hybrid A) from NRC, Pomegranate, Solapur. These scions are currently being multiplied and will be planted in the upcoming monsoon season.

4.3. VEGETABLE CROPS

Tomato

Processing tomato IET: The entry 2023/TOPROC-3 recorded maximum fruit yield of 58.5 t ha^{-1}.

Determinate tomato AVT-II: Among six entries tested, the entry 2021/TODVAR-2 registered highest marketable fruit yield of 41.3 t ha^{-1}.

Hybrid Determinate AVT-II Trial: Among six hybrids evaluated, 2021/TODHYB-3 recorded maximum marketable fruit yield of 56.4 t ha^{-1}.

Cherry Tomato AVT-II: Among six entries tested, the entry 2021/TOCVAR-2 recorded the highest marketable fruit yield of 24.6 t ha^{-1}. Total soluble solids varied from 5.20 to 6.88°Brix with majority genotypes registering TSS around 6. Highest vitamin C was found in Line 2021/ TOCVAR-2 and highest carotenoids and lycopene content in 2021/TOCVAR-6. Antioxidant capacity and total phenols were significantly higher in line 2021/TOCVAR-3.

BWR IET: Out of nine entries were tested, three entries such as 2023/TOBWR-8, 2023/TOBWR-5 and 2023/ TOBWR-3 recorded maximum marketable fruit yield of 30 t ha^{-1}.

ToLCV Hybrid AVT-I Trial: Among seven entries, the hybrid 2022/ToLCVHYRES-4 registered highest fruit yield of 76.5 t ha^{-1}.

ToLCV Varietal AVT-I Trial: The entry 2022/ ToLCVVARRES-2 recorded maximum marketable fruit yield (44.0 t ha^{-1}) followed by 2022/ToLCVVARRES-5 (41.1 t ha^{-1}).

ToLCV Hybrid AVT-II Trial: Among seven entries tested, 2021/ToLCVHYRES-2 recorded highest marketable fruit yield of 75.1 t ha^{-1}. Among different lines, total soluble solids varied significantly from 3.90 to 5.20 °Brix. Line 2021/TODHYB-2 recorded highest TSS of 5.20°Brix). Vit C were significantly higher in line 2021/TODHYB-2 and 2021/TODVAR-6. Total carotenoids and lycopene were highest in line 2021/ TODVAR-5 and antioxidant capacity and total phenols in 2021/TODVAR-2.

Chilli

Varietal Trial (IET): Among the 11 entries evaluated, the entry IET/2023/CHIVAR 2 recorded the highest marketable red ripe fruit yield of 46.52 q ha^{-1}.

Varietal Trial (AVT I): The entry 2022/CHIVAR 4 recorded the maximum marketable red ripe fruit yield of 52.89 q ha^{-1} among the ten entries tested.

Varietal Trial (AVT II): Among fourteen entries tested, the entry AVT II/2021/CHIVAR 4 recorded recorded the maximum marketable red ripe fruit yield of 51.52 q ha^{-1} followed by AVT II/2021/CHIVAR 2 (49.77 q ha^{-1}).

Hybrid Trial (IET): A total of eight hybrids were evaluated and among them, the entry IET/2023/CHIHYB 8 recorded the highest marketable red ripe fruit yield of 67.79 q ha^{-1} followed by IET/2023/CHIHYB 6 (67.26 q ha^{-1}).

Hybrid AVT-I Trial: Seven hybrids were tested RBD design with three replications and among them, the entry 2022/CHIHYB-1 (55.05 q ha^{-1}) recorded the maximum red ripe fruit yield.

Hybrid AVT-II Trial: Eight hybrids were tested in RBD with three replications and among them, 2021/CHIHYB 3 recorded the highest marketable red ripe fruit yield (108.97 q ha^{-1}).

Resistant IET Trial: A total five entries were evaluated and among them, the entry IET/2023/CHLCVRES 2 recorded the highest red ripe pod yield of 59.07 q ha^{-1}.

Resistant AVT-II Trial: A total of nine entries were tested and among them, the entry 2021/ CHILCVRES-9 recorded the highest red ripe fruit

yield of 99.33 q ha^{-1} followed by 2021/CHILCVRES-1 (98.33 q ha^{-1})

Bell Pepper

Varietal Trial (IET): Among ten entries evaluated, the entry 2023/CAPVAR-10 (188.67 q ha^{-1}) registered highest fruit yield.

Varietal Trial (AVT-I): Among seven entries tested, the entry 2022/CAPVAR-8 recorded the marketable fruit yield of 173.00 q ha^{-1}.

Varietal Trial (AVT-II): Among six entries tested, the entry 2021/CAPVAR-3 recorded the highest marketable fruit yield of 106.4 q ha^{-1} followed by 2021/CAPVAR-7 (105.55 q ha^{-1}).

Brinjal

Germplasm evaluation trial: Seven germplasm accessions were evaluated for yield and attributing traits, IIHR-846 recorded the highest fruit yield (3.21 t ha^{-1}).

Varietal Long IET Trial: Among 13 entries tested, 2023/BRLVAR-6 recorded the highest fruit yield of 255.6 q ha^{-1}.

Varietal Round IET Trial: Among twelve entries evaluated, the entry 2023/BRRVAR-8 recorded the highest fruit yield of 271.8 q ha^{-1}.

Varietal Long AVT-I: Among 14 entries tested, the entry 2022/BRLVAR-14 recorded the highest marketable fruit yield of 562.96 q ha^{-1}.

Varietal Round AVT-I: Among 14 entries, the entry 2022/BRRVAR-9 recorded the highest marketable fruit yield of 540.7 q ha^{-1}.

Varietal Long AVT-II: Among ten entries, the entry 2021/BRLVAR-7 recorded the highest marketable fruit yield of 459.3 q ha^{-1}.

Varietal Round AVT-II: Among twelve entries, the entry 2021/BRRVAR-8 recorded the highest marketable fruit yield of 429.6 q ha^{-1}.

Long IET trial: Among six entries, the entry 2023/BRLHYB-4 recorded highest marketable yield of 305.6 q ha^{-1}.

Long AVT-I Trial: Among seven entries, 2022/BRLHYB-3 registered highest marketable yield of 585.2 q ha^{-1}.

Hybrid Round AVT-I trial: Among seven entries, 2022/BRRHYB-7 recorded highest marketable fruit yield of 577.8 q ha^{-1}.

Hybrid Round AVT-II Trial: Out of six hybrids, 2021/BRRHYB-6 recorded highest marketable fruit yield of 562.2 q ha^{-1}.

Okra

YVMV Hybrid IET Trial: Among eight hybrids, 2023/OKYVHYBRES-2 recorded highest fruit yield (172.9 q ha^{-1}).

YVMV Varietal IET Trial: Out of eleven varieties, 2023/OKYVVARRES-11 was the maximum yielder (197.6 q ha^{-1}).

YVMV Hybrid AVT-I Trial: The entry 2022/OKYVHYBRES-6 registered highest marketable fruit yield (195.93 q ha^{-1}) out of eight entries tested.

YVMV Varietal AVT-I Trial: The entry 2022/OKYVVARRES-1 recorded the highest fruit yield of 200.5 q ha^{-1} followed by 2022/OKYVVARRES-1 (190.4 q ha^{-1}).

YVMV Hybrid AVT-II Trial: The entry 2021/OKYVHYBRES-2 recorded the highest marketable fruit yield of 194.6 q ha^{-1} followed by 2021/OKYVHYBRES-8 (189.8 q ha^{-1}).

YVMV Varietal AVT-II Trial: Among ten entries, the entry 2021/OKYVRES-9 recorded the highest fruit yield of 213.8 q ha^{-1} followed by 2021/OKYVRES-1 (198.9 q ha^{-1}).

Ridge Gourd

Varietal AVT-II: Five ridge gourd varieties were evaluated in RBD with four replications, two entries namely, 2021/RIGVAR-3 (209.7 q ha^{-1}) and 2021/RIGVAR-4 (191.6 q ha^{-1}) recorded highest yield.

Hybrid AVT-I Trial: Five ridge gourd hybrids were evaluated in RBD with four replications during summer season, two entries namely, 2022/RIGHYB-4 (274.6 q ha^{-1}) and 2022/RIGHYB-3 (256.4 q ha^{-1}) recorded highest yield.

Hybrid AVT-II Trial: Seven ridge gourd hybrids were evaluated in RBD with four replications during summer season and among them, two entries namely, 2021/RIGHYB-7 (297.8 q ha^{-1}) and 2021/RIGHYB-6 (287.2 q ha^{-1}) were recorded highest yield.

Bitter Gourd

Varietal IET Trial: Among seven varieties evaluated, the yield levels were higher in two entries namely 2023/BIGVAR-4 (112.6 q ha^{-1}) and 2023/BIGVAR-1 (85.7 q ha^{-1}).

Hybrid IET Trial: Out of eight hybrids, the entries namely 2023/BIGHYB-3 (123.25 q ha^{-1}) and 2023/BIGHYB-7 (115.00 q ha^{-1}) were high yielders.

Hybrid AVT-I Trial: Nine bitter gourd hybrids were evaluated during summer and two entries namely, 2022/BIGHYB-6 (120.37 q ha^{-1}) and 2022/BIGHYB-8 (112.00 q ha^{-1}) recorded higher yields.

Hybrid AVT-II Trial: Among seven hybrids, the entry 2021/BIGHYB-2 (144.5 q ha^{-1}) was the highest yielder followed by 2021/BIGHYB-3 (105.86 q ha^{-1}) during summer season.

Biochemical characterization of Bitter gourd AVT-II: Out of seven lines, TSS varied from 2.37 to 4.17 °Brix. Highest vitamin C, total phenol and antioxidant activity by FRAP was found in AIC-24-48. Highest total carotenoid was observed in Line AIC-24-44. Line AIC-24-48 and AIC-24-44 had highest antioxidant capacity.

Bottle gourd

AVT II Varietal trial: Complete plant mortality was observed at the flowering stage caused by GSB and *Fusarium* wilt diseases in some genotypes. Out of remaining three entries, the entry 2021/BOGVAR-7 recorded the highest marketable fruit yield of 355.2 q ha^{-1}.

IET Hybrid trial: Due to complete plant mortality at the flowering stage caused by GSB and *Fusarium* wilt diseases, only one genotype yield was given (216.9 q ha^{-1} 2023/BOGHYB -6).

AVT II Hybrid Trial: The genotype 2021/BOGHYB-4 did not germinate. The entries such as 2021/BOGHYB-1, 2021/BOGHYB-3, 2021/BOGHYB-5, 2021/BOGHYB-6, and 2021/BOGHYB-7 were affected due to complete plant mortality due to incidence of GSB and *Fusarium* wilt diseases at the flowering stage. The entry 2021/BOGHYB-2 recorded the marketable fruit yield of 373.7 q ha^{-1}.

Cucumber

Varietal IET Trial: Among five entries, the entry 2023/CUCUVAR-5 recorded maximum fruit yield of 495.7 q ha^{-1}.

Hybrid IET: Among five entries, the entry 2023/CUCUHYB-2 recorded the marketable fruit yield of 538.8 q ha^{-1}.

Hybrid AVT-I Trial: The entry 2022/CUCUHYB-1 recorded highest marketable fruit yield of 473 q ha^{-1} and identified as the best entry among the six entries tested.

Variety AVT-II: Among seven entries, the entry 2021/CUCUVAR-4 recorded highest marketable fruit yield of 338.5 q ha^{-1}.

Hybrid AVT-II Trial: Out of six hybrids, 2021/CUCUHYB-1 registered highest marketable fruit yield (550.3 q ha^{-1}).

Muskmelon

Variety AVT-I: Among seven entries, the entry 2022/MMVAR-3 recorded maximum marketable fruit yield of 252.5 q ha^{-1}.

Hybrid AVT-I Trial: Among seven entries, 2022/MMHYB-3 recorded highest marketable fruit yield of 246.9 q ha^{-1}.

Pumpkin

Germplasm evaluation trial: Among 28 accessions evaluated, the accession 2023/IIHR-P-7 recorded the highest fruit yield (54.3 t ha^{-1}).

Varietal Trial (AVT-I): Among six entries, the entry 2022/PUMPVAR-3 recorded the highest marketable fruit yield of 411.1 q ha^{-1}.

Varietal trial (AVT-II): Among seven entries, 2021/PUMPVAR-1 recorded the marketable fruit yield of 465.5 q ha^{-1}. Total soluble solids varied significantly between the lines (5.63 to 8.83°Brix). Highest vitamin C and total carotenoids were observed in line 2021/PUMVAR-6. Antioxidant capacity (FRAP) and total phenols were significantly higher in line 2021/PUMVAR-6. Line 2021/PUMVAR-6 showed good quality parameters among all.

Carrot

Varietal Evaluation (Tropical) AVT-I: Among seven carrot tropical varieties evaluated, entry 2022/CARTRVAR-1 recorded significantly highest marketable root yield (259.80 q ha^{-1}). The entry 2022/CARTRVAR-1 recorded the highest carotenoid (14.58 mg 100 g^{-1}) and phenolic content (29.12 mg GAE 100 g^{-1}). Entries such as 2022/CARTRVAR-3 and 2022/CARTRVAR-4 demonstrated superior vitamin C levels, with 13.30 mg 100 g^{-1} and 13.25 mg 100g^{-1}, respectively.

Hybrid (Tropical) AVT-I: Out of seven entries, 2022/CARTRHYB-2 recorded highest marketable root yield (228.8 q ha^{-1}). The entry 2022/CARTRHYB-4 had the highest TSS (10.05 °Brix) while 2022/CARTRHYB-5 exhibited highest phenolic content (23.30 mg GAE/100g).

Hybrid Evaluation AVT-II (Temperate): Out of five entries, the entry 2021/CARTEHYB-2 recorded highest

root yield (155.0 q ha^{-1}). The entry 2021/CARTEHYB-2 recorded maximum content of carotenoids (14.53 mg 100 g^{-1}), phenolics (23.37 mg GAE/100g), and FRAP antioxidant potential (22.43 mg ACE100 g^{-1}). The entry 2021/CARTEHYB-1 exhibited the highest TSS (9.90 °Brix).

Carrot Hybrid Evaluation AVT-II (Tropical) trial: Out of six entries, 2021/CARTRHYB-6 recorded the highest root yield (183.3 q ha^{-1}). The entry 2021/CARTRHYB-4 exhibited highest carotenoid content (16.05 mg 100 g^{-1}) and phenolic content (24.73 mg GAE 100 g^{-1}). TSS was maximum in 2021/CARTRHYB-6 (9.90 °Brix), and vitamin C content was highest in 2021/CARTRHYB-2 (14.74 mg 100 g^{-1}).

Garden Pea

Garden Pea (Early)-IET: Among the lines evaluated, 2023/PMVAR-2 recorded the highest green pod yield (51.46 q ha^{-1}) followed by 2023/PMVAR-1 (37.08 q ha^{-1}).

Garden Pea (Mid)-IET: Among the lines evaluated, 2023/PMVAR-3 recorded the highest green pod yield (117.56 q ha^{-1}) followed by 2023/PMVAR-1 (98.47 q ha^{-1}).

Garden Pea (Mid)-AVT-1: Among the lines evaluated, 2022/PMVAR-9 recorded highest green pod yield (120.01 q ha^{-1}) followed by 2022/PMVAR-5 (118.64 q ha^{-1}).

Garden Pea (Early)-AVT-II: Among the lines evaluated, 2021/PEVAR-3 recorded the highest green pod yield (119.63 q ha^{-1}) followed by 2021/PEVAR-9 (103.92 q ha^{-1}).

Garden Pea (Edible Podded)-AVT-II: Among evaluated lines, 2021/PMVAR-7 recorded highest green pod yield (122.06 q ha^{-1}) followed by 2021/PMVAR-3 (119.85 q ha^{-1}).

Garden Pea (Mid)-AVT-II: The line 2021/PMVAR-5 recorded the highest green pod yield (119.04 q ha^{-1}) followed by 2021/PMVAR-1 (112.10 q ha^{-1}).

French Bean

Varietal trial (IET): The entry 2023FBVAR-4 recorded highest pod yield of 107.4 q ha^{-1} among the test entries.

Dolichos Bean

Varietal Trial (Pole) IET: The line 2023/DOLPVAR-7 recorded the highest green pod yield (287.6 q ha^{-1}) followed by 2023/DOLPVAR-4 (273.9 q ha^{-1}).

Varietal Trial (Pole) AVT-I: The entry 2021/DOLPVAR-7 recorded the highest green pod yield (206.2 q ha^{-1}) followed by 2021/DOLPVAR-5 (198.6 q ha^{-1}).

Varietal Trial (Pole) AVT-II: The line 2021/DOLPVAR-9 recorded the highest green pod yield (222.9 q ha^{-1}) followed by 2021/DOLPVAR-2 (202.9 q ha^{-1})

Cowpea

Varietal trial (IET): Entry 2023COPBVAR-4 recorded the highest pod yield of 180.37 q ha^{-1} followed by 2023COPBVAR-6 (179.06 q ha^{-1}).

Varietal trial (AVT-II): Entry 21COPBVAR-3 recorded the highest pod yield of 123.15 q ha^{-1} followed by 21COPBVAR-4 (104.27 q ha^{-1}).

Cluster bean

Varietal Trial IET: The entry 2023/CLBVAR-2 recorded highest pod yield of 143.42 q ha^{-1}

Drumstick

Germplasm evaluation trial: Among 24 accessions, the accession 2023/IIHR-D-20 recorded maximum number of 97.8 flowers per inflorescence.

Cabbage

AVT-II: Among six entries, 2021/CABVAR-4 recorded highest head yield of 473.16 q ha^{-1}.

Hybrid AVT-I Trial: Among six entries, 2022/CABHYB-4 recorded maximum marketable head yield of 630.8 q ha^{-1}.

Hybrid AVT-II Trial: Out of seven entries, 2021/CABHYB-7 recorded highest head yield of 615.5 q ha^{-1}.

4.4 Flower crops

Marigold

Among six French marigold genotypes, Pusa Parv was better performing for loose flower yield (477.1 g per plant) with 4.40 cm average flower diameter. Arka Pari and Arka Madhu were early to flower with fifty percent flowering in 45 days.

Tuberose

For cut flower, double floret genotypes BRH-19 and Arka Vaibhav performed better than the other varieties. BRH-19 (4.89) recorded the highest number of spikes per clump followed by Arka Vaibhav (4.46). For pot culture, Shayadhri Vaman was found superior with dwarf compact spike (44.77 cm) and good number of florets per spike (49.67), and number of spikes per plant (3.07). For loose flower, Arka Keerthana was superior with early flowering (94.63 days), medium size flower bud (1.31 g), diameter of flower (4.53 cm) and single flower weight (1.42 g). It produced highest number of

spikes per plant (8.38) with the loose flower yield of 18.92 t ha^{-1}.

Gladiolus

For cut flower purpose. Arka Ranjini was found superior with early flowering (62.20 days), highest number of florets remained open at a time (4.13) and number of spikes per plant (2.13). It was followed by Pusa Manmohak (red colour) and Pratap Glad-1 (half white) with highest number of florets per spike (16.07 and 15.40), and number of spikes per plant (1.80 and 2.07), respectively.

Ornamental Kale

Genotypes for Cut stem types - KtOK-125 and KtOK-39 (Purple) and pot /bedding types - KtOK- 2 and KtOK- 1 were tested with Ornamental Kale Fringed as check. Maximum plant height was recorded in KtOK-125 followed by Ornamental Kale Fringed. Diameter of central coloured portion was maximum in Ornamental Kale Fringed. Average stem diameter and head size were maximum in Ornamental Kale Fringed followed by KtOK- 2.

Collection and evaluation of *Jasminum* spp.: Morphological characterization and evaluation of 15 genotypes of *Jasminum sambac*, 4 genotypes of *Jasminum grandiflorum* and three genotypes of *Jasminum auriculatum* was done.

Effect of organic stimulants on performance of chrysanthemum: In chrysanthemum var. Scent Yellow, application of NPK @ 75: 112.5: 75 kg ha^{-1} (75% RDF) + foliar application of seaweed extract IFFCO Sagarika @ 3 ml L^{-1} resulted in maximum flower yield per plant (477.4 g) and benefit-cost ratio of 3.94.

Enhancement of growth cycles in crossandra stock plants using PGR's for propagation: In crossandra, plants sprayed with 300 ppm GA_3 recorded the maximum increase in the length of cut-back stem, minimum time to reach 10 cm long shoots (115.90 days) and the maximum diameter of the shoot (2.50 mm). Rooting in cuttings was also highest at 63.2%.

4.5 Medicinal and Aromatic Crops

Betelvine

Collection and maintenance of germplasm: Five germplasm lines were collected from Haveri (3), Davanagere (1) and Tamil Nadu (1). A total 109 accessions of *Piper betle L.* are maintained in the field gene bank as NAGS centre.

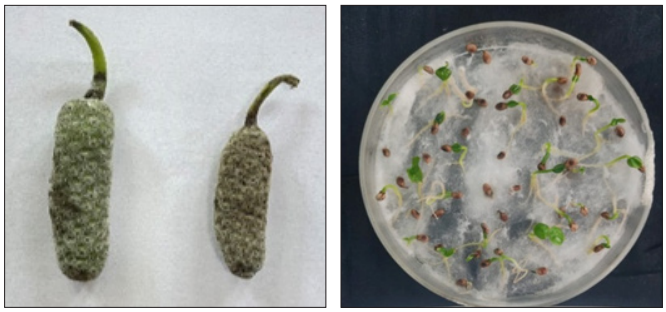
Germplasm characterization and evaluation: A total of sixty-nine germplasm accessions were characterized for 11 qualitative and 20 quantitative traits. The data on plagiotropic shoot traits was recorded in 45 lines and inflorescence traits were recorded in 33 clones. Variability for quantitative traits has been noted in the germplasm; Orthotropic leaf length/breadth (l/b) ratio was lowest in IIHR BV 31 (1.22 cm) and highest in IIHR BV45 (1.63 cm). The lowest adventitious root production recorded in IIHR BV 8 (4.10) and highest in IIHR BV 53 (13.90). Number of nodes per plagiotropic shoots was maximum in IIHR BV 34 (14.30) followed by IIHR BV 33 (13.80). Plagiotropic leaf length/breadth (l/b) ratio was lowest in IIHR BV 31 (1.13 cm) and maximum in IIHR BV 48 (1.69 cm). Number of plagiotropic shoots per meter length of vine is maximum in IIHR BV 53 (4.80) followed by IIHR BV 44 and IIHR BV 45 (4.60). Longer plagiotropic shoots were recorded in IIHR BV 71 (59.66 cm) followed by IIHR BV 32 (53.91cm) and IIHR BV 34 (53.60 cm).

In qualitative traits, plagiotropic leaf lamina shape is elliptic in five accessions, wide elliptic shape in 10 clones followed by ovate shape in 30 accessions. Clones differed for flower color and among 33 germplasm accessions, six accessions recorded yellow and 27 clones exhibited beige flower color. All germplasm accessions showed coriaceous orthotropic leaf texture except Maghai and IIHR BV 53 where it is membranaceous. Germplasm lines had acuminate leaf apex shape except IIHR BV 23 which recorded acute leaf apex shape. The data on flowering revealed that, IIHR BV 24, IIHR BV 37, IIHR BV 53 is profuse flowering among female clones. Among male clones, IIHR BV 1, IIHR BV 58 and IIHR BV 163 are found to be profusely flowering.

Crop improvement: Ten inter-varietal crosses were carried out. The germination percent in different crosses ranged from 29.76% (IIHR BV 23 × IIHR PBH 9-13) to 86.36% (IIHR BV 53 × IIHR BV 58). Around 993 hybrid seedlings were raised from different crosses and are being established in the polybags under polyhouse.

Hybridisation

Hybridisation was attempted with Meetha pan as female parent which is shy flowering clone with very few inflorescence. The seed germination percent in Meetha pan crosses was maximum in IIHR BV 170 × IIHR PBH 6-4 (89%) followed by IIHR BV 170 × IIHR PBH 9-13 (76.92 %). A total 5 inter specific crosses was carried out with *P. colubrinum*. Fruit set was not observed in the crosses attempted.



Fruit Set and Germinating Seeds from Meetha pan crosses

Evaluation of Hybrids: Hy 09-16 is a female hybrid, producing very attractive, elliptic, light green leaves resembling Kapoori type, resistance to powdery mildew and field tolerance to leaf spots with high leaf yield per vine ((231.6) followed by Kapoori Badami (154.6), Hy 09-13 (150) and Hirehalli local (123.8). More than 200 Hybrid seedlings from different crosses selected based on vigour and leaf traits have been field planted for further screening.

4.6 PLANT PROTECTION

Tomato/ Chilli/ Cucurbits - Mapping of viral diseases in vegetable crops: The results demonstrated that begomovirus infections were most prevalent in both tomato and chilli samples across Karnataka, Telangana, and Tamil Nadu. Following begomoviruses, mixed infections involving cucumoviruses (CMV) and potyviruses (ChiVMV) were the next most common. Tobamovirus infections were the least frequent in the samples tested. Additionally, a significant finding of this study was the detection of tomato brown rugose fruit virus (ToBRFV) in tomato samples.

IDM for bacterial wilt management of solanaceous vegetable crops: For integrated management of bacterial wilt of tomato, soil application of bleaching powder @ 15 kg ha^{-1} before transplanting, soil amendment with lime depending upon pH of the soil, seedling root dipping in Streptocycline @ 200 ppm and drenching of Copper oxychloride @ 0.3% thrice at 10-day interval started 20 days after transplanting is recommended for Bengaluru region.

Integrated management of bitter gourd virus diseases: For Karnataka state, the integrated management of bitter gourd virus diseases comprises growing of two rows of maize as boarder crop along with Silver Agri-mulching and erecting of 15 yellow and blue sticky traps per acre with rotational spray of AMC @ 5.0 ml L^{-1} followed by Spray of sea weed extract Sagarika @ 2.0 mL L^{-1} + Neem oil @ 2.0 mL L^{-1} and Priproxifen @ 0.1% at 10 day interval. It is a promising practice with overall reduction in vector incidence, virus incidence and enhanced yield and BC ratio of 2.09.

Integrated management of gummy stem blight stem/ splitting disease of cucurbits: During Rabi 2023 at Hesaraghatta location, gummy stem blight severity in muskmelon var. Arka Siri ranged between 20.97 to 79.27 PDI among different management interventions imposed. The treatment that consists of First spray of Carbendazim @ 0.1% started at first sign of disease followed by spray of Zineb @ 0.2% after 10 days of first spray, third spray Azoxystrobin 4.8% + Chlorothalonil 40% SC @ 0.25% was the best treatment with lowest disease severity of 20.97 and highest yield of 20.17 t ha^{-1}.

Eco-friendly approach for management of soil borne diseases of Solanaceous crops: Field trial was carried out in *Rabi* 2023 under natural epiphytotic condition to study the effect of different management interventions on incidence of bacterial wilt (*Ralstonia solanacearum*) in tomato F_1 hybrid NS501. The bacterial incidence ranged between 4.00 to 31.00% across different treatments. T_6 treatment with drenching of copper oxychloride 45% plus Kasugamycin 5% WP @ 3 g L^{-1} at the time of earthing and foliar spray of copper oxychloride 45% plus Kasugamycin 5% WP @ 3 g L^{-1} recorded significantly lower disease incidence and highest marketable yield compared to other treatments.

Monitoring emerging diseases of vegetable crops: During 2023-24 increased prevalence of collar rot (Southern blight) caused by *Sclerotium rolfsii* Sacc. was recorded on tomato in Bengaluru rural, Ramanagara, Chikkaballapur and Kolar districts of Karnataka. The incidence ranged from 12.37 to 32.67%.

IPM module for management of Chilli thrips (*Thrips parvispinus*): The cumulative mean data from the experiment indicated that the Integrated Module was the most effective in controlling thrips, recording a significantly lower count of 6.2 thrips per plant. The Integrated Module achieved highest yield of 3.9 t ha^{-1} for red chilli, which was statistically similar to the yield of the Chemical Module at 3.6 t ha^{-1}. The Bio-Intensive Module followed with a yield of 2.9 t ha^{-1}, all significantly higher than the control (2.1 t ha^{-1}).

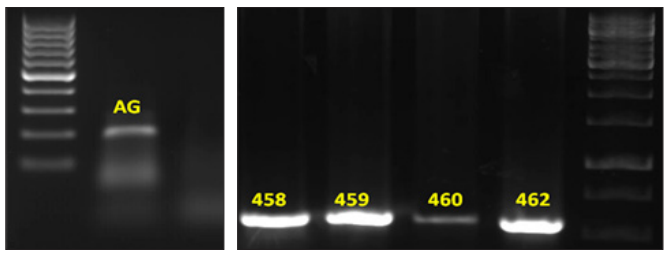
Arka Neem Pellet based insect pest management in cabbage: Based on three years of experimental data, it has been concluded that spraying ICAR-IIHR's Neem seed powder pellets at a concentration of 30 g L^{-1}, starting 10-15 days after transplantation and continuing at weekly intervals until one-fourth head formation,

effectively managed aphids and diamondback moth (DBM). This method is as effective as Diafenthiuron 50WP at 1 g L^{-1} and Spinosad 45SC at 0.3 mL L^{-1}.

Survey and surveillance for new invasive insect pest *Tuta absoluta* in tomato: *Tuta absoluta* infestation was quite low, ranged between 10-35% during 2023-24.

Emerging viral diseases in cucurbitaceous crops: *Begomoviruses* (F: Geminiviridae) causes severe devastation and crop losses in vegetable crops. Among the reported begomoviruses, Squash leaf curl China virus infecting ash gourd is predominant during the reporting period. It affects all the stages of crop growth. The typical symptoms were severe curling, rosetting, vein thickening, interveinal chlorosis, no flowering or fruit set if the infection at early stage, fruits shows malformation, distorted shape and hard pulp. The typical symptomatic leaves were processed for PCR based diagnostics and results confirmed the infections of SqLCCV on ash gourd.

PCR based diagnostics for ashgourd and squash (SqLCCV)



Index: AG: Ash gourd , 458: Ash gourd, 459: Ash gourd, 460: Cucumber 462: Squash

4.6 Energy Management in Agriculture

Energy auditing for dry chilli cultivation

Energy auditing study for dry chilli cultivation was carried out in eleven villages (Bhadrapur, Shankarabande, Shishvinahalli, Saidapur, Bommapur, Kabbur, Gundur, Belavalakoppa, Nalatvad, Kuntanahal and Ibrahimpur) in Karnataka State under selected agro-climatic zones namely, Northern Dry Zone, Central Dry Zone and Northern Transition Zone, respectively. The highest energy was utilized for fertilizer application (41.49%) followed by land preparation (15.94%), plant protection (14.14%), transportation (8.87%), irrigation (4.97%), harvesting (4.79%), manure application (4.05%), drying (3.08%), grading (1.83%), bagging (0.37%), seed bed preparation (0.21%), raising of seedlings (0.06%), sowing (0.03%), mulching and drip lining (0.02%) and stickering (0.02%), respectively.

The average percentage of energy utilized under direct energy sources *viz.*, men, women, tractor, diesel and electricity were found to 9.55%, 10.55%, 0.84%, 29.36% and 4.770 %, respectively. The indirect energy sources *viz.*, seed, fertilizer, pesticide and machinery were found to be 0.01%, 42.04%, 2.91% and 0.03%, respectively. The percentage of total direct and indirect energy utilized for dry chilli cultivation was computed to be 55.01% and 44.99%.

Energy auditing for green chilli cultivation

The energy auditing for green chilli was carried out in six villages (Jodisanenahalli, Sindigere, Chikkahalli, Nagarahalli, Aralalu and Obalapura) in Karnataka State in selected agro-climatic zones namely, Northern Dry Zone, Central Dry Zone and Eastern Dry Zone, respectively. The highest energy was utilized for fertilizer application (38.93%) followed by plant protection (18.18%), land preparation (13.21%), transportation (9.72%), harvesting (8.13%), irrigation (4.93%), manure application (4.89%), seed bed preparation (1.44%), transplanting (0.19%), bagging (0.14%), mulching and drip lining (0.10%), raising of seedlings (0.10%) and sowing (0.03%), respectively.

The average percentage of energy utilized under direct energy sources *viz.*, men, women, tractor, diesel and electricity were found to 9.04%, 10.32%, 0.71%, 32.26% and 4.58%, respectively. The indirect energy sources *viz.*, seed, fertilizer, pesticide and machinery were found to be 0.005%, 39.62%, 3.42% and 0.04%, respectively. The percentage of total direct and indirect energy utilized for green chilli cultivation was computed to be 56.92%% and 43.08%.

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5.1. Training Programs Organized

On-campus Trainings

Title of the Program	Date	Number of participants
ICAR-IIHR, Bengaluru		
Entrepreneurship Mushroom spawn production	03.01.2024-05.01.2024	15
Flower cultivation for the Tribal farmers of Tumkuru, Karnataka (TSP)	06.01.2024	70
Water melon and musk melon cultivation and input distribution for the farmers of Tumkuru dist. Karnataka	06.01.2024	100
Technologies in chilli and onion crop production and value addition for tribal farmers of Theni and Namakkal district, Tamil Nadu (TSP)	07.01.2024	89
Soil and water management in vegetable crop production	08.01.2024 - 09.01.2024	33
Entrepreneurship Mushroom cultivation	08.01.2024-12.01.2024	27
Exposure visit cum on campus training to participate National Seminar flower technologies by tribal farmers of Tumkuru district of Karnataka (TSP)	11.01.2024	50
Training and exposure visit to participate in National Seminar flower technologies for tribal farmers of Mysore district of Karnataka (TSP)	11.01.2024	57
Improved production technologies, Post harvest processing and Value addition of Fruits' for tribal farmers of Jharkhand State under MIDH	12.01.2024-17.01.2024	59
Management strategies for export and advances in production technology of vegetable, fruits and ornamental crops Off-line Physical training handled session on Value chain of horticulture crops	16.01.2024-18.01.2024 16.01.2024 - 22 .08.2024	25
Analytical aspects of heavy metals in fruits	19 .01.2024-	15
Cultivation aspects of Dragon fruit & Jack fruit on at IIHR, Bengaluru to famers and officials of Department of Horticulture, Coimbatore	30.01.2024-	20
Improved Production Technology, Post-Harvest Processing and Value Addition of Selected Fruit Crops (Jack fruit, Tamarind, Custard apple. Avocado and Kamalam fruit) to farmers of Jharkhand state under MIDH scheme	12.02.2024-17.02.2024 (Batch-I) 26.02.2024-28.02.2024 (Batch II)	52 20
Hydroponics and Vertical Farming for famers from Sarkarsamakulam, Coimbatore, Tamil Nadu	13.02.2024	20
Capacity building program and Entrepreneurship development in Horticultural technologies for the FPOs of Tamil Nadu under TNAU-FPO project	14.02.2024-18.02.2024	108
FSSAI-sponsored workshop on 'Food Safety' The Role of Surveillance, Detection and Control system Advances	20.02.2024	110

Cultivation, Primary Processing, Quality Aspects and Marketing of Commercially Important Medicinal Crops and Jasmine"	20.02.2024	30
Coordinated training and demonstration programme on "Scientific Beekeeping"	22.02.2024	30
Nutrient Management in Horticultural Crops for SC/ST farmers of Karnataka (Mandya, Tumakuru, Chitradurga, Chamarajanagar, Kolar) in collaboration of KSCST, IISC, Bengaluru	22.02.2024-23.02.2024	22
Interstate Training Programme cum Exposure Visit on "Hydroponics and Vertical Farming for trainees from Chennai, Tamil Nadu	27.02.2024-29.02.2024	30
Soil, plant and water analysis for nutrient recommendation in horticultural crops	27.02.2024-29.02.2024	08
How to write a Winning Proposal for BIRAC Big Funding" & "Conceptualization and Designing of Agri Projects for Assured Funding from Banks	29.02.2024	15
Improved production technologies, Post harvest processing and Value addition of Fruits' for farmers of Jharkhand ICAR-IIHR, Bengaluru (MIDH)	04.03.2024-06.03.2024	46
Soilless Culture/Cocoponics for terrace/roof top/vertical gardening	05.03.2024-07.03.2024	35
Training and exposure visit to National Horticultural Fair and Horticultural technologies for Mysore district farmers ICAR-IIHR, Bengaluru (TSP)	05.03.2024	50
Training and exposure visit to National Horticulture Fair and training to ICAR-IIHR technologies for tribal farmers of Dharmapuri District of Tamil Nadu (TSP)	05.03.2024	300
Composting of Farm/ Kitchen Wastes	05.03.2024-07.03.2024	24
Value Addition and Waste Utilization of Flowers	06.03.2024	20
Workshop on Hi-Tech Farming Techniques "(Hydroponics and Vertical Farming)")" jointly organized by COE– Protected Cultivation, ICAR-IIHR, Bengaluru and SPH	06.03.2024	38
Exposure visit for the farmers of Kadavur block of Karur District of Tamil Nadu under SSEOERS- ATMA on Chilli cultivation	06.03.2024	40
Exposure visit for the farmers of Kundadam block of Tirupur District of Tamil Nadu under ATMA on Chilli varieties, hybrids and cultivation	07.03.2024	20
Entrepreneurship Mushroom cultivation training	12.03.2024-14.03.2024	20
Pollen cryopreservation in vegetables for hybrid seed production	18.03.2024-22.03.2024	3
Agri business Incubation, Startup Ecosystem and its activities to students of Acharya Bengaluru B-School	08.04.2024	38
Pollen cryopreservation in vegetables for hybrid seed Production	20.05.2024-24.05.2024	3
Mushroom cultivation training	24.05.2024	20
Management Strategies for export and advances in production technology of Vegetable, Fruits and Ornamental crops for the Extension Officers of Kerala	05.06.2024-07.06.2024	25
Training for farmers of Virudhunagar district under ATMA on flowers, fruits and vegetable cultivation	18.06.2024-20.06.2024	120

Entrepreneurship Mushroom spawn production training	19.06.2024-21.06.2024	16
Hands on training on Production of Fruit and vegetable powder in collaboration with BESST-HORT	20.06.2024-22.06. 2024	26
Advanced technologies in Horticulture for the farmers of Karnataka under RKVY	23.06.2024-24.06.2024	20
Entrepreneurship Mushroom cultivation training	24.06.2024-28.06.2024	20
Soil, plant and water analysis for nutrient recommendation in horticultural crops	26.06.2024-28.06.2024	18
Improved vegetable production technologies" for the tribal farmers of Tamil Nadu under TNTSP	27.06.2024 -28.06.2024.	40
EDP Training on Quality Vegetable Seedling Production	27.6.2024	16
EDP on quality vegetable seedling production	27.06.2024	12
Collaborative Refresher Training Program "Extension for Horticultural technologies" MANAGE and ICAR-IIHR	10.07.2024 -12.07.2024	40
Value chain Extension jointly with MANAGE, Hyderabad	07.08.2024-09.08.2024	150
Cocoponics/Soilless Cultivation: A New Method of Growing Vegetables in Terrace/Rooftop/Vertical Gardens	19.08.2024	46
Refresher training program on "Opportunities for Value Addition in Horticultural Produce" for MANAGE	20.08.2024-22.08.2024	23
Novel technologies of ICAR-IIHR for farmers of Chamarajanagar District as part of SCSP programme in collaboration with KSDA, Chamarajanagar District.	02.09.2024	60
Cocoponics and Arka Fermented Cocopeat Production' for coir entrepreneurs from Tamil Nadu sponsored by TANCOIR, Government of Tamil Nadu	03.09.2024-04.09.2024	23
Hi-Tech Horticulture for farmers of Madhubani District, Bihar	09.09.2024 13.09.2024	21
Special training programme for the officers of NABARD on "Digital Agriculture, Use of IOT, Innovative and Hi-Tech Agriculture"	17.09.2024-19.09.2024	26
Kamalam Fruit Production and Value Addition was organized on by the Centre of Excellence (CoE) for Kamalam under MIDH	25.09.2024	125
DP Training (Jul-Sep 2024) on Commercial Breeding of Chilli and Capsicum	30.9.2024	47
Global GAP for export of Pomegranate and Mango	18.10.2024	60
Rural Horticultural Work Experience Programme (RHWEP) B.Sc. (Hons.) Horticulture students of College of Horticulture, Mudigere Campus, UAHS, Shimoga	11.11.2024-16.11.2024	25
Packaging, Storage, and Ripening Methods for Extension of Shelf Life and Quality Maintenance of Fruits and Vegetables	5.12.2024	12
MOBILE JOURNALISM, Collaborative Training Programme of MANAGE and ICAR-IIHR at Bengaluru (online)	06.12.2024	35

Hybrid seed production in cucurbits	10.12.2024-11.12.2024	18
Grafting technology and protected cultivation of vegetable crops for SC farmers of West Bengal	18.12.2024 21.12.2024	11
Improved technologies and varieties/hybrids of ICAR-IIHR, Bengaluru under SCSP Programme on Kisan Diwas for farmers	23.12.2024	80
Advanced Horticultural Technologies for the exporters under RKVY	13.11.2024-15.11.2024	20
CHES, Chettalli		
Scientific Cultivation of Avocado, Rambutan, Mango and Jack fruit to Technical Staff of State Horticultural Mission (SHM), Kasaragod District, Kerala	18.01.2024-20.01.2024	12
Household waste management and composting for home gardens in urban areas	05.01.2024	66
Awareness cum training programme on basic virtue of rooftop gardening	12.01.2024	83
Scientific Cultivation of Acid Lime, Avocado, and Teasel gourd" for Farmers of Tenkasi, Tamil Nadu organized at ICAR-IIHR-CHES, Chettalli during	12.02.2024-14.02.2024	12
Scientific Cultivation of Acid Lime, Avocado, and Teasel gourd" for Farmers of Virudhunagar, Tamil Nadu	12.02.2024-14.02.2024	15
Scientific Cultivation of Acid Lime, Avocado, and Teasel gourd" for Farmers of Virudhunagar, Tamil Nadu	12.03.2024-14.03.2024.	15
Induction and Orientation Training Programme for Newly Recruited Technicians (T-1)	22.05.2024-07.06.2024	4
One day Training on Rejuvenation of Coorg mandarin cum Input Distribution under RKVY	23.09.2024	150
Scientific Honey bee keeping and Apiary management as part of RKVY during 28.10.2024- 30.10.2024, 12.11.2024- 14.11.2024 and 10.12.2024-12.12.2024	October, November & December	75
CHES, Bhubaneswar		
Household waste management and composting for home gardens in urban areas	05.01.2024	66
Basic virtue of rooftop gardening	12.01.2024	83
Sensitization workshop on Importance of virus indexing in major horticultural crops	31.03.2024	25

Training for the Extension Officers of Kerala– Batch III from 5-7 June 2024

Training Programme for farmers of Jharkhand state from 12th to 17th Feb 2024

Training programme on "Hi-tech horticulture" for the farmers from ATMA Madhubani

Training programme on "Hi-tech horticulture" for farmers from ATMA Saharsa, Bihar during 25.11.2024-28.11.2024

Off-Campus Trainings

ICAR-IIHR, Bengaluru	Date	No. of participants
Improved Production Technologies for Horticultural Crops in Idukki District of Kerala" as part of TSP Scheme	04.01.2024	102
ICAR-IIHR technologies to the tribal farmers of Purulia dist, KVK, Purulia, West Bengal as part of TSP	21.01.2024	200
Farmer training program in collaboration with JVR Horticultural Research Station, Malyal as part of TSP	25.01.2024	65
Farmers field school on mango crop at Panasachoudenahalli village under NABARD project	08.02.2024	32
Health camp and input distribution for scientific rearing of sheep and goat at Hosadurga village of Kanakapura taluk, Ramanagara district (Farmer FIRST Project in collaboration with NDRI & NIANP)	20.02.2024	80
Training programme at Nelluru village, Devanahalli Taluk	23.02.2024	35
ICAR-IIHR technologies for the tribal farmers of BR hills of Chararajanagar district of Karnataka BR Hills Chamrajnagara as part of TSP	26.02.2024	69
ICAR-IIHR technologies for tribal farmers of Masinakudi Nilgiris District of Tamil Nadu Masinakudi, Nilgiris (TSP)	21.03.2024	88
Good dairy management practices and value addition at NDRI, Bengaluru	21.03.2024	35
ICAR-IIHR technologies for tribal farmers of Lower Pulney hills of Dindigul district of Tamil Nadu (TSP)	28.03.2024	65
ICAR-IIHR technologies for the tribal farmers of Puttur, DK District as part of TSP	21.06.2024	80
ICAR-IIHR vegetable varieties/hybrid and technologies for the Malnadu regions	21.06.2024	110
New Varieties and Improved Technologies of ICAR-IIHR and Distribution of Inputs" as part of SCSP programme at Jamboni, Jhargram dist, West Bengal	28.06.2024	100
Scientific Approach Towards Production and Processing of Kamalam (Dragon Fruit) by the Centre of Excellence (CoE) for Kamalam, ICAR-IIHR, Bangalore.	18.09.2024-27.09.2024	13
Kitchen Garden and Improved vegetable production technologies for the tribal farmers of Tamil Nadu under AINTHINAI MISSION	07.10.2024	190

Precision farming in vegetable production" in farmers' fields of Kanakapura taluk, Ramanagara district Sathnur hobli, Kanakapura taluk, Ramanagara district	10.10.2024	25
Capacity building program on ICAR-IIHR Horticultural Technologies	18.10.2024	131
Potential of Soilless Media for Vegetable Cultivation in Lakshadweep Islands' at Kavaratti Island, Lakshadweep.	23.10.2024	47
Improved vegetable production technologies, Kitchen garden and canopy management in fruit crops" for tribal farmers of Trichy dist in Tamil Nadu.	07.11.2024	136
New Varieties and Improved Technologies of ICAR-IIHR and input distribution Korakai village, Mangalur block, Cuddalore district, Tamil Nadu	20.11.2024	72
New Varieties and Improved Technologies of ICAR-IIHR and input distribution KVK, Kalkiri, Madanpalli, AP	28.11.2024	40
New Varieties and Improved Technologies of ICAR-IIHR and input distribution KVK Haradanahalli, Chamaraja Nagar Karnataka	29.11.2024	120
New Varieties and Improved Technologies of ICAR-IIHR and input distribution Kanthalloor, Idduki dist., Kerala	10.12.2024	130
Canopy management in fruit crops organized by ICAR-IIHR for the tribal farmers of Pachamalai hills, Tamil Nadu as part of AINTHINAI Project.	22.12.2024	50
CHES, Chettalli		
Scientific Cultivation of Avocado at Harapanahalli and Kudligi taluks of Vijayanagara district	20.05.2024- 21.05.2024	60
CHES, Bhubaneswar		
Development of model nursery in horticultural crops in Mayurbhanj dist of Odisha	29.02.2024- 04.03. 2024	18
Development of model nursery in horticultural crops in Jharsuguda dist of Odisha	11.03.2024- 15.03.2024	18
Awareness cum training programme on Basic Virtue of Rooftop gardening	11-01-2024 15-01-2024 08-02-2024 10-02-2024 18-02-2024	25 110 72 26 17

KVK, Hirehalli		
	Number of trainings	**Number of participants**
On Campus	12	693
Off Campus	20	1269
Total	32	1962

Hon'ble Secretary (DARE) & Director General (ICAR) distributed the inputs to tribal farmers of West Bengal as part of TSP of ICAR-IIHR in Farmers Meet

Hon'ble Secretary (DARE) & Director General (ICAR), New Delhi **Dr. Himanshu Pathak** distributed the input kits developed by ICAR-IIHR to tribal farmers of Puruliadist in West Bengal on 21.01.2024. The inputs such as vegetable seeds, Arka vegetable special micro nutrients and Arka microbial consortium to the different beneficiaries of TSP in the presence of Dr. S.K. Singh, DDG (Hort Science), ICAR, New Delhi during the Farmers Meet on Encouraging Innovation to Adopt Climate Resilient Agriculture at KVK, Kalyan, Purlia District, West Bengal.

Training Programme at Idukki, Kerala under TSP scheme on 04.01.2024

5.2. Demonstrations

On-Farm Trials

Description of OFT	Location	Number
ICAR-IIHR, Bengaluru		
Composting of farm residues at Cherupuzha, and Kitchen waste composting	Kasaragod, Kerala and Vajram Apartments, Yelahanka	5
Arka Nutri Garden for augmenting mid-day meal programme	Haralahalli, Chikakadaluru and Dudda of Hassan dist and BR hills of Chamarajanagar dist, Karnataka	5
Arka Fermented Cocopeat production demonstration	Kavaratti Island, UT of Lakshadweep	1
IIHR Green peas (Arka Priya)	Gopalpura	01
ICAR-IIHR Kitchen garden kits	KVK,Kottayam	50
French bean (Arka Arjun)	Karumandurai	20
Ridge gourd (Arka Vikram)	KVK,Mangalore	02
ICAR-IIHR Kitchen garden kits	Karumandurai	50
ICAR-IIHR Kitchen garden kits	Pachamalai	45
ICAR-IIHR Kitchen garden kits	KVK Mangalore	20
ICAR-IIHR Mucuna (Arka Shubra)	Namakkal	01
IIHR technologies	**KVK, Hirehalli**	03

Front-Line Demonstrations

Mode of Demonstration with number of demonstrations	Place
New vegetable varieties and hybrids of vegetable and fruit crops of ICAR-IIHR (120) Integrated crop management practices in fruit and vegetable crops (70) Use of botanical pesticides and bio-products in integrated crop protection in fruit and vegetable crops (100) Foliar Nutrition in Banana (30)	Selected villages of Jhamboni block, Jhargram district, West Bengal
Integrated crop management practices in ICAR-IIHR hybrids in tomato and chilli (60) Improved varieties / hybrids of ICAR-IIHR and production technology of fruit crops (70) Integrated crop production technology of ICAR-IIHR varieties/ hybrids in fruit, vegetable, flower and medicinal crops (300) Demonstration of Mango – Alphonso (70) Demonstration of Guava – Arka Poorna (60) Demonstration of use of Neem Soap , AMC (Powder), Arka Sasya Poshak A & Arka Sasya poshak B (100)	Chamaraja Nagar district, Karnataka

Integrated crop management practices in ICAR-IIHR hybrids in tomato, chilli, ridge gourd, French bean, Yard long bean and other vegetable crops (70) Improved varieties and production technology of fruit crops (120) Improved varieties and production technology of ICAR-IIHR varieties/ hybrids in fruit and flower crops (120) Demonstration of Tomato hybrid Arka Smarat (15) Demonstration of Chilli hybrid - Arka Sanvi (15) Demonstration of Arka Harshita Brinjal seedlings (05) Demonstration of Arka Bhanu Marigold seedlings (20) Demonstration of Chilli hybrid - Arka Yashaswini (15)	Kolar district, Karnataka
Integrated crop production technology of ICAR-IIHR varieties/ hybrids in vegetable crops (120)	Kadalur district, Tamil Nadu
Integrated crop management practices in ICAR-IIHR hybrids in tomato, chilli, ridge gourd, French beans, Yard long beans and other vegetable crops (80)	Sivagangai district, Tamil Nadu
Mango hybrid Arka Udaya (60) Demonstration of lime – Balaji (35) Demonstration of Amla – Krishna and NA-7 Plants (30) Demonstration of Sapota – Cricket ball (30) Demonstration of Dragon fruit – Pink and White (30) Demonstration of Annona / Sitaphal – Arka Sahan (08) Demonstration of Jackfruit – Siddu and Shankara (20) Demonstration of Arka Vegetable seed kits (300)	Chamarajnagar district of Karnataka and selected villages in Kalkiri, Madanpalli dist of AP
Mango hybrid -Arka Suprabhath (40) Mango variety Kesar (25) Mango variety Dashehari (30) Demonstration of Jamun (15) Demonstration of Tamarind (10) Demonstration of Banana Yelakki Plants (05) Demonstration of Chilli Hybrid Arka Gagan,F1 (10) Demonstration of Cowpea Arka Suman and Arka Samrudhi (20) Demonstration of Garden Pea Arka Ajit (10) Demonstration of Palak Arka Anupama (40) Demonstration of Veg Amaranth Arka Samraksha (20) Demonstration of Ridge Gourd Hybrid Arka Vikram, F1 (20) Demonstration of Arka Savi of Rose (05)	Selected villages in Kalkiri, Madanpalli dist of Andhra Pradesh
Demonstration of Guava – Arka Kiran rooted (60) Demonstration of Coriander Arka Isha (20) Demonstration of Yard Long Bean Arka Mangala (50)	Kalkiri, Madanpalli dist of AP and Kanthalloor village, Idukki dist, Kerala
Demonstration of Tomato hybrid Arka Abedh (15)	Hondarbalu and Malladevanahalli villages of Kolar dist, Korakai village, Mangalur block, Cuddalore dist, TN
Demonstration of Tomato hybrid Arka Apeksha (05) Demonstration of Chilli hybrid - Arka Tanvi (15) Demonstration of Brinjal Arka Keshav (15) Demonstration of Amaranth Arka Suguna (30) Demonstration of AMC (Liquid & Powder) Pongamia soap, Neem Soap, Vegetable special, Banana special, Citrus special (50)	Kanthalloor village, Idukki district, Kerala

Demonstration of Chilli Hybrid Arka Meghana ,F1 (10) Demonstration of Brinjal Arka Nidhi (10) Bottle Gourd Arka Bahar and Arka Shreyas (10) Demonstration of Dolichos Bean (Pole Type) Arka Prasidhi and Arka Krishna (50)	Selected villages in Kalkiri, Madanpalli dist of AP and Korakai village, Mangalur block, Cuddalore dist, TN
Demonstration of French Bean Arka Arjun (70)	Chamarajnagar dist of Karnataka, Idukki dist of Kerala and Cuddalore dist of TN
Demonstration of Cucumber Arka Veera (10) Demonstration of Okra Hybrid Arka Nikita, F1 (40) Demonstration of Pumpkin Arka Suryamukhi (50)	Madanpalli district of Andhra Pradesh, Idukki dist of Kerala and Cuddalore dist of TN
Demonstration of Ridge Gourd Arka Prasan (20)	Kanthalloor village, Idukki dist, Kerala and Korakai village, Mangalur block, Cuddalore dist, TN
Demonstration of use of AMC, Neem Soap, and Vegetable special, Pongamia soap, Mulching Sheet and crates (80)	Korakai village, Mangalur block, Cuddalore dist, TN
Demonstration of use of Light Traps, Fruit fly lures, Water Traps, Mulching Sheets, Melon traps and plastic crates (70)	Selected villages in Chamarajnagar dist and Kanthalloor, Idukki dist of Kerala
Demonstration of Ragi var. ML-365 (CS) (250) Demonstration of Ragi var. ML-365 (CS) (290) Demonstration of Redgram BRG-4(TL)/BRG-5(TL) (150) Demonstration of Field bean HA-4 (CS) (250) Demonstration of Proso millet- improved variety (30) Demonstration of Foxtail millet - improved variety (50)	Kolar, Chamarajnaga, Ramanagar and Chikkaballapur dists
Demonstration of brown top millet (20)	Ramanagar district
Integrated Farming System practices to enhance the income of mango-based cropping systems (NABARD project) (14)	Panasachoudenahalli village, Chintamani
Arka Onion seeder & Arka Onion Bulblet planting material (1)	Bashettihalli and Chelur, Chikkaballapura dist
Composting of farm residues (2)	Cherupuzha, Kasaragod, Kerala
Arka Nutri Garden for augmenting mid-day meal programme (3)	Haralahalli, Chikakadaluru and Dudda of Hassan dist,
IIHR technologies (14)	**KVK, Hirehalli**

5.3 Farmer–Scientist Interface Meetings

Place	Number of meetings	Number of participants
Integrated Farming System practices to enhance the income of mango-based cropping systems was done at Panasachoudenahalli village, Chintamani Taluk (NABARD project) at ICAR-IIHR	6	220

Brainstorming and fruit diversity show on papaya and passion fruit on 17.01.2024 at CHES, Chettalli	1	150
Field day cum diversity fair on Avocado on 15.06.2024 at CHES, Chettalli	1	300
Awareness programme on PPV&FR Act, Fruit Diversity show and Field Day on Mangosteen and Rambutan in collaboration with PPV&FRA, Ministry of Agriculture and Farmers Welfare, GoI, New Delhi on 19.10.2024 at CHES, Chettalli	1	250
Farmers-scientist interaction of post-harvest management of mango produce done on 29.07.2024 at CHES, Bhubaneswar	1	
KVK, Hirehalli	2	277

5.4. Exhibition

Event and Location	Date and venue
Exhibition of papaya and passion fruit genotypes	17.01.2024 at CHES, Chettalli
Demonstration of Flower waste utilization technology	16.01.2024-26.01.2024, at Lalbagh Republic Day flower show, Bengaluru
National Horticulture Fair -2024 ICAR-IIHR Bengaluru	04.03.2024 to 07.03.2024
Exhibited stall at GKVK, Exhibition, UAS Bengaluru	12.03.2024 UAS Bengaluru, GKVK Campus
Triphal Diversity Show-2024	31.05.2024-02.06.2024 at ICAR-IIHR Bengaluru
Exhibition of avocado fruit genotypes in Field Day cum Diversity Fair on Avocado	15.06.2024 CHES, Chettalli
Agri Exhibition -2024Kongu Kalyana Mandapa, Salem	26.07.2024
State Level Mega Farmers Day 2024 TNAU, Coimbatore	26.09.2024 - 29.09.2024
Bharat Traditional Vegetables and Seeds Festival Padavani College, Salem	06.10.2024
Coco Fest @ 2024 – The festival of coconut KVK, Lakshadweep	20.11.2024 – 22.11.2024
Krishimela	14.11.2024 - 17.11.2024 at GKVK, Bengaluru
CHES, Bhubaneswar	
Krushi Odisha 2024 with a theme “Celebrating Women”	12.01.2024-14.01.2024 Janata Maidan, Bhubaneswar
Agrivision 2024	ICAR-National Rice Research Institute, Cuttack on 19.01.2024-20.01.2024
National Horticulture Fair 2024	ICAR-IIHR, Bengaluru, 05.02.2024-07.02.2024
Foundation day of ICAR-CIWA	17.02.2024 at Bhubaneswar
National Seminar on Climate Smart Agriculture OUAT, Bhubaneswar	03.03.2024 at OUAT, Bhubaneswar
SoA-Agri-Confluence (SAC)-2024	Siksha-O-Anusandhan, Bhubaneswar on 12.03.2024-14.03.2024
Foundation day ICAR-IIWR	Bhubaneswar on 12.03.204
Aam Mahotsav 3.0	NABARD Regional office, Nayapalli, Bhubaneswar 10.06.2024-12.06.2024

5.5 Media (TV, Radio, Newspaper, Webinars etc.) Television Programes/Radio talk

Name	Mode	Number of Meetings/ Date
IIHR Bengaluru		
"Protected Cultivation of Vegetable Crops"	Live phone in programme at DDK, Bengaluru on 17.01.2024	01
1. Release varieties of Brinjal by Dr TH Singh 2. Improved varieties and hybrids of Brinjal by Dr TH Singh	Programme in DD Chandana	02 on 05-03-2024 and 06-03-2024
KVK, Hirehalli	TV Talks	05
	News paper	18
CHES, Chettalli	**Akashavani, Madikeri**.	
Dr. Muralidhara, B.M.	Radio talk on "Cultivation of Off-season Litchi"	04/01/2024
Dr. Muralidhara, B.M.	Radio talk on "Cultivation of Rambutan"	11/01/2024
Dr. A T Rani	Radio talk on "Management of Insect Pests of Litchi fruit crop"	23/05/2024
Dr. A T Rani	Radio talk on "Management of Insect Pests of Teasel gourd"	30/05/2024
Dr. Nayan Deepak G.	Radio talk on "Cultivation Practices for Passion Fruit"	21/05/ 2024
KVK, Hirehalli	Radio talks	02

Revenue Generation

Different centers /divisions	Revenue generated (Rs.)
RFS-Fruit crop nursery (January-December 2024)	1,74,44,382/-
RFS-Seed production unit (January-December 2024)	2,66,21,686/-
RFS-Flower and medicinal crops (January-December 2024)	90,69,563/-
Division of Natural Resources	77,33,273/-
Division of Basic Sciences	44,21,585/-
Division of Crop Protection	53,56,211/-
Division of Social Sciences and Training (January-December 2024)	51,25,637/-
Agricultural Technology Information Centre (January-December 2024)	1,76,00,000/-
ICAR-IIHR, Bengaluru (April-December 2024)	1,91,28,000/-
CHES, Chettalli (January-December 2024)	1,03,89,504/-
CHES, Bhubaneswar (January-December 2024)	32,93,710/-
Experimental Farm, Hirehalli	17,28,529/-

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6.1. PG Education

a) Courses Offered for IARI-IIHR Students during the 67th Academic Session of ICAR-IARI, New Delhi

A total of 74 courses were offered to IARI-IIHR Ph.D. and M.Sc. students during the first semester of the 2024-25 academic year, across 15 disciplines.

b) Award of M.Sc. and Ph.D. Degrees

List of ICAR-IARI (Outreach campus at ICAR- IIHR) Ph.D. Degrees awarded

S. No	Name of the Student	Roll No	Discipline	Name of the Guide
1.	Ms. B.H. Sushmitha	11516	FSC	Dr. T. Sakthivel
2.	Mr. Nitin P S	11512	FSC	Dr. M. Sankaran
3.	Ms. Lavanya H N	11631	VSC	Dr. B. Varalakshmi
4.	Mr. Yathish V C	11623	VSC	Dr. M. Pitchaimuthu
5.	Ms. Sangeetha Priya. S	11500	FLA	Dr. C. Aswath
6.	Mr. Vittal Kamble	11595	PHT	Dr. C.K. Narayana
7.	Mrs. B. Vanlalneihi	10900	VSC	Dr. K. Madhavi Reddy
8.	Mrs. Anushree Anand	11104	PHT	Dr. D. V. Sudhakar Rao
9.	Mr. Sourav Mahapatra	11132	VSC	Dr. E. S. Rao
10.	Ms. Soudamini Karjee	11030	FLA	Dr. C. Aswath

MSc Degrees awarded for SAU students

Name of Student	University	Degree	Thesis Title	Name of the Guide
Sri Lalita Yellapragada	OUAT	MSc (Ag.) Fruit Science and Horticulture Technology	Influence of girdling on flowering, fruit set, yield and quality of Mango cv. Arka Neelachal Kesari	Dr. G. C. Acharya (Co-Chairman)
Plabita Saikia	OUAT	MSc (Ag.) Fruit Science and Horticulture Technology	Effect of micronutrients on yield and quality of mango (*Mangifera indica* L.) cv. Amrapali	Dr. G. C. Acharya
T. Priyanka	OUAT	MSc (Ag.) Fruit Science and Horticulture Technology	Influence of foliar application of nano boron and nano zinc on fruit retention, yield and quality of mango	Dr Deepa Samant
Anjana M	OUAT	MSc (Ag.) Vegetable Science	Studies on genetic variability and comparative inherent abiotic stress tolerance capacity of winged bean (*Psophocarpus tetragonolobus* L.) *Vis-à-vis* other legume vegetables	Dr. A. V. V. Koundinya

Ayesha Siddiqua	OUAT	M.Sc. Bioinformatics	Molecular Diversity Analysis of *Psophocarpus* species	Dr. A. V. V. Koundinya
Varhsan HS,	UAS, GKVK	M.Sc Agric. Statistics		2022-2024
Pallavi	UAS, GKVK	M.Sc Agric. Statistics		2022-2024
Sukanya Ranebennur	UAS, GKVK	M.Sc Agric. Statistics		2022-2024

c) ICAR-IIHR PG Faculty recognised with ICAR-IARI, New Delhi

S. No	Name of the Scientist	Discipline
1.	Dr. Sandeep kumar G.M., Scientist, ICAR-IIHR	Plant Pathology
2.	Dr. Satya Priya Singh, Scientist, CHES, ICAR-IIHR	Entomology
3.	Dr. Ramesh, K.V., Scientist, ICAR-IIHR	Plant Physiology
4.	Dr. V. Baskaran, Pr. Scientist, ICAR-IIHR	Floriculture & Landscaping
5.	Dr. K. Abirami, Pr. Scientist, ICAR-IIHR	Fruit Science
6.	Dr. G. Senthil Kumaran, Pr. Scientist, ICAR-IIHR	Agricultural Engineering (FMPE)
7.	Dr. Sreenivasa V, Sr. Scientist, ICAR-IIHR	Genetics and Plant Breeding
8.	Dr. Devindrappa, Scientist, SS, ICAR-IIHR	Nematology
9.	Dr. Reena Rosy Thomas, Pr. Scientist, ICAR-IIHR	Computer applications
10.	Shri. Challuri Srinivas, Sr. Technician, ICAR-IIHR	Library Science

d) Research guides recognized with ICAR-IARI, New Delhi

S. No	Name of the Scientist	Discipline
1.	Dr. Sandeep Kumar G.M., Scientist, ICAR-IIHR	Plant Pathology
2.	Dr. Satya Priya Singh, Scientist, CHES, ICAR-IIHR, Bhubaneswar	Entomology
3.	Dr. Prathibha M.D., Scientist, ICAR-IIHR	Plant Physiology
4.	Dr. A. Carolin Ratnakumari, Pr. Scientist, ICAR-IIHR	Agricultural Engineering (FMPE)
5.	Dr. B.R. Jayanthi Mala, Sr. Scientist, ICAR-IIHR	Entomology
6.	Dr. G. Selvakumar, Pr. Scientist, ICAR-IIHR	Microbiology
7.	Dr. G. Karunakaran, Pr. Scientist, ICAR-IIHR	Fruit Science
8.	Dr. Priti Sonavane, Scientist (Sr. Scale), ICAR-IIHR	Plant Pathology
9.	Dr. Pritee Singh, Senior Scientist, ICAR-IIHR	Biochemistry
10.	Dr. (Ms.) A.T. Rani, Scientist, ICAR-IIHR	Agricultural Entomology
11.	Dr. Nayan Deepak G., Scientist, ICAR-IIHR	Fruit Science
12.	Dr. P.V.R. Reddy, Pr. Scientist, ICAR-IIHR	Entomology
13.	Dr. Rajendiran, S., Sr. Scientist, ICAR-IIHR	SSAC
14.	Dr. V. Sridhar, Pr. Scientist, ICAR-IIHR	Entomology

15.	Dr. Pushpa Chetan Kumar, Scientist, ICAR-IIHR	Food Science and Nutrition
16.	Dr. Vageesh Babu Hanur, Pr. Scientist, ICAR-IIHR	MBB
17.	Dr. Gobinda Chandra Acharya, Pr. Scientist, ICAR-IIHR	Vegetable Science
18.	Dr. Manamohan Siddappa Maligeppagol, Pr. Scientist, ICAR-IIHR	Plant Physiology
19.	Dr. Devindrappa, Scientist (SS), ICAR, IIHR	Nematology
20.	Dr. Sreenivasa V., Sr. Scientist, ICAR-IIHR	Genetics & Plant Breeding
21.	Dr. Sridhar Gutam, Pr.Scientist, ICAR-IIHR	Plant Physiology

Enriching the Academic Journey

Inauguration of new dining facility

The ICAR-Indian Institute of Horticultural Research (ICAR-IIHR), Bengaluru, witnessed the inauguration of new dining facilities on 5th September 2024 at its campus in Hesaraghatta. The event was graced by the presence of Dr. Sanjay Kumar Singh, Deputy Director General of Horticultural Sciences, ICAR, New Delhi, Shri. Y. S. Patil, IAS, Commissioner of Agriculture, Government of Karnataka, Dr. Tusar Kanti Behera, Director, ICAR-IIHR, Dr. Prakash Patil, Project Coordinator-Fruits and Dr. R. Venugopalan, Chairman of PG Education, ICAR-IIHR.

ICAR-IIHR Students sports meet 2024

A three-day sports meet was held for the students of IARI-IIHR from 27th to 29th August 2024. The event was inaugurated by Dr. Tusar Kanti Behera, Director, ICAR-IIHR, with an opening volleyball match between senior and junior students Students competed in 19 sporting events, including cricket, football, volleyball, badminton, carom, chess, table tennis, races, and relays, with separate events for boys and girls. All 96 students participated as teams vying for the top championship. The overall winners were Kodachadri, followed by Himadri and Sahyadhri. Among the girls, Ms. Kota Meghana was recognized as the best performer, while Mr. Raghavendra HC earned the distinction among the boys.

BEST student award

Ms. Chandana S, Ph.D. student in Floriculture & Landscape Architecture, was awarded the Best Student Award for 2023 on 5th September 2024, during 58th Foundation Day celebration of ICAR-IIHR, Bengaluru.

DEEKSHARAMBH 2024

The ICAR-IIHR in Bengaluru has evolved into a prominent academic center under IARI, focusing on education, training, and capacity building. Since the introduction of Ph.D. programs in 2014-15, the institute has expanded its offerings to include M.Sc. programs alongside Ph.D. programs across eight disciplines: Fruit Science, Vegetable Science, Floriculture and Landscaping, Post-Harvest Technology, Plant Pathology, Entomology, Plant Physiology, and Molecular Biology and Biotechnology. In the recent academic year, 2024-25, the institute welcomed a cohort of 33 students.

Under the guidance of Professor Dr. Tusar Kanti Behera, Director, ICAR-IIHR Bengaluru, students received valuable advice to excel in their academic pursuits. Dr. Prakash Patil, Project Coordinator (Fruits), Dr. M.

Sankaran, IARI-Hub Coordinator, Dr. R. Venugopalan, Chairman of the PGE Cell, and the Heads of Divisions extended a warm reception to the newcomers, fostering an environment of support and encouragement.

To familiarize students with the campus and its resources, an orientation program namely **DEEKSHARAMBH 2024** was organized from 21st to 28th, November 2024. The program included a variety of activities, such as exposure tours to key institute facilities, including Academic/Research/Lab buildings, the Agriculture Technology Information Centre (ATIC), Seed & Planting Material Sales Counter, Statistics Lab, Library, BESST-Hort, Revolving Fund Scheme (RFS) – Seed, Mushroom, Agribusiness Incubation (ABI), and sports and recreational areas like the Indoor Badminton Workshop. A visit to the Central Horticultural Experiment Station and Krishi Vigyan Kendra (KVK) Hirehalli was organized. Dr. N. Loganandhan, Head of KVK-Hirehalli, provided an overview of the ongoing frontline demonstrations, training programs, plant health clinic, honey testing laboratory, seed production unit, AMC, vegetable special production facilities, nursery, and farm at KVK. Students also visited the Centre of Excellence on Kamalam and were briefed on ongoing research activities related to Kamalam by Dr. Karunakaran G., PI of CoE, Kamalam.

Deeksharambh 2024 program was concluded with a formal valedictory session. The ceremony was graced by the presence of Dr. Sanjay Kumar Singh, Deputy Director General of Horticultural Sciences, ICAR, New Delhi; Dr. T. Janakiram, former Vice-Chancellor of Dr. YSR Horticultural University, Dr. Tusar Kanti Behera, Director ,ICAR-IIHR; Dr. Prakash Patil, Project Coordinator (Fruits), ICAR-IIHR, Bengaluru and Dr. R. Venugopalan, Chairman of PG Education, ICAR-IIHR.

MoU with WSU, Australia

ICAR-IIHR has signed a MoU with Western Sydney University, Australia, to allow candidates to undertake dual Ph.D. Degrees in the field of Horticultural Sciences (Breeding, Biotechnology, Protected cultivation, Precision farming, Plant Protection and Post Harvest Management) in Horticultural Crops. Under this dual Ph.D. degree program, two students namely Ms. Gowthami G. V. and Jaykishan Rajivbhai Korat selected to carry out their PhD course work with Western Sydney University (WSU), Australia. The professors from the Western Sydney University gave valuable feedback to the students. They also suggested the names of specialized faculty from WSU for further interaction by the students for refinement of the programme. Both the Professors from WSU delivered a talk on the works in Western Sydney University.

Students successful in competitive exams

During 2024, four students from IARI-IIHR, Bengaluru Hub selected for ARS: Dr Sushmitha (guide Dr Sakthivel); Dr Thaneshwari (guide Dr Aswath); Dr Manisha (guide Dr Padmini) and Dr Lavanya (guide Dr Varalakshmi) for their great achievements.

Placement cell

A placement cell was set up for the IARI-IIHR students under chairmanship of Dr. Vageeshbabu S. Hanur. As part of the activities of the cell, the following meetings & trainings are conducted.

1. A Skill Development Training Program for senior PG students of ICAR-IIHR was held from 20.8.2024 to 23.08.2024 on "Statistical Methods for Research Data Analysis using R" with Certificate of Completion.
2. On 18th November 2024, a Guidance Training was held by CIPC with Professor, for the PG students who were preparing for the ARS interviews in the respective horticultural subjects at the ASRB, by both offline and online modes.
3. On 1st December 2024, an interactive meeting with horticultural industry leaders and PG students, was held in the presence of Dr. Sawant, at ICAR-IIHR, Bengaluru.

Agriculture Education Day

PG Education, ICAR-IIHR celebrated Agriculture Education Day on 3rd December 2024 at National Public School, Chikkabanavara. Faculty and students from ICAR-IIHR shared insights on "Endless Opportunities" in Agriculture, scope of careers in agriculture, Innovations like agri-tech and precision farming and vital role of agriculture in sustainability and food security. The students were inspired to see how agriculture is more than farming—it's a future full of possibilities.

Dissertation work completed

Student's name	University	Degree	Thesis Title	Guide
A.Sarath Babu	ANGRAU	M.Sc. (Ag.) (Agric. Microbiology)	Studies on nodule microflora of vegetable legumes for nodulation efficiency and plant growth promoting abilities	Dr. G. Selvakumar
Ms Bindu, H. (Roll NO. 11591)	IARI-IIHR, Bangalore	Ph. D Degree in Post harvest Technology (Horticulture) on 15h February 2024.	Thesis Title: Standardization of storage temperature and pretreatments for extension of storage life of muskmelon	Dr. V. Sudhakar Rao, Principal Scientist, Division of PHT & AE
Mr. Abhilash, K	University of Horticultural Sciences, Bagalkot	Ph. D	submitted his thesis entitled "Studies on source – sink relationship of coloured grape varieties in mild tropics of India" to the	Dr. J. Satisha.
Ms U. Sri Pavani,	COH YSRHU, Anantharajupeta	Ph. D	submitted his thesis entitled "Evaluation of pomegranate (Punica granatum L) progenies for improved horticultural traits and confirmation of hybridity using marjers"	Dr. Anuradha Sane

- Dr. Shamina Azeez mentored Mr. Naveen AN, SPARSH FELLOW of BIRAC and BESST – HORT on-site incubatee for the 'Post-Harvest Reduction and Value Addition of Avocado Products', from February 2023 up to January 2024.
- **Internship training to students:** One month internship training to B.Tech (IT) student, Vellore lnstitute of Technology, Tamil Nadu from 3rd June, 2024 - 3rd July 2024 by Dr. Reena Rosy Thomas and Dr. M.K Chandra Prakash

- About 25 B.Sc final year Students of College of Horticulture, Mudigere, UAHS Shimoga, were given orientation during their exposure visit to ICAR-IIHR under Rural Horticulture Work Experience Programme (RHWEP), from l1th to 15th November, 2024, at ICAR-IIHR, Bengaluru. It was coordinated by **Harishkumar HV,** Scientist (Agric. Economics) and others.

6.2. TRAINING AND CAPACITY BUILDING PROGRAMMES TO STAFF

Scientific staff

S.No	Name of the staff	Designation	Training title	Institute	Date
1	Dr. G Karunakaran	Principal Scientist	30 Days Winter School International training programme on Technological Advances leading to smart farming & Agripreneurship		01.01.2024-30.01.2024
2	Dr E SrinivasaRao	Principal Scientist	Building and leading effective teams	Administrative Staff College of India	21.02.2024-23.02.2024
3	Dr M Arivalagan	Senior Scientist	International Training course on the Production and use of food composition data in nutrition	SAARC FOODS and ICMR-NIN Hyderabad	19.02.2024-24.02.2024
4	Ramya H.R	Scientist	Workshop on Generative AI Tools for Agriculture	ICAR-NAARM, Hyderabad	26.06.2024-28.06.2024
5	Dr Reena Rosy Thomas	Principal Scientist			
6	Safeena S.A	Principal Scientist	International Training Programme on " Agri Tech 2050: A Next Generation Training for Agripreneurship & Innovation Horizon"	Sri Konda Laxman Telangana State Horticultural University, Hyderabad	05.05.2024-20.05.2024
7	Dr Sreenivasa V	Scientist	Multivariate Data Analysis Using R	ICAR-NAARM Hyderabad	26.08.2024-30.08.2024
8	Dr Ramesh K.V	Scientist	Training-cum-awareness program on JGate@CeRA	Kerala Agricultural University, Thrissur	16.10.2024
9	Dr. K.N Poornima	Scientist	Next Generation Sequencing (NGS) Data Ananlysis	NAARM Hyderabad	21.10.2024-25.10.2024
10	Dr. Rohini M.R	Scientist	International workshop cum webinar on CRISPR Genome Editing	GLOSTEM	22.07.2024-26.07.2024
11	Dr. Tejaswini P	Principal Scientist	Orientation Programme for retiring govt officials planning for a retirement life	NAARM	29.08.2024
12	Dr. Sridhar Gutam	Principal Scientist	Workshop on Open Access Publishing	MANAGE Campus, Hyderabad	30.07.2024-31.07.2024

Training on E- Governance to Scientific staff at ICAR-IIHR during 6-8 May 2024

S.No	Name of the staff	Designation
13	Dr A V V Koundinya	Scientist
14	Dr Mahadevaiah	Sr. Scientist
15	Dr Abhishek Mandal	Scientist
16	Dr Anupa	Scientist

17	Dr C Chandrashekara	Sr. Scientist
18	Dr Chandrashekar	Scientist
19	Dr D C Manjunath Gowda	Scientist
20	Dr D Kalaivanan	Sr. Scientist
21	Dr M K Chandra Prakash	Principal Scientist
22	Dr Manjunatha L	Scientist
23	Dr NR Prasanna Kumar	Sr. Scientist
24	Dr Rajendiran	Sr Scientist CHES Chettali
25	Dr Rani A T	Senior Scientist
26	Dr Pushpa Chethan Kumar	Scientist
27	Dr Reena Rosy Thomas	Principal Scientist
28	Dr Smitha G R	Senior Scientist
29	Dr Sreenivasa V	Senior Scientist
30	Dr Sridhar Gutam	Principal Scientist
31	Dr TR Rupa	Principal Scientist
32	Dr Umamaheswari	Principal Scientist
33	Dr Usha Bharathi	Senior Scientist
34	Mrs PL Anushma	Scientist

Technical staff

S.No	Name of the staff	Designation	Training title	Institute	Date
1	Mr H. D Parashuram	Senior Technical Officer	Drone Pilot Training Programme	No. 36/278, Laxmi Nagar, Pune	11.02.2024-15.02.2024
2	Dr Omkar Naik	Technical Officer			
3	Mr Deenadayalan	Technical Officer			
4	Mrs S Saroja	Senior Technical Officer	Unique Identification Characteristics of insect pests and their damaging symptoms and management	NBAIR	18.03.2024-22.03.2024
5	Dr S Onkar Naik	Technical Officer			
6	Shri Syed Mukarum Ali Ahmed		Administrative and Financial Management	ICAR-NAARM, Hyderabad	25.11.2024-29.11.2024
7	K.N Jagadish	Chief Technical Officer	Drone Pilot Training Program	Mallarabanavadi Village, Bengaluru	02.09.2024-09.09.2024
8	Saroja	Senior Technical Officer			
9	Vinod Kumar	Technical Trainee (T-1)			
10	Ravikant Prajapathi	Technical Trainee (T-1)			
11	Asmit Singh	Technical Trainee (T-1)			
12	Dr Mandakanta Bhattacharya	Medical Officer	Retiring Govt officials Planning for happy retirement life	NAARM, Hyderabad	29.08.2024

13	K. Sivakumar Reddy	Technician	TDS Seminar	ICAR-IIHR	08.08.2024
14	Janakshi	Technical Officer			
15	Prashantha Kumar G.M	Technical officer	Tuber Vegetable based Nutri Gardens by organic and Ubran Framing	ICAR-CTCRI Thiruvanathapuram,	18.11.2024-22.11.2024

Training on E- Governance to technical staff at ICAR-IIHR during 6-8 May 2024

S.No.	Name	Designation
16	Dr Lakshmipathi	Chief Technical Officer
17	Dr Lokesha	Senior Technical Officer
18	Dr Onkar Naik	Technician
19	Mr Amal Johny	Technician
20	Mr Chandra Kumar	Senior Technical Officer
21	Mr P Dayananda	Senior Technical Officer
22	Mrs Deepa T	Technical Assistant CHES Chettali
23	Mrs Jyothi Appu Naik	Technical Officer
24	Mrs Lijina	Technical Assistant CHES-Chettali
25	Ms Anuradha RT	Senior Technical Officer
26	Ms VM Shilpashree	Technical Officer
27	Shri S Krishnananda	Technical Officer
28	Sri BC Patra	Senior Technician

Induction and Training Programme to newly joined technical staff (Technician 1) at ICAR-IIHR from 15.05.2024 to 14.06.2024

S. No.	Name	S. No.	Name
29	Sandip Kumar	45	Sunny Kumar
30	Asmit Singh	46	Harit Kranti Yadav
31	Awadhesh Dher Dubey	47	Prakash Hazari
32	Ratan Kumar Jha	48	Akash Kumar
33	Mallikarjun Nilappa Nidagutti	49	Animesh Singha Ray
34	Shivom Gupta	50	Ravikant Prajapati
35	Ajit Kumar	51	Savrav Kumar
36	Amit Maurya	52	Koushik Chandra das
37	Kavindra Kumar	53	Vinod Kumar
38	Vivek Kumar	54	ArnitaManjumdar
39	Ketan Raj	55	KumariDarshana
40	Rajnath Kumar	56	Gulshan Kumar
41	Anuj	57	Ghanshyam Pandit
42	Ankur Sharma	58	Avijit Mondal
43	Sudhir Tripathi	59	Randheer Kumar Thakur
44	Aniket Rajendra Walhekar		

Administrative staff

S.No	Name of the staff	Designation	Training title	Institute	Date
1	Jayashree	LDC	Pre examination Training	ICAR-NIASM, Baramati	21.08.2024-06.09.2024
2	Shri K.M Vijay Kumar	Asst Administrative officer	Administrative and Financial Management	ICAR-NAARM, Hyderabad	25.11.2024-29.11.2024
3	V. Raghuraman	Senior Administrative officer	Retiring Govt. Officials Planning for happy retirement life	NAARM, Hyderabad	29.08.2024
4	Pooja Kumari	Asst Administrative officer	All India official language conference	New Delhi	14.09.2024-15.09.2024

Training on E- Governance to administartive staff at ICAR-IIHR during 6-8 May 2024

5	Mr Senthil Kumar	AAO CHES Chettali
6	Mrs Annapurna Behera	AAO
7	Mrs CM Jenny	AO
8	Mrs Prashanti	AAO
9	Mrs Sangeetha M	AAO
10	Mrs Shylaja Chandrashekhar	AAO
11	Mrs Veda Kurnalli	Junior Stenographer
12	Shri S Thippeswamy	CTO
13	Smt. Anuradha L	AF&AO
14	Smt Mubeen Taj	Personal Assistant
15	Smt Suvasini Pradha	Private Secretary
16	Sri Arun Kumar Barik	Assistant

Training Programme on GeM to administrative staff at ICAR-IIHR on 16.07.2024

S.No	Name	Designation
17	Jayashree M	LDC Purchase Section
18	Renuka R	UDC Purchase Section
19	Sangeetha M	AAO
20	Bhagyalakshmi	Asst
21	Shylaja Chandrashekar	AAO (Stores)
22	Anuradha L	AFAO
23	Prashanthi C	AAO
24	Jyoti Appu Naik	Technical Officer
25	Prathiba M	PA
26	Sai Monicalakshmi	LDC
27	Pooja Kumari	AAO
28	Mallesh B	UDC
29	T.C Jagadeesh	UDC

30	G.S Rama Krishna	UDC
31	R Prasanna Kumar	LDC (Stores)
32	K.M Vijaya Kumar	AAO
33	Mohan CM	AAO
34	T Viswanatham	AAO
35	KG Jagadeshan	SFAU
36	Mukaram	AAO

TDS Seminar for administrative staff at ICAR-IIHR on 08.08.2024

S.No	Name	Designation
37	G.S Ramakrishna	UDC
38	P. Senthil Kumar	Asst Administrative officer
39	Renuka R	UDC
40	Sangeetha M	Asst Administrative Officer
41	S. Bhagyalakshmi	Assistant
42	T.C Jagadeesh	UDC
43	Jayashree M	LDC
44	Anuradha L	AFAO
45	P. Chandrakala	AAO
46	Pankaj Gopalwani	LDC
47	S. Sumithra Devi	AAO
48	V. Raghuraman	SAO
49	Veda Kurnalli	Personal Assistant
50	Sridevi G.C	UDC
51	Aachal Palewar	AAO
52	Pooja Kumari	AAO
53	Sanjeevani Desai	LDC
54	Anitha P	UDC
55	Dipanwita Del	AAO
56	Sadik Ali	F&AO
57	Mallesh B	UDC
58	Vinay V.R	Assistant Audit and accounts
59	Prathiba M	Personal Assistant Audit and Accounts
60	J Mathew	AO
61	B. Muraleedharan	AO
62	HR Surendra	AAO

Orientation Training Programme for Newly Recruited Assistant at ICAR-IIHR from 21.10.2024 to 25.10.2024

S.No	Name	S. No	Name
63	Mayank Chauvasia	80	Shefali Seth
64	ArpitSharda	81	Romita Dey
65	Tanvi Saini	82	M. Mathuramuthu Bala

66	Tejaswini C Hanji	83	Neelabh Pandey
67	Vishal Singh	84	Utkarsh Sinhe
68	Anushma Mitra	85	Yogesh Kaswan
69	Shashank Singh	86	Sambhavi J
70	Vivek Kumar	87	Jayasri R
71	Pradeep Kumar	88	Gowrabathina Yasaswi
72	Akik Shah	89	Monika M.T
73	Sonu Bala	90	Tejaswani Joshi
74	Pushpa Rani	91	Aparna Kaushik
75	Sonam Singh	92	Hinge Vishal Dattatirya
76	Rajeesh Pujari	93	Anand ST
77	Nirmal Singh	94	Kushal Mukherjee
78	Ashok Upadhyay	95	Pradeep Biradar
79	Mohit Ahlawat	96	S. Karthik

Foreign Deputation

1	Dr R Asokan	Principal Scientist	Basic Sciences	XXVII International Congress of Entomology	Kyoto	25.08.2024-30.08.2024
2	Dr Shankara S Hebbar	Principal Scientist	Vegetable Crops	Capacity building training in climate-smart and hi-tech agriculture (Energy films & Standardizing Soilless colour capsicum cultivation under semi-climate controlled polyhouse)	Hawkesbury Institute for the Environment western Sydney University, NSW 2751 Australia	08.09.2024-15.09.2024
3	Dr Kanupriya	Senior Scientist	Fruit Crops	Capacity building training in climate –smart and hi-tech agriculture (Standardizing vertical soilless strawberry cultivation under polyhouse)	Hawkesbury Institute for the Environment western Sydney University, NSW 2751 Australia	08.09.2024-15.09.2024
4	Dr Sridhar Gutam	Principal Scientist	Basic Sciences	2nd Global Summit on Diamond Open Access	Cape Town, South Africa	08.12.2024-14.12.2024

Attachment Training to ARS probationers

Name of the Scientist	Name of the Parent Institute	Name of the Guide
Dr. Pavithra V.	ICAR-IISS Mau, Uttar Pradesh	Dr. B. Balakrishna

6.3. Others

- Mrs. M. Malarvizhi has completed Ph.D. in Biotechnology, Jain (deemed to be) University and submitted thesis entitled "Identification of QTLs for fruit quality characters and expression analysis of lycopene pathway related genes in Guava (*Psidium Guajava* L.)" in November 2024, Guided by Dr. K.V. Ravishankar
- Dr. S. Ramachandran attended training program on "Sustainable Land Management" sponsored by Centre of Excellence, Indian Council of Forestry Research and Education held at Institute of Wood Science and Technology, Bengaluru during 16-18th December, 2024

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7. Awards and Recognitions

7.1. Awards

- Dr. Patil BL awarded 'Sir C.V. Raman Young Scientist State Award' in the field of Agriculture Sciences & Animal Husbandry for the year 2023 instituted by the Government of Karnataka and jointly conferred by IISc, Bengaluru and KSCST, Govt. of Karnataka.

- Dr. M. V. Dhananjaya, Principal Scientist, Division of Vegetable Crops received "Dr. M.H. Marigowda National Endowment Award 2022-23 for the Best Horticultural Research" for the year 2022-23, from UAS, GKVK, Bengaluru.

- Dr. M. V. Dhananjaya, Principal Scientist, Division of Vegetable Crops received "Dr. KALAYYA KRISHNAMURTHY NATIONAL AWARD - 2023-24, for the Best Agricultural Research" from UAS, GKVK, Bengaluru.

- Dr M Sankaran was awarded Eminent Scientist of the year 2024 by the Indian Pomological Society, Hc & RI, TNAU, Periyakulam
- Dr Sakthivel received Distinguished Scientist Award during 7th International Symposium on Minor Fruits at Institute of Agriculture, Visva-Bharati , West Bengal on 23 November 2024.
- Dr. Manjunatha Gowda DC was awarded NAAS Young Scientist in Horticultural Sciences 2024 by National Academy of Agricultural Sciences NASC Complex, DPS Marg, Pusa New Delhi – 110012, INDIA
- Best Scientist Award bestowed to Dr. Vijay Rakesh Reddy S for his outstanding research contribution in the field of Horticulture by The Society for Promotion of Horticultural Science and Technology during the International Conference on Emerging Postharvest Technologies for Shelf-life Enhancement and Valorization of Horticultural Crops (ICPHTV-24) from 4th - 5th January 2024.
- Dr. Linta Vincent received Himadri Young Scientist Award 2021 & 2022 from Indian Society of Horticultural Research & Development (ISHRD) during Progressive Horticulture Conclave held at Navsari Agricultural University, Gujarat during 18-20 January 2024
- Dr. Muralidhara BM received 'Young Horticultural Scientist Award' from Society for Horticultural Research and Development, Uttar Pradesh, India on 1st February 2024.
- Distinguished Scientist Award' received by Dr. Rajiv Kumar for outstanding contribution in the field of Floriculture during 6th International Conference on 'Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2024)', during July 15-20, 2024 at Vietnam by the Society for Scientific Development in Agriculture & Technology, Meerut.
- Fellow of AAPMHE Award received by Dr. R Umamaheswari from Association for Advancement of Pest management in Horticultural Sciences.
- Young Scientist Award received by Dr. Prasannakumar NR from Entomological Society of India.
- Best Teacher Award received by Dr. Rajiv Kumar during 58th Foundation Day of ICAR-IIHR Bengaluru during September 5, 2024.

Dr. Rajiv Kumar, Principal Scientist receiving 'Best Teacher Award' during 58th Foundation Day of ICAR-IIHR Bengaluru, September 5, 2024.

- Dr. HB Singh award received by Dr. Deepa Samant given by Society of Agriculture & Biological Sciences Research (SABSR), India.
- Best technology award received by Dr. T R Usharani for embryogenic cell suspensions for mass multiplication of banana cv Elakki bale from Hon'ble Union Minister of Agriculture and Farmers Welfare Shri Shivraj Singh Chouhan during 96th ICAR Foundation and Technology Day ceremony.
- Best oral presentation award for the paper entitled "Influence of crop growth stage based drip-fertigation scheduling on growth and yield of chrysanthemum (*Dendranthema grandiflora* Tzelev.)" received by Sujatha A. Nair, G.R. Smitha and D. Kalaivanan International Conference on Precision Horticulture-2024 organized by TNAU, Horticultural College and Research Institute, Periyakulam during 22-24 August, 2024.
- Dr. Sreenivasa V received Best oral presentation for the abstract 'Combining ability studies for biomass traits and andrographolide content in Kalmegh (*Andrographis paniculata* Nees.)' during 'National Seminar on Medicinal and Aromatic Plants in Perspective of Health and Wealth' held at DMAPR, Anand, Gujarat during 22nd – 23rd October, 2024.
- DCR-Best research paper award for the year 2024 received by Dr. Muralidhara BM for the article 'Evaluation of fruit detachment forces and related characteristics reveals differential fruit detachments at developmental stages and cultivar differences in cashew' published in Scientia Horticulturae 331 pp 113128.
- Dr. M Siddarood, Ph. D. student guided by Dr. E Sreenivasa Rao received Dr. GS Randhawa Award-2023 for PG students research by Society for Promotion of Horticulture, Bengaluru for thesis work on 'WBNV resistance in watermelon'.

Best paper presentation awards received during National Conference on Recent Trends and Future Prospects of Floriculture in India' organized by ICAR- IIHR, during 9-11 January, 2024 at Bengaluru.

- "Amelioration measures for bicarbonate toxicity in Rose" received by Varalakshmi LR, Shilpa Shree KG, Chethan Kumar and Tejaswini P
- Vertical farming: A case study on its feasibility for commercial cultivation of *Limonium sinuatum* (L). Mill." authored by Safeena SA, Aswath C, Senthil Kumaran G, Shilpa Shree KG, D. Kalaivanan and ML. Chaithra.
- 'Diversity in morphology, Fusarium wilt resistance and genetic traits of gladiolus (*Gladiolus hybridus* Hort.)' authored by Priya Bhusaraddi, T. Usha Bharathi and Preeti Sonavane.
- 'Response of gerbera var. Arka Nesara to orientation of vertical structures in different directions'. received by Sangeetha Priya S, Aswath C, Safeena SA, Sujatha A. Nair and Kalaivanan D
- 'Evaluation of marigold for its nematocidal properties and as rotational crop for nematode management' by Umamaheswari R, Tejaswini Prakash P, K. Hima Bindu, Pritee Singh, D. Kalaivanan and TK Radha
- Dr. Pritee Singh for the paper "Edible flowers: potential source of bioactive compounds".
- 'Extraction of anthocyanin and polyphenolic antioxidants from waste rose petals and assessing their storage stability'. received by Sushmita Javalagaddi, Smitha GR, Arivalagan M, Seetharamu GK, Sujatha A. Nair, Kalaivanan D and Manjunath.
- "Economic feasibility and spread of Arka Savi rose variety in India" received by Dr. Harishkumar HV.
- "Floral Blocks- An eco-friendly product from floral waste" by S. Bhuvaneswari, GR. Smitha and Sujatha Nair.
- "Development of fibre enriched avocado powder using cabinet dryer – a profitable venture" by Sameela C, Preethi P, SVR. Reddy, Shamina Azeez, G. Karunakaran and BM. Muralidhara in 'International Seminar on Emerging trends in post harvest technology and valorization of horticultural crops' 4th-5th, January 2024, TNAU, Coimbatore.
- Best oral presentation in 3rd Indian Horticulture Summit cum International Conference Theme: Technological Interventions for Boosting Horticultural Production organized by SHRD, UP

and RARI, Jaipur, Rajasthan from 1-3 Feb, 2024 for the paper entitled "Neoteric approaches to reduce storage browning in avocado pulp and cubes" received by Preethi P, Reddy SVR, Shamina Azeez, Karunakaran G and Muralidhara BM.

- 'Composting of flower waste: Sustainable approach for solid waste management' received by Sushmita Javalagaddi, Smitha GR, Seetharamu GK, Kalaivanan D, Sujatha A. Nair, Arivalagan M and Manjunath Ramanna
- 'Standardization of nutrient solution for gerbera var. Arka Nesara grown on soil-less wick system'. received by Sangeetha Priya S, Aswath C, Safeena SA, Sujatha A Nair and Kalaivanan D
- 'A comprehensive web-based system for Flower Crops cultivation'. received by Dr. Reena Rosy Thomas
- "A Comprehensive Web based System for Flower Crops Cultivation" authored by Reena Rosy Thomas, Chandra Prakash MK, and Ramya HR.

Best paper presentation awards Received during International Conference on Plant Protection in Horticulture (ICPPH-2024) held during 25th-27th September 2024 at ICAR-IIHR, Bengaluru.

- "Identification of heat stable source of resistance to *Meleidogyne incognita* in brinjal" received by Dr. T H Singh et al.
- "Management of fruit and vine rot in pointed gourd in Eastern India received by G Sangeetha et al.
- 'Vitamin-D Enrichment Technology in Elm Oyster Mushroom (*Hypsizygus ulmarius*) received by Dr. Chandrashekhara C
- Fellow of AAPMHE conferred to Dr. Jayantimala BR.
- Research Paper Award (Dr. VG Prasad) for publication on 'Effect of *Bacilus pumilus* IIHR Bp and *Pseudomonas putida* IIHR Pp on *Meloidogyne incognita* infecting okra" received by Dr. R. Umamaheswari.
- 'Micronutrient based Silicon Nutrition for Chilli (*Capsicum annuum* L.) production and its induced Resistance to Insect Pests received by Dr. G C Satisha, V Sridhar, G M Sandeep Kumar and R H Hamsini.
- 'Vitamin-D Enrichment Technology in Elm Oyster Mushroom (*Hypsizygus ulmarius*) received by Meera Pandey, Debi Sharma, G Senthil Kumaran, G C Satisha and C Chandrashekara.
- "Differential enzyme activities and gene expression-A comparative approach" received by Poojitha S. R., T. Usha Bharathi, Shamina Azeez, Nandeesha and Priti Sonavane.
- 'Effect of Indian honey bee pollination in marigold hybrid seed production' received by Veeresh, Tejaswini P, Venkata Rami Reddy P, Venugopalan R, Rajiv Kumar, Hima Bindu, Usha Bharathi T and Laxman RH.
- 'Introns as key regions in biosystematics of *Colletotrichum siamense* and *C. truncatum*' received by Ravi Teja DV and Sriram S.
- Dr. Mahesha B received Best Oral Presentation Award.
- 'Mechanism of salicylic acid-mediated resistance in mango against anthracnose' received by Dr. Supriya, ML and Dr. Sriram S.
- 'Screening of mango genotypes for the identification of resistance source to anthracnose' received by Dr. Supriya, ML and Dr. Sriram S

Awards received during Indian Phyto Pathological Society (South zone) Meet & National symposium on plant heath management a sustainable tool in addressing crop diseases under climate resilient agriculture. UAS, Dharwad, December 11-12, 2024, Karnataka, India.

- Best oral paper presentation Award for 'Unravelling Mango defence Responses to Anthracnose: Screening, Genetic, Biochemical and Pathogenicity Insights' received by Dr. Supriya ML and Dr. Sriram S
- Best poster presentation for 'Morpho-cultural and molecular characterization of *Colletotrichum* species causing mango anthracnose in India' received Dr. Supriya ML and Dr. Sriram S.

7.2. Recognitions

- Food Safety Referral Lab (FSRL) at ICAR-IIHR has been upgraded to National Reference Lab for Fruits and Vegetables by FSSAI.
- Dr. R B Tiwari was recognized as convenor for BIS, New Delhi FAD 20 panel-IV working on underutilized fruits and vegetable standards.
- Dr. S Bhuvaneswari and Dr. Vijay Rakesh Reddy S were recognized as members for BIS, New Delhi FAD 20 panel-IV working on underutilized fruits and vegetable standards

- Dr. AVV Koundinay as Technical team members in seed verification of corianders seeds & certified vegetable seeds mini-kit under Directorate of Horticulture, Govt of Odisha.
- Dr. GC Acharya acted as a member of Board of Studies of CV. Raman Global University, Bhubaneswar.
- Dr. GC Acharya acted as the Chief Guest in the plenary session of Research and Extension Monitoring Cell Meeting on 15.04.2024 of Faculty of Agricultural Sciences, Siksha o Anusandhan Deemed to be University.
- Dr GC Acharya acted as Member of the technical expert team for source verification of seeds and Planting material for Kharif 2024- under Directorate of Horticulture, Krishi Bhavan, Bhubaneswar
- Dr. GC Acharya acted as an Expert Group Meeting on Crop Planning & diversification for Kalahandi and Ganjam under GEF 7 FOLUR Project on 28 May 2024 at Krushi Bhavan, Bhubaneswar.
- Dr. GC Acharya acted as a member of the State Variety release Committee of horticultural crops under Department of Agriculture and Famers' empowerment, govt of Odisha.
- Dr. GC Acharya acted as a Board of studies meeting of Faculty of Agriculture, Sri Sri University.
- Dr. GC Acharya acted as a member of the technical committee for providing recommendation on different aspects of Odisha Balabhadra Jaibika Chasa Mission, under Department of Agriculture & Food Production, Govt of Odisha.
- Dr. GC Acharya acted as a member of the Internal Screening committee under the state plan Scheme-Innovative projects on Horticulture under Govt of Odisha, Agriculture & Farmers' Empowerment Department.
- Dr. GC Acharya acted as a Member of the Technical committee meeting on area expansion programme under the state sector scheme 'Development of potato, vegetable and spices: under Directorate of Horticulture, Department of Agriculture & Farmers Empowerment', Govt of Odisha.
- Dr. GC Acharya acted as a Member of the Regional Advisory Group (RAG) of NABARD RO Bhubaneswar.
- Dr. Satyaprya Singh, acted as a member of Source verification of procurement of seeds/planting material under Directorate of Horticulture, Govt of Odisha.
- Dr. GC Acharya acted as a member of the committee for finalization of Standard Operating Procedure for minimum seed certification standards for 'Tissue culture Based seed potato Production' using ARC technology, under Department of Agriculture & Farmers Empowerment, Govt of Odisha.
- Dr. GC Acharya was invited for chairing a panel discussion in the session on 'Sustainable Production System: Farming, Livestock and Fishery' during the mega event SOA Agri-Confluence (SAC), organized by Siksha'O' Anusandhan, held on 12.03.2024
- Dr. GC Acharya acted as a member of the technical committee for the 'Nutrition at Doorstep' initiative under the state plan of Directorate of Horticulture, Govt of Odisha.
- Dr. GC Acharya acted as a Member of the Technical Support Group meeting under Directorate of Horticulture, Govt of Odisha.
- Dr. GC Acharya acted as a member of the jury to scrutinize the technical presentations of the students on the occasion of State level World Soil Day celebrated by directorate of Agriculture & Food Production, Department of Agriculture & Farmers Empowerment, Govt of Odisha on 04.12.2024.
- Dr. B L Patil Fulbright-Nehru Academic & Professional Excellence Fellowship (2022-23), by USIEF, to visit University of California, Davis, USA, for 9 months.

Editors and members of journals and professional Societies

Editor/member of Editorial Board

- Dr. Rajiv Kumar served as Editor in Chief for the Journal of Horticultural Sciences, ICAR-IIHR, Bengaluru.
- Dr. M Sankaran Member, Editorial Board, Indian Journal of Horticulture, IAHS, New Delhi
- Dr. Rajiv Kumar served as Editor for Indian Journal of Horticulture, New Delhi and Indian Journal of Plant Genetic Resources, ICAR-NBPGR, New Delhi. Dr. Anil Kumar Nair and Dr. T R Rupa are Section Editors in Journal of Horticultural Sciences
- Dr. S. Sriram is Section Editor for Indian Journal of Agricultural Sciences.
- Dr. Anil Kumar Nair is member in Editorial Board for Indian Journal of Ecology

- Dr. Smitha G.R. is member in Editorial Board of the Plant Physiology Reports (Formerly Indian Journal of Plant Physiology) for the year 2024.
- Dr R B Tiwari, Dr. Anil Kumar Nair, Dr. S Sujatha, Dr C Kanupriya, Dr. Yukti Verma, Dr Deepa Samant, Mr. Sachin Agnihotri, Mr Jagadeeshan and Mrs. Pooja Kumari are members in Editorial Board of Bagwani
- Dr. PV. Rami Reddy is Chief Editor of Pest Management in Horticultural ecosystems
- Dr. R. Umamaheswari is Associate Editor (Nematology) for Journal of Biological Control.
- Dr. Venkataravanappa is serving as Member in Editorial Boards of Archives of phytopathology And Plant Protection.
- Dr. G. Selvakumar served as a member of the editorial board of World Journal of Microbiology and Biotechnology (Springer).
- Dr. G. Selvakumar served as a guest editor for Current Research in Microbial Sciences (Elsevier).
- Dr. Kalaivanan D served as executive member, Bangalore Chapter of Indian Society of Soil Science, UAS, Bangalore.
- Dr. Kalaivanan D served as member of editorial board for Journal of Applied Biology and Biotechnology, Gwalior, Madhya Pradesh, India.
- Dr. TR. Rupa served as a member of the editorial board of the Journal of the Indian Society of Soil Science, New Delhi.
- Dr. Partha P. Choudhury: Member in the Editorial Board of *Weed* – a Journal of Asian-Pacific Weed Science Society, Australia.
- Dr. S. Sriram serving as Vice President of Association for Advancement of Pest management in Horticultural Ecosystem.
- Dr. V. Sridhar is serving as President, Association for Advancement of Pest management in Horticultural Ecosystem.
- Dr. R. Umamaheswari is serving as Secretary of Association for Advancement of Pest management in Horticultural Ecosystem.
- Dr. Priti Sonavane as Joint Secretary in Editorial Board Member of Association for Advancement of Pest Management in Horticultural Ecosystem for 2023-25.
- Dr. Vijay Rakesh Reddy S has been an editorial board member for the Journal of Agriculture and Ecology published by the Society for Agriculture and Arid Ecology Research, Bikaner, Rajasthan.

Members of special committees of Central and State government organizations

- Dr. G. Selvakumar, served as a member of the Technical Committee of Bangalore Solid Waste Management Company Limited, Bengaluru.
- Dr. G. Selvakumar, served as the Principal Member from ICAR-IIHR, on the Bureau of Indian Standards Sectional Committee TXD 25 on Coir and Coir Products.
- Dr. G. Selvakumar, served as an external member of the Institute Technology Management Committee (ITMC) of ICAR-National Bureau of Agricultural Insect Resources, Bengaluru.
- Dr. Kalaivanan D served as member of Coir and Coir Products Sectional Committee (TXD 25) of Bureau of Indian Standards (BIS), Ministry of Food, Civil Supplies and Consumer Affairs, Government of India.
- Dr. BL. Patil Member of Karnataka State Agriculture Council, facilitated by the Indian Chamber of Food and Agriculture (ICFA), since 2024.
- Dr. BL. Patil Member of Research Advisory Committee for Indian Wood Science & Technology (IWST, ICFRE-Dehradun), Bengaluru, India, in September, 2024.
- Dr. Laxman RH has been nominated as Member of the Institute Management Committee of CPCRI, Kasaragod.
- Dr. Partha P. Choudhury served as Alternate member representing IIHR in FAD 27 (Pesticide Residue Analysis) and FAD 27, Panel VI (For Honey), Food and Agriculture Division, Bureau of Indian Standards.
- Dr. Partha P. Choudhury served as member, FAD 27, Panel IX (Single Pesticide Residue Analysis), Food and Agriculture Department, Bureau of Indian Standards.
- Dr. Partha P. Choudhury acted as a DG nominee for the DPC of scientist at ICAR-Central Tobacco Research Institute, Rajahmundry.
- Dr. Partha P. Choudhury served as External Examiner for the evaluation of PhD thesis entitled Ecotoxicological risk assessment of pesticide

residues in the polder based aquaculture system of kuttanad using an untargeted metabolomics approach' submitted by the student of Cochin University of Science and Technology, Kerala.

- Dr. BL. Patil: DBT Nominee, for Institute Biosafety Committee (IBSC) of Eurofins Advinus Agrosciences Services India Pvt. Ltd. (2023-2026).
- Dr. DC. Lakshamana Reddy recognized as Distinguished Principal Scientist by IMRF, Vijayawada, Andra Pradesh.
- Dr. B Balakrishna as Member in the committee of Cost Revision of Protected Cultivation – Polyhouse and Shade house unit under National Horticulture Mission and Atal Bhujal scheme, Department of Horticulture Karnataka.
- Dr. A. Carolin Rathinakumari served as Primary Member of Agriculture and Food Processing Equipments Sectional Committee, FAD 20 during the year 2024.
- Dr. K. Hima Bindu served as member, Executive Committee of Karnataka State Medicinal Plants Authority.
- Dr. B. Varalakshmi has been nominated by the DST, New Delhi to serve as a Member of the Expert committee for the Award of INSPRIRE fellowships to the PhD students in the field of Agricultural Sciences for a period of 3 years from 1.6.2024 to 31.05.2027.
- Dr. BL. Patil Member of Jury to evaluate IT-BT startups (Elevate-2023, Multi-City Pitching), Karnataka Innovation & Technology Society, Dept. of IT & BT, Govt. of Karnataka.

Experts/Examiners/Jury members/Assessment and Advisory committees

- Dr. Anuradha Sane served as external expert for M Sc thesis evaluation on Effect of rooting media and IBA on growth and development of dragon fruit (*Hylocereus polyrhizus*) cuttings by Koyya Unnathi Madhuri, VHM/22-09, Fruit science, YSRHU, Venkataramanagudem.
- Dr. K. Hima Bindu acted as External examiner for student of MSc. degree in Horticulture (Plantation, Spices, Medicinal and Aromatic crops) of Tamil Nadu Agricultural University, Coimbatore.
- Dr. K. Hima Bindu attended as Director nominee in First Joint Working Group (JWG) meeting between the Council of Scientific & Industrial Research (CSIR), Indian Council of Agricultural Research (ICAR), and the Ministry of Ayush for the Overview and Finalization of the Work Planon 19th September, 2024 at All India Institute of Ayurveda (AIIA), Gautam Puri, Mathura Road, Sarita Vihar, New Delhi.
- Dr. M Sankaran Member, Academic Council, Dr.YSRHU, V.R.Gudem, Andhra Pradesh
- Dr. M Sankaran Member, Board of PG studies, Dr.YSRHU, V.R.Gudem, Andhra Pradesh
- Dr. M Sankaran Member, Board of studies, Kalasalingam school of Agriculture and Horticulture, Krishnan Kovil, Srivilliputhur, Tamil Nadu
- Dr. M Sankaran External examiner for a Ph. D Student, FVVE, MPKV, Rahuri, Maharashtra
- Dr. K. Hima Bindu served as chairperson, Poster evaluation committee during National Conference on Recent Trends and Future Prospects of Floriculture in India organized by ICAR- IIHR, Hesaraghatta, Bengaluru during 09-11 January, 2024.
- Dr. K. Padmini served as Expert member (Horticulture) of the assessment committee at Dr. YSR. Horticultural University, Venkataramanaguddam for Career Advancement scheme (CAS) on 2024.
- Dr.T.H.Singh IIHR Scientist as External Examiner: Conducted PhD Thesis viva-voce of Mr. Vasa Anil Kumar, ID No. 18123P06 and Thesis entitled on Breeding for bacterial wilt resistance in large round fruited brinjal (*Solanum melongena* L.) at COA, OUAT.
- Dr. Sujatha A. Nair served as DG's nominee in the assessment committee, for the Career Advancement Scheme of ARS scientists of the Indian Institute of Spices Research, Kozhikode on 20th December, 2024.
- Dr. Rajiv Kumar served as External examiner for conducting final Viva Voce of Ph.D. (Horticulture) student Ms. Sindha Mallikaben Ravjihai (Reg. No. 1020221020) of Department of Floriculture and Landscape Architecture, Navsari Agricultural University (NAU), Navsari, Gujarat on 09.9.2024 at NAU, Navsari, Gujarat.
- Dr. Rajiv Kumar served as External Examiner for conducting public defense (Viva Voce) of PhD student Mr. Baranidharan R (Id No. 2020631001) at Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu on 09.07.2024.

- Dr. G. Selvakumar, served as the DG nominee for the promotion of scientists of ICAR-Indian Institute of Rice Research, Hyderabad, under the Career Advancement Scheme.
- Dr. TR. Rupa served as a member of the judging Committee for Prof. Sant Singh Memorial Award for Excellence in Education and Research in Soil Science during 2024.
- Dr.TR. Rupa conducted the final public defense examination for the Ph.D. student in the discipline of Soil Science and Agri. Chemistry at TNAU, Coimbatore on 07th February, 2024.
- Dr. TR. Rupa served as an External Examiner to conduct the final thesis viva voce examination of PhD student of Soil Science, Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri on 16th January, 2024 at MPKV, Rahuri.
- Dr. TR. Rupa served as an External Examiner to conduct the public defense for the PhD student of the Department of Soil Science & Agricultural Chemistry, TNAU, Coimbatore on 07th February, 2024 at TNAU, Coimbatore.
- Dr. BL Patil External Expert in the *CSIR* Assessment Committee for promotion of Scientists, in the area of 'Biosciences & Biotechnology' held at CSIR-CIMAP, Lucknow, during 13-14 February, 2024.
- Dr. KV. Ravishankar served as a panelist in the Panel discussion event on Genome, conducted by International Society of Gene and Cell Therapy and AIML-Bio 2024 on 11-12, September 2024.
- Dr. V. Sankar acted as an external examiner to evaluate the PhD degree thesis from Department of Vegetable Science, HC&RI, TNAU, Periyakulam, Tamil Nadu.
- Dr. R. Venugopalan served as external member in Doctoral Committee of the Department of Biostatistics, NIMHANS (Institute of National Importance), Bengaluru.
- Dr. R. Venugoplan served as an external member of Board of Faculty (PG studies) with Dr. YSR. Horticultural University, Andhra Pradesh.
- Dr. Harishkumar HV served as external examiner to evaluate thesis (online) of MSc student in the discipline of Agricultural Marketing from University of Agricultural Sciences, GKVK, Bengaluru in the month of January, 2024.
- Dr. Harishkumar HV served as external examiner to evaluate thesis (online) of a MSc student in the discipline of Agricultural Economics from Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior in the month of February-2024.
- Dr. Harishkumar HV appointed as paper setter for final theory examination of PhD course "Operations Research AEC-605" for Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) in the month of March 2024.
- Dr. Harishkumar HV appointed as paper setter for final theory examination of BSc (Agri.) course "Agricultural Finance & Co-operation AEC-202" for University of Agricultural Sciences, Raichur in the month of November 2024.
- Dr. A. Carolina Rathinakumari served as an expert in the Selection Committee Meetings held on 28.05.2024 at JSS Mahavidyapeetha, Mysuru-570004.
- Dr. A. Carolin Rathinakumari served as Member-Expert Committee member and reviewed the project entitled 'Centre for Promotion of Additive Manufacturing (CPAM) - Agri & Food Processing' of CDAC, Kolkata held on line on 08.04.2024.
- Dr. A. Carolin Rathinakumari served as External Expert and evaluated the posters of Master Degree Students of Far Machinery & Power Engineering presented in the PG Science Week - 2024 held on 6th August 2024 at University of Agricultural Sciences, GKVK, Bengaluru.
- Dr. A. Carolin Rathinakumari served as external examiner and conducted the qualifying viva-voce of Er. Aveen Ragh (2022-8-005) of Kelappaji College of Agricultural Engineering and Technology, Tavanur, Kerala Agricultural University, Tavanur, 679573 on 14.10.2024.

Resource persons

- Dr. Yukti Verma delivered a lecture on 'Analytical aspects of Heavy metals in Fruits and Vegetables' in training on Heavy metal Contamination issues and Analytical Aspects in Fruits and Vegetables organized by BESST HORT at ICAR-IIHR, Bengaluru on 19.01.2024.
- Dr. Anuradha Sane delivered Invited talk on gender equality to newly joined M.Sc students as a part of Deeksharamb program at ICAR-IIHR, Bengaluru.
- Dr S. Sujatha delivered a lecture on 'Good Agricultural Practices in Palms (Coconut)' on

29.04.2024 in the Training programme on Recent Advances in Good Agricultural Practices for Management of Emerging Insect Pests in Coconut Duration at NBAIR, Bengaluru 29-04-2024 to 03-05-2024 sponsored by CDB, Kochi.

- Dr S. Sujatha delivered for two lectures viz., 'Recent Advances in Fruit Crops and Globally Accepted Best Practices in Fruit Crops' on 12.07.2024 in Training programme on "Globally Accepted Best Horticulture Practices" held at MANAGE, Hyderabad.
- Dr. Safeena SA delivered lecture on Classification of different Vertical farming and Hydroponic systems on 27.02.2024 during Interstate Training Programme on "Hydroponics and Vertical Farming" organized by COE–Protected Cultivation, ICAR-IIHR and Dept. of Horticulture, Govt. of Tamil Nadu during 27-29 February 2024.
- Dr. Safeena SA delivered a lecture on 'Innovations in Vertical Farming and Hydroponics in Horticultural Crops' and Models of different Vertical farming and Hydroponic systems and Nutrient management in Hydroponics' on 06.03.2024 during Workshop on Hi-Tech Farming Techniques "(Hydroponics and Vertical Farming)".
- Dr. G.R. Smitha delivered a guest lecture on the topic 'Sustainable management of flower waste to produce value-added products and environmental protection' on 12.02.2024 in short course on "Sustainable Horticultural Waste Management: Industrial and Environmental perspective" organized by the University of Horticultural Sciences, Bagalkot.
- Dr. G.R. Smitha delivered a guest lecture on the topic 'IIHR flower crop technologies and cultivation of rose and chrysanthemum' on 23.02.2024 in a training program organized by the Department of Horticulture, Government of Karnataka at Nelluru village, Devanahally Taluk.
- Dr. G.R. Smitha delivered a guest lecture on the topic 'Value addition in flower crops' on 12.11.2024 in a training program on 'Horticultural marketing and post harvest technologies' organized by Punjab Agricultural Management and Extension Training Institute (PAMETI) in collaboration with MANAGE, Hyderabad.
- Dr. Shilpa Shree KG delivered a lecture on "Growing media/substrates used in Hydroponics and Vertical farming" on 06.03.2024 in Workshop on Hitech farming techniques (Hydroponics and Vertical farming) organized at ICAR-Indian Institute of Horticultural Research, Bengaluru.
- Dr. Kalaivanan D delivered online lecture on 'Soilless cultures for Business development' on 05.02.2024 in the Entrepreneurship Orientation Program on Medicinal and Aromatic Plants-VIII (EOPMAP-VIII) held from 1st to 12th February, 2024.
- Dr. D. Kalaivanan delivered a lecture titled "Soilless Cultures for Business Development" on 05.08.2024, for participants in the Entrepreneurship Orientation Program on Medicinal and Aromatic Plants-9 (EOPMAP-9), held from August 1 to 12, 2024 organized by ICAR-DMAPR in collaboration with its Medi-Hub Technology Business Incubator.
- Dr. D. Kalaivanan delivered two lectures on 'Soilless Cultivation for Urban Farming and Terrace Gardening' and "Hydroponics and Vertical Farming" on 06.09.2024, in the training program on "Horticulture Value Chain" for officers from the Directorate of Horticulture, Government of Odisha, organized by MANAGE, Hyderabad.
- Dr. D. Kalaivanan delivered a lecture entitled "Cocoponics: A Futuristic Soilless Vegetable Production System" as part of the ISSS Bangalore Chapter lecture series on 19.10.2024, at GKVK.
- Dr. Yukti Verma delivered a lecture on 'Water and Nutrient Management in Vineyards' in 3 days Online Training Program 'Sustainable viticulture: Solutions to strengthen local and global trade' held from 13-15th March, 2024 organized by ICAR-NRC for Grapes, Pune and sponsored by MANAGE, Hyderabad.
- Dr. Yukti Verma delivered a special talk on ''Sustainable development and Green Practices'' on 13.11.2024 to the students of PM Shri Kendriya Vidyalaya CRPF Yelahanka, Bengaluru.
- Dr. AVV. Koundinya attended as a resource person and delivered an invited lecture on 'Promotion of Vegetable Cultivation under Protected Cultivation' 30.12.2024 during Workshop cum Orientation Training on Harnessing Innovative Strategies in Horticulture under OIIPCRA FY 2024-25, organized by Directorate of Horticulture, Government of Odisha:.
- Dr. GC Acharya delivered a lead talk during the technical sessions in the international conference Building Small Holder Climate Resilience for Achieving Sustainable Food Systems under the theme 'Climate resilience and sustainable food system' at OUAT, Bhubaneswar during 17-19 September 2024.
- Dr. GC Acharya delivered a seminar lecture on Trends & Challenges in Horticulture" on 27.11.2024 in the BJB Autonomous college, Bhubaneswar.

- Dr. GC Acharya delivered a Lead Lecture' on 'Need for promoting indigenous underutilized vegetables-way for diversification and Agri-ecosystem resilience" during 3rd International Conference on "Climate-Smart Nutri-Sensitive Integrated Farming System for Gender-equitable Sustainable Agriculture: Prospects and Challenges (ICNSFS - 2024)" Organized by Pragati International Scientific Research Foundation (PISRF), India & ICAR - Central Institute for Women in Agriculture (CIWA), Bhubaneswar (Orissa), India during November 06-08, 2024.
- Dr. GC Acharya delivered a lecture on "Commercial vegetable production practices" during the Training and capacity building programme on "Efficient Water Management and production practices of Horticultural crops" organized by ICAR-IIWM during 4th-11th December 2024.
- Dr. GC Acharya delivered an Invited lecture on Vegetable cultivation-Scope and Potential in the Dissemination workshop on eco-village development organized by AGRAGAMEE and Karl Kubel Stiftung during 18-19th January 2024.
- Dr. GC Acharya delivered a lecture on Horticulture-based entrepreneurship through technology interventions for high value vegetable crops on 15.01.2024 during training program, titled 'Gender-Sensitive Agri-Horti based Dimensions for addressing Livelihood, Nutrition, and Entrepreneurship' during 15-19 January, 2024, organized jointly by ICAR-CIWA and MANAGE, Hyderabad.
- Dr. GC Acharya delivered a talk for MS Swaminathan Memorial Lecture Series on "Underutilized leafy vegetables" on 01.02.2024 at Faculty of Agricultural Sciences, Siksha O Anusandhan Deemed to be University.

Review of Research Manuscripts

- Dr. K. Padmini was awarded certificate of recognition as reviewer in Journal of Environmental Biology.
- Dr. K. Padmini, Dr Safeena SA and Dr Mahesha B served as reviewers for Journal of Horticultural Sciences.
- Dr. B. Varalakshmi was the Reviewer of the Journal of Horticultural Sciences, SPH, Bengaluru.
- Dr. T R Rupa reviewed research manuscripts for Frontiers in Science, The Journal of Indian Society of Soil Science, Journal of Horticultural Research, and The Mysore Journal of Agricultural Sciences.
- Dr S Sujatha reviewed research papers for Industrial Crops and Products, Journal of Plant Nutrition and Soil Science, Agricultural Water Management, Agriculture, Indian Journal of Agricultural Sciences.
- Dr. Venkataravanappa is a reviewer for Physiological and Molecular Plant Pathology, Archives of Phytopathology and Plant Protection, Indian Phytopathology and Virus Disease.
- Dr. Manjunatha L served as reviewer for Indian Phytopathology and Journal of Horticultural Sciences.
- Dr. B L Patil reviewer for project proposals submitted for availing Fulbright-Nehru Academic and Professional Excellence Fellowships (FNAPE), from India, in 2024.
- Dr. R Venugopalan, served as a reviewer for the Journal of Indian Society of Agricultural Statistics, New Delhi.
- Dr. Preethi P served as reviewer for Journal of Horticultural Sciences, Journal of the Science of Food and Agriculture, Applied Fruit Science, ACS Food Science & Technology, Journal of Culinary Science & Technology, Food and Scientific Reports, CyTA - Journal of Food.
- Dr. Vijay Rakesh Reddy S served as reviewer for Journal of Horticultural Sciences, Indian Journal of Agricultural Sciences.

Meetings Attended

- Dr. G. Selvakumar attended the Workshop cum Brain Storming Session for the Technical Committee Members of BIS Committees on Food and Agriculture and Textiles on 20.08.2024 at the National Institute for Training on Standardization, Noida on 20-08-2024.
- Dr. TR. Rupa participated in the meeting to discuss on 'Voluntary Carbon Market (VCM) in agriculture and formulate appropriate strategies of the Council for facilitating implementation of VCM in agriculture sector in the country' through online organized by ICAR-CRIDA, Hyderabad on 12th April 2024.
- Dr. TR. Rupa attended meeting of 'Standing Committee on Budget and Finance of Indian Society of Soil Science (ISSS)' at Division of Soil Science and Agricultural Chemistry, ICAR-IARI, New Delhi on 31st May, 2024.
- Dr. TR. Rupa attended 'Executive Council Meeting of Indian Society of Soil Science (ISSS)' at Division of Soil Science and Agricultural Chemistry, ICAR-IARI, New Delhi on 01st June, 2024.

- Dr. TR. Rupa participated and presented a technology on 'Use of leachate produced through composting as liquid manure' through online during 8th meeting of standing committee constituted for evaluation of technology for waste management organized by Central Pollution Control Board, New Delhi on 10th June, 2024.

- Dr. Sreenivasa V attended the Regional Horticulture Research, Extension Advisory and Project Formulation Workshop 2023-24 (South Zone) and presented technology "Arka Bhringaraj" for Multi Locational Trial under UHS, Bagalkot held during 20th to 21st June, 2024 at College of Horticulture, UHS Campus, GKVK, Bengaluru.

Invited/ Lead Talks in Conferences/ Symposia

- Dr. Anuradha Sane delivered invited lecture in Progressive Horticulture National Symposium at Srinagar Garhwal (PHNS-2024) on Horticulture in the Himalayas during17th-19th October, 2024.

- Dr. K. Hima Bindu delivered a lead talk on Bio-prospection of medicinal plants for yield and quality at ICAR -Indian Institute of Horticultural Research. In the National Seminar on Medicinal and Aromatic Plants in Perspective of Health and Wealth organized by ICAR-DMAPR Anand, Gujarat during 22-23 October, 2024.

- Dr. K. Hima Bindu delivered a invited lecture on "Conservation of Genetic Resources, GI and variety Protection in Betelvine" during ICAR-CAFT training on "Influence of Microbiome and Native Biota on Conservation of Genetic Resources of Important Horticultural Crops and Their Quality" on 12ff January, 2024, at COH, Mysuru.

- Dr. K. Hima Bindu presented the work on medicinal crops at ICAR-IIHR and areas of collaboration in medicinal crops in First Joint Working Group (JWG) meeting between the Council of Scientific & Industrial Research (CSIR), Indian Council of Agricultural Research (ICAR), and the Ministry of Ayush for the Overview and Finalization of the Work Planon 19th September, 2024 at All India Institute of Ayurveda (AIIA), Gautam Puri, Mathura Road, Sarita Vihar, New Delhi.

- Dr. K. Hima Bindu delivered a talk "IIHR technologies in Betelvine cultivation" during training programme on "IDM of phytophthora foot rot in Betelvine" is being conducted by KVK, Utukuru at Kolumulapalli Village, C.K Dinne, on 21't August, 2024.

- Dr. K. Hima Bindu delivered an invited lecture on High value medicinal plants for Business development" on 8th Aug, 2024ICAR-DMAPR with its Medi-Hub Technology Business Incubator (TBI) has organized an Entrepreneurship Orientation Program on Medicinal and Aromatic Plants-9 (EOPMAP-9) from 1st to 12th August, 2024.

- Dr. K. Hima Bindu delivered an invited lecture on "Enhancement of yield and phytochemicals in medicinal crops through plant breeding "on 6th February, 2024 ICAR-DMAPR with its Medi-Hub Technology Business Incubator (TBI) has organized an Entrepreneurship Orientation Program on Medicinal and Aromatic Plants-8 (EOPMAP-8) from 1st to 12th August, 2024

- Dr. Safeena SA served as Keynote speaker on "Doubling farmers' income through floriculture interventions" on 9th January, 2024, during National Conference on "Recent Trends and Future Prospects of Floriculture in India, held at IIHR, Bengaluru, 9-11 Jan, 2024.

- Dr. Safeena SA delivered the invited talk (online) on "Potentiality of Hydroponics and Vertical Farming Sustaining Food and Nutritional Security" for Students Research fellows and Scientists at ICAR Research Complex for North East Hill Region, Umiam, Meghalaya, on 18th December, 2024.

- Dr. Rajiv Kumar delivered lead lecture on 'Protected Cultivation of Flower Crops for Future', on 14.11.2024 during 'International Conference on Futuristic Horticulture (ICFH-24)', organized by HG & RI, TNAU, Tamil Nadu, from November 14-15, 2024.

- Dr. Rajiv Kumar delivered expert lecture on 'Advances in crop improvement in flower crops in relation to competitive exam', to students and faculties of ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat on September 09, 2024.

- Dr. Rajiv Kumar delivered Guest Lecture on 'Genetic Improvement in Commercial Flower Crops' to the postgraduate students and faculty of Department of Floriculture and Landscape Architecture, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, on July 9, 2024.

- Dr. Kalaivanan D delivered a keynote speaker address on 'Sustainable Soil Health Management for Horticultural Crops' in the three days International Conference on Science and Technology for Sustainable Future' held at Acharya Institute of Technology on 29th May, 2024.

- Dr. TR. Rupa delivered a plenary lecture on Long-Term Conservation Horticulture in Mango Orchards: Comparative Carbon and Energy Efficiencies of Conventional vs. Conservation Management Practices in the 'Global Soils Conference 2024 - Caring Soils Beyond Food Security: Climate Change Mitigation & Ecosystem Services', 19-22 November 2024, New Delhi.
- Dr. TR. Rupa delivered an invited talk on "Soil health for Sustainable Horticulture" on 20th February, 2024 at Sri M Visvesvaraya Institute of Technology, Bengaluru.
- Dr. T.R. Rupa delivered an invited talk on "Soil Changes following Long term Conservation Horticultural practices" on 07th February, 2024 at Tamil Nadu Agricultural University, Coimbatore.
- Dr. TR. Rupa delivered a guest lecture on "Land restoration, Desertification, and Drought Resilience" on the occasion of World Environment Day on 05th June, 2024 at Vivekananda Vidyavardhaka High School, Hesaraghatta, Bengaluru.
- Dr. TR. Rupa delivered a special talk on "Mission Life-Save Water under Shiksha Saptah" to encourage the students to strive for the best, along with providing a platform to boost their morale and confidence on 26th July, 2024 at PM Shri KV CRPF Yelahanka, Bengaluru.
- Dr. TR. Rupa delivered an invited talk on "Methodology of testing of physical and chemical parameters of organic fertilizers/soil such as pH, EC, Moisture, Carbon and NPK" on 03rd October, 2024 in the 5 days Refresher Training Course for 20 fertilizer analysts and technical officers from State notified laboratories for State Agriculture Department under FCO-1985 at Regional Centre for Organic and Natural Farming (RCONF), Ardendale, Kannamangala, Bangalore.
- Dr. R. Venugopalan was invited as lead speaker to deliver a talk on "Application of Statistical Principles in Life Science Research" on 03.05.2024, organized by REVA University, Bengaluru.
- Dr. R. Venugopalan was invited as guest of honour and delivered an invited talk on "Application of ICT in Big Data Analytics & AI/ML for Crop Modelling using advanced Statistical methods" during 24.07.2024 to 03.08.2024 during Training Programme on "Horticultural Experiment Analysis with R-Tool (HEART) held at UHS(B) campus, Bengaluru.
- Dr. Harishkumar HV acted as rapporteur in the Technical Session "Socio-economic impact, marketing and IPR and policy issues in the National Conference on Recent Trends and Future Prospects of Floriculture in India held at ICAR-IIHR, Bengaluru during 9-11 January, 2024.
- Dr. R. Venugopalan was invited as lead speaker to deliver a talk on "Application of ICT in Big Data Analytics & AI/ML for Crop Modelling using Advanced Statistics" during the 10 days Faculty Development Program on "The Role of ICT in Agricultural & Allied Sectors" from 25.06.2024 to 04.07.2024 organized by Karnataka Science and Technology Academy (KSTA), Bengaluru.

Membership in Institute Management Committee/ Others (Chairing sessions etc)

- Dr. TH. Singh acted as Co-chair for task force committee for monitoring of DUS test trail on Marigold at ICAR-IIHR on 13.02.2024.
- Dr. M Sankaran IMC Member, ICAR-NRCB, Tiruchirapalli, Tamil Nadu and ICAR-CIARI, Srivijayapuram, A & N Islands
- Dr. Laxman RH has been nominated as Member of the Institute Management Committee of CPCRI, Kasaragod.
- Dr. J. Satisha was nominated by DG, ICAR as a member of Institute Management Committee of ICAR-NRC Grapes, Pune for 3 years from 29-02-2024 to 28-02-2027
- Dr. S. Sriram has been nominated as Member of Institute Management Committee of ICAR-Central Tuber Crops Research Institute, Thiruvananthapuram and ICAR – NRC for Mushroom, Solan.
- Dr. PV. Rami Reddy-Member, Institute Management Committee (IMC) of ICAR-National Institute of Animal Nutrition and Physiology (NIANP), Bengaluru.

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8. Linkages and Collaborations

8.1. Linkages with other ICAR Institutes/Govt. agencies at ICAR-IIHR

Project Title	PI	Funding Agency
Agri Consortia Research Platform on Water	Dr. Anil Kumar Nair	ICAR
Strengthening the infrastructure for augmenting quality seed production and distribution of ICAR-IIHR bred vegetable varieties to the farmers of Karnataka State (24.04.2023 to till date)	Dr. MV. Dhananjaya	RKVY, Karnataka
Establishment of HAL-IIHR Seed Production Centre P.I. (24/04/2023 to till date)	Dr. MV. Dhananjaya	HAL, Bengaluru (CSR)
Establishment of a NIDHI-Technology Business Incubator (TBI)-Business Entrepreneurship and Start-up support through Technology in Horticulture (BESST-HORT) at ICAR-Indian Institute of Horticulture Research, Bengaluru 5th April 2023 to till date	Dr. MV. Dhananjaya	DST
CRP on molecular breeding in Cucumber 2018-2023	Dr. M. Pitchaimuthu	
CRP on Structural and functional genomics of Okra, Custard Apple and Drumstick 2023-24	Dr K V Ravishankar	---
CRP-AB on Brinjal	Dr. TH. Singh	ICAR-NBPGR, New Delhi
Delineating the role of next-generation quantum dots/ nanomaterials in detecting and decontaminating pesticide residues in grapes: A DUAL APPROACH	Dr. Abhishek Mandal	ANRF-DST
ICAR-AICRP on Energy in Agriculture and Agro-based Industries	Dr. A. Carolin Rathinakumari	ICAR
Development of customized smart package for Chilli and Okra transportation and storage	Dr. S. Bhuvaneswari	Maharashtra Agribusiness Network (MAGNET)
Enhancing the Shelf-life of Cashew Apple to increase the market potential	Dr. Vijay Rakesh Reddy S	ICAR-Directorate of Cashew Research, Puttur, Karnataka
Molecular diagnosis, characterization and discovery of seed transmission mechanism of yellow mosaic disease in ridge gourd (*Luffa acutangula*)	Dr. Mahesha B	DST
Network Project (AINP on Emerging Pests)	Dr. D. K. Samuel	ICAR
Demonstration of Integrated Farming System Practices for the enhancement of income of farmers under Mango based cropping system	Dr. Atheequlla GA	NABARD
Farmer First Project entitled: Enriching Knowledge – Integrating Technology and Institutions for holistic village development in horticulture-based farming system	Dr. Balakrishna	ICAR New Delhi

Enhancing livelihood security of small-holder farm women of Karnataka through horticultural interventions using pluralistic extension approaches (DST-STIHCB1817)	Dr. Ramya HR	DST
Intercropping of medicinal crops in coffee plantation in high altitude zone of Karnataka	Dr. Hima Bindu	NMPB Ministry of AYUSH
Genetic enhancement and post-harvest studies in Bacopa monnieri	Dr. Hima Bindu	NMPB Ministry of AYUSH
Consortium Research platform on hybrid Technology (Tomato). Development of hybrids resistant to biotic (ToLCV, early blight and root knot nematodes and abiotic stresses (high temperature & drought in Tomato).	Dr H.C. Prasanna	ICAR
CRP on Farm Mechanization and Precision Farming	Dr. G. Senthil Kumaran	ICAR
Centre of Excellence for Kamalam Fruit	Dr. G. Karunakaran	MIDH, Govt. of India
Pre clinal and clinical trails to validate the health benefits/ claims of Jack fruit, Jamun, Bitter Gourd, and Dragan fruit products developed by IIHR collaborative project between ICAR-ICMR, New Delhi	Dr. G. Karunakaran	ICAR-ICMR, New Delhi
Off-season production of dragon fruit for doubling the farmers income	Dr. G. Karunakaran	RKVY, Govt. of India
Scaling up the production of quality planting materials of jack fruit, tamarind, dragon fruit and avocado through farmer participatory approach	Dr. G. Karunakaran	RKVY, Govt. of India
Clean Plant programme	Dr. G. Karunakaran	ICAR-Asian Development Bank and National Horticulture Board, New Delhi

8.2. DUS Testing funded by Protection of Plant Varieties & Farmer's Rights Authority, New Delhi

S. No	Title of the Project	Principal Investigator (PI)
1.	DUS testing centre on Mango	M. Sankaran
2.	DUS testing centre for Papaya and Custard apple	Vasugi C.; (Papaya); T. Sakthivel; (Custard apple)
3.	Development of DUS Test Guidelines for Sapota (*Achras Zapota* L.)	Dr A. Nagaraja
4.	Formulation and validation of DUS testing guidelines for Avacado *(Persea Americana Mill*)	Dr. G. Karunakaran
5.	Formulation and validation of DUS testing guidelines for dragon fruit (*Hylocereus sp*.)	Dr. G. Karunakaran
6.	Preparation for plant Variety Protection and DUS Testing through ICAR-SAU system and conduct of DUS test on Tomato, Brinjal, Okra, Garden Pea, Cucumber (*Cucumis sativus*), Bottle gourd (*Lagenaria sinceraria*), Bitter gourd (*Momordica charantia*), Pumpkin (*Cucurbita moschata*), Pointed gourd (*Trichosanthes dioca*), Watermelon and Muskmelon	Singh, T.H. (Brinjal) Pitchaimuthu, M. (Okra) M. Thangam (Garden Pea) Varalakshmi, B. (Bitter gourd & Bottle gourd); Sreenivas Rao, E. (Watermelon and Muskmelon) Raja Shankar (Pumpkin) Vivek Hegde (Cucumber)

8.	Validating crop specific DUS testing guidelines for Amaranth, Palak and Ridge Gourd	Varalakshmi, B.
9.	Developing DUS testing guidelines for Summer Squash (*Cucurbita pepo* L.)	Raja Shankar
10.	Formulation and Validation of DUS testing guidelines for Curry leaf (*Murraya koenigii* Spreng)	Raghu, B.R.
11.	Genetic purity testing of non – notified carrot crop of farmers variety "Madhuva n Gajar"	K. Padmini
12.	Establishment of DUS nodal centre at IIHR, Bangalore for China aster floricultural crops	Rajiv Kumar
13.	Establishment of DUS nodal centre at IIHR, Bangalore for jasmine floricultural crop	Sujatha A. Nair; Dr. M. Ganga (from TNAU)
14.	DUS Centre for Rose (w.e.f. 23.6.2020), DUS center for Rose and National Rose Repository	Tejaswini P
15.	DUS centre for Chrysanthemum	Rajiv Kumar
16.	DUS Centre for Marigold (w.e.f. 22.07.19); Validation of DUS testing guidelines for marigold	Tejaswini P (Co-Nodal centre)
17.	Nodal DUS centre at IIHR, Bengaluru for Tuberose and Carnation floriculture crops	Usha Bharathi (P.I.)
18.	DUS testing of Crossandra	Safeena S.A. (P.I.)
19.	DUS Centre for Gerbera	Dr. P. NaveenKumar

8.3. Linkages with other ICAR Institutes/Govt. agencies at CHES (ICAR-IIHR) Bhubaneswar

Project Title	PI	Funding Agency
Micro/ in vitro propagation of underutilised vegetable crops and supply in the state of Odisha (MIDH, Govt. of Odisha)	Dr. GC. Acharya	MIDH
Establishment of Virus Indexing laboratory for Horticultural Industry in Odisha (RKVY)	Dr. GC. Acharya	RKVY
SEEDS: Social and Economic Empowerment through Dedicated Seed production clusters for vegetable crops in Odisha (MIDH, Govt. of Odisha)	Dr. P. Srinivas	MIDH
Setting up of incubation and large scale mass production unit of Arka Microbial Consortium (AMC) in Odisha for Horticulture Industry	Dr. GC. Acharya	MIDH
Establishment & Demonstration of Mango-based Intercropping Systems for Enhancing Income of Mango-growers of Odisha	Dr. Deepa Samant	MIDH
Establishment of a Mother Block and a Model Nursery for Production of Quality Planting Materials (QPM) of Dragon fruit in Odisha"	Dr. Deepa Samant	MIDH
Deciphering the role of native endophytes to elucidate broad spectrum resistance mechanisms in wild brinjal under the east-coast Odisha ecosystem	Dr. GC. Acharya	S&T, Govt of Odisha

Demonstration on Integrated Pest, Disease and Nutrient Management for healthy seedling production of horticultural crops	Dr. P. Srinivas	MIDH
Innovative technological interventions for rooftop gardening, peri-urban and urban horticulture for aesthetics, nutrition, and healthy environment in selected cities of Odisha" for the State Plan Scheme "Innovative Projects	Dr. P. Srinivas	State Plan, Govt. of Odisha
Technological interventions to boost productivity and fruit quality of *Kuchinda chilli*, a land race of Odisha State	Dr. GC. Acharya	MIDH
Establishment of a Honey testing Laboratory at CHES (ICAR-IIHR), Bhubaneswar under National Bee Keeping and Honey Mission	Dr. Satyapriya Singh	NBB, Mini Mission of NBHM, Govt. of India
Plant Health Clinic: Promoting Sustainable Horticulture	Dr. Satyapriya Singh	MIDH

8.4. Linkages with other ICAR Institutes/Govt. agencies at CHES (ICAR-IIHR), Chettali

Project Title	PI	Funding Agency
Rejuvenation of Coorg Mandarin and Establishment of Training Centre on Mushroom and Bee Keeping for Enhancing Farmers Income of Western Ghats, Karnataka Through FPOs and Farmers Participation	Dr. Muralidhara BM	RKVY

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9. Publications and Presentations

9.1. Research papers

1. Aditi Kundu, Karivaradharajan Swarnalakshmi, Sushmita Rajkhowa, Anirban Barik SN, Bhagyasree, Tankeswar Nath, Bidyut Kumar Sarmah, Srikant Ghosh. (2024). Phytochemicals, UPLC-QTOF-MS/MS analysis, potential acaricidal activity and molecular modeling of Datura metel grown in North-Eastern India. *Journal of Natural Pesticide Research*. **10**: 100086**.** (NAAS rating: 6.0)

2. Aghora TS, Hira Lal, Reddy BR, Mohan N, Mahadevaiah C, Thangam M, Dhananajaya MV, Nagana G. Patil Indraja G, Rakesh K, Dubey N, Rai and Behera TK **(2024).** Cowpea: Breeding and Genomics. *Vegetable Science*. **51**(1):1-10 DOI: 10.61180/vegsci.2024.v51.i1.01(NAAS rating: 5.54)

3. Ajay Kumar K, Rekha A, Venugopalan R, Honnabhyraiah MK, Mohankumar S and Shivashankara KS.(2023). Variability in morphological parameters of Jamun (Syzygium cumini Skeels) genotypes. *International Journal of Minor Fruits, Medicinal and Aromatic Plants*. **9** (2): 94-101 (NAAS rating: 4.77)

4. Amaresh, Abhishek GJ, Jagadeesh MS, Aswini Nunavath, Dhanya V G, Adhini S. Pazhany, Arun Kumar, Pooja Dhansu, Ravinder Kumar, Meena Minturam, Appunu C, Hemaprabha G and Sreenivasa V. (2024). Unravelling Biomass Potential and Commercial Cane Traits in Saccharum and Erianthus Introgressed Progenies. *AMA, Agricultural Mechanization in Asia, Africa and Latin America*. **55**(6): 18159-18165 (NAAS rating: 6.30**)**

5. Anju Kamra, Ajay Singh Sindhu, Mallikarjun G, Devindrappa M and Bharat Gawade. (2024). Nematode Management in Polyhouse Cultivation. *Indian Journal of Nematology*. **53** (Special Issue): 43–48. DOI: 10.5958/0974-4444.2024.00004.4 (NAAS rating: 5.80)

6. Anu CN, Ashok K, Bhargava CN, Yogi D, Manamohan M, Jha GK and Asokan R**.** (2024). CRISPR/Cas9 mediated validation of spermatogenesis□related gene, tssk2 as a component of genetic pest management of fall armyworm, Spodoptera frugiperda (J. E. Smith) (Lepidoptera: Noctuidae). *Archives in Insect Biochemistry and Physiology*. DOI: 10.1002/arch.22121, (NAAS rating: 8.20)

7. Anuradha Sane, John J, Vasugi C, Dinesh MR and Pradheep K. (2024). Morphological Characterization and SSR Marker Assay of Mango Landraces of West Coast of Kerala, India. *Indian Journal of Plant Genetic Resoures* **37**(2): 195-205. DOI: 10.61949/0976-1926.2024.v37i02.02 (NAAS rating: 5.17)

8. Anusha N, Sridhar V, Balasubramani V, and Murugan M. (2024). Using CLIMEX, a bioclimatic software for predicting the impact of climate change on potential distribution of invasive tomato leaf miner, Phthorimaeaabsoluta (Meyrick) (Lepidoptera: Gelechiidae). Journal of Entomological Research, 48 : 7-12. (NAAS rating: 5.63)

9. Anusha N, Balasubramani V, Sridhar, Ashok K, Murugan M and Sreekanth P**.** (2024). Predicting the impact of climate change on the potential geographical distribution and growth index of mirid predator, Nesidiocoris tenuis (Reuter) (Heteroptera: Miridae) using CLIMEX. *Phytoparasitica*, **48** (1) : 7-12. (NAAS rating: 7.40)

10. Anusha N, Venkatasamy, Balasubramani & Sridhar V, Marimuth M, Johnson Thangaraj E. (2024). Life table studies of tomato leaf miner, *Phthorimae absoluta* (Meyrick) (Lepidoptera: Gelechiidae) on artificial diet. *Journal of Entomological Research*. **48**: 569-573. 10.5958/0974-4576.2024.00110.0. (NAAS rating: 5.63)

11. Anusha Nitta V, Balasubramani, Sridhar V, Murugan M, Johnson YS, Satyamoorthy NK, Kavitha M**.** (2024). Prediction of number of generations of serpentine leaf miner, Liriomyzatrifolii (Burgess) (Agromyzidae: Diptera) in India assessed by CLIMEX under climate change scenario. Journal of Horticultural Sciences. 19 (2): https://doi.org/10.24154/jhs.v19i2.2879 (NAAS rating: 6.10)

12. Archana Mukherjee, Janardanan Sreekumar, Madhavi Nair Sheela, Sheela Immanuel, Manas Ranjan Sahoo and Vivek Hegde. (2024). Enhancing Adaptability, Nutritional Quality in

Tropical Tuber Crops: Source for Adaptive Food and Nutrition. *Food and Nutrition Sciences*. **15**(11): 1141-1169. (NAAS rating: 7.90)

13. Arivalagan M, Priyanka DR, Rekha A and Tripathi PC. (2024). Assessment of *in vitro* alpha-glucosidase inhibitory activity, phenolics, flavonoids and antioxidant potential of jamun (*Syzygium cumini*) seeds. *Journal of Horticultural Sciences*. **19**(1). https://doi.org/10.24154/jhs.v19i1.2837 (NAAS rating: 6.10)

14. Ashok K, Bhargava CN, Asokan R, Pradeep C, Kennedy JS, Manamohan M and Anil Rai. (2023). CRISPR/Cas9 mediated mutagenesis of the major sex pheromone gene, *acyl-CoA delta-9 desaturase* (*DES9*) in Fall armyworm *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae). *International Journal of Biological Macromolecules*, https://doi.org/10.1016/j.ijbiomac.2023.126557 (NAAS rating: 14.30)

15. Ashok K, Bhargava CN, Asokan R**,** Pradeep C, Kennedy JS, Anil Rai and Manamohan M. (2023). First report on the utility of pupal case for early determination of CRISPR/Cas9 ribonucleoprotein mediated genomic edits in the Oriental fruit fly, *Bactrocera dorsalis* (Hendel) (Tephritidae: Diptera). *Archives in Insect Biochemistry and Physiology,* e22024, *https://doi.org/10.1002/arch.22024.* (NAAS rating: 8.45)

16. Ashok K, Bhargava CN, Asokan R, Pradeep C, Pradhan SK, Kennedy JS, Balasubramani V, Murugan M, Jayakanthan M, Geethalakshmi V and Manamohan M**.** (2023). CRISPR/Cas9 mediated editing of pheromone biosynthesis activating neuropeptide (PBAN) gene disrupts mating in the Fall armyworm, *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae). *3 Biotech*. **13**:370. https://doi.org/10.1007/s13205-023-03798-3 (NAAS rating: 8.89)

17. Ashok K, Bhargava CN, Pradeep C, Pradhan SK, Jha GK, Manamohan M, Shivanna B and Asokan R**.** (2024)**.** Toward the genetic suppression of Bactrocera dorsalis (Diptera: Tephritidae) through CRISPR/Cas9-mediated editing of spermatogenesis-related genes, tssk1 and topi for imparting male sterility. *Annals of the Entomological Society of America*. https://doi.org/10.1093/aesa/saae021 (NAAS rating: 8.30)

18. Ashok K, Rohan Wishard, Asokan R, Prasad Babu K, Sampath Kumar CN, Bhargava MS, Parvathy, Pradhan SK, Aravintharaj R, Anil Rai and Manamohan M. (2023). Inter and intra individual genomic edits contributing to white eye phenotype in the mango fruit fly, *Bactrocera dorsalis* Hendel (Diptera: Tephritidae) obtained through microinjection of ribo nucleoprotein complex. *The Nucleus*, DOI: 10.1007/s13237-023-00458-y (NAAS rating: 5.65)

19. Ashwathappa KV, Muttappagol M, Venkataravanappa V, Hiremath S, Manjunatha L, Madhu GS & Reddy CL (2024). Molecular characterization of 'Candidatus Phytoplasma australasiaticum'associated with ornamentals, amaranthus, French bean and sunhemp crops and development of rapid LAMP assay for detection. Physiological and Molecular Plant Pathology, 134, 102423. (NAAS rating: 8.70)

20. Aswathi Gopal, Ravichandran Veerasamy, Vijayalakshmi Dhankshnamurthi, Senthil Alagarsamy, Arul Loganathan, Radhamani sengodan, Jagedeeswaran Ramasamy and Pitchaimuthu Mottaiyan. (2024). Enhansing drought tolerance in okra through melatonin application: A compherehensive study of physiological, biochemical and metabolic responses. *Notulac Botanicae Horti Agrobotanici Cluj-Napoca*. **54**(4): 14055.DOI:10.15835/nbha52314055 (NAAS rating: 7.80)

21. Atheequlla GA, Vasanthi C, Mahadevaiah C, Dhananjaya MV and Ramya HR. (2024). Leveraging quick response (QR) Codes for horticultural information access: A stakeholder perspective. *Journal of Horticultural Sciences*. **19**(1). https://doi.org/10.24154/jhs.v19i1.2914. (NAAS rating: 6.10)

22. Balakrishna, SN. Harshitha M, Sankaran, Rupa TR and Neeraj Verma (2023). Development of standard protocols for assessment of cropped area in mango using sentinel MSI. *Progressive Horticulture*. 55(2): 127-133. (NAAS rating: 4.90)

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24. Beeresha HK, Halesh GK, Dhananjaya MV, Pitchaimuthu M, CN Hanchinamani and KV

Ravishankar. (2024). Genetic variability analysis in F2 segregating populations for yield and its contributing traits in okra [*Abelmoschus esculents* (L.) Moench] *International Journal of Advanced Biochemistry Research* 2024; SP-8(7): 517-524. (NAAS rating: 5.29)

25. Bhanothu Shiva, PetikamSrinivas, DeepaKhulbe, LellapalliRitesh, Penumatsa Kishore Verma, Rahul Kumar Tiwari, Milan Kumar Lal and Ravinder Kumar. (2024). Isolation and characterization of native antagonistic rhizobacteria against Fusarium wilt of chilli to promote plant growth, Peerj 12:e17578 (NAAS rating: 8.70)

26. Bharathi TU, Lallawmzuali R and Kirthishre SP (2024). Diversity in flower morphology of the single-type tuberose *(Agave amica* (Medik.) Thiede & Govaerts). *Genet Resour Crop Evolution*. **71**:1-15. https://doi.org/10.1007/s10722-024-01906-7. (NAAS rating: 8.00)

27. Bhargava CN, Ashok K, Asokan R, Anu CN, Pradeep C and Manamohan M. (2023). CRISPR/Cas9 mediated mutagenesis of the sex lethal (*sxl*) gene impacts fertility of the Fall armyworm, *Spodoptera frugiperda* (J.E.Smith) (Lepidoptera: Noctuidae). *Archives in Insect Biochemistry and Physiology, https://doi.org/10.1002/arch.22035.* (NAAS rating: 8.20)

28. Bhargava CN, Ashok K, Asokan R, Prasad Babu K, Parvathy MS, Yogi D, Shashikala T, Chiranth RK, Ashok U and Harsha CG (2024). CRISPR/Cas9 mediated editing of the white (wh) locus affects body size affects body size and reproduction of the Oriental fruit fly, Bactrocera dorsalis (Hendel). Agricultural Research, https://doi.org/10.1007/s40003-024-00731-9. (NAAS rating: 7.40)

29. Bhargava CN, Asokan R, Murali Mohan, Manamohan M, Sridhar V and Anitha Peter (2024). Ribonucleoprotein Complex (sgRNA+Cas9) mediated in vitro restriction assay to predict in vivo Editing of the white Gene of the Fall Armyworm, Spodoptera Frugiperda (J. E. Smith) (Lepidoptera: Noctuidae). Mysore Journal of Agricultural Sciences, 58: 33-42. (NAAS rating: 4.63)

30. Bhat NV, Dinesh MR, Vageeshbabu HS, Acharya GC, Sudhakar Rao DV and Bastia D. **(2023).** Evaluation and characterization of TILLING-based putative mutant populations of papaya cv. Arka Prabhath. *Indian Journal of Horticultural Sciences* 80(4), 305-312. DOI : 10.58993/ijh/2023.80.4.1 (NAAS rating: 5.58)

31. Bhusal S, Raju R, Nithyashree ML, HarishKumar HV (2024). Agricultural Scenario of Nepal: Growth Performance and Swot Analysis. *Environment and Ecology.* **42** (3) : 1044—1054. https://doi.org/10.60151/envec/CBGK5372. (NAAS rating: 4.87)

32. Bindu H, Sudhakar Rao DV, Narayana CK, Ansari MF, Srinivasa Rao E, Satisha J, Selvakumar G And Shivashankara KS (2024). Impact of polysaccharide and lipid based edible coatings on storage life and quality of muskmelon (*Cucumis melo*) fruits during low temperature storage. *Indian Journal of Agricultural Sciences* 94 (9): 990–995 (NAAS rating: 6.40)

33. Bishnoi P, Thakre M, Maurya P, Jagga S, Gangappa ND, Nagaraja A and Mithra Sevanthi A (2024). Pulp colour and pigment composition have no genetic correlation with seed hardness in guava (Psidium guajava L.). *The Journal of Horticultural Science and Biotechnology*, 1–14. https://doi.org/10.1080/14620316.2024.2392090 995 (NAAS rating: 7.90)

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35. Carolin Rathinakumari A, Senthil Kumaran G, Venu SA, Ashok R. Suraj Murugesh Huchagoudar and Surendra AR (2024). Energy Input-Output Analysis for Onion Production in Major Onion Growing Areas of Karnataka State. Journal of Agricultural Engineering 61(2): 275- 285 5.85 (NAAS rating: 11.10)

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38. Chandrashekara C, and Meera Pandey(2024)An optimized substrate combination for cultivating exotic King oyster mushroom, *Pleurotus eryngii*, 30(1): 203-207.

39. Chandrashekara C, Meera Pandey and Kalaivanan D (2024). A new casing formulation for enhancing yield of milky mushroom, *Calocybe indica*, 30 (1): 197-202. (NAAS rating: 5.14)

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41. Das A, Aghora TS, Reddy MK, Nandeesha P and Venugopalan R. (2024). Identification of source of resistance to Horse Gram Yellow Mosaic Disease (HgYMD) in French Bean (*Phaseolus vulgaris* L.). *Legume Research.* **47**(5): 860-865. (NAAS rating: 6.80)

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45. Divija, S.D., Saravan Kumar, P., G Krishnarao and P D Kamala Jayanthi. (2024). Onion (Allium cepa L.) attracts Scoliid wasps by mans of generalist florl volatiles. *Journal of Chemical Ecology*. https://doi.org/10.1007/s10886-024-01513-x. NAAS rating 8.30

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47. Dutta D, Bhattacharya E, Ray A, Ghosh B, Aathira U, Mandal A, Choudhury PP and Bahadur M. (2024) Genotoxic impact of agricultural insecticides as contaminants of river Teesta on the resident fish *Pethia conchonius*. *Scientific Report*. **14**: 28283. https://doi.org/10.1038/s41598-024-74434-0 (NAAS rating: 10.60)

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9.2. Papers published in Proceedings and Souvenirs

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9.3. Books

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9.4. Book Chapters

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19. Vageeshbabu SH and Ananda Kumar P. (2024). Transgenic eggplant.GB:CABI UK p. 23-44.

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9.5. Technical Bulletins

1. Anuradha Sane, Naveen Kumar P, Janakiram T, Anil Kumar Nair, Gopal Krishna C, Leela Sahijram, Shivashankara KS, Laxman RH, Sujatha S and Senthil Kumar R. (2024**)**. Bird-of-Paradise (*Strelitzia reginae* L)-A high value crop for doubling farmers income. ICAR-IIHR

2. Kalaivanan D, Selvakumar G. Ganeshamurthy AN, Shankara Hebbar S and Carolin RA. (2024). Cocoponics - A Futuristic Soilless Vegetable Production System. ICAR-IIHR

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4. Pitchaimuthu M. (2024). Hybrid Seed Production Techniques in Okra. ICAR-IIHR

5. Pushpa CK, Ranjitha K, Carolina RA and Senthil Kumar G. (2024). Technologies of post-harvest technology and agricultural engineering division. ICAR-IIHR

6. Rajendiran S, Senthilkumar M, Rani AT, Madhu GS and Muralidhara BM. (2024). Vegetable Nutrition Gardening: A Practical Guide. ICAR-IIHR

7. Rupa TR, Ganeshamurthy AN, Raghupathi HB, Ramachandran S and Aruna B. (2024). Plant tissue analysis and interpretation for horticultural crops. ICAR-IIHR

8. Rupa TR, Yukti Verma, Radha TK and Shivani Singh Yadav. (2024). Soil sampling techniques for fertility appraisal in horticultural crops. ICAR-IIHR

9. Varalakshmi LR and Chethan Kumar G. (2024). Management of salt affected soils in Horticultural Crops. ICAR-IIHR

9.6. Extension Folders/Brochures

1. Madhavi Reddy K, Naresh Ponnam, Ramya H.R, and Atheequlla G.A. (2024). Advances in chilli crop production in Kannada ICAR-IIHR.

2. Mahesha B. (2024). Integrated disease management in ridgegourd yellow mosaic disease caused by Tomato leaf curl New Delhi virus.

3. Meera Pandey, G Senthil Kumaran, Chandrashekara C and GM Sandeep Kumar. **(**2024).

   Kannada: a.Yanthrikruta gunamattada anabe bija utpadane, b. Milky mathu Macrocybe anabe besaya, c. Sidda anabe tantrajnana, d. Shiitake anabe besaya, e. Mulya vardita anabe utpannagalu, f. Aayaster anabe besaya

4. Meera Pandey, G Senthil Kumaran, Chandrashekara C and Sridhar V. (2024)

   Telugu: a. Vittana sahitha puttagodugula penchibygula (RTF) sanketikata, b. Muthyapu chippa puttagodugula sagu, c. Shitake putta godugula pempakam, d. Yantrikarna dwara nanyamiana puttagodugula vittana(spawn) utapatthi, e. Putta godugula viluva penchu utpatthula sanketikathalu, f. Pala mariyu Macrocybe puttagodugula sagu

5. Meera Pandey, G Senthil Kumaran, Chandrashekara C and Anushma PL. (2024).

   Malayalam: a. Redi tu froottu (RTF) koon baag technology, b. Chippik koon Krishi, c. Shittaakke koon Krishi, d.Yanthraval krithaguna nilavaaramulla koon vithu uthpaadanam, e. ICAR-IIHR mashroom moolya varddhitha ulppannangal, f. **P**aalkkoon maakrocybee koon krishi

6. Meera Pandey, G Senthil Kumaran and Chandrashekara C. (2024).

   Tamil: a. Sipi kalan valarpu murai, b. Sitake kalan valarpu, c. Eathiramayakapata taramana kalan

vidhai urpathi, d. ICAR-IIHR Kalan upayogithu mathipukutapata porulkalin tholilnutpangal, e. Pal kalan matrum macrocybe kalan valarpu

7. Muralidhara BM, Nayan Deepak G, Sakthivel T, Karunakaran G, Rajendiran S, Rani AT, Madhu GS and Chaithra MT. (2024). Kodagina Kittaleya Krishi. In Kannada, ICAR-IIHR.

8. Muralidhara BM, Nayan Deepak G, Sakthivel T, Karunakaran G, Rajendiran S, Rani AT, Madhu GS and Chaithra MT. (2024). Production technology of Coorg Mandarin. ICAR-IIHR

9. Pitchaimuthu M and Vivek Hegde. (2024). Production Technology of Cucumber (*Cucumis sativus* L.) in English ICAR-IIHR

10. Pitchaimuthu M and Vivek Hegde. (2024). Production Technology of Cucumber (*Cucumis sativus* L.) in Kannada ICAR-IIHR

11. Ramya HR, Satisha GC and Radha TK. (2024). Arka Tarakari Special (Kannada). ICAR-IIHR.

12. Ramya HR, Selvakumar G and Radha TK. (2024). Arka Microbial Consortium in Kannada "Arka Sookshmanujeevigala Sammishrana". ICAR-IIHR.

13. Rani AT**,** Madhu GS, Venkataravanappa V, Jayanthi Mala BR, Muralidhara BM, Nayan Deepak G, Rajendiran S and Rakshith V. (2024). Management of diseases and insect pests of Coorg Mandarin. ICAR-IIHR

14. Rani AT, Madhu GS, Venkataravanappa V, Jayanthi Mala BR, Muralidhara BM, Nayan Deepak G, Rajendiran S and Rakshith V. (2024). Kodagina Kittaleyalli Kandubaruva Rogagalu matthu Keeta Peedegala Nirvahane. In Kannada ICAR-IIHR.

15. Reddy PVR. (2024). Jenukrishi (Kannada). ICAR-IIHR

16. Rohini MR and D Kalaivanan. (2024). A guide for soilless cultivation of medicinal herbs.

17. Senthil Kumaran G., Meera Pandey, Chandrashekara C, Pooja Kumari and Nair AK. (2024).

    Hindi: a. Ready to fruit bag ki techniki, b. Khumb mushroom kii kethi, c. Shiitake mushroom kii kethi, d. Machinikrut gunavakthayukth spawn utpadan e. Mushroom Mulya varditha utpad poudogiki, f. dudiya aur Macrocybe mushroom kiikethi

18. Sridhar V, Madhavi Reddy K, Ramya HR, Naresh Ponnam and Atheequlla GA. (2024). Integrated management options against South-East Asian Thrips, *Thrips parvispinus* in Chilli in Kannada. ICAR-IIHR.

19. Varalakshmi LR and Chethan Kumar G. (2024). Heavy Metal pollution and control measures in peri urban areas. ICAR-IIHR.

9.7 Presentation in Conferences/ Seminars/ Symposia etc

International conference on 'Emerging post harvest technologies for shelf-life enhancement and valorization of horticultural crops', 4-5 January 2024, TNAU, Coimbatore

1. Pushpa CK and Karunakaran G. Development of ready-to-serve dragon fruit beverage by subjecting to high pressure homogenization and its quality evaluation.

2. Rincy TK, Reddy SVR, Preethi P, DV Sudhakar Rao and Ranjitha K. Effect of composite edible coatings on the shelf-life of mango fruits.

National Conference on Recent Trends and Future Prospects of Floriculture in India 9-11 January, 2024, ICAR-IIHR, Bengaluru. Book of Abstracts p. 314.

1. Anuradha Sane, Tejaswini, P Madhavilatha, Shubha R Rao and K Arathi. Clonal fidelity assessment in in *vitro* regenerated plants of carnation using ISSR and SSR markers.

2. Aswath C, Safeena SA and S Sangeetha Priya. Advances in vertical farming and hydroponic cultivation of flower crops.

3. Bhuveneswari S, Smitha GR and Sujatha A Nair. Floral Blocks: An eco-friendly product from floral waste. p 212.

4. Harishkumar HV. Economic feasibility and spread of Arka Savi rose variety in India.

5. Lalduhsanga, Sujatha A Nair, Usha Bharathi T, Rohini MR and Smitha GR. Documentation of rare and endangered orchid species of Sairep peak, Mizoram. p: 2.

6. Naveen Kumar P, D Mahesha Reddy, T Anuradha and SA Safeena. Recent trends and priorities in improvement of commercial flower crops.

7. Priya Bhusaraddi, Usha Bharathi T and Preeti Sonavane. Diversity in morphology, *Fusarium* wilt resistance and genetic traits of gladiolus (*Gladiolus hybridus* Hort.).

8. Priya M, Smitha GR, Sujatha A Nair, Tejaswini P, Dhananjaya MV, Kalaivanan D, Shivashankara KS and Venugopalan R. Influence of different rootstocks, nutrients and type of cuttings on propagation in rose through cuttings. p 165.

9. Priya SS, Aswath C, Safeena SA, Sujatha A Nair and Kalaivanan D. Response of gerbera var. Arka Nesara to orientation of vertical structures in different directions.

10. Priya SS., Aswath C, Safeena SA, Sujatha A Nair and Kalaivanan D. Standardization of nutrient solution for gerbera var. Arka Nesara grown on soil-less wick system.

11. Raju R, HarishKumar HV and Sreenivasa Murthy D. Economic analysis of crossandra cultivation in India.

12. Reddy PVR. Flowers and Pollinators: Partnering in essential ecosystem services

13. Reena Rosy Thomas, Chandra Prakash MK and Ramya HR. A Comprehensive Web based System for Flower Crops Cultivation. pp. 142.

14. Safeena SA, Aswath C, Senthil Kumaran G et al. Vertical farming: A case study on its feasibility for commercial cultivation of *Limonium sinuatum* (L). Mill.

15. Sridhar V and Onkara Naik. Pollinator diversity in ornamental ecosystems.

16. Sridhar V. and Onkara Naik. Efficacy of acaricides and entomopathogens for management of Red Spider Mite, *Tetranychus urticae* on Gerbera under polyhouse condition.

17. Sumalatha A, Arivalagan M, Reddy DCL, Vijaya Bhaskar V, and Tejaswini P. Influence of male sterility on carotenoid content in African marigold (*Tagetes erecta* L.).

18. Sushmita J, Smitha GR, Seetharamu GK, Kalaivanan D, Sujatha A Nair, Arivalagan M and Manjunath R. Flower waste: Sustainable approach for solid waste management p 219

19. Sushmita J, Smitha GR, Arivalagan M et al. Extraction of anthocyanin and polyphenolic antioxidants from waste rose petals and assessing their storage stability. p 202

20. Umamaheswari R, Tejaswini P, Hima Bindu K et al. Evaluation of marigold for its nematicidal properties and as rotational crop for nematode management.

3rd Horticulture Summit cum International Conference held at Jaipur by SHRD, UP and RARI, Jaipur, Rajasthan from 1-3 Feb 2024.

1. Sonam Meena, Satisha Jogaiah**,** Sanjay K Singh and Linta Vincent. Rapid multiplication of some grape rootstock genotypes using semi-hardwood stem cuttings.

2. Ajay Kumar, Vasugi C, Umamaheshwari R, Sriram S**,** Satisha J, Kanupriya C and Usha Rani TR. Screening of inter-specific hybrid progenies of guava for resistance to nematode & wilt.

3. Preethi P. Neoteric approaches to reduce storage browning in avocado pulp and cubes**.**

Webinar on Entrepreneurship Orientation Program in Medicinal and Aromatic Plants - VIII (EOPMAP-VIII), February 5, 2024, ICAR-DMAPR, Boriavi, Anand, Gujarat, India.

1. Kalaivanan, D - Soilless cultures for business development.

National Seminar on "Green Horizons: Career avenues in Plant Biology and Plant Biotechnology", February 19, 2024, Ethiraj College for Women, Chennai, Tamil Nadu

1. Kalaivanan, D - Cocoponics: A NextGen Farming for Vegetable Production in Urban and Periurban Spaces

National Seminar on Smart Technologies for Sustainable Agriculture and Environment during 22-23 February, 2024, ICAR-CRIDA, Hyderabad.

1. Shilpa Shree KG, MD Prathibha and Varalakshmi LR. Screening of French bean germplasm for salt stress tolerance at seedling stage by principal component analysis

International Conference on Science and Technology for Sustainable Future, May 29-31, 2024, Acharya Institute of Technology, Bengaluru, Karnataka, India.

1. Kalaivanan, D - Sustainable Soil Health Management for Horticultural Crops

International Conference on Precision Horticulture, 20-24 August 2024, HC&RI, TNAU, Periyakulam, Abstract Book (Eds. Rajangam J et al.) p 241, ISBN Number-788197 856662

1. Harish Kumar HV, Safeena SA, Vincent L, Naresh P, Raju R and Behera TK. Export potential of horticulture in India: Trends, Challenges, and Future Prospects. p.119.

2. Naveen Kumar P, Sujatha A Nair and Safeena SA. Precision roduction technologies in flower crops.

3. Reddy SVR, Preethi P, Sudhakar Rao DV. Standardization of optimum storage temperature and packaging for the Malayan apple (*Syzygium malaccence* L.).

4. Sankaran M, C Ravindran, K Abirami and P Mauvarasi. Recent advances in the improvement of fruit crops. pp 83-103

5. Sujatha A Nair, GR Smitha and D Kalaivanan. Influence of crop growth-stage based drip- fertigation scheduling on growth and yield of chrysanthemum (*Dendranthema grandiflora* Tzelev.)

International Conference on Plant Protection in Horticulture (ICPPH-2024) -Advances and Challenges, September 25-27, 2024, ICAR-IIHR, Bengaluru-560089

1. Bhagyasree SN, Kamala Jayanthi PD, Rami Reddy PV and Sankaran M. Pollinator diversity and behaviour in Wild species of mango.

2. Chandrashekara C. Vitamin D enrichment technology in Elm Oyster mushroom *Hypsizygus ulmarius*

3. Harishkumar HV. Promoting eco-friendly plant protection in horticulture: The role of ATIC at ICAR-IIHR.

4. Jayanthi Mala BR, Kamala Jayanthi PD and Shivashankara KS. Exploiting attractive cues from the expanded host range of tea mosquito bug, *Helopeltis antonii*: A management perspective

5. Linta Vincent, Sriram S, Satisha J and Nandeesha P. Identifying downy mildew resistant pre-breeding lines in grapes

6. Mahesha B, Dhananjaya MV and Samuel DK. Exploration and validation of seed transmission mechanism of cucumber green mottle mosaic virus in bottlegourd

7. Manjunatha L et al. The First report of *Bipolaris* species causing stem rot and fruit blotch in Kamalam (dragon fruit) in India

8. Mythra R, G Selvakumar and Radha TK. *In vitro* screening of *Rhizobacteria* for biological control of major pathogens in tomato and chilli.

9. Nandeesha P, Madhusudan Rao, Lakshmana Reddy DC, Linta Vincent and Sriram S Towards Genome editing grapes for Powdery mildew resistance

10. Pitchaimuthu M. Screening of okra advance lines resistance to Yellow Vein mosaic Virus and Enation Leaf Curl Virus under Hotspot area of Villupuram, Tamil Nadu

11. Poojitha SR, T Usha Bharathi, Shameena Azeez, Nandeesha P and Priti Sonavane. Differential enzyme activities and gene expression- A comparative approach

12. Prasannakumar NR, Ashok K, Venkataravanappa V, Jyothi N, Rahul Dubey, Ravi M and Asokan R. Exploring the virus vector interactions through the immune responsive genes in Bemisiatabaci (Gennadius) (Hemiptera: Aleyrodidae)

13. Ramesh KV. Powdery mildew induced changes in gas exchange parameters in tomato and disease area estimation through SAM using hyperspectral camera data

14. Rani AT, Madhu GS, Muralidhara BM, Nayan Deepak G, Rajendiran S. First report of Cossid larva as a stem borer on avocado (*Persea americana* Mill.) in South India.

15. Reddy PVR and Varun Rajan V. Relevance of wild and native species to sustain ecosystem services in the context of climate change

16. Reena Rosy Thomas, Chandra Prakash MK and Ramya HR. Web-based crop protection system for horticulture crop cultivation p. 33

17. Sonavane P. Differential enzyme activities and gene expression- A comparative approach.

18. Sridhar V, Ashok BH, PVR Reddy et al. Feasibility studies on Sterile Insect Technique (SIT) for the management of South American tomato moth, *Phthorimaea* (Tuta) *absoluta* (Meyrick).

19. Umamaheswari R. Holistic modules for nematode management in cucumber under protected conditions

20. Singh TH. Identification of heat stable sources of resistance to *Meloidogyne incognita*

21. Pooja R, Uma Maheshwari R, Chandrashekar N, Usharani T R, Vasugi C et al. Comparative transcriptomics of guava roots reveals insights into nematode resistance

22. Chandrashekar N, S Ali, Zahoor AM et al (2024). Isolation and characterization of pathogen inducible PR Gene promoter from *Arabidopsis thaliana* in response to *Alternaria Brassicae.*

Progressive Horticulture National Symposium (PHNS-2024) on Horticulture in the Himalayas (17-19th October, 2024).

1. Anuradha Sane, Naresh Negi and BNS Murthy. Exploring pomegranate diversity from Himachal Pradesh: Collection, survey and evaluation of genetic resources

1st International e-Conference on Agro-Environmental Sustainability (ICAGENS 2024), 19-20 October 2024.

1. Radha TK, Umamaheswari R, Onkar Naik S and Lokesha AN. Actinobacteria and its secondary metabolites for sustainable production of vegetable crops.

Workshop on 'Potential of Soilless Media for Vegetable Cultivation in Lakshadweep Islands' October 23, 2024, Kavaratti Island, Lakshadweep, India.

1. Kalaivanan D. - Practicalities and advantages of soilless vegetable cultivation in Lakshadweep.

National Conference on Smart Farming Solutions for Ornamental Horticulture Nov 8-9, Mahranapratap Horticultural University, Karnal.

1. Sumangala HP. Fostering the resilience of urban landscape through sustainable practices.

International Conference on Emerging Viruses (*VIROCON-2024*), at DRDO, Gwalior, MP, from 11-13 Nov. 2024

1 Patil BL. Keynote Talk on Emerging Emaraviruses: The Indian context.

Global Soils Conference 2024-Caring Soils Beyond Food Security: Climate Change Mitigation & Ecosystem Services', 19-22 November 2024, New Delhi.

1. Rupa TR, Ganeshamurthy AN, Laxman RH and Prabhakar M. Long-term conservation horticulture in Mango Orchards: Comparative Carbon and Energy Efficiencies of Conventional vs. Conservation Management Practices

7th International Symposium on Minor Fruits, Medicinal and Aromatic Plants, 22 – 23 November, 2024 held at Vishva Bharati, Srineketan, West Bengal

1. Sakthivel T, Sushmitha BH and G Karunakaran. Custard apple breeding in India - advancements, challenges and potential outcomes.

National Seminar on "Plant Health Management a sustainable tool in addressing crop diseases under climate resilient Agriculture" 11-12 December, 2024, at UAS Dharwad.

1. Patil BL. Pigeonpea sterility mosaic emaraviruses: the legume-infecting Emaraviruses

Others

1. Thangam M, C Mahadevaiah and V Keshava Rao. (2024). Identification of anthocyanin rich pole *Dolichos* accessions for development of nutrient rich genotypes. In ISVS Golden Jubilee National Seminar on Technological Innovations in Vegetable Production under Changing Climate Regime, 24-26 Feb, 2024, ANDUA&T, Ayodhya. UP. pp 73

2. Sumangala HP (2024). Vertical gardening. Lead lecture in Annual 27th Flower Show during 02-11 February 2024. BMC 3D Auditorium, V.J.B. Botanical Garden & Zoo, Byculla, Mumbai-27.

3. Sumangala HP. (2024). Education, Employment and Entrepreneurship through Horticulture. In Conference on Women in Agri Business" 22 August 2024 at BIEC, Bengaluru.

9.8. Popular articles

1. Anupa T, ShilpaShree KG, Anushma PL, Linta Vincent, Murulidhara BM and Satisha J. (2024). Angur prasar mey bench grafting Taknik. Baagwaani. Vol 13. pp 95.

2. Archa Nair, Pushpa CK, Ranjitha K and Karunakaran G. (2024). Dragon Fruit Peel: An Emerging Horticulture Waste for Valorization. *The Agriculture Magazine*. 3(8): 409-412

3. Atheequlla GA, Tejaswini P and Vasanthi C. (2024). Arka Savi: The Breakthrough Rose Revolutionizing Floriculture. *Agri-India Today*. 4(9): 17-19

4. Carolin Rathinakumari A, Kalaivanan D and Senthil Kumaran G. (2024). Arka Vertical Garden Structure. *Amrut Vatika* (Natural Farming Bulletin), Kitchen Gardeners Association, Bhubaneswar, Odisha. pp 69-72.

5. Chandana S, Sujatha A. Nair and Smitha GR (2024). The art and science of dry flower production. *The Science World*. 4(9): 3580-3586.

6. Kalaivanan D, Nilimesh Mridha, Meghana R Sagar and V Ranjitha. (2024). Wool waste management. *Agro India* (May): 27-29.

7. Kalaivanan D, Selvakumar G and Anil Kumar Nair. (2024). From waste to wealth: Unlocking the potential of post-methanated cattle dung slurry for soil and crop management. *Agro India* (December 2024): 42-44.

8. Kalaivanan D. (2024). Cocoponics: Mannillada Sulabha Krishi. *Shramajeevi Krishi* (December): 55-57.

9. Kamble V, Kamble BS, Priya S, Reddy SVR and Preethi P. (2024). Biosensors: An innovative approach for modern agriculture. *Agritech Today* 2(4): 137-139

10. Karunakaran G, Linta Vincent and Anushma PL (2024) Sidhuvum Shankarayum- Tumkuril uruvaya maniykangal. *Krishi Jagran*. 8(1) : 48-49.

11. Karunakaran G, Rupa TR, Arivalagan M, Tripathi PC, Sakthivel T, Ruchitha T and Abhilash K. (2024). Abiu – An emerging potential fruit for diversification in fruit orchard. *Indian Horticulture* (May-June): 1-11.

12. Meghana K and Smitha GR. (2024). Agrivoltaics - As a solution to food and energy demands. *Agro India* (December): 12-15.

13. Meghana K and Smitha GR.(2024). Snapdragon – A promising flower crop for commercial cultivation. *Agro India* (May): 9-12.

14. Naveen Kumar P, Safeena SA, Aswath C and Senthil Kumaran G. (2024). Vertical Flower farming-A Smart Choice. *Indian Horticulture.* 69(5): 43-44

15. Raghu BR. (2024). Hybrids in onion: a dream yet to realise in India. *Food and Scientific Reports*. 5(12): 23-27.

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17. Safeena S.A. (2024). Arka Vertical Farming Module. *Augmented Reality Post cards.*

18. Sakthivel T. (2024). Profitable custard apple farming (Tamil): *Vikatan Plus*. 437: 6-10

19. Sangeetha G, Singh HS, Sudhakar Rao DV, Kundan Kishore and Atheequlla GA. (2024). Mango fruit blackening caused by Sooty Blotch with Arka Mango Wash technology to boost mango marketability. *Agri-India Today* 04(12):97-99

20. Sangeetha Priya S, Aswath C and Safeena SA. (2024). Wick system - An efficacious technique for gerbera cultivation. *Indian Horticulture* 69(3):18-21.

21. Shilpa Shree KG, Rupa TR, Anupa T and Prathibha MD (2024). Phasalon me jaivutteja ka ki roop mein Samudra shaival ka effect (Hindi). *Bagwani – Rajbhasha Patrika*:93-94

22. Swagatha Kumar S and Anuradha Sane**.** (2024). Bird of Paradise- An exotic enchanting bloom for landscaping. *Krishi Science*. 5 (5).

23. Sonam M, Satisha J**,** SK Singh, Linta V and AK Jha. (2024). Aqua rooting of semi-hardwood grape cuttings: A rapid cloning technique for rootstocks. *Indian Horticulture* (July-Aug) pp: 11-13.

24. Srinivas P and D Kalaivanan. (2024). Starting rooftop garden: Points to ponder. *Amrut Vatika* (Natural Farming Bulletin*)*, Kitchen Gardeners Association, Bhubaneswar. pp 73-77.

25. Sushmita Javalagaddi and Smitha GR (2024). Miyawaki Forest-A sustainable approach for environment conservation. *Agro India* (June): 36-38

26. Sushmita Javalagaddi and Smitha GR. (2024). Smart Landscaping – Approaches for energy conservation. *Agro India* (May): 9-12.

27. Thirumalaisamy PP, Anuradha Sane, Suma A, Pradheep K et al (2023) Wood apple: A fruit rich in nutritional and medicinal values. *Agritech Today*1 (November): 70-73

28. Tripathi PC, Anuradha Sane, Kanupriya and Muralidhara BM (2024). Longan Cultivation. *Agro India* (November) pp. 28-31

29. Tripathi PC, Anuradha Sane, Kanupriya and Pritee Singh (2024). Macadamia Nut: A fruit with splendid taste. *Agro India* (March).pp 24-27

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31. Varalakshmi B, Pitchaimuthu M, Rao ES, Kumar S, Jayanthi PDK, Raghupathy HB, Mahesha B, and Nair AK. (2024). Arka Vikram: An early, high-yielding hybrid of ridge gourd. *Indian Horticulture* 69(3):3-5.

32. Vasanthi C, Atheequlla GA and Ramya HR. (2024). Eco-Friendly agriculture through green credits: Building a sustainable and resilient future. *AgriGate* e- Magazine.04 (08): 241-247

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10.1. DIVISION OF FRUIT CROPS

HORTIIHRCIL2023 (010): Genetic improvement of fruit crops for improved productivity, quality and resistance to biotic and abiotic stresses – (**PI -Dr. M. Sankaran)**

HORTIIHRCIL2023 (011): Development and refinement of production technology of fruit crops – (**PI -Dr. J. Satisha)**

HORTIIHRCIL2023 (012): Evaluation and demonstration of natural farming approaches in horticultural based cropping system – (**PI -Dr. B. L. Manjunath)**

10.2. DIVISION OF VEGETABLE CROPS

HORTIIHRCIL2023 (020): Genetic improvement of self and often-cross pollinated vegetable crops for improved productivity, quality and resistance to biotic and abiotic stresses – (**PI –Dr. H. C. Prasanna)**

HORTIIHRCIL2023(021): Development and refinement of production technologies for tropical Vegetables - (**PI -Dr. S. Shankara Hebbar)**

HORTIIHRCIL2023 (023): Genetic improvement of cross pollinated vegetable crops for improved productivity, quality and resistance to biotic and abiotic stresses – (**PI -Dr. M. Pitchaimuthu)**

10.3. DIVISION OF FLOWER AND MEDICINAL CROPS

HORTIIHRCIL2023 (030): Breeding of flower crops for high yield, multiple utility; and environmental sustainability – (**PI -Dr. P. Naveen Kumar)**

HORTIIHRCIL2023 (031): Development of production protocols for cultivation and sustainable utilization of commercially important ornamental and medicinal crops – (**PI -Dr. Sujatha A Nair)**

HORTIIHRCIL2023 (032): Genetic Improvement of Medicinal Crops – (**PI -Dr. K. Himabindu)**

10.4. DIVISION OF POST HARVEST TECHNOLOGY AND AGRICULTURAL ENGINEERING

HORTIIHRCIL2023 (044): Development and Scale-up of appropriate technologies for Postharvest loss Reduction in Selected Fruits and Vegetables – (**PI -Dr. R. B. Tiwari)**

HORTIIHRCIL2023 (043): Development of Machinery for Conservation/Saving Inputs in Production and Processing of Horticultural Crops – (**PI -Dr. G. Senthil Kumaran)**

10.5. DIVISION OF CROP PROTECTION

HORTIIHRCIL2023 (050): Diagnosis, forecasting and integrated disease management in horticultural crops & Standardizing Mushroom production technology – (**PI -Dr. S Sriram)**

HORTIIHRCIL2023 (060): Integrated management of biotic stress induced by insect pests and nematodes in tropical horticultural crops and insect mediated ecosystem services–(**PI -Dr. P.V. R. Reddy)**

10.6. DIVISION OF BASIC SCIENCES

HORTIIHRCIL2023 (070): Understanding the physiological, biochemical mechanisms and pesticide dynamics, and their application for improving productivity and quality of mandate horticultural crops – (**PI -Dr. K. S. Shivashankara**)

HORTIIHRCIL2023 (110): Understanding the molecular mechanisms and the use of Biotechnological approaches for the improvement of horticultural crops – (**PI -Dr. B. L. Patil)**

10.7. DIVISION OF NATURAL RESOURCES

HORTIIHRCIL 2023 (080): Soil, Nutrient and Water Management in Horticultural Crops – (**PI -Dr. T. R. Rupa)**

10.8. DIVISION OF SOCIAL SCIENCES AND TRAINING

HORTIIHRCIL2023 (90): Improving knowledge and skill of stakeholders for improving productivity of horticultural crops and impact assessment of adopted technologies – (**PI -Dr. B. Balakrishna)**

HORTIIHRCIL2023 (091): Development and application of economic, statistical and ICT tools and strategies for assessing and improving productivity of horticultural crops – (**PI -Dr. R. Venugopalan)**

10.9. CENTRAL HORTICULTURAL EXPERIMENT STATION – CHETTALLI

HORTIIHRCIL2023 (170): Development, refinement and popularization of horticultural crops and technologies for high altitude regions of Western Ghats of India- (**PI -Dr. S. Rajendiran)**

10.10. CENTRAL HORTICULTURAL EXPERIMENT STATION – BHUBANESWAR

HORTIIHRCIL 2023 (180): Development and Refinement of Technologies for Improving the Productivity of Fruit and Vegetable Crops in East Coast Region of India – (**PI -Dr. G. C. Acharya)**

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11. Major Recommendations of Institute Research Council

11.1. IRC recommendations

The 94th IRC meeting was held from 13th to 14th August, 2024 under the chairmanship of Dr. T. K. Behera, Director, ICAR-IIHR in Dr G. S. Randhawa Auditorium of ICAR-IIHR, Bengaluru. Project wise presentations were made by Project leaders from all divisions of the main Institute as well as regional stations and KVK Heads.

Division of Fruit Crops

General comments

- It was suggested to first address all the problems related to the main mandated crops and later other crops can be taken in a phased manner.
- Disease resistance breeding and rootstock breeding should be kept as top priority in the breeding programmes
- For maintenance of germplasm/ PPVFRA notified varieties of fruit crops, a separate funding may be sought from PPV&FRA, NBPGR or other agencies to meet the expenditure for their maintenance in the long run
- New varieties and technologies should be circulated to all ATARI's and KVK's for wider publicity.
- Crops may be prioritized for mutation breeding where it is necessary in collaboration with BARC-BRNS
- A report/publication of germplasm of fruit crops having IC numbers may be published

HORTIIHRCIL2023 (010): Genetic improvement of fruit crops for improved productivity, quality and resistance to biotic and abiotic stresses (Project Leader: Dr. M. Sankaran)

- Widening of genetic base of polyembryonic mango varieties may be attempted
- Efforts may be made to introduce *Mangifera laurina* from Australia as it is immune to anthracnose
- Pyramiding of genes for specific traits in mango may be initiated
- Half sibs of Peddaneelum may be raised
- Large mutant population may be raised to obtain soft seeded pink fleshed guava varieties.
- Back crossing of F2 progenies in papaya with *Vasconcellea* may be taken up
- Crossing may be attempted among selected F1 progenies in papaya
- Breeding varieties for blight resistance may be intensified
- Large number of hybrids in grapes may be raised in mildew resistance breeding
- Screening of selected progenies of grapes for salinity and drought may be carried out
- OP seedlings may be raised from round the year variety of jamun
- Markers may be developed to distinguish zygotic and nucellar seedlings in jamun
- Breeding should be oriented towards widening the genetic base of existing varieties
- Mutation population from Arka Sahan seeds may be developed
- Half sibs of Arka Sahan may also be raised
- Promising lines of custard apple may be given to AICRP (Arid Fruits) for MLT
- Efforts need to be made for reducing rind thickness in pummelo
- Screening avocado germplasm for rootstock for *Phytophthora* resistance
- Only few promising parents with desirable traits may be selected for hybridization work rather than crossing many parents
- Dwarf and purple colored jackfruit may be collected
- Chemical profiling of jackfruit seeds from all the varieties may be carried out
- Success story about area expansion in dragon fruit in last 5 years may be prepared
- Seeds from available germplasm may be characterized for calcium and protein contents
- Wood apple germplasm maintained at UHS, Bagalkot may be examined to avoid duplicate collections.
- Work on improvement of Coorg mandarin may be intensified and post harvest management need to be worked out

Project No.: HORTIIHRCIL2023 (011): Development and refinement of production technology of fruit crops (Project Leader: Dr. J. Satisha)

- Rapid multiplication of guava may be taken on priority using leaf cutting by creating low cost poly tunnels
- Vegetative propagation of inter-generic hybrids in papaya may be initiated on priority
- Propagation of Annona and Pummelo through leaf cuttings may be attempted
- Nutrient absorption pattern in different mango rootstocks may be initiated
- Sensor based irrigation in guava may be initiated

Project No.: HORTIIHRCIL2023 (012): Evaluation and demonstration of natural farming approaches in horticulturally based cropping system (Project Leader- Dr. B.L. Manjunath)

- Nutrient uptake pattern in different systems (natural farming, organic farming, modern farming) may be recorded.
- Prioritization of crops and varieties that can fit in the natural farming system

Division of Vegetable Crops

General comments

- For speed breeding work, other institutes may be approached for collaboration in potential vegetable crops.
- Studies on nutritional profiling and anti-nutritional factors in vegetable crops/underutilized crops may be initiated..
- Pre-breeding work should be strengthened.

Project No.: HORTIIHRCIL2015 (020): Genetic improvement of self and often-cross pollinated vegetable crops for improved productivity, quality and resistance to biotic and abiotic stresses (Project Leader-Dr K. Madhavi Reddy up to August 2024 and Dr. H.C. Prasanna from September, 2025 onwards)

- In addition to existing *Ty* genes in tomato, new source of ToLCV resistance shall be identified for discovery of novel *Ty* genes
- A set of germplasm for heat tolerance may be identified/developed and work may be initiated on heat set and foliar disease resistance in tomatoes.
- In view of the recent incidence of late blight in Northern India and varied response of existing Ph genes, stable source of resistance to Late Blight may be identified
- Efforts may be focused on developing thin segment with high pungency (1 lakh SHU) and high ASTA (>200 ASTA) in chilli
- Chilli leaf curl resistance may be tested in hot spots in different locations of India
- MAS for resistance to powdery mildew and anthracnose may be initiated in chilli
- Efforts may be made to develop lines in different segments in brinjal with combined resistance to bacterial wilt and Root Knot Nematode. The mapping genes for resistance to both diseases may be taken up immediately.
- Persistent calyx in okra is an emerging trait and shall be considered as a target trait for breeding.
- Breeding efforts may be focused on development of okra hybrids rather than development of OPs
- Heterotic pool of both seed and pollen parent may be created for development of okra hybrids
- Work on Enation Leaf Curl Virus (ELCV) resistance combined with YVMV has to be intensified
- Purple podded cowpea may be developed
- Work on GMS lines and hybrids in beans may be intensified
- Development of line and/or variety for summer season in Dolichos and Garden pea may be strengthened in the ongoing work
- Capsicum line with resistance to high temperature, thrips and powdery mildew is the requirement for open field condition
- Doubled haploids may be attempted and CMS lines development may be initiated in capsicum
- Medicinal property of curry leaf powder may be studied

Project No.: HORTIIHRCIL2023 (023): Genetic improvement of cross pollinated vegetable crops for improved productivity, quality and resistant to biotic and abiotic stresses (Project Leader: Dr. M. Pitchaimuthu)

- Rootstock breeding in watermelon may be strengthened especially for GSB management

- Emphasis shall be given to important muskmelon segments like cantaloupe than acidulous group melons
- Breeding for *Fusarium* and downey mildew resistance in muskmelon
- Mutation breeding may be attempted in onion for disease resistance as well as quality traits
- Work on green leaf onion type may be explored
- Herbicide resistance may be explored in onion
- In radish, leaf quality traits also shall be investigated for vegetable purpose
- Orange colored, slender carrot with small core trait may be developed
- Ridge gourd with low Cucurbitacin may be developed
- Traits specific work in cucumber such as summer suitability, perfect bi-colour, stay green type and predominant female flower may be taken up
- Utilization of *C. hystrix* species may be explored in cucumber
- New rootstocks in bottle gourd and ash gourd have to be exploited
- Dual type dwarf moringa can be an immediate breeding goal. Pod bearing moringa genotypes during off season may be explored (winter tolerant moringa types) for North Indian condition

Project No.: HORTIIHRCIL2015 (021): Development and refinement of Production technology of Vegetable crops (Project Leader - Dr. S. S. Hebbar)

- Sensor based methods for water management have to be standardised crop wise
- Single cut vegetable may not be considered for protected cultivation

Division of Flower & Medicinal Crops

General comment

- Efforts to be made to popularize released varieties and technologies in farmers' field

Project No.: HORTIIHRCIL2023 (030): Breeding of flower crops for high yield, multiple utility and environmental sustainability (Project Leader: Dr. P. Naveen Kumar)

- Advanced breeding lines of cut flower varieties of rose need to be evaluated in protected cultivation.
- In chrysanthemum, emphasis to be given in developing varieties suitable for polyhouse cultivation and white rust resistance.
- In China aster, promising lines for cut flower, loose flower and bedding/pot culture purpose need to be identified
- Trait specific tuberose and gladiolus lines may be registered with ICAR-NBPGR, New Delhi/ PPV&FRA, New Delhi.
- Mutation breeding may be attempted in Dahlia

Project No.: HORTIIHRCIL2023 (032): Genetic Improvement of Medicinal crops (Project Leader: Dr. K. Hima Bindu)

- Value added products from medicinal herbs may be developed.
- Trait specific *Centella asiatica* lines (Genetic stocks) may be registered with ICAR-NBPGR, New Delhi/ PPV&FRA, New Delhi.
- New activity on Mutation breeding in Brahmi is approved.
- Wedelolactone content of the main crop and ratoon crop are to be studied
- Antidiabetic activity of *Gymnema sylvestre* extracts to be studied

Division of Post Harvest Technology and Agricultural Engineering

General comments

- Priority should be given to scaling up existing technologies using BESST-HORT facilities.
- Impact analysis of the PHT&AE technologies may be studied.
- Export potential of processed fruits and vegetables may be studied.

Project No. HORTIIHRCIL2023 (044): Development and Scale-up of Appropriate Technologies for Post-Harvest Loss Reduction in Selected Fruits and Vegetables (Project leader: Dr. R. B. Tiwari)

- Collaboration with mango pack-houses needs to be explored for demonstration of hot water treatment of mangoes
- Possibility of hiring or buying a refrigerated-container for conducting static simulation studies related to sea shipment for export may be explored
- Anti-nutritional properties of underutilized crop products should be analysed.

Project No. HORTIIHRCIL2023 (043): Development of Machinery for Conservation / Saving Inputs in Production and Processing of Horticultural Crops (Project leader: Dr. G. Senthil Kumaran)

- Emphasis should be given to develop machinery for harvesting of different horticultural crops.
- Vertical structures amenable for microgreen cultivation (open/controlled) may be developed

Division of Crop Protection

General comments

- SoP's for pest management in major crops to be developed by the Division and submitted to the Director
- Caution should be exercised in reporting new diseases.

Project No.: HORTIIHRCIL2023 (050): Diagnosis, forecasting and integrated disease management in horticultural crops & Standardizing Mushroom production technology (Project Leader: Dr. S. Sriram)

- The external seed borne nature of tomato leaf curl virus New Delhi virus (ToLCNDV) in cucurbits has to be ascertained.
- Diagnostics for mixed infections have to be developed.
- For clinical trial for testing the medicinal properties of mushroom, Regional Cancer Centre at Thiruvananthapuram may be contacted

HORTIIHRCIL2023 (060): Integrated management of biotic stress induced by insect pests and nematodes in tropical horticultural crops and insect mediated ecosystem services (Project Leader: Dr. P.V.R. Reddy)

- Fruit bagging may be evaluated for fruit borer and fruit fly management in mango
- The possibility of using steam, CO_2 flush and nitrogen to disinfest thrips on okra as post-harvest treatment may be explored. Slitter can be introduced to reduce the temperature in consultation with post-harvest technologist and agricultural engineering scientist
- There are 18 compounds listed for the insecticide activity on botanicals. To shortlist the same, fractionization may be carried by reducing the area of trapping for in depth understanding of efficacy. The retention index may be used to check the ecotypes
- The interaction between phylloplane microflora and entomofungal pathogen (*Cladosporium* sp.) effective against *Thrips parvispinus* has to be studied
- Impact of phylloplane on entmopathogenic fungi (*Metarhizium anisopliae*) used for the tea mosquito bug management may be studied
- Allelopathic effect of plants other than marigold on nematodes may be explored

Division of Basic Sciences

Project No: HORTIIHRCIL2023 (110): Understanding the molecular mechanisms and the use of biotechnological approaches for the improvement of Horticultural crops. (Project Leader - Dr. B.L. Patil, w.e.f: July-2024; Dr. Asokan, until June-2024)

- Strategies are to be evolved for the removal of transgenes in vegetative propagated crops
- Parent specific molecular markers are to be utilized for identifying doubled haploids in fruit crops (papaya, guava and pomegranate)
- Double haploids need to be developed in papaya
- F_1s are to be used in doubled haploids of cucumber
- Fine mapping and candidate gene identification should be prioritized in chilli
- DNA melt curve and challenge inoculation can be used as strategy to screen genome edited papaya plants, to reduce overload of plants in T1, T2, T3…
- In capsicum, *Colletotrichum truncatum* can also be used for screening dsRNA efficiency
- The *cap 20* gene can be tried for anthracnose management in mango
- Chemical mutagenesis can be tried to improve the success rate in guava for *Fusarium* wilt resistance
- Molecular and morphological markers for male sterility should be developed in Okra & Tomato

PROJECT NO. HORTIIHRCIL2023 (070): Understanding the Physiological, Biochemical mechanisms and Pesticide dynamics and their application for improving productivity and quality of mandate horticultural crops (Project Leader: Dr. K. S. Shivashankara)

- Transcriptome & metabolite studies in onion under flooding stress should be initiated
- With the available mango sequencing data, look for the variability in SVP1 and FT genes of five regular and alternate bearing varieties. Check with Dr. N.K. Singh (NIPB, Delhi)
- SOC gene can also be included in the study.

- Studies on pollen/floral biology of the flowers are to be initiated in order to determine the reason for misshapen fruits in jackfruit

Division of Natural Resources

Project No.: HORTIIHRCIL2015 (080): Soil Nutrient and Water Management in Horticultural Crops (Project Leader: Dr. T. R. Rupa)

- Experiments can be initiated on precision farming using sensors under protected cultivation
- Efficacy of bio-stimulants in breaking seed dormancy can be explored
- Identified mycorrhizal isolates can be tested on Coorg mandarin, mangosteen and rambutan crops at CHES, Chettalli.
- The iron and zinc nanoparticles synthesized at ICAR-NRC for Grapes, Pune can be evaluated in different crops at ICAR-IIHR, Bengaluru.

Division of Social Sciences and Training

Project No.: HORTIIHRCIL2023 (090): Improving knowledge and skill of stakeholders for improving productivity of horticultural crops and impact assessment of adopted technologies (Project Leader: Dr. B. Balakrishna)

- As area under dragon fruit is increasing its effect on glut in market may be studied and accordingly value addition may be promoted
- Major export-oriented crops may be taken to identify the research and extension gaps

Project No.: HORTIIHRCIL2023 (091): Development and application of economic, statistical and ICT tools and strategies for assessing and improving productivity of horticultural crops (Project Leader: Dr. R. Venugopalan)

- Weightage for trait based on its importance may be considered while developing non-parametric stability models in AICRP (F) data base
- Non-parametric stability methods developed may be submitted for technology certification.
- Profitability of marigold flower production v/s seed production may be worked out
- Impact studies on Rose variety - Arka Parimala to be carried out
- Economics of IIHR chilli varieties with private varieties may be compared, a research article or policy paper could be developed from this study

CENTRAL HORTICULTURAL EXPERIMENT STATION, CHETTALLI

Project No: HORTIIHRCIL2023 (170) - Development, refinement and popularization of horticultural crops and technologies for high altitude regions of Western Ghats of India (Project Leader: Dr. Rajendiran S.)

- After proper identification of all insect pests, a publication/data base may be brought out on insect pests of avocado at the earliest
- The correlation between seasonal variation in weather parameters and pest incidence in avocado needs to be studied

CENTRAL HORTICULTURAL EXPERIMENT STATION, BHUBANESWAR

Project No.: HORTIIHRCIL2023 (180): Development and Refinement of Technologies for Improving the Productivity of Fruit and Vegetable, Crops in East Coast Region of India (Project Leader: Dr. G. C. Acharya)

- An activity on genetic improvement of Teasel Gourd for yield and quality is recommended to be carried out
- Impact study and economic analysis of the IIHR and CHES technologies in Odisha may be carried out in a systematic way.
- Surveillance of diseases on horticulture crops in Odisha state is to be done periodically
- Study on the temperature tolerant natural enemies (parasitoid and predator) is suggested

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12. Commercialization of Technologies

12.1. Licensing of technologies

During the period, a total of 78 licenses were done for 43 technologies involving 60 licensees (clients) generating a revenue of Rs. 1,56,56,580/- from the licensing. The major technologies licensed during the period include ICAR-IIHR biopesticide technologies *viz*, "*T. harzianum*-1% W.P"; "*T. viride*-1.5% W.P"; "*P. fluorescens*-1% W.P"; "*P. chlamydosporia*-1 % W.P", Arka Microbial Consortium, Arka Mango Special, Arka Vegetable special, Arka Banana Special, Arka Fresh Cut Fruits Technology, Arka Vertical Garden Model, Light cum suction trap, Okra Advanced Breeding line IIHR-385-5-1 , Okra Advanced Breeding line IIHR-386-7-2, Chilli CGMS line with maintainer IHR 4390 & IHR 4391, Marigold hybrid Arka Bhanu etc. The licensing profile during this period is tabulated below.

Licensing profile in 2024

Technology licensing profile	Total
Total number of clients	60
Total number of licenses	78
Total number of technologies licensed	43
Total revenue (Rs.) (Incl. of tax)	1,56,56,580

Licensing of Avocado variety Arka Supreme to Mr. Ramesh S. Kodagu (Dist.), Karnataka on 5.3.2024 during NHF 2024

Licensing of Chilli Inbred line IHR 4597 to M/s. Bhairavi Bio Sciences Pvt. Ltd. Hyderabad on 5.9.2024 during Institute Foundation Day

12.2. Media Coverage (Radio, TV programs, Newspaper articles etc.,)

The report on the technology licensing of ICAR –IIHR was covered in various Oriya newspapers and media

News paper clips

The news about the 2nd ICAR-IIHR Industry Meet-2024 (organised in collaboration with SPH, Besst-Hort and IP&TM Unit, ICAR, New Delhi) was covered in various press and media.

Screen shot from television programme

12.3. Patents

During the period, two patents filed earlier were granted and two new patents were filed. The details are provided in Table 1.

List of patents filed/granted during January-December 2024

IPR	Application/ Registration No.	Name of Innovation/Technology/ Product/ Variety with name of lead innovator	Date of Filing/ Registration	Application Granted/ Registered
Patent	201941033416	Suction Trap for Insects (by Dr. V. Sridhar)	19.8.2019	Patent No. : 523430 Date of grant : 11.03.2024
	201841022601	Iron Fortified Mushroom and Process of producing thereof (by Dr. Meera Pandey)	16.6.2018	Patent No.: 506921 Date of grant 05.2.2024
	202411068350 TEMP/E-1/79428/2024-DEL	Arka vertical farming module (by Dr. Safeena S. A.)	10.9.2024	Application filed
	202411086351	dsRNA-based composition for plant pest control, method of preparing the same, and uses thereof (by Dr. R. Asokan)	09.11. 2024	Application filed

The revenue generated under Professional Service Function/ (CPC) Jan to Dec 2024 is Rs. 3,70,55,906/-

Professional Service Function on contract service (testing), contract research (paid up trial), consultancy service (field trial) and training

ICAR encourages researchers to participate in collaborative work and extend services to external agencies as per the established framework of professional service functions. Under this framework, ITMU, ICAR-IIHR process professional service requests such as contract service, contract research, consultancy and training regularly. During the period January to December 2024, a total of 1463 professional service functions were undertaken at the Institute. This included 1422 services under contract service (testing), of which 90% is of phytosanitary testing (virus, bacteria, fungus, nematode and insect screening) followed by DNA fingerprinting with a revenue generation of Rs. 3,08,73,269. The total contract research (paid up trials) were 11 No's with the revenue of Rs. 54,48,292/- . The number of consultancy services during the period were 27 with revenue of Rs. 5,66,048/- and 03 trainings were conducted with revenue of Rs. 1,68,297/-. Thus, the total revenue generated under professional service functions was Rs. 3,70,55,906/- (Three crores seventy lakhs fifty five thousand nine hundred six only).

A view of the contract service (testing of samples) at ICAR-IIHR

Consultancy visit to M/s Sakata Seed India Pvt. Ltd.

Contract research to M/s Dr. Heinisch Agro Solutions Evaluation of bioefficacy and phytotoxicity of AgroBeize product against late blight and early blight in tomato.

Number of services and revenue under professional service functions in 2024

Type of service	Number of Services	Total revenue generated in Rs. (Including GST@ 18%)
Contract Service (Testing)	1422	3,08,73,269
Contract Research (Paid up trial)	11	54,48,292
Consultancy service (Field visit)	27	5,66,048
Training	03	1,68,297
Total	**1463**	**3,70,55,906**

Awareness programme on Protection of Plant Varieties and Farmers' Right Act, 2001: ITMU, ICAR-IIHR, Bengaluru and ICAR-Krishi Vigyan Kendra, Hirehalli jointly organised the awareness programme at ICAR-KVK Hirehalli on 29th February 2024. Fifty participants attended the programme.

i. ITMU, ICAR- Indian Institute of Horticultural Research, Bengaluru and ICAR-Krishi Vigyan Kendra, Hirehalli jointly organised the awareness programme on Protection of Plant Varieties and Farmers' Right Act, 2001 at ICAR-KVK Hirehalli on 29th February 2024. Fifty participants attended the programme.

Awareness programme on Protection of Plant Varieties and Farmers' Right Act, 2001 at ICAR-KVK Hirehalli on 29th February 2024

Organisers with the participants during the awareness programme on Protection of Plant Varieties and Farmers' Right Act, 2001 at ICAR-KVK Hirehalli on 29th February 2024

World Intellectual Property Day: ICAR-IIHR organized the World Intellectual Property Day with the theme "IP and Sustainable Development Goals: Building our Common Future with Innovation and Creativity" on 30th April 2024. Dr. R. Kalpana Sastry, Former Joint Director, ICAR-NAARM & Founder a-Idea, MD Aghub, PJTSAU, Hyderabad was the key speaker in the event. The event was attended by the scientific, technical, administrative staff, students of the main campus and online through zoom link by the staff of Regional stations under ICAR-IIHR, KVK, Hirehalli and KVK, Gonikoppal and SHZTMC'S.

IP-Week Online Awareness Programme and Panel discussion from 8th -14th August 2024: The ICAR-IIHR, Bengaluru as the Nodal Institute and four other ICAR Institutes namely ICAR-CPCRI, ICAR-CISH, ICAR-CIARI and ICAR-CIAH joined along with IP&TM unit, New Delhi. About 50 participants joined online every day during the programme.

The IP-Week Online Awareness Programme Panel discussion was also organised on 13th September 2024, online with ICAR-IIHR, Bengaluru as the Nodal Institute. All the ICAR horticultural Institutes (23 Nos) joined online along with IP&TM unit, New Delhi. In opening remarks given by Dr. Neeru Bhooshan, Assistant Director General, IP&TM, the importance of IP protection and IP portfolio management like filing patents, PPVFRA registration, copyrights, trademarks, designs etc which is mandatory for every ICAR institute in today's scenario.

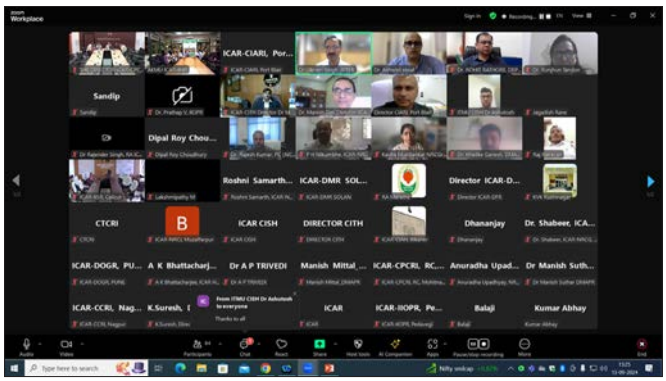
Dr. Sanjay Kumar Singh, Deputy Director General (Hort.), ICAR, New Delhi chaired the meeting. Welcoming the delegates and colleagues across the twenty three Horticultural Institute who had joined online, he remarked that it is a very important day for ICAR. He wished that the discussion culminates into a practical way forward for strengthening the IP portfolio of ICAR in the coming years. Dr. Vikram Singh invited the IP experts one by one to share the key points to take care in each of the intellectual properties.

Dr. Ashwini Siwal, Assistant Professor in Intellectual Property Laws at Faculty of Law, University of Delhi, reiterated the three basic parameters or pillars associated with IP filing viz., novelty, non obviousness and utility. He also stressed the importance of prior search for viability of a patent and to project the claim very explicitly and categorically during drafting.

Dr. Rohit Rathore, Deputy Controller of Patents & Designs Indian Patent Office, New Delhi further substantiated that the information which is intended to be filed as an IP should not be in public domain or published before the filing of the product or process. He further clarified the two categories under section 3H of the Indian Patent Act which says that the methods of agriculture or horticulture cannot be patented and for plant parts or biological processes for production of plants eg., grafting etc cannot be patented. As the best approach to patent filing, he spotted on literature and patent review to avoid pre grant and post grant opposition.

Dr. Dipal Roy Choudhury, Joint Registrar at Protection of Plant Varieties and Farmers' Rights Authority explained in detail the registration and protection of plant varieties.

Mr. Rahul Bagga, Founder and Managing Director, Aumirah, New Delhi and Dr. Ranjhun Tandon, Founder of IP inculcator explained further the parts of a patent application and that copyrights are a bundle of rights for ownership and authorship. About 100 participants joined online during the programme.



IP-Week Online Awareness Programme Panel discussion

2nd ICAR –IIHR Industry Meet-2024

ICAR-Indian Institute of Horticultural Research, Bengaluru organized the 2nd ICAR –IIHR Industry Meet-2024 in collaboration with SPH, BESST-HORT and IP&TM Unit, ICAR, New Delhi ICAR-IIHR, Bengaluru on 24th October 2024. The programme started with the inauguration of ABI incubation unit and exhibition in the premises of IIHR. The exhibition showcased the licensed technologies and products of various ICAR Institutes in the South Horticultural Zonal Technology Management Centres (SHZTMCs) together with the exhibits from various industries and incubatees. About 141 registered stakeholders participated in the programme including several industrialists, aspiring entrepreneurs and start-ups and contributed to the success of the event.

During the inaugural session, Dr. Tusar Kanti Behera, Director, ICAR-IIHR in his introductory remarks, highlighted the lead role played by IIHR in technology commercialization, professional service functions and Agri-business Incubation in horticultural technologies. This was followed by special address by Guests of Honour Dr. KVSSLV Prasada Rao, CGM, NABARD, Bengaluru; Dr.V. B. Patel, ADG (Fruit and Plantation Crops), ICAR, New Delhi and Dr. K. G. Jagadeesha, I.A.S. CEO & Secretary, Coffee Board, Bengaluru and Dr. Vishnuvardhana, Vice Chancellor, U.H.S., Bagalkot. The Presidential address was delivered by the chief guest, Dr. Udham Singh Gautam, D.D.G. (Agricultural Extension), ICAR, New Delhi. Dr. Gautam congratulated the innovators, licensees and appreciated the efforts of IIHR in organizing the meet. He further described the horticultural research scenario in different ICAR institutes and appreciated the role of IIHR being a pioneer Institute in technology commercialization and revenue generation.

MoU exchanges for four ICAR-IIHR technologies were done namely 'Okra Advanced breeding lines IIHR 385-5-1 & Okra Advanced Breeding line IIHR -386-7-2' to M/s. Eldorado Agritech Pvt. Ltd., Bengaluru; 'Arka Jackolate' technology to KVK, Hirehalli; 'Arka Bhanu marigold hybrid' to M/s Fertilizers Shop and 'Arka Vertical Farming Model' to Mr. Shivaprakash H.M. Bengaluru. Following this, the delegates on the dais also released two publications *viz.*, 'Souvenir of 2nd ICAR-IIHR Industry Meet 2024' and publication from ABI, IIHR entitled 'A glimpse of R & D recognition at IIHR'. After the inaugural session, the technical sessions commenced with Session I on 'Interactive session with Industries'. The chairman was Dr. Udham Singh Gautam, DDG (Agricultural Extension), ICAR, New Delhi; Co-Chairman was Dr. Venkatasubramanian, Director,

ATARI Zone XI, Bengaluru. Panellists in this session were Shri. P. B. Kaginalli, MD, Gamma Agromedical Processing Pvt Ltd, Bengaluru; Dr. S. Rajendra Prasad, Ex-VC, UAS Bengaluru and Dr. M. S. Rao, Ex-Principal Scientist & Head, ICAR-IIHR, Bengaluru.

Session II was on 'Scope and prospects of Horticulture technologies for emerging market demand', chaired by Dr. Dinakar Adiga, Director, DCR, Puthur and Co-Chaired by Dr. M. S. Rao, Ex Principal Scientist & Head, ICAR- IIHR, Bengaluru. There were 8 presentations in this session by ICAR Institutes of SHZTMCs namely ICAR –IIHR, Bengaluru; ICAR- National Research Centre for Banana, Tiruchirapalli; ICAR- National Research Centre for Grapes, Pune, ICAR- Indian Institute of Spices Research, Kozhikode, ICAR-Indian Institute of Oil Palm Research, Pedavegi, ICAR-Directorate of Onion and Garlic Research, Pune; ICAR-Directorate of Cashew Research, Puttur and Director, ICAR-National Research Centre for Pomegranate, Solapur.

It was followed by Industry session-III on 'Success stories of ABI/BESSTHORT incubates' chaired by Dr. Surya Rao Rangoli, Seed Regulation Manager, Syngenta, Bengaluru and Co-chaired by Dr. R. Selvarajan, Director, ICAR-NRC for Banana, Trichy. IIHR incubatees namely Dr. Ruchi Sahu from M/s. AIRR Organics & Biofertilizers Private Ltd., Mr. Prashantha D. S. from M/s. AG Organicz, Mr. Divakar from M/s. Arekal Organics & Bio-fertilizers Pvt.Ltd., Mr. Nishanth, M/s. NS Foods, Mr. Dinesh Rao, M/s. Earth First Solutions Pvt.Ltd. and Dr. Niranjan Prabhu, M/s. Ecophytocare India Pvt. Ltd. shared their experiences and success stories through Agri-Business Incubation, ATIC market facilities and mentorship provided to them by IIHR.

Mr. Krishan G Thakur, Business Manager from Agrinnovate India Ltd. (AgIn), New Delhi highlighted the role of AgIn in technology commercialization, IP protection, etc. and creation of public-private partnerships in research and other capacity building endeavors. In concluding session, recommendations of the three sessions were presented by the rapporteurs and finalized by Chairman, Dr. Tusar Kanti Behera, Director, ICAR-IIHR, Bengaluru.

Glimpses of the 2nd ICAR –IIHR Industry Meet-2024

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Visit of Union Agriculture Minister Shri Arjun Munda to ICAR-IIHR, Bengaluru

The Union Minister of Agriculture & Farmers Welfare and Tribal Affairs, Shri Arjun Munda, visited ICAR-IIHR, on 7th January. Shri Munda inaugurated of the 'Techno-Expo,' showcasing ICAR-IIHR technologies, and the Farmers Facilitation Centre for central sector schemes under SCSP, STC & NEH and engaged in insightful discussions with stakeholders. The Minister stressed the importance of aligning production standards with international norms to ensure competitiveness. The visit witnessed the exchange of Memorandums of Understanding (MoUs) with organizations such as the Karnataka Exotic Fruit Farmer's Association and Deccan Exotics India Producer Company Limited. In his closing remarks, Honorable Union Agriculture Minister Shri Arjun Mundaji urged the scientists to align their activities with the vision of "Atmanirbhar Bharat" and expressed his best wishes for ICAR-IIHR to achieve greater heights in the coming years.

National Conference on "Recent Trends and Future Prospects of Floriculture in India" ICAR-IIHR, Bengaluru in collaboration with the Society for Promotion of Horticulture, Bengaluru organized the National Conference from 9th to 11th January, 2024 featuring nine thematic areas *viz*., Germplasm conservation and improvement of ornamental crops, Improved production technologies and precision floriculture, Hi-tech and diverse floriculture, Quality seed, planting material production and startups, Post-harvest management and innovations in value-addition, Innovations in pest and disease management, Environmental floriculture, Socio-economic impact, marketing and IPR and policy issues and road map for promotion of Floriculture and stakeholders' interaction meet. Flower growers who had adopted and popularized ICAR-IIHR varieties and technologies were also felicitated during the event.

Brainstorming & Fruit Diversity Show on Papaya and Passion Fruit" at CHES, Chettalli on 17th January, 2024: More than 150 growers have participated and displayed 70 genotypes of papaya and 40 genotypes of passion fruit. Lectures on Good Agriculture Practices in Passion Fruit, Papaya Cultivation Integrated Pest Management in Papaya and Passion Fruit and Integrated Disease Management in Papaya and Passion Fruit were arranged.

QRT Review meeting of AICRP on Medicinal and Aromatic Plants and Betelvine: QRT review meeting of AICRP on Medicinal and Aromatic Plants and Betelvine was held on 29th February, 2024 at ICAR-IIHR. The QRT team was headed by the Chairman, Dr. Dr. N.C. Gautam, Formerly Vice Chancellor, Mahatma Gandhi, Chitrakoot Gramodaya Vishwavidyalaya, Satna, Madhya Pradesh.

National Horticulture Fair-2024

The yearly event of National Horticulture Fair-2024, which was held during 5-7 March, 2024 at ICAR-IIHR, Bengaluru, witnessed the gracious presence of Sushri Shobha Karandlaje, Hon'ble Union Minister of State for Agriculture and Farmers' Welfare, Govt. of India who emphasized the adoption of climate resilient crop varieties and technologies for equipping the farmers in sustaining the production under the adverse climatic conditions and focus on value addition. The participation of 70000 stakeholders from 22 states in the three-day fair highlights the importance of live demonstrations and dissemination of latest technologies.

Triphal Diversity Show

ICAR-IIHR organized Triphal diversity show during 31st May to 2nd June, 2024 in collaboration with

ICAR-NRCB, Tiruchirapalli. Varietal diversity of 300 mango, 100 jackfruit and 100 bananas were showcased in collaboration with ICAR-NRCB, Tiruchirapalli. Dr Sanjay Kumar Singh, DDG, Horticultural Sciences emphasized on national and global implications of mango, jackfruit and banana cultivation for the sustainable livelihoods of farmers. Various custodian farmers were felicitated for their role in conservation of unique germplasm of mango, banana and jackfruit.

International Yoga Day: The 10th International Yoga Day was observed on 21st of June, 2024 with the theme 'Yoga for Self and Society' both at main institute and research centres. The Chief Guest, Mrs. Chethana Prasad and Prof. Tusar Kanti Behera, Director of ICAR-IIHR emphasized the importance of incorporating yoga into daily routines.

Inauguration of Planting Material Sales Outlet at Hirehalli farm

Planting material sales outlet at Hirehalli was inaugurated on 20th July, 2024 by the Chief Guest, Prof. Sanjay Kumar Singh, Honourable Deputy Director General (Horticulture Sciences), ICAR in the presence of Prof. Tusar Kanti Behera, Director, ICAR-IIHR, Heads of Divisions, Chief Administrative Officer, Senior Finance and Accounts Officer and Head, KVK. The Sales Unit was established as part of Centre of Excellence for Kamalam Fruit, Mission for Integrated Development of Horticulture (MIDH), Government of India. An Interaction Meet on Kamalam Fruit (Dragon Fruit) and other fruit crops was also organized on this occasion.

Execution of Global Campaign for एक पेड़ माँ के नाम at ICAR-IIHR on 21st August 2024

The momentum for the Global Campaign for #एक_पेड़_माँ_के_नाम#Plant4Mother was launched on the World Environment Day 2024 at ICAR-IIHR Bengaluru. As per the directions of Government of India, the staff and students of ICAR-IIHR planted the saplings of fruit crops and forest tree species in the campus on 21st August 2024.

Celebration of 58th Foundation Day of ICAR-Indian Institute of Horticultural Research

58th Foundation Day of ICAR-IIHR was celebrated on 5th September 2024 at its institute campus Bengaluru. Dr. Rakesh Chandra Agrawal, Deputy Director General, Education Division, ICAR, New Delhi, was Chief Guest, Dr. R. Gopakumar, Director, ICTS- TIFR, Bengaluru was Guest of Honour. Dr. Sanjay Kumar Singh, Deputy Director General, Horticultural Sciences, ICAR, New Delhi, presided over the function in the presence of Prof. Tusar Kanti Behera, Director, ICAR-IIHR, and Dr. Prakash Patil, Project Co-ordinator-Fruits, Bengaluru. The Directors and Regional Heads of ICAR Institutes situated at Bengaluru, staff and students of IIHR, invitee farmers and entrepreneurs attended the programme. On the occasion, innovative farmers were felicitated for being the ambassadors of institute technologies and institute technologies licensees were also felicitated. Further, past staff members of the institute were felicitated remembering their contribution to the institute and seven MoUs were also exchanged. The dignitaries also inaugurated the postgraduate school students mess and laid the foundation stone for the advanced training centre for farmers and other stakeholders.

International Conference on Plant Protection in Horticulture (ICPPH-2024): Advances and Challenges' during 25-27 September 2024 at ICAR-IIHR, Bengaluru

ICAR-IIHR and The Association for Advancement of Pest Management in Horticultural Ecosystems (AAPMHE) organized the "International Conference on Plant Protection in Horticulture: Advances and Challenges" which was attended by 225 delegates representing 21 states in India and 7 from abroad. Distinguished guests,

included Chief Guest Dr R. Muniappan, Director IPM Innovation lab, Virginia Tech university, USA, was the Chief guest of the event while Dr. N. K. Krishnakumar, Former DDG Horticultural Sciences, ICAR, Dr. S. N. Sushil, Director, ICAR-NBAIR, Bengaluru, and Dr. R Selvarajan, Director ICAR-NRCB, Trichy were the guests of honour and was presided over by Prof. Tusar Kanti Behera, Director, ICAR-IIHR, Bengaluru. The Conference spread over eight technical sessions deliberated on important emerging issues related to plant protection including Biosystematics and Taxonomy, Emerging approaches in pest management like genome editing, AI tools, Sterile Insect Technique etc., Biological Control approaches and success stories, Biosecurity and Plant Quarantine etc. There were 20 invited lectures, 154 oral presentations and 85 poster presentations.

Celebration of Gandhi Jayanthi and Swachhta Bharat Diwas @ 2024 at ICAR-IIHR on 02.10.2024

The ICAR-Indian Institute of Horticultural Research, Hessarghatta, Bengaluru has celebrated the Gandhi Jayanthi and Swachhta Bharat Diwas @ 2024 on 02.10.2024. The Director, Guests and School Children, Swachh Bharath Nodal officer Dr V.Sankar and the team paid floral tributes to Mahatma Gandhi. The Director Dr.T.K.Behera emphasised that the institute is continuously implementing the thoughts of Mahatma Gandhi by uplifting the weaker sections of society through centrally funded projects, massive cleanliness drives in offices, research fields and surrounding area. He also emphasized the farmers for use of IIHR friendly technologies for doubling the farm income. The Chief Guest of the function, Mrs. R. Lalitha, President, Hurullichickanhalli, Gram Panchayat appreciated ICAR-IIHR efforts towards cleanliness drive outside the campus. The prizes were distributed to winners & participants of the drawings, essay and plastic waste disposal collection competitions conducted for school and college students and also for sanitation workers. The Swachhata Hi Sewa-2024 Special Campaign was observed at Central Horticultural Experiment Station, Chettalli, Kodagu

ICAR-IIHR retains Overall Championship of ICAR-Interzonal Sports Tournament

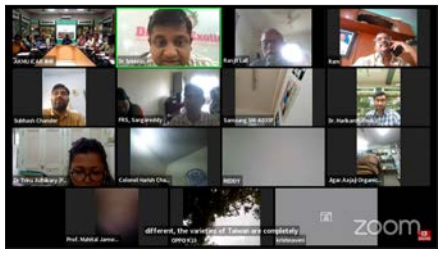
ICAR-IIHR sports contingent participated and won 'Overall Championship of the ICAR-Interzonal Sports Tournament" consecutively for second time in ICAR-Interzonal Sports Tournament held at ICAR-Central Arid Zone Research Institute, Jodhpur, Rajasthan from 14th to 17th October 2024. The contingent comprising twenty-five men and four women participated both in individual and team events.

Fruit Diversity Show, Awareness Programme on PPV&FR Act and Field Day on Mangosteen and Rambutan at CHES-Chettalli

Central Horticultural Experiment Station (CHES), Chettalli conducted an Awareness Programme on the Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, coupled with a Fruit Diversity Show and a Field Day focusing on Mangosteen and Rambutan on 19th October 2024 in collaboration with the Society for Promotion of High-value Exotic Horticultural Crops and the PPV&FR Authority. In the event MoU was exchanged for Licence of Rambutan variety Arka Coorg Arun and farmers' varieties of jackfruit - Harigold (JK 2/24) and Thirumala (JK 12/24) were released. Dr. Trilochan Mohapatra, Chairperson of the PPV&FR Authority and Prof. Tusar Kanti Behera, Director, ICAR-IIHR highlighted the crucial role of farmers' rights and significance of PPV&FR Act, particularly in protecting the intellectual property rights of farmers.

National Webinar on Kamalam Fruit Production and Value Addition organized by CoE Kamalam, Hirehalli, ICAR-IIHR, Bengaluru

National webinar on Kamalam Fruit Production and Value Addition was organized on 25th September 2024 by Centre of Excellence (CoE) for Kamalam**,** under the aegis of the ICAR-IIHR, Bengaluru for attracting youth towards kamalam fruit farming & entrepreneurship. The event was sponsored by MIDH, GoI and conducted in association with Karnataka Exotic Fruit Farmers Association (KEFA) & Deccan Exotics FPO, Hyderabad. The webinar consisted of multiple technical sessions, covering aspects of Kamalam fruit production, post-harvest management, and innovative value addition techniques shared by progressive farmers and young entrepreneurs excelling in the field of kamalam fruit cultivation.



Vigilance Awareness Week 2024

The Vigilance Awareness Week 2024 was observed at ICAR-IIHR, Bengaluru from 28th October to 3rd November 2024 aligning with this year's theme of *"Culture of Integrity for Nation's Prosperity."* The Chief Guest, Shri S. N. Siddaramappa, Retired Police Commissioner of Belagavi, delivered an impactful address on *"How to Be Vigilant to Prevent Corruption,"* emphasizing proactive measures for a corruption-free work culture. The event was presided over by Prof. Tusar Kanti Behera, Director, ICAR-IIHR. Throughout the week, several competitions were conducted for the staff of ICAR-IIHR. The week concluded with a Valedictory Function on 4th November 2024. The Chief guest Shri Ramesh G., Commissioner of Income Tax and Chief Vigilance Officer of Karnataka Antibiotics and Pharmaceuticals Ltd. had delivered an enlightening talk on *"Preventive Vigilance"* and emphasized the importance of maintaining integrity in public service. The function was presided over by Prof. Tusar Kanti Behera, who distributed prizes to the winners of the various competitions, marking a successful observance of Vigilance Awareness Week at ICAR-IIHR.

CHES, ICAR-IIHR, Bhubaneswar Celebrated 32 Years of Excellence in Horticultural Research and Development"

Central Horticultural Experiment Station (CHES), ICAR-Indian Institute of Horticultural Research, Bhubaneswar commemorated its 32nd Foundation Day on 6th November 2024 with great enthusiasm and pride. Dr R C Agrawal, Deputy Director General (Ag. Edu), ICAR, Prof. Tusar Kanti Behera, Director, ICAR-IIHR, Dr. Gobinda Chandra Acharya, Station Head of CHES, Dr. Gourahari Naik, former head of CHES, Dr. Janmejaya Ray, Advocate at the Supreme Court and social worker graced the occasion. All the working staff and retired staff of CHES, scientists from CTCRI, KVK personnel, SOADU students, CHES staffs and virtually connected scientists from Bengaluru campus participated in the event.

Visit of Minister for Agriculture, Horticulture, Animal Husbandry & Veterinary, Arunachal Pradesh to ICAR-IIHR, Bengaluru

Shri Gabriel Denwang Wangsu, Honourable Minister for Agriculture, Horticulture, Animal Husbandry & Veterinary, Dairy Development, Fisheries, Food & Civil Supplies, Legal Metrology and Consumer Affairs, Govt. of Arunachal Pradesh and his delegation visited ICAR-IIHR on 28th November, 2024 to witness the ongoing research, education and extension work in

horticulture. The delegation visited various facilities of ICAR-IIHR such as fruit crops nursery unit, food safety lab, phytosanitary certification unit, mushroom unit, seed unit and BESSTHORT and a formal meeting was convened in hybrid mode and connected the district level Horticulture Officers of Govt. of Arunachal Pradesh. Honourable Agriculture Minister of Govt. of Arunachal Pradesh appreciated the research, education and extension activities of ICAR-IIHR and he also expressed his happiness about the performance of Arka IIHR varieties in Arunachal Pradesh.

World Soil Day 2024

World Soil Day - 2024 was celebrated at ICAR-IIHR, Bengaluru with the theme "Caring for Soils: Measure, Monitor, Manage"on 05.12.2024. The Chief guest, Dr. G.B. Brahma Prakash, Former Professor and Head, Dept. of Agric. Microbiology, UAS, Bengaluru delivered a lecture on the topic "Biodiversity Beneath Your Feet" highlighting importance of below ground biodiversity. Dr. Prakash Patil, Director i/c, ICAR-IIHR stressed on the need for sustaining soil health for the future generations. Soil Health Cards were distributed to farmers on the occasion.

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14. North East Hill Plan, Tribal Sub Plan and SC Sub Plan

14.1. NEH Programs

ICAR-IIHR has conducted capacity building programs, trainings and demonstrations in mandated horticultural crops, biological control of crop pests, diseases and nematodes for the benefit of farmers, trainers, KVK personnel and entrepreneurs of the NEH region as part of NEH plan. The activities are summarized below

Training to farmers on ICAR – IIHR technologies suitable for NEH region

ICAR–IIHR organized training programme on "ICAR–IIHR technologies suitable for NEH and inputs distribution" in forty seven batches in all eight states. A total of 1535 members participated in various training programmes.

Demonstration on ICAR-IIHR technologies

Forty-five field demonstrations both on-farm and off-farm campus on ICAR-IIHR technologies have been conducted by various KVKs. A total of 1073 farmers participated in the demonstration.

Input distribution

During the period a total quantity of 1616.2 kg seeds of different ICAR-IIHR vegetables varieties were distributed to 2508 beneficiaries across all NEH states. About 2,000 kg AMC and 4200 kg micronutrients special were distributed to 852 farmers for improving soil health and quality of horticultural crops. Distributed 8010 vegetable seed kits to 2508 beneficiaries for kitchen gardening and soil less cultivation of vegetables along with Arka Sasya Poshak Ras 'A' and Arka Sasya Poshak Ras 'B'. List of seeds and planting materials distributed to beneficiaries are given below.

Capacity building on ICAR-IIHR technologies suitable for NEH

Two capacity building programs (at Jowai and at Gangtak) on ICAR-IIHR technologies have been organized during the reporting period.

Important ICAR-IIHR varieties demonstrated

State	Crop and variety
Arunachal Pradesh	Tomato (Arka Abhed, Arka Rakshak), Okra (Arka Nikita), Watermelon (Arka Shyama), Muskmelon (Arka Siri), French bean (Arka Suvidha)
Assam	Tomato (Arka Abhed), Pumpkin (Arka Chandan, Arka Suryamukhi), Okra (Arka Nikita), Watermelon (Arka Shyama), French bean (Arka Sharath), Garden pea (Arka Uttam, Arka Chaitra)
Manipur	Tomato (Arka Rakshak, Arka Samrat), Chilli (Arka Kyhati, Arka Meghana), Ridge gourd (Arka Sujat), Garden pea (Arka Apoorva), Okra (Arka Nikita), Pumpkin (Arka Suryamukhi, Arka Chandan), French bean (Arka Arjun, Arka Sharath), Coriander (Arka Isha), Yard Long Bean (Arka Mangala)
Meghalaya	Tomato (Arka Rakshak, Arka Abhed), Chilli (Arka Harita), Cucumber (Arka Veera), Garden pea (Arka Apoorva), Okra (Arka Nikita), Palak (Arka Anupama)
Mizoram	Tomato (Arka Abhed, Arka Samrat), Chilli (Arka Kyhati), Coriander (Arka Isha), Garden pea (Arka Priya), Yard Long Bean (Arka Mangala), Cucumber (Arka Veera)
Nagaland	Tomato (Arka Abhed, Arka Rakshak), Chilli (Arka Kyhati), French bean (Arka Suvidha)
Sikkim	Tomato (Arka Rakshak, Arka Abhed), Okra (Arka Nikita), French bean (Arka Sharath), Avocado (Arka Supreme, Arka Coorg Ravi), Guava (Arka Kiran)
Tripura	Tomato (Arka Abhed), Chilli (Arka Gagan), Brinjal (Arka Nidhi), Ridge gourd (Arka Prasan, Arka Vikram)

Capacity building program on ICAR-IIHR Technologies for Horticultural Crop Production in NEH Region at Jowai

ICAR-IIHR in collaboration with Department of Horticulture, North Eastern Hill University (NEHU), Tura and Deen Dayal Upadhyay Community College for Skill Development (DDUCCSD), Wahiajer, Jowai, organized a "Capacity Building Programme on ICAR-IIHR Technologies for the Production of Horticultural Crops in NEH Region" on May 25, 2024, at DDUCCSD, Jowai with the participation of about 200 farmers, predominantly women. In the program ICAR-IIHR distributed 50 kg of horticultural inputs to each participant with the aim to disseminate advanced IIHR technologies to farmers in the West Jaintia Hills, promoting sustainable horticultural practices with minimal chemical use.

Capacity Building Programme and Input distribution in Sikkim State

ICAR-IIHR has successfully conducted the "Capacity Building Programme on Avocado Cultivation and Inputs Distribution under the NEH Scheme at ICAR RC for NEH Region, Sikkim Centre, Tadang, on 5th October, 2024. A total of 4000 fruit plants (Avocado, Guava, Jackfruit, Pummelo and Passion fruit), vegetable seeds, AMC and Papaya seeds were distributed during the program.

Success stories

Yard Long Bean (*Vigna unguiculata* L.) variety Arka Mangala

Shri Ch. Khogendro Singh is a vegetable farmer from Khoijuman village of Bishnupur district and had conducted OFT on "Performance of Yard Long Bean variety Arka Mangala" in 625 m^2 with technical support from KVK-Bishnupur. Cumulative yield of 1580 kg was obtained in 4- month period with gross returns of Rs 69,520/- @ Rs 44 per kg pods and net returns Rs 59,720/. Field day was conducted on 27th September 2024. Feedback was collected from Shri Khogendro Singh through DD Manipur and the coverage was broadcast on 03.12.2024 via DD Imphal.

Arka Gagan – a potential Chilli variety

Mr. Pintu Sarma, a smallholder farmer from Kamalpur village of Dhalai Tripura cultivated Arka Gagan chilli variety with the technical support from KVK Dhalai. The yield of Arka Gagan chillies was higher by 40% than previously grown varieties.

Mr. Ratan Das, a progressive farmer from small village (Salema GP) in Dhalai district also cultivated the Arka Gagan chilli variety. The average yield was 15-18 t per acre with net profit of Rs.1.50 lakhs per acre. Natural disease resistance of Arka Gagan reduced frequent pesticide applications and lowered the production costs.

FLD of the Chilli variety (Arka Gagan)

14.2 SCSP programmes

During the period a total quantity of 525 kg of seeds of different varieties of vegetable crops developed at ICAR-IIHR were distributed to 1250 beneficiaries. About 4,66,155 number. of planting material of different hybrids of vegetable, fruit and flower crops were distributed to 900 farmers and 2275 kg seed of different field crops developed by UAS, Bengaluru were distributed to 600 farmers. About 250 litres of Chemical Pesticides were given to 150 farmers, 2710 kg botanical pesticides to 1600 farmers, 1700 kg of Arka Microbial Consortium to 500 farmers, 2100 kg micro-nutrient formulations to 750 farmers, 72 rolls of mulching sheet to 25 farmers, 750 number of traps and lures to 180 farmers, 30 packets seeds of exotic vegetables to 50 farmers and 450 number of plastic crates to 250 farmers. Overall, the input distribution covered 4618 acres. Timely advisory services for protected cultivation of vegetable crops were provided that increased the crop yield substantially,

develop marketing system and enhance their net-income by 2 to 2.5 times (Rs.1.25 to Rs. 2.60 lakhs additional net income per acre).

Capacity development programmes (9 on-campus and off-campus) were also organized in different states by covering >5000 farm families, who received information and also skill-oriented training programmes, both through on-campus and on-farm programmes. Capacity building programmes were also organized for the selected beneficiary farm women on production of mushrooms and also on RTF bag production, which in turn they spread among their peer farm women and also outside their village, i.e., near block and district headquarters.

14.3 Tribal Sub Plan (TSP) programmes

Activities undertaken during 2024

Description	Unit	Achievements
Training for farmers in horticulture crop production	No. of Training	72
	No. of Farmers	7524
Distribution of planting material/seed of horticultural crops	No. of plants/cuttings	317485 Nos
	No. of beneficiaries	933
	Seed (kg)	1841 kg
	No. of beneficiaries	2633
	Seed Tubers (kg)	NIL
	No. of beneficiaries	NIL
	Others- Related to technology transfer	NIL
	No. of beneficiaries	NIL
Distributions of agricultural inputs like pesticides, fungicides, fertilizers, traps and small farm implements, etc	Implements (Nos.)	NIL
	No. of beneficiaries	NIL
	Pesticide (Kg/Lit)	NIL
	No. of beneficiaries	NIL
	Fertilizers (q)	NIL
	No. of beneficiaries	NIL
	Micronutrients (q)	10549 kg
	No. of beneficiaries	4480
	Others – Bio-fertilizers	NIL
	No. of beneficiaries	NIL
Demonstration of technologies in horticulture	Number	2
	No. of beneficiaries	100

రైతులకు ఆధునిక వంగడాలు, మొక్కలు పంపిణీ

కేవీకేలో రైతులకు చిత్రనాలు, అంటు మొక్కలు అందజేస్తున్న శాస్త్రవేత్తలు

కలికిరి, డిసెంబరు 6 (ఆంధ్రజ్యోతి): స్థానిక కృషి విజ్ఞాన కేంద్రంలో శుక్రవారం రైతులకు ఆధునిక రకం చిత్రనాలు, పండ్ల మొక్కలు పంపిణీ చేశారు. బెంగళూరుకు చెందిన ఐసీఏఆర్, ఐఐహెచ్ఆర్ (ఇండియన్ ఇన్స్టిట్యూట్ ఆఫ్ ఆర్టికల్చర్ రీసెర్చ్) ఆధ్వర్యంలో రైతులకు కూరగాయలు, పండ్లతోటలకు సంబంధించిన చిత్రనాలు, అంటు మొక్కలు పంపిణీ చేశారు. ఐసీఏఆర్ ప్రిన్సిపల్ సైంటిస్ట్ టీహెచ్ సింగ్, ఐఐహెచ్ఆర్ సీనియర్ సైంటిస్ట్ డాక్టర్ ఆతకుల పంపిణీ కార్యక్రమంలో పాల్గొన్నారు. రైతులు పండించే కూరగాయలు, పండ్లను ఫుడ్ ప్రాసెసింగ్ కంపెనీలకు సరఫరా చేయడం ద్వారా అధిక ఆదాయం పొందవచ్చని సూచించారు. ఈ సమావేశంలో రాయదోటి వ్యవసాయ పరిశోధన కేంద్రం ఏపీ ఆశోక్‌కుమార్ రెడ్డి, కేవీకే కోఆర్డినేటర్ మంజూల, కేవీకే శాస్త్రవేత్తలు, వ్యవసాయ, ఉద్యాన శాఖల అధికారులు పాల్గొన్నారు.

Sustainable Horticulture and Women Empowerment through TSP program at Kalahandi, Odisha

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15. Official Language Implementation

The Official language implementation section of the Institute carried out the following activities for the effective implementation of Official Language Policy of Govt. of India during January to December 2024.

15.1. ICAR-IIHR, Bengaluru

Quarterly Meetings of Official Language Implementation Committee

During 2024, three quarterly meetings of Official Language Implementation Committee of the institute were convened on 18th July , 28th Oct and Jan 24th during Apr-June, July-September and October-December 2024 respectively.

Hindi Workshops

The Institute organized five Hindi Workshops in the year 2024. Hindi Workshops have been organized on 05th February, 04th May, 10th June, 23rd August and 21st October, 2024.

Hindi Fortnight Celebration

The Indian Institute of Horticulture Research, Hesaraghatta, Bengaluru organized Hindi Fortinight during 17th September to 1st October 2024. Various Hindi competitions, viz., Hindi Recitation, Hindi Terminology and Noting, Hindi Conversation, Hindi Song, Hindi Essay, Hindi Typing, Hindi Presentation Skill and Extempore were organized.

Shri Kamal Kumar Aggarwal, Chief Engineer, Central Public Works Department Kendriya Sadan Kormangala Bengaluru, was the Chief Guest of Inaugural Function. During his address, The Chief Guest stressed that we must remember that language is a powerful tool capable of bridging differences and understanding. The vast and varied expressions of Hindi have the ability to connect people from different regions and cultures. It is our responsibility to ensure that this language, which is the soul of our country, continues to shine for generations to come. The use of Hindi in offices is not only a respect for our language but also promotes team spirit in the office. Dr. Prakash Patil, Director (Acting) of the institute presided over the program and remarked that it is easy for Kannada speakers to learn and speak Hindi, because many words in Kannada and Hindi are similar, which have come from Sanskrit language. With the help of Artificial Intelligence tools available for translation in Hindi language, those who are non-Hindi speakers can also do their work easily. He urged all the employees to actively participate in the competitions organized during Hindi Fortnight .

The valedictory and prize distribution ceremony of Hindi Fortnight was organized on 01 October 2024 under the chairpersonship of Dr. Tusar Kanti Behera, Director, ICAR-IIHR, Bengaluru, with Dr. Vinay Kumar Yadav, Professor and Head, Department of Hindi, Bishop Cotton Women's Christian College, CSI compound, Mission Road, Bengaluru. The Chief Guest said that Hindi is emerging as a global language today. He said that Hindi is also very popular in foreign countries. He further said that people from many states come to the cities of India to earn their livelihood and they use Hindi as the main language for communication. Hindi is a language spoken and understood in every state of India, and now it should also get the status of official language. It is essential to have a language to identify India in front of the world, which is entitled to the most popular language in India, “Hindi”. On this occasion, the chief guest appreciated the efforts of scientists in the agricultural sector and also gave a lecture on this. Dr. Tusar Kanti Behera, Director, said that working in Hindi is not difficult for us, there are similar words in Hindi in various languages of India, so there is no difficulty for any Indian to understand and speak Hindi. My request is to use Hindi as much as possible in office work and contribute to the promotion of Hindi. And also informed the chief guest that the employees of this institute are doing more and more work in Hindi. Prizes and Certificates for the winners of different competitions were distributed during the valedictory function.

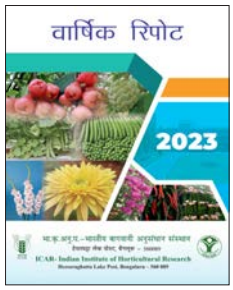
Inaugural Function in the presence of Chief Guest

Valedictory function

Address by the Director

Prize distribution

Hindi Publications



Annual Report 2023 of ICAR-IIHR was brought out in Hindi during 2024. The Hindi Magazine Bagwani with 39 articles is being compiled and printed.

Hindi Incentive Scheme

Hindi incentive scheme was implemented at the Institute for working in Hindi originally. The prizes and certificates for the participants were distributed during the valedictory function of Hindi Fortnight Celebration.

15.2. CHES, Bhubaneswar

The ICAR-IIHR-Central Horticultural Experiment Station, Bhubaneswar observed 'Hindi Week' from 13th September to 20th September 2024. Hindi Week was inaugurated by Assistant Director General, Horticulture- ICAR, Dr. Sudhakar Pandey on 13th September 2024. He shared his views on the importance of organizing Hindi Utsav in ICAR system. During the week-long program, various competitions like extempore speech, Hindi translation, essay competition, antakshari competition were organized for the staff and students in which all categories of staff participated enthusiastically. In the closing ceremony, Dr. Govind Chandra Acharya, Chairman & Principal Scientist introduced the Chief Guest and welcomed the Chief Guest and the members present in the gathering. In the closing ceremony, the Chief Guest Shri Laxmikant Nayak, Senior Branch Officer, Life Insurance Corporation of India, Bhubaneswar Branch, along with Head of Central Horticultural Experiment Station distributed prizes among the winners. He summarised the importance of Hindi in our everyday activities. He also told that Hindi language plays an important role in spreading Indian tradition all over the world. Three employees were awarded for using Hindi language in government work. Mrs. Annapurna Behera, Assistant Administrative Officer conducted the program and informed about various activities organized during Hindi week. Hindi week was coordinated by Mrs. Annapurna Behera, Mr. Manoj Kumar Patnaik, Syed Amin Ansari and Mrs. Suvasini Pradhan under the guidance of Head Dr. G.C. Acharya. Scientists, administrative and accounting staff and technical staff played the role of judges in various sessions.

Hindi week celebration at CHES, Bhubaneshwar

15.3. CHES, Chettalli

The "Hindi Week Celebration" was observed at ICAR-IIHR-Central Horticultural Experiment Station, Chettalli, Kodagu, Karnataka during 17th-20th September, 2024. The Inaugural function of the Hindi Week Celebration was organized on 17th September, 2024. Dr. S. Rajendiran, Head (i/c) & Chairman, OLIC, CHES, Chettalli inaugurated the Hindi Sapthaah Celebration-2024. He highlighted the significance of Hindi as an official language and its importance in communication, unity of people, and development of the country. Then he addressed the staff of the station to actively participate in the Hindi Week Celebrations. Dr. A.T. Rani, narrated the events to be organized during the Hindi Week Celebration.

Several competitions *viz*., Identification of things, Writing of Hindi Alphabets and Numbers, Anthaakshari of Hindi Songs and Debate in Hindi were organized for the staff of the station during 17th-20th September, 2024 by the OLIC. Many staff members of the station had actively taken part in all the events. On 18.09.2024, the OLIC members visited Government High School, Chettalli and conducted a competition of Essay Writing in Hindi amongst students of class VIII, IX and X, and also created awareness and importance of Hindi Week Celebration. Nearly 70 participants including students and teachers took part in the programme.

The Valedictory Function was organized on 20th September, 2024. Shri Manoj, Hindi Teacher from Government High School, Chettalli graced the function as the Chief Guest. Dr Rani A.T., welcomed the Chief Guest and the staff. The Chief Guest recommended practising Hindi in day to day life to learn the language quickly and easily. Then Hindi Workshop was organized and Shri Manoj taught "Letter Writing in Hindi". Then Dr. Rani A.T., briefed the activities and competitions of "Hindi Week Celebration-2024". The prizes were presented to the winners of various competitions. Students from Government High School, Chettalli had also attended the function and received the prizes. Dr. S. Rajendiran delivered the presidential address, and briefed the steps taken by the station in increasing usage of Hindi in various office communications and works, and congratulated all the staff members and prize winners for their active participation in different events.

Hindi week celebration at CHES, Chettalli

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16.1 ITMC identified varieties

Fruit crops

Wax apple: CHESM-1

It is a regular bearing and high yielding variety, the growth habit is spreading type. The fruits are seedless and have attractive pink colour. The average fruit weight ranged from 35 to 40 g with more than 90% moisture content and 6.4 to 7.6 0 Brix TSS. The average yield is 90–120 kg per plant.

Vegetable crops

Watermelon: Sel-4 (High yielding biofortified carotene rich variety)

- Sel-4 is an orange fleshed variety in jubilee segment and takes 75-80 days after sowing for maturity. Fruits have parrot green coloured rind with dark green stripes.
- Fruit weight varies between 4-8 kg with an estimated yield of 80 t ha-1. Fruits are medium to large oblong with high TSS (11-12%).
- Fruit texture is firm and juicy with granular, crisp texture
- It is high in carotene content (28.34 µg g^{-1}) compared to red fleshed varieties (17.33 µg g^{-1}), 63% higher than red fleshed varieties.

Cluster bean: Arka Siddhi (Advanced breeding line IIHRCB 22-1-1)

- Plants are tall erect (90-110 cm), single stemmed and vigorous with dark green trifoliate leaves
- Flowers are pink-white in colour in long racemose inflorescence
- Pods are long (10-14 cm), green, borne in cluster at each node, string less with smooth texture, meaty and slow growing seeds. Pod yield under optimum condition is 20-28 t ha^{-1}.

Flower crops

Climbing rose: Arka Veraraghavan

- It is a red rose, a climber with the parentage of Carefree Beauty x Doris Tysterman suitable for multiple landscape features
- Flowers are red (RHS red purple group n 66-a) with yellow basal spot (RHS yellow group 3-c)
- Flower of large size (10-12 cm) with multiple petals (50-60)
- Environmentally friendly rose with field tolerance to black spot and thrips

16.2 ITMC identified technologies

1. Red Dragon fruit powder technology:

- The product has very attractive dark purple colour and free flowing nature with addition of least quantity of additives (4-8%).
- It contains higher amount of bioactive compounds such as anthocyanin (96.93 mg 100 g^{-1}), total

antioxidant (120.80 mg 100 g^{-1}) and total phenol content (576.560 mg GAE 100 g^{-1}) compared to commercially available spray dried powder (anthocyanin: 1.88 mg 100 g^{-1}, total antioxidant: 20.94 mg 100 g^{-1}, and total phenol content: 91.08 mg GAE 100 g^{-1}).

- Rich in minerals particularly potassium (1.72%), Fe (22.54 ppm), Mn (11.30 ppm), Zn (13.18 ppm), Cu (5.98 ppm), and also protein (3.30%) & crude fibre (2.60 %).
- Shelf life is six months when packed in aluminium laminated pouches and stored at ambient. The deterioration in nutritional quality is minimal when stored at low temperature (8-10 °C).

- The net benefit to cost ratio is 1.77: 1.00
- The product meets the FSSAI standards under Section 2.3.35: Dehydrated Fruits
- The product is suitable for preparation of different value-added product like cookies, cakes, muffins, milkshake and Dip tea bags.

2. Arka tender jack fruit frozen patties and kabab

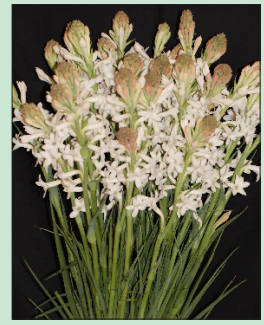
- Both the tender jack products scored organoleptic score of 7-8 on a 9 point hedonic scale
- Rich in crude fibre, minerals and antioxidants
- Shelf life is one year under frozen conditions without rancidity
- Preservative free and meet the FSSAI standards under Section 18.2.4: Ready-to-Eat and Ready-to-Cook Products.
- The Benefit: Cost Ratio is 1.36:1.00

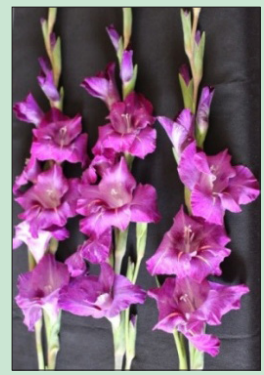
16.3 Varieties identified by SVRC in Karnataka

Crop	Variety/ hybrid	Proposed Zones	Brief description
Custard apple	**Arka Sahan**	**2,3,4,5,6 and 7**	Progeny of Island Gem (*Annona atemoya* Hort.) x Mammoth (*A. squomosa* L.). Fruit weight of 410 g. Less number of seeds (8 seeds per 100 g pulp). High pulp recovery (74.0%) and TSS (30.0 °Brix). Average yield is 12 t ha^{-1}.
Guava	Arka Poorna	5 and 6	Yield : 40 to 42 kg per tree per year after 4th year of planting. Medium to big sized fruits (200 to 220g) with medium soft seeds (4 to 6 kgf) and TSS of 12 to 13 ^{o}Brix. Firm and white pulp. Rich in ascorbic acid.
Guava	Arka Rashmi	1, 5 and 6	Fruits are round, medium sized (180 to 200 g) with medium thick pericarp (> 1 cm). Pulp is dark red, with medium soft seeds (4-6 kgf) and medium in lycopene (4.93 mg 100 g^{-1} pulp) and high in ascorbic acid (220 to 235 mg 100 g^{-1}) Yield: 38 to 40 kg per tree per year after 4th year of planting.
Mango	Arka Suprabhath (Amrapali x Arka Anmol)	All zones	Regular, bunch bearing and high yielding (35-40 kg per plant in 4th year of bearing) with fruit weight of 200-250 g, fruit shape is like Alphonso and has pulp colour of Amrapali, deep orange firm pulp, pulp recovery (>70%), TSS (>22 °B), acidity (0.12%), carotenoids (8.35 mg 100 g^{-1} FW) and flavonoids (9.91 mg 100 g^{-1} FW) and it has got the shelf life of 8-10 days.
Mango	Arka Udaya (Amrapali x Arka Anmol)	All zones	Semi-vigorous growth. Fruit weight of 200 to 250 g. Bunch bearing. 35-40 kg fruit yield per plant in 4th year of bearing. Firm with deep yellow orange in colour, sweet in taste with good TSS (24°Brix) and high pulp recovery (77%). The fruits have better keeping quality (12-15 days).

Pummelo	Arka Anantha	All zones	Clonal selection of 25-5, 80-90 fruits per tree per season after 4 years of planting, fruit weight with 0.9-1.2 kg, Oblique fruit shape and has sweet pink pulp colour, TSS (11-12°Brix) and acidity (1.0-1.2%).
Pummelo	Arka Chandra	All zones	Clonal selection of 18-5. Medium vigorous growth habit. Average yield of 35-40 fruits per tree per season after 4 years of planting. Fruit weight ranges from 0.8-1.0 kg, spheroid fruit shape and white pulp, TSS (11-12 °B), acidity (0.89%) and sweet in taste.
Ridge gourd	Arka Prasan	All zones	Early flowering. Takes 34-35 days for the first female flower appearance and 42-45 days for first picking of fruits. Green, long, tender fruits. Yield: 26-30 t ha^{-1} in 120-135 days duration.
French bean	Arka Arjun	All zones	Plants are bushy and photo-insensitive. Pods are ready for harvest in 47 days after sowing. Pods are round, stringless, smooth, long (14.2 cm) and crisp with no parchment. Yield potential of 16.5 t ha^{-1} in 70 days. Resistant to Mung Bean Yellow Mosaic Virus disease
Velvet bean (*Mucuna pruriens* var *utilis*)	Arka Dhanvantari	1, 4, 8 and 10	Long duration line comes to maturity 180-190 days after sowing. Non-itchy trichomes on pods. High seed yield (2- 2.5 t ha^{-1}) (32% increase). High L-Dopa content (4.5 to 5.5%)
Velvet bean (*Mucuna pruriens* var *utilis*)	Arka Daksha	3, 5 and 6	Seed yield 1.6-2 t/ha, medium duration matures in 150-160 days after sowing Non-itchy trichomes on pods High seed yield (1.6- 2 t ha^{-1}) (35% increase) High L-Dopa content (3.5 to 4.5%)
Ashwagandha	Arka Ashwagandha	3 & 5	It is a high yielding variety from pure line selection with double the dry root yield (11.95 q ha^{-1}) and total withanolide content (0.58 %) compared to check Jawahar Ashwagandh -20 (5.27 q ha^{-1} & 0.32 %). Variety matures in 180 days with pencil thickness roots
Centella asiatica	Arka Prabhavi	3 & 5	Produces 13 t of fresh herb and 2.3 tonnes of dry herb per hectare per year with higher asiaticoside content (3.85%) and higher tri-terpenoid content (7.27%). Good for herbal industries.
Centella asiatica	Arka Divya	3 & 5	Higher dry biomass yield of 2.5 t per hectare per year, moderate asiaticoside content 0.54 to 1.69% and moderate tri-terpenoid content 1.67 to 3.56%. It is good for both industry and use as green vegetable purpose.
Okra hybrid	Arka Nikita	1,3,4,6,7	Genetic male sterile line, high yielding 22.46 t ha^{-1}. Dark green, medium, smooth and tender fruits. Early fruiting. Suitable for all seasons. Rich in iodine content (33.31 µg kg^{-1}). High mucilage content (1.08% (FW) and high edible fiber content (8.85% DW).
Indian bean (*Dolichos* bean)	Arka Vistar	1, 3 and 8	Photo insensitive, average yield of 35-37 t ha^{-1}. Duration: 120-150 days. Fruit characters: dark green, tender, thick and long.
Indian bean (*Dolichos* bean)	Arka Krishna	1, 3 and 8	Photo insensitive, average yield: 25-30 t ha^{-1}. Duration: 120-150 days. Fruit characters: dark green smooth pods with shininess suitable for fresh market. Highly preferred in Karnataka State.
Gladiolus	Arka Amar	4 & 7	It flowers in 70 to 75 days, yields 2.5 lakh spikes per hectare. It is resistant to *Fusarium* wilt disease.
Gladiolus	Arka Kesar	4 & 7	It yields 1.49 lakh spikes per hectare. It is resistant to *Fusarium* wilt disease.

16.4 Varieties identified under CVRC

Crop	Variety and specific traits		Recommended States
Crossandra	**Arka Shravya:** Average loose flower yield 3030 kg acre^{-1} yr^{-1}. Moderately resistant to *Phytophthora* wilt. Novel flower colour belonging to Orange –Red group (35.B) of RHS colour chart		Andhra Pradesh Maharashtra, Karnataka
Tuberose	**Arka Prajwal hybrid:** It is high yielding single type variety. The flower buds are attractive, bolder with slightly pinkish tinge on the tip. The flower yield is 17 t ha^{-1} yr^{-1}		West Bengal, Assam, Punjab, Uttar Pradesh, Bihar, Rajasthan, Delhi, Maharashtra, Karnataka, Tamil Nadu
Tuberose	**Arka Vaibav hybrid:** It produces double type flowers with yield level of 2.5-3.0 lakh spikes ha^{-1} yr^{-1}. Flower buds are greenish in colour with white florets. Suitable for cut flower and has tolerance to root knot nematode.		West Bengal, Assam, Punjab, Uttar Pradesh, Bihar, Rajasthan, Delhi, Maharashtra, Karnataka and Tamil Nadu
Rose	**Arka Savi Hybrid:** Flowers are Purple Red in colour and are produced in bunches. Potential yield of loose flowers expected is 25-30 t acre^{-1} year^{-1}. It has added advantage of long shelf life of flowers (5-6 days)		Karnataka, Tamil Nadu, Andhra Pradesh, Telangana
Gladiolus	**Arka Amar Hybrid:** It flowers in 70 to 75 days, yields 2.5 lakh spikes ha^{-1}. It is highly resistant to *Fusarium* wilt disease.		Himachal Pradesh, Punjab, Jharkhand, Andhra Pradesh and Maharashtra
Gladiolus	**Arka Aayush Hybrid:** It yields 2.75 lakh spikes ha^{-1}. It is resistant to *Fusairum* wilt disease		West Bengal, Punjab, Rajasthan and Maharashtra

Gladiolus	**Arka Kesar Hybrid:** It yields 1.49 lakh spikes ha^{-1}. It is resistant to *Fusarium* wilt disease		Himachal Pradesh and Rajasthan
Gladiolus	Arka Pratham Hybrid: It is an early flowering (55 to 60 days) variety with unique floret colour. It yields 2.28 spikes ha^{-1}.		West Bengal, Punjab, Rajasthan and Maharashtra
Gladiolus	Arka Naveen Hybrid: Florets are open faced, medium, wavy, arranged in two rows. It produces flowers in 60 to 65 days with 16 florets per spike and yields 2.06 lakh spikes ha^{-1}.		Punjab, Rajasthan, Bihar and Delhi

* * * * * *

17. Personnel

17.1 DIRECTOR

Dr. T. K. Behera, Director

17.2 SCINTIFIC STAFF, ICAR-IIHR, HESARAGHATTA.BENGALURU .KARNATAKA

DIVISION OF FRUIT CROPS

S. No.	Name	Designation
1.	**Dr. M. Sankaran, Ph.D.** (Horticulture)	Principal Scientist and Head
2.	**Dr. B. L. Manjunath, Ph.D.** (Agronomy)	Principal Scientist
3.	**Dr. Anuradha Sane, Ph.D.** (Horticulture)	Principal Scientist
4.	**Dr. S. Sujatha, Ph.D.** (Agronomy)	Principal Scientist
5.	**Dr. T. Sakthivel, Ph.D.** (Horticulture)	Principal Scientist
6.	**Dr. J. Satisha, Ph.D.** (Horticulture)	Principal Scientist
7.	**Dr. Nagaraja A, Ph.D.** (Horticulture)	Principal Scientist
8.	**Dr. C. Vasugi, Ph.D.** (Horticulture)	Principal Scientist
9.	**Dr. G. Karunakaran, Ph.D.** (Horticulture)	Principal Scientist
10.	**Dr. K. Abirami, Ph.D.** (Horticulture)	Principal Scientist
11.	**Dr. Kanupriya, Ph.D.** (Horticulture)	Senior Scientist
12.	**Dr. Linta Vincent, Ph.D.** (Fruit Science)	Scientist (Sr. Scale)
13.	**Ms. Anushma P. L, M.Sc** (Fruit Science)	Scientist
14.	**Dr. Anupa T, Ph.D.** (Fruit Science)	Scientist (Sr. Scale)

DIVISION OF VEGETABLE CROPS

S. No.	Name	Designation
1.	**Dr. H. C. Prasanna, Ph.D.** (Plant Breeding)	Principal Scientist and Head
2.	**Dr. M. Pitchaimuthu, Ph.D.** (Horticulture)	Principal Scientist
3.	**Dr. B. Varalakshmi, Ph.D.** (Horticulture)	Principal Scientist
4.	**Dr. S. Shankar Hebbar, Ph.D.** (Agronomy)	Principal Scientist
5.	**Dr. T. H. Singh, Ph.D.** (Horticulture)	Principal Scientist
6.	**Dr. Anil Kumar Nair, Ph.D**. (Agronomy)	Principal Scientist
7.	**Dr. M. V. Dhananjaya, Ph.D.** (Plant Breeding)	Principal Scientist
8.	**Dr. K. Padmini, Ph.D.** (Horticulture)	Principal Scientist
9.	**Dr. E. Srinivasa Rao, Ph.D.** (Horticulture)	Principal Scientist
10.	**Dr. V. Sankar, Ph.D.** (Horticulture)	Principal Scientist
11.	**Dr. M. Thangam, Ph.D.** (Vegetable Science.)	Principal Scientist
12.	**Dr. Raja Shankar, Ph.D.** (Vegetable Science.)	Principal Scientist
13.	**Dr. C. Mahadevaiah, Ph.D.** (Genetics & Plant Breeding)	Senior Scientist promoted to Senior Scientist Level 13A w.e.f. 15.12.2022 through CAS

14.	**Dr. Vivek Hegde, Ph.D.** (Vegetable Science)	Scientist
15.	**Dr. Smaranika Mishra, Ph.D.** (Vegetable Science)	Scientist
16.	**Dr. Raghu B.R., Ph.D.** (Plant Breeding)	Scientist promoted to Level 12 w.e.f. 27.04.2022 through CAS.
17.	**Dr. Ponnam Naresh, Ph.D.** (Vegetable Science)	Scientist promoted to Level 12 w.e.f. 01.01.2023 through CAS.
18.	**Dr. M. Senthil Kumar, Ph.D.** (Vegetable Science.)	Scientist
19.	**Dr. Manjunatha Gowda, Ph.D.** (Vegetable Science)	Scientist
20.	**Mrs. Bharghavi H. A, M.Sc.** (Genetics and Plant Breeding)	Scientist

DIVISION OF FLOWER AND MEDICINAL CROPS

S. No.	Name	Designation
1.	**Dr. P. Naveen Kumar, Ph.D.**	Principal Scientist and Head
2.	**Dr. Tejaswini Prakash, Ph.D.** (Plant Breeding)	Principal Scientist
3.	**Dr. Sujatha A Nair, Ph.D.** (Horticulture)	Principal Scientist
4.	**Dr. K. Hima Bindu, Ph.D.** (Plant Breeding)	Principal Scientist
5.	**Dr. Rajiv Kumar, Ph.D.** (Horticulture)	Principal Scientist
6.	**Dr. V. Baskaran, Ph.D.** (Floriculture & Landscaping)	Principal Scientist
7.	**Dr. Safeena S. A., Ph.D.** (Floriculture & Landscaping)	Senior Scientist has been appointed to the post of Principal Scientist Level 14 w.e.f. 22.02.2024.
8.	**Dr. H. P. Sumangala, Ph.D.** (Horticulture)	Principal Scientist
9.	**Dr. T. Usha Bharathi, Ph.D.** (Floriculture)	Senior Scientist promoted to Senior Scientist Level 13A w.e.f. 08.01.2022 through CAS.
10.	**Dr. Smitha G. R, Ph.D.** (Horticulture-Floriculture)	Senior Scientist promoted to Principal Scientist Level 14 w.e.f. 08.01.2023
11.	**Dr. Sreenivasa V, Ph.D.** (Plant Breeding)	Senior Scientist promoted to Senior Scientist Level 13A w.e.f. 29.04.2023 through CAS.
12.	**Dr. Rohini M.R, Ph.D.** (Spices, Plantation crops & M.A.P)	Scientist

DIVISION OF POST-HARVEST TECHNOLOGY & AGRICULTURAL ENGINEERING

S. No.	Name	Designation
1.	**Dr. R. B. Tiwari, Ph.D.** (Horticulture)	Principal Scientist and Head (In charge)
2.	**Dr. D. V. Sudhakara Rao, Ph.D.** (Horticulture)	Principal Scientist
3.	**Dr. G. Senthil Kumaran, M.Tech, Ph.D.** (Farm Machinery & Processing)	Principal Scientist
4.	**Dr. Carolina Rathina Kumari, A.M.E, Ph.D.** (Farm Machinery & Processing)	Principal Scientist
5.	**Dr. S. Bhuvaneshwari, M.E** (Agric. structure & Process Engineering)	Principal Scientist

6.	**Dr. Ranjitha, K. Ph.D.** (Microbiology)	Senior Scientist
7.	**Dr. Pushpa Chethan Kumar, Ph.D.** (Food & Nutrition)	Senior Scientist promoted to Senior Scientist Level 13A w.e.f. 15.12.2022 through CAS
8.	**Dr. Vijay Rakesh Reddy S, Ph.D.** (Fruit Science)	Scientist
9.	**Dr. P. Preethi, Ph.D.** (Fruit Science)	Scientist

DIVISION OF CROP PROTECTION

S. No.	Name	Designation
1.	**Dr. S. Sriram, Ph.D.** (Plant Pathology)	Principal Scientist and Head
2.	**Dr. P. Venkat Rami Reddy, Ph.D.** (Agricultural Entomology)	Principal Scientist
3.	**Dr. V. Sridhar, Ph.D.** (Agricultural Entomology)	Principal Scientist
4.	**Dr. P. D. Kamala Jayanthi, Ph.D.** (Agricultural Entomology) & National Fellow	Principal Scientist
5.	**Dr. D.K. Samuel, Ph.D.** (Plant Pathology)	Principal Scientist
6.	**Dr. G. Sangeetha, Ph.D.** (Plant Pathology)	Principal Scientist
7.	**Dr. Uma Maheshwari, Ph.D.** (Nematology)	Senior Scientist promoted Principal Scientist Level 14 w.e.f. 07.01.2023
8.	**Dr. C. Chandrashekara, Ph.D.** (Plant Pathology)	Senior Scientist
9.	**Dr. B. R. Jayanthimala, Ph.D.** (Agricultural Entomology)	Senior Scientist promoted to Senior Scientist Level 13A w.e.f. 11.05.2023 through CAS
10.	**Dr. N .R. Prasanna Kumar, Ph.D.** (Agricultural Entomology)	Scientist
11.	**Sh. G. M. Sandeep Kumar,** (Plant Pathology)	Scientist promoted to Level 12 w.e.f. 15.09.2021 through CAS.
12.	**Dr. B. Mahesha, Ph.D.** (Plant Pathology)	Scientist
13.	**Dr. Priti S. Sonavane, Ph.D.** (Plant Pathology)	Scientist promoted to Level 12 w.e.f. 01.01.2023 through CAS.
14.	**Dr. V. Venkataravanappa, Ph.D.** (Plant Pathology)	Senior Scientist
15.	**Dr. Bhagyasree S. N, Ph.D.** (Agricultural Entomology)	Scientist
16.	**Dr. Manjunatha L, Ph.D.** (Plant Pathology)	Scientist
17.	**Dr. Keerthi M.C, Ph.D.** (Agricultural Entomology)	Scientist

DIVISION OF BASIC SCIENCE

S. No.	Name	Designation
1.	**Dr. Basavaprabhu L. Patil, Ph.D.** (Biotechnology, Agric. Sciences)	Principal Scientist and Head w.e.f. 02.02.2024
2.	**Dr.K.S. Shiva Shankara, Ph.D.** (Plant Physiology)	Principal Scientist
3.	**Dr. R. Asokan, Ph.D.** (Agric. Entomology)	Principal Scientist

4.	**Dr. K. V. Ravishankar, Ph.D.** (Plant Physiology)	Principal Scientist
5.	**Dr. M. Manmohan, Ph.D.** (Plant Physiology)	Principal Scientist
6.	**Dr. K. Bhanuprakash, Ph.D.** (Plant Physiology)	Principal Scientist
7.	**Dr. R. H. Laxman, Ph.D.** (Plant Physiology)	Principal Scientist
8.	**Dr. Shamina Azeez, Ph.D.** (Plant Biochemistry)	Principal Scientist
9.	**Dr. Partha P. Choudhury, Ph.D.** (Agric. Chemicals)	Principal Scientist
10.	**Dr. H. S. Vageesh Babu, Ph.D.** (Agricultural Biotechnology)	Principal Scientist
11.	**Dr. Sridhar Gutam, Ph.D.** (Plant Physiology)	Senior Scientist promoted Principal Scientist Level 14 w.e.f. 09.05.2021
12.	**Dr. Arivalagan M, Ph.D.** (Biochemistry)	Senior Scientist
13.	**Dr. P. Nandeesha, Ph.D.** (Biotechnology)	Scientist promoted to Senior Scientist Level 13A w.e.f. 07.02.2022 through CAS.
14.	**Dr. D. C. Lakshamana Reddy, Ph.D.** (Biotechnology)	Senior Scientist promoted to Principal Scientist Level 14 w.e.f. 12.06.2022
15.	**Dr. T. R. Usha Rani, Ph.D.** (Biotechnology)	Senior Scientist
16.	**Dr. Preeti Singh, Ph.D.** (Biochemistry)	Senior Scientist promoted to Senior Scientist Level 13A w.e.f. 01.01.2022 through CAS
17.	**Ms. Poornima K.N, M.Sc** (Biotechnology)	Scientist
18.	**Dr. Ramesh K.V, Ph.D.** (Plant Physiology)	Scientist
19.	**Mr. Virupakshagouda. U. Patil, M.Sc** (Biotechnology)	Scientist
20.	**Dr. Abhishek Mandal, Ph.D.** (Agricultural Chemicals)	Scientist
21.	**Dr. Prathibha M.D, Ph.D.** (Plant Physiology)	Scientist
22.	**Dr. Chandrashekar N, Ph.D**. (Agricultural Biotechnology)	Scientist

DIVISION OF NATURAL RESOURCES

S. No.	Name	Designation
1.	**Dr. L. R. Varalakshmi, Ph.D.** (Soil Sci.)	Principal. Scientist and Head (In charge) w.e.f. 19.12.2024.
2.	**Dr. T. R. Rupa, Ph.D.** (Soil Science)	Principal Scientist
3.	**Dr. G. C. Sathisha, Ph.D.** (Soil Science)	Principal Scientist
4.	**Dr. G. Selvakumar, Ph.D.** (Microbiology)	Principal Scientist
5.	**Dr. Radha T. K, Ph.D.** (Microbiology)	Senior Scientist promoted to Senior Scientist Level 13A w.e.f. 10.02.2022 through CAS.
6.	**Dr. D. Kalaivanan, Ph.D.** (Soil Science)	Senior Scientist promoted to Senior Scientist Level 13A w.e.f. 28.04.2022 through CAS.
7.	**Dr. S. Ramachandran, Ph.D.** (Soil Science)	Senior Scientist
8.	**Dr. Chethan Kumar Gurumurthy, Ph.D.** (Soil Science)	Scientist
9.	**Dr. Shilpashree K.G, Ph.D.** (Soil Science)	Scientist
10.	**Dr. Yukti Verma, Ph.D.** (Soil Science)	Scientist

DIVISION OF SOCIAL SCIENCES AND TRAINING

S. No.	Name	Designation
1.	**Dr. V. K. J. Raghavendra Rao, Ph.D.** (Agric. Extension)	Principal Scientist and Head (In charge)
2.	**Dr. R. Venugopalan, Ph.D.** (Statistics)	Principal Scientist
3.	**Dr. B. Balakrishna, Ph.D.** (Agric. Extension)	Principal Scientist
4.	**Dr. R. Senthil Kumar, Ph.D.** (Fruit Science)	Principal Scientist
5.	**Dr. M. K. Chandraprakash, M.C.A.** (Computer Applications)	Principal Scientist
6.	**Dr. Reena Rosy Thomas, M.C.A.** (Computer Applications)	Principal Scientist
7.	**Dr. Raju R, Ph.D.** (Agric. Economics)	Senior Scientist
8.	**Dr. Atheequlla G.A, Ph.D.** (Agric. Extension)	Scientist promoted to Level 12 w.e.f. 15.09.2021 through CAS.
9.	**Dr. Harish Kumar, Ph.D.** (Agric. Economics)	Scientist
10.	**Dr. Ramya H.R, Ph.D.** (Agric. Extension)	Scientist

PROJECT CO-COORDINATOR'S CELL (PC FRUITS)

S. No.	Name	Designation
1.	**Dr. Prakash Patil, Ph.D.**	Principal Scientist And PC Fruits
2.	**Dr. S. Priyadevi, Ph.D.** (Fruit Science)	Principal Scientist

CENTRAL HORTICULTURAL EXPERIMENT STATION, CHETTALLI

S. No.	Name	Designation
1.	**Dr. Rajendiran S, Ph.D.** (Soil Science)	Senior Scientist and Head (In charge) promoted to Senior Scientist Level 13A w.e.f. 02.09.2022 through CAS.
2.	**Dr. Muralidhara B. M, Ph.D.** (Fruit Science)	Scientist
3.	**Dr. Rani A.T, Ph.D.** (Agri. Entomology)	Scientist
4.	**Dr. Nayan Deepak G, Ph.D.** (Fruit Science)	Scientist
5.	**Shri. Madhu G. S, M.Sc** (Plant Pathology)	Scientist

CENTRAL HORTICULTURAL EXPERIMENT STATION, BHUBANESHWAR

S. No.	Name	Designation
1.	**Dr. Gobinda Chandra Acharya, Ph.D.** (Horticulture)	Principal Scientist and Head
2.	**Dr. Petikam Srinivas, Ph.D.** (Plant Pathology)	Principal Scientist
3.	**Dr. Deepa Samant, Ph.D.** (Horticulture)	Senior Scientist
4.	**Sh. Kishor Kumar Mahante, M.Sc** (Fruit Science)	Scientist
5.	**Smt. Vaisakhi K.C, M.Sc** (Soil Science)	Scientist
6.	**Dr. Ayyagari V. V. Koundinya, Ph.D.** (Vegetable Science)	Scientist
7.	**Shri. Satyapriya Singh, M.Sc** (Agricultural Entomology)	Scientist

KVK, GONIKOPPAL

S. No.	Name	Designation
1	**Dr. Rajendiran S, Ph.D.** (Soil Science)	Senior Scientist and Head (In charge)

KVK, HIREHALLI

S. No.	Name	Designation
1.	**Dr. Loganandhan, Ph.D**	Principal Scientist And Head (In charge)

17.3. TECHNICAL STAFF

DIVISION OF FRUIT CROPS

S. No.	Name	Designation
1.	Dr. Lakshmipathi	Chief Technical Officer (Field/Farm)
2.	Shri H. V. Manoj Kumar	Technical Assistant (Lab)
3.	Shri. G. Suresh	Technical Assistant (Field/Farm)
4.	Shri. H. Prakash	Senior Technician (Field/Farm) promoted Technical Assistant (T-3) Level 5 w.e.f. 01.01.2025
5.	Shri. M. Lakshmipathy	Technical Assistant (Field/Farm)
6.	Shri. Mallikarjuna Swamy	Technician (Field/Farm) promoted to Senior Technician (T-2) Cat-I Level4 w.e.f. 19.03.2023
7.	Smt. Himaswetha C. N.	Technician (Field/Farm) promoted to Senior Technician (T-2) Cat-I Level 4 w.e.f. 18.02.2024.
8.	Shri. Ravikant Prajapati	Reported to duty as Technical Trainee (T-1) w.e.f. 03.05.2024
9.	Shri. Walhekar Aniket Rajendra	Reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024
10.	Shri. Sandeep Kumar	Reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024

DIVISION OF VEGETABALE CROPS

S. No.	Name	Designation
1.	Dr. Lakshmipathi	Chief Technical Officer (Field/Farm)
2.	Shri H. D. Parashuram	Senior Technical Officer (Field/Farm)
3.	Shri. D.V. Ramamurthy	Technical Officer (Field/Farm)
4.	Shri L. Devaraj	Technical Assistant (Field/Farm)
5.	Smt. D. Vimala	Technical Assistant (Lab)
6.	Smt. S. V. Venkatalakshmamma	Technical Assistant (Lab)
7.	Shri. C. Sridhara	Technical Assistant (Field/Farm)
8.	Shri H. V. Puneeth	Technical Assistant (Field/Farm)
9.	Shri H. S. Suresh	Senior Technician (Field/Farm)

10.	Shri H. J. Vinod Kumar	Technical Assistant (Field/Farm)
11.	Shri N. Muniraju	Technical Assistant (Field/Farm)
12.	Shri. Muralidhara	Technical Assistant (Lab)
13.	Shri. Vinod Kumar	Reported to duty as Technical Trainee (T-1) w.e.f. 02.05.2024
14.	Shri. Kethan Raj	Reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024
15.	Shri. Prakash hazare	Reported to duty as Technical Trainee (T-1) w.e.f. 10.06.2024
16.	Shri. Vishal	Reported for duty as Technical Trainee (T-1) w.e.f. 29.07.2024

DIVISION OF FLOWER AND MEDICINAL CROPS

S. No.	Name	Designation
1.	Anuradha Ravasaheb Thabbannavar	Senior Technical Officer (Field/Farm)
2.	Shri. V. Chaluvaraju	Technical Officer (Field/Farm)
3.	Shri. M. Pandurangaiah	Senior Technician (Field/Farm)
4.	Shri. H. R. Venkatesha	Technical Assistant (Field/Farm)
5.	Shri. N. Naveen Kumar	Technical Assistant (Field/Farm)
6.	Shri. A. Rudresha	Technical Assistant (Field/Farm
7.	Shri. Rajanath Kumar	Reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024
8.	Shri. Ratan Kumar Jha	Reported to duty as Technical Trainee (T-1) w.e.f. 07.05.2024
9.	Shri. Shivom Gupta,	Reported to duty as Technical Trainee (T-1) w.e.f. 08.05.2024

DIVISION OF POST HARVEST TECHNOLOGY AND AGRICULTURAL ENGINEERING

S. No.	Name	Designation
1.	Shri. P. Dayananda	Senior Technical Officer (Mech-Workshop)
2.	Shri. P.T. Mahantesh	Technical Officer (Mech-Workshop)
3.	Shri. P. Paramashivaiah	Technical Officer (Lab)
4.	Ms. H. Bharathamma	Techncal Officer (Lab)
5.	Shri. H.S. Ananda Murthy	Technical Assistant (Lab)
6.	Smt. R. Anjanamma	Senior Technician (Field/Farm) promoted to Technical Assistant (T-3) Cat-II Level 5 w.e.f. 27.12.2023.
7.	Shri Ankur Sharma	Reported to duty as Technical Trainee (T-1) w.e.f. 09.05.2024

DIVISION OF CROP PROTECTION

S. No.	Name	Designation
1.	Smt. S. Saroja	Senior Technical Officer (Lab)
2.	Dr. S. Onkaranaik,	Technical Officer (Field/Farm)
3.	Shri. Gundappa Manoji	Technical Assistant (Field/Farm)
4.	Ms. R. Meenakshi	Senior Technician (Field/Farm)
5.	Shri. Mohan, B.P	Technician (Field/Farm) promoted to Senior Technician (T-2) Cat-I level 4 w.e.f. 31.01.2024

6.	Shri. Harit kranti yadav	Reported to duty as Technical Trainee (T-1) w.e.f. 25.04.2024
7.	Shri. Sunny Kumar	Reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024
8.	Ms. Kumari Dharshana	Reported for duty as Technical Trainee (T-1) w.e.f. 06.05.2024
9.	Shri. Kaushik Chandra Das	Reported for duty as Technical Trainee (T-1) w.e.f. 11.06.2024

DIVISION OF BASIC SCIENCES

S. No.	Name	Designation
1.	Dr. Jyothi V. Divakar	Assistant Chief Technical Officer (Lab)
2.	Dr. A. N. Lokesha	Senior Technical Officer (Field/Farm)
3.	Shri. Siddaraju B.N.	Technical Officer (Lab)
4.	Shri. B. Madhusudhana Rao	Senior Technical Officer (Field/Farm)
5.	Smt. M. Malarvizhi	Technical Officer (Lab)
6.	Shri. Banoth Sreenu	Senior Technical Assistant (Lab)
7.	Mrs. J. Latha	Technical Assistant (Field/Farm)
8.	Shri. Hanumantharaju M	Senior Technician (Field/Farm)
9.	Shri. Amal Johny	Technician (Lab) promoted to Senior Technician (T-2) Cat-I level 4 w.e.f. 14.01.2024.
10.	Shri. Saurav Kumar	Reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024
11.	Ms. Arnita Majumdar	Reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024
12.	Shri. Ajit Kumar	Reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024
13.	Shri. Kavindra Kumar	Reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024
14.	Shri. Akash Kumar	Reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024

DIVISION OF NATURAL RESOURCE

S. No.	Name	Designation
1.	Shri. R. Lakshmisha	Assistant Chief Technical Officer (Field/Farm)
2.	Shri. M. Venkatesh	Technical Officer (Lab)
3.	Shri. L. Balakrishna,	Technical Officer (Field/Farm)
4.	Smt. V. M. Shilpashree	Technical Officer (Lab)
5.	Shri. N. Ramachandra,	Technical Officer (Lab)
6.	Smt. R. Sheela	Senior Technician (Lab)
7.	Shri. Ghanshyam Pandit	Reported to duty as Technical Trainee (T-1) w.e.f. 03.05.2024

DIVISION OF SOCIAL SCIENCES AND TRAINING

S. No.	Name	Designation
1.	Shri. V. Shashi Kumar	Technical Assistant (Lab)
2.	Shri. Gulshan Kumar	Reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024
3.	Shri Randheer Kumar Thakur	Reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024

FARM MANAGEMENT

S. No.	Name	Designation
1.	Shri. K. V. Ramesh Babu	Assistant Chief Technical Officer (Field/Farm)
2.	Shri. Nagaraj Kodekal	Technical Officer (Mech-Workshop)
3.	Shri. K. N. Avinash	Technical Officer (Lab)
4.	Shri. V. Ramesh,	Technical Officer (Lab)
5.	Shri. Y. Rajanna	Technical Assistant (Tr. Driver-Workshop)
6.	Shri. B. Avinash,	Technical Assistant (Field/Farm
7.	Shri. Asmit Singh	Reported to duty as Technical Trainee (T-1) w.e.f. 25.04.2024

RFS NURSERY

S. No.	Name	Designation
1.	Shri. T. N. Nagaraju	Technical Assistant (Field/Farm)
2.	Shri. Anurag Kumar	Reported for duty as Technical Trainee (T-1) w.e.f. 26.06.2024

LIBRARY

S. No.	Name	Designation
1	Shri. Challuri Srinivas	Technician (Information Technology) promoted to Senior Technician (T-2) Cat-I Level 4 w.e.f. 02.04.2024

PHOTOGRAPY CELL

S. No.	Name	Designation
1.	Shri. K. Chandrashekaraiah	Senior Technical Officer (DRA-Photography)

PC (FRUITS)

S. No.	Name	Designation
1.	Shri. Bhupendra Sagore	Reported to duty as STO (T-6) w.e.f. 12.02.2024 and posted at PC (Fruits) ICAR-IIHR, Bengaluru.

PRIORITIZATION, MONITORING & EVALUATION CELL (PME CELL)

S. No.	Name	Designation
1.	Dr. Ravindra Kumar	Chief Technical Officer (Lab)
2.	Shri. C. Chandra Kumar	Senior Technical Officer
3.	Shri. Awadhesh Dher Dubey	Reported for duty as Technical Trainee (T-1) w.e.f. 29.04.2024 and posted at PME cell, ICAR-IIHR, Bengaluru

MEDICAL AND PARAMEDICAL (IIHR Dispensary)

S. No.	Name	Designation
1.	Dr. Mandakrantha Bhattacharya	Chief Technical Officer (Medical)

AGRICULTURAL KNOWLEDGE AND MANAGEMENT UNIT CELL (AKMU)

S. No.	Name	Designation
1.	Shri. S. Thippeswamy	Chief Technical Officer (Information Technology)
2.	Shri. S. Krishnananda	Technical Officer (Information Technology)

RFS VEGETABLE CROPS

S. No.	Name	Designation
1.	Dr. N. S. Nage Gowda	Assistant Chief Technical Officer (Field/Farm)
2.	Shri. G. M. Prashanthkumar	Technical Officer (Field/Farm)

RFS FLOWER CROPS

S. No.	Name	Designation
1.	Shri. D. Vamana Naik	Technical Officer (Field/Farm)

TRANSPORT SECTION

S. No.	Name	Designation
1.	Shri. Siddaram G. Kalashetty	Assistant Chief Technical Officer (Transport-Workshop)
2.	Shri. Suresh Angadi	Technical Officer (Tractor Driver-Workshop)
3.	Shri. P. Narayanappa	Technical Officer (Driver-Workshop)
4.	Shri M.R. Suresh	Senior Technical Assistant (Driver-Workshop)
5.	Shri K. Velmurugan	Senior Technical Assistant (Driver-Workshop)

ADMINISTRATION

S. No.	Name	Designation
1.	Smt. Jyoti Appu Naik	Technical Officer (Information Technology)

LANDSCAPE UNIT

S. No.	Name	Designation
1.	Shri. A. Rajanna	Senior Technician (Field/Farm) promoted to Technical Assistant (T-3) Cat-II level 5 w.e.f. 01.01.2025

WORK SHOP UNIT

S. No.	Name	Designation
1.	Shri. K. M. Harish	Assistant Chief Technical Officer (Civil Overseer-Workshop)
2.	Shri. S. Narendra	Senior Technical Officer (Electrician-Workshop)
3.	Shri. R. Manjunath	Technical Officer (Welder-Workshop)

4.	Shri. R. Sridhar	Technical Officer (Ref.-Workshop)
5.	Shri. M. Ganesh	Technical Officer (Ref.-Workshop)
6.	Shri. Animesh Singha Ray	Reported to duty as Technical Trainee (T-1) w.e.f. 22.04.2024
7.	Shri. Mallikarjun N.N	Reported to duty as T-1(Technician) w.e.f. 09.05.2024

PG EDUCATION

S. No.	Name	Designation
1.	Shri. Avijit Mondal	Reported for duty as Technical Trainee (T-1) w.e.f. 06.05.2024

CENTRALHORTICULTURAL EXPERIMENT STATION, CHETTALLI

S. No.	Name	Designation
1.	Smt. Deepa T. J	Technical Assistant (Library)
2.	Shri. Giriraja Naik	Technical Assistant promoted to Senior Technical Assistant (T-4) (Laboratory) Cat-II level 6 w.e.f. 21.01.2024.
3.	Miss. Lijina A	Technical Assistant (Lab) promoted to Senior Technical Assistant (T-4) (Laboratory) Cat-II level 6 w.e.f. 21.01.2024.
4.	Shri A.M. Jagadish	Technical Officer (Driver-Workshop)
5.	Shri. Shivaraj D.T	Technician (Field/Farm
6.	Shri. Amrit Kumar	reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024 and posted at ICAR-IIHR-CHES, Chettalli
7.	Shri. Suvam Mishra	Reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024 and posted at ICAR-IIHR-CHES, Chettalli
8.	Shri. Bhanu Pratap Singh Pandoliya	Reported to duty as Technical Trainee (T-1) w.e.f. 06.05.2024 and he is posted ICAR-IIHR-CHES, Chettalli

CENTRALHORTICULTURAL EXPERIMENTSTATION, BHUBANESHWAR

S. No.	Name	Designation
1.	Shri. Singray Majhi	Senior Technical Officer (Lab)
2.	Shri. K. Biju	Technical Officer (Computer-Lab.)
3.	Mrs. Suchitra Behera	Technical Officer (Field/Farm)
4.	Shri. Abhimanyu Das	Technical Assistant (Field/Farm)
5.	Shri. Purna Chandra Majhi	Technical Assistant (Field/Farm)
6.	Shri. Manoj Kumar Pattnaik	Technical Officer (Lab)
7.	Shri. Syed Idrish Ali	Technical Officer (Driver-Workshop)
8.	Shri. Chandrasena Durga	Technical Officer (Elect.-Workshop)
9.	Shri. Bishnucharan Patra	Senior Technician (Laboratory), CHES, Bhubaneswar promoted to Technical Assistant (T-3) Cat-II level 5 w.e.f. 23.12.2023.
10.	Shri. Ameen Ansari M. D	Reported to duty as Technical Trainee (T-1) w.e.f. 02.05.2024 and posted at ICAR-IIHR-CHES, Bhubaneswar

KVK, GONOKOPPAL

S. No.	Name	Designation
1.	Shri. B. Prabhakara	Chief Technical Officer (Field/Farm)
2.	Shri. K. V. Veerendra Kumar	Chief Technical Officer (Field/Farm)
3.	Dr. S. C. Suresh	Assistant Chief Technical Officer (Field/Farm)
4.	Dr. K. T. Mohan Kumar	Reported to duty as STO (T6) w.e.f. 24.05.2024
5.	Dr. Bharbhai Mrunal Deepak	Reported to duty as STO (T6) w.e.f. 27.05.2024
6.	Shri. Benecio Fernandez	Technical Officer (Computer-Lab)
7.	Ms. Lakshmi R	Technical Assistant (Field/Farm) promoted to Technical Officer (T-5) Cat-II Level 7 w.e.f.12.09.2023

FARM, HIREHALLLI

S. No.	Name	Designation
1.	Shri. N. T. Nagendrappa	Technical Assistant (Field/Farm)
2.	Shri. G. Manjanna	Senior Technician (Field/Farm)
3.	Shri. Sanjeev Kengere	Senior Technician (Field/Farm)

KVK, HIREHALLI

S. No.	Name	Designation
1.	Shri. P. R. Ramesh	Chief Technical Officer (Field/Farm)
2.	Shri. K. N. Jagadish Shri. J. M. Prashanth	Chief Technical Officer (Field/Farm) Chief Technical Officer (Field/Farm)
3.	Shri. B. Hanumanthe Gowda	Chief Technical Officer (Field/Farm)
4.	Ms. Radha R. Banakar	Chief Technical Officer (Field/Farm)
5.	Shri. Somashekhar	Chief Technical Officer (Field/Farm)
6.	Shri K. S. Sanna Manjunath	Senior Technical Officer (Field/Farm)
7.	Shri. K. N. Shashidhara	Senior Technical Assistant (Lab)
8.	Shri. M. H. Ningappa	Senior Technician (Driver Workshop)

ADMINISTRATATION, FINANCE & ACCOUNTS

IIHR, HESARAGHATTA BANGALORE, KARNATAKA

ADMINISTRATATION

S. No.	Name	Designation
1.	Shri. Sachin Agnihotri	Senior Administrative Officer has been promoted to the post of CAO w.e.f. 01.01.2024
2.	Shri. V. Raghuraman	Senior Administrative Officer
3.	Shri. T. Viswanathan	Administrative Officer has been promoted to the post of SAO w.e.f. 01.01.2025
4.	Smt. Prashanthi Chadrashekaraiah	Assistant Administrative Officer

5.	Smt. Pooja Kumari	Assistant Administrative Officer
6.	Ms. M. Sangeetha	Assistant Administrative Officer
7.	Shri. C. M. Mohan	Assistant Administrative Officer
8.	Shri. H. R. Surendra	Assistant Administrative Officer
9.	Shri. S. M. A. Ahmed	Assistant Administrative Officer
10.	Shri. K. M. Vijay Kumar	Assistant promoted to the post of AAO w.e.f. 01.06.2024
11.	Smt. Shylaja Chandrashekar	Assistant promoted to the post of AAO w.e.f. 28.03.2024
12.	Shri. P. Senthil Kumar	Assistant Administrative Officer CHES-Chettalli
13.	Smt. Annapurna Behera	Assistant Administrative Officer (Bhubaneshwar)
14.	Shri. Arun Kumar Barik	Assistant (Bhubaneshwar) promoted to the post of AAO w.e.f. 01.11.2024.
15.	Shri. Ajayan P	Private Secretary transferred from ICAR-Sugarcane Breeding Institute, Coimbatore to ICAR-IIHR, Bengaluru & reported to duty on 08.11.2024.
16.	Shri. M. V. Giri	Private Secretary
17.	Shri. S. Rajendran	Private Secretary
18.	Shri. S. Ravi Kumar	Private Secretary
19.	Smt. Suvasini Pradhan	Private Secretary
20.	Smt. Mubeen Taj	Personal Assistant
21.	Smt. M. Prathibha	Personal Assistant
22.	Smt. S. Sheela	Personal Assistan
23.	Smt. Veda Kurnalli	Personal Assistant (Hirehalli)
24.	Smt. S. Bhagyalakshmi,	Assistant
25.	Shri. V. R. Vinay	Assistant
26.	Smt. R. Shilpa	Assistant, Promoted
27.	Smt. K. C. Lakshmidevi	Assistant Promoted
28.	Shri. Mohit Ahlawat	Assistant (DR) reported to duty at ICAR-IIHR, Bengaluru on 11.09.2024
29.	Mr. Shashank Singh	Assistant (DR) reported to duty at ICAR-IIHR, Bengaluru on 13.09.2024
30.	Ms. Pushpa Rani	Assistant (DR) reported to duty at ICAR-IIHR, Bengaluru on 17.09.2024
31.	Mr. Vishal Singh	Assistant (DR) reported to duty at ICAR-IIHR, Bengaluru on 17.09.2024
32.	Ms. Romita Dey	Assistant (DR) reported to duty at CHES, Bhubaneshwar on 17.09.2024
33.	Ms. Anushna Mitra	Assistant (DR) reported to duty at ICAR-IIHR, Bengaluru on 20.09.2024
34.	Mr. Pujari Rajesh Ramesh	Assistant (DR) reported to duty at ICAR-IIHR, Bengaluru on 23.09.2024

35.	Ms. Sonam Singh	Assistant (DR) reported to duty at ICAR-IIHR, Bengaluru on 25.09.2024
36.	Mr. Nirmal Singh	Assistant (DR) reported to duty at ICAR-IIHR, Bengaluru on 26.09.2024
37.	Mr. Ashok Upadhay	Assistant (DR) reported to duty at ICAR-IIHR, Bengaluru on 27.09.2024
38.	Ms. Tejaswini C. Hanji	Assistant (DR) reported to duty at ICAR-IIHR, Bengaluru on 27.09.2024
39.	Ms. Tanvi Saini	Assistant (DR) reported to duty at ICAR-IIHR, Bengaluru on 30.09.2024
40.	Mr. Neelabh Pandey	Assistant (DR) reported to duty at CHES-Chettalli, Bengaluru on 30.09.2024
41.	Mr. Arpit Sharda	Assistant (DR) reported to duty at ICAR-IIHR, Bengaluru on 30.09.2024
42.	Ms. Sonu Bala	Assistant (DR) reported to duty at ICAR-IIHR, Bengaluru on 01.10.2024
43.	Mr. Mayank Churasia	Assistant (DR) reported to duty at ICAR-IIHR, Bengaluru on 03.10.2024
44.	Shri. L. Gangadareshwara	Upper Division Clerk
45.	Smt. R. Renuka	Upper Division Clerk
46.	Shri. G. S. Ramakrishna	Upper Division Clerk
47.	Shri. T. C. Jagadeesh	Upper Division Clerk
48.	Smt. V. Bindu	Upper Division Clerk
49.	Shri. B. Mallesh	Upper Division Clerk
50.	Ms. Sai Monicalakshmi	Lower Division Clerk
51.	Smt. M. Jayashree	Lower Division Clerk
52.	Shri. R. Prasanna Kumar	Lower Division Clerk

FINANCE AND ACCOUNTANTS

S. No.	Name	Designation
1.	Shri. K.G. Jagadeesan	Senior Finance And Accounts Officer
2.	Smt. L. Anuradha	JAO, promoted to AFAO w.e.f. 18.01.2024
3.	Smt. Rina Pattnayak	Assistant Finance And Accounts Officer (Bhubaneshwar)

SKILLED SUPPORT STAFF IIHR BENGALURU, FARM HIREHALLI, CHETTALLI, GONIKOPPA, BHUBANESHWAR

S. No.	Name	Designation
1.	Shri. Aveen	Skilled Support Staff
2.	Smt. K. S. Poornima	Skilled Support Staff
3.	Smt. Rathnamma B	Skilled Support Staff

4.	Shri. Hanumantharayappa	Skilled Support Staff
5.	Shri. N. Maruthi	Skilled Support Staff
6.	Shri. T. V. Lakshmaiah	Skilled Support Staff
7.	Shri. R. Ashok Kumar	Skilled Support Staff
8.	Shri. H. L. Shankar	Skilled Support Staff (Chettalli
9.	Shri. B. K. Ramesh	Skilled Support Staff (Chettalli)
10.	Shri. K. Mayandi	Skilled Support Staff (Chettalli)
12.	Shri. A. S. Narayana	Skilled Support Staff
13.	Shri. Abhimanyu Bhulugayan	Skilled Support Staff (Bhubaneshwar)
14.	Shri. Gagan Bihari Sundaray	Skilled Support Staff (Bhubaneshwar)
15.	Shri. Biswanath Paikaray	Skilled Support Staff (Bhubaneshwar)
16.	Shri. Bulu Kumar Maharana	Skilled Support Staff (Bhubaneshwar)
17.	Shri. Harihar Bindhani	Skilled Support Staff (Bhubaneshwar)
18.	Shri. Gobind Chandra Ranasingh	Skilled Support Staff (Bhubaneshwar)
19.	Shri. Gobinda Naik	Skilled Support Staff (Bhubaneshwar)
20.	Smt. Subasini Singh	Skilled Support Staff (Bhubaneshwar)

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18. Meteorological data during January-December 2024

ICAR-IIHR, Bengaluru

Month	Rainfall (mm)	Temperature (°C)		Relative humidity (%)		Evaporation (mm)	Mean wind speed (km h^{-1})
		Maximum	Minimum	08.30 hrs	13.30 hrs		
January	0.2	28.7	15.9	88.8	45.6	3.9	4.2
February	0.0	32.0	15.2	80.9	31.3	6.2	4.7
March	0.0	34.3	18.1	68.3	29.0	8.3	4.1
April	0.0	36.1	19.3	65.6	27.6	9.4	4.7
May	170.9	33.4	22.8	80.9	51.5	7.1	4.2
June	106.8	30.2	21.8	87.1	65.2	5.8	5.4
July	58.2	28.3	21.7	89.1	71.0	4.5	8.0
August	225.9	29.0	21.6	90.5	70.9	4.6	4.5
September	17.9	29.6	20.5	88.3	63.0	5.1	5.1
October	391.0	28.6	20.8	92.6	71.9	3.6	2.0
November	57.9	27.4	18.4	90.5	66.8	3.5	2.9
December	48.1	26.6	17.7	92.3	69.9	2.9	2.8

KVK, Gonikoppal, Kodagu

Month	Rainfall (mm)	Temperature (°C)		Relative Humidity (%)		Number of Rainy Days
		Maximum	Minimum	Maximum	Minimum	
January	2	29.3	17.1	99	40	1
February	0	32.5	16.4	99	22	0
March	0	33.7	19.1	100	27	0
April	14	34.6	20.7	87	35	2
May	291.5	31.1	21.1	100	57	13
June	452.5	27.2	20.5	100	76	19
July	879	25.7	20.3	99	79	28
August	215	27.6	20.5	100	70	16
September	55.5	27.5	19.6	100	68	6
October	67	28.9	19.8	100	60	4
November	49	29.0	18.1	99	54	2
December	62	29.8	18.0	99	53	2

CHES, Bhubaneswar

Month	Rainfall (mm)	Temperature (°C)		Relative humidity (%)		Evaporation (mm)	Mean wind speed (km h^{-1})
		Maximum	Minimum	07.00 hrs	14.00 hrs		
January	22.6	27.4	16.2	91	55	2.8	-
February	6.2	32.4	20.1	90	50	4.4	-
March	50.2	34.3	23.3	92	56	5.1	3.6
April	24.2	39.6	25.6	83	42	6.7	3.2
May	115.4	37.9	26.9	86	55	8.1	3.1
June	203.7	37.2	26.8	89	64	7.7	1.1
July	318.5	32.2	26.3	96	88	5.0	0.1
August	383.6	32.5	25.6	96	88	5.5	-
September	234.8	32.8	25.7	96	90	4.0	-
October	125.0	33.6	24.9	91	70	2.9	1.0
November	9.3	30.9	19.6	88	54	2.9	0.4
December	92.9	28.1	17.8	86	58	3.0	-

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Trainings and Field days organized by ICAR-IIHR in 2024

Off-Campus Training Programme on Scientific Cultivation of Avocado Organized by CHES, Chettalli

Capacity Building and Input Distribution Programme conducted at KVK, Surguja, Chhattisgarh

Field Day organized on Mandukaparni (*Centella asiatica*) at Kalasapur village, Gadag, Karnataka by ICAR-IIHR on 05.12.2024

Field Day on Marigold Hybrid Arka Bhanu Organized on 15.10.2024 in Tumkuru dist Karnataka

Training cum Workshop on "The Potential of Soilless Media for Vegetable Cultivation" organized in Lakshadweep Islands

Demonstration of Girdling Technology in Off-season Litchi organized by CHES (ICAR-IIHR), Chettalli on 13.12. 2024 at Laxmijala Estate, Madapura, Kodagu, Karnataka

Arka IIHR

भाकृअनुप
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