BOOK OF ABSTRACTS

Digital Horticulture for Food and Nutrition

H.P. Singh
D.K. Varu
J.S. Parihar
Dinesh Kumar
H. Choudhary

Junagadh Agricultural University (J.A.U.)
May 28-31, 2024

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H.P. Singh

D.K. Varu

J.S. Parihar

Dinesh Kumar

H. Choudhary

Amit Singh Memorial Foundation (ASM Foundation)

249, Vijayee Veer Awas, Sector 18-A, Dwarka, New Delhi-110078

Email:ltamitsinghfoundation@gmail.com

Website: www.lasm.org.in

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and
Vice Chancellor, Junagadh Agricultural University (JAU), Junagadh, Gujarat, India

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Dr. V.P. Chovatia
Vice Chancellor
Junagadh Agricultural University, Junagarh and
Chairman, Organizing Committee of the National Conference

Foreword

Horticulture, represented by fruits, vegetables including tubers, spices, medicinal and aromatic plants, mushroom, pollinators, and plantation crops, is not only fundamental to food and nutritional security of growing population but is critical to ecology, livelihood, environmental services and economic prosperity.The past decade has seen appreciable growth and development of horticulture due to change in policy and investment, which helped in achieving targeted production, reaching to the tune of 356 million tonnes from 28 million hectare. But the challenges ahead are much grater than before to meet the needs of 1.7 billion people, with decline land and water in the environment of threat from the climate change. It is estimated that 770 million of horticultural produce would be needed by 2047. Can we produce to meet the need? Answer would be difficult with current pace, demanding new technology and innovations.

Digital horticulture represents a transformative approach to enhancing the efficiency, sustainability, and profitability of horticultural practices through the integration of digital technologies. The digital horticulture has to aim at establishing a resilient, sustainable, and technologically advanced horticultural sector that leverages digital innovation to meet the contemporary demands of food production, environmental stewardship, and economic prosperity. The digital transformation of the horticultural sector presents an opportunity to achieve unprecedented efficiency, sustainability, and economic growth. By embracing digital horticulture, policymakers can spearhead a future where technology and horticulture work hand in hand to overcome the challenges of modern food production and environmental services.Thus the policy frameworks in digital horticulture must aim to modernise the sector, improve yield quality and quantity, and address the challenges posed by climate change and global food security.The policy measures should be Infrastructure, support for digital horticulture, research and development, financial incentive and support, regulatory framework, data governance, market access and supply chain Innovation. Policy may also address implementation strategy which should include stakeholder engagement, monitoring

In the digital horticulture, digital images and sensors are used in conjunction with integrated machine learning with the aims to improve industrial metrics such as, yield, profit and sustainability. These are expected to transform the commodity trading in the sector, purchase of inputs, and facilitate traceability of inputs and products. The technique used are Block Chain, IoT (Internet of things) and data information platform. The Block Chain is a type of distributed ledger that is used to capture, organise, and validate data in almost every aspect of Digital Horticulture, which needs IoT based data collection. In the system of digital horticulture, the crop management is tailored on information. Edge computing and machine learning capability are essential to improve data from IoT devices. A well architected Artificial Intelligence (AI) helps in achieving higher yields while optimising resource use efficiency, hence enabling farm to be more sustainable, viable and profitable. However, AI (Artificial Intelligence) has to be integrated with IA (Information Architecture). Digital marketing, is a promotion of brands to connect with potential customers using the internet in several forms of digital communication application tools. The digital marketing of horticultural activities could be a platform of content marketing, search engine optimisation (SEO), Search Engine marketing (SE) and social media marketing. There is a growing interest on digital horticulture, using e-platform for information exchange and management, not only for marketing but also for production system and value chain management using various types of data driven platform for decision making. Therefore, while digital horticulture provides a lot of opportunities and it also poses many challenges.

Recognising the needs for adoption of digital horticulture, to draw the lesson from past trend and develop strategies for larger adoption of digital horticulture, the **ASM Foundation,** New Delhi in association with **Junagadh AgriculturalUniversity**, Junagadh, is organising a **NationalConference on Paradigm and Dynamics ofDigital Horticulture for Food, Nutrition, andEntrepreneurship**. The conference will have the collaboration of Confederation of

Horticulture Associations of India, New Delhi, Trust for Advances in Agricultural Services, New Delhi, Jain Irrigation System Jalgaon, Dhanuka Agritech Ltd, Gurgaon and Pralsar Bio-product Pvt. Ltd., Jalgaon.

The conference has sought valuable inputs from all the stakeholders, through knowledge sharing for developing strategic recommendations to develop policy framework and understand the current status of digital horticulture. The conference will also analyse likely impact of digital horticulture on production and productivity of horticultural crops for Food, Nutrition, and Entrepreneurship, and how these challenges can be mediated through various technologies. Accordingly, the conference will address the challenge of digital horticulture through knowledge sharing. It is expected to enhance knowledge, identify technologically viable, futuristic research for improved food and nutrition. The conference is structured for presentation by leader in field of expertise, and deliberation on the issues in technological areas spread over 15 technical sessions. Besides, introductory and valedictory sessions, there will be an open session for industry, entrepreneurs and field functionaries. Subject in each session will be identified and moderated. The Panelist will be given enough time for sharing their views with power point presentation, to encourage the opinion and innovations. Individual expert will present in the form of poster and few selected abstracts will also have opportunity for oral presentation. Best oral and poster paper shall be evaluated by team of experts and selected one will be awarded.

The conference will host several key activities, including workshops, a Farmer's quiz, a Mango eating competition, the conferment of awards, and post-conference tours. "Shodh Chintan," a publication featuring expert articles on digital horticulture, will be released. We greatly appreciate your support in addressing the critical issues surrounding digital horticulture to promote Food, Nutrition, and Entrepreneurship. This Book of Abstracts compiles summaries of papers to be presented in various formats, such as Plenary lectures, Keynote lectures, oral papers, and poster papers, organised according to the plenary and technical sessions within the theme area.

To confront the challenges associated with coconut and mango cultivation, two workshops have been arranged for the 29th of May, 2024

1. National workshop on the Dynamics of Mango Production, Utilisation, and Strategies for addressing Challenges in Amrit Kaal
2. National workshop on the Dynamics of Coconut Production, Utilisation, and Strategies for addressing Challenges in Amrit Kaal

These workshops will feature four technical sessions, including Panel Discussions, spanning a broad spectrum of thematic areas. Each session will be highlighted by a panel of experts, including scientists, farmers, policy planners, industry representatives, and field functionaries. Distinguished experts will introduce the subjects of each session, leading to moderated discussions to derive meaningful outcomes. The workshops aim to engage over 150 farmers, offering them a unique chance to gain expert advice and insights.

Considering that horticulture is emerging as a key driver of development, there is a need for effective technology transfer through a revamped approach to extension services. Therefore, a National Workshop on Reorienting Extension Services for Horticulture through Digital Management has been organised. This workshop aims to discuss critical issues and develop a technical and policy framework for horticulture extension.

It is my pleasure to introduce this invaluable Book of Abstracts, which provides essential discussion points for developing a policy framework on digital horticulture. I extend my compliments to the team led by Dr. H. P. Singh, Chairman of CHAI, for their diligent work in compiling and editing this Book of Abstracts.

Dr. V.P. Chovatia
Vice Chancellor
Junagadh Agricultural University, Junagarh
Chairman, Organizing Committee

Preface

Since its establishment in 2001, the Amit Singh Memorial (ASM) Foundation has diligently pursued its mission, engaging in a wide array of activities beyond organizing conferences and Sangosthis. With a steadfast commitment to societal advancement, the Foundation has launched ten prestigious awards across various fields, aiming to foster societal growth comprehensively. Moreover, it has dedicated itself to championing the cause of India's farmers, spearheading initiatives to invigorate national agriculture and horticulture through farmer motivation. It is with great pride that I announce the ASM Foundation's receipt of the Institutional Excellence Award in 2017 from AIASA, New Delhi, in acknowledgment of its exceptional efforts in revitalising rural India by engaging youth in agricultural reform. Additionally, the CNRI, New Delhi, has honoured the late Amit Singh Memorial Foundation with the Appreciation Award in 2019, recognising its role in cultivating a patriotic society.

The Foundation acknowledges the pivotal role of leaders in agricultural and horticultural advancement through science, technology, and policy. It celebrates these contributions by bestowing awards such as the Amit Krishi Rishi, Amit Padam Jagriti, and Amit Prabudh Manishi on eminent figures in agriculture/horticulture. The Amit Udyan Ratna Award highlights innovative horticulturists who adapt technologies to local needs, driving positive change and inspiring their peers. The Amit Swah Award lauds contributions to human wellness, while the Amit Agrani Award encourages young scientists to develop innovative concepts with practical applications. Additionally, the Foundation recognizes underappreciated efforts in national projects with the Best Performing AICRP Coordinating Centre Award, and celebrates academic excellence with the Lt. Amit Singh Memorial Medal at Dr. YSR Horticulture University and Junagadh Agricultural University.

I'm thrilled to present the Book of Abstracts-2024, commemorating the 16th year of our esteemed national and global conferences, alongside the Swadesh Prem Jagariti Sangosthi. These gatherings persist in tackling vital issues, with this year's spotlight on the essential modernization within horticulture. We are hosting a pivotal national conference on the "Paradigm and Dynamics of Digital Horticulture for Food, Nutrition, and Entrepreneurship," in collaboration with Junagadh Agricultural University (JAU), Junagadh. This conference aims to serve as a premier forum for in-depth discussions and explorations into digital horticulture.

This edition of the Book of Abstracts, enriched with comprehensive abstracts for your information, exemplifies the dedication and meticulous effort of Dr. H. P. Singh and his team throughout its compilation and editorial processes. My deepest appreciation goes to them and all those who contributed to this invaluable resource. Their collective efforts are poised to greatly enrich all involved stakeholders.

Bimala Singh
Managing Trustee LASMF

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1.1 PLENARY SESSION-1 (HALL NO.-1)
PARADIGMS AND DYNAMICS OF DIGITAL HORTICULTURE TO ADDRESS THE CHALLENGES OF PRODUCING MORE WITH LESS

1.1.1 Paradigms in Digital Horticulture – A Prospective

H.P. Singh[1] and J.S. Parihar[2]

[1]*Former, DDG (Hort.), ICAR and Chairman, Confederation of Horticulture Associations of India New Delhi*

Email: hpsingh50@gmail.com

[2]*Former, Outstanding Scientist & Dy.Director, Space Applications Centre, ISRO, Ahmedabad*

Email: jsparihar@yahoo.com

Addressing the food and nutritional needs of a growing population remains a challenge, demanding a development strategy underpinned by science and technology, conducive environment, and efficient resource utilization.With the population's dietary needs, rising expandable income, urbanisation, and evolving health consciousness, it is estimated that 778 million tons of horticultural produce will be needed by 2047. The adoption of digital technology in horticulture is seen as a pivotal solution, offering versatile tools that are set to revolutionise the production of horticultural crops and ensure food and nutritional security.These technologies streamline numerous farming activities, including planning, financing, reporting, and monitoring operations and performances. The application of technology spans different segments of horticulture, from basic uses such as utilising mobile devices for technical assistance and farm monitoring, to more advanced implementations like employing satellites and Global Positioning Systems (GPS) for weather forecasting and field mapping, respectively. The past decade has witnessed significant evolution in digital horticulture, driven by the availability of high power and affordable computing systems and technologies such as IoT, AI, machine learning, blockchain, GPS, smartphones, drones, and sensors. This expansion in potential and accessibility is further complemented by focused government investments in digitization.As digital horticulture continues to develop, it promises to be a critical component in addressing the complex challenges of sustainable food production and ensuring the long-term prosperity of India's horticultural sector. Thus creating win-win situatuion to both producers as well as consumers, while ensuring cleaner environment and longterm sustainability.

1.1.2 Geomatics for Digitalisation of Horticulture

Jai Singh Parihar

Formerly- Outstanding Scientist and Dy.Director, Space Applications Centre, Indian Space Research Organisation, Ahmedabad, Gujarat, INDIA,

Email: jsparihar@yahoo.com

In order to meet the ever increasing and competing demand for food, fibre, nutrition and livelihood with limited and non-expandable agricultural land, digitalized horticulture may serve better the requirements of rapid expanding population, than traditional agriculture.However, continuous increasing cost of inputs, need for introducing traceability of inputs used as well as guiding judicious use of inputs, adaption of digital techniques in horticulture is the imperative.Geomatics comprising remote sensing, geographic information system (GIS), positioning & navigation systems popularly known as GPS, and Information &

communication technology (ICT) is a fully digital technology.It has potential to provide timely information about available land for horticulture, suitable sites for cultivation of a crop, area covered by a crop, condition of crop and expected crop yield even before the harvest.Geomatics can also support generation, as well as communication of information related to post harvest processing, value addition and supply chain.Some examples of crop area estimation, condition monitoring, production forecasting, site suitability analysis, supporting information needs for creating crop storage facility etc.with the use of geomatics are presented and discussed in this paper.

1.2 PLENARY SESSION-2 (HALL NO.-1)

PARADIGMS AND DYNAMICS OF DIGITAL HORTICULTURE TO ADDRESS THE CHALLENGES OF PRODUCING MORE WITH LESS

1.2.1 Digital Fast Track: Unveiling Plant Riches through Accelerated Bioprospecting

Sanjay Kumar
Agricultural Scientists Recruitment Board, New Delhi-110012
Email: sanjayplp1@gmail.com

The quest for novel plant-based resources holds immense potential for breakthroughs in agriculture and related fields.Traditional bioprospecting, however, often relies on manual exploration and chemical analysis, a slow and labor-intensive process.This presentation unveils how the integration of digital systems is revolutionizing the field, enabling researchers to identify valuable plant resources with unprecedented speed and accuracy.

The talk will explore a suite of digital tools and technologies transforming bioprospecting.Big data analysis plays a central role, allowing researchers to mine vast databases containing chemical properties, traditional knowledge, and ecological data.This empowers them to pinpoint promising plant species with a higher likelihood of harboring desired biomolecules.Machine learning further augments this process, learning from existing data to predict the presence of specific biomolecules within plant populations, guiding targeted collection efforts.

Remote sensing techniques add another layer of efficiency.By analyzing satellite and aerial imagery, researchers can identify vegetation characteristics that might indicate the presence of valuable bioresources.This prioritizes field exploration efforts, focusing on areas with a higher potential for success.Once promising plant materials are collected, high-throughput screening methods facilitated by digital automation can rapidly assess the biological activity of plant extracts, significantly accelerating the identification of potential leads.

By integrating these digital tools, researchers can create a streamlined bioprospecting pipeline.This not only reduces discovery time but also allows for more focused exploration, maximizing resource allocation.The presentation will showcase successful real-world applications of digital systems, highlighting cases where big data analysis, machine learning, and remote sensing have guided researchers to novel plant resources with exceptional medicinal or industrial applications.

1.2.2 Drone (Unmanned Aerial Vehicles) Technology – A Way Forward to Smart Horticulture

V. Praveen Rao
Former Vice Chancellor, PJTSAU, Hyderabad 500030
Email: velchalap@gmail.com

Rapid evolution of autonomous drone technology offers a new tool for making horticulture farming practices more efficient, equitable and less damaging to the environment at a time when agri-horticulture progress is critical to achieve food & nutritional security, climate change mitigation and SDGs target set by the global community.Autonomous drones can replace several farming tasks previously performed by satellites, manned aerial aircraft, ground-based spray equipment, and manual labour.From a business perspective, for small and marginal farmers who account for 85% of total agricultural land holdings in India, a key implication of Kisan drones lies in utilising this smart disruptive precision tool as a solution to ease resource and productivity constraints such as climatic risk, soil degradation, water scarcity, inefficient and indiscriminate fertilizer and agrochemical use, labour shortages and rising operational and production costs.Furthermore, for farmers, FPOs, crop consultants etc.who do not currently practice smart horticulture, field application of Kisan drones also becomes a gateway for future adoption of smart horticulture capabilities, delivered more affordably by autonomous drone technology.Adoption of Kisan drones by farmers and associated farm management and spraying practices (see Table 4) will have significant implications for agri-input value chain players, For example, it offers scope to agrochemical companies, to develop plant protection products and formulations to address the potential disruption as well as opportunities offered by drone spray technology.Agrochemical companies investigating product formulation requirements and the remote sensing capability of autonomous drone technologies are also pushing for an integrated platform between plant protection products and data driven solution offerings.Below are some examples of the agriculture drones that help to achieve the above goals in a better way.

1.2.3 Gaining Perspective of Indian Horticulture in Amrit Kaal using Digital Technology

Suresh K. Malhotra
Maharana Pratap Horticultural University
Karnal – 132001, Haryana
Email: malhotraskraj@gmail.com, vc.@mhu.ac.in

India has made rapid pace in Agriculture after independence and now ranks in top positions in the world in production for many of the agricultural including horticultural items.Horticulture production increased from 25 million tonnes in 1950-51 to355.2 million tonnes (2nd estimates) in 2023-24.Though we have become self-sufficient for many important crops, but further increasing production and productivity for sustaining upcoming future populationis a major challenge before us that too in the event of climate change.With the increasing awareness and rising income, consumers are asking for more diversified and nutritious diets, has led to high demand for horticultural products.In the current scenario, timely access, affordability and efficiency of agricultural information is very crucial for raising agricultural productivity.

It is evident that digital technology witnessed extremely useful scenario for farmers for getting an easy access to customized digital information in horticulture regarding improved varieties and hybrids, high quality seeds and planting material, alternate cropping systems, plant health and nutrient management, input management, marketing, export, import and entrepreneurship.There have been some successful initiatives of digitalization in Indian horticulture such as ITC e-Choupal, Nagarjuna i-Kisan project (Andhra Pradesh), Amul honey Collection Centres (Gujarat), Knowledge Network for Grass-root Innovations –Society for Research and Initiatives (SRISTI) (Gujarat) and many others.There has been paradigm shift in digitalization with advent of smart mobile phones.Mobile telephone is the most influential tool to disseminate information to farmers.The push and pull SMS, interactive voice response system (IVRS), mKisan and Kisan Call Centres (KCC) are the mobile telephony initiatives to cater to the diverse need of farmers and information dissemination.To harness the potential of mobile telephony under National e-Governance Plan-Agriculture (NeGP-A), Ministry of Agriculture and Farmers Welfare has launched various modes of delivery of e-enabled services.

Indian agriculture is very complex in nature and facing many challenges such as shrinking farm size, high dependence on monsoon, low credit flow towards small and marginal farmers, low flow of information, declining soil health and less water use efficiency.Given this complexity of agriculture, the challenges are more for food, nutrition and income security, where digital technology can play a greater role.Digitalization in horticulture sector has a great potential to bring about significant innovation and transformation.The adoption of digital technologies can help India to increase crop productivity, reduce waste, post harvest losses, increase agricultural export, enhance farmers' income, and improve food and nutrition security.Apart from this, it will help in protecting environment and sustainable development of horticulture in particular and agriculture in general.The study estimates that India will be home to 900 million internet users by the end of 2025 and that 56% of the 141 million new netizens will be from rural India.The increase in internet and mobile phone penetration in India has exhibited a significant impact and now Indian agriculture is ready for digital transformation.

Digital technologies can help farmers make better decisions, increase productivity, and reduce the environmental impact of agriculture.Some of the important areas of digitalization are weather monitoring and forecastingcan help farmers make informed decisions about planting, harvesting, and irrigation; precision farming digital technologies such as GPS, drones, and remote sensing can help farmers optimize the use of resources such as water, fertilizers, and pesticides.This can reduce input costs and environmental impact while increasing yields.Digital platforms can help farmers monitor crop growth and detect pests and diseases early. This enables them to take timely action and reduce crop losses.Digital platforms can help farmers access markets and get fair prices for their produce. For example, e-commerce platforms can connect farmers directly with consumers, cutting out intermediaries.Digital tools can help farmers collect, store, and analyze data on crop yields, weather patterns, soil health, and other factors.This information can inform decision-making and improve farming practices over time. Digital platforms can help farmers manage their farms more efficiently.For example, farm management software can help farmers plan tasks, track inputs and outputs, and manage labour and equipment.

The information technology can play a very crucial role in digitalization of horticulture and thus by disseminating location specific and timely information to farmers to help them make better and well-informed decisions.Government of India is running many schemes to make agriculture digital, smart and also to increase farmer's income; mainly Soil Health Card Scheme, Pradhan Mantri Fasal Bima Yojana, Pradhan Mantri Krishi Sinchai Yojana, Paramparagat Krishi Vikas Yojana, National Agriculture Market, Micro Irrigation Fund, Rainfed Area Development Programme.These programs are being executed and managed digitally.Special emphasis is being given on electronic and mobile app-based agriculture.Sensors, Internet of Things (IoT), data collection, data analysis tools and IT systems-based agriculture have just started in India.India will have to understand the challenges and possibilities associated with digitalization and smart agriculture and formulate policies to further extend benefits of digitalization to remaining farm families.

The appreciable growth and expansion of horticulture reflects its increasing significance in India's development landscape.This sector provides diverse range of opportunities for nutritional and income security, including fruits and nuts; plantation crops; vegetables, root and tuber crops; medicinal and aromaticplants; floriculture and landscapes; mushrooms, and bee keeping.Environmental sustainability drive the adoption of eco-friendly practices in horticulture for organic farming and integrated pest management.The information driven horticulture can help in addressing the challenges through adoption of alternate horticulture based cropping patterns to combat erratic weather, extreme weather events and adapting to climate smart practices.The other emerging concerns of water scarcity and limited arable land demanding digitalized precision horticulture advisory based innovative approaches like water efficient irrigation practices, multilayer cropping and vertical farming.Various customized apps can guide for utilization of cold chains, cold storage and transportation infrastructure can reduce post-harvest losses.The small and marginal farmers often face challenges in getting good price and accessing markets, especially international ones.The FPO's, SHG, state cooperatives, multistate cooperatives, and e-commerce platforms offer better solutions.In recent times, digitalization has proved useful in the dissemination of right information to needful farmers at right time.However, with the advent of innovative technologies like GPS, sensors, and drones help farmers optimize resource use by providing real-time data for right decision making.

According to an estimate about 696 million ton of horticultural produce shall be needed by 2050 which covers the Amritkaal period starting from 2023 till 2047.Amritkaal has been envisioned as an era of options and opportunities, innovation-based modernization, and planned transformative growth for Indian horticulture.A timeframe of about 25 years, encourages us for formulation and implementation of strategies for food and nutritional security that balance economic development with environmental conservation.Horticulture needs to be productive and sustainable based on climate smart resilience to meet huge demand for 1.6 billion health-conscious population.Confederation of Horticulture Associations of India jointly with NAAS organized a discussion in 2023 to suggest strategies which includes digitalization also where technology integration is important with Internet of Things (IoT), artificial intelligence (AI), sensor utilization, and automation to enhance production efficiency, monitor crops, and manage resources optimally and implementing of precision agriculture practices to maximize yields while minimizing resource consumption.This involves targeted use of inputs, precise monitoring, and adaptive management techniques.Though it appears to be ambitious to meet targets of horticulture production of 696 million tonnes by 2050 but our past achievements have builtup our confidence and strategy worked out needs to be pursued in a serious manner of implementation to achieve short, medium and long term goals of sustainable development of horticulture.

1.3 PLENARY SESSION-3 (HALL NO.-1)

PARADIGMS AND DYNAMICS OF DIGITAL HORTICULTURE TO ADDRESS THE CHALLENGES OF PRODUCING MORE WITH LESS

1.3.1 Digitalisation of Education with Special Reference to Horticulture

P.S. Pandey
Vice-Chancellor
Dr.Rajendra Prasad Central Agricultural University, Pusa, Samastipur
Email: vc@rpcau.ac.in

Digital horticulture education leverages digital technologies to provide a dynamic and accessible learning experience for individuals interested in the science and art of plant cultivation.Through online courses, webinars, and interactive platforms, digital horticulture education allows learners to access a wealth of information on topics ranging from botany and soil science to precision agriculture and sustainable practices.Integrating virtual labs, IoT simulations, and interactive content, this form of education fosters a practical understanding of horticultural concepts.Also, digital horticulture education facilitates global collaboration, enabling students and professionals to connect, share knowledge, and stay updated on industry advancements.The flexibility of online learning platforms caters to diverse audiences, offering the convenience of self-paced learning while incorporating innovative tools to enhance engagement and comprehension in the field of horticulture.

Keyword: Digital horticulture, digital technologies, Digitalisation of Education

1.3.2 Digital Technology for Efficient Management of Abiotic Stresses

Anil Kumar Singh
National Academy of Agricultural Sciences
New Delhi-110012, India
Email: aksingh.icar@gmail.com

Crop production is an integrated outcome of soil-water-nutrient-plant-atmospheric interactions and conventional approach will not be able to enhance productivity in a sustained manner as each component of this complex system is influenced differentially by the various external factors as well as the availability and quality of natural resource base.The latest data indicate that in 2023 (hottest year on record) the annual CO_2 concentration exceeded 420 ppm and earth warmed up by more than 1.4°C compared to 1850.It has also led to an increase in the uncertainty associated with onset, intensity and distribution of rainfall.Global warming has also resulted in the country experiencing extreme events on 86 percent of the days in 2022 and 2023.Abiotic stresses can reduce crop production anywhere between 50 to 70 percent.Additionally, abiotic stress like water stress, nutrient deficiency, radiation intensity, humidity changes, can also affect insect pests and plants diseases significantly. Therefore, there is an urgent need to adopt new tools and technologies that will enhance production per unit input in an eco-friendly and sustainable manner.Precision farming was the first development using RS, GIS, GPS and sensor technology for maximizing production after taking due care of spatial and temporal variability.With development of tools like artificial intelligence (AI), machine learning (ML), deep learning (DL), unmanned aerial vehicles (UAVs-drones) drones, wireless sensors, and internet of things (IoT), robotics etc.the future lies in digital agriculture.It has the potential to make the agriculture production systems more productive and sustainable concomitantly with efficient use of time and resources.It will enable the farmers to take decisions in real time and reduce the drudgery involved in day-to-day farming operations.Sharing of information among various organizations involved in the whole process will create opportunities for development of disruptive interventions.Digital agriculture takes care of the entire chain from sowing to harvest, processing & value addition, marketing and finally the consumers.Since digital agriculture is technology based, the initial investment would certainly be on the higher side but long-term gains through its adoption will be offset by long term multiple benefits.The abiotic stresses are not only confined to high temperature or drought but also include stresses related to radiation, pollutants, cold waves, water logging (flooding), salinity and nutrient deficiencies.This paper reviews the impact of abiotic stresses on crop production, highlights the solutions available and how digital technology can enhance crop production as well as benefit all stakeholders.

1.3.3 Digital Agriculture and Horticulture in India: Initiatives, Challenges and Opportunities

Babita Singh, Neelam Patel and Kavibharathi P.
NITI Aayog, Govt.of India, New Delhi
Email: drbabita9@gmail.com

India's agricultural landscape is witnessing a pivotal shift propelled by technological breakthroughs and digital interventions.The Initiative for Digital Agriculture stands at the forefront of this change, targeting a comprehensive transformation.This initiative harnesses digital technologies to amplify production, productivity, ensure sustainability, and bolster market reach.Given horticulture's substantial 33% contribution to agriculture's Gross Value Added (GVA) and the production of 355.25 million tons of produce in 2023-2024 (as per 2023-2024 1st Adv.Est.), its integration with digital solutions promises significant benefits.Technological advancements supporting this digital revolution in horticulture encompass remote sensing, Internet of Things (IoT) devices, drones, blockchain, and data analytics.These tools provide crucial insights into crop health, streamline resource allocation, and enable real-time monitoring, thereby enhancing yields and promoting sustainable practices.Furthermore, digital platforms and mobile applications are pivotal in granting farmers access to market intelligence, expert advisory services, and e-commerce avenues.India's digital agriculture and horticulture strategies prioritize four key objectives: broadening information access, optimizing resource utilization, fortifying market connections, and empowering farmers through digital education and training.Despite remarkable achievements, challenges like uneven internet access, data privacy issues, and sustainability concerns persist.Initiatives are actively addressing these challenges while ensuring the inclusivity of all farming communities.

The progression of India's digital agricultural ecosystem is a confluence of government-led efforts, technological progression, and heightened digital platform engagement.This evolution spans from disseminating information via official portals to emphasizing efficiency, transparency, and novel market engagements.Government schemes such as e-NAM, PMKSY, NHM, and NeGPA exemplify the synergy between technology and agriculture, driving productivity, profitability, and sustainability.The Digital Agriculture Mission aims to encourage and speed up projects based on cutting edge technologies.In summation, India's strides in digitalizing agriculture are commendable, yet the sector harbours untapped growth potential.The nation's dedication to fostering digital agriculture through diverse government schemes, collaborations with tech enterprises, and support for start-ups hints at a bright and promising future.

Keywords: Digital agriculture, horticulture, technological innovations, Internet of Things, drones, blockchain, market access, sustainability, Government initiatives, India

1.3.4 Applicationof Digital Technology in Plant Protection

P.K. Chakrabarty
Formerly, Member (Plant Sciences), ASRB and ADG (Plant Protection & Biosafety)
ICAR, DARE, Ministry of Agriculture and Farmer's Welfare, GoI New Delhi
Email: pranjibc@gmail.com

Over the decades, increasing demands for diverse agri-food products have significantly influenced global agricultural patterns.Factors such as changing lifestyles, growing populations, and urbanization have directly affected the production and consumption of these products.A major concern for the future of the agri-food sector is whether scientific advancements can sustainably and effectively feed the global population by 2050.Digital technology offers promising solutions, potentially revolutionizing food production in critical

regions worldwide.The term "digital technologies in agriculture" generally refers to technologies that expand data collection in the field, incorporating artificial intelligence, connectivity protocols, and automation.These technologies simplify numerous agricultural operations, including planning, financing, reporting, and monitoring.Digital technologies are employed across various segments of farming, from farm equipment and animal handling facilities to agronomy and communication.They range from basic applications, such as using mobile devices for technical assistance and farm monitoring, to more advanced implementations involving satellites and GPS for weather prediction and field mapping.The origins of Digital Agriculture (DA) date back to the mid-20th century when computers were first used to analyze farm data and satellites to monitor crop growth.However, DA has truly come into its own in the 21st century, thanks to the availability of powerful, affordable computing systems and technologies like GPS, smartphones, drones, and sensors.The paper explore for use of digital agriculture in management of insect pests

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PLENARY SESSION-4 (HALL NO.-1)

NATIONAL WORKSHOP 1

Reorienting Extension Services for Horticulture through Digital Management

Extension services in horticulture play a crucial role in disseminating knowledge, technologies, and practices to farmers, aiming at improving productivity, quality, and sustainability.However, traditional extension methods often face challenges such as limited reach, resource constraints, and the inability to provide personalised advice. Integrating digital technologies into extension services can overcome these challenges, offering scalable and efficient solutions to meet the diverse needs of horticultural producers. Reorienting extension services for horticulture through digital management presents a transformative opportunity to modernise agricultural support systems, making them more responsive, inclusive, and effective.By harnessing the power of digital technologies, we can empower horticultural producers to achieve higher productivity, sustainability, and economic growth.

Objectives of the panel discussion

1. **Enhance Reach and Accessibility**: To expand the coverage of extension services to reach a larger number of horticultural producers, including remote and underserved areas.
2. **Improve Timeliness and Relevance**: To provide real-time, crop-specific, and location-specific agricultural advice to farmers, thereby increasing the effectiveness of extension services.
3. **Facilitate Knowledge Sharing and Collaboration**: To foster a community of practice among horticultural producers, researchers, extension workers, and other stakeholders through digital platforms.
4. **Promote Data-Driven Decision Making**: To leverage digital tools for collecting, analyzing, and utilizing data for informed decision-making and personalized extension services.
5. **Enhance Capacity Building**: To utilize digital learning platforms and tools for the continuous professional development of extension workers and farmers.

Strategies

1. **Digital Platforms and Mobile Applications:** Develop and deploy mobile apps and web platforms that offer advisory services, market information, weather forecasts, and pest and disease management tips.
2. **Remote Sensing and Geographic Information Systems (GIS)**: Utilize remote sensing technology and GIS for precision agriculture, including crop monitoring, soil health assessment, and resource

mapping.

3. **Social Media and Communication Technologies**: Leverage social media, SMS, and instant messaging services for rapid dissemination of information and interactive communication.

4. **E-Learning and Capacity Building Modules**: Create online courses, webinars, and interactive modules for skill development and knowledge upgradation of farmers and extension workers.

5. **Data Analytics and Artificial Intelligence**: Implement AI and data analytics to analyze farm data, predict agricultural outcomes, and provide customized advice.

Implementation Plan

- Phase 1: Needs Assessment and Stakeholder Engagement: Conduct surveys and workshops with farmers, extension workers, and other stakeholders to identify needs, challenges, and opportunities for digital extension services.
- Phase 2: Technology Development and Piloting: Develop digital tools and platforms tailored to the needs of horticultural producers and pilot them in selected areas to assess their impact and effectiveness.
- Phase 3: Capacity Building and Training: Organize training sessions and provide resources to extension workers and farmers on how to effectively use digital technologies.
- Phase 4: Scaling and Evaluation: Scale up successful digital extension services to wider areas, continuously monitor their impact, and make iterative improvements based on feedback and outcomes.

Expected Outcomes

- Increased adoption of best practices in horticulture, leading to improved crop yield, quality, and sustainability.
- Enhanced knowledge and skills among horticultural producers and extension workers through continuous learning and capacity building.
- A robust network of horticultural stakeholders actively engaged in knowledge exchange and collaborative problem-solving.
- Data-driven insights and recommendations guiding horticultural practices and policy-making.

Conclusion

Reorienting extension services for horticulture through digital management presents a transformative opportunity to modernise agricultural support systems, making them more responsive, inclusive, and effective.By harnessing the power of digital technologies, we can empower horticultural producers to achieve higher productivity, sustainability, and economic growth.

1.4.1 Re Orienting and Re Focusing Farm Extension Services for Efficient Delivery of Horticultural Technologies: A Way Forward

V.V. Sadamate

Agricultural Extension Specialist and Former Adviser Agriculture
Planning Commission (Now NITI Aayog), New Delhi
Email: sadamatevv@gmail.com

The horticulture sector significantly contributes to the Gross Value Added (GVA), with 356.05 million tonnes (MT), including fruits (140 MT), vegetables (166 MT), and other horticultural products (25 MT).Both public and private sectors play essential roles in transferring technology to farmers and stakeholders.Furthermore, the sector is vital for nutritional security at the household level, as fruit and vegetable consumption is on the rise across different population segments.Originating as an academic discipline in Sabour, Bihar, and later developed by the Indian Agricultural Research Institute (IARI) in New Delhi, the structure, scope, and content of Agricultural Extension delivery models have seen substantially reformed over a period of time.These models include State Farm Universities & Krishi Vigyan Kendras (KVK) outreach, various Development Departments through central schemes, Commodity Boards, private sector providers, farmer-led initiatives (FOs, FPOs, Co-ops), NGOs, media platforms, financial institutions, and the use of internet and social media.Each model plays a unique role depending on the agro-climatic context.Challenges in horticultural extension include policy support, investment, location-specific technologies, manpower, outreach, inclusion of women and youth, public-private partnerships, quality of planting materials, training, marketing, and the use of ICT and advanced technologies.There is an urgent need to reevaluate extension services in the horticulture sector to address the varying performance and needs of producers, the role of the private sector, marketing and export opportunities, timely advisories, the involvement of FPOs-FPCs, enhanced outreach, the impact of media and technology, and effective value chain management.Further, strategies to strengthen extension services in horticulture would include promoting commodity-specific FPOs, integrating advanced ICT applications (like AI, ML, drones, sensors, robotics, data analytics), scaling up successful models through PPPs, revisiting R&E linkages, organizing interfaces between research organizations and stakeholders, capacity building, potential mapping, expanding outreach, improving marketing linkages, and promoting high-tech horticulture.Additionally, there's a call for regular monitoring and evaluation of horticultural programs to focus on outputs, outcomes, and impacts.

1.4.2 Reorienting Extension Services for Horticulture through Digital Management

N.B. Jadav
Director of extension Education
Junagadh Agricultural University, Junagadh – 362001

Extension and Advisory Services (EAS) are delivered by millions of extension professionals representing the public, private and civil society located across the globe and have been helping in addressing farmers' needs over the years.A fundamental change in agricultural support systems is the redirection of extension services for horticulture through digital management.With the rapid advancement of digital technologies, there is an unprecedented opportunity to revolutionize how knowledge and resources are disseminated to farmers.This transformation involves the integration of various digital tools and platforms to streamline communication, enhance access to information and provide tailored support to horticulture practitioners.At the core of this paradigm shift are mobile applications like Green veg, Ugaoo etc.designed specifically for the horticulture sector.These apps serve as comprehensive resources for farmers, offering guidance on crop management practices, pest and disease identification, weather forecasting, market trends.By harnessing the ubiquity of smartphones, extension workers can reach a wider audience and deliver timely advice directly to farmers' fingertips.In addition to mobile apps, online platforms play a crucial role in digital management of extension services.These platforms serve as virtual hubs where farmers can access training materials, participate in webinars and engage in peer-to-peer knowledge sharing.Furthermore, they facilitate the collection and analysis of data, enabling extension workers to identify emerging trends, monitor the effectiveness of interventions and make data-driven decisions.Virtual training sessions represent another key component of digital management in horticulture extension services.By leveraging video conferencing tools, extension workers can conduct interactive training sessions on various topics such as sustainable farming practices, integrated pest management, and post-harvest handling techniques.These virtual sessions not only reduce the logistical challenges associated with in-person training but also allow for greater flexibility and scalability.Moreover, digital management enables extension workers to provide personalized support to farmers based on their specific needs and circumstances.

Keywords: *Horticulture, Extension Services, Digital technology*

1.4.3. Dynamics and Paradigms in extension for its Adaptation in Horticulture

S.V. Suresha
Vice Chancellor, University of Agricultural Sciences
Bangalore-560065, Karnataka
Email: vc@uasbangalore.edu.in

India's successful journey toward food self-sufficiency, highlighted by the Green Revolution of the 1960s, has been complemented by recent efforts to achieve nutritional security through the Golden Revolution, focusing on horticulture. Fruits and vegetables are vital to modern diets, offering essential vitamins, minerals and fiber. To meet both domestic demand and international market opportunities, agricultural extension services need to adapt, providing horticultural farmers with tailored information and market insights to guide crop production.

During 2021-22, India's horticulture production reached 347 million tonnes across 28 million hectares and estimated horticulture production for 2022-23 is 352 million tonnes. Since India's independence, horticulture production has surged fourteen fold, contributing significantly to the nation's move from food security to nutritional security. The sector now accounts for about 33 per cent of the agricultural GDP despite covering only 18per cent of cultivated land. Overall, horticulture contributes over Rs. 10 lakh crores annually to the national economy.

Digital interventions are proving to be transformative tools, promoting innovation across horticulture, with numerous initiatives in place to facilitate this transition. Karnataka, one of India's leading horticultural states, has been at the forefront of adopting digital agriculture, a modern farming approach that leverages digital technologies and data analytics to optimize agricultural practices. The state's Department of Horticulture and State Agricultural Universities (SAUs) collaborate with farmers, entrepreneurs and technology firms to develop digital solutions that can boost horticulture. The government invests heavily in infrastructure and training to help farmers embrace these technologies. The digitalization initiatives like e-SAP modules and online e-Books detailing horticultural practices were effectively implemented in the state.

University Krishi Vigyan Kendras (KVKs) have partnered with District Agro Meteorological Units (DAMU) to provide timely weather forecasts and horticultural advisories to growers. Additionally, the All India Coordinated Research Project (AICRP) on Agrometeorology at the University of Agricultural Sciences, Bangalore, offers farmers detailed weather advisories and cropping recommendations.

Several key projects under the National Horticultural Mission, such as e-NAM, and the Mission for Integrated Development of Horticulture, have already demonstrated the potential of Information and Communication Technology (ICT) to revolutionize extension services. Complementing these national initiatives, UAS Bangalore has pioneered impactful ICT-based solutions like e-Krushi Agritech Portal, Agri War Unit, and the use of drone technology. Also, WhatsApp messages were sent with timely information to a large number of farmers' group to support decision-making.

Challenges persist in the horticulture value chain due to the perishability of products and logistical constraints. Addressing these requires an effective framework for ICT development and information dissemination. Emerging technologies such as Robotics, Automation, Artificial Intelligence and Machine Learning can significantly enhance the effectiveness of extension services, providing farmers with the tools to increase productivity and ensure a sustainable economic future.

Exploring these dynamics and paradigms, examining how ICT interventions can transform extension in horticulture through knowledge sharing and collaboration among stakeholders, one can aim at identifying best practices and innovative strategies to meet the evolving needs of the horticulture sector, ultimately contributing to food& nutritional security and entrepreneurship in the country.

2. TECHNICAL SESSION-2 (HALL NO.-1)

NEW PARADIGMS IN RESEARCH AND DEVELOPMENT FOR DIGITAL HORTICULTURE

2.1 Keynote Lecture

2.1.1 Prospects of Digital Horticulture in Gujarat

A.R.Pathak*[1], D.K.Varu[2], P.A.Pandya[3]
1.Former Vice Chancellor, Junagadh Agricultural University, Junagadh & Navsari Agricultural University, Navsari, Gujarat- 362001
2.Professor 3.Assistant Professor, Junagadh Agricultural University, Junagadh, Gujarat
Email: arpathak1949@gmail.com

Digital technology is revolutionising horticulture by offering innovative solutions to improve productivity, efficiency, and sustainability.This paper explores the diverse applications of digital technology in horticulture, ranging from precision agriculture and smart irrigation to crop monitoring and market analysis.Through a comprehensive review of literature and case studies, it highlights the benefits, challenges, and future prospects of digital technology adoption in horticultural practices.In Gujarat, India, where agriculture plays a crucial role in the economy, the adoption of digital horticulture practices has gained momentum.This research article explores the impact of digital technologies on horticulture in Gujarat, highlighting the benefits, challenges, and future prospects.Through a comprehensive review of existing literature, government initiatives, and case studies, this paper provides insights into how digitalisation is transforming horticultural practices in Gujarat and its implications for sustainable agriculture.

Keywords: Digital Horticulture, Gujarat, Precision Horticulture, IoT, AI, Technology, Sustainable Development

2.1.2 Leveraging IoT and AI-Based Technologies for Precision Horticulture

H.D. Rank*, R.J. Patel and P.H. Rank
Department of Irrigation & Drainage Engineering
College of Agricultural Engineering & Technology
Junagadh Agricultural University, Junagadh, Gujarat
Email: hdrank@jau.in

Precision horticulture, a contemporary agricultural method, emphasizes meticulous crop production management using advanced technologies and data-driven techniques.This approach involves precise monitoring and manipulation of environmental factors such as soil moisture, temperature, and nutrients to promote optimal plant growth and health.By employing sensor networks, drones, and satellite imaging systems, farmers can collect real-time data on crop conditions, enabling tailored irrigation, fertilization, and pest control strategies that minimize waste and maximize productivity.As the demand for precision horticulture grows, driven by IoT and AI technologies, it becomes imperative to intensify efforts in research and innovation.This need is underscored by increasing population pressures, changing climate conditions, and evolving agricultural landscapes.Effective collaboration among researchers, industry stakeholders, policymakers, and funding agencies is crucial to overcome challenges related to scalability, accessibility, data privacy, and regulatory frameworks.Interdisciplinary research that integrates agronomy, computer science, data analytics, and social sciences is vital for developing comprehensive solutions that cater to the diverse needs of farmers globally.By prioritizing sustainability, equity, and resilience, precision horticulture research and innovation can ensure that technological advancements benefit all stakeholders and contribute to broader food security and environmental objectives.Fostering a culture of innovation, collaboration, and responsible stewardship will maximize the transformative potential of IoT and AI, shaping a sustainable and resilient future for agriculture and society.

Keywords: IoT, Artificial Intelligence, Precision Horticulture, Crop Production, Agriculture, Smart Farming, Sensor Networks, Data Analytics

2.1.3 Digital Horticulture– An Experience from Telangana

B. Neeraja Prabhakar
Sri Konda Laxman Telangana State Horticultural University
Mulugu, SiddipetDist-Telangana, 502279
Email: vcskltshu@gmail.com

Indian Horticulture sector has been the mainstay of Indian Agriculture with a contribution of about 30 per cent to the agricultural GDP from about 14 per cent area and 40 per cent of total export earnings in agriculture as a whole.Horticulture production has increased 13-folds from 25 million metric tons during 1950-51 to 355.25 million tonnes during 2022-23 surpassing food grain production.In recent years, horticulture has emerged as a key sector in India's agricultural landscape, with a focus on increasing production, improving quality and by reducing wastage through value addition.

In view of prevailing critical challenges *viz*., Climate change, food security, food safety, and sustainability, innovative technologies like precision horticulture and digital horticulture are occupying a predominant place in recent times.Hence to meet the current challenges, **Digital horticulture** with recent advancements such as Robotics, Artificial intelligence (AI), sensor-based solutions Cloud Computing, Internet of Things,

Computational Intelligence and Big Data, *etc*., are leading to the fourth stage of revolution in the agricultural sector known as Agriculture 4.0.

Precision farming is a management concept based on observation and response to intra-field variations.New technologies such as Global Positioning Systems (GPS), sensors, satellite/aerial images and Geographical Information Systems (GIS) are utilized to assess and analyze variations in horticultural production.

Utilizing big data analytics, artificial intelligence, and machine learning algorithms to analyze farm data in Horticulture which enables to optimize decision-making processes and improves overall operational efficiency and productivity.The prominent initiation by the Horticultural University, Telangana under digital horticulture is having collaboration with Samhitha Crop Care Clinics, a unique, precision farming advisory focussing exclusively on low yielding citrus orchards.The most unique features of Samhitha Crop Care Clinics includes Digital Tree Health Audit (DTHA), Unmanned Aerial Vehicles (UAVs) fitted with advanced multi-spectral digital cameras to inspect the citrus orchards.In addition to this, soil and weather sensing gadgets were used to monitor irrigation and drainage requirements of the plants and also in monitoring insect pests and disease.

Drones are unmanned aerial vehicles (also known as UAVs), which are used for surveillance in various industries.Drones have great potential to transform Indian Horticulture.Drones are being employed for various operations in aerial surveillance, mapping, land inspection, monitoring, spraying fertilizers, checking for diseased or rotting crops, and much more.The practical application of drones in horticulture in Telangana was documented in spraying of pesticide in vegetable crop fields and orchards.

Smart Irrigation/Fertigation is another component of digital horticulture in which IoT-enabled devices will enable farmers to monitor soil moisture levels in real-time and apply precise irrigation techniques.This not only conserves water but also improves crop health and optimizes resource allocation.

Under Smart irrigation, Sri Konda Laxman Telangana State Horticultural University (SKLTSHU), has initiated experiment in regulation of irrigation in Grape wherein it was concluded that Regulated deficit irrigation (RDI) Technology in grape cv.Thompson Seedless grafted on Dogridge was standardized for Telangana state at Grape Research Station, Rajendrangar.Irrigation applied to the grape vines at the rate of 60 % evaporation replenishment (ER) at shoot growth and berry setting to harvest and at the rate of 20 % ER at bud differentiation and development, bloom to shatter stage have saved amount of water (46 %) without affecting yield and quality over conventional method of drip irrigation with 80 % ER at all growth stages.Similarly, stage wise fertigation scheduling with 80% RDF (400 kg N, 400 kg P_2O_5 800 kg K_2O/ha/year) at different growth stages *viz*., 1-30 days (30% N), 31-60 days (60% P_2O_5) and 61-120 days (30% K_2O) after back pruning; 1-40 days (30% N), 41-70 (30% P_2O_5), 71-105 (30% N and 30% K_2O), 106 days to harvest (30% K_2O) after forward pruning along with 10% each of N, P_2O_5 and K_2O at rest period can save 20% fertilizers without affecting yield and quality in Grape variety Thompson Seedless grafted on Dogridge rootstock.

Another digital innovation from SKLTSHU is an mobile app by name, e-Short, It is mobile based app for providing advisories services to the farmers.After downloading the app from play store, the farmer after entering his details such as name, mobile no., email ID, village, mandal & district, he will get one time OTP from which he can login to the app.In this app farmer can find major fruit crops and vegetable crops of Telangana State along with pictures of insect and pest damages and nutritional disorders.Farmer can correlate the problem identified in the field and can correlate with the features.If not resolved or not identical, a voice message describing his problem along with photographs of the field.This app will be helpful in providing real time solutions to horticultural farmers of Telangana State.

Hence, digital horticulture is essential for farming businesses to stay data-driven, efficient, and resilient to meet the increasing food demands. Even though digital technology application helps in solving several pain-points across the spectrum of traditional agriculture value chain, it is still at a nascent stage in developing countries like India.Hence digital horticulture further needs integrated and sustainable efforts for implementing in a large scale by creating wide scale exposure and awareness to educate the scientific community/ students/ educated unemployed youth/farmers and the stake holders in the field of advanced farming technologies so as to have a symbolizing balance between traditional knowledge, information management and innovative technologies.

2.1.4 Digital Tools and Technologies for the Vegetable Seed Production

Jaysing C.Rajput, Yogesh V.Lokhande, Kishor R.Patole and Bhausaheb P.Jadhav

Nirmal Seeds Pvt.Ltd.

P.O.Box No.63, Bhadgaon Road Pachora-424201, Dist.Jalgaon, Maharashtra, India

Email: drjcrajput@nirmalseedsindia.com

Producing high-quality seeds is essential for successful and sustainable agriculture.This process involves selecting superior plant varieties and employing rigorous cultivation and harvesting techniques to maintain and enhance the genetic purity, vigor, and performance of plant species, thereby optimizing crop yields and quality.Vegetables serve as protective foods in the human diet, offering essential nutrients such as vitamins, fibers, minerals, and nutraceuticals due to their rich composition.The widespread use of digital technologies is revolutionizing agriculture.In vegetable seed production, precision farming techniques like artificial intelligence (AI), remote sensing, and unmanned aerial vehicles (UAVs) are employed.Digital tools used in seed grading and processing allow farmers to monitor and manage their crops with exceptional precision.Digital innovations have transformed vegetable seed production, providing opportunities for increased efficiency, sustainability, and profitability.As technology evolves, it's crucial for stakeholders to collaborate to overcome challenges and ensure these advancements are accessible worldwide.The integration of digital tools in vegetable seed production represents not just a technological shift but a vital step toward a more resilient and productive agricultural future.

Keywords- Seed production, GIS, GPS, Drones, Remote sensing, Artificial Intelligence

2.1.5 Importance of Digitalisation in the Tissue Culture industry

Kalyani K. Moharir and Anil B. Patil

Tissue Culture Division, Jain Irrigation Systems Limited, Jain Hills, Jain Agri Park

Shirsoli RoadJalgaon-425001 Maharastra

Website: www.jains.com; Email patil.anil@jains.com

Over the past three decades, tissue culture technology has become an industry in India, with a growing demand for quality planting materials.Significant improvements have been made in tissue culture plant production systems over the last two decades.The primary hardening stage of in vitro plants is critical for the commercial success of this technology.Climate control during this stage is vital for the plants' survival and growth.The introduction of digitalization in primary hardening has had a significant impact on maintaining the micro-climate of greenhouses.Data from the past three years show that there was 96.8% uniformity in temperature levels and 94.5% uniformity in humidity, compared to 87.9% and 83.7% respectively when the systems were operated manually.Digitalisation has also enhanced plant performance; root development improved by 32.3%, leaf surface area by 17.5%, and stem girth by 18.9%.Additionally, digitalization has reduced the human resources required to operate the climate control system by 454%.

Keywords: Acclimatization, In vitro, micro-climate

2.2 Oral Presentation

2.2.1 *In Vitro* Regeneration of Litchi cv.Shahi via Indirect Organogenesis

Shashi Prakash[1], Hidayatullah Mir[1], Feza Ahmed[1], Tushar Ranjan[2] and Sanjay Sahay[1]
[1]Department of Horticulture (Fruit and Fruit Technology),
Bihar Agricultural University, Sabour, Bhagalpur-813210, India
[2]Department of Molecular Biology and Genetic Engineering, Bihar Agricultural University
Sabour, Bhagalpur-813210, India
Email- shashixii@gmail.com

Shahi cultivar of litchi which has got GI certification from Bihar in 2018 is a heavy bearing variety with large, sweet and juicy fruits having unique aroma.In this experiment an efficient in vitro regeneration protocol for litchi cv.Shahi has been developed via indirect organogenesis using leaf and nodal segment explants.The pre sterilized explants were cultured on MS medium fortified with different concentrations of BAP, 2,4-D and IAA either alone or in combination for induction of callus.Highest callus induction from leaf explants was recorded in medium containing 2.0 mg/L BAP + 3.0 mg/L 2, 4-D while maximum percent callogenesis from nodal segment explants was recorded on MS medium fortified with 3.0 mg/L BAP + 2.0 mg/L IAA.For shoot regeneration from callus MS medium augmented with various combinations of BAP and IAA along with fixed concentrations of GA_3 and coconut water were tested.It was observed that 3.0 mg/L BAP + 3.0 mg/L IAA + 1.0 mg/L GA_3 along with 15 % coconut water resulted in maximum percent callus forming shoots.The regenerated shoots were rooted in half strength MS medium added with 2.0 mg/L IBA.This is the first report for in vitro regeneration of litchi cv.Shahi via indirect organogenesis and can be effectively utilized for generating sufficient planting material as well as can also be utilized as an elementary step for various biotechnological procedures.

Keywords- In vitro, Litchi, Shahi, indirect organogenesis, BAP

2.2.2 Paradigm and Dynamics of Digital Horticulture

Sangeeta Kumari, M.D.Ojha, N.Y.Azmi and Ranvir Kumar
Agricultural Research Institute, Lohianagar, Patna
Email: sangeeta6b@gmail.com

Digital horticulture represents a paradigm shift in agriculture, using technology to enhance food production, improve nutrition, and encouraging entrepreneurship.This abstract explores the paradigm and dynamics of digital horticulture, focusing on its implications for food security and economic development.The integration of digital technologies such as precision agriculture, remote sensing, Internet of Things (IoT), and artificial intelligence (AI) has revolutionized traditional horticulture practices. The domain of Horticulture includes cultivation, plant propagation, breeding of plants, production of crops, Plant Physiology as well as Biochemistry and Genetic Engineering. These technologies enable farmers to monitor crops in real-time, optimize resource use, and make data-driven decisions, leading to higher yields and lower production costs.

Furthermore, digital horticulture has significant implications for nutrition.By facilitating the production of diverse and nutrient-rich crops, it can help reduce malnutrition and improve public health.In addition, digital technologies can enhance food traceability and safety, ensuring that consumers have access to high-quality, nutritious produce. From an entrepreneurial perspective, digital horticulture opens new opportunities eg., providing access to market information, financial services, and e-commerce platforms, enabling smallholder farmers to connect with buyers and increase their income. Moreover, digital technologies can empower farmers to become agripreneurs, developing innovative solutions and value-added products.

However, the adoption of digital horticulture is not without challenges.Limited access to technology, lack of digital literacy, and inadequate infrastructure are key barriers that need to be addressed.Governments, NGOs, and the private sector must collaborate to provide training, infrastructure, and financial support to smallholder farmers, ensuring that they can fully benefit from digital horticulture.

Digital horticulture represents a transformative approach to agriculture, with far-reaching implications for food security, nutrition, and entrepreneurship. By harnessing the power of technology, we can create a more sustainable and inclusive food system, ensuring that everyone has access to nutritious and affordable food.

Keywords: Digital horticulture, artificial intelligence, remote sensing, technology.

2.2.3 Exploring the Medicinal and Nutritional Potential of Soursop (*Annona muricata*): A Comprehensive Study on Phytochemical Composition and Health Benefits

V. Shajeeda Banu and D.R. Singh
Bihar Agricultural University, Sabour- 813210, Bihar
Email: drsinghhort66@gmail.com

In recent years, there has been a great interest in exploring various underutilized fruits for their medicinal potential within traditional medicine systems, aiming to address diverse human health concerns.Traditional medicine contains a vast reservoir of plants with medicinal and pharmacological properties, offering a wide range of novel bioactive compounds.Micronutrient deficiency poses a significant public health challenge.This study investigates the nutrient composition, phytochemical profile, antioxidant activity, and sensory attributes of Soursop (*Annona muricata*).Soursop, the largest fruit within the Annonaceae family, is well known for its unique aroma and flavour. The plant exhibits various pharmacological activities, including cytotoxic, antileishmanial, wound healing and antimicrobial effects, as well as anti-carcinogenic and genotoxic effects.The study explores the qualitative aspects, including phytochemical composition, proximate analysis, antioxidant activity, and sensory evaluation of Soursop squash.Notably, Soursop fruits were found to be rich in Vitamin C (48 mg/100 g) and ascorbic acid (145.23 mg/100g), providing protection against oxidative stress and enhancing food digestion.Substantial quantities of polyphenols (117.71 mg/100g), carotenoids (33.65 μg/100g), and antioxidants (76.03%) were identified in Soursop, enhancing its therapeutic potential.The study holds promise for the utilization and domestication of Soursop, offering a potential solution to combat malnutrition.The nutritional and medicinal properties of Soursop could be potential in addressing public health concerns associated with nutrient deficiencies, thereby contributing to improved overall health outcomes.

Keywords: *Annona muricata*, Antioxidant activity, Nutritional benefits, Soursop, Phytochemicals, Traditional medicine.

2.2.4 Effect of De-leafing and Graded Multi Micronutrients on Growth, Flowering and Flower Yield of Spider Lily (*hymenocallis litterolis* l.) cv.Local

Pooja V. Maheta, N.S.Joshi and Mital Vaghasiya
Krushi Vigyan Kendra, Junagadh Agriculture University,Amreli
Email: poojahorti@jau.in

The present investigation was carried out at Horticulture Instructional Farm, Junagadh Agricultural University; Junagadh (Gujarat) during 2018-19.The experiment was laid out in Randomized Block Design with factorial concept (FRBD).The treatments comprised factor A- 2 level- no deleafing and deleafing De-leafing is the practices in lily in which the leaves are removed by cutting the plants.It is done to provide rest to the plant during kharif because there is flower yield with very low demand and even market price.So, during kharif at the end of June the plant put in rest by leaf cutting.It provides the favourable condition to the plant getting qualitative and quantities flower production.Factor B- having four levels of micronutrient grade four formulations.De-leafing during kharif (at the end of June) with an application of multi-micronutrient grade IV @ 1 % with three equal splits at 15 days before de-leafing and 30 & 45 days after deleafing to get higher yield and net return in spider lily flower crops.

Keywords: Spider lily, Deleafing, Micronutrient, Flower yield, Net return

2.2.5 Effect of Growth Regulators on Growth, Yield and Quality of China Aster (*Callistephus chinensis* l.Nees) cv.Kamini

Mansa K.P., N.S. Joshi and Pooja V. Maheta
Krushi Vigyan Kendra
Junagadh Agriculture University, Amreli
Email: poojahorti@jau.in

The present investigation entitled “Effect of growth regulators on growth, yield and quality of china aster (*Callistephus chinensis* L.Nees) cv.Kamini” was carried out at Jambuvadi farm, College of Horticulture, Junagadh Agricultural University, Junagadh during the year 2020-21.The treatments comprised of three plant growth regulators *i.e*., GA_3, Alar and BA at three levels concentration (GA_3 at 100, 150 and 200 ppm, Alar at 500, 1000 and 1500 ppm, BA at 25, 50 and 75 ppm).The experiment was laid out in Randomized Block Design (RBD) which comprising of ten treatments with three replications.

Among the treatment GA_3 at 200 ppm recorded maximum values for plant height (15.71, 30.61 and 47.03 cm at 30, 60 and 90 DAT, respectively), number of branches (5.83, 9.27 and 12.74 at 30, 60 and 90 DAT, respectively), enhanced the number of flowers (77.58), Flower yield per plant (251.47g) and Flower yield per plot (2110.67 g).While Alar at 500 ppm application recorded minimum values for leaf area (34.53, 63.53 and 79.17 cm^2 at 30, 60 and 90 DAT, respectively) in early flowering (52.61 days),

Therefore, foliar application of GA_3 200 ppm at 30 and 45 DAT wasfound to bebest in order to get maximum growth, yield and quality of china aster cv.Kamini.

Keywords: China aster, Growth regulators,GA_3, Alar, BA.

2.2.6 Effect of PGRs and Cow Urine on Pineapple Propagation through Crown in Soilless Culture under Protected Condition

[1]S.K. Bhuva and [2]K.J. Prajapati
Assistant Professor, Department of Horticulture, College of Agriculture, JAU, Junagadh
E-mail: skbhuva@jau.in

The present investigation was conducted at High-Tech Horticultural Park, College of Horticulture, Junagadh Agricultural University, Junagadh during the year of 2020.It was aim to use crown for propagation material reduce wastage of fruits and soilless culture represents a valid opportunity in areas with severe soil degradation and limited water availability.The experiment was laid out in CRD with three repetitions.There were eight treatments comprising Control (T_1), IBA 400 ppm (T_2), IBA 600 ppm (T_3), IBA 800 ppm (T_4), NAA 600 ppm (T_5), NAA 800 ppm (T_6), NAA 1000 ppm (T_7) and Cow urine 15 % (T_8).

The result of this experiment revealed that application of IBA @ 600 ppm has enhanced the growth characters and gave maximum percentage of rooted crown (94.44 %), maximum length of root (5.58, 8.26 and 11.08 cm) at 15, 25 and 35 days, respectively, maximum length of leaf (13.35, 16.27 and 19.67 cm) at 15, 25 and 35 days, respectively, maximum no.of leaves (70.58, 80.28 and 91.06) at 15, 25 and 35 days, respectively.IBA @ 600 ppm also gave maximum fresh root weight (16.46 g), maximum dry root weight (7.77 g), maximum fresh shoot weight (136.33 g), maximum dry shoot weight (57.67 g), maximum survival rate (65.91 %) and minimum mortality rate (24.09 %).

While NAA @ 800 ppm gave maximum no.of roots (70.58, 80.28 and 91.06) at 15, 25 and 35 days, respectively.Cow urine @ 15% taken minimum days required for root initiation (2.67 days) and maximum shoot weight ratio (0.896).Maximum root weight ratio (0.152), maximum Root: Shoot ratio (Fresh) (0.128) and maximum Root: Shoot ratio (Dry) (0.179) were recorded with the application of IBA @ 400 ppm.

Keywords: Pineapple, Crown, Propagation, Cow urine, PGRs

2.2.7 Influence of Chemicals on Growth, Yield and Quality of Baby Corn (*Zea mays* L.)

[1]B.R.Gondaliya and [2]Dixita Padhiyar
[1&2]Ph.D.Scholar, Department of vegetable science, COH, JAU, Junagadh, Gujarat
Email: bhavikpatel21398@gmail.com

The experiment entitled “Effect of chemicals on growth, yield and quality of baby corn (*Zea mays* L.)” was conducted during summer, 2020 on var.GAYMH 1 at Horticulture Polytechnic, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India.The experiment was laid out in randomized block design with three replications and eight treatments *viz.,* GA_3 40 ppm (T_1), NAA 40 ppm (T_2), mepiquat chloride 200 ppm (T_3), CCC 200 ppm (T_4), PBZ 200 ppm (T_5), putrescine 50 ppm (T_6), PBZ 200 ppm Seed soaking (T_7) and Control (T_8).Seed soaking was done on previous day of sowing for 3 hrs.and kept in shade.Foliar application was done at 30 DAS.Among different treatments, application of PBZ 200 ppm seed soaking (T_7) delayed germination process and took maximum days (8.33) to obtain 50 % germination.Maximum plant height at 45 DAS (147.87 cm), at 60 DAS (239.47 cm) and at last harvest (244.47 cm) was recorded with the application of GA_3 40 ppm (T_1).Reflective effect of foliar application of mepiquat chloride 200 ppm (T_3) was detected in getting higher yield parameters *viz*., cob weight (42.660 g plant^{-1}), cob yield without husk (0.622 kg plot^{-1} and 2.593 t ha^{-1}) and harvest index (6.43 %).Number of

cobs (3.53) plant^{-1} werefound maximum with application of GA_3 40 ppm (T_1).Application of PBZ 200 ppm Seed soaking (T_7) improved cob yield with husk (3.768 kg plot^{-1} and 15.703 t ha^{-1}) whereas, maximum green fodder yield (10.353 kg plot^{-1} and 43.14 t ha^{-1}) was obtained with the application of NAA 40 ppm (T_2).Length and girth of cob were found non-significant.Foliar application of GA_3 40 ppm (T_1) indicated distinguished effect on quality of baby corn.Fresh and dry baby cob samples were analysed and higher total sugar content, reducing sugar content and protein content were obtained in the treatment of GA_3 40 ppm.However, protein content from dry baby corn was found non-significant.The highest net return of ₹ 2,19,406 ha^{-1} and maximum benefit: cost ratio (1.49) were obtained with NAA 40 ppm (T_2).

Keywords: -Baby corn, GA_3, mepiquat chloride, NAA, paclobutrazol (PBZ), putrescine.

2.2.8 Unlocking the Potential of Underutilized Fruits of the Andaman and Nicobar Islands

V.Shajeeda Banu[1], Shrawan Singh[2] and D.R.Singh*[3]

[1&3] *Bihar Agricultural University, Sabour- 813210, Bihar*
[2]*Indian Agricultural Research Institute, New Delhi*
Email : drsinghhort66@gamil.com

The Andaman and Nicobar Islands are home to a variety of underutilized fruits, each with unique flavors, nutritional benefits, and cultural significance.This abstract highlights some of these lesser known fruits including Khoonphal (*Haematocarpus validus*), Chalta (*Dillenia indica*), Rambutan (*Nephelium lappaceum*), Mangosteen (*Garcinia mangostana*), Wood Apple (*Aegle marmelos*), Soursop (*Annona muricata*) and Jamun (*Syzygium cumini).*These fruits offer a range of flavours, from sweet and tangy to sour and refreshing.They are used in various culinary applications, including jams, jellies, chutneys, beverages, and desserts.Additionally, many of these fruits have high nutritional value, containing essential vitamins, minerals, and antioxidants.Despite their potential as valuable food sources, these fruits remain underutilized in the Andaman and Nicobar Islands.Promoting their cultivation, consumption, and commercialization can not only enhance food diversity and nutrition but also contribute to the preservation of local biodiversity and the discovery of new economic opportunities in the region.By raising awareness about the benefits and versatility of these underutilized fruits, stakeholders can work towards integrating them into local diets, culinary traditions, and agricultural practices.This concerted effort can unlock the hidden potential of these fruits, enriching the culinary landscape and promoting sustainable food systems in the Andaman and Nicobar Islands.

Keywords: Underutilized fruits, Andaman and Nicobar Islands, Nutritional richness, Biodiversity preservation, Economic opportunities.

2.2.9 Design and Development of a Mini Tractor - Mounted Clod Crusher

V.R.Vagadia[1], K.P. Jishna[2], P.H. Rank[3] and M.N. Gajera[4]
[1]HOD, Department of Farm Engineering,
[2]PG Student, Department of Farm Machinery and Power Engineering
[3]Sr.Res.Asstt., Department of Farm Engineering Department,
[4]Sr.Tech.Asstt., of Farm Machinery and Power Engineering, Junagadh Agricultural University
Junagadh (Gujarat) , India-362001, Email: vrvagadia@jau.in

Clod formation following ploughing or disking is a major concern in India's arid and semi-arid zones.Clod prevents seed-soil close contact and restricts the penetration of furrow openers used in seed drilling.Small-scale farmers can purchase small tractors, but smaller tillage implements suitable for mini tractors are not available in the market.To overcome the current problems in seedbed preparation, a mini tractor-mounted clod crusher was developed and tested at the Wheat research station field, JAU, Junagadh during the year 2022 – 2023 and the data were analyzed statistically with ANOVA tests using computer software.The results showed that the overall best performance of the machine in terms of clod MMD, fuel consumption and field efficiency was found to be 9.25 mm, 7.696 l/ha and 84.72 % at the forward speed of 3.0- 3.5 km/h with dead weight of 100 kg respectively.

Keywords: Clod crusher, Clod MMD, mini tractor, blades, primary unit, secondary unit

2.2.10 Induction of Callus and Protocorm-Like Bodies (PLBs) Using the New Shoot Bud with Nodal Region of *Phiaus tankerville* (Banks) Blume

Tshering Chomu Bhutia, Kalaivanan, N.S, Suman Natta, Biswas, S.S, De, L.C., Ashok Kumar, Dibankar Sahaand Sankar Prasad Das*
ICAR-National Research Centre for Orchids, Pakyong, Sikkim, 737106, India
Email: Sankar.Das@icar.gov.in

Orchids being one of the most beautiful and elegant flower which belongs to the Orchidaceae family with 763 genera and over 28,000 recognized species and is the second biggest flowering plant family globally.*Phiaus tankerville* (Banks) Blume is one of the terrestrial member of Orchidaceae family known for its medicinal properties and ornamental use.Due to incessant use of the species for trade and consumption there is slight decrease in the habitat which has become critically endangered.Therefore, the explant of new side shoot bud with nodal region was inoculated in MS media which was prepared manually having stock solution of macro and micro-nutrients, Iron-EDTA, Vitamins and Organic supplements.Three media of MS stock solution was prepared with various concentration of BAP only (A), NAA only (B) and in combination (C) fortified with 3% sucrose, 8gm agar with pH of 5.6 and inoculated with new shoot bud with nodal region. Response of shoots was observed after 40 days of inoculation.The shoots proliferated and showed callus formation in C media which has a composition of NAA (0.5mg/l) & BAP (1mg/l).While other media showed only shoot growth with no callus formation.After 60 days the new shoot proliferated plant along with the callus formed were transferred to the media containing the combination of hormones and supplements for differentiation, shooting followed by rooting.

Keywords: Terrestrial, Hormones, Proliferation and supplements

2.3 Poster Presentation

2.3.1 Digital Horticulture

Monika Patel[1]*, Paramveer Singh[2] andSwapnil Bharti[3]
Department of Horticulture (Vegetable and Floriculture)
Bihar Agriculture College, Sabour
Bihar Agricultural University, Sabour, Bihar
Email: monika91patel@gmail.com

It is said that, "Artificial intelligence (AI) cannot exist without information architecture (IA)." We have a more precise word for IA in greenhouse growing: Digital Horticulture.The fuel for AI is data.The demand for massive amounts of clean, high-quality data (jet fuel) increases with the sophistication of the AI (rocket ship).However, in the haste to embrace artificial intelligence, businesses—including data scientists and machine learning experts themselves—sometimes forget how important it is to establish a strong framework for the collection, use, and exchange of data within the company.Artificial intelligence (AI) in greenhouses: a well-designed AI system may maximize resource efficiency and assist producers reach higher yields, making indoor farms more profitable, sustainable, and feasible.Artificial intelligence (AI) may assist growers in making data-driven decisions and enable them to adopt a forward-thinking perspective on sustainability and efficiency by producing analytical analytics across inherent greenhouse operations.Thus, the fusion of artificial intelligence with human expertise is driving the next revolution in agricultural methods.

Keywords: Digital Horticulture, Artificial Intelligence, Information Architecture

2.3.2 Mechanization and Robotics in Fruit Crops

Lunagariya Radhika J.*, D.K.Varu, Mithapara Kinnari, D.*** and Gorasiya Chirag A.******
**Ph.d.research scholar, Department of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh-362001 (Gujarat-India)*
*** Principal and Dean, College of Horticulture, Junagadh Agricultural University, Junagadh-362001 (Gujarat-India)*
****Ph.d.research scholar, Department of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh-362001 (Gujarat-India)*
*****Ph.d.research scholar, Dept.of Soil Science and Agricultural Chemistry, Junagadh Agricultural University, Junagadh-362001 (Gujarat-India)*
Email: radhikalunagariya8@gmail.com; Mob: 9624948150

Mechanization and robotics play pivotal roles in modernizing fruit crop cultivation, addressing labour shortages, and enhancing efficiency.Mechanization involves the use of various machineries such as harvesters, sprayers, pruning equipment and maintaining orchards.Robotics further revolutionizes the field by introducing autonomous systems capable of intricate tasks like fruit picking, sorting, and disease detection.Integration of sensors and AI algorithms enables robots to navigate orchards, identify ripe fruits, execute precise actions, reducing labour costs and improving yield quality of fruit crop.Moreover, these technologies enhance overall crop quality by minimizing damage during harvesting and post-harvest processes.The integration of mechanization and robotics in fruit farming marks a transformative shift, promising higher yields, resource optimization, and a more resilient agricultural sector in the face of evolving global challenges.

Keywords: Mechanization, robotics, fruit crops, yield and quality

2.3.3 Horticulture Development in the Andaman Islands for Sustainable Agriculture and Economic Growth

V. Shajeeda Banu and D.R. Singh
Bihar Agricultural University, Sabour- 813210, Bihar
Email: drsinghhort66@gamil.com

The Andaman Islands, in the Bay of Bengal, served as a fertile ground for the development of horticulture, which played an important role in sustainable agriculture and driving economic growth.The climatic condition of the Andaman Islands, characterized by tropical rainforests and coastal plains, provided an ideal environment for cultivating a wide array of horticultural crops.Over the years, the island progressed in successful cultivation of tropical fruits such as mangoes, bananas and papayas, along with the exotic spices like cloves and nutmeg.A high-value crop like coconut, arecanut and black pepper were also grown and contributes to both domestic and international markets.Horticulture played a crucial role in enhancing food security and reducing dependency on imported agricultural produce in the Andaman Islands.By promoting diversified cropping systems and implementing sustainable farming practices, horticulture strengthened the resilience of local food systems.From an economic standpoint, the development of horticulture created employment opportunities, particularly benefiting rural communities and marginalized groups.Value addition activities such as processing and marketing of horticultural products contributed to increased income and livelihood security for small-scale farmers.Moreover, the promotion of horticulture aligned with broader objectives of environmental conservation and ecotourism development.Through sustainable agricultural practices, horticulture preserved and enhanced the natural beauty of the islands, attracting eco-conscious tourists and promoting green tourism initiatives.

Keywords: Andaman Islands, Horticulture development, Sustainable agriculture, Economic growth, Food security, Environmental conservation

2.3.4 Efficacy of IBA on Rooting of Cuttings, Growth and Survival of Croton (*Codiaeum variegatum* L.)

S.B. Malaviya*, B.V. Thumar
E-mail: malaviyashweta1zz1@gmail.com

The experiment was conducted at Hi-tech Horticulture Park, College of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) during September to December-2021.The experiment was laid out with Completely Randomized Design with four replications.Application of IBA @ 300 ppm proved to be significant for the hardwood cuttings of hibiscus for the parameters like minimum days required for sprouting (21.50 days), success percentage (85.00 %), survival percentage (82.32 %), number of leaves (15.05), number of shoots (3.60), leaf area (109.73 cm^2), length of main shoot (6.72 cm), girth of main shoot (2.81 mm), fresh weight of shoot (4.98 g), dry weight of shoot (2.69 g), number of roots (29.85), length of longest root (13.27 cm), fresh weight of roots (2.15 g), dry weight of roots (1.86 g), minimum mortality percentage (17.67 %) and maximum root: shoot ratio (0.43).

2.3.5 Papaya grafting – A new and sustainable technique of propagation

P.K. Modi*, Ankur Patel, K.D. Bisane, Bhumika D. Movaliya and Vrutti Patel
Fruit Research Station (ICAR-AICRP on Fruits)
Navsari Agricultural University, Gandevi
*Email:*prmodi.horti@nau.in

Papaya (Carica papaya L.) is a globally significant fruit in terms of economics and nutrition. It reproduces both sexually and asexually. While traditional propagation is by seeds, vegetative methods utilizing in vitro and ex vitro cultures are increasingly common. Vegetative propagation techniques, particularly cutting and grafting, are widely explored. Research includes experiments where seedlings of the yellow-fleshed GJP-1 cultivar served as rootstock for grafting with the Red Lady scion cultivar. The study found that seedling stems with diameters of 0.3-0.5 cm are ideal for cleft grafting in early February to March. Under a low tunnel with a polythene cover, the survival rate was 96.33% at 30 days post-grafting. Optimal grafting conditions were temperatures of 22-25°C and humidity levels of 75-80%.

Keywords: Scion, Rootstock, Cleft Grafting, Low Tunnel, Survival

3. TECHNICAL SESSION-3 (HALL NO.-2)

DIGITAL HORTICULTURE FOR MITIGATION AND ADAPTATION TO CLIMATE CHANGE

3.1 Keynote Lectures

3.1.1 Climate Change Collision and Adjustment for Horticultural Crops in Saurashtra Region

V.P. Chovatia*, D.K.Varu and Parth Pandya*****
**Vice Chancellor, JAU, Junagadh, * Principal and Dean, CoH, JAU, Junagadh*
**** Parth Pandya, T.O.to VC, JAU, Junagadh*
Email: dkvaru@jau.in, principalcoh@jau.in

Climate change is the overtime change in climate may be due to natural or because of human activity that alters the composition of the global atmosphere resulted to reform the life of living things including plants.Climatic parameters like temperature, wind velocity, cyclone, humidity, etc.are altering every year in Gujarat.Seasonal variation is became big issues. Diurnal variation in temperature appearing in every season.Rain intensity and quantum is increased with lower rainy days.However, it also extend up to October and sometime November instead of August, which have affected and changed the physiology of many horticultural crops.Total cold days are also reduced.It is true that the horticultural crops are more vulnerable against the climate change.The collision of climate change to various horticultural crops are becoming dangerous day by day.It affecting the growth and development, quality and productivity.The rise in temperature would lead to higher respiration rate, alter photosynthesis rate and partitioning of photosynthets to economic parts. It could also alter the phenology, shorten the crop duration, days to flowering and fruiting, hasten fruit maturity, ripening and senescence. The sensitivity of individual crop to temperature depends on inherent tolerance and growing habits.Extended rains, higher temperature during winter, higher day-night temperature, less dew formation, off seasonal rain, etc.during the last three years, had heated not only the time or regulation of flowering but also the fruit setting intensity and finally the yield in mango.Similarly, off seasonal rain during March-April-May had also disturbed the resting time of guava and custard apple resulted for the poor yield. Higher temperature during September-October also hastened the early ripening in guava and custard apple also reduced the harvesting time.Likewise, heavy and extended rain during September-October also disturbed the resting time means *hasta bahar* in pomegranate and acid lime.In tropical and sub-tropical regions, even moderate warming may lead to decline in yield.However, crop yields may improve as result of a small increase in temperatures in high latitudes; It is not possible to mitigate completely the alteration of different variation of climate parameters adversely affecting the crops.However, adjustment of various techniques used for the successful cultivation of the crops is only way to overcome the adverse effect of the climate change.Use of tolerant or resistant varieties against heat/cold stress, drought stress, etc.Similarly, many adaptation or adjustments like time of transplanting, planting, time of training or pruning, methods of training/pruning, irrigation management, fertilizer management as well as maturity indices and harvesting may adjusted to protect the crop from the climate change.

Keywords: Climate, Atmosphere, Velocity, Vulnerable, Mitigation, Adjustment, Photosynthates, Temperature, Tropical, etc.

3.1.2 Use of Digital Technology in Production and Utilization of Cashew

J.D. Adiga, Vanitha, K. Shamshudeen, M. and Mohana G.S.
ICAR- Directorate of Cashew Research, Puttur
Puttur-574202, Karnataka
Email: Jd.Adiga@icar.gov.in

In the current scenario, digital technologies play a pivotal role in the management and dissemination of information.Recognizing this necessity, the ICAR-Directorate of Cashew Research in Puttur has created various apps and websites that are effectively used to connect with stakeholders.One significant development is the Cashew Phenology Data Management System, accessible at https: //cashew.icar.gov.in/phenology/ .Phenology examines the sequence of periodic events in a plant's lifecycle, such as shooting, flowering, and fruiting, which is crucial for understanding how weather influences both vegetative and reproductive growth phases, thereby aiding in crop management.The BBCH scale, depicting cashew phenology, was developed for the first time in this domain by ICAR-Directorate of Cashew Research, Puttur.This webpage offers detailed insights into cashew phenology and provides tools for analyzing data from phenological studies.

Furthermore, the Fertilizer Calculator and DCR-Cashew Nutrient Manager app were developed with financial support from RKVY-RAFTAAR, Government of Karnataka.These digital tools assist farmers and stakeholders in calculating the precise fertilizer requirements for cashew based on soil fertility levels.The app and website can be customized for cashew-growing regions throughout India and other locations, including calculators for lime and foliar nutrient applications.They also provide information on nutrient deficiency symptoms in cashew and their management.The 'Cashew Pest Database', available at https: //cashew.icar.gov.in/pest, offers extensive information on the primary, secondary, and minor insect pests of cashew.It includes details on symptoms, seasonality, biology, alternate hosts, and management measures.The 'Pest Calendar' section provides pictorial information on the occurrence periods of significant pests.Another resource is the website on Beneficial Arthropods in cashew plantations at https: //cashew.icar.gov.in/beneficialinsect/.This page provides basic information about various beneficial arthropods, including predators, parasitoids, and pollinators, which play crucial roles in pest management and pollination, leading to successful seed set.

The main website of the ICAR-Directorate of Cashew Research, https: //cashew.icar.gov.in/, is a comprehensive portal that offers detailed information about the institute's vision, mission, objectives, facilities, research programs, staff, publications, and links to related organizations.It includes a 'For Farmer' section with extensive information on cashew cultivation, addressing topics such as cashew farmers, grafts, brochures, statistics, varieties, weather advisories, and success stories across 17 sections.Additionally, the website for the All India Coordinated Research Centres for Cashew (AICRP-Cashew) at https: // cashew.icar.gov.in/aicrpc/ outlines the history, mandate, personnel, activities, and achievements of the 14 AICRP centers spread across India, focusing on crop improvement, management, and protection.

Lastly, the Cashew India app provides comprehensive information on cashew cultivation and other aspects, enhancing access to the cashew germplasm database.Recently, an AI-based app, Cashew Protect, has also been introduced to help identify pests, diseases, and nutrient deficiencies.

3.1.3 Role of Digital Farming System in High Value Horticultural Crops under Hi-Tech Protected Structures for Ensuring Productivity and Demand in Urban and Semi-Urban Areas

****Awani Kumar Singh, M.Hasan, Jogendra Singh, Bhawana Singh, K.G.Gainiamliu and Parvesh Kumar**

Center for Protected Cultivation Technology, ICAR-IARI, New Delhi
Email: singhawani5@gmail.com

In today's scenario, the increasing Indian population coupled with diminishing cultivated land and irrigation water pose significant challenges in meeting the demand for horticultural produce in both urban and semi-urban areas.This is exacerbated by the escalating migration from villages, exceeding 60% compared to previous times.Urban dwellers, often economically affluent and health-conscious, seek fresh and hygienic horticultural products at any cost.Additionally, the adverse impacts of climate change and global warming have led to unpredictable weather patterns, as well as biotic and abiotic stresses, further reducing horticultural crop production.These factors collectively hamper production, productivity, and quality standards, making it difficult to satisfy public demand for horticultural produce.To address these challenges, there's a pressing need for digital farming systems tailored for horticultural crops, along with the adoption of high-tech protected structures in urban areas to cater to market demands effectively.

Digital farming is integral component of computer farming, precision farming, smart farming, Sensor farming, IoT farming, hi-tech farming, LEDs farming, robotic farming, drone farming, drip-fertigation farming, automation farming, decision support farming, data-driven greenhouse farming.These methods are primarily utilized within protected structures for high-value horticultural crops like tomatoes, cherry tomatoes, colored capsicum, Parthenocarpic cucumbers, musk melons, lettuce, pak-choi, Chinese cabbage, parsley, celery, beet leaves, and spinach etc.The benefits of digital farming systems include significant savings of labor, water, inputs, pesticides, insecticides, nematicides, costs, and time.Moreover, they tailor microclimate conditions such as temperature, humidity, sunlight, LEDs lighting, CO_2 levels, photosynthesis, ventilation, aeration, soil moisture/tension, nutrients, water, and pesticides to meet crop requirements.Digital farming enhances flowering, fruiting, quality, color, quantity, productivity, shelf life, post-harvest attributes, market price, water and fertilizer use efficiency, and overall sustainability throughout the year and in off-season periods.This transition from manual to automated processes increases horticultural crop production by facilitating product and process traceability.Digital farming applications provide agricultural producers with precise, real-time insights into various factors affecting productivity, including plant health, soil quality, weather conditions, and pest and disease pressures.Analyzing data collected through digital farming can assist producers and researchers in making informed decisions to achieve over 50% increases in yields, enhanced efficiency, reduced costs, and better resource management.

Utilizing a variety of sensor-based devices such as Dataloggers, temperature/RH/solar meters, pH/EC meters, oxygen meters, CO_2 meters, TDS meters, nutrient meters, soil moisture meters, photosynthesis meters, TSS meters, Lycopene meters, photoperiod meters, light meters, solar radiation meters, rain gauges, chlorophyll meters, humidity controllers, drip and fertigation systems, foggers, solar coolers/heaters, computers with programming capabilities, weather stations, automation technologies, disease monitoring applications, nutrient management tools, mobile devices for IoT integration, GIS/GPS systems, drones, sprayers, heaters, and other necessary equipment and inputs.These components form the foundation of a sophisticated digital farming infrastructure tailored for horticultural production.They play a crucial role in managing both biotic and abiotic stress factors during crop cultivation, leading to an increase of over 50% in quality, color, quantity, and income compared to traditional farming methods.

A number of companies in Europe, Asia, and the United States have already found success with digital based hi-tech vertical farming business models. Because they're located in urban areas, logistics costs are lower.By using technology and optimizing growth conditions, they use up to 95% less water than traditional farming and in some cases, produce zero agricultural runoff, because they are inside and vertical and they use less land and inputs.This paper can open new directions to speed up the DH application on the farm and link traditional agriculture with modern farming technologies.Digital high-tech protected farming systems represent the future of horticultural crops, playing a pivotal role in addressing food security, nutrition, entrepreneurship, and generating income, especially for unemployed youth in urban and semi-urban areas.Embracing these systems could transform the country into a new digital India.

3.1.4 Climate Resilient System for Production of Horticultural Crops

Bal Krishna, Sanjay Sonje, Rajendra Kumar, Anil Dhake
Jain R&D, Jain Irrigation Systems Ltd.Jain Hills,
Jalgaon, Maharashtra
Email: yadav.balkrishna@jains.com

The climate change which was only noticed and studied by climatologists in previous decades is now evident to each and everyone and farmers are facing its challenges.The horticultural crops are better rewarding crops to the farmers but the impact of climate change is more on horticultural crops as they are specific to environmental requirements.Climate change is inevitable and the horticulture production must grow to fulfill the nutritional security of the nation and world.Jain Irrigation Systems Ltd has been working to find solutions to avoid climate change impact on horticultural crops.Based on climate risk assessment, a number of technologies like cultivation in greenhouses, polyhouses, screenhouses, use of temporary crop covers etc has been evaluated in various fruit crops.Besides these fruit covers and plant covers have been implied to avoid negative impact of natural variables in crops.Establishment of young plants like banana, papaya and several others is 100% even during peak summer when maximum temperature is more than 42C.Individual tree cover, crop cover and fruit cover are able to protect fruits from sunburn and hail besides improving fruit quality, keeping them fruit fly free and bruise free.These aspects have been studied by us in mango, banana, sweet orange, Mandarin, guava and pomegranate for the last five years.

3.2 Oral Presentation

3.2.1 Intercropping of Seed Spices with Guava Tree

S.S. Meena*, S.Lal, M.D. Meena and Y.K. Sharma
ICAR- National Research Centre on Seed Spices, Tabiji, Ajmer 305206 (Raj.), India
E-mail: ssmnrcss5@yahoo.com

The traditional farming systems, currently in vogue in semi-arid and arid regions of the country, are largely subsistence in nature and are need based.Besides, they are not necessarily efficient in utilization of resources for a given location.This leads to loss of precious natural resources.Sustainability and profitability of framing systems particularly of marginal and small holding facing serious challenges due to declining trend of per capita low availability and shrinking size of operational holdings.To overcome this a field experiment was carried out during 2016-17 to 2019-20 at ICAR-NRC on Seed Spices, Ajmer to investigate the response of intercrop combination (seed spices with guava) for increasing productivity, sustainability and profitability.The experiment comprises of11 treatments *viz*., Fenugreek + Guava, Coriander +Guava, Nigella +Guava, Anise + Guava, Ajwain+Guava, Sole Fenugreek, Sole Coriander, Sole Nigella, Sole Anise, Sole Ajwain and Sole Guava are laid in randomized block design with three replications.Results based on three years pooled data revealed that, out of eleven different treatments, sole crops treatment alone recorded highest yield compared to inter crop treatments, however after perusal of data related to economics of production it was observed that fenugreek + guava inter cropping was found most remunerative as it recorded highest net returns and B: C ratio (Rs.105903.00 and 1.82).Thus, inter cropping of fenugreek with guava is suggested for getting higher net return and B: C ratio, higher system productivity and profitability.

Keywords: fruit crops, profitability, intercropping, seed spices, System productivity

3.2.2 Advances in Sustainable Use of Plastic in Horticulture

G.V. Prajapati
Associate Professor, AICRP on PEASEM, Dept.of REE
College of Agricultural Engineering & Technology
Junagadh Agriculture University, Junagadh, India
Email: prajapati_girish@jau.in

Horticulture stands as a vital pillar of agricultural development, contributing significantly to the agricultural GDP of the nation.With an expanding footprint covering approximately 25 million hectares, horticultural production has surpassed food grain production in India, exceeding 300 million tonnes.However, challenges such as water scarcity and erratic monsoons necessitate innovative solutions for sustainable agricultural practices.Plasticulture, the strategic use of plastics in horticulture, emerges as a promising avenue to address these challenges.The present status of horticulture in India, highlighting its pivotal role in economic development.Despite being the world's second-largest producer of fruits and vegetables, India's productivity lags behind other leading nations.Plastic technologies, including micro-irrigation systems and plastic mulches, greenhouse, poly house, net house offer solutions to optimize water usage and enhance crop yields.The adoption of plasticulture in horticultural production has seen a significant rise in recent years, notwithstanding concerns about plastic waste management.Innovative techniques such as hydroponics and vertical farming represent the forefront of modern horticultural practices.These methods leverage plastics for efficient resource utilization, reduced environmental impact, and enhanced crop quality.However, the burgeoning issue of plastic waste necessitates a shift towards sustainable waste management

strategies.Traditional approaches, such as open dumping and landfilling, exacerbate environmental degradation and pose significant challenges to achieving sustainable waste management goals.The imperative of advancing sustainable plastic usage in horticulture while addressing the adverse effects of plastic waste.Advances in the sustainable use of plastic in horticulture hold immense potential to transform agricultural practices, ensuring both productivity and environmental sustainability.By embracing innovative plasticulture technologies and adopting responsible plastic usage practices, the horticulture sector can realize its full potential, contributing to national economic growth while safeguarding the environment for future generations.The adoption of innovative practices such as micro-irrigation, plastic mulches, hydroponics, and vertical farming offers a beacon of hope, promising increased productivity and reduced environmental impact.Embracing responsible plastic usage and prioritizing sustainability, the horticulture sector can chart a course towards a greener, more prosperous future, ensuring the well-being of both the environment and future generations.It is imperative for stakeholders across the agricultural value chain to collaborate and prioritize sustainability in horticultural production systems for a greener and more prosperous future.Together, we can harness the transformative power of plasticulture to cultivate a sustainable and resilient agricultural landscape for generations to come.

Keywords: Plasticulture, Sustainable agriculture, Plastic waste management, Innovative horticultural practices, Environmental sustainability

3.2.3 Influence of Different Intercropping Patterns on PAR (Photosynthetically Active Radiation) and Leaf Temperature of Jasmine (*Jasminum Sambac* L.)

Trupti Dodiya[1], S.K. Bhuva[2], Tejal Chaudhari[2] and V.M. Savaliya[3]
[1]*Assistant Professor, College of Agriculture, JAU, Mota Bhandariya*
[2]*Assistant Professor, Department of Horticulture, College of Agriculture, JAU, Junagadh*
[3]*Scientist, Krishi Vigyan Kendra, JAU, Khapat*
Email: truptidodiya@jau.in

The present investigation was carried out at Floriculture Research Farm, ASPEE College of Horticulture and Forestry, N.A.U., Navsari.Two intercropping seasons were taken, first during winter season and second during Kharif season of 2014-15 with a view to study suitable intercropping systems under jasmine.Three annual flowers were grown as intercrop under jasmine with different planting ratios *viz*., African marigold, French marigold and Gaillardia.The results obtained from the experiment were subjected to statistical analysis.Treatment T_7 (Sole jasmine) recorded significantly maximum PAR (On upper canopy- 1446.27ìmol/m^2/s^1 and on middle canopy- 1332.51 ìmol/m^2/s^1) and leaf temperature (On upper canopy- 29.02°C and on middle canopy- 24.67°C) during second intercropping season while the data recorded during first intercropping season showed non-significant effect.

Keywords: *Jasminum sambac*, Intercropping, PAR, Leaf temperature

3.2.4 Smart Farming: Internet of Things (IoT)-Based Sustainable Horticulture in Varying Climatic Conditions

Lunagariya Radhika J.*, D.K.Varu, Mithapara Kinnari, D.*** andGorasiya Chirag A.******

**Ph.D.Research Scholar, Department of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh-362001 (Gujarat-India)*

*** Principal and Dean, College of Horticulture, Junagadh Agricultural University, Junagadh-362001 (Gujarat-India)*

****Ph.D.Research Scholar, Department of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh-362001 (Gujarat-India)*

*****Ph.D.Research Scholar, Dept.of Soil Science and Agricultural Chemistry, Junagadh Agricultural University, Junagadh-362001 (Gujarat-India)*

Email: radhikalunagariya8@gmail.com; Mob: 9624948150

Smart farming is a development that has emphasized information and communication technology used in machinery, equipment, and sensors in network-based hi-tech farm supervision cycles.Innovative technologies, the Internet of Things (IoT), and cloud computing are anticipated to inspire growth and initiate the use of robots and artificial intelligence in farming.Such ground-breaking deviations are unsettling current agriculture approaches, while also presenting a range of challenges.This investigates the tools and equipment used in applications of wireless sensors in IoT agriculture, and the anticipated challenges faced when merging technology with conventional farming activities.Furthermore, this technical knowledge is helpful to growers during crop periods from sowing to harvest; and applications in both packing and transport are also investigated.

Keywords: crop management; sustainable agriculture; smart farming; internet-of-things (IoT); advanced agriculture practices

3.2.5 Biofortification: an Excellent Approach for Malnutrition and Crop Productivity in Varying Climatic Conditions

Lunagariya Radhika J.*, D.K.Varu, Mithapara Kinnari, D.*** andGorasiya Chirag A.******

**PhD.Research Scholar, Department of Fruit Science, College of Horticulture Junagadh Agricultural University, Junagadh-362001 (Gujarat-India)*

*** Principal and Dean, College of Horticulture, Junagadh Agricultural University Junagadh-362001 (Gujarat-India)*

****PhD.Research Scholar, Department of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh-362001 (Gujarat-India)*

*****PhD.Research Scholar, Dept.of Soil Science and Agricultural Chemistry, Junagadh Agricultural University, Junagadh-362001 (Gujarat-India)*

Email: radhikalunagariya8@gmail.com; Mob: 9624948150

Modern agriculture has been largely successful in meeting the energy needs for ever increasing population in developing countries.Micronutrient malnutrition has been designated as the most serious challenge to humanity as two-third of the world's population especially; women and children are at the risk of deficiency in one or more essential mineral elements.Besides, the micronutrient deficiencies are becoming increasingly common in horticulture as a result of higher levels of removal by ever more productive crops combined

with breeding for higher yields, at the expense of micronutrient accession efficiency.Therefore, horticulture must now focus on a new model that will not only produce more food, but deliver better quality food as well.Among which, "Biofortification" offers a simple and highly effective solution to micronutrient deficiency problems in crop plants and to increasing their concentration in foods.

Keywords: *Biofortification, malnutrition and crop productivity*

3.3.6 Study of Soil and Soil Less Media on Agro-Morphological, Yield and Economics of Lettuce (*Lactuca sativa* L.) Cultivars under Protected Condition

Thushal R Y, **Awani Kumar Singh **, Gograj Singh Jat, Jeetendra Kumar Ranjan, Ram Asrey, Gyan Prakash Mishra, Jogendra Singh M.Hasan, Kishor Gavhane, Anand Gupta and Bhawana Singh

ICAR- CPCT-Indian Agricultural Research Institute, New Delhi-110012, India

An experiment was conducted at the Centre for Protected Cultivation and Technology (CPCT), ICAR-Indian Agricultural Research Institute, New Delhi during 2022-23 to study the effect of soil and soilless media on agro-morphological traits, yield, and economics of lettuce cultivars under protected condition.This experiment was laid out with a factorial randomized block design of 3 replications.Agro-morphological and yield parameters such as plant height (cm), plant canopy spread (cm), number of leaves, head and leaf shape, head or leafy type, heading firmness, leaf color, leaf length (cm), leaf width (cm), root length (cm), root weight (g), fresh plant biomass (g) and yield/m2(kg/m2) of different lettuce genotypes were studied.All the varieties grown in soil media showed better results than soilless media except root length and root weight which were more in soilless media.Among the varieties, V9 (Lollo Rossa) showed better performance and V12 (Red Rose) showed poor performance in leafy types.Among head types, V16 (Great Lakes) showed better performance and V15 (Butterhead Green) showed poor performance.Concerning economics, the cost of cultivation was the same for all the cultivars, whereas thegross income, net returns, and benefit-costratio were highest in V9 (Lollo Rossa) and lowest in V12 (Red Rose) in leafy types.Among head types, the highest and lowest gross income, net returns, and benefit-costratio were observed in V16 (Great Lakes) and V15 (Butterhead Green).The cost of cultivation was high in soilless media which resulted in less gross income, net returns, and benefit-cost ratio compared to soil.From all these results we can infer that soil was the best media for lettuce production Lollo Rossa was the best variety among leafy types whereas Great Lakes was among head types.

3.2.7 Role of Smart Technologies for Efficient Management of Ornamentals and Flowering Plants Under Protected Cultivation

Swapnil Bharti[1], Sachin A.J.[2], Paramveer Singh[3], R.B Verma[4] and Avanish Kumar Singh[5]
[1,3] Assistant Professors (Floriculture & Landscaping)
[2] Assistant Professor (Medicinal & Aromatic Plants)
[4]Chairman, Horticulture (Vegetable & Floriculture)
[5]Assistant Professor (Vegetable Science)
Department of Horticulture (Vegetable & Floriculture)
Bihar Agricultural University, Sabour, Bhagalpur
Email: swapnilbharti315@gmail.com

India's horticultural sector is heavily dependent on floriculture, which also makes a substantial contribution to the country's agricultural economy and global market presence.The cultivation of ornamental plants and high-value flower crops are taken up in relatively smaller areas inside protected structure but yield higher returns per unit area due to their high market value.These structures are typically enclosed environments where growth conditions (e.g., lighting, temperature, humidity, and irrigation) can be controlled.However, the cost of labor, agricultural inputs, unavailability of skilled manpower and inappropriate application of agricultural resources has become the major concern of the ornamental industry.Therefore, sensing and automation technologies have been introduced to reduce labor requirements and to ensure efficient management operations.These technologies have been categorized into two groups: ground based and aerial based.Precision agriculture techniques, coupled with sensor technologies, are also revolutionizing the way flowers are cultivated.By monitoring temperature, nutrient content, and moisture levels, sensors placed in the soil allow producers to optimize their fertilization and irrigation techniques.This information and technology for site-specific farming allows farmers to identify, analyze and manage the spatial and temporal variability of soil and plants for optimum profitability, sustainability, and protection of the environment.Additionally, remote sensing technologies, such as aerial imagery and drones, provide real-time data on crop health, allowing for early detection of diseases and pests.They are not only enhancing crop yields and resource efficiency but also play a crucial role in sustainable and environmentally responsible farming practices as the world faces the challenges of feeding a growing population while conserving natural resource, sensor -based agriculture stands out as a pivotal solution to address this pressing issue.

Keywords*:* Precision farming, Ornamental plants, Smart Agriculture, Sensor

3.2.8 Smart Monitoring System for Protected Cultivation Towards Sustainable Agriculture Management

Paramveer Singh, Sachin A.J., Swapnil Bharti and Ajay Bhardwaj
Department of Hort.(Veg.& Flori.), Bihar Agricultural University, Sabour
Email: shekhawatdeep@rediffmail.com

Food security has become a growing global concern in the 21st century, with the growing global population, urbanization, and climate change presenting significant challenges to sustainable agriculture.Farmers face many challenges that hinder their capability to produce crops sustainably, including limited access to water, unpredictable weather, and high energy charges.In addressing these challenges, there is a necessity for advanced solutions that force technology to augment crop growth and lessen waste. Protected cultivation technology offers the potential to increase crop production per unit area and ensure crop production

throughout the year by controlling environmental conditions.Regulating the growth and health of plants in protected cultivation is essential to ensuring optimum crop production and making agriculture more efficient.However, this is laborious work and is currently done manually.Digital Twins can be considered a new phase in smart and data-driven protected horticulture. A Digital Twin is a digital equivalent to a real-life object, in which it mirrors its behaviour and states over its lifetime in a virtual space. Research shows that they can significantly increase productivity and sustainability and are able to deal with the increasing scarcity of green labour in protected horticulture.The concept of the Digital Twin is in a formative stage in protected horticulture, but there are existing applications that are not framed as Digital Twins yet. There is a main emphasis on the cultivation process at the greenhouse level, among others for climate control, energy management, and lighting. Advanced applications, including predictive and prescriptive abilities across the complete lifecycle, are still in an initial phase of development, although predictive Digital Twins are gaining prominence. Studies carried out in different parts of the world and in different climatic conditions have made it clear that it is very important to use smart technologies to solve the problems experienced in the field of protected cultivation, both locally and globally. For this reason, grow agricultural products in protected structures controlled by smart systems.

Keywords: Climate change, protected cultivation, sustainability, real-life, smart technologies

3.2.9 Exploring the Relationship between Temperature Increase and Water Requirement for Banana

P.A. Pandya*, G.V. Prajapati, D.D. Vadalia and S.H. Parmar
Centre of Excellence on Soil and Water Management
Office of the Research Scientist (Agril.Engg.), RTTC
Junagadh Agricultural University, Junagadh-362001 (Gujarat)
Email: papandya@jau.in

Climate change alters temperature and precipitation patterns, leading to shifts in weather conditions such as increased temperatures, changes in rainfall patterns, and more frequent extreme weather events like droughts or floods.Efficient water management is essential for sustainable agriculture, especially in regions like Saurashtra where water resources are limited or under pressure due to competing demands.Estimating crop water requirements allows farmers to allocate water resources effectively, balancing the needs of banana cultivation with those of other crops and stakeholders.The present study was conducted for Junagadh station in Saurashtra region of Gujarat, India to analyse the effect of temperature increase in crop water requirement of Banana using FAO-56 CROPWAT model.The trend analysis of minimum and maximum temperature revealed using Mann Kendal test revealed that the minimum temperature is increasing.The crop water requirement for banana for the average climatic data from 1980 to 2020 was estimated as 1736 mm.One and two Degree increase in minimum monthly temperature will result in increase of annual CWR of banana as 1743 mm and 1751 mm respectively.This demonstrates a continued incremental rise in water demand with higher minimum temperatures.One and two degree increase in maximum monthly temperature will result in a crop water requirement of 1769 mm and 1801 mm respectively.Overall, the data underscores the sensitivity of banana crop water requirement to changes in temperature, with higher temperatures generally correlating with increased water demand.This information is valuable for agricultural planning and adaptation strategies in the face of climate change, emphasizing the importance of efficient water management practices and resilient crop varieties.

Keywords: Climate change, Water management, Banana cultivation, Temperature increase Crop water requirement, Adaptation strategies

3.2.10 Evaluation of Tomato Varieties Under Poly House and Net House Condition

D.K. Varu* and K.D. Patel**
**Principal and Dean, College of Horticulture, JAU, Junagadh, Gujarat*
***Principal, College of Polytechnic in Horticulture, JAU, Junagadh, Gujarat*
Email: dkvaru@jau.in

An experiment was conducted to investigate the effect of growing conditions and different varieties in tomato.The experiment was conducted at High-Tech Park, College of Horticulture, JAU, Junagadh (Gujarat).The treatments comprised with two growing conditions like Naturally ventilated poly housee (P1) and Net house (P2) with different varieties like GT-1 as a check, Badshah, Laxmi, Samrat, Red gold, Angha, VNR 3335 and Shaktoiman.The fruit yield and yield attributes like fruit length, fruit weight, number of fruit/ plant and fruit yield (kg/pl.& ton/ha) were exerted significant effect due to various protected conditions except fruit girth.Significantly, maximum fruit length (58.03 cm), fruit weight (60.45 g), number of fruits per plant (27.53) and fruit yield (1.23 kg/pl.& 60.93 t/ha) were recorded in net house (P_2) as compared to poly house (P_1).Similarly, the variation was also exerted significant effects for yield parameters during all the years as well as pooled for varieties.Maximum fruit girth (53.86 cm) was noted in Badshah (V_2) but was found at par with Lakshmi (V_3), Samrat (V_4), Red Gold (V_5) & Shaktiman (V_8).Similarly, maximum fruit length (67.46 cm), number of fruits per plant (34.51) and fruit yield (1.49 kg & 73.49 t/ha) were registered in Red Gold (V_5) followed by Samrat (V_4).However, highest fruit weight (66.28 g) was noted in Shaktiman (V_8).Likewise, poor performance was observed in GT-1 (check).The effect of different protected condition was found significant during both the years and pooled.Maximum plant height and No.of branches per plant were also recorded in net house (P_2).Similarly for varieties, the variation was also observed significant highest plant height and number of branches per plant (310.20 cm & 12.95) were registered in variety GT-1 (Check) followed by Badshah (V_2).Flowering and fruit setting are the important parameter which reflects on earliness of the crop.The variation was observed significant during all years and pooled for all parameters except fruit setting percentage for protected conditions.Significantly, lowest days to flowering, days to maturity and days to first picking (40.33, 76.08 & 81.94 days) were noted in net house (P_1).In case of varieties, minimum days to flowering, fruit setting & first picking (38.94, 54.50 & 81.89 days) were noted in Lakshmi (V_3), Samrat (V_4) and Shaktiman (V_8), respectively.Maximum fruit setting percentage (53.65%) was recorded in Red Gold (V_5) but was observed at par with Shaktiman (V_8).The interaction effect between protected conditions and varieties were observed non significant for all flowering and fruit setting parameters.For quality parameters, highest acidity (0.49%) and TSS (5.20 ^{0}B) was noted in naturally ventilated poly house (P_1).Similarly, highest acidity and TSS (0.53% and 5.64 ^{0}B) were recorded in hybrid GT-1 (V_1), whereas, highest ascorbic acid (252.56 mg/100 g) was noted in Badshah.The organolaptic characters were also exerted significant due to different environment condition and highest score of color, flavor, taste, texture and overall acceptability were recorded in net house (P_2).In case of varieties, highest score of color, flavor, taste, texture and overall acceptability were recorded in Red Gold (V_5).

Keywords*:* *Tomato, Badshah, Quality, Green house, net house, Organolaptic parameters*

3.3 Poster Presentation

3.3.1 Effect of Soil and Soilless Media on Biochemical Composition of Lettuce (Lactuca sativa L.) Cultivars under Protected Condition

Thushal R.Y., **Awani Kumar Singh, Gograj Singh Jat, Jeetendra Kumar Ranjan, Ram Asrey, Gyan Prakash Mishra and Bhawana Singh**
ICAR- Indian Agricultural Research Institute, New Delhi-110012, India
Email: singhawani5@gmail.com

An experiment was conducted at the Centre for Protected Cultivation and Technology (CPCT), ICAR-Indian Agricultural Research Institute, New Delhi during 2022-23 to study the effect of soil and soilless media on the biochemical composition of lettuce cultivars under protected conditions.This experiment was laid out with a factorial randomized block design with 3 replications.Biochemical traits such as total soluble solids/TSS (p brix), antioxidant activity (DPPH inhibition %), respiration rate (ml CO 2 /kg/h), moisture content (%), chlorophyll content (mg/g FW), total carotenoid content (mg/g FW) and ascorbic acid content of different lettuce genotypes were studied.All the varieties grown in soil media showed a slight increase in biochemical composition compared to soilless media (Cocopeat) except for total carotenoid content.From this study, we can conclude that soil is a suitable medium for growing lettuce genotypes in protected condition as compered to open field condition.

Keywords: Soil, Soilless, Lettuce, Protected condition, Biochemical composition.

3.3.2 Effect of Different Sowing Time and Planting Distance on Growth, Yield and Quality of Okra (*Abelmoschus esculentus* (L.) Moench)

[1]Dixita Padhiyar and [2]B.R.Gondaliya
[1&2]Ph.D.Scholar, Department of vegetable science, COH, JAU, Junagadh, Gujarat
Email: - dixitap963@gmail.com

The experiment entitled "Effect of different sowing time and planting distance on growth, yield and quality of okra (*Abelmoschus esculentus* (L.) Moench)" was conducted at the farm of Polytechnic in Horticulture, Junagadh Agricultural University, Junagadh during the year 2022 in summer season.Total nine treatment combinations comprising three sowing time *viz.,* 2nd fortnight of February (S_1), 2nd fortnight of March (S_2), 2nd fortnight of April (S_3) and three planting distance *viz.,* 45 cm × 30 cm (D_1), 60 cm × 30 cm (D_2), 75 cm × 30 cm (D_3) were allocated in Randomized Block Design with factorial concept in three replications.Result showed that okra seeds sown on 2nd fortnight of March (S_2) recorded maximum plant height (98.64 cm), number of primary branches (2.18), number of flowering nodes (16.87), days to last picking (90.11), pod length (12.91 cm), pod diameter (2.10 cm), number of pods per plant (15.22), average weight of 10 pods (120.52 g), total number of pickings (13.78), marketable pod yield (1.92 kg/net plot), marketable pod yield (4.62 t/ha), chlorophyll content (28.44 SPAD) and ascorbic acid content (6.57 mg/100 g).However, okra seed sown on 2nd fortnight of April reported minimum days to 50 % flowering (42.89) and first picking (46.78).In case of planting distance 75 cm × 30 cm recorded maximum plant height (82.20 cm), pod length (11.94 cm), pod diameter (1.96 cm), number of pods per plant (13.86), average weight of 10 pods (112.54 g) and ascorbic acid content (6.53 mg/100 g).However, maximum marketable pod yield per net plot (1.88 kg) and marketable pod yield per hectare (4.36 t) was recorded in treatment D_1 (45 cm × 30 cm).Interaction effect of sowing time 2nd fortnight of April and planting distance 60 cm × 30 cm recorded minimum days to

50 % flowering (41.67) and first picking (45.33).Whereas, among interaction of sowing time 2nd fortnight of March and planting distance 60 cm × 30 cm (S_2D_2) noted maximum number of flowering nodes (18.97) at final harvest, number of pods per plant (14.83), marketable pod yield per net plot (2.46 kg) and marketable pod yield per hectare (5.61 t).Though, the gross return (₹ 280433.33 per ha.), net return (₹ 207162.15 per ha.) and the benefit cost ratio (1: 2.83) were reported the highest in the plants sown on 2nd fortnight of March at the spacing of 60 cm × 30 cm (S_2D_2). Hence, for getting maximum yield, gross, net return and B: C ration okra should be sown on 2nd fortnight of March at the spacing of 60 cm × 30 cm.

Keywords: -Okra, Sowing time, planting distance, fortnight, marketable pod yield

3.3.3 Smart Horticulture

Monika Patel[1]* and R.B.Verma[2]

Department of Horticulture (Vegetable and Floriculture)
Bihar Agriculture College, Sabour
Bihar Agricultural University, Sabour, Bihar
Email monika91patel@gmail.com

Smart horticulture is another name for horticulture 4.0.Smart horticulture involves accurate perception, smart operation, and smart control during the cultivation, transportation, and sale of horticultural goods through the deep integration of biotechnology, engineering, information technology, and regulation technologies.It significantly raises productivity, resource-use efficiency, and land output rates.This encourages the horticultural industry's general sustainable improvement.Smart sensors, new-generation mobile communications, computers, IOT, big data, new-generation breeding, microclimate control facilities, cloud computing, and block chain are some of the novel technologies used in smart horticulture.Expert opinion is also very important.In this situation, labor input should be minimized while yield and quality are significantly increased using intelligent horticulture.Agricultural development can be bolstered by smart horticulture through increased productivity, optimized production patterns, and financial gains.In order to solve problems with productivity, environmental impact, food security, and sustainability, smart horticulture is essential.

Keywords: Smart Horticulture, New-generation Breeding, Microclimate Control

3.3.4 Effect of Biofertilizers and Growing Media on Growth of Air-layers of Pomegranate (*Punica granatum*) in Varying Climatic Conditions

Lunagariya Radhika J.*, D.K.Varu, Mithapara Kinnari, D.*** and Solanki sandhya M.******

*Ph.d.research scholar, Department of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh-362001 (Gujarat-India)
** Principal and Dean, College of Horticulture, Junagadh Agricultural University, Junagadh-362001 (Gujarat-India)
***Ph.d.research scholar, Department of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh-362001 (Gujarat-India)
**M.Sc.(Hori) Student.Department of Fruit Science, College of Horticulture, SDAU, Jagudan
Email: radhikalunagariya8@gmail.com

An experiment entitled Effect of biofertilizers and growing media on growth of air-layers of pomegranate (*Punica granatum L.)* was carried out under shade net house at College Farm, College of Horticulture,

Jagudan during kharif, 2021 and laid out by FCRD with three repetitions.Finding regarding effect of biofertilizers and media on growth of air layers is less hence the present experiment was conducted.It consists of total treatment combinations having two different biofertilizers [Bio NPK consortium and phosphorus solubilizing bacteria (PSB) and five different growing media combinations (soil + sand, soil + FYM, soil + vermicompost, soil + sand + FYM and soil + FYM + vermicompost) were used in 1: 1: proportion on volume basis.The maximum number of new shoots, length of new shoot, length of layer, number of leaves and stem diameter were recorded at 60 and 75 days respectively after planting along with maximum fresh and dry weight of shoot at 75 days after planting were recorded in pomegranate layers planted in bio NPK consortium as compared to phosphorus solubilizing bacteria (PSB).

Keywords: *Pomegranate, Biofertilizers, Growing media, Air layer, Growth*

3.3.5 Exploring the Future Prospects of *Bixa Orellana* Cultivation in Bihar Region

V. Shajeeda Banu and Awdesh Kumar Pal and D.R.Singh

Bihar Agricultural University, Sabour- 813210, Bihar

Email: shajeedabanu847@gmail.com

Bixa orellana, commonly known as annatto or sindoor plant, holds significant potential as a versatile crop with numerous applications in various industries ranging from food to pharmaceuticals.In recent years, Bihar has focused in agricultural diversification initiatives aimed at enhancing farmer's income and promoting sustainable practices.*Bixa orellana*, with its resilience to diverse climatic conditions and relatively low input requirements, represents a viable option for crop diversification in the region.Its adaptability to subtropical climates aligns well with Bihar's agro-ecological conditions, offering farmers an alternative cash crop that can flourish alongside traditional staples.The future of *Bixa orellana* cultivation in Bihar holds potential for economic empowerment at both the individual and community levels.The crop's high market demand, due its use as a natural food colouring agent, spice, and medicinal ingredient, offers profitable income opportunities for farmers.Moreover, its cultivation can contribute to employment generation and value addition through processing and marketing activities, thereby strengthening rural livelihoods.From an environmental perspective, *Bixa orellana* cultivation has the potential to enhance biodiversity and promote ecological sustainability.As a perennial shrub, it can serve as a natural barrier against soil erosion and contribute to carbon sequestration, thus mitigating the adverse effects of climate change.Moreover, the cultivation of *Bixa orellana* can enhance social development by empowering marginalized communities, including smallholder farmers and women, through inclusive value chains and capacity building initiatives.

Keywords: *Bixa orellana*, Bihar region, Crop diversification, Economic empowerment, Environmental sustainability.

4. TECHNICAL SESSION-4 (HALL NO.-1):

ADVANCES IN DIGITAL HORTICULTURE FOR PRODUCTION AND UTILIZATION OF FRUITS AND PLANTATION CROP

4.1 Keynote Lecture

4.1.1 Revolutionizing Temperate Horticulture through Digital Technologies

Mahendra Kumar Verma (ARS-1995)
IAHS Gold Medal, FIAHS, FISNS, FISHRD, FSHRD
ICAR-Central Institute of Temperate Horticulture
Old Air Field, Rangreth, Srinagar, Jammu and Kashmir, India, PIN-191132
Email: mahenicar10@gmail.com

The digital technologies are reshaping the landscape of temperate horticulture management, offering unprecedented opportunities for increased productivity, sustainability, and profitability.By leveraging IoT, AI, data analytics, and other digital tools, horticulturists can optimize resource utilization, minimize risks, and meet the growing demands of a rapidly evolving market.As we continue to innovate and embrace new technologies, the future of temperate horticulture management looks promising and exciting.

4.1.2 Retrospect and Prospects of Underutilized Semi-Arid Fruit Crops

A.K. Singh, D.S. Mishra, Jagdish Rane and Anand Sahil
ICAR-CIAH-Central Horticultural Experiment Station, Godhra, Gujarat
Email: aksbicar@gmail.com

India is origin of many fruit crops and the most of crops is limited to its growing region only.In spite of their high nutritional and medicinal properties their commercial cultivation is lacking.Most of underutilized fruits are in the core recipes of many *ayurvedic* formulations.The tribes of India are severely malnourished along with multiple nutrient-deficiency disorders due to ignorance about importance of fruits and vegetables in their diets.The tribal areas are full of biodiversity having natural vegetation which is not yet harnessed fully.Owing to which, a wide gap is existing between health and optimal use of natural sources of nutrients *i.e*., underutilized fruit crops.The fruit crops, which are neither grown commercially on large scale nor traded widely, may be termed as underutilized fruit crops.These crops are cultivated, traded, and consumed locally.These fruits have many advantages like easier to grow and hardy in nature, producing a crop even under adverse soil and climatic conditions.So, exploitation of underutilized fruit crops can be a solution of health and nutrition insecurity, poverty, and unemployment.The consumption of underutilized fruit crops can provide nutrition to the poor and needy masses by meeting the nutrient requirements of vulnerable groups.As underutilized fruits are a rich of source of carbohydrates, fats, proteins, energy, vitamins: A, B_1, B_2, B_3, B_6, B_9, B_{12}, C, folic acid, and minerals: Ca, P, Fe, and dietary fiber.These fruits are rich in bioactive compounds to prevent and cure various diseases like marasmus, night blindness, anemia, diabetes, cancer, hypertension, bacterial, fungal and viral infection, and hidden hunger.It is also established fact that seasonal, locally available, and cheap fruits can also keep the population healthy and nutritionally secure rather than costly off-season ones.The underutilized crops have the potential to give health and economic security to

the people by giving employment and by fetching good returns from their sale in raw form as well as value-added products.As many as 150 tropical, 50 subtropical, and 20 temperate fruits hold considerable value and the potential of a veritable treasure of a large number of world's fruits still remains to be explored and underutilized.Many underutilized fruits, well adapted to marginal lands and with low cost inputs, may thus be of great benefit for the survival of poor communities, employment generation and sustainability of agricultural ecosystems.The semi-region has strength to produce high quality ber (*Ziziphus mauritiana*), aonla (*Emblica officinalis*), bael (*Aegle marmelos*), pomegranate (*Punica granatum*), lasoda (*Cordia dichotoma*), khirni (*Monilkara hexendra*), karonda (Carissa congesta), jamun (*Syzygium cuminii*), chironji (*Buchanania lanzan*) tamarind (*Tamarindus indica*), wood apple (*Feronia limonia*), custard apple (*Annona squamosa*),fig (*Ficus carica*), phalsa (*Grewia subinaequalis*), mulberry (*Morus nigra*), acid lime (*Citrus aurantifolia*), manila tamarind (*Pithecellobium dulce*), Indian date (*Phoenix ductylifera*),timru (*Diospyrus melenoxylon*), mahua (*Madhuca indica*),pilu (*Salvadora oleoides),*kair (*Capparis decidua*) and palmyra palm (*Borassus flabellifer*) in fruit crops.There is need of hour to explore plant genetic resources, nutracetical and economic potential, and development of climate smart production technologies of these crops to make the wasteland of semi-arid region productive, resulting into better socioeconomic conditions of the farmers of region.

4.1.3 Use of Digital Technologies for Smart Production of Grape: A Review

R.G. Somkuwar and Rutuja Nale
National Research Centre for Grapes, Pune – 412 307
Email: rutujanale2502@gmail.com

There is a need to continuously monitor the long-term impact of viticultural management practices and to assess the possibility of improving the environmental impact of vineyards.This is particularly important in grape vineyard, since growers face challenges related to climate change, labour shortages and increasing production costs.In recent years, there has been a significant development and testing of non-invasive digital technologies, some of which have already led to improvements in the cultivation, management and harvesting of grapes in order to produce high-quality grapes in environmentally friendly way.In this paper, we describe a number of sensing technologies, including spectroscopy, multispectral and hyperspectral imaging, chlorophyll fluorescence, thermography as well as the platforms where they are generally mounted remote monitoring.Artificial intelligence (AI) has also been discussed as a means of transforming data into different pieces of information used by grape growers to make informed decisions.The main objective of the use of these technologies is to obtain and provide data and information to grape growers in order to improve the management of land and vineyards through a more informed decision-making process.The current and future application of these technologies and artificial intelligence in vineyards is discussed in terms of soil properties and topography, vegetative growth, canopy structure, nutrient and water status, pests and diseases, crop forecasting, yield and fruit composition, vineyard sampling, targeted management and selective harvesting.

Keyword: Digital viticulture, Precision viticulture, Smart viticulture, Artificial intelligence, Remote sensing

4.1.4 Advances in Precision Production of Fruits through the Use of Digital Technologies

B.N.S. Murthy* and Sridhar Gutam
ICAR-Indian Institute of Horticultural Research, Bengaluru
Email: bns.murthy@gov.in

The integration of digital technologies has ushered in a new era of precision production in fruit cultivation, offering unprecedented opportunities for optimizing resource use, enhancing crop resilience, and improving overall farm productivity and profitability.In India, where fruit production plays a vital role in agricultural livelihoods and food security, digital innovations hold immense potential in addressing pressing challenges such as water scarcity, climate change impacts, and market volatility.Collaborative efforts between government agencies, research institutions, technology providers, and farmer communities are crucial in fostering a conducive ecosystem for digital adoption and innovation diffusion.The future of precision fruit cultivation lies in leveraging data-driven insights, adopting sustainable practices, and harnessing the power of digital technologies to create a resilient, efficient, and thriving fruit sector in India.

4.1.5 Digital Technology in Production of Palms with Special Reference to Oil Palm

P. Rethinam
Plantation Crops Management Specialist
18,Lakshmi Nagar, S.N.Palayam, Coimbatore 641007, Tamil Nadu, India
Email: palms02@hotmail.com; Palms002@yahoo.com; dr.rethinam@gmail.com

Digital technologies encompass a wide array of electronic tools and resources that manipulate, store, or analyse data, driving continual enhancements in agriculture.In the realm of agriculture, these tools, including social media, mobile devices, online platforms, and multimedia applications, have become instrumental in transforming practices.Particularly in the cultivation,of various palm crops such as Coconut, Arecanut, Oil Palm, date palm, and Palmyrah, key digital technologies are driving significant advancements.Robotics revolutionizes harvesting by enhancing efficiency and precision, while IoT and Sensors play a vital role in monitoring produce, assessing environmental conditions, and tracking soil moisture levels in real-time.Artificial Intelligence (AI) empowers predictive analytics and improves decision-making, especially in fertilizer optimization and pest management.Drones enable aerial surveillance for detecting palm health issues, spraying pesticides, applying fertilizers, and optimizing irrigation and harvest timings.Additionally, Extended Reality and The Metaverse enhance health and food safety through immersive experiences, while Virtual Reality (VR) offers virtual field experiences, aiding in training and decision-making.Data Analytics unlocks insights for farmers and food producers, boosting productivity and efficiency, while Blockchain addresses consumer concerns about food safety and traceability.Cloud Connectivity offers real-time internet connections, providing flexible resources and economies of scale to propel palm cultivation into the digital age.

However, despite the availability of high-yielding varieties, Coconut, Arecanut, and Oil Palm remain underutilized, highlighting the need for further optimization through digital technologies.These technologies, such as AI and drones, optimize cultivation practices by predicting pest outbreaks and automating tasks.AI enhances Coconut fertilizer usage and drying processes, while weather forecasting aids in threat detection, protecting crops from droughts or heavy rainfall.In Arecanut and Date Palm farming, AI improves efficiency

and sustainability, with AI-powered sensors monitoring environmental variables and drones aiding in pollination.For Oil Palm, AI manages pests and predicts harvests, fostering sustainability.While digital technology has already transformed palm cultivation, further efforts are needed to realize its full potential and address challenges in the industry.

4.1.6 Potential of Oil Palm Cultivation in North Eastern Region for Import Substitution and Vegetable Oil Security in India

K. Suresh
Director, ICAR-Indian Institute of Oil Palm Research, Pedavegi, Andhra Pradesh, India
Email: Director.iiopr@icar.gov.in

North Eastern region of India is bestowed with a unique topographic and climatic composition which is broadly different from rest of India.This requires a special attention and hand holding to bring the region back to growth trajectory which it enjoyed a few decades back.Majority of the population in this region are dependent on Agriculture for their livelihood and the fruits of real green revolution are yet to benefit these areas.On the other side, the gap between demand and production of edible oils of the country has never shown a trend of narrowing down, during recent times.Further, with increasing population and purchasing power parity, this gap is expected to be further widened.Statistically, around two-thirds of domestic edible oil demand are met by imports which accounts to Rs.1,57,000 crores per year.Among these imports, palm oil plays a major role by occupying prime position with a contribution of nearly 60 per cent in volume.Incidentally, oil palm is known to be the highest oil yielding crop with an economic life span of 25 to 30 years.It has the potential to bridge the gap between demand and supply of edible oils.

In vision 2020 of North-Eastern council, widespread promotion of horticulture and floriculture is recommended for the development of NER.Complementing to it, the committee on “Reassessment of potential areas for oil palm cultivation in India and revision of targets upwards” has identified suitable areas for cultivation of oil palm in NE region.A GIS based suitability assessment was made with the available spatial information on the critical parameters of oil palm cultivation *viz*., rainfall quantum and distribution, minimum temperature, length of dry period, slope of the terrain and soil depth.All the states of NE region except Sikkim indicated suitability for oil palm cultivation to a tune of 9.62 lakh ha.Oil Palm development programme in the NER started with Mizoram taking the lead during 2006 followed by Nagaland, Arunachal Pradesh, Assam and Tripura and presently an area of 43,507 ha has been realized.

Oil palm is environmentally friendly crop.This crop has been introduced to India in an area of 4.25 lakh ha in various states.In none of the states, environmental issues are reported due to oil palm cultivation.Further, with its huge biomass producing nature it acts as a great carbon sink, helping in neutralizing the impacts of climate change.In India, it is not recommended to plant oil palm by replacing the existing forests.Therefore, oil palm plantation with long life cycle itself acts as a temporary forest and helps to improve the environment.The huge biomass generated in oil palm plantations adds to soil biological system and improves its condition.Oil palm responds very well to management and among all the practices recommended, water and nutrient management are the most important ones.For successful cultivation of oil palm in NE region, the growers need to follow important best management practices, which has been highlighted in the paper.

4.1.7 Advances in Precision Production and Utilization of Banana Using Digital Technology

R. Selvarajan
Director, ICAR-National Research Centre for Banana, Tiruchirappalli, Tamilnadu - 620 102
Email: selvarajanr@gmail.com

Precision agriculture is a swift developing and combines more technologies to monitor, improve the crop productivity and resource management.Digital technologysuch as artificial intelligence (AI), IoT, sensors, drones, and autonomous vehicles, as well as advances in data management and analysis tools, remote sensing technologies are providing detailed insights on crop health monitoring, precise irrigation and fertilization management.Bananas and Plantains (Musa spp.) are grown in 140 countries in tropics and sub-tropics and is one of the staple food crops and basis of livelihood of millions of people. Bananas represent the most traded fruit globally, prompting the development of analytical models utilizing digital technologies to address banana supply chain challenges.Thus, the use of machine learning and deep learning algorithms has a positive impact in the economic, social and environmental. Employing digital technologies across various stages of the banana supply chain, including pre-harvest, harvest, post-harvest, processing, and retail.Digital technologies applications in areas such as crop type classification, efficient monitoring of resources like water and soil, pests and diseases detection ripeness assessment, quality grading, yield prediction and decision support system.The farm will use AI to analyze data collected by weather monitoring stations and soil moisture sensors to control irrigation levels, section by section.Supervisory control and data acquisition systems are now being used to integrate and process the data needed to maximise the efficiency of irrigation systems in banana.A supply-chain tracking system will track the fruit from farm to market.Blockchain provides a secure method of storing and overseeing the data, which encourages the development and utilization of data-driven transformation for the smart farming systems.The targeted approach could help the farmers save the internal resources and increase banana yield and productivity.In this review article, the digital technology based precise banana production and value chain is discussed in detail

Keywords: Artificial intelligence, Smart irrigation, ripening, Forecasting, Banana supply chain, Drones, Internet of Things, Remote sensing, Future challenges.

4.2 Oral Presentation

4.2.1 Evaluation of Various Selections and Variety on Growth, Flowering, Yield and Quality in Papaya

D.K. Varu
Principal and Dean, College of Horticulture, JAU, Junagadh, Gujarat
Email: dkvaru@jau.in

An experiment was conducted to evaluate the different selections along with Pusa Dwarf as a check for growth, flowering, yield and quality traits in papaya.The experiment was conducted at Fruit Research Station, Madhadi bag farm, Department of Horticulture, College of Agriculture, JAU, Junagadh (Gujarat).The results revealed that the maximum number of fruits per plant (36.38) and fruit yield (33.81 kg/plant & 84.52 ton/ha) were noted in Selection-4 (GJP-1).The bearing height is good shine and the check variety Pusa Dwarf performed with lowest bearing height, but was found at par with Selection-4 (GJP-1).Variation in growth parameters was found significant and the lowest plant height and the maximum number of leaves/plant were recorded in Pusa Dwarf, while the highest stem girth was noted in Selection-6, but they were observed at

par with Selection-4 (GJP-1).Flowering is the main object of plant to target the yield.Significantly the lowest days to flowering was noted in Selection-1 but maturity in Selection-4.The maximum number of female flower/node was registered in Selection-3, whereas the highest length of pistillate flower, staminate flower and male flower stalk were noted in Selection-6, however, all were found at par with Selection-4(GJP-1).Among the various physical parameters studied, the highest fruit length & weight (25.02 cm & 1832 g) were noted in Selection-6, whereas the highest fruit girth (47.3 cm) was noted in Pusa Dwarf, but was observed at par with Selection-4 (GJP-1).It was also performed better for highest pulp weight (1327.93 g) and pulp seed ratio (1230.56).Likewise, the highest pulp-peel ratio (5.74) was noted in Selection-8, but the lowest peel weight (166.10 g) and seed weight (63.63 g) were registered in Selection-2 & 7.In the present study, Selection-6 & 4 (GJP-1) established its supremacy in quality parameters viz., TSS, total sugars, reducing sugar, non-reducing sugar over other selections.The organolaptic parameters have also great significant to judge the preferability of the variety.The highest score of pulp color and taste were noted in Selection-6 & 5, respectively, whereas the highest flavour, texture and over all acceptability were registered in Selection-2, however it was found at par with Selection-4 (GJP-1).Fruit firmness and shelf life of the fruit is also an important feature which enhances the more market prices for longer period due to good keeping quality.The highest fruit firmness and shelf life were noted in Selection-7.Papaya Ring Spot Virus (PRSV) is the major devastating disease of papaya.The result was also observed significant and the lowest PRSV infestation was noted in Selection-4 (GJP-1).

Keywords: Organolaptic parameters, Papaya, Papaya Ring Spot Virus, Shelf life, TSS

4.2.2 Variability for Flowering and Morphological Traits in Palmyrah Across Growing Regions in India

Sumitha.S*, B.Augustine Jerard, K.Rajendra Prasad, M.I.Manivananan, and Raja Goud
ICAR-AICRP on Palms, ICAR-CPCRI, Kasaragod 671124 Kerala
Email: sumithasundaram12@gmail.com

Palmyrah (*Borassus flabellifer* L.)belongs to family Arecaceae being a remunerative tree crop of dry lands is extensively grown from time immemorial all over India *viz.,*Tamil Nadu, Andhra Pradesh, Telangana, Chhattisgarh, Odisha, West Bengal, Bihar, Kerala, Karnataka, Goa, Maharashtra and Gujarat, to be more precise, almost every part of the tree is commercially valued and hence it is also designated as ‘Kalpaka Vriksha’.Occurrence of palms was also reported in Andaman Islands and NE region.Being a dioecious crop, first flowering in it aids in the identification of male or female Palmyra palm plant.Flowering in this crop occurs throughout the year.Male flowers are generally small in size and clusters of those flowers enclosed within inflorescence (catkin-based) producing bracts.Female flowers globose, green, carpel 3-4, stigma 3, sessile.The potentiality of this tree crop has been rightly felt, which is evident from the fact that innumerable products (both edible and non edible) are prepared from this poor man’s palm.Value added products can also be prepared from the matured fruits.One can have an edible sweet spongy haustorium or apocolon, on germination of the non edible seed nuts from ripened fruits.Fruits both fully ripened as well as immature are much valued for the delicious nungu and fibrous mesocarp.Variability for leaf production, petiole length, inflorescence branches, petiole spines, biometrical analyses for morphological and reproductive traits were noticed in palmyrah growing regions.There is a rich genetic diversity of palms with respect to palm height (dwarf and tall), fruit size (small to large), fruit shape (oval and round), fruit colour (blackish, orange, dark brown and yellowish) and numbers of endosperm per fruit (one to four).Observation of floral biology is undertaken and differences in the flowering period are observed over the locations.In west coast areas, the flowering initiated during July 2023 and observed till date (March 2024).On the east coast (Killikulam and Pandrimamidi), the flowering was observed from November 2024.In Odisha flowering commenced

during January 2024.At Sabour flowering not seen till February, 2024.The challenges in establishing palmyrah plantations are long juvenile phase, dioecious nature, absence of clearly defined dwarf or better performing genotypes and lesser information on breeding behavior.To enable systematic breeding in palmyrah, basic research on descriptor traits need to be further strengthened, through in depth germplasm characterization and better understanding of variability.

4.2.3 Influence of Pre-harvest Chemical Spray on Growth Pattern and Yield in Mango (*Mangifera indica* L.) cv.Mallika

Deepak Kumar[1], Kumari Karuna[1*], Abhay Mankar[2], Ahmar Aftab[1] and Vikash Chandra[1]

[1]*Department of Horticulture (Fruit & Fruit Tech.) Bihar Agricultural University Sabour, Bhagalpur – 813210, Bihar*

[2]*Dy.Dirctor Training, BAU, Sabour, Bhagalpur - 813210, Bihar*

Email: kkaruna10@gmail.com

The present investigation was carried out during the two consecutive years during 2020-21 and 2021-22 in the Department of Horticulture (Fruit and Fruit Technology), BAC, Sabour to study the "Influence of pre-harvest chemical spray on growth pattern and yield in mango (*Mangifera indica* L.) cv.Mallika".The experimental findings revealed that shoot length (15.15 cm) and leaf numbers/shoot (12.67) were maximum in treatment combination potassium nitrate (3 %) + urea (3 %) + salicylic acid (2000 ppm).Under reproductive parameters highest panicle length (18.48 cm), total number of flowers/panicle (1016.67), hermaphrodite flowers (32.21 %), duration of flowering (24.00 days), duration of fruit set (24.9 days), fruit set per cent (1.88), fruit retention per cent (18.94) and with lowest male flower (67.79 %), lowest fruit drop (81.06 %) as well as sex ratio (2.11) were recorded in the treatment combination of potassium nitrate (3 %) + urea (2 %) + salicylic acid (2000 ppm).Regarding yield parameter the maximum number of fruit/plant (38.83) was obtained from treatment combination potassium nitrate (3 %) + urea (2 %) + salicylic acid (2000 ppm).Hence from the experiment, it could be concluded that the foliar feeding of the combination of potassium nitrate (3 %) + urea (2 %) and salicylic acid (2000 ppm) during last week of October & mid-November was the best time to increase yield potentiality of mango cv.Mallika with improved fruit quality under subtropical condition of Bihar, India.

4.2.4 Utilising GIS and Remote Sensing in Fruit Crops

Bhadarka Chandni R.[1], Janika Vallabhbhai Bhadarka[2], N.N.Karmur[3] and D.R.Kanzaria[4],

[1*]*Ph.D.Scholar, Department of Fruit Science, College of Horticulture, JAU, Junagadh*

[2]*Ph.D.Scholar, Department of Floriculture and Landscape Architecture, College of Horticulture, JAU, Junagadh*

[3]*Department of Horticulture, College of Horticulture, JAU, Junagadh*

[4]*Associate professor, Department of Fruit Science, College of Horticulture, JAU, Junagadh*

Email: bhadarkachandni@gmail.com

Fruit crops have a significant impact on improving land productivity, creating jobs, growing exports, improving the financial standing of farmers and business owners, and providing people with food and nutrition security.An updated and trustworthy database is necessary for methodical planning and decision-making in order to manage the dominant crops effectively and expand the area under fruit crops. A cutting-edge technique for enhancing scientific management techniques for fruit crops is remote sensing (RS).It helps compile and

update data. The fields of remote sensing and geographic information systems (GIS) are becoming more and more exciting and useful these days. They offer vital tools that can be used at many levels to help make decisions that will ultimately lead to sustainable socioeconomic development and the preservation of natural resources. Fruit crops have successfully benefited from the application of GIS and remote sensing technologies in recent decades.The quick planning of various control management programmes can be greatly aided by GIS and remote sensing. Additionally, GIS and remote sensing have been used in tandem in a number of studies to address developmental planning-related problems. A reliable data base for baseline information on natural resources is also provided by remote sensing, which is necessary for the design, execution, and oversight of any developmental programme.

Keywords: GIS, remote sensing, fruit crops, natural resources *etc.*

4.2.5 The Impact of Fertilizers and Paclobutrazol on the Reproductive Patterns of Revitalized (*Mangifera indica L.*) cv.Kesar Mango Trees

S.K. Bhuva, N.D. Polara, D.R. Kanzaria, H.N. Patel and D.K. Varu
Assistant Professor, Department of Horticulture, College of Agriculture, JAU, Junagadh
Associate Professor, Department of Horticulture, College of Agriculture, JAU, Junagadh
Principal and Dean, COH, JAU, Junagadh
Email: skbhuva@jau.in

The field experiment was conducted at FRS, JAU, Junagadh during 2016-19 to increase growth, yield and fruit quality of rejuvenated mango tree for the benefit of farmers whom have very old orchard of cv.Kesar mango under south Saurashtra Agro- Climatic conditions.This experiment was laid out in the Factorial RBD with 9 treatments combinations were replicated thrice.The treatment comprised of three levels of RDF (FYM 100 kg + 750 g N + 160 g P + 750 g K) of mango viz., 100 %,125 % and 150% and three levels of paclobutrazol i.e.0.0, 5.0 and 7.5 g.a.i.From it, The maximum canopy spread (N-S) (3.90 m), (3.73 m) and (E-W) (4.11 m), (3.95 m) in (F_3) and (P_1) respectively in pooled.While minimum days to flowering 184.41, 183.66 and minimum days to full bloom 202.78, 204.31 in (F_3) and (P_3) respectively in pooled.In case of yield, maximum no.of fruits/tree (128.17), (138.64) and fruit yield (26.83 kg/tree), (26.61 kg/tree) in (F_3) and (P_3) respectively in pooled.In quality, Maximum TSS (18.99) and minimum acidity (0.19) was recorded in (P_3).Maximum Non-reducing sugar 3.24, 3.67 in (F_3) and (P_3) respectively in pooled while Maximum total sugar (15.90) in (P_3).Application of F_3P_3 (150 % RDF along with soil application of paclobutrazol @ 7.5 g.a.i /tree) gave maximum no.of fruit/tree (155.48), fruit yield kg/tree (32.06),Non-reducing sugar (3.98) and total sugar (16.33).

Keywords: Fertilizers, Paclobutrazol, Rejuvenation and Mango

4.2.6 Effect of Time of Irrigation and Level of Pruning on Yield and Quality of Off-seasonal Custard Apple (*Annona squamosa* L.) cv.GJCA-1

J.S.Parasana*, D.K.Varu, D.R. Kanzaria and Shivani Patel
College of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat
jsparasana@jau.in

A field experiment was conducted to determine the different times of irrigation and level of pruning on yield and quality for induced early flowering and fruiting in custard apple (*Annona squamosa* L.) cv.GJCA-

1 at Fruit Research Station, Madhadi Baug, JAU, Junagadh, Gujarat, India during 2021-22.The results revealed that the number of fruits per tree was 41.60 kg per plant in the treatment of no irrigation which is the highest as compared to other treatments.The information is given to the scientific community that the custard apple should not be irrigated after completion of rest to take early flowering and fruiting due to higher temperatures of 41.4 ºC with lower humidity of 45.3 % in the Saurashtra region of Gujarat.

4.2.7 Performance of Different Varieties and Genotypes of Guava under HDP

N.D. Polara, S.K.Bhuva, P.A. Dafda, Pratik Pansuriya and D.K. Varu
Department of Horticulture, College of Agriculture, JAU, Junagadh
Email: ndpolara@jau.in

Guava is an important fruit crops.It is grown in many states on large scale including Gujarat, through climatic and edaphic conditions are favourable for cultivation of guava in Saurashtra region of Gujarat state.The area of guava is concentrated at Bhavanagar and Junagadh districts.There is good demand of guava in local markets and out of Saurashtra.Farmers intended to grow guava fruit crop probably because it is more economical.It is consumed as fresh and several valuable products *i.e.*nectar, jam, jelly and juice.Hence, the attempts was made for performance guava varieties for growth, yield and quality under HDP orchard with using six guava varieties Viz., V_1 – Lucknow-49, V_2 – Lalit, V_3- Shweta, V_4 - Allahabad Safeda, V_5 - Sarangpur Selection (Local) and V_6 - Bhavanagar Local and replicated four times.The spacing is 2.0 x 1.5 m and two tree per treatment.The maximum number of fruit per plant and fruit yield were reported in Lalit cultivar (V_2) for and it was at par with V_3 and V_1 varieties.The fruit weight was significantly affected by various treatments and the maximum average fruit weight was noted in Shweta cultivar (V_3) which was found at par with treatment V_6, V_1 & V_2.Similar trend was observed for pulp weight. Various varieties showed significant effect on quality parameters and the highest TSS, total sugar and reducing sugar was recorded in Sarangpur selection (V_5) and minimum acidity (0.356) was recorded in Lalit cultivar (V_2).

4.2.8 Effect of Growth Retardants on Papaya (*Carica papaya* L.) CV.GJP 1

D.R. Kanzaria, Chandni Bhadarka, N.N. Karmur and J.S. Parsana
College of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat
Email: dilip_kanzaria@yahoo.com

The investigation entitled ‘Effect of growth retardants on papaya (*Carica papaya* L.) cv.GJP 1 was carried out at Fruit Research Station, Lalbaug, Junagadh Agricultural University, Junagadh during the year 2022-23.The experiment was carried out in Randomized Block Design with three replications and 10 treatments comprised T_1- (Control), T_2- (Ethrel 150 ppm), T_3- (Ethrel 250 ppm), T_4- (Ethrel 350 ppm), T_5- (Cycocel 750 ppm), T_6- (Cycocel 1500 ppm), T_7- (Cycocel 3000 ppm), T_8- (Paclobutrazol 250 ppm), T_9- (Paclobutrazol 500 ppm) and T_{10}- (Paclobutrazol 1000 ppm).The result on the effect of growth retardants indicated that the treatment of cycocel 3000 ppm executed the minimum plant height (142.44 cm), average internodal length (2.87 cm), bearing height (63.97 cm), height of the plant at the time bearing (105.90 cm), leaf stalk length (46.51 cm), days to first flowering (61.83), days to first fruit set (66.61), male: female ratio (plant) (0.89) and highest number of leaves (33.74). The result on the effect of growth retardants indicated that the treatment

ethrel 250 ppm recorded maximum average fruit length (21.91 cm), average fruit circumference (44.25 cm), average fruit weight (1262.21 g), average pulp weight (1021.35 g), average peel weight (160.65 g), pulp: peel ratio (6.36), TSS (9.10 °Brix), total sugar (9.53 %), reducing sugar (7.99 %), non reducing sugar (1.54 %) and minimum average peel weight per cent (12.73 %).

4.2.9 Influence of Season and Climatic Conditions on Growth Parameters of Softwood Grafts of Sapota cv.Kalipatti

Mithapara Kinnari D.*, Karetha K.M., Lunagariya Radhika J.***, and Butani A.M.******

**Research Scholar, Dept.of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh*

***Associate Professor, College of Horticulture, Junagadh Agricultural University, Junagadh*

****Research Scholar, Dept.of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh*

*****Assistant Professor, College of Horticulture, Junagadh Agricultural University, Junagadh*

Email: kinnaridmithapara@gmail.com; Mob: 9737601933

An investigation was carried out at Hi-Tech Horticulture Park, Department of Horticulture, JAU, Junagadh during the year 2019-20.The treatments comprised of three level of season (S) viz., S1 = February-March (Summer), S2 = June-July (Kharif), S3 = September-October (Winter) and three level of environmental conditions (C) *viz*., C1 = Open field, C2 = Net house, C3 = Polyhouse.The experiment was laid out in Completely Randomized Design (CRD) with Factorial concept comprising nine treatment combinations with three replications.The result indicated among season February-March recorded highest scion length (8.04 cm) and (9.19 cm) at 90 and 120 DAG, respectively.September-October recorded maximum number of nodes per graft (8.50, 11.26, 12.29 and 14.43), highest graft girth (0.72 cm, 0.74 cm, 0.78 cm and 0.81 cm), highest rootstock length (19.19 cm, 19.58 cm, 20.09 cm and 20.55 cm) at 30, 60, 90 and 120 DAG, respectively and highest graft height (25.02 cm) and (26.08 cm) at 30 and 60 DAG, respectively.While maximum number of leaves per graft (8.57) and (11.43) at 30 and 60 DAG, respectively was noted in September-October whereas, (14.77) and (16.43) at 90 and 120 DAG, respectively was noted in February-March.The result indicated different environmental conditions polyhouse recorded maximum number of nodes per graft (5.87, 9.69, 11.03 and 13.58) and maximum number of leaves per graft (6.72, 12.59, 14.99 and 18.11) at 30, 60, 90 and 120 DAG, respectively whereas, highest graft girth (0.60 cm) and (0.65 cm) at 30 and 60 DAG, respectively and highest scion length (8.84 cm) at 120 DAG.The result indicated among interaction effect September-October + Open field recorded highest graft height (27.04 cm, 27.89 cm and 28.38 cm) at 30, 60 and 90 DAG, respectively and highest rootstock length (21.01 cm) and (21.26 cm) at 30 and 60 DAG, respectively.Maximum number of nodes per graft (8.80) at 30 DAG and was noted in September-October + Net house whereas, (13.13, 14.73, 18.33) at 60, 90 and 120 DAG, respectively was noted in June-July + Polyhouse.Maximum number of leaves per graft (8.90) at 30 DAG was noted in September-October + Net house while (14.00) at 60 DAG was noted in June-July + Polyhouse whereas, (16.30) and (19.90) at 90 and 120 DAG, respectively was noted in February-March + Polyhouse.

Keywords: Sapota, softwood grafting, season, environmental conditions.

4.2.10 Efficacy of IBA on Rooting of Cuttings, Growth and Survival of Croton (Codiaeum variegatumL.)

B. Malaviya[1], B.V. Thumar[2]
Email: malaviyashweta1zz1@gmail.com

The experiment was conducted at Hi-tech Horticulture Park, College of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) during September to December-2021.The experiment was laid out with Completely Randomized Design with four replications.Application of IBA @ 300 ppm proved to be significant for the hardwood cuttings of hibiscus for the parameters like minimum days required for sprouting (21.50 days), success percentage (85.00 %), survival percentage (82.32 %), number of leaves (15.05), number of shoots (3.60), leaf area (109.73 cm 2), length of main shoot (6.72 cm), girth of main shoot (2.81 mm), fresh weight of shoot (4.98 g), dry weight of shoot (2.69 g), number of roots (29.85), length of longest root (13.27 cm), fresh weight of roots (2.15 g), dry weight of roots (1.86 g), minimum mortality percentage (17.67 %) and maximum root: shoot ratio (0.43).

4.3 Poster Pressentation

4.3.1 Effect of Integrated Nutrient Management on Growth, Yield and Quality in Rejuvenated Guava (*Psidium guajava*) cv. Bhavnagar Red

J.S. Parasana*, D.K.Varu, Sandeep Makhmale and Shivani Patel
College of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat
Email: jsparasana@jau.in

A field experiment was conducted to determine the different combinations of integrated nutrient management on growth, yield and quality in rejuvenated guava (*Psidium guajava*) cv.Bhavnagar Red at Fruit Research Station, Madhadi Baug, JAU, Junagadh, Gujarat, India during 2020-21 and 2021-22.The results revealed that treatments exerted significant effects results.The treatment T4 showed a significant effect on fruit characters like fruit weight (155.22 and 158.11 g), length (8.03 and 8.15 cm), girth (7.78 and 7.86 cm), number of fruits per tree (513 and 523.67), yield (79.72 and 82.88 kg/plant as well as 22.08 and 22.96 t/ha) respectively.At the same time, quality parameters were also affected significantly.The maximum non-reducing sugar (4.75 and 4.79 %) was observed in fruits of treatment T8.However, minimum acidity (0.48 and 0.74 %) was reported in treatment T4 and T8 fruits.Total sugar (7.13 and 7.18 %), reducing sugar (2.39 and 2.44 %) and TSS (11.23 and 11.74 °B) were significantly affected by treatment T_4.Ascorbic acid (234.34 and 238.23) was found maximum in the fruits of treatment T_4 for 2020-21 and in T_3 for 2021-22, respectively.Farmers of South Saurashtra Agro Climatic Zone growing guava are recommended to apply 187.5 g of each N : P_2O_5 : K_2O/plant along with FYM 5 kg/plant + Vermicompost 2.5 kg/pl.+ *Azospirillum* 125 ml/pl.+ *PSB* 15 g/pl.as basal dose during *Kharif* season and remaining 187.50 g N/pl.as a split after completion of *Kharif* season for getting higher yield and net return.

4.3.2 Utilising GIS and Remote Sensing in Fruit Crops

Bhadarka Chandni r.[1], Janika Vallabhbhai Bhadarka[2], N.N.Karmur[3] and D.R.Kanzaria[4],

[1]Ph.D.Scholar, Department of Fruit Science, Department of Floriculture and Landscape Architecture, [3]Department of Horticulture, [4]Associate professor, Department of Fruit Science, College of Horticulture, JAU, Junagadh*

Email: bhadarkachandni@gmail.com

Fruit crops have a significant impact on improving land productivity, creating jobs, growing exports, improving the financial standing of farmers and business owners, and providing people with food and nutrition security.An updated and trustworthy database is necessary for methodical planning and decision-making in order to manage the dominant crops effectively and expand the area under fruit crops.A cutting-edge technique for enhancing scientific management techniques for fruit crops is remote sensing (RS).It helps compile and update data.The fields of remote sensing and geographic information systems (GIS) are becoming more and more exciting and useful these days.They offer vital tools that can be used at many levels to help make decisions that will ultimately lead to sustainable socioeconomic development and the preservation of natural resources.Fruit crops have successfully benefited from the application of GIS and remote sensing technologies in recent decades.The quick planning of various control management programmes can be greatly aided by GIS and remote sensing.Additionally, GIS and remote sensing have been used in tandem in a number of studies to address developmental planning-related problems.A reliable data base for baseline information on natural resources is also provided by remote sensing, which is necessary for the design, execution, and oversight of any developmental programme.

Keywords: GIS, remote sensing, fruit crops, natural resources *etc.*

4.3.3 Impact of Biofertilizers and Growing Media on Growth and Seedling Vigour of Tamarind (*Tamarindus indica* L.)

Y.Shiny Maria[1], P.Vinaya Kumar Reddy[2], M.Madhavi[3], Dr Salomi Suneetha[4]

[1] Ph.D Scholar, Department of Fruit science, Dr.YSRHU, College of Horticulture, Venkataramannagudem, AP

[2] Associate Professor, Department of Fruit science, Dr.YSRHU, College of Horticulture, Venkataramannagudem, AP

[3]Professor, Associate Dean, Department of Fruit science, Dr.YSRHU, College of Horticulture, Venkataramannagudem, AP

[4]Professor, Dean of Student Affairs, Department of Biochemistry, Dr.YSRHU, College of Horticulture, Venkataramannagudem, AP

Email: yspfromnsp7@gmail.com

Tamarind is a multipurpose plant as most of the tree parts are used in the chemical, pharmaceutical, food and textile industries.Root stock is the important criteria in the tamarind to produce healthy grafts for the propagation.To achieve this, substrates with biofertilizers and growing media is required for the production of quality planting material.Hence, an investigation was carried out at Dr.YSRHU- College of Horticulture, Venkataramannagudem, on 'Impact of biofertilizers and growing media on growth and seedling vigour of tamarind (*Tamarindus indica* L.)' in the year 2021- 22 with two factors.Biofertilizers(B) at 4 levels and

Growing media (M) at 4 levels with sixteen treatment combinations in a factorial randomized block design (FRBD) that was replicated thrice and observations were recorded.Among biofertilizers, *Azospirillum* (B_1) was found superior in the parameters viz., Minimum number of days required for initiation of germination, days taken for 50% germination, maximum germination percentage, total chlorophyll content of leaves.Whereas, media inoculated with PSB was found highest in fresh and dry weight of root.The media consists of soil + cocopeat + vermicompost (M_4) recorded maximum in total chlorophyll content, fresh and dry weight of shoot, vigour index I & II and root: shoot ratio.The interaction effect of M_4B_1 (Soil + cocopeat + vermicompost + *Azospirillum*) showed maximum chlorophyll content (62.73), fresh and dry weight of shoot (41.97 g and 13.99 g), vigour index I (7,725.74), vigour index II (1,396.06), fresh and dry weight of root (21.36 g and 7.12 g) and concluded as best treatment combination.

Keywords: *vermicompost, biofertilizers, Azospirillum, vigour index, chlorophyll*

4.3.4 Effect of Storage Temperature and Sarco-testa on Seeds of Oapaya *(Carica papaya* L.) to Sustain the Viability, Germination and Seedling Growth

K.D. Patel, I.L. Pithiya and Sinchana Jain N.R.
Principal Polytechnic in Horticulture, Junagadh Agriculture University, Junagadh-Gujarat
kdpatel@jau.in

The purpose of this study was to investigate the effects of storage temperature and the presence of sarcotesta on the viability, germination, and seedling growth of papaya seeds.This experiment was conducted at the College of Horticulture, Junagadh Agriculture University in Junagadh district, Gujarat, during 2019.The experimental design was a factorial completely randomized design, featuring ten different treatment combinations.These included T1 (-4 ! with sarcotesta), T2 (0 ! with sarcotesta), T3 (4 ! with sarcotesta), T4 (8 ! with sarcotesta), T5 (Room temperature with sarcotesta), T6 (-4 ! without sarcotesta), T7 (0 ! without sarcotesta), T8 (4 ! without sarcotesta), T9 (8 ! without sarcotesta), and T10 (Room temperature without sarcotesta).The results indicated that treatment T10 (Room temperature without sarcotesta) yielded the highest germination percentage (61.00%), as well as the best outcomes in seed vigor index length and mass (2443.78 and 76.07, respectively), shoot length (13.50 cm), root length (26.53 cm), seedling length (40.03 cm), number of leaves (8.73), fresh weight (2.50 g), and dry weight (1.25 g) compared to all other treatments after a storage period of one month.Conversely, treatment T1 (-4 ! with sarcotesta) maintained the highest seed viability percentage (78.22%) over all other treatments after the same storage period.It was observed that seed and seedling growth parameters generally decreased as the storage period extended.

Keywords: Temperature, sarcotesta, seed viability, vigor index.

5. TECHNICAL SESSION-5 (HALL NO. 2)

DIGITAL PRODUCTION MANAGEMENT IN VEGETABLES AND ALLIED CROPS

5.1 Keynote Lectures

5.1.1 Advances in Precision Farming of Vegetable Crops using Digital Technology

Pugalendhi[1] and H. Usha Nandhini Devi[2]
[1] Former Dean (Hort.), Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore
[2]Associate Professor (Hort.), Centre for Post Harvest Technology, Agricultural Engineering College and Research Institute, Tamil Nadu Agricultural University, Coimbatore
Email: pugalabi@yahoo.co.in

Precision farming aims to increase crop quality and profitability by utilizing contemporary technologies like field mapping and satellite images.It also maximizes the utilization of conventional resources to foster sustainable agriculture, which helps to address the growing ecological and economic issues.Farmers receive information on all important areas, such as crop status, weather forecasts, environmental changes, *etc*., based on this data.Another significant distinction between precision farming and conventional agriculture is the latter's inability to manage fields as a unified block and instead must be divided into distinct areas.This type of zoning permits a variety of management choices for specific field segments, such as changing the amount of fertilizer, optimizing technique movement, and using fuel more frugally.Specialized tools and software are needed for precision farming in order to gather and process all the data.There are three categories into which precision agricultural technology can be divided: satellite, airborne, and ground.The former is appropriate for machine control, mapping, scouting, and production planning.The latter two are pertinent to solving greater global issues, such as yield state analysis in real-time from any location.Combining several technologies is advised to get unbiased data.Aerial technologies for crop management are based on using unmanned aerial vehicles (UAVs) or drones which are controlled remotely and consume less fuel.With IoT based precision agriculture, growers can control all the most critical information: from air temperature to soil conditions.Moreover, technology solves the problem of manually researching large farms by collecting data independently.Also, robotic systems are increasingly being introduced which can free up human labor for other tasks and use water more rationally.Precision farming and artificial intelligence are fields that are always evolving, offering newer instruments for controlling agricultural output.Applications that use image-based pattern recognition technology can modify plant feeding and watering schedules based on the type of plant.AI-enabled sprayers, for instance, are able to identify particular weeds and target them with precision without harming the crops that are being cultivated.Thus, precision sustainable agriculture is the most advanced farming system that allows solving both production and socially significant problems offering sustainable production.

Keywords: Precision farming-digital technologies – resource management – maximising output - sustainable production.

5.1.2 Potential Utilization of Digital Technology in Production and Trade of Floricultural Products

K.V. Prasad[1]*, S.P. Jeevan Kumar[1]
ICAR-Directorate of Floricultural Research, Pune-411036, Maharashtra, India
Email: kvprasad66@gmail.com

Floriculture industry is a part of lifestyle horticulture industry worth USD 300 billion.As per International Trade Centre, the global flower trade was valued at over USD 104 billion in 2019, with exports from developing countries accounting for a significant share of this value.

Flowers are always an integral part of Indian culture.They have been cultivated for aesthetic purposes, as also for their fragrance and extraction of nutraceuticals.Traditional flowers remains the backbone of Indian floriculture with 95% of area out of 305000 ha under loose flowers producing 2301000 MT.Cut flowers are grown in the remaining 5% of the area producing 762000 MT of different cut flowers (NHB 2019-20).

Consistent demand for new varieties to cater varied consumer preferences, shrinkage of natural resources coupled with climatic vagaries kindled to look for an alternative method of cultivation.Digital technology has played a prominent role in precision agriculture particularly artificial intelligence (AI) and Internet-of-all-things (IoT).These technologies uses the drones, sensors and GPS mapping to optimize the crop inputs with concomitant increase in yields with significant reduction in waste.Monitoring of plant growth and health would enable growers to supplement precise fertilization, irrigation and pest management practices that ultimately reduce the environmental impact of flower production (Ferroukhi et al., 2023).Moreover, deploying robotics, automation and AI have played prominent role in reducing labor costs with increased efficiency in flower cultivation.For instance, automated planting-cum-harvesting systems performed tasks with much rapid and pace than manual labour which reduces the cost of labour (Jha et al., 2019).

This paper highlights the recent developments in the area of digital applications in floriculture in the following areas

3D Imaging for landscaping
Artificial Intelligence
Block chain technology
Data analytics
Digital Flowers
Digital Monitoring
Drone Imaging and Mapping
Imaging technologies
IoT
Machine Learning
Online B2B B2C Trade
RFID based tagging
Smart Barcodes for traceability
Robotics in production, harvesting and management
Sensor based grading of flowers
Wearables for diagnostics
Smart Irrigation technologies
Smart Vertical production Systems etc.

The paper also deals with the role of digital technology in shaping the floriculture industry with few case studies and anticipates further research in this domain for edification of varied stakeholders involved in the domain.

Keywords: Artificial Intelligence, Digital Agriculture, Internet of All Things, Machine Learning

5.1.3 Use of Digital Technology for Efficient Management of Medicinal and Aromatic Plants

Manish Das[1*], N.Srinivasa Rao[2], Akanksha Srivastav[3]
[1] Director, ICAR-DMAPR, Anand 387 310, India
[2] Principal Scientist, ICAR-NAARM, Hyderabad 500 030, India
[3] Research Associate, ICAR-NAARM, Hyderabad 500 030, India
Email id: manishdas50@gmail.com

The cultivation and management of medicinal and aromatic plants (MAPs) have entered a transformative phase with the integration of digital technology into agricultural practices.The incorporation of sensors, drones, AI, IoT devices, and satellite imagery offers farmers better understandings into crop health, environmental conditions, and supply chain management.These digital tools empower farmers to make informed decisions, optimize resource allocation, and enhance the quality of medicinal and aromatic products.Digital platforms reorganize crop management, offering tools for planning, pest monitoring, and harvest forecasting.Blockchain technology ensures traceability, fostering trust in the authenticity of MAP products.Remote sensing technologies particularly satellite imagery contribute to crop monitoring, early pest detection and sustainable land management.This comprehensive approach signifies a necessary evolution in MAP cultivation, addressing the demand for natural and high-quality products in present-day markets and ensuring a resilient and productive future for the sector.

5.1.4 Precision Production Technologies in Spices and Development of Value Chain Using Digital Technology

[1]K. Nirmal Babu*, [2]V. Srinivasan, [2]LjoThomas and [2]Dinesh R.
[1]Formerly with ICAR-Indian Institute of Spices Research, Marikunnu PO, Kozhikode, Kerala
[2] ICAR-Indian Institute of Spices Research, Marikunnu PO, Kozhikode -673012, Kerala
[3]Formerly with Indian Council of Agricultural Research, New Delhi
Email: nirmalbabu30@gmail.com

Spices are high value and low volume commodities used in food, stimulant, preservative, flavour, colour, cosmetics, medicine and pharma.With diverse agro-ecological conditions India is the home of a wide range of spice crops and is the largest producer, consumer and exporter of spices in the world.Indian spices are the most sought after due to their exquisite aroma, texture, taste and medicinal value.

Due to high value output per unit area spice commodities play a vital role in the export sector of agricultural goods.The potential of technology and innovation ecosystems in spice value chain development and the trends in production and trade of spices in transforming new ideas into realty for profitability and sustainable viability of spice economy.To ensure global food security, technology interventions in the agricultural industry are becoming increasingly prominent and precise.The present agricultural revolution is being driven by technology and data analytics, and it appears to hold enormous potential for enhanced productivity, tackling climate change as well as a management of value chains.India has taken significant steps to embrace digital advancements in agriculture, aiming to revolutionize the farming landscape.Use of digital technology in developing market intelligence and traceability systems need to be leveraged to gain critical awareness and control of spice markets.Creating an active flow of information and resources from farm to fork in block chain can help to manage bottle necks and overcome the challenges posed in global spice trade.

Keywords: AI, Bigdata analysis, Block chain, Digital technologies, Economy, Innovation ecosystem, IoT, Market intelligence, Precision farming, Robotics, Smart farming, Spices, Value chain

5.1.5 Precision Production of Seed Spices using Digital Technology

Gopal Lal
Member (Ag.) Cauvery Water Management Authority (Ministry of Jal Shakti), GoI, New Delhi & Ex.Director, ICAR-National Research Centre on Seed Spices, Ajmer, Rajasthan
Email: glal67@yahoo.co.in

India is known for seed spices worldwide.We are the largest producer, consumer and exporter of seed spices on the planet.Seed spices contribute about 51.79 % of total area and 19.06 % of production of total spices in the country.Seed spices, the low volume and high value crops are most remunerative commodities of the arid and semi-arid regions of India.We also call them low input loving crops as they consume very less quantity of inputs.Pretending to the medicinal value and economic importance, lot of scope and opportunities are there in seed spices but many emerging biotic and abiotic challenges are also present which need to address for sustainable and quality production.Precision farming approach using digital technology can play a pivotal role in addressing the challenges in seed spices.Precision farming (PF) is a scientific farm management approach that uses IT to ensure that the crops and soil receive exactly what they need for optimum health and productivity.PF is a combination of various technologies rather than a one-off approach and allows for site specific management to utilize resources efficiently and get economic gains.

Precision farming and digital technology includes GPS, GIS, remote sensing, advanced data analytics tools, VRT, precise seeding, automated irrigation systems, MIS, GSS, LLL, YMM, combine harvesters with yield monitors, smart pest & disease management, PFM, Robotics & automation, IOTs, Drone technology etc.for fast & precise management.This 4thRevolution in Agriculture idea involves, Use of the IoT, that connects billions of physical devices around the world to the internet, all collecting and sharing data; big data, providing farmers granular data on rainfall patterns, water cycles, fertilizer requirements; AI to improve crop production & real-time monitoring, harvesting, processing, and marketing and Robotic system that can perform tasks like ploughing, sowing seeds, applying fertilisers and spraying pesticides with precision to accelerate and improve the efficiency of the activities throughout the entire production chain.

These different types of precision farming technologies and techniques collectively contribute to a more efficient, sustainable and productive agricultural industry.The nations' agriculture/ horticulture in general and seed spices sector in particular can attain new heights in production and export of quality produce matching with international standards, if we grow smartly using digital technology with precise approaches.Adoption of precision farming in this sector at large scale is most imperative for the production of quality produce for health & economic security and to save the valuable inputs vis-à-vis agro-ecosystem.

Keywords: Seed spices, precision farming, digital technology, precise management, quality sustainable production.

5.2 Oral Presentation

5.2.1 Evaluation of Chilli (*Capsicum annuum* L.) Genotypes for Yield and Leaf Curl Disease under Field Conditions

Swati Saha*, K. Chandrashekar, Savarni Tripathi, Basavraj, Devidas and Anil Khar
ICAR-Indian Agricultural Research Institute, Regional Station, Pune
Survey No.125A, Baner Phata, ITI Road, Aundh, Pune-411067
**Email id: swatisaha1980@gmail.com*

India is the major producer, consumer and exporter of chilli.Chilli exports contributes about 42% of the total quantity of spice exported from India.It is also one of the major components in Indian culinary as a spice for imparting pungency as well as colouring agent in food preparation. A large number of chilli varieties have been developed by different research stations for different agroclimatic regions.Hence, our objective was to evaluate chilli genotypes for yield and disease tolerance/resistance for Western Maharashtra Plain Zone (Pune).Twenty-three chilli genotypes were evaluated during rabi season of 2022-23 for yield traits and tolerance to leaf curl disease.Maximum number of fruits/plants was recorded in Pune Chilli Selection-1 (PCS-1; 252.82) followed by PCS-14 (205.91).However, maximum yield/plant (556.57g) and total yield (20.61 t/ha) was recorded in PCS-14 due to its larger individual fruit size which was much higher than the national average of 7-10 t//h.The ascorbic acid content was maximum in PCS-43 (176.67 mg/100 g) and maximum Total Soluble Solids were recorded in genotype EC787067 (11.57 R”B).Percent leaf curl index was lowest in PCS-1 (15%) and PCS-2 (18%) against the susceptible check Kashi Anmol (78.13%). Few promising chilli selections like PCS -14, PCS -1, PCS -2 and PCS -43 were identified for this agroclimatic region.These selections can be used in future breeding programmes.

Keywords: Chilli, yield, leaf curl index, TSS, Ascorbic acid

5.2.2 Kale (*Brassica oleracea* var acephala): a Potential Ornamental for Aesthetics in the Digital Era

Tarak Nath Saha#, Ganesh B.Kadam, D.V.S.Raju, M.R.Dhiman* and K.V.Prasad
ICAR-Directorate of Floricultural Research, Pune, Maharashtra
**ICAR-IARI Regional Station, Katrain*
Email: tarak.saha@icar.gov.in

In the digital world with the shrinking land, increased urbanization and quest for new & designer plants, a number of ornamental plants are being explored and utilized.Among all, Ornamental Kale (*Brassica oleracea* var acephala) is having a great potential due to its attractive leaves with brilliant succulent central portion.It is basically the same as the kale grown for vegetables, except the ornamental types have showy white or reddish-purple leaves.It is a cool season crop and is very closely related to cabbage, producing leaves in a tight rosette.They are also edible but have a bitter flavour.In the present study the ornamental kale varieties developed by ICAR-IARI Regional Station, Katrain were evaluated at ICAR-DFR under AICRP (Floriculture) for its utility as ornamentals (cut flowers and pot culture).

The results revealed that among the varieties evaluated *viz* KtDH-57, KtOK-39 and Crane Red (control) for Cut Flowers,the entry KtDH-57 performed well in terms of plant height (52.98 cm), diameter of stem (2.97 cm), average head size (13.94 cm), early for number of days taken to head formation (82.33) and number of days taken for colour development (108.22) besides, enhanced vase life of the head (8.66 days).The

leaf pattern was round for KtDH-57 and Crane Red, whereas wavy for KtOK-39.Similarly, both the inner leaf colour and colour of leaf margin were observed green for KtDH-57 and Crane Red (Yellowish green leaf margin), whereas it was purple for KtOK-39.The plant of KtOK-39 appeared to be more attractive, medium in height, better head formation with rosette type of look and was found suitable for cut flower under Pune condition.

Whereas for Pot Culture, among the varieties evaluatednamely KtOK-1, KtOK-2, KtOK-2-1, KtOK-3 and KtOK-4, KtDH-19 and Nagoya Mix (control),plant height was found maximum in KtOK (41.6 cm) followed by KtOK 2-1 (32.56 cm), KtOK-2 (28.55 cm) and least in KtOK-1 (21.72 cm).However, optimum height for pot plant is in the range of 26 to 28 cm.Plant spread (27.61 cm), stem diameter (3.24 cm) and average head size (14.27 cm) was found maximum in control.Duration of head retention on plant was more in KtOK-4 (37.55 cm) followed by control (36.22 days), KtOK-3 (35.55 days).The leaf pattern of all the tested entries were fringed and colour of leaf margin were green (Greenish to purple).Therefore, based on the evaluation KtOK-1, 2, 2-1 and 19 were found suitable under Pune condition.

Thus, ornamental kale holds a great potentially to be used as pot plant, cut stem (flower) as well as landscaping plants in the digital world.

Keywords: Ornamental Kale, cut flower, pot culture, head, rosette, leaf margin.

5.2.3 Pros and Cons of Digital Agriculture for Medicinal Plants Cultivation

Raghuraj Singh and Manish Das
ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand, Gujarat
Email: raghuraj9271@gmail.com

Digital agriculture has emerged as a transformative force in modern farming practices, extending its reach to the cultivation of medicinal plants.With the help of digital agriculture, a favourable environment may be created by making an automatic environmental controlled chamber for cultivation of medicinal plants.The inputs may be applied at variable rate as per requirement/deficiency of inputs in the medicinal plants cultivation field with the help of image analysis and transformed data combining with input applicator.The pros and cons of digital agriculture in medicinal plant cultivation are advantages and challenges involved.Advantages of digital agriculture in medicinal plant cultivation include precision farming techniques, enhanced monitoring and management, increased efficiency and productivity, improved quality control and promotion of sustainable agriculture practices.However, challenges include initial investment and technological barriers, data privacy and security concerns, dependency on technology, the digital divide, and ethical considerations.Addressing these challenges is crucial to ensure the responsible and inclusive adoption of digital agriculture practices in medicinal plant cultivation, fostering sustainability and socioeconomic development.

5.2.4 Cut Flower Quality Attributes of Different Dahlia (*Dahliavariabilis* L.) varieties in SaurashtraRegion of Gujarat

K.R. Zalaand K.M. Karetha
**1Ph.D Scholar Department of Floriculture and LandscapeArchitecture, COH, JAU,Juangadh,*
[2]Professor and Head, Department of Post-Harvest Technology, COH, JAU, Junagadh,
Email: kuvarsinhzala@gmail.com

Experiment was conducted with 16 different decorative types of dahlia varieties at Jambuvadi Farm, College of Horticulture, Junagadh Agricultural University, Junagadh which falls under South Saurashtra Agro-climatic Zone during two years, i.e., 2021-22 and 2022-23.Results obtained from the pooled data analysis for both the years under present studies pertaining flowering parameters with respect to different varieties are as under.Variety Good Day recorded less number of days (46.44) to initiate flower bud Variety Nearest Blue recorded largest stem girth (11.39 mm).Maximum flower diameter was recorded in Prime Minister (17.07 cm).Highest stalk length (25.46 cm) was observed in variety Pusa Sona.Highest weight of single flower (79.55 g) was observed in variety Pusa Sona.Maximum number of flowers per plant (5.56), per plot (83.50) and per hectare (21806.41) was produced in variety Pusa Sona.

Keywords: Dahlia, Cut flower, Stalk

5.2.5 Effect of Apical Pinching and Growth Retardants on Seed Yield Parameter of Okra (*Abelmoschus esculentus* (L.) Moench.) cv.GO-6

C.A. Babariya*, D.S. Deshmukh, M.J. Jadav and P.G. Mandod
Department of Seed Science and Technology, College of Agriculture
Junagadh Agricultural University, Junagadh – 362001, Gujarat, India
**Email:* cababariya@jau.in

The investigation was undertaken at the Sagdividi Farm, Department of Seed Science and Technology, College of Agriculture, Junagadh Agricultural University, Junagadh, during *kharif* 2021 to Effect of apical pinching and growth retardants on seed yield parameter of okra (*Abelmoschus esculentus* (L.) Moench.) cv.GO-6.Among 20, 30 DAS apical pinching which reducing the plant height (cm) and increase number of branches per plant, number of leaves per plant, dry weight of fruit (g), number of fruits per plant, days to harvest, fruit girth (cm), seed yield per plant (g), days to flower initiation.Without pinching (P0) increase the plant height at 30, 60, 90 DAS and harvest, fruit length, number of seed per fruit.To application of different concentration plant retardants tried, CCC 200 ppm [seed soaking + foliar spray (S3)] of treatment superior result in respect of dry weight of fruit (g), seed yield per plant (g), number of fruits per plant, number of branches per plant, fruit length (cm), fruit girth (cm), number of seed per fruit.However, CCC 400 ppm exhibited more number of leaves, days to flower initiation, days to harvest and minimum plant height at seed soaking stage (S1).

Keywords: Apical pinching, growth retardant treatment, okra, seed yield parameter

5.2.6 Soaking Kinetics of Green Chickpea var. Pusa 112

Anamika Thakur[1], Meenakshi Raina[1], Alka Joshi[1], Dinesh Kumar[1]
[1]Division of FS & PHT, ICAR-IARI, Pusa, New Delhi, India
Email: alka.foodtech@gmail.com

Pulses hold a crucial position in the Indian agricultural economy.Chickpeas serve as cost-effective sources of protein, energy, vitamins, and minerals.Conditioning of the grains is an essential step before any processing operation.Chickpea (*Cicer arietinum* L.) is an important pulse crop grown and consumed all over the world as it is a good source of carbohydrates and protein.The study was conducted using Pusa Green 112 variety of chickpea.Soaking characteristics of chickpea (Pusa Green 112) whole grain, kernel and hull was detarmined at temperatures between 20 to 100°C.The associated changes in grain properties (mechanical and physical) after soaking were also determined.It was found that water absorption increased with increase in temperature.The hydration rate decreased with increase in soaking time.The maximum moisture content of whole seeds, kernel and hull obtained at 100°C was 60.1% (w.b.), 56.3% (wb) and 65.1% (wb), respectively.Moisture diffusivity for whole chickpea during hydration in the given temperature range varied from $7.36 x10^{-4}$ to $1.29 x10^{-3}$ m^2/s while for kernel it was 0.044 to 0.083 m^2/s.Activation energy for hydration of whole Bengal gram was found to be 60.63kJ.mol^{-1} while that of kernel was 26.76 kJ.mol^{-1}.The changes in physical and mechanical properties as a result of hydration were determined in the moisture content range of 10-50% (wb).Linear relationships between physical properties of whole grain, kernel and hull with moisture content were established.

Keywords: *Soaking kinetics, Pusa 112, Moisture diffusivity, Activation energy*

5.2.7 *Moringa oleifera*: a Climate Smart Crop for Sustainable Production Systems

Lalu Prasad Yadav[1*], Gangadhara K.[1], V.V.Apparao[2], A.K.Singh[3] and Jagdish Rane[4]
[1-3], ICAR - Central Horticultural Experiment Station (CIAH), PMS (Godhra), Gujarat-389340
[4]ICAR- Central Institute for Arid Horticulture, Bikaner, Rajasthan- 334006
Email: yadavlaluprasad682@gmail.com

This study aimed to select elite germplasm based on nutritional, antioxidants and protein profiling of leaves of *Moringa oleifera* germplasm.Principal components analysis (PCA) using the fifteen nutritional traits of thirty-four accessions of *M.oleifera* indicated that 74.70% variability was accounted for the first six principal components (PCs) with eigenvalues e"1.The first principal component (PC1) had an eigenvalue of 3.6 and explained 23.90% of the total variation.Nitrogen, protein, magnesium, iron, zinc, calcium, and potassium had high positive eigenvectors in PC1.The second component (PC2) explained 15.27% of the total variance with an eigen value of 2.29 and positively correlated to copper, calcium, phosphorus, and total phenols.Protein content was significantly and highly correlated with nitrogen content in leaves ($r = +1.0$).High magnitude and significant correlation were found between FRAP and DPPH ($r = +0.9$).The thirty-four germplasm were investigated in this study on quality parameters at ICAR-Central Horticultural Experiment Station, Godhra, Gujarat, India and grouped in five main clusters.Distance estimates based on the fifteen qualitative traits ranged from 2734.15 to 3868.43.The cluster V had maximum mean values for nutrients (mg/100 g dw) iron (81.76),zinc (7.66), manganese (27.13), calcium (4470.58), magnesium (1068.28), sulfur (3758.68), nitrogen (4615.84), potassium (1558.51), protein (29.40 g/100 g), total phenols (900.21 mg GAE/100 g fw), DPPH (31.17 µmol (TE)/g fw) and FRAP (50.42 µmol (TE)/g fw).The

germplasm CHES D_40 and CHES D_45 (cluster V) could be utilized for further exploration based on their nutritional, antioxidants and protein content and for conservation of nutritionally superior germplasm for sustainable production.

Keywords: *Moringa oleifera,* Principal components, Antioxidants, Nutrients, Protein, Sustainable production

5.2.8 Estimation of hybrid vigour of fruit yield and its yield attributing character in okra [*Abelmoschus esculentus* (L.)Moench]

A.S. Jethava[1], Urvi Jakasania, S.N. Zinzala[2] and V.H. Kachhadia[3]
Associate Research Scientist[1], Agril.Officer[2] and Research Scientist (G-O) [3]
Vegetable Research Station, Junagadh Agricultural University, Junagadh
Email: vrs@jau.in

The present investigation was carried out to generate information on heterosis for yield and its components in okra [*Abelmoschus esculentus* (L.) Moench] through line x tester analysis.The experimental materials comprised of 6 lines, 4 testers and resultant 24 hybrids along with a standard check variety GJOH-4.The experiment was conducted in a Randomized Block Design with three replications for fourteen characters at Vegetable Research Station, Junagadh Agricultural University, Junagadh during summer and *kharif* 2021.Analysis of variance revealed highly significant differences among genotypes and hybrids for all the characters indicating the presence of sufficient amount of genetic variability for all the characters under study.On the basis of *per se* performance and standard heterosis 2017/OKYVRES-1 x HRB-108-2 was the best cross combination for fruit yield and its contributing characters followed by AOL-8-05 x Kashi Kranti.

Keywords: Heterosis, heterobeltiosis, standard heterosis, fruit yield, okra

5.2.9 Impact of Pollination on Yield and Quality of Musk Melon Fruits by *Tetragonula laeviceps* Smith in Net House Condition

V.C. Gadhiya[1], J.J. Pastagia[2] and M.K. Kanani[3]
[1]Assistant Professor, College of Agriculture,
Junagadh Agricultural University, Mota Bhandariya -365 610
[2]Professor and Head, N.M.College of Agriculture,
Navsari Agricultural University, Navsari -396 450
[3]Assistant Research Scientist, Agri.Res.Station,
Junagadh Agricultural University, Amreli- 365 601
Email: drvcgadhiya@jau.in

Studies on effect of pollination by *Tetragonula laeviceps* Smith on yield and quality of musk melon fruits in net house condition were carried out at Navsari Agricultural University, Navsari for two seasons during *Kharif*– 2013 and *Rabi*– 2014.The study was made by comparing two treatments *i.e.,* bee pollination by sting less bees and hand pollination (as musk melon is being completely cross pollinated crops).There was non-significant difference between the numbers of fruit set, per cent fruit set, weight of fruit, diameter of fruit length of fruit and total soluble solid content of fruit in hand pollination treatment and bee pollination treatments.However, the higher number of fruit set was recorded in treatments of bee pollination (13.40 fruits/20 flowers) as compared to hand pollination (12.40 fruits/20 flowers).The maximum mean per cent

fruit set was found in bee pollination (67.00%) than hand pollination (62.00%).The mean weight of fruit from hand pollination and bee pollination flower was 1189.40 g and 1271.93 g, respectively.The mean diameter of fruit from hand pollination and bee pollination flower was 11.62 cm and 11.66 cm, respectively.The mean length of fruit from hand pollination and bee pollination flower was 11.05 and 11.13 cm, respectively.The mean total soluble solid content of fruit from hand pollination and bee pollination flower was 11.21 per cent and 10.97 per cent, respectively.

Keywords: Stingless bees, *Tetragonula laeviceps,* Pollination, Per cent fruit set and Musk melon

5.2.10 *In vitro* Multiple Shoot Regeneration from NRCO Pahiopedilum-II Flower Bud

Mahamaya Banik, Suman Natta, Kalaivanan, N.S, Biswas, S.S., De, L.C., Ashok Kumar, Dibankar Saha and Sankar Prasad Das*

ICAR-National Research Centre for Orchids, Pakyong, Sikkim, 737106, India

Email: Sankar.Das@icar.gov.in

Paphiopedillum orchids are known worldwide for their mesmerizing beauty and very sturdy to grow meristematically. The available reported successes are from stem explants or ovule culture.Stem explants source enforced researchers to deploy the whole mother plant.So, present study was conducted as comprehensive assessments of flower bud efficiency for development of multiple side shoot to be utilized as a explants source of NRCO Pahiopedilum-2 stock variety which may avoid discarding the entire plant. The study was carried out at Plant Tissue Culture Lab of ICAR-NRC for Orchid, Pakyong, Sikkim.In this assessment four treatments(viz., Heller media, ½ strength Murashige and Skoog media, full strength Murashige and Skoog media, Gamborg media plus plant growth hormones, coconut water) each with five replications were carried out to identify best media composition for regeneration of explants to be utilize as *in-vitro* explants source for induction of callus or Protocorm like body (PLBs). The best media for meristems' regeneration of Paphiopedilum–II was with Heller media containing 2.21% Sucrose, 8.05% (v/v) Coconut water. The addition of growth substances (NAA, IAA, BAP or Kinetin) did not contribute in explants differentiation.

Keywords: Pahiopedillum, Explant, Orchid, Tissue

5.2.11 Effect of elicitors on vegetative growth, flowering and corm traits of gladiolus varieties

Tejashwani, P., K. Swaroop, M.K. Singh, K. P. Singh, Reeta Bhatia and V.K. Sharma

Division of Floriculture and Landscaping,

Indian Agricultural Research Institute, New Delhi-110012

E-mail: kishan.swaroop @rediffmail.com

Gladiolus (Gladiolus hybridus Hort.), commonly known as the sword lily, is a perennial bulbous flowering plant celebrated as the "queen of bulbous flowers." This accolade stems from its glamorous, attractive flower spikes which bear florets of substantial form, brilliant colors, striking shapes, and varying sizes, all coupled with an excellent shelf life. Native to South Africa, the gladiolus belongs to the monocot family Iridaceae and sub-family Ixiodeae. It is widely cultivated as a cut flower for interior decorations, bouquets, and for landscaping as borders and beds. Recent research on gladiolus cultivation has primarily utilized a broad spectrum of plant growth regulators (PGRs). However, there is an emerging interest in exploring the effects of growth elicitors—natural or synthetic compounds that stimulate a plant's defense mechanisms—on various gladiolus varieties. These studies focus on how elicitors affect vegetative growth, flowering, and corm traits. To investigate the impact of growth elicitors on the morphological characteristics of gladiolus varieties, an experiment was conducted at the research farm of the Division of Floriculture& Landscaping, Indian Agricultural Research Institute, New Delhi, during the winter season. The study examined the effects of Benzyladenine (BA), Naphthalene Acetic Acid (NAA), and foliar sprays of silicon in various concentrations and intervals on gladiolus varieties such as Pusa Shanti and PusaRajat.Initial results revealed significant effects on various traits of these gladiolus varieties under different concentrations and treatments of elicitors. Specifically, the variety Pusa Shanti achieved maximum plant height (115.00 cm), spike length (102.33 cm), number of shoots per plant (2.33), and number of florets open at a time (10.00) with the application of NAA at 150 ppm. Conversely, PusaRajat showed optimal growth with a foliar application of 2% silicon, resulting in the longest spike length (107.00 cm), rachis length (65.33 cm), number of florets per spike (21.66), and length of tepals (6.13 cm) compared to the control treatment. These findings indicate that certain traits in gladiolus can be significantly enhanced through the strategic use of different elicitors at various concentrations.

Keywords: Growth elicitors, Gladiolus varieties, Silicon

5.3 Poster papers

5.3.1 Estimation of Combining Ability for Fruit Yield and Its Yield Attributing Character in Okra [*Abelmoschus esculentus* (L.) Moench]

V.H.Kachhadia[1], Urvi Jakasania, A.S.Jethava[2], S.N.Zinzala[3]

Research Scientist (G-O) [1], Associate Research Scientist[2] and Agril.Officer[3]

Vegetable Research Station, Junagadh Agricultural University, Junagadh

Email: vrs@jau.in

The present investigation was carried out to generate information on combinig ability for yield and its components in okra [*Abelmoschus esculentus* (L.) Moench] through line x tester analysis.The experimental materials comprised of 6 lines, 4 testers and resultant 24 hybrids along with a standard check variety GJOH-4. The experiment was conducted in a Randomized Block Design with three replications for fourteen characters at Vegetable Research Station, Junagadh Agricultural University, Junagadh during summer and *kharif* 2021.Female parent AOL-8-05 and male parents HRB-108-2 and AOL-12-59 were found to be good general combiners for fruit yield per plant and thus can be exploited in future breeding programmes.The sca effects estimates revealed that six hybrids were found to be good specific combiners by exhibiting significant and positive SCA effect, the maximum magnitude of SCA effect was observed in 2017/OKYVRES-1 x HRB-108-2 (36.486) followed by 2018/OKYVRES-3 x Kashi Kranti (35.486) and AOL-8-05 x Kashi Kranti (34.903) which can be used as heterotic hybrids in future.

Keywords: Combining ability, gene action, GCA and SCA effects, fruit yield, okra

5.3.2 Enhancing Vegetable Productivity through Precision Agriculture

Avanish Kumar Singh[1], R.V.Verma[2], Anupam Adarsh[3], Swapnil Bharti[4], Amrita Kumari[5] and Sachin A.J.[6]

[1,4,5,6] *Assistant professor - cum – Jr.Scientist, Department of Horticulture (Vegetable & Floriculture) Bihar Agricultural University, Sabour Bhagalpur -813210.*

[2,] *Associate professor - cum – Senior Scientist, Department of Horticulture (Vegetable & Floriculture) Bihar Agricultural University, Sabour Bhagalpur -813210.*

[3,] *Assistant professor - cum – Jr.Scientist, Department of Horticulture (Vegetable Science) Nalanda College of Horticulture, Noorsarai.*

Email: Avanish2395@bausabour.ac.in

Precision agriculture (PA) has emerged as a transformative approach in modern agriculture, offering tailored solutions to optimize resource utilization, improve crop yields, and mitigate environmental impacts.It has important role in enhancing vegetable productivity, by integration of advanced technologies and data-driven strategies during cultivation process.It facilitates precise monitoring and management of various factors influencing vegetable growth, including soil quality, moisture levels, and nutrient content.The adoption of precision agriculture in vegetable farming has provided growers with advanced solutions to address food quality and security concerns.Automation technologies now enable the recording of various parameters like quality, color, size, shape, external defects, sugar content, and acidity, among other inner characteristics.It coupled with the monitoring of field functions such as synthetic substances sprayed and fertilizer usage, facilitates comprehensive vegetable and fruit processing methods.Vegetable quality and yield maps are particularly valuable during crop harvesting to ensure the separation of produce with different qualities.Precision vegetable farming continues to gain attraction in many developing nations, due to strategic guidance from both the public and private sectors to facilitate its widespread adoption.Precision agriculture based on "doing the right thing in the right place at the right time".It can be achieved by utilizing sophisticated information technologies, like Geographic Information Systems (GIS), which allows farmers to adapt to varying environmental variables, monitor plant health, estimate yields, and optimize crop production.It enables site-specific management practices as per requirements of different vegetable crops and growing conditions.It can develop predictive models for disease outbreaks, pest infestations, and yield fluctuations, allowing for timely crop management strategies.It has enhances seed placement accuracy and spacing uniformity, optimizing plant growth and maximizing yield potential. Automated systems for weed detection and removal enable efficient weed control measures, reducing competition for resources and minimizing yield losses.It has immense potential to revolutionize vegetable production by optimizing resource management and fostering sustainable farming practices.It has helped in ensuring food security in an era of increasing population growth and environmental pressures.

Keywords: Precision Agriculture, GIS, Vegetable Farming

5.3.3 Development of Indian Bean Variety Gujarat Indian Bean-3 in Gujarat state

Jadeja S.R., Asodariya K.B.and Kachhadia V.H.
Vegetable Research Station, JAU, Junagadh-362001 (Gujarat)
Email: sarmanrjadeja@jau.in

A Indian bean variety GIB-3 (JIB(P)-15-03) was developed at vegetable research station, Junagadh agriculture university, Junagadh and was evaluated under state and coordinated trials during 2015-16 to 2020-21, during late *kharif / Rabi* season at various location along with check varieties; Gujarat papdi -1, GJIB-2 and GNIB-21.On the basis of mean pod yield data from the state trials GIB-3 recorded highest pod yield of 225.24 q/ha as compared to check varieties; Gujarat papdi-1, GJIB-2 and GNIB-21.Which was 13.96 % higher than the check variety Gujarat papdi -1 (197.65 q/ha) under one testing trial, where as in 12 testing trials, the mean pod yield of GIB-3 variety was167.67 q/ha, which was 12.64% higher than the state check GJIB-2(148.85 q/ha) while in 10 testing trials this variety has recorded 160.69 q/ha pod yield, which was 31.65% higher than the check variety GNIB-21.The pods of this variety are medium in size with whitish green in colour and moderately curved in shape, fresh kernel colour is green with attractive shining, pods bearing habit is buncy type.In fresh seeds of pods contained 3.53 percent protein, 3.75 percent total soluble sugar, 0.19 percent acidity and total 46.01/100g phenols which were more as compares to check variety GJIB-2.

5.3.4 Effect of Organic Manures, Biofertilizers and Biostimulants on Growth and Yield of Drumstick (*Moringa oleifera* Lam.)cv.PKM-1

A.D. Polara, S.K.Bhuva, D.R.Kanzaria, H.N.Patel, J.S.Parsana and D.K.Varu
Department of Horticulture, College of Agriculture, JAU, Junagadh
Email: ndpolara@jau.in

Drumstick(*Moringa oleifera* Lam.) is the most widely known and utilized species.India is the largest producer of this nutritionally rich, fast growing, drought tolerant, hardy crop capable of getting adapted to varied ecosystems.It is well known for its nutritive value in leaves, pods, and seeds.The flower buds are also used for culinary purposes. The demand for the drumstick pod increased day by day among urban and rural populations of India.So experiment was planned with nine treatments *i.e.*FYM at 30 kg/plant (T1), Vermicompost at 12 kg/plant (T_2), FYM at 25 kg/plant + BF (*Azospirillum* and PSB each at 50 ml/plant) (T_3),Vermicompost at 8 kg/plant + BF (*Azospirillum* and PSB each at 50 ml/plant) (T_4), FYM at 25 kg/plant+Enriched banana pseudostem sap 3.0 % (T_5), Vermicompost at 8 kg/plant + Enriched banana pseudostem sap 3.0 % (T_6), FYM at 25 kg/plant + Sea weed extract at 5.0 % (T_7), Vermicompost at 8 kg/plant + Sea weed extract at 5.0 % (T_8) and Control (FYM 20 kg/plant and 40: 20: 20 N: P: K g/plant) (T_9) with three replication in Randomized Block Design (RBD).The results revealed that maximum plant height was recorded in treatment T_9 and was found statically at par with treatment T_7, T_4 and T_3.The maximum number of pods and pod yield were found in treatment T_9.

5.3.5 Effect of Soil and Soilless Media on Agro-morphological, Yield and Economics of Lettuce (*Lactuca sativa* L.) Cultivars under Open Field Condition

Thushal R.Y., **Awani Kumar Singh **, Gograj Singh Jat, Jeetendra Kumar Ranjan, Ram Asrey, Gyan Prakash Mishra, Jogendra Singh and M.Hasan
ICAR- CPCT-Indian Agricultural Research Institute, New Delhi-110012, India
Email: singhawani5@gmail.com

An experiment was conducted at the Centre for Protected Cultivation and Technology (CPCT), ICAR-Indian Agricultural Research Institute, New Delhi during 2022-23 to study the effect of soil and soilless media on agro-morphological traits, yield, and economics of lettuce cultivars under open condition.This experiment laid out at factorial randomized block design with 3 replications.Agro-morphological and yield parameters such as plant height (cm), plant canopy spread (cm), number of leaves, head and leaf shape, head or leafy type, heading firmness, leaf color, leaf length (cm), leaf width (cm), root length (cm), root weight (g), fresh plant biomass (g) and yield/m2 (kg/m2) of different lettuce genotypes were studied.All the varieties grown in soil media showed better results than soilless media except root length and root weight which were more in soilless media.Among the varieties, V9 (Lollo Rossa) showed better performance and V12 (Red Rose) showed poor performance in leafy types.Among head types, V16 (Great Lakes) showed better performance and V15 (Butterhead Green) showed poor performance.Concerning economics, the cost of cultivation was the same for all the cultivars, whereas the gross income, net returns, and benefit-cost ratio were highest in V9 (Lollo Rossa) and lowest in V12 (Red Rose) in leafy types.Among head types, the highest and lowest gross income, net returns, and benefit-cost ratio were observed in V16 (Great Lakes) and V15 (Butterhead Green).The cost of cultivation was high in soilless media which resulted in less gross income, net returns, and benefit-cost ratio compared to soil.From all these results we can infer that soil was the best media for lettuce production.Lollo Rossa was the best variety among leafy types whereas Great Lakes were among head types.

5.3.6 Effect of Organic Modules of Nutrition in Enhancing the Yield of Garden Pea and Improvement in Microbial Population in Cauliflower-Pea- Onion Cropping System

R.B. Verma[1] *, A.B. Singh[2], V.K. Singh[2], A.K. Bhardwaj[2], Ravi Kumar[3], and Anuradha Sinha[4]
[1]Associate Professor- cum Sr.Scientist, Deptt.of Hort.(Veg.& Flori.), BAU, Sabour*
[2]Assistant Professor-cum Jr.Scientist, department of Hort.(Veg.& Flori.), BAU, Sabour
[3]Technical Assistant, Deptt.of Hort.(Veg.& Flori.), BAU, Sabour
[4]SMS (Horticulture), KVK, Aurangabad, BAU, Sabour
Email: rbv1963@gmail.com

The principles and practices of traditional agriculture eroded gradually due to the over dependency on chemicals inputs in recent years, which directly or indirectly disturbed the ecosystem and resulted in decreasing trends in crop productivity as well as microbial population.The development of organic corridor along the Basin of Ganga River is a big challenge of Government of Bihar in the promotion of organic farming through crop residue management, use of compost, green manuring and adopting sound biological plant protection measures.It would go a long way in bringing back the health of soil, increasing microbial population and minimizing the environmental pollution. Keeping these facts in mind, an experiment was

conducted at Vegetable Research Farm, department of Hort.(Veg.& Flori.), BAC, BAU, Sabour during 2018-19, 2019-20 and 2020-21 involving seven organic modules (T 1 : 100% RDN @60kgN/ha through FYM, T 2 : 75% RDN (FYM) + 25% RDN (Vermicompost), T 3 : T 2 + Azotobacter, T 4 : T 3 + PSB, T 5 : T 4 + one spray of Panchagavya at 45 DAT, T 6 : T 2 + two spray of Panchagavya at 30 & 45 and DAT.T 7 : 1/3 RDN (FYM) +1/3 RDN (Vermicompost) + 1/3 RDN (Neem cake)) inrandomised block design replicated thrice to explore the possibilities of organic modules for increasing the productivity of garden pea and improvement in microbial population.The initial soil PH, organic carbon, available N, P, and K, total bacteria, actinomyces, fungi, PSP and Azotobacter was 7.20, 0.50%;178.55, 14.75 and 187.00kg/ha, 14.05 x 10^6 CFUg -1, 11.12 x 10^5 CFUg -1, 8.95 x 10^4 CFUg -1, 10.32 x 10^6 CFUg -1, 15.00 x 10^6, CFUg -1of dry soil, respectively.After three cycle of cropping system it was observed that the yield increased gradually over the extending organic periods and the maximum increase in the pod yield of pea over three years of organic culture was the highest under treatment of 75% RDN (FYM) + 25% RDN (VC) + Azotobacter + PSB + Panchagavya at 45 DAT (T 5), however, Per cent increase in microbial population was observed up to three times when compared with initial values.

6. (TECHNICAL SESSION-6 (HALL NO.-1):

DESIGNER CULTIVARS THROUGH THE USE OF DIGITAL HORTICULTURE

6.1 Keynote Lecture

6.1.1 Digitization for Speed Breeding in Vegetable crops

Tusar Kanti Behera*, Jagesh Kumar Tiwari, Suresh Reddy Yerasu, Pradip Karmakar
ICAR-Indian Institute of Vegetable Research, Varanasi-221305, Uttar Pradesh
**Email: tusar@rediffmail.com*

In the current climate change scenario and limited land resources with burgeoning population pressure, it is important to harness the potential of digital technology in speed breeding of vegetable crops.This has led to the rapid development of new cultivars against various biotic and abiotic stress along with quality parameters.The use of drones, sensors, cameras, automated phenotyping facility coupled with advance genotyping has led to rapid identification of genes/QTLs for vegetable improvement through introgression of new genes and novel traits. Taken together, digital technology has immense potential for rapid improvement of vegetable crops.

6.1.2 Use of Digital Technology for Speeding the Improvement Program

Sudhakar Pandey 1, Salej Sood 2 and Y.S.Reddy 3
1 Indian Council of Agricultural Research, New Delhi
2 ICAR-Central Potato Research Institute, Shimla
3 ICAR-Indian Institute of Vegetable Research, Varanasi
Email: sudhakariivr@gmail.com, sudhakarpandey.hsd@icar.org.in

Distillation plays a crucial role in modernising and enhancing breeding data management by storing a comprehensive array of breeding-related data, including germ-plasm information, pedigree records, trait

evaluations, molecular marker data, field trial results, and environmental data.In tandem with the digital revolution in agriculture, genomics has become a cornerstone of modern plant breeding.The advent of next-generation sequencing (NGS) technologies has provided rapid and cost-effective access to genomic data, enabling researchers to decode the genetic blueprint of crops with unprecedented speed and accuracy.By analysing the vast array of genetic information encoded in plant genomes, scientists can now identify genes associated with desirable traits such as yield, disease resistance, and nutritional quality.This newfound understanding of the genetic basis of complex traits has revolutionised breeding strategies, allowing breeders to develop improved cultivars with greater precision and efficiency.Building on the foundation laid by genomics, gene editing technologies have emerged as powerful tools for targeted genome modification.At the forefront of this revolution is the CRISPR-Cas9 system, which allows scientists to precisely edit DNA sequences with unprecedented accuracy and efficiency.Unlike traditional transgenic methods, which often involve the introduction of foreign DNA, gene editing enables precise modifications at specific loci within the genome.This precision offers immense potential for crop improvement, allowing breeders to introduce or modify desirable traits with unprecedented speed and precision while minimising unintended effects.Thu there is a need to explore the convergence of digital technology, genomics, next-generation sequencing, and gene editing in the context of accelerated crop improvement programs.The integration of digital technology, genomics, and gene editing represents a paradigm shift in crop improvement, offering unprecedented opportunities to enhance productivity, sustainability, and resilience in agriculture.By embracing these technologies and addressing the associated challenges, stakeholders can unlock the full potential of crop improvement programs to meet the growing demands of a rapidly changing world.

6.1.3 Okra Research in India-Retrospect and Prospect

R.K. Yadav*, Suman Lata, S.Bhargava Kiran, Anjan Das, Nishant, Reshav Naik Arjun Singh, Harshwardhan Choudhary and B.S. Tomar
Division of Vegetable Science,
ICAR-Indian Agricultural Research Institute, NewDelhi-110012
**Email: rkyadavneh@gmail.com*

Okra(*Abelmoschus esculentus* (L.) Moench), also called as lady's finger and bhendi, is an important crop of tropical and subtropical regions of world.Its tender pods are used in fresh and processed form which have high nutritive value, extensive industrial application and significant forex earnings (NHB database 2022).Okra is fourth most important crop after tomato, brinjal and chilli from seed industry viewpoints in India.Okra is proved to be a very remunerative crop for farmers, but due to bhendi Yellow Vein Mosaic Viruss (YVMV) and okra Enation Leaf Curl Virus (ELCV) diseases its successful production has become a challenge for the farmers all over the world.Presence of high genetic diversity in India for various traits, has been exploited to develop number of improved varieties in the past. A wide range of breeding methods and techniques have been employed to breed high yielding, stress tolerant varieties also keeping consumer preference as priority. In the beginning, researchers applied conventional breeding methods such as pure line selection and hybridization for cultivar development."Pedigree method" has been the most widely followed method in okra improvement. Most popular and widely adapted cultivars, like Pusa Sawani, Hissar Unnat, Varsha Uphar, Kashi Pragati, Pusa Bhindi-5 were developed by intervarietal hybridization.Interspecific hybridization is the go to method in okra specifically to transfer YVMV and ELCV resistance from wild relatives. This resulted in development of several YVMV resistant cultivars such as Punjab Padmini and Parbhani Kranti, using *Abelmoschusmanihot,* while Arka Anamika was derived from *A.tetraphyllus*.Inter-specific gene transfer in okra is hampered by various pre and post zygotic barriers.To address the frequently occurring F_1 sterility issue in wide hybridization polyploidy breeding (colchicine-induced amphidiploidization of F_1) is practiced.Through mutation breeding novel desirable variability was created using gamma irradiation

(MDU-1and Parbhani Tillu) and EMS treatment (Punjab-8). Heterosis is exploited to evolve hybrids that are very much popular due to high yield, uniformity, earliness, stress tolerance and wide adoptability.A large number of public and private sector hybrids has been developed and commercialized in India which made okra to the level of field crops in terms of seed value and market.Due to better taste and health benefits the demand for okra has increased significantly in foreign countries both in terms of pod and seed.Genetic Male Sterility (GMS) system has also been used to economizing hybrid seed production.Trait targeted breeding in okra is been successful with identification of several lines and development of verities for processing, export and resistant to stresses. Despite high economic importance of okra, its genetic improvement is slow compared to other vegetable crops primarily due to limited application of advanced biotechnological tools in okra improvement.Complex genome architecture is the major limiting factor in utilization of genomics and molecular breeding in okra.Other challenges in okra breeding include frequent breakdown *Begomovirus* resistance.Therefore, for maintenance of sustainable production in future we have to utilized conventional as well as molecular techniques, like RNA interference (RNAi), marker-assisted recurrent selection (MARS), genome-wide selection (GWS), targeted gene replacement, next generation sequencing (NGS), and nanobiotechnology to provide a rapid way for okra improvement in future and also to mitigate the problem of climate change.

6.1.4 Biotechnological Approaches for Precision Breeding in Fruit Crops through Use of Precision Technologies

Anju Bajpai and Muthukumar, M.
ICAR-Central Institute for Subtropical Horticulture, Lucknow
Email: anju.bajpai@gmail.com

Conventional breeding methods have yielded improved varieties having fruit quality, aroma, antioxidants, yield, and nutritional traits.However the threats of climate change and biotic and abiotic stress tolerance coupled to higher nutritional quality has demanded complementary novel strategies.Biotechnological research in fruit crops has offered immense scope for large-scale multiplication of elite clones, in vitro, mutagenesis, and genetic transformation.Advanced molecular methods, such as genome-wide association studies (GWAS), QTLomics, genomic selection for the development of novel germplasm having functional traits for agronomic and nutritional quality, and enrichment of bioactive constituents through metabolic pathway engineering and development of novel products, are now paving the way for trait-based improvement for developing genetically superior varieties in fruit plant species for enhanced nutritional quality and agronomic performance.In this review, we highlight the applications of in vitro and molecular breeding approaches for use in fruit breeding.

6.1.5 Applications of Genomic Tools for Improvement of Cucurbitaceous Vegetables

Harshawardhan Choudhary, R.K.Yadav, Padmanabha, K., S.S. Dey, G.S.Jat and B.S.Tomar
Division of Vegetable Science, ICAR- Indian Agricultural Research Institute, New Delhi-12
Email: harshahit2001@yahoo.co.in

Cucurbitaceous vegetables contribute to nearly one-fifth of the total vegetable production in India and an important component for livelihood of millions of small and marginal farmers and sometimes even in

marginal land of riverbeds.The domestication syndrome of Cucurbitaceae crops includes nonbitter fruits, increased fruit size, sometimes with higher sugar or carotenoid content, decreased physical defences (e.g.wild chayote fruits are spiny), and more compact and less branched growth with increased apical dominance.Cucumber and melons are two important Cucurbits from Asian origin and being widely cultivated in India and worldwide.The genomic information in these two crops were made available early so that many genomic tools could be utilized for improvement of many traits in these crops in India also.Production of commercial elite varieties faced many constraints due to fungal and viral diseases.Improvement in yield, quality and resistance to diseases is normally achieved by selecting genotypes with desirable character combinations existing in the nature or by hybridization but it may be time consuming approach.Genomic assisted breeding to introduce new genes from wild or related species into commercialvarieties for improvement of specific traits especially disease resistance and fruit quality traits facilitate rapid improvement.

Indian cucumber cultivars exhibited mainly monoecious sex expression coupled with crown fruit inhibition which is supposed to be the main reason for lower productivity.Gynoecism has been extensively exploited in heterosis breeding for enhancing productivity of cucumber worldwide but exotic gynoecious lines were not stable at higher temperature and they possessed very few lateral branches which were not suitable for open field condition.The F2 mapping population was developed using the Indian monoecious cultivar of light-green-fruited Pusa Uday as the recurrent parent and the American gynoecious pickling line G421 as a donor.Two markers, SSR13251 and SSR15516, were found to be closely linked to the F locus at 1.5 and 4.5 cM, respectively, by marker analysis of F2 individuals.The amplified product of 430 bp generated using a SCAR marker (CsACS1G) in gynoecious (MMFF) and sub-gynoecious (MMFf) plants of the F2 population confirmed the dominance of F alleles.The IBLs were developed by backcrossing Pusa Uday with BC1 and BC2 progenies followed by foreground and background selection of plants displaying the gynoecious habit in the background of Indian slicing cucumber.Seven QTLs for gynoecism were detected in two genomic regions (chromosome 5 and 6) on which three significant QTLs (qGyn 5.1, qGyn 6.5 and qGyn 6.6) had higher LOD score (10.5, 26.2, and 24.5) and phenotypic variance (5.9, 14.5 and 14.5%) in BC1F2 population.However, two significant QTLs (qGyn 5.1 and qGyn 6.1) accounted for gynoecism which could explain 22.90 and 12.88% of the phenotypic variation with the LOD score of 15.86 and 11.82.Novel source of Fusarium wilt resistance from Indian melon germplasm was identified from DSM-11 and TOLCNDV resistance was identified from Cucumis melo var.momordica accessions DSM-132 & DSM-19.Snap melon fruits are associated with inferior fruit quality traits like very low sugar content (TSS<4) and undesirable fruit flavor which makes it a challenging job to transfer resistance gene from snap melon to muskmelon without compromising the fruit quality traits including its unique flavor and Total Soluble Solid (TSS) content (>12) which is a measure of sweetness as well as market acceptability.Introgression of gene from wild relative involves a substantial breeding efforts including screening against the pathogen in severe disease pressure in field condition to follow the resistant offspring plants in each successive generations.96 diverse genotypes of Cucumis melo from different groups (cantalupensis, inodorous, momordica, conomon, callosus) having resistant and susceptible genotypes for Fusarium wilt were subjected to dd RAD sequencing (GBS). A total of 4,21,949 Bi –allelic SNP at read depth 10 could be generated among 96 genotypes in comparison to reference genotype which genome sequence is publically available. A large number of polymorphic markers could be generated between susceptible and resistant genotypes.The highest number of 26, 252 Bi allelic homozygous polymorphic SNP marker could be generated in comparison to reference to one resistant genotype.Based on genotype contrast between resistant and susceptible genotypes, few CAPS markers were designed and are being validated in segregating population. Two functional SCAR markers Fom2- R408 and Fom2- S342 developed from LRR domain of Fom-2 gene were identified and validated which could be used for selection of resistant plant during backcrossing for introgression of fom-2 gene into commercially susceptible cultivars.Based on fruit quality traits and resistance to Fusarium wilt, selections were made from backcross population of (Kashi Madhu X DSM-11-6) and characterized with validated molecular markers for presence of Fom-2 gene.For mapping of ToLCNDV resistance gene, 3 CAPS primers were designed from position interval of ToLCNDV QTL in chromosome 11 between D14 and D23 markers and 1 CAPS marker could be identified for association with susceptibility factor.The complete genomes of two parental lines (Pusa Sarda and DSM 132) and two extreme bulks (S- bulk and R-bulk) were re-sequenced. A major QTL differentiating Pusa Sarda and DSM 132 is located in genomic region on chromosome 6 and a 0.9 Mb (900 Kb) area is considered the candidate QTL related with ToLCNDV resistance in melon. In the identified QTL region, 397 homozygous SNPs between the Pusa Sarda and DSM 132 genomes were discovered.The identification of 44 nonsynonymous variants (SNPs) resulted in the classification of five variants (five SNPs) as high impact variants with stop gain effect.Annotation of variants revealed that there are 44 nonsynonymous variants located in/associated with 27 protein-coding genes.Among the 27 genes, six genes appeared to be associated with Begomo virus resistance.Novel monoecious line (DMM-31) of muskmelon with round fruit and excellent fruit quality was developed which will be utilized for easy and economical hybrid seed production.F2 mapping population was phenotyped for different quality traits like TSS, acidity, sucrose and fructose content and genotyped with 120 molecular markers distributed throughout the genome and many QTLs for different fruit quality traits could be identified which will be a valuable source of information for future muskmelon improvement programme.Two hundred eight RILs (F5) were developed from the contrasting parents for climacteric fruit ripening behavior and 19 lines were selected for better fruit quality traits and shelf life.New genomic resources and information will be quite helpful for melon improvement programme in future.Increased selection efficiency through marker assisted breeding (MAB) may be attained through early selection and screening plant population under variable disease pressure or even without the occurrence of disease in the growing environment.

6.1.6 Potential Use of Digital Technology in Speed Breeding of Onion and Garlic

Vijay Mahajan and Ashwini Benke
ICAR-Directorate of Onion & Garlic Research, Pune, 410505
**Director, ** Scientist*
Email: Vijay.mahajan@icar.gov.in; director.dogr@icar.gov.in; Ashwini.benke@icar.gov.in

"Integrating novel digital tools will prove valuable in enhancing breeding progress, particularly for quantitative traits that are challenging to breed.To realize the full potential of breeding technologies, it is crucial to integrate and manage vast genetic, genomic, phenotypic, and environmental data using digital technology.In this article, we discuss speed breeding methods, encompassing a range from molecular to digital breeding techniques.Digital tools in breeding are expected to account for complex factors such as climate, geography, and multiple quantitative traits in the breeding process.Broadly speaking, the use of digital tools in breeding represents not merely a single activity but a convergence of technologies.This involves various initiatives to actively harness advanced technologies like big data and artificial intelligence (AI) for agricultural breeding.The rapid development of digital technologies promises significant advancements in breeding techniques, including biotechnology, genomics, and phenomics, and is set to notably enhance progress in onion plant breeding.Novel integrated digital tools will be instrumental in refining these techniques.Digital tools are anticipated to reduce the time required to develop new onion varieties.Additionally, digital techniques can aid in breeding varieties with potential for higher yield, resistance to pests, and enhanced nutritional quality.This will ultimately boost the potential for onion production in the country, ensuring a supply of high-quality onions."

6.2 Oral Presentation

6.2.1 Thar Vaibhav: a Climate Smart New Bunch Bearing Variety of Acid Lime for Sustainable Production Systems

D.S.Mishra[1], Vikas Yadav[2], A.K.Singh[3] and Jagadish Rane[4]
[1-3], ICAR - Central Horticultural Experiment Station (CIAH), PMS (Godhra), Gujarat-389340
[4]ICAR- Central Institute for Arid Horticulture, Bikaner, Rajasthan- 334006
Email: dsmhort@gmail.com

Acid lime (*Citrusaurantifolia* Swingle) is an important sub-tropical and tropical fruit crop of India and is the third most important citrus fruit next to mandarins and sweet orange.It prefers warm and dry climate with low rainfall for better growth and production.A well drained soil with a pH of 6.5 to 7.0 is ideal for better growth and yield of limes.Gujarat is considered to be ideally suitable for growing acid lime on commercial scale.So far no systematic research findings have not been reported which can be useful to know the best suitable variety or type for this zone for commercial cultivation of acid lime, therefore, an attempt was made to develop high yielding and bunch bearing variety of acid lime.Acid lime selection, 'Thar Vaibhav' was collected from the existing population of acid lime located in Ghoghomba, Panchmahal, Gujarat which was established through air-layers under field condition at CHES, Godhra.Selected genotype first flowered during 3rd year.It is drought hardy variety, prolific bearer, and shows early fruit maturity in summer months (April-May).Fruits are round with attractive yellowish smooth peel.Fruit is juicy (49%), acidic (6.84%) with less number of seeds/fruit (6-8).It bears fruits mostly on the periphery of the canopy.It is high yielder with an average yield/plant of 60 kg during 6th year of planting under rain-fed hot semi-arid conditions in western India.Fruit ripens in 125-135 days in summer while rainy season and winter season crop may take 145-155 days from fruit set with excellent keeping quality at ambient storage.On an average, it bears 3-9 fruits/bunch and such varieties are in great demand by acid lime growers of country, therefore, it was released to satisfy the needs of growers.This variety is highly accepted by the farmers in western Indian plains as it has bigger fruit size and bears profusely in bunches with high juice content, acidity and ascorbic acid.Also, it is comparatively less affected by citrus canker and leaf miner and is highly suitable to grow under rain-fed dry-land conditions with lifesaving irrigations during summer months.

Keywords: *Citrusaurantifolia,* Bunch bearing, Variety, Rain-fed, Sustainable production

6.2.2 Assessment of Genetic Variability of Indian Bean (*Lablab purpureus* var.*typicus* L.) for Nutritional Security under Rainfed Semi Arid Conditions of Gujarat

Gangadhara K[1], L.P. Yadav[1], V.V.Appa Rao[1], A. K. Singh[1] and Jagadish Rane[2]
[1]Central Horticultural Experiment Station (ICAR-CIAH), Vejalpur Godhra-Vadodara Highway, Godhra, Panchmahal,Gujarat, India
[2]ICAR-Central Institute for Arid Horticulture, Bikaner
Email: gangacib@gmail.com

The field experiment was carried out during 2020-2023 at Central Horticultural Experiment Station (ICAR-CIAH), Vejalpur, Gujarat under rainfed semiarid conditions to evaluate the Indian bean genotypes for higher yield as well as quality parameters.Genetic divergence was worked out to identify major yield contributing

traits towards total variation based on principal component (PCA) analysis and find out the extent of genetic diversity through Mahalanobis D^2 technique.The wide range of variation was observed with respect to pod yield, pod colour and quality parameters especially proteins, anthocyanins and other antioxidants.The eigen values of PC-I was comprised approximately 34.84% of total variation followed by PC-II (18.24%), PC-III (13.727) and PC-IV (10.52%) of total variations.Based on relative magnitude of D^2 estimates, 60 genotypes were broadly grouped into eight clusters.The inter cluster D^2 value was maximum between cluster V and VIII followed by between cluster IV and VIII.The cluster VIII found to be the most divergent because maximum clusters attached to this cluster, shown the highest inter cluster distances followed by cluster VII.The genotypes with maximum inter cluster distance are genetically more divergent and these could be utilized in the hybridization to obtain promising segregents in Indian bean.Thus, more weightage should be given to the clusterII and I for selection of inbred and development of variety in future breeding programme.The highly divergent genotypes like CHESDB-7 (Thar Kiran), CHESDB-50 (Thar Ganga), CHESIB-31 (IC-631578), CHESIB-10 (IC-631577), CHESIB-40 (IC-631579), CHESDB-01, CHESDB-56 and CHESDB-54 were identified for higher yield and quality (Proteins and anthocyanins) based on its mean performance over the seasons to different horticultural traits under dry land semi-arid conditions of western India may be used for commercial cultivation or further breeding programme for genetic improvement in Indian bean.

6.2.3 Diversity in Onion (*Allium cepa* L.) for Yield and Quality

Sangeeta Shree[1*], Kavya Eppakayala[2] and V.K.Singh[3]
[123]Department of Horticulture (Vegetable and Floriculture)
Bihar Agricultural University, Sabour - 813 210, Bhagalpur, Bihar.
Email: sangeetashreee@gmail.com

Onion (*Allium cepa* L.) is an important bulb crop and is one of the most popular vegetables produced worldwide.It has been cultivated since ancient times and used around the world for its pungent flavour as a seasoning or condiment ingredient.It is an indispensable ingredient in every household.Besides, it has got innumerable medicinal properties.The bioactive compounds and many other nutrients present in onion act as functional food which varies with genotypes and show a great degree of divergence.The knowledge about genetic diversity of a crop species is very important and prerequisite for its exploitation.Therefore, study was performed on 40 genotypes of onion for studying the genetic diversity for yield and physiologically active food components present of onion.The work was carried out in the Department of Horticulture (Vegetable and Floriculture), Bihar, Agriculture College, Sabour.The genotypes included the accessions from different research centres and universities of the country as well as local collections.The experiment was laid out in Randomised Block Design and planting was done at row spacing of 15 cm and plant spacing of 10 cm.The analysis of variance indicated highly significant difference among genotypes of onion for all the traits under study, viz.plant height (cm), number of leaves per plant, leaf length (cm), leaf width (cm), pseudostem length (cm), neck thickness (cm), polar bulb diameter (cm), equatorial bulb diameter (cm), bulb size index, average bulb weight (g), TSS (°Brix), dry matter content (%), total sugar content (%), anthocyanin content (mg/100g), sulphur content (%), total phenol content (mg GAE/100g) and pungency (imole /100g).Genotype LC-2 had the highest average bulb weight while LC-2 was superior with respect to polar bulb diameter.Cluster analysis of genotypes was performed and on the basis of Mahalanobis D2 values all the genotypes were grouped into seven clusters.Among the different clusters, cluster I had maximum number of genotypes.The highest inter cluster distance was observed between cluster VI and VII followed by cluster I and VII.Cluster mean values were highest for most of the traits with the genotypes present in cluster V and VII.Different traits had different degree of contribution towards diversity of the genotypes.The highest contribution towards genetic divergence was exhibited by equatorial bulb diameter, followed by total phenol content, pungency,average bulb weight and anthocyanin content.

6.2.4 Role of Artificial Intelligence in Vegetable Crop Improvement

Anupam Adarsh, Shashank Shekhar Solankey and Randhir Kumar
Nalanda College of Horticulture,BAU Sabour
Email: Anupamadarsh111@gmail.com

Vegetable crop production faces numerous challenges, including unpredictable environmental conditions, pest or disease pressure, and fluctuating market demands.To address these challenges and enhance productivity, sustainability, and resilience in vegetable farming, the integration of artificial intelligence (AI) technologies emerged as a promising approach.This explores the role of AI in vegetable crop improvement throughout the growing season, focusing on real-time monitoring, dynamic crop management, predictive modeling for pest and disease management, crop health assessment, adaptive breeding, precision harvesting, and quality control.AI-powered sensors, drones, and imaging systems enable continuous monitoring of crop health, environmental conditions, and pest populations, providing farmers with real-time insights and decision support.Dynamic crop management practices, by AI algorithms analyzing real-time data, optimize irrigation scheduling, fertilizer applications, and pest control measures, enhancing resource use efficiency and minimizing crop losses.Predictive models leverage historical and real-time data to forecast pest and disease outbreaks, enabling proactive management strategies.It also facilitates adaptive breeding by integrating genomic and phenotypic data to develop vegetable varieties with improved traits and resilience to stressors.Furthermore, AI-powered robotic systems automate harvesting operations and quality assessment, ensuring consistent product quality and reducing post-harvest losses.Overall, the utilization of AI in vegetable crop improveme holds great potential for advancing agricultural practices, improving crop yields, and ensuring food security in the face of evolving challenges.The deployment of AI technologies in vegetable crop management holds great potential to improve food traceability, reduce losses and waste, and mitigate the vulnerability to food fraud.By harnessing real-time data and predictive analytics, AI enables stakeholders to make informed decisions, enhance efficiency, and ensure the integrity and safety of vegetable products throughout the supply chain.

6.2.5 DUS Characterisation of Okra (*Abelmoschus Esculentus* (L.) Moench) Genotypes Through Qualitative Characters

C.A.Babariya*, M.J.Jadav and D.S.Deshmukh
Department of Seed Science and Technology, College of Agriculture
Junagadh Agricultural University, Junagadh – 362001, Gujarat, India
**Email: cababariya@jau.in*

The investigation was undertaken at the Sagdividi Farm, Department of Seed Science and Technology, College of Agriculture, Junagadh Agricultural University, Junagadh, during *kharif* 2021 to DUS characterize 23 okra genotypes released for general cultivation in Gujarat at state level as well as at the National level in central India based on the qualitative characters.Observations for twenty three okra genotypes were recorded for 14 morphological and 2 seed characters.Okra genotypes were divided into two groups based on the colour of the stem: green (19 genotypes) and red (4 genotypes), while based on the intensity of the stem's green colour, okra genotypes were grouped as light (20 genotypes) and medium (3 genotypes).All okra genotypes were divided into two groups based on the colour of the flower petals: cream (8 genotypes) and yellow (15 genotypes), while genotypes were divided into two groups based on the flower's purple base petal colour: both side (18 genotypes) and inside (5 genotypes), while based on the fruit colour, okra genotypes were grouped as green (9 genotypes) and light green (11 genotypes).Based on the fruit surface between ridges, the 23 genotypes of okra were categorized as flat (20 genotypes) and convex (3 genotypes).The okra genotypes were categorized as absent (12 genotypes) and weak (11 genotypes) based on the constriction of the basal region of fruits.The okra genotypes were divided into three groups based on fruit pubescence: weak (16 genotypes), medium (2 genotypes) and strong (5 genotypes), while okra genotypes were divided into three groups based on the shape of fruit apex: acute (15 genotypes), narrow acute (3 genotypes) and blunt (5 genotypes).All the 23 okra genotypes were having green colour between veins.The okra genotypes were divided into two groups: dark (18 genotypes) and medium (5 genotypes) based on the intensity of colour between veins.The okra genotypes were divided into light green (20 genotypes) and purple (3 genotypes) groups based on the colour of the leaf veins.

6.2.6 Studies on Stigma Receptivity for Hybrid Seed Production in Okra (*Abelmoschus esculentus* (L.) Moench)

A.Babariya*, D.Sruthi, B.Mahesh and T.Suryateja
Department of Seed Science and Technology, College of Agriculture
Junagadh Agricultural University, Junagadh – 362001, Gujarat, India
**Email:* cababariya@jau.in

A field experiment was conducted during *kharif* 2019 to study the effect of stigma receptivity of seed parent for hybrid seed production in okra using JOL-2K-19 as male parent and JF-55 as female parent.The pollination on same day of emasculation recorded significantly the maximum number of crossed fruits retained per plant (5.48), fruit set percentage (54.78%), fruit weight per fruit (32.06 g), fruit length (19.01 cm), fruit girth (5.22 cm), hybrid seed weight per fruit (4.05 g), number of seeds per fruit (47.22), seed yield per plant (30.52 g) and 100 seed weight (6.21 g) and also seed quality parameters recorded maximum seed germination percentage (86.02%), seedling shoot length (15.11 cm), seedling root length (8.81 cm), seedling dry weight (29.08 mg), seedling vigour index I (length) (2059.24) and seedling vigour index II (mass) (2500.75) as compared to pollination one day and two days after emasculation.

Keywords: Stigma receptivity, pollination, emasculation, okra, quality, seed yield

6.2.7 Moleculer Characterization of Brinjal (*Solanum melongena*L.) Genotypes through Random Amplified Polymorphic DNA

Mehta, D.R.[1*] and Patel Rucha[2]
[1*]*Professor & Head, Department of Genetics and Plant Breeding, JAU, Junagadh.*
[1]*M.Sc.Student, Department of Biotechnology, JAU, Junagadh.*
Email: drmehta@jau.in

The genetic diversity among 12 brinjal genotypes were studied using seventeen RAPD markers.The experiment was conducted at Biotechnology Laboratory, Department of Genetics and Plant Breeding, J.A.U., Junagadh during the year 2015-16.Seventeen RAPD primers generated total of 232 bands in which 224 bands were polymorphic (96.55%).The average bands per primer were 13.17.The polymorphic information content (PIC) was recorded from 0.7947(OPC-17) to 0.9405 (OPB-20).Similarly, RAPD primer index (RPI) ranged from 3.9739 (OPB-20) to 18.819 (OPC-17)with an average of 12.4250 bands per primer.Jaccard's coefficient of similarity of 12 brinjal genotypes ranged from 27.9% (JBL-08-08 with all genotypes) to 59.3% (between JBL-10-011 and JBG-10-208).The phylogenetic tree constructed by UPGMA

method generated two main clusters which again sub-grouped in their respective sub-clusters.Genetic diversity analysis through RAPD marker gave highest (100%) polymorphism percentage with primers *viz.,* OPA-05, OPA-14, OPA-15, OPA-16, OPA-18, OPB-18, OPB-20, OPC-17, OPD-12, AC-14, AY-12 and OPN-05.Therefore, these primers were most useful for genetic diversity analysis to generate DNA fingerprinting in brinjal genotypes.

Keywords: Brinjal, RAPD, genetic diversity

6.2.8 Heterosis, Combining Ability and Gene Action for Fruit Yield and Its Attrubting Traits in Tomato (*Solanum lycopersicum* L.)

Mehta, D.R.and Sojitra, Tanvi V.
Dept.of Genetics & Plant Breeding, College of Agriculture, J.A.U., Junagadh, Gujarat
Email: drmehta@jau.in

An experiment was conducted in tomato with a view to estimate heterosis, combining ability and nature of gene action involved in the inheritance of fruit yield and its components using line x tester analysis involving seven lines and four testers.The resultant 28 hybrids along with 11 parents were evaluated in randomized block design two replications during at Vegetable Research Station, Junagadh Agricultural University, Junagadh.

The magnitude of heterotic effects was high for plant height, number of fruits per plant, fruit yield per plant, average fruit weight, pericarp thickness and ascorbic acid; moderate for remaining traits except number of picking which had no positive heterosis.

The highest, positive and significant heterobeltiosis for fruit yield per plant and some of its component traits were recorded in the crosses, JTL-12-02 × DVRT-2, JTL-15-02 × DVRT-2, JTL-12-10× JT-3, JTL-15-05 × JT-3, JTL-12-11× AT-3 and JTL-15-05 × JT-3.Two crosses *viz.,* JTL-12-02 × DVRT-2, JTL-15-02 × DVRT-2 and JTL-12-10 × GT-1 showed positive and significant standard heterosis for fruit yield per plant.Such crosses could be exploited commercially for practical plant breeding programme in tomato.

The analysis of variance for combining ability revealed that the mean square due to lines was highly significant for days to first flowering, average fruit girth and ascorbic acid, while mean square due to testers was significant only for average fruit length.In case of lines x testers interaction, the mean square was highly significant for all the characters under investigation indicated pre-dominant role of non-additive gene actions in the inheritance of all the traits.This was also confirmed by the ratio ó^2 sca/ó^{2}gca.

The estimates of gca effects for fruit yield and its related traits indicated that three lines *viz.,* JTL-15-02, JTL-12-02 and JTL-12-10 and one tester (DVRT-2) were found good general combiner for fruit yield per plant and some of its component traits.The estimation of sca effects of the crosses indicated the seven hybrids manifested significant and positive sca effects for fruit yield per plant.The best three specific combinations were JTL-12-02 × DVRT-2, JTL-12-10 × GT-1 and JTL-12-11× AT-3 which resulted from good x good, good x poor and poor x poor combiner parents, respectively.The high sca effects observed for fruit yield per plant was associated with desirable sca effects manifested by one or two component traits.

On the basis of *per se* performance, heterotic response, combining ability estimate and gene action involved in the expression of fruit yield and its components, the two crosses *viz.,* JTL-12-02 × DVRT-2 and JTL-12-10 × GT-1 appeared to be most suitable for exploitation in practical plant breeding programme in castor.These hybrids recorded 72.83 and 38.46 per cent higher yield over standard parent and significant sca effects in desirable direction for fruit yield and some of its components traits.Therefore, these two crosses could be exploited for heterosis breeding programme to boost the fruit yield in tomato.

Keywords*:* Heterosis, Combining ability, Gene action and Line x Tester mating design

6.2.9 Diversity and Antioxidant Potential of *Morinda citrifolia* L.Genotypes from Andaman and Nicobar Islands, India.

V.Shajeeda Banu[1], Shrawan Singh[2] and D.R.Singh*[3]
[1&3] Bihar Agricultural University, Sabour- 813210, Bihar
[2]Indian Agricultural Research Institute, New Delhi
Email: drsinghhort66@gamil.com

Morinda citrifolia L., commonly known as Indian mulberry or Noni, is a source of natural antioxidants and phytochemicals for the herbal and pharmaceutical industries.This study investigated the phytochemical diversity and antioxidant activity of 33 genotypes of *M.citrifolia* from the Andaman ans Nicobar Islands, India, aiming to identify promising cultivars for commercial utilization.Significant diversity (p=0.05) was observed among the *M.citrifolia* genotypes for phytochemicals and micronutrients, highlighting the richness of the germplasm in health benefiting compounds. Carotenoids content exhibited strong correlations with ascorbic acid, tannin, flavonoids, and phenol, underscoring their collective contribution to the antioxidant activity of *M.citrifolia*.The study identified several promising genotypes, including FRG-14, JGH-5, TRA-1, TRA-2, and HD-6, for commercial applications based on their high phytochemical content and antioxidant activity.Furthermore, positive correlations between antioxidant activity and carotenoids, flavonoids, as well as micronutrients such as Cu, Mn, and Mg were observed, highlighting its comprehensive nature and antioxidant potential.These findings provide valuable insights into the genotypic variation of *M.citrifolia* and its implications for the herbal and pharmaceutical industries.

Keywords: *Morinda citrifolia*, Phytochemical diversity, Antioxidant activity, Genotypic variation, Pharmaceutical industry

6.2.10 Exploration of Genomic Divergence in Trichosanthes Dioica for Morphological and Biochemical Attributes

A. Singh[1]* Ankit Kumar Sinha[2], Bhavana P.[1], Harshawardhan Choudhary[2], Gyan Prakash Mishra[2], J.K.Ranjan[2], Reshma Shinde[1], Mahesh D.[1], Nawed Anjum[1], Sajiya Ekbal[1], Jitendra Rajak[2]
[1]ICAR-Research Complex for Eastern Region, Ranchi, Jharkhand-834010
[2]ICAR-Indian Agricultural Research Institute, New Delhi-110012
Email: aksingh171162@rediffmail.com

A research endeavour took place at the ICAR-Research Complex for Eastern Region, Ranchi, Jharkhand, aiming to evaluate the genomic diversity of pointed gourd genotypes regarding fruit yield and quality traits.The primary goal was to pinpoint superior genotypes for future breeding initiatives.The study involved 46 unique pointed gourd genotypes organized in a Randomized Block Design (RBD) with three replications.The data collected underwent thorough statistical analyses, encompassing genetic variability, analysis of variance (ANOVA), correlation coefficients, path analysis, exploration of genetic divergence, and biochemical characterization.The ANOVA results unveiled noteworthy variations across all 46 pointed gourd genotypes concerning both fruit yield and quality traits.Key attributes, such as the number of fruits per plant, harvest frequency, pulp seed ratio, and total phenol content, displayed significant positive correlations with total fruit yield (t/ha) at both genetic and observable levels.Particularly noteworthy was the positive direct effect of pulp weight on total fruit yield (t/ha), indicated by a coefficient of 0.99.The study identified total fruit yield (t/ha) as the primary contributor to the observed genetic diversity.Linear transformation produced

seven principal components explaining a cumulative variation of 78.27 percent.To establish genotypic clusters, Tocher's method was employed, resulting in the grouping of the 46 genotypes into twelve distinct clusters based on squared D2 values.The study highlighted significant variability among pointed gourd genotypes, suggesting ample opportunities for selection-based improvement.Selection based on characteristics such as the number of fruits per plant, pulp weight, and pulp seed ratio is expected to significantly enhance yield.Noteworthy genotypes, such as Swarna Alaukik, HAP-79, HAP-70 (for yield-related attributes), and HAP-106 (for quality traits), emerged as promising candidates.These promising genotypes hold potential for future breeding initiatives and are recommended for cultivation in the Eastern Plateau and Hill Region.This strategic cultivation aims to enhance the nutritional well-being of the local population in that area.

Keywords: Pointed gourd, Genetic diversity, Fruit quality, Yield, HAP-79 and HAP-106

6.3 Poster Presentation

6.3.1 Sustainable Propagation of *Eulophia andamanensis* through *Invitro* Techniques

V. Shajeeda Banu and D.R. Singh
Bihar Agricultural University, Sabour- 813210, Bihar
Email: drsinghhort66@gamil.com

Efficient micropropagation of the tropical orchid *Eulophia andamanensis* was achieved through a direct and dependable technique.Utilizing pseudobulbs and axenic leaf buds, placed on MS culture media with a high auxin to cytokinin ratio, facilitated rapid propagation.Although approximately 40% of cultures exhibited moderate contamination, attributed to the source of explants, this issue did not hinder the overall success of the process.Notably, shoot multiplication significantly improved upon subculture onto freshly prepared medium, indicating the repeatability of the experiment cycles.Various media compositions containing growth regulators, such as 1 mg/l BAP + 0.5 mg/l NAA, 2 mg/l BAP + 0.5 mg/l NAA, and others, were explored.Among these, media formulations containing 1 mg/l BAP + 0.5 mg/l NAA and 2 mg/l BAP + 0.5 mg/l NAA, along with the control, exhibited particularly promising results for Pseudobulb explants.Interestingly, Pseudobulb explants outperformed axenic buds, with no observed callusing in leaf slices and bud explants.This study underscores the efficacy of the proposed micropropagation protocol for *Eulophia andamanensis*, offering a practical approach for mass propagation of this tropical orchid species.

Keywords: Callusing, *Eulophia andamanensis*, Micropropagation, Pseudobulbs, Tropical Orchid.

6.3.2 Effect of Seed Pelleting on Pongevity of Onion (*Allium cepa* L.) Seeds During Storage

Sondarva Jyoti, J.B.Patel.and K.P.Vaghasiya
Email: sondarvajyoti6568@gmail.com

The study entitled "Effect of seed pelleting on longevity of onion (*Allium cepa* L.) seeds during storage" was carried out from summer 2020 and onwards at the Seed Testing Laboratory, Department of Seed Science and Technology, College of Agriculture, Junagadh Agricultural University, Junagadh.The experimental material comprised of different seed pelleting treatments [P1: Raw seed (absolute control), P2: Standard pellet (Control) (Carbandazim), P3: Thiamethoxam, P4: Seed priming + standard pellet, P5: Nano nutrition (Zn,

Fe), P6: Biostimulant mixture, P7: Biological (*Bacillus* spp.), P8: Micronutrients mixture 1 (Regular phosphorus, manganese, sulphur, copper, zinc and molybdenum) and P9:

Micronutrients mixture 2 (Nano phosphorus, potassium, manganese, sulphur, copper, zinc and molybdenum)] were evaluated.After seed pelleting treatments, the seeds were stored in cold storage conditions and the observations on germination percentage and seed vigour parameters were recorded at two months interval up to fourteen month of storage (up to germination went down below 70%).The results were analyze using Completely Randomized Design.After fourteen months of storage, significantly the maximum germination (80.33%), seedling length (10.59 cm), seedling dry weight (14.64 mg), seedling vigour index I (850.41) and seedling vigour index II (1176.16) was recorded in seeds pelleted with micronutrient mixture 2 (P9: Nano phosphorus, potassium, manganese, sulphur, copper, zinc and molybdenum), while it was recorded lower (15.00%, 3.42 cm, 2.93 mg, 50.80 and 58.95, respectively) in seed priming and seed pelleting (P4).

6.3.3 Spectrum of Genetic Variation and Correlation Coefficient Analysis in Bunch Groundnut [*Arachis hypogaea* L.]"

S.M.Makwana and A.V.Modhvadiya
College of Horticulture, Junagadh Agriculture University, Junagadh
Email: makwana_shardul@jau.in

The study was conducted using a Randomized Block Design with three replications on sixty groundnut genotypes at Junagadh Agricultural University during the kharif-2020 growing season.Data analysis was performed using the Indo-Stat software.The analysis of variance showed highly significant differences for all traits studied.The phenotypic coefficient of variation was slightly higher than the genotypic coefficient of variation across all traits.High heritability estimates were observed for all traits except for days to maturity, days to 50% flowering, and shelling out-turn, which exhibited medium heritability.Correlation studies indicated that pod yield per plant was significantly and positively correlated with kernel yield per plant, followed by harvest index and number of mature pods per plant, both at the genotypic and phenotypic levels.These traits are crucial and likely contribute significantly to higher pod yield.

Keywords Bunch Groundnut, spectrum of genetic variation and combining ability

7. TECHNICAL SESSION-7 (HALL NO. 2)

DIGITAL MANAGEMENT OF WATER AND NUTRIENTS FOR ENHANCED PRODUCTIVITY

7.1 Keynote Lecture

7.1.1 Strategic Approaches for Enhancing Water Productivity in Horticulture through Digital Management

H.P. Singh
Confederation of Horticulture Associations of India (CHAI), New Delhi, India
Email: hpsingh2008@gmail.com / hpsingh2008@gmail.com

Declining water availability to horticulture, has been a matter of discussion to ensure food and nutritional security of growing population across the globe.Global population is estimated to reach 9.6 billion in

2050, of which, major population shall be in Asia.India will be a most populous country, overtaking China and will face challenge of feeding growing population with declining land and water in the scenario of climate change.Among various resources, water is most critical as many of the countries are already in scarcity zone.In India also, availability of water has declined drastically reaching to scarce zone, with estimated availability of 1453 m^3, compared to 1700 m^3/ person recommended.Since food demand will continue to increase it is important to improve the ability to produce more nutritious food with less water.The scenario demands for increasing production per unit of water and changes in consumption practices.Water productivity is usually estimated as the amount of horticultural output produced per unit of water consumed.This could be in physical term or in economic term.Nevertheless, water productivity is a holistic approach and maximization has to be achieved by plant factor and land factors management strategies.Plant factor includes varieties, seeds and planting material, production system management, pest and disease control and also management of produce, or a value chain management.Field factors are soil heath management and water management.In field water productivity enhancement micro-irrigation has proved as success story in many horticultural crops.It maximises the synergistic interactions of improved cultivars, water and fertiliser and could be seen as the congruence of sustainability, productivity, profitability and equity.Since, micro-irrigation greatly enhances water, fertiliser and energy use efficiency and promotes precision horticulture, the sustainability could be achieved without the burden of environmental degradation.Horticulture has to gain much for meeting the challenge of more production with declining land and water by adoption of efficient techniques towards high water productivity.Trials conducted on micro-irrigation and fertigation on more than 50 Horticultural crops have clearly demonstrated a savings of 40-50 % in water, 30-50 percent in fertiliser, 50-100 % enhancement in yield and improved quality of produce besides containment in incidence of the diseases.At present, the country has coverage of about 12.5 million hectares in micro- irrigation with a plan to cover about 69 million hectares by 2050.Institutional support system linked with public and private enterprise and concerted efforts with identified destination involving all the stakeholders keeping the technology at driving seat and farmers as center of attention is bound to have faster and inclusive growth with the policy of per drop more crop, to achieve highest productivity of water.There is success story across the country for enhancing water productivity and farmers' income across the country.The concept of source to root in PPP mode has gained popularity.The paper deals with strategic approaches for enhancing water productivity in horticulture with emphasis on micro-irrigation.

Keywords: Water Productivity, Horticulture, Water Management, Micro-irrigation, Drip Irrigation and Precision Horticulture

7.1.2 Smart Irrigation Systems

T.B.S. Rajput
Scientist (Retired), Water Technology Centre, IARI New Delhi 110012
Email: tbsraj@yahoo.com

Smart irrigation systems encompass those innovative technologies that combine the power of data analytics, automation, and precision for managing water most efficiently.Water resources demands in all sectors including agriculture is increasing.Water scarcity, climate change, soil health, crop yield and quality and energy and cost savings give rise to the question of sustainability in agricultural production.To meet this challenge superior technologies, need to be adopted to increase water productivity in agriculture which is the largest consumer of water.Smart irrigation systems offer a promising solution for optimizing water use, increasing crop yields, and reducing environmental impact.

Smart irrigation systems, also known as digital irrigation or precision irrigation is a practice of watering crops as per their actual requirements.These systems integrate various technologies to deliver water precisely where and when it is needed, based on real-time data and the specific requirements of the crops.Digital irrigation encompasses various technologies and approaches, each with its unique features and applications.Some of the primary types include drip irrigation, soil moisture sensors, weather-based systems, remote control and automation, subsurface drip irrigation, agricultural weather stations, scheduling system sand aquaponics and hydroponics:

In view of the pressing need for efficient water management in agriculture and the availability of different types of smart irrigation systems mentioned above, farmers can select appropriate type of digital irrigation systems to optimize their crop production while conserving valuable resources.These systems are not only a response to the challenges of modern agriculture but also provide a sustainable solution for ensuring food security.Smart irrigation systems offer a wide range of advantages including water conservation, increased crop yields, cost savings, environmental sustainability and remote monitoring.However initial cost, accuracy of data, technological literacy and infrastructure remain challenges in implementing digital/ smart irrigation on a large scale.

We had initiated a drip irrigation scheme for farmers owning half to one care land holdings in district Alwar, Rajasthan in the year 2012 under Precision Farming Development Centre at Water Technology Centre, IARI, New Delhi.We have been providing guidance through formal and informal channels to all such farmers who joined the group.I am happy to report that in past decade the number of farmers has grown more than ten times.Encouraged by the increased incomes several of these farmers have started adopting other technologies including polyhouses etc.The article aims to present this real field case of farmers adoption of digital irrigation technologies.

7.1.3 Digital Management of Water for Enhancing Water Productivity

Narendra Kumar Gontia
Honorary Fellow CHAI and Former Dean Ag Engg & Ex Officiating Vice Chancellor
Junagadh Agricultural University, Junagadh
Email: nkgontia@gmail.com; nkgontia@yahoo.com; nkgontia@jau.in

Agriculture consumes about 80 percent of the total water resources in India, water governance in this sector involves improving irrigation efficiency, promoting water saving techniques, encouraging crop patterns that use less water, and fairer sharing of water.Where newer challenges are emerging in the management of water, digitalization is increasingly spurring change within the sector.Globally, a growing body of evidence indicates the positive influence of the spread of mobile technologies, remote-sensing services and distributed computing: these technologies are generally said to enhance access to information, inputs, and markets, as well as increasing production and productivity, streamlining supply chains, and reducing operational costs.

India accounts for about 2.45 per cent of world's surface area, 4 per cent of the world's water resources and about 18 per cent of world's population.The country is subjected to uneven distribution of water, challenged by the negative impact of climate change.Thus, there is a need for proper water management and water conservation.India receives an annual average rainfall of 1170 mm.Its uneven spatial and temporal distribution is a major concern for crop production.Out of the total 4,000 billion cubic meters (BCM) of total water resources, the utilizable water resources have been assessed as 1123 BCM (690 BCM sur-face water and 433 BCM groundwater sources).The mean annual flow in all the river basins in India is estimated to be 1,869 BCM.The projected water demand by 2050 will be 1447 BCM which is 324 BCM more than the pre-sent level of utilizable water resources.In addition to agriculture, the demand from other sectors such as industry, energy, municipal etc.are also increasing day by day.Thus, there is a need to identify and analyze the challenges in the agricultural water management sector and formulate strategies for (i) enhancing productivity of challenged agro-ecosystems, i.e.rainfed and water logged areas (ii) producing more from less water by efficient utilization of surface and ground-water in irrigated areas, and (iii) safe use of a portion of grey water for agricultural production purpose in a sustainable manner.

The key factors to be adopted for efficient water management are; use of water judiciously as and when required, use of Efficient methods of irrigation: MIS, more crop/unit of water applied, use of mulching for reducing evaporation losses, increasing crop diversity by growing crops with less water requirement, use of digital platforms viz.RS & GIS techniques for accurate and in Time surveying, Planning, Decision Making, Execution, Monitoring and Impact Assessments of Water Management Practices.

In recent times India has made remarkable achievements in water sector, which is evident from the large growth in irrigated agriculture, increase in agricultural production, and advancements in drinking water supplies in rural and urban areas.In doing so, development of water resources has crossed the thresholds of physical sustainability in many areas, manifested by groundwater depletion, groundwater quality deterioration, dwindling supplies and increasing pollution of Surface water.Therefore, Digital water can help improve water management's transparency and account-ability.Using digital platforms to track water use, monitor water quality, and share information with the public, water managers can increase transparency and build trust with local communities.This can help to promote more sustainable water management practices and can help to reduce conflicts over water resources.

Keywords: Water Management, Digital Water Management, Remote Sensing & GIS, Sensors, UAVs, Water use efficiency, Water productivity

7.2.4 Potential use of Digital Technology for Enhancing Water Productivity in Eastern India

Arti Kumari[1], Ashutosh Upadhyaya[2*] and Anup Das[3]

[1]Scientist, ICAR-Research Complex for Eastern Region, Patna 800014, India

[2] Principal Scientist & Head (DLWM),

ICAR-Research Complex for Eastern Region, Patna 800014, India

[3]Director, ICAR-Research Complex for Eastern Region, Patna 800014, India

Email: aupadhyaya66@gmail.com

The global escalation of population growth and the exacerbation of water scarcity challenges due to climate change have underscored an urgent imperative to enhance water productivity across diverse sectors.This necessity is equally critical for India, particularly amid prevalent water scarcities.The enhancement of water productivity (WP), indicative of achieving "more crop or value per drop of water," has thus reached a pivotal juncture.This emphasizes the vital necessity to optimize agricultural yield while concurrently conserving water resources.Such efforts are indispensable for ensuring sustainable food production, given the mounting pressures arising from water scarcity and the unpredictability of climate conditions.However, research efforts on the water productivity (WP) of field crops within farmers' fields remain limited.The current status of water productivity in Eastern India underscores significant variations in irrigation water productivity for rice and other field crops across different states.For instance, the irrigation water productivity of rice in Eastern India is merely 0.49 kg/m^3, indicating a relatively low level of productivity.However, in these regions, states like Uttar Pradesh (0.35kg/m^3), Bihar (0.4 kg/m^3), Odisha (0.35kg/m^3), and Assam (0.38kg/m^3) also exhibited notably low levels of irrigation water productivity, particularly concerning water-intensive rice crops.These findings emphasize the pressing need for further investigation and strategic interventions to address this gap and improve water productivity in the region.In light of these challenges, digital technology presents a transformative opportunity to revolutionize water management practices, optimize resource allocation, and mitigate the impacts of water stress.Despite the challenges associated with the adoption of digital agriculture, such as high upfront costs and limited technical know-how, the study underscores the importance of concerted efforts from stakeholders to overcome these barriers.Initiatives to make low-cost technologies accessible to smallholder farmers, skill development

and extension services, and improve rural infrastructure are essential for promoting widespread adoption of digital solutions.Overall, leveraging digital tools and embracing digitalization presents unparalleled opportunities for Eastern India to address its water management challenges effectively, enhance agricultural productivity, and ensure sustainable socio-economic development in the region.

Keywords: Eastern India, water productivity, digital technology, precision agriculture, smart irrigation

7.1.5 Precision Water Management Technologies for Enabling Digital Horticulture in India

Pothula Srinivasa Brahmanand
Project Director, Water Technology Centre,
ICAR-Indian Agricultural Research Institute, New Delhi;
Email: pd_wtc@iari.res.in

The judicious utilization of water resources for agriculture and horticulture sectors is gaining significance in recent times as water is a limiting factor for crop production and it faces stiff competition from other sectors like industry and energy.Hence, we need to emphasize on precision water management technologies for enhancing water productivity of agricultural and horticultural crops.Artificial Intelligence (AI) and Internet of Things (IoT) help fruit and vegetable growers to ensure precise irrigation for higher crop yield and better quality.It is heartening to note that the horticultural produce of India was 352 Mt during 2022-23 which plays crucial role in nutritional security.At the same time, in the backdrop of diminishing water resources, we need to promote IoT based automated water management for enabling Digital horticulture and for enhancing water productivity.With the advent of modern developments in information technology, machine learning, geographic position system (GPS), geographic information system (GIS), drone-based monitoring, and automation, the precision irrigation system has become more strengthened now.Though precision irrigation water management is in a nascent stage in India, we have ample scope and opportunities to increase its adoption in India.We need to make a phase-wise transition of precision irrigation management from concept level to field adoption through aggressively promoting mobile app-based digital horticulture solutions and strengthening cluster approach on the basis of cooperative farming model, national flagship programmes and public-private partnership.

Automated irrigation systems are designed to utilize real-time devices which can constantly maintain desired soil conditions to increase water productivity of horticultural crops thereby enhancing the net returns of the farmers.Similarly, canal automation, IoT enabled variable rate of irrigation and integrated mulch cum drip technology play vital role in enhancing water productivity of horticultural crops in irrigated ecosystem.The solar powered automated surface irrigation system developed by Water Technology Centre, ICAR-Indian Agricultural Research Institute is energy efficient and it has potential to save nearly 25% of water as compared to the conventional method of irrigation.We need to focus on advanced research in the design and development of IoT based hydroponics and aeroponics monitoring and alert systems which will provide ample scope for enhancing water and nutrient use efficiency of high value fruits and vegetables under protected cultivation.

Keywords: Digital horticulture; Precision water management; Water productivity Solar powered automated surface irrigation system

7.1.6. Impact of Customised Balance Nutrition on Productivity, Quality, Soil Health & Climatic resilience in Tomato

Murlee Yadav*, Naresh Deshmukh and Arvind Kulkarni
Mahadhan Agritek Limited, Sai Hira Building, Mundhwa Road, Pune
Email: murlee.yadav@dfpcl.com

Balance nutrition ensures application of fertilizers on 4R principles *i.e.,* **right ratio, right dose,right method**, **right time,** which in turn results in sustenance of soil fertility (physical, chemical, and biological), increase in crop productivity & quality as well as improvement in climatic resilience due to reduction in GHG emission.It also enhances tolerance of the plant to abiotic (heat/cold/drought) and biotic (diseases/ insects) stresses.

Nitrous oxide (N_2O) is one of the major GHG with a GWP of 298 and lifetime of 120 years.Agriculture accounts for 84% of global anthropogenic N_2O emissions (Smith *et al.*2008) and 71% of the total annual direct emission of N_2O in Asia (Zhu et al.2005).Nitrogenous (N) fertilizer input into agricultural systems is considered the major source of N_2O emissions from agricultural soils (Mosier and Kroeze 2000).N_2O is produced in soils mainly by the bacterial processes of nitrification and denitrification after fertilizer application.Vegetable fields are characterized by intensive production and high N application rates.Consequently, intensively managed vegetable cultivation will not only contribute to substantial N2O emission but will also lead to soil acidification (Guo *et al*., 2010).India accounts for 14% of the world's total vegetable production.India is next only to China in vegetables production.**Tomato ranks third in priority** after potato and onion in India with **0.865Mha area** under cultivation and 11% share of world production.Cultivation of tomato is also likely to go up by nearly 4%.There is a growing interest in the resource use and environmental burdens arising in agricultural and horticultural production system.Most studies on GHG emissions from agricultural sector were focused on methane and nitrous oxide emission mainly from rice-wheat and maize wheat system.Carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are the three major greenhouse gases (GHG).The atmospheric concentrations of these gases have substantially exceeded the pre-industrial levels by about 40%, 150%, and 20%, respectively (IPCC, 2013).Globally agriculture, forestry, and other land use (AFOLU) sector accounts for 24% of total global anthropogenic emissions of GHGs mainly methane and nitrous oxide (IPCC, 2014).Of global anthropogenic emissions in 2010, agriculture accounted for about 43% of N_2O and about 47% of CH_4 increase in emission compared to 1970.During 1970-2000, GHGs emission increased at the rate of 1.3% yr^{-1}, but during 2000-2010, the rate of increase was 2.2% yr^{-1}.Of the total 40% of this increase was from Asia, mostly China and India (IPCC 2014).

Nitrogenous (N) fertilizer input into agricultural systems is considered the major source of N_2O emissions from agricultural soils (Mosier and Kroeze, 2000).N_2O is produced in soils mainly by the bacterial processes of nitrification and denitrification after fertilizer application.Vegetable fields are characterized by intensive production and high N application rates which may be lost as N_2O, NO_x or NH_3

Balanced nutrient management as per the crops and their stages plays an important role in improving the productivity, quality and saving significant quantity of nutrients.Improving the nutrient use efficiency and balancing the nutrient as per the crop & their specific stages is one of the major challenges.Horticultural crops like Grapes, Tomato, Banana, Pomegranate, Melons, Citrus, and other horticultural & high value field crops are very responsive to nutrients through fertigation.However, currently application of most of the nutrients is through bulk fertilizers & through soil application.Fertigation is practiced in few crops with low dose of nutrients.This is a big bottle neck for productivity and quality of our horticultural crops as these crops do not get nutrient as per their stage specific requirement on real time basis.

MAL (100% Subsidiary of Deepak Fertilizers & Petrochemicals Corporation Ltd.) has been working on the above objective from last 35 years.As per MAL's experience Nutrient Use efficiency (NUE) in horticultural crops can be further enhanced through customization of nutrients as per crop and their stages through fertigation in comparison to nutrients applied on individual basis through fertigation & enhancing the features of Nutrients/Product/Solution.

After understanding this need, Mahadhan Agritek Ltd.(MAL) invested efforts in these directions and started R & D and initiated multilocation trials (Maharashtra, Karnataka, Gujarat, Rajasthan, Chhattisgarh, AP, Telangana, Tamilnadu etc) in 2018-19 on development of Crop & Stage Specific Customized Water Soluble Fertigation Grades along with complete package in the principle of 20: 80 nutrient ratio (soil vs.fertigation) for Tomato, Grapes, Pomegranate, Banana, Melons, Citrus, Potato, Sugarcane, Chilli and other fertigated crops, so as to cater the requirement of nutrients as per the crop's and their stages on real time basis.The basis of this research was Soil Health Status (pH, EC, Calcium Carbonate, OC, Nutrient Status etc), 4R principle, Right form nutrient, Nutrient partition in the crops, Target productivity and Exportable/premium quality.

MAL introduced Crop specific and Stage Specific Customized WSF Grades along with complete nutrition solution in the brand name "SOLUTEK" in 2020-21 for Grapes, Tomato, Pomegranate& Banana after 3 years of extensive multilocation in-house trials & validation through SAUs/ICAR Institutes.Under these Solutek fertigation solutions, 80% nutrients go through three Customized Water-Soluble Crop & Stage Specific Fertigation Grades and 20 % nutrients goes through soil applied Enhanced Efficiency Fertilizers boosted with **Nutrient Unlock Technology** (NUT) which are mentioned as below:

Fertigation Customized Water-Soluble Grades

Solutek Tomato : (**Grade-1**: 17: 14: 09+TE, **Grade-2**: 13: 12: 19+TE &

Grade-3: 09: 08: 28+TE)

Soil Applied Bulk fertilizers: Enhanced Efficiency Fertilizers Croptek 9: 24: 24+TE and Bensulf SUPERFAST (90% S)

Each grade is recommended at specific crop stages at pre-defined use rates, no.of application & interval between two applications.This gives farmers a lot of ease in terms of decision making, in terms of what to use, when to use as well as in managing the compatibility issues.These Solutek grades & solutions are thoroughly tested, validated, and evaluated against **RDF** through straight fertilizers for 2-3 years in ICAR Institute like IIHR, Bangalore & IARI, New Delhi.

Solutek solutions not only increased the productivity & quality of fruits but also improved the nutrient use efficiency significantly by saving significant quantity of nitrogen, phosphorus and potash versus existing RDF and common farmer practices.In addition to this, it also sustained the post-harvest soil status in comparison to RDF.As per 3 year's study (2020-21,2021-22 & 2022-23) at IIHR, Bangalore & 1 year study at IARI, New Delhi; Solutek Solution increased 23 % yield & 11% lycopene content along with significant saving of 62 % nitrogen over IIHR's RDF while 39 % increase in yield, 6% fruit firmness,7% TSS & 33 % reduction in N2O emission against IARI, New Delhi RDF (150: 60: 60).There is significant improvement in Soil Health parameters (pH, EC & Nutrient parameters) against RDF in both the cases.MAL's inhouse trials conducted between 2019-20 to 23& recorded 40% increase in yield, other quality as well as soil health parameters over farmer practice.

Overall, 'Solutek solution not only increasing farmer's income by enhancing their crop productivity, quality, Soil Health parameters and saving in input cost, but also making their farm operation very easy and convenient because farmers are not required to make any decisions every now and then, they don't have to put many fertilizers from many different sources because all the nutrients are customized as per crop & their critical growth stages in '**Solutek Solutions'**.The doses per application per hectare, interval of application and total no.of applications are all well-defined for each grade in Solutek Solution.Over and above these '**Solutek**

Solution' are improving the NUE significantly. Hence, saving significant quantity of Nitrogen *i.e.*62-67% along with minimum percentage of Amide nitrogen.

India is committed to reduce its GHG intensity by 30% under the nationally determined commitment by the year 2030 (MoEFCC, 2019).Seventy seven percent (77%) of the total N_2O emission is due to the application of nitrogenous fertilizers (MoEFCC, 2019).Type of Nitrogenous fertilizers and water management impact on climate change because of emission of GHG.Therefore, development of climate smart technologies for mitigation of GHG emissions, is the need of the hour.Hence, Solutek Solution will be one of the effective/Climate SMART technologies to reduce the Green House Gas emission due to significant saving in Nitrogen dosing.

Way forward: Ag IOT started integrating with above mentioned Solution to reduce the impact of climatic variation, abiotic & biotic stresses, and soil variability and to develop Algorithm for giving solution on Realtime basis to farmer.

7.2 Oral Presentation

7.2.1 Influence of Integrated Nutrient Management on Various Growth Attributes and Yield of Mango (*Magnifera indica* L.) cv.Jamadar

G.S. Vala, V.C. Dodiya, T.K. Mandaviya* and V.S. Bambhaniya
Agriculture Research Station (Fruit Crops),
Junagadh Agricultural University, Mahuva, Bhavnagar (Gujarat), India
Email: tarun0756@jau.in

Mango belongs to the family *Anacardiaceae*.Mango is known as the "King of fruits".It is one of the most important tropical fruit of the world and the national fruit of India.amadar is local variety of Bhavnagar district of Gujarat.Fruits are green, medium in size having typical smell and colour.Nutrient management is of vital importance and affects growth, yield and quality of the crop.An experiment was conducted to find out the influence of integrated nutrient management on various growth attributes and yield of mango (*Magnifera indica* L.) cv.Jamadar during 2013-14 to 2016-17 at Agriculture Research Station (Fruit Crops), Junagadh Agricultural University, Mahuva.The trial was laid out in Randomized Block Design with four replication and seven treatments.Four year pooled data revealed that the highest plant height (5.33 m), maximum plant spread (E-W) (4.34 m), plant spread (N-S) (3.97 m), fruit girth (9.53 cm), fruit length (8.76 cm), fruit weight (185.50 g), fruit yield (18.40 kg/plant and 3271 kg/ha), total sugar (14.78%) and TSS (26.81%) was obtained in treatment T7 comprising full dose of RDF NPK (kg/ha) + FYM.Treatment having 50 % N from RDF + 50 % N from Castor Cake kg/pl/ Year proved as the next better treatment.

Keywords: Mango, Growth attributes, Yield, Jamadar, INM

7.2.2 Effect of Foliar Spray of Chemicals to Induce Flowering and Fruiting on Rejuvenated Mango Trees cv. Kesar

[1]S.K. Bhuva, [2]N.D.Polara, [3]D.R. Kanzaria, and [4]D.K.V7aru

Assistant Professor, Department of Horticulture, College of Agriculture, JAU, Junagadh
Associate Professor, Department of Horticulture, College of Agriculture, JAU, Junagadh
Associate Professor, COH, JAU, Junagadh
Principal and Dean, COH, JAU, Junagadh
E-mail: skbhuva@jau.in

The field experiment was conducted at FRS, JAU, Junagadh during 2016-19 to earliness in flowering and fruiting and quality in rejuvenated mango tree for the benefit of farmers whom have very old orchard of cv.Kesar mango under south Saurashtra Agro- Climatic conditions.This experiment was laid out in the RBD having 6 treatments *viz*.T_{1-}Urea 2%, $T_{2-}KNO_3$ 2%, T_{3-}ZnSO4 0.2% + Boric acid 0.1%,T_4-Ethrel 200 ppm,T_5-Cycocel 1000 ppm and T_6-Control and 4 replication.From it, maximum canopy spread (E-W) (6.83 m) and (N-S) (6.88 m) in Urea 2% At June and August in pooled.Maximum fruit length 10.36 cm and fruit width 6.64 cm, maximum average weight of fruit (233.09 g), maximum no.of fruits/tree 154.67, fruit yield 36.03 kg/tree and fruit yield 3602.85 kg/ha in Cycocel 1000 ppm At October and November.While in quality maximum reducing sugar 13.07 %, non reducing sugar 4.07 %, total sugar 17.14 % and TSS 20.50 °B were recorded in KNO_3 2% At September and October.

Keywords: Fertilizers, Paclobutrazol, Rejuvenation and Mango

7.2.3 Equitable Nutrient Management of Developing Plants in Nursery and During Transportation: An Approach for Sustainable and Enhanced Earnings

A. K.Singh[1], Ranju Kumari[2 *] Subhash Chandra[3],Rajeesh Singh [4], Tarun Kumar [5] and Divya Tiwari[6]

[2 &6] *Astt.Professor cum J.Scientist, NCOH, Noorsarai, Nalanda, BAU, Sabour, Bhagalpur.*
[1] *Senior Scientist and Head KVK, Saraiya, Muzaffarpur, DRPCAU, Pusa, Samastipur.*
[3] *Assistant Professor Cum Junior Scientist, CAE, RPCAU,Pusa.*
[4 &5] *Subject Matter Specialist KVK, Saraiya, Muzaffarpur, DRPCAU, Pusa, Samastipur.*
Email: ranjupusa@gmail.com

The present study is based on the high-tech nursery and its nutrient management in horticultural crops.This review Article is covered all key aspects of nutrient management in high-tech nursery.Care and management of growing plants in the nursery, during transport and planting in field is essential as care and management of plant in nurseries and during transport are the heart of our ornamental, vegetative fruits and forest industries.Most of the seedlings planted by farmers are produced in local small scale plant nurseries and very costlier which have an important role in the sustaining the development of local community and doubling the income of farmers.Very few plants nurseries managers have received professional training and advice on the techniques of nursery management.Thus, this study discusses in details the nutrient requirement and way of its application in managing of growing plant in nurseries, as well as during transportation.

Nutrient management in nursery is a vital component of scientific nursery management.It should be given due importance by the nursery man to produce healthy seedlings of plants.Plant Nutrients and their requirement for their growth and development.Plants absorb a large number of elements from soil, air and

water during growth and development.But only sixteen elements are found to be essential in plant nutrition.Often nurserymen are encountered with some deficiency symptoms appearing in nursery plants and therefore, they should have sufficient knowledge to identify the deficiency symptoms so that corrective steps can be taken effectively for better management of nursery plants or greenery industry.

Keywords: Micro nutrient, macro nutrients, humus, fertilizer, nursery, seedling, etc.

7.2.4 Effect of Different Nutrient Management on Soil Available Uutrients, Micronutrients Content and Uptake by Cucumber Plant and Fruit under Polyhouse

[1]A.M. Butani, [2]Mital Vaghasiya and [3]D.K.Varu
[1]Dr.A.M.Butani, Assistant Professor, College of horticulture, Junagadh Agricultural University Junagadh,E-mail ambutani@jau.in (Mobile No: 9427242366)
[2]Mital M.Vaghasiya, Research Associate, College of horticulture, Junagadh Agricultural University Junagadh,E-mail mitalvaghasiya7@gmail.com (Mobile No: 9724215650)
[3]Dr. D.K.Varu, Principal and Dean, College of horticulture, Junagadh Agricultural University Email: dkvaru@jau.in

An experiment was conducted at High tech Green house, College of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) during the year 2021-22 to study effect of different nutrient management on content and uptake by cucumber plant and fruit under polyhouse.The treatment comprised with eight treatments.The experiment was designed in Completely Randomized Design (CRD) with three replications.The effect of different nutrient managemnt on Soil- N,P,K and micronutrient, Organic Carbon and Plant & fruit - Content & uptake N,P,K and micronutrient at harvest were found significant in T_3 (100 % RDF + Panchgavaya 3%) at 30,40,60 days after sowing.

Keywords: Cucumber and Nutrient

7.2.5 Effect of Different Mulching and Integrated Liquid Organic Nutrients on Yield, Yield Attributes and Economics in Banana Cv. Grand Naine

Chudhari Tejal, H.V. Vasava, T. Dodiya, and D.K.Varu
College of Horticulture, J.A.U., Junagadh, Gujarat, India-362001
Email: tejalhorti@jau.in

The present experiment entitled "Effect of different mulching and integrated liquid organic nutrients on yield, yield attributes and economics in banana cv.Grand Naine**.**" was carried out at Fruit Research Station, Madhadi Baug, Department of Horticulture, Junagadh Agricultural University, Junagadh during the year 2016-2017 and 2017-2018.The experiment was laid out in Randomized Block Design with Factorial concept (FRBD) consisting two factors and three replications.Variations due to different treatments were significant for the number of hands per bunch, number of fingers per hand, and finger weight, but not for finger length and diameter with mulching.Maximum values were observed with silver mulch.For liquid organic formulation, all parameters except finger diameter were significant, with the highest values recorded for Jivamrut + Seaweed extraction.Interaction effects were insignificant when pooled.Fruit yield variations were significant throughout the years, with highest yields observed with silver mulch and Jivamrut + Seaweed extraction.Interaction effects varied across years.The highest net realizations were obtained with silver mulch, Jivamrut, and their combination.

Keywords: Mulches, Integrated liquid organic nutrients, Yield, Economics, Banana, Grand Naine

7.2.6 Enhancing Banana cv.Grand Naine: The Impact of Varied Mulching and Integrated Liquid Organic Nutrients on Flowering, Growth, Quality, and Organoleptic Attributes

T.Chudhari, H.V.Vasava, H.Chaudhari, A.M.Butani, and D.K.Varu
College of Horticulture, J.A.U., Junagadh, Gujarat, India-362001
Email: tejalhorti@jau.in

The present experiment entitled "Enhancing Banana cv.Grand Naine: The Impact of Varied Mulching and Integrated Liquid Organic Nutrients on Flowering, Growth, Quality, and Organoleptic Attributes" was carried out at Fruit Research Station, Madhadi Baug, Department of Horticulture, Junagadh Agricultural University, Junagadh during the year 2016-2017 and 2017-2018.The experiment was laid out in Randomized Block Design with Factorial concept (FRBD) consisting two factors with three replications.The study revealed significant growth improvements with silver mulch, particularly in plant height, stem girth, and leaf count.Among liquid organic formulations, the combination of Jivamrut @ 500 l/ha + Sea weed extraction @ 3 % showed notable growth parameters.Flowering remained insignificant across all years.Treatment variation was insignificant for mulching in quality parameters, but significant for liquid organic formulations, especially in TSS and total sugar.Organoleptic parameters were unaffected by mulching but showed significant effects with liquid organic formulations, with notable results in color, flavor, and aroma, particularly in treatments involving panchgavya @ 3 % + Jivanrut @ 500 l/ha + biofertilizer@20 ml/plant (Azo.+ PSB+KSB).Interaction effects were significant in individual years but insignificant when pooled.

Keywords: Mulches, Integrated liquid organic nutrients, Flowering, Growth, Banana

7.2.7 Soil Moisture Sensor-based Irrigation Scheduling to Improve Production and Water Consumption Efficiency of Drip-Irrigated Tomato Crops

Vikas Sharma[1] and S.S.Lakhawat[2*]
[1]*School of Agriculture, Lovely Professional University, Phagwara-144411, Punjab, India*
[2]*Department of Horticulture, Maharana Pratap University of Agriculture and Technology, Udaipur-313001, Rajasthan, India*
Email: lakhawatss@gmail.com

A field experiment was conducted at research farm of Lovely Professional University with six drip irrigated treatments where irrigation scheduling was decided by the TDR and granular matrix soil moisture sensors.A plot having flood irrigation was taken as control for comparison.Among all the soil moisture sensor based drip irrigated treatments, the plant height, number of branches/plant, number of cluster/plant, number of fruits/cluster and marketable tomato yield were found 7 to 22%, 12 to 14%, 11 to 55% and 25 to 50% and 16 to 23%, respectively higher than that were recorded under the flood irrigation (*i.e.*control).In water

scarcity condition, the irrigation at 100% field capacity of soil was maintained automatically by TDR based soil moisture sensor (installed at 25 cm depth) and drip irrigation approach was found the best for tomato with significantly maximum irrigation water saving (54%), crop yield (16.2 t/ha), water use efficiency (0.866 t/ha-cm) and B: C ratio (2.8) over conventional flood irrigation method (*i.e.*control).The sensor-based drip irrigation system has undeniably and unambiguously demonstrated superiority over flood irrigation due to high irrigation water saving ability and high water use efficiency hence, it can be adopted as a water saving measures at farmer's field.Soil moisture sensor based drip irrigation system can maintain the optimum moisture condition (by minimizing water losses) in plant root zone and thereby increase the effective utilization of available fresh water resources towards crop production.

Keywords: Drip irrigation, Fruit yield, Granular matrix moisture sensor, TDR based soil moisture sensor, Tomato, Water Saving and Water use efficiency

7.2.8 Simulating the Water Productivity of Sweet Corn Crop by Aquacrop Model

H. Rank[1*], R.M. Satasiya[2], R.J. Patel[3], P.B.Vekariya[3], K.C. Patel[4]
[1*]*Department of Farm Engineering, College of Agriculture, JAU, Junagadh*
[2*]*Polytechnic in Agril.Engg., JAU, Targhadia*
[3*]*Department of Soil and Water Conservation Engg., CAET, JAU, Junagadh*
[4*]*Director IT Cell, JAU, Junagadh*
Email: prasangrank@jau.in

India faces a water crisis, threatening agricultural productivity.This study investigates water management strategies for sweet corn cultivation using the AquaCrop model.Field experiments evaluated the effects of irrigation, fertigation, and mulching on sweet corn yield and water use efficiency under surface drip irrigation.The AquaCrop model was calibrated and validated using field data to simulate crop canopy, cob yield and water productivity of sweet corn crop.This study utilizes the AquaCrop model to simulate the response of sweet corn crops to various irrigation and fertigation strategies, including surface drip irrigation (SDI) with and without mulches.Field data from a two-year experimental period, encompassing crop growth parameters, soil conditions, and climate variables, were integrated into the model to predict canopy cover, biomass, yield and water productivity.Calibration and validation of the model were conducted for specific treatments, and model efficiency was assessed using performance parameters such as the Nash–Sutcliffe model efficiency coefficient (NSE), Pearson Correlation Coefficient (r), and Willmott's index of agreement (d).The model accurately simulated yield attributes under different management options, showing higher performance during calibration than validation.Furthermore, the study evaluates the impact of climate change on sweet corn crop yield and water productivity using future climate predictions.It was found that the yield is projected to increase with rising temperatures and CO2 levels.By 2050-51, the yield is estimated to increase to 24.112 tons/ha (+4.29% compared to present), and by 2099-2100, it is projected to further increase to 24.278 tons/ha (+5.01% compared to present).Notably, the simulated sweet corn yield exhibited an increase despite the projected rise in temperature inputs in the future.However, it is crucial to acknowledge that the warmer climate anticipated in the future will likely necessitate an increase in crop water requirements.Nevertheless, the adverse effects of elevated temperatures in the future may potentially be mitigated by an increase in carbon dioxide levels.Water productivity, measured in terms of yield per unit of water (Kg/cum), is also expected to increase with rising temperatures and CO2 levels.By 2050-51, water productivity is projected to reach 7.31 Kg/cum (+2.36% compared to present), and by 2099-2100, it is estimated to be 7.20 Kg/cum (+3.88% compared to present).

7.2.9 Effect of IrrigationTtechniques and Polythene Mulch in Muskmelon (*Cucumismelo* L.)

K.B. Asodariya[1], R.K. Rathod[2], S.R. Jadeja[3] and V.H. Kachhadia[4]
Assistant Professor (Agronomy) [1], Sr.Research Assistant[2]
Assistant Professor (pl.Breeding) [3], and Research Scientist (Garlic & Onion)[4]
Vegetable Research Station, Junagadh Agricultural University, Junagadh – 362 001 (Gujarat)
Email: kbasodaria@jau.in

Muskmelon is a species of Cucumis that has been developed into many cultivated varieties.The fruit flesh is either sweet or bland, with or without a musky aroma, and the rind can be smooth, ribbed, wrinkled or netted.The sweet-flesh varieties are often collectively called muskmelon.In addition to their consumption when fresh, dried melons are sometimes also used.Other varieties are cooked, or grown for their seeds, which are processed to produce melon oil, some are grown only for their pleasant fragrance.Muskmelon (Cucumis melo L.) is an important vegetable crop in the world, and is often cultivated with irrigation in semiarid or arid regions.High yield of top quality is a prerequisite for proûtable production of muskmelon.There are some researches that showed that muskmelon is sensitive to water stress.Water deûcit can cause reduced fruit yield, on the other hand, excessive soil water can damage for muskmelon and cause fruit quality problems.

For this, the experiment was conducted for three years during summer season from 2021 to 2023 at Vegetable Research Station, Junagadh (Gujarat) to study the enhancement of water productivity by drip irrigation and mulching in muskmelon.The experiment was carried out with seven treatments replicated four times and laid out in Randomized Block Design.The treatments included were T_1: Irrigation at 0.5 bar+ black polythene mulch, T_2: Irrigation at 0.7 bar + black polythene mulch, T_3: Irrigation at 0.9 bar + black polythene mulch T_4: Irrigation at 0.5 bar, T_5: Irrigation at 0.7 bar, T_6: Irrigation at 0.9 bar, T_7: Flood Irrigation at 0.9 bar.The initial status of soil was low in available N and Zn, medium in available P, K and S and high in Fe, Mn, Cu and B.

The statistical analysis of three years data revealed that different growth characters, yield attributes and fruit yields of muskmelon The Highest marketable fruit yield of 170.83 q/ha was recorded under the treatment T1 (Irrigation 0.5 bar + black polythene mulch), and same was found par (155.11 q/ha) with T2 (Irrigation 0.7 bar + black polythene mulch).Irrigation at 0.5 bar in black polythene mulch also have the highest vine length (180.85 cm), fruit diameter (11.36 cm), number of fruits/plant (3.26), average fruit weight (788.47 g), fruit yield per plant (170.83 g) and B: C ratio (6.25).However, the TSS content in fruit (%) was not significantly affected due to different treatments.

Keywords: *Muskmelon, Black polythene mulch, Water productivity*

7.2.10 A Review on Orchid Nutrient Management Strategies

Siddhartha Sankar Biswas[A*], L.C.De[B], Kalaivanan N.S.[B], S. Natta[B], Chandan G.H.[B], A. Kumar[A] and S.P. Das[B]
[a]ICAR- National Research Centre for Orchids, Darjeeling Campus, Darjeeling, West Bengal
[b]ICAR- National Research Centre for Orchids, Pakyong, Sikkim
Email: siddssac20475@gmail.com

Orchids are mostly epiphytes.They have some mechanisms to survive when nutrient availability is limited.Also domesticating the epiphytic orchids potted plants is quite difficult.Nutrient management for orchids is also

different from other field crops.Generally nutrient solutions are applied to orchids, once in a week or two.Like other crops, for orchid also, scientific studies have put their major emphasize on N, P and K.Beside N, P, K, Ca and Mg also required in huge quantity for different orchids.Some reports on integrated nutrient management of orchids are also available.

Keywords: Orchid, Nutrients, Mineral nutrition, Organic nutrition, Growing media

7.3 Poster Presentation

7.3.1 Influence of NPK Fertilizer on Growth and Yield of Drumstick (*Moringa oleifera* L.) CV. PKM-1

H.J. Senjaliya*, J.S.Vora and K.D. Patel
Email: hjpatel25@gmail.com

A research experiment was conducted at the Lal Baugh Farm, College of Horticulture, Junagadh Agricultural University, Junagadh during the year 2021-22 to study the influence of NPK fertilizer on growth and yield of drumstick (*moringa oleifera* l.) cv.PKM-1.The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replications.Plants were planted at distance of 3.00 x 3.00 m^2.Pruning was done at 2 m height on second fortnight of October.The treatments comprised of three levels of nitrogen *viz.,* 40 g/plant, 60 g/plant and 80 g/plant, two levels of phosphorus *viz.,* 15 g/plant and 30 g/plant and three levels of potassium *viz.,* 15 g/plant, 30 g/plant and 45 g/plant.The maximum plant height, number of branches per plant, number of pods per plant and pod yield were recorded with application of nitrogen 80 g/plant.maximum number of branches per plant, days of initiation of first flower, number of pods per plant, pod yield and minimum days of first harvest were noted with application of 30 g/plant.maximum plant height, number of branches per plant, number of pods per plant, pod yield, minimum days of initiation of first flower, days of first harvest were recorded with application of 45 g/plant.In case of interaction effect maximum number of branches per plant and maximum pod yield found with application of 80 g/plant nitrogen, 30 g/plant Phosphorus and 45 g/plant Potash.

Keywords: Drumstick**,** Nitrogen, Phosphorous, Potassium, Growth and Yield

7.3.2 Effect of Irrigation and Fertility Levels on Summer Soybean [*Glycinemax*(L.) Merrill]

S.K. Chhodavadia*, P.K. Chovatia, V.B.Bhalu and B.K. Dobariya
Department of Agronomy, College of Agriculture, JAU, Junagadh, Gujarat
Email: skchhodavadia24589@jau.in

A field experiment entitled "Effect of irrigation and fertility levels on growth, yield and quality of summer soybean [*Glycine max* (L.) Merrill]" was carried out during summer season of 2021 at the Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh.There were 12 treatment combination consisting of three irrigation scheduling based on IW/CPE ratio (I_1= 0.6, I_2= 0.8 and I_3= 1.0) and fertility levels (F_1: 40-80-0 NPK kg/ha, F_2: 30-60-0 NPK kg/ha, F_3: 25-50-0 NPK kg/ha and F_4: 20-40-0 NPK kg/ha) were tested in a split plot design with three replications.The results indicated that irrigation scheduling at 1.0 IW/CPE ratio recorded significantly higher values of plant height (30, 60 DAS and at harvest), number of branches per plant and dry matter production.Similarly, irrigation

scheduling at 1.0 IW/CPE ratio recorded significantly higher value of yield attributes, yield and quality components *viz.,* number of pods per plant, seed yield (1764 kg/ha), stover yield (2274 kg/ha) and oil yield followed by 0.8 IW/CPE ratio.Almost all the growth attributes, yield attributes, yield and quality parameters as well as net return and B: C ratio of soybean was found significantly higher when crop was sown at fertilizer application of F_2 (30-60-0 NPK kg/ha) closely followed by F_1 (40-80-0 NPK kg/ha) over F_3 (25-50-0 NPK kg/ha) and F_4 (20-40-0 NPK kg/ha).Soil moisture study from various soil depths and consumptive use of water observed maximum under 1.0 IW/CPE ratio with least water use efficiency over other.Whereas, higher WUE was obtained when crop was irrigated 0.6 IW/CPE ratio.

7.3.3 Effect of Micronutrients on Yield and Nutrients Uptake by Tomato

H.L. Sakarvadia and K.B. Asodariya
Department of Soil Science and Agricultural Chemistry,
College of Agriculture, Junagadh Agricultural University, Junagadh – 362 001
E-mail : hlsakarvadia@jau.in

A field experiment was conducted on *Typic Heplustptes soils* of Vegetable Research Farm, Junagadh Agricultural University, Junagadh, Gujarat to study the effect of micronutrients on yield and nutrients uptake by tomato.The results revealed that the mean fruits (20.32 t ha^{-1}) and stalk (15.6 kg ha^{-1}) yields as well as Fe, Mn, Zn and Cu uptake by fruits and stalk of tomato were increased significantly due to soil application of $FeSO_4$ 15 kg ha^{-1} and $ZnSO_4$ 8 kg ha^{-1} as per soil test value (STV), follow by foliar multi-micronutrients supplementation through 1.0 % spray of multi-micronutrients mixture Grade-IV having Fe-4.0%, Mn-0.1%, Zn-5.0%, Cu-0.5% and B-0.5 % at 45, 60 and 75 days after sowing and which were statistically at par with each other but, significantly superior over control.The magnitude of increased in fruit yield were 26.0 and 20.9 % owing to soil application of $FeSO_4$ @15 kg ha^{-1} + $ZnSO_4$ @ 8 kg ha^{-1} and 1.0 % foliar application of micronutrients mixture Grade -IV at 45, 60 and 75 days after sowing over control, respectively.Significantly higher value of fruit length (5.4 cm), plant height (67.0 cm), No of fruits per plant (41.8), plant fruit girth (8.1 cm) and fruit weight (53.0 g) were also recorded with soil application of 15 kg $FeSO_4$ ha^{-1} and 8 kg $ZnSO_4$ ha^{-1} as per soil test value (STV), follow by foliar application of multi-micronutrients mixture Grade IV.The soil application of multi-micronutrients mixture as per STV or foliar spray 1.0% grade -IV were found beneficial and economical for increasing tomato yield.

7.3.4 Effect of Nutrient Management on Growth, Flowering and Yield in Cucumber under Polyhouse

[1]A.M.Butani, [2]Mital Vaghasiya and [3]D.K.Varu
[1]Dr.A.M.Butani, Assistant Professor, College of horticulture, Junagadh Agricultural University, Junagadh,E-mail ambutani@jau.in (Mobile No: 9427242366)
[2]Mital M.Vaghasiya, Research Associate, College of horticulture, Junagadh Agricultural University, Junagadh,E-mail mitalvaghasiya7@gmail.com (Mobile No: 9724215650)
[3]Dr.D.K.Varu, Principal and Dean, College of horticulture, Junagadh Agricultural University, (E-mail dkvaru@jau.in (Mobile No: 9724455737)

An experiment was conducted at High tech Green house, College of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) during the year 2021 and 2022 to study the effect of nutrient management on growth, flowering and yield in cucumber under polyhouse.The treatment comprised with eight treatments.The experiment was designed in Completely Randomized Design (CRD) with three replications.The effect of nutrient on length of vine, days taken to initiation of first female flower, no.of female flowers per plant, days taken for first picking, average weight of fruit, no.of fruit per plant, average yield per plant, yield per hectare and T.S.S were found significant in treatment T_3 (100 % RDF + Panchgavaya 3%) at 30,40,60 days after sowing.

Keywords: Cucumber and Nutrient

7.3.5 Evaluation of Salt Tolerance Varieties of Onion (*Allium cepa*) With and Without FYM under Saline Irrigation Condition

K.B. Ranpariya, M.A. Davara and H.L. Sakarvadia
Email: kbranpariya@jau.in

A Field experiment was conducted during 2017-18, 2018-19 and 2019-20 at Fruit Research Station, J.A.U., Mangrol.To study the effect of FYM on yield of different onion varieties and chemical properties of soil under saline irrigation water.Irrigation water having EC 12.70 dS m^{-1}.The experiment conducted with two levels of FYM (F_0 -Control, F_1 -FYM @ 20 t/ha) and four varieties of onion (V_1-Pilipatti, V_2 -Agri.found light red, V3-Talaja red, V_4-GJRO-11) by adopting Randomized Block Design with Factorial concept having four replication.The result indicated that the bulb yield of onion increased significantly with the application of FYM.The highest bulb yield 6393 kg/ha and the lowest Na/K ratio in bulb (0.084) were observed with the application of FYM 20 t/ha.Among the different variety of onion, variety Agri.Found Light Red produced significantly the highest bulb yield 7290 kg/ha, bulb girth (3.59 cm), bulb length (3.70 cm) and the lowest Na/K ratio (0.56) in fodder.Soil chemical parameter like soil EC was significantly influenced by FYM application, while other soil properties like pH, SAR and ESP remain unaffected.Significantly the lowest EC (4.11 dS m^{-1}) was observed with the application of FYM 20 t/ha.

7.3.6 Effect of Saline Irrigation Water on Garlic Varieties

M.A. Davara, K.B. Ranpariya and H.L. Sakarvadia
Email: madavara@jau.in

A pot experiment was conducted during 2018-19 and 2019-20 at Net House, Department of Soil Science and Agricultural Chemistry, Junagadh Agricultural University, Junagadh to assess four levels each of Salinity (S_1 - 2.0, S_2 - 3.0, S_3 - 4.0, S_4 - 5.0) and Garlic varieties (V_1 - GG-2, V_2 - GG-4, V_3 - GJG-5, V_4 - G-282) by adopting completely randomized design (Factorial) replicated three times.The result indicated that with increase in salinity levels of irrigation water from 2.00 dS m^{-1} to 8.00 dS m^{-1}, there was decrease in yield and growth of all the garlic varieties under study.Application of irrigation water having 2.00 dS m^{-1} recorded significantly the highest garlic bulb yield of (62.01 g/pot), plant height (26.38 cm), bulb height (17.07 mm), bulb girth (19.67 mm), no.of cloves/bulb (6.48) and significantly the lowest Na/K ratio in bulb (0.113), straw (0.23).Soil chemical parameters like EC (2.18 dS m^{-1}), SAR (7.00 me/l) and ESP (5.98 %) also observed the lowest with irrigation water having EC 2.0 dS m^{-1}.Under saline irrigation water, among the different varieties of garlic GJG-5 variety recorded significantly highest bulb yield (58.87 g/pot), plant height (24.40 cm), bulb height (16.56 mm), bulb girth (18.96 mm), no.of cloves per bulb (6.05), lowest Na/K ratio in bulb (0.157) and straw (0.36).

7.3.7 Acetyl Salicylic Acid is a key for Alleviation of Soil Moisture Deficit Stress in Banana

Ankur Patel*, P.K. Modi, K.D. Bisane and Vrutti Patel
Fruit Research Station (ICAR-AICRP on Fruits)
Navsari Agricultural University, Gandevi
*Email:*ankurpatel2019@nau.in

Banana (referring to banana, plantain and cooking bananas) are economically important high-value commercial as well as subsistence food crop. Originally, that have been adapted from the humid tropics to broad subtropics climatic conditions. Banana plants are long-duration crop, it is prone to water stress any time in the crop cycle as in change in rainfall pattern, shortage of rainfall or decrease of groundwater. During this time supplementary irrigation is essential to shield the negative impacts of water deficit. Besides, higher leaf area index and shallow root system make banana susceptible to soil water stress. The requirement of water in banana crop is high and it is sensitive to flood and drought. Therefore, an experiment was framed to assess the resistance power of banana plant against water stress. The soil moisture stress at primordial initiation (5 MAP) and flowering stage increases the duration of harvesting by 9.8 to 16.9 days. Also, the yield was decreased by 12.39-18.69 %. The hands per bunch and fingers per bunch were decreased by 5.29 to 5.73 and 7.10-11.11 respectively over control. The treatment of soil moisture stress + foliar priming with 0.1 mM Acetyl salicylic acid recorded more relative water content as well as higher yield and yield attributing characters as compare to without foliar priming.

8. TECHNICAL SESSION-8 (HALL NO.-1)

INNOVATION IN PLANT HEALTH CARE FOR ENHANCED PROFITABILITY OF HORTICULTURE PRODUCE

8.1 Keynote Lecture

8.1.1 Managing the Risk of Insect Pests and Diseases through the Use of Digital Technology

Subhash Chander
ICAR-National Research Centre for Integrated Pest Management,
Rajpur Khurd Campus, New Delhi-110067
Email: Subhash.Chander6@icar.gov.in; schanderthakur@gmail.com

Insect pests, diseases, nematodes, and weeds significantly impact crop production, causing an average yield loss of about 20%, which equates to 60 million tonnes of food grains and 65.3 million tonnes of horticultural produce.The primary strategy to increase production involves cultivating improved crop varieties and enhancing crop and pest management, as expanding agricultural land is not feasible due to its diversion to other developmental activities.Currently, national priorities include producing safe, quality food, conserving the environment, doubling farmers' incomes, and promoting exports.Integrated Pest Management (IPM) has been a cornerstone policy for crop protection since 1985, with significant efforts directed towards promoting its adoption among farmers to minimise pesticide use.Additionally, pest problems have intensified during the post-Green Revolution years due to intensive agriculture practices, such as heavily fertilised

monocultures, high-yielding cultivars, multiple cropping, and now, climate change.There is a pressing need to vigorously pursue the adoption of IPM across the country to achieve the critical goals of ensuring the availability of safe food and improving the economic conditions of farmers, which are essential for transforming the nation into a developed country.The paper explores the use of digital system for effective IPM applications.

8.1.2 Precision Management of Diseases in Pomegranate through Digital Technologies: Present Scenario

[1]Jyotsana Sharma, [2]Manjunatha N.and [3]Ruchi Agarrwal
[1]Retd.Principal Scientist (Pl.Path.); [2] Senior Scientist (Pl.Path.), [3] PI DBT-BioCARe
ICAR-National Research Centre on Pomegranate, Solapur
Email: jyotisharma128@yahoo.com

Pomegranate, an important horticultural crop globally, has been afflicted by a number of pest and diseases in the recent past.Pathogens that did not cause substantial economic losses earlier have now emerged as a serious threat to the growing pomegranate industry.In view of absence of disease-resistant pomegranate varieties, spread of diseases due to infected planting material and un-informed decisions for disease management by the farmer has aggravated the problem further.In such a scenario, resorting to precision management of diseases in important crops such as pomegranate seems to be judicious.The current review provides an insight to the various digital technologies that have been developed and are being deployed for precision management, with their limitations of course.These technological advances not only aid in on-field diagnosis but can also be trained to provide advisory facilitating a better on-farm management and increasing farmers' income many fold.However, precision pest and disease diagnosis and management through digital technologies is still in infancy with regard to horticulture; hence, lot of research in this area is required before successfully implementing it in pomegranate.

8.1.3 Impact of Abiotic Factors on the Incidence of Red Spider Mite, *Tetranychus urticae* Koch Infesting Brinjal

[1]V.J. Chavda, [2]V.C. Gadhiya, [3]J.Sharma, [4]M.F. Acharya, [5]M.K. Ghelani and M.K. Kanani
College of Agriculture, Junagadh Agricultural University, Junagadh 362001(Gujarat)
Email: drvcgadhiya@jau.in

With a view to know the effect of weather parameters on incidence of red spider mite, *Tetranychus urticae* Koch infesting brinjal, investigation on "Population dynamics of red spider mite, *Tetranychus urticae* Koch infesting brinjal" were carried out under field condition during *Kharif* (September–February, 2021-22) at the Instructional Farm, College of Agriculture, Junagadh Agriculture University, Junagadh, Gujarat.The population of red spider mite was commenced from 37^{th} SMW (2^{nd} week after transplanting) and continued till 5^{th} SMW to the tune of 0.44 and 0.98 mite/4 cm^2 per leaf, respectively.However, the pest population was increased gradually with crop growth and reached to peak in 45^{th} SMW to the tune of 18.40 mite/4 cm^2 per leaf.With the crop maturity the population of *T.urticae* was decreasing gradually from 45^{th} to 5^{th} SMW and then finally vanished out.The red spider mite, *T.urticae* population remains active throughout the crop season with the population ranging from 0.98 to 18.40 mite/4 cm^2 per leaf.The red spider mite, *T.urticae* had the highly significant positive correlation with maximum temperature ($r = 0.658^{**}$).While, the pest having significant negative correlation with morning relative humidity ($r = -0.585^{**}$) and evening relative

humidity (r = -0.458*) at high and moderate level, respectively.The minimum temperature (r = 0.011) and bright sunshine hour (r = 0.214) were non-significant positive correlated with red spider mite population among studied parameters.However, rainfall (r = -0.403) showed negative non-significant correlation with mite population.

Keywords: Red spider mite**,** brinjal, *Tetranychus urticae* and population dynamics

8.1.4 Advances in Rootstock Research for Abiotic Stresses in Fruit Crops

O.P. Awasthi
Head, Division of Fruits & Horticultural Technology
ICAR–Indian Agricultural Research Institute, New Delhi-110012
E mail: awasthiciah@yahoo.com

Fruits are major sources of phytonutrients and dietary fibers which are essential for human health and are often referred as 'Protective Food'.India is the second largest producer of fruits in the world, after China with a production of 108.34 million metric tons during 2022-23.However, productivity of fruit crops during the last one decade has been witnessing a declining trend from 17.6 Mt/Ha (2012-2013) to 15.45 Mt/Ha (2022-2023) thus resulting in a decrease of almost 12.22% which is thought provoking.The major factors attributed to productivity decline are several abiotic stresses.These stresses are the consequence of fruit crops being committed to the land for several decades with longer production periods and vulnerability to intermittent precipitation events, thermal stress, drought, salinity stress, indiscriminate use of irrigation water etc.Such stresses and further likely to aggravate under the era of climate change.

Rootstock selection and improvement with the goal of imparting tolerance to various abiotic stresses would be an ideal strategy for mitigating these challenges.It is well understood that rootstock is inextricably linked with the success or failure of orcharding enterprise because plant's first line of defense against abiotic stress is in its roots.Certain species of rootstock and ecotypes seem to have a combination of key genes, quantitative trait loci and molecular networks that mediate plant responses to drought, salinity, heat, freeze tolerance and other abiotic stresses.Several studies have shown the importance of rootstocks for increasing food security by increasing the efficiency of natural (water soil) resource utilization and decreasing the use of chemical inputs.Purposefully selected rootstocks enable the scion variety to express its genetic potential in terms of tolerance to various stresses, fruit quality and achieving real yield, modify architecture of plants.This paper attempt to provide a brief review of the rootstock research done in different fruit crops of national importance, technologies developed and future line of root stock research for the tropical, subtropical, semi-arid and arid fruits of the hot and cold region.

8.2 Oral Presentation

8.2.1 Isolation, Identification and In-vitro Evaluation of Trichoderma sp.Against Banana Fusarium Wilt Pathogen *Fusarium oxysporum* f.sp.cubense [Foc- race1]

Gopi M*, Padmanaban B, Amol Chaudhary, Anil.B.Patil
Crop Protection, Jain Research & Development Laboratory, Jain Agri Park, Jain Irrigation Systems Limited, Jalgaon, Maharashtra- 425 001.
**Email: muthukathan.gopi@jains.com*

Fusarium oxysporum f.sp.cubense (Foc) is one of the most devastating constraints to banana production worldwide.Due to the persistence of the pathogen in the soil, and the perennial production system of the host, the disease is difficult to manage.

A total of 400 Banana rhizosphere soil samples were collected from different districts of Tamil Nadu: Kolli Hills, Yercaud,Thandikudi, Bodimettu and Pollachi.Trichoderma was isolated from the samples using the Trichoderma selective medium.Five different Trichoderma sp.were identified using rDNA ITS.The following five isolates of Trichoderma were identified: Trichoderma asperellum JISL3 (NCBI acc no.PP231027), Trichoderma sp.JISL4, Trichoderma hamatum JISL5 (NCBI acc no.PP231041), Trichoderma yunnanense JISL6 (NCBI acc no PP9428322), Trichoderma harzianum JISL7 (NCBI acc no.PP231059).The five Trichoderma isolates evaluated under in-vitro condition by Dual culture plate assay.out of five isolates T.asperellum JISL3 overgrown the Foc mycelium, inhibiting the mycelial growth of Foc 87.5%.Trichoderma sp.JISL4 overgrown the Foc mycelium, inhibiting the mycelial growth of Foc 82.5%.T.hamatum JISL5 inhibiting the mycelial growth of Foc 75.0%, T.yunnanense JISL6 inhibiting the mycelial growth of Foc 80.0%, T.harzianum JISL7 inhibiting the mycelial growth of Foc 75.0%.Among these isolates, T.asperellum JISL3 showed the strongest inhibition of the growth of Foc.Further these Trichoderma isolates are being evaluated individually and in combination under pot culture and field conditions.

Keywords: Banana, Trichoderma asperellum, T.yunnanense, T.harzianum, T.hamatum

8.2.2 Enterobacter Cloacae Causing Rhizome Rot Disease in Banana Plants cv.Grand Naine (AAA) in India- A New Report

Gopi M, Padmanaban B, Akhilesh A.Mishra, Atul B. Patil, Vijayendra S. Dalvi, Anil B. Patil
Crop Protection, Jain Research & Development Laboratory, Jain AgriPark, Jain Irrigation Systems Limited, Jalgaon, Maharashtra- 425 001
Email: muthukathan.gopi@jains.com

India stands as the foremost global producer of bananas, yielding 29.7 million tonnes from a cultivated area spanning 0.88 million hectares, with a productivity of 37 MT/ha.Rhizome rot disease is a significant challenge in banana cultivation, leading to germination failure and plant mortality at an early-stage, with an incidence ranging from 5% to 30%.A survey was conducted in prominent banana-growing villages in Jalgaon district, Maharashtra, A total of 22 infected plants were collected, from which 10 isolates were selected for pathogenicity.

The pathogen was isolated and the bacterial colonies exhibited circular morphology, measuring 2–3 mm in diameter, with a convex shape and a grayish to white coloration.Subsequently, two isolates were identified

and characterized through morphological and pathogenicity assessments.Symptoms included yellowing of lower leaves progressing to young leaves, with longitudinal sections of roots displaying red or brown discoloration.Additionally, red coloration was observed in cross sections of the corm, extending up to the stem.

The 16S rRNA sequences corresponding to the isolates were deposited in GenBank under the Accession Numbers OR678542 (JISL 1) and PP320448 (JISL 17).For the pathogenicity tests, the two isolates were cultured in nutrient broth for 48 hours at 37±1°C, after which the cells were harvested via centrifugation.A culture suspension containing 2×108 CFU/mL was prepared, and from this 0.5 mL was injected into the rhizomes of three-month-old tissue-cultured plants.The inoculated plants were then kept in a glasshouse environment at 32±2°C.After 6-12 days, symptoms of rhizome rot appeared in all plants inoculated with the two bacterial isolates, while none of the control plants displayed symptoms.

E.cloacae is also reported as a facultative anaerobic human pathogen that is widely distributed.This disease has been reported in the following plants: Allium cepa, Capsicum annuum, and Manihot esculenta, rice and tomato plants.To the best of our knowledge, this is the first report of E.cloacae causing symptoms of banana rhizome rot in field samples.

Keywords: Banana, Enterobacter cloacae

8.2.3 Host Preferences of *Aphis gossypii* for Mass Rearing for Laboratory Studies

Shinde.S., Padmanaban .B., Atul.B.Patil, Rupesh Bari, Akhilesh A.Mishra, and B.K.Yadav

Jain R&D Lab, JISL, Jain Hills, Jalgaon, Maharashtra-425 001.

Email: dr.padmanaban.b@jains.com

Banana is infected by four important viral diseases such as BBBTV, BSV, BBMV and CMV.Cucumber Mosaic Virus is an important viral disease affecting bananas in Maharashtra and causing crop and yield loss .In order to undertake the laboratory studies there is need of aphid colony and to rear the aphids in large scale there is a need to identify potential host .Field observations were made to identify the potential hosts.In India more than 33 weed hosts have been reported and out of which 18 hosts were susceptible to CMV infection.The aphid population observations on ten host plants were recorded .In each plant, observations on three leaf and replicated thrice.Among the ten host plants under field conditions, the ability of the hosts to harbour higher number of *Aphis gossypii* was in *Hibiscus rosasinensis* and *Gossypium hirusutum,* followed by *Hibiscus safadariba and Solanum nigrum* in the next category .In the next category the following plants were recorded: *Physalis* spp., *Nerium oleander* and *Acalypha indica* .Whereas the weed hosts *Euphorbia hirta*, *Commelina benghalensis* and *Tridax prucumbens* encouraged a small population only.The banana plants could not encourage the aphid population built up.In the perspective of rearing aphids for laboratory studies the hosts like *Hibiscus rosasinensis, H.sabadariffa* and *A.indica* are the best choices.For a temporary culture maintenance *S.nigrum* and *Physalis* spp are considered as best keeping in view of the smaller plant size, leaf succulence and easy maintenance, however these plants succumb to fungal infection when the humidity is very high.During winter season the aphid population will get diminished and undergo changes in such situations the aphids can be maintained in small host plants like *Commellina benghalensis*, *T.prucumbens* and *E.hirta* under laboratory conditions in an ambient conditions.

Keywords: *Solanum nigrum*, *Aphis gossypii*, Weed hosts, Cucumber Mosaic Virus and *Physalis* spp.Host preference.

8.2.4 Comprehensive Study on Climatic and Ecological Drivers of Seasonal Fluctuation of Guava Fruit Fly

H.N. Patel, J.M. Thumar and K.P. Baraiya
Department of Plant Protection, College of Horticulture, JAU, Junagadh
Email: agrihitu_2004@jau.in

The present experiment was carried out at Fruit Research Station, Sakkar baug, College of Horticulture, Junagadh Agricultural University, Junagadh during the year 2022-23.Incidence of the guava fruit fly was recorded standard meteorological week wise throughout the course of the investigation.The fruit fly population was recorded from the 23rd standard meteorological week to the 52nd standard meteorological week.The peak incidence of fruit fly was recorded at 35th SMW which was 865.13 fruit flies per trap.On the other hand, the lowest population of fruit fly (10.00 fruit flies/trap) was recorded at 52nd SMW.Furthermore, the maximum activity of fruit fly was remained throughout August month with 800.31 fruit flies per trap and the minimum activity of fruit fly was observed during the December month with 21.12 fruit flies per trap.The effects of various weather parameters on the fluctuation of the fruit fly population on guava indicated that the population of fruit fly had a highly significant positive correlation with evening humidity (r = 0.670), morning humidity (r = 0.669) and minimum temperature (r = 0.522).While, wind speed (r = 0.216) and rainfall (r = 0.293) were also found positively correlated but it was non-significant to the fruit fly population.Temperature fluctuation (r = -0.696), relative humidity fluctuation (r = -0.616), bright sunshine hours (r = -0.486) and evaporation (r = -0.483) had a highly significant negative correlation with fruit fly population.Furthermore, maximum temperature (r = -0.362) had a significant negative correlation with the fruit fly population.

8.2.5 Reaction of Different Brinjal Genotypes Against Alternaria Leaf Spot Disease and Management under South Saurashtra Condition

Sudani D.P., Kanzaria K.K.*, Gadhiya V.C[1]., Bhaliya C.M., Kelaiya D.S. and Kachhadia V.H[2].
Department of Plant Pathology, Junagadh Agricultural University, Junagadh, Gujarat, India.
[1]Department of Entomology, Junagadh Agricultural University, Mota Bhandariya-Amreli.
[2]Vegetable Research Station, Junagadh Agricultural University, Junagadh, Gujarat, India.
Email: kkkanzaria@jau.in

A field experiment was conducted to screen eleven different genotypes of brinjal against Alternaria leaf spot disease caused by *Alternaria alternata* (Fr.) Keissler as well as management of disease.Among different genotypes, two genotypes *viz*., JBL-21-05 and JBL-21-04 exhibited moderately resistant reaction, six genotypes *viz.,* JBL-21-09, JBL-21-12, JBL-21-03, JBR-21-02, JBL-21-11 and JBL-21-06 showed moderately susceptible reaction and three genotypes *viz.,* JBL-21-08, JBL-21-07 and JBR-21-01 gave susceptible reaction against Alternaria leaf spot of brinjal.Under field evaluation of fungicides, total seven fungicides were tested for their efficacy against Alternarialeaf spot of brinjal.Among them, pyraclostrobin 13.3 + epoxiconazole 5 SE found significantly superior over rest of the treatments and showed minimum disease intensity (8.26%) at 0.025% concentration with 83.97 per cent disease reduction over control and maximum fruit yield of 470 q/ha.It was remained statistically at par with fluxapyroxad 250 g/l + pyraclostrobin 250 g/l SC at the same concentration with 9.24 per cent disease intensity, 82.05 per cent disease reduction over control and fruit yield (445 q/ha) as against control treatment that had 52.05 per cent disease intensity and minimum fruit yield of 265 q/ha.

8.2.6 Isolation, Characterization, and Formulation of Native Isolates of Entomopathogenic Nematodes and Their Associated Symbiotic Bacteria

Anil[1], Hosamani, A.K.[3], Veena, K.[3], Jagadish Rane[2] A.K. Singh[1], Gangadhara K.[1],

[1]Central Horticultural Experiment Station (ICAR-CIAH), Vejalpur
Godhra-Vadodara Highway, Godhra, Panchmahal,Gujarat, India
[2]ICAR-Central Institute for Arid Horticulture, Bikaner
[3]University of Agricultural Sciences, Raichur, Karnataka
Email: anildp444@gmail.com

Entomopathogenic nematodes (EPNs) are essential for leveraging their biological control potential, ensuring species specificity and safety by enhancing integrated pest management (IPM) and promoting agricultural sustainability.This research fosters effective, eco-friendly pest management solutions, benefiting both farmers and ecosystems.The study focused on isolating, identifying, and characterizing native entomopathogenic nematode (EPN) strains from various habitats in UAS, Raichur.Out of 15 in situ traps deployed, nine EPN samples were recovered, with a 60% recovery rate.Morphometric analysis revealed significant variations in lengths and other morphological features among different EPN species.Molecular characterization confirmed the presence of nine EPN strains in UAS, Raichur, exhibiting high sequence similarities (99%).Additionally, symbiotic bacteria associated with EPNs were identified, showcasing diverse bacterial species within this ecological niche.Bioassay studies demonstrated the virulence of EPN species against Galleria mellonella larvae, with Heterorhabditis indica exhibiting the highest mortality rates (54%).Furthermore, a talc-based formulation containing a mixture of EPN strains, with H.indica being predominant, was developed for potential application in pest management.Overall, the findings provide valuable insights into the diversity, morphology, molecular characteristics, and virulence of native EPN strains, and talc-based formulation highlighting their potential for biocontrol applications in agricultural ecosystems.

Keywords: Entomopathogenic nematodes, Infective Juveniles, Symbiotic bacteria, Virulence, and *Galleria* larvae

8.2.7 Cutting Edge Technology for Plant Disease Management

***Amrita Kumari, Avanish Kumar Singh and Ajay Bhardwaj**

Assistant Professor cum Junior Scientist, BAU Sabour, Bhagalpur, 813210
**Email: Amrita0023@bausabour.ac.in*

Plant disease management has a lengthy history and has employed a range of techniques, the most well-known of which are manual interventions and visual symptom identification.Based on historical research, it is known that modern solutions must be adopted to address the evolving problems in agriculture.The capacity for observation was crucial for early agricultural civilizations to recognize the signs of plant diseases.However, this visual symptom-based approach proved to be unsuccessful and often caused a delay in identification and response.The discovery of chemical pesticides in the mid-1900s was a significant breakthrough for medicine since it provided physicians with an effective tool for treating a variety of diseases.Regrettably, the extensive and careless use of these substances led to adverse effects on organisms that were not intended targets, the emergence of resistant strains, and environmental problems.Modern technology, such as advanced imaging systems and molecular diagnostics, has made it possible to precisely and early diagnose plant diseases.Techniques like hyperspectral imaging and PCR-based tests provide for

quick and accurate pathogen detection, allowing for proactive measures to be taken before disease outbreaks.Remote sensing technologies, like satellite and drone photography, provide an accessible means of large-scale disease surveillance.Real-time information sharing between farmers, academics, and extension organizations has become simpler with the rise of digital platforms and communication technology.There are various challenges in incorporation of these cutting edge technologies into agricultural practices.The purchase and use of modern technology, such as expensive upfront equipment for precision farming and sophisticated sensors, might provide financial challenges for many farmers.Not only Budgetary obstacles, but also other challenges like limited technical expertise, infrastructure limitations poses a great threat in implementation of modern technology for plant disease management.

Keywords: Plant disease management, remote sensing, hyperspectral imaging etc

8.2.8 Using Fishing Net for the Management of Rhinoceros Beetle, *Oryctes rhinoceros* (L.)Infesting Juvenile Coconut (*Cocos nucifera*) Palms

S.M. Wankhede*, K.V. Malshe, S.L. Ghavale, B.A. Jerard and S. Sumitha
ICAR-AICRP on Palms, Regional Coconut Research Station, Bhatye, Ratnagiri (M.S.), India
Dr.Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli-415 712
Email: drsantoshwankhede@gmail.com

Rhinoceros beetle, *Oryctes rhinoceros* (L.) is a major pest of coconut in India and other coconut producing countries causing direct and indirect losses to the palms.Beetle infestation results in reduced yield and fatal to seedlings, young or old palms in some situations.Adult stage of the beetle causes damage.It makes burrows and resides between leaf sheaths, near the crown and cuts the leaf in unopened conditions.In spite of its successful control, lack of awareness in farmers about the management of rhinoceros beetle is proving to be a setback.In this context, an evaluation trial on effectiveness of fishing net for the management of rhinoceros beetle infesting juvenile coconut palms was initiated during April 2022 at ICAR-AICRP on Palms, Regional Coconut Research Station, Bhatye (DBSKKV, Dapoli), Maharashtra, (India).The trial was non-replicated and two to six years old 35 palms were selected for experiment.Fishing nylon net (Disco 20mm size) cut in 10 feet length and loosely tied circular fashion on the base of spear with 3-4 adjacent fronds) at one month interval.Post treatment observations were recorded on leaf, spindle damage and number of adults beetle trapped on nylon net at monthly interval.The maximum leaf and spindle damage was found 28.5 and 17.1 per cent, respectively during pre-count observations in the months of April, 2022.However, minimum leaf damage (2.13%), spindle damage (2.42%) and adults beetle trapped on nylon net (0.16 nos.) were observed in December 2023.The decline trends were observed in nylon net treatment.However, increasing trends was observed in control treatment from May, 2022 to December, 2023.The fishing nylon net has found effective for the management of rhinoceros beetles infesting juvenile coconut palms over the control and would help to reduce the further crop damage due to rhinoceros beetle in the region.

Keywords: *Coconut palms, leaf damage, nylon net, rhinoceros beetle, spindle damage*

8.2.9 To Find Out the Effectiveness of Different Botanical Extract against Sucking Insect Pest in Cumin

A.V.Khanpara and P.P.Konkani
Polytechnic in Agriculture, Junagadh Agricultural University,
Halvad – 363 330 (Dist.– Morbi)
Email : alpesh@jau.in

The different nine botanicals with control were evaluated under field condition against insect pest and diseases of cumin during Rabi 2023-24.Results revealed that in first spray before first spray none of treatments found significant.At three days after spraying first most effective treatment was B.bassiana @ 40g/10 lit (6.45 thrips/plant) which was at par with Hing powder @0.500 kg/10 lit (6.71thrips/plant).Second most effective treatment was Dhatura leaf extract @1.25kg/lit (7.19 thrips/plant).At seven days after spraying first effective treatment was Neem oil 0.5% (7.85thrips/plant).Second most effective treatment was Chilli+ Garlic extract @50 ml/10lit (12.63 thrips/plant).Third most effective treatment was B.bassiana 40g/10 lit (14.60 thrips/plant) which was at par with Hing powder@0.500 kg/10 lit (14.80 thrips/plant).At ten days after first spraying most effective treatment was Neem oil 0.5% (6.59 thrips/plant).Second most effective treatment was Nimastra @200 ml/10 lit (17.13 thrips/plant) which was at par with B.bassiana 40g/10 lit (17.53 thrips/plant).In second spray at three day after spraying, most effective treatment was B.bassiana @40g/10 lit (7.86 thrips/plant) which was at par with Hing powder @0.500 kg/10 lit (7.93 thrips/ plant).Second most effective treatment was Dhatura leaf extract @1.25kg/10 lit (8.73 thrips/plant).At seven days after spraying most effective treatment was Neem oil 0.5% (8.79 thrips/plant).Second most effective treatment was Chilli+ Garlic extract @50 ml/10lit (10.99 thrips/plant).At ten days after second spraying Neem oil 0.5% (3.12 thrips/plant) found most effective.Second most effective treatment was Nimastra @200 ml/10 lit (15.99 thrips/plant).

8.2.10 Evaluation of Arka Microbial Consortium (AMC) for Guava

S.B. Jadhav, M.H. Shete, R.V. Kadu S.S. Dighe R.B. Kadu and Prakash Patil
All India Coordinated Research Project on Fruits
Mahatma Phule Krishi Vidyapeeth, Rahuri (MS), India
Email: satishjadhav2010@rediffmail.com

Guava is the fourth most important fruit crop after mango, banana and citrus.It can grow in tropical and sub-tropical areas.It is a rich source of vitamin C and pectin along with calcium and phosphorus.The field trial was laid out at AICRP on Fruits MPKV, Rahuri with four treatments in RBD replicated seven times to evaluate the performance of Arka Microbial Consortium.The three years of pooled data showed a significant difference in growth, yield, and quality contributing character of guava.The maximum fruits per plant (334), yield per plant (55 kg) and yield per ha (14.8 t) were recorded in T3 (75% RDF+ AMC soil application 5 kg/ acre twice a year along with FYM) and found at par with T2 (75% RDF + AMC soil application 4 times @ 5g/lit through biofertigation).Less vitamin C content (190 mg/100 g) and higher seed wt.(2.91 g) was recorded in T4.

Significantly maximum P_2O_5 (29.1 kg/ha) andK_2O (441 kg/ha) in soil was recorded in T1 (100% RDF).A reduction in pH was noticed as compared to the initial status of pH.The microbial count was significantly influenced by different treatments.Significantly maximum fungi (18.5 x10^5cfu/g) and bacteria (24.9 x10^6cfu/ g) were counted in T3.The maximum B: C ratio (1.50) was recorded in T3 followed by T2 (1.47).

Keywords: AMC, fertilizers, yield, guava

8.3 Poster Presentation

8.3.1 Efficacy of various Herbicides in *Kharif* Pigeonpea [*Cajanus cajan* (L.) Mill sp.]and Determination of their Persistence through Bioassay Technique

P.K. Chovatia*, K.V. Hirapara and S.K. Chhodavadia
Department of Agronomy, College of Agriculture, JAU, Junagadh, Gujarat
Email: skchhodavadia24589@jau.in

An experiment entitled "Efficacy of various herbicides in *kharif* pigeon pea [*Cajanus cajan* (L.) Millsp.] and determination of their persistence through bioassay technique" was conducted on medium black calcareous clayey soil at Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat) during *kharif* and *rabi* seasons of 2021-22 and 2022-23.The experiment comprising 10 treatments was laid out in randomized block design with three replications.Results indicated that next to the weed free treatment, pendimethalin 1000 g/ha **or** oxyfluorfen 180 g/ha as pre-emergence *fb* IC &HW at 30 and 60 DAS and IC &HW at 20 and 45 DAS *fb* glyphosate 900 g/ha as post-emergence at 75 DAS, enhanced growth parameters *viz*., plant height, branches/plant, yield attributes like, number of pods/plant and ultimately gave higher seed and stalk yields along with improved quality parameters *viz*., protein content.These treatments also reduced population and dry matter of weeds, inhibited nutrient removal by weed and increased uptake of nutrients by the crop.From the pot bioassays study, it can be concluded that pre and post emergence application of herbicides showed significant phytotoxic effect up to 60 DAS, but at 90 DAS, residue level of pre and post emergence herbicides was below detectable level in the surface soil so that did not show any significant phytotoxic effect on sorghum and cucumber.There was no residual phytoxicity of mentioned pre and post-emergence herbicides through field bioassay and it is safe to grow succeeding groundnut, green gram and pearl millet crops.

8.3.2 Isolation and Identification of Bacterial Endophytes from Micropropagated Tissue Culture Banana Plants [Grand Naine (AAA)]

Gopi M.*, Padmanaban B., Akhilesh A.Mishra, Nalini P.and Anil.B.Patil
Crop Protection, Jain Research & Development Laboratory, Jain AgriPark, Jain Irrigation Systems Limited, Jalgaon, Maharashtra- 425 001.
**Email: muthukathan.gopi@jains.com*

Plants are normally associated with diverse microorganisms, some of which may stimulate plant defense responses and development.Bacteria that associate with plants include rhizobacteria, epiphytic and endophytic bacteria.Endophytic bacteria colonize the internal tissues of the plants with no apparent negative effects on their host.An attempt was made to isolate bacterial endophytes associated with the tissue culture banana plants.

Six different distinct endophytic bacterial isolates from root, corm, stem of banana tissue culture Grand Naine (AAA) plants.The bacterial group analysis by 16S-ribosomal RNA gene, showing the genera Prista aryabhattai JISL10 (NCBI acc no.PP237221), Bacillus pumilus JISL11 (NCBI acc no.PP237259), Bacillus subtilis JISL12 (NCBI acc no.PP238096), Ochrobactrum sp.JISL13, Paenibacillus sp.JISL14, Delftia sp.JISL10.Therefore, we demonstrate here that the abundant bacterial community exists in banana tissues, Further these endophytic bacterial preparation of bioformulation for plant growth-promoting (PGP) traits, management of biotrophic necrotrophic fungi.

Keywords: Banana, *Prista aryabhattai,Bacillus pumilus, Bacillus subtilis*, *Paenibacillus sp, Delftia* sp.

8.3.3 Screening of Synthetic Elicitors and Other Chemicals for the Management of Fusarium Wilt of banana (Foc-race 1)

Gopi M*, Padmanaban B.
Crop Protection, Jain Research & Development Laboratory, Jain AgriPark, Jain Irrigation Systems Limited, Jalgaon, Maharashtra- 425 001.
**Email: muthukathan.gopi@jains.com*

Banana is one of the most important fruit crops of the world.The crop is affected by fusarium wilt disease Fusarium oxysporum f.sp.cubense (Foc).It is reported that the pathogen survives in the soil for more than 30 years, so far no effective control measures are available.Therefore, the synthetic elicitors and chemicals are being evaluated for disease management.

The present study was conducted to observe the in-vitro application of various synthetic elicitors such as Salicylic acid, Sodium silicate, Boric acid and Orthosilicic acid on various concentrations on mycelial growth of Foc.The mycelial growth of Foc was 100% inhibited on PDA medium amended with Sodium silicate 0.5%, Boric acid 0.5%.Salicylic acid 5mM completely inhibited the fusarium growth.Orthosilicic acid 0.4% and 0.5% inhibited the mycelial of Foc 55.5% and 66.6% respectively.Further these elicitors are being evaluated individually and in combination under pot culture and field conditions.

Keywords: Synthetic elicitors, Salicylic acid, Sodium silicate.

8.3.4 Impact of Organic Amendments on Incidence of Termites Infesting Groundnut

M.K.Kanani[1], A.L.Gohil[2], V.C.Gadhiya[3] P.K.and Borad[4]
[1]Assistant Research Scientist, Agricultural Res.Station,
Junagadh Agricultural University, Amreli- 365 601
[2]*Block technology Manager, ATMA, Tal: Jesar Dist.Bhavnagar*
[3]*Assistant Professor, College of Agriculture,*
Junagadh Agricultural University, Mota Bhandariya- 365 610
[4]Rtd.Professor and Head, B.A.College of Agriculture
Anand Agricultural University, Anand – 388 110
**Email: kananimayur551@gmail.com*

Field experiment was conducted on impact of organic amendments on incidence of termite in groundnut during summer *and Kharif,* 2012 at Agronomy farm, B.A.College of Agriculture, Anand Agricultural University, Anand.The soil application of neem cake, castor cake and vermicompost @ 1 tonne/ha at the time of land preparation before sowing were found to be more effective in suppressing the termites incidence in groundnut during *summer* and *Kharif* seasons.These treatments produced higher (1878 to 2283 kg/ha) pod and haulm (3967 to 4282 kg/ha) yield during *summer* as well as in *Kharif* season (2141 to 2411 kg/ha) pod and (3693 to 4227 kg/ha) haulm.Increased in yield over control was 39.88 to 50.55 per cent of pod and 47 to 51.33 per cent of haulm in *summer*, whereas it was 48.80 to 54.54 per cent of pod and 46.62 to 52.99 per cent of haulm in *Kharif* season.The loss in pod was up to 7.22 per cent and in haulm was up to 3.48 per cent in summer, while in *Kharif* it was 7.80 per cent of pod and 7.04 per cent of haulm.

Keywords: Termite, organic amendments, Groundnut

8.3.5 Role of Organic Mulches in boosting Fruit Quality and Soil Health

N.Y.Azmi*, M.D. Ojha, Sangeeta Kumari, Shivnath Das and Ranju Kumari
Bihar Agricultural University, Sabour (Bhagalpur)
Agricultural Research Institute, Patna
Email: -nikhatazmi1971@gmail.com

Bihar is one of the strongest agricultural states.The percentage of population employed in agricultural production in Bihar is around 80 per cent, which is much higher than the national average.With the introduction of high yielding varieties after green revolution, injudicious application of chemical fertilizers, pesticide etc.has led to the depletion of soil organic carbon and thereby deterioration of soil fertility.Soil organic matter is the fraction of the soil that consists of plant or animal tissue in various stages of breakdown (decomposition).Soil organic matter contributes to soil productivity in many different ways.Soil organic matter is a tremendous source of plant nutrients and water holding capacity.In an organic system, it is important to rely on the locally available sources of fertility enhancement.Organic mulches are the key to growing healthy, high-yielding organic crops.Successful organic fertility management should primarily feed the soil microbial life in a long-term manner, rather than simply feeding the plants.Organic mulches are playing vital role in organic cultivation.Organic mulches are environment friendly which are frequently and successfully used for high density orcharding of perennial fruit crops.The several organic mulch such as weeds, dry grasses, fallen leaves, banana leaf, paddy straw, shredded papers, wood chips, compost etc are commonly used for covering the soil surface around the root zone of plants.Organic mulches can considerably check the weed population, enhance air and water movement in root zone of plants, improve physical chemical and biological properties of soil.It also conserves soil moisture by reducing evaporative water loss from the soil surface.Organic mulches also checks soil erosion, increases fertilizer and water use efficiency against water and heat stress, substantial boosting in protozoan inhabitants, greatly influences the quality attributes and post harvest life of the fruits.It also increases soil temperature which gives optimum temperature for better seed germination.

Organically grown fruits have great demand in recent year due to their extra nutrition and pleasant flavor in comparison to traditionally grown fruit crops.Organic cultivation of fruit crops improves the soil health and appreciably gets better quality fruits.Soil ecology is a chief element which significantly enhances soil quality and productivity because major activities of soil microbes are decomposition of organic materials, mineralization of nutrients, nitrogen fixation, suppress of crop pests and protection of root.The high population of beneficial organisms and wealth diversity of soil microbes both the condition reduce several crop pest exploits.Therefore, an urgent need to confirm incorporation of organic mulches for getting sustainable yield, maintaining soil health and improved fruit quality because healthy soil produces quality fruits and healthy prosperous India.

Keywords: organic matter, Organic mulches, soil erosion, fertilizer, water use efficiency, heat stress.

8.3.6 Twister disease management in onion bulb crop through integrated approaches

M.K. Pandey, S. Pandey and P.K. Gupta
Regional Research Station (RRS)
National Horticultural Research and Development Foundation (NHRDF)
Nashik - 422 003 (Maharashtra) India
E.mail: manojpandeysln@gmail.com

Onion is a major horticultural crop widely used as a spice, condiment, and vegetable in a variety of dishes. The green leaves, as well as immature and mature bulbs, are consumed raw or used in various cuisines. Onions have significant export potential, offering substantial foreign revenue opportunities. However, onion crops can suffer from various diseases during their growth period, including twister disease. Twister disease frequently affects onion crops in nearly all onion-growing regions, causing considerable damage, particularly during the kharif season. A trial was conducted at RSS, Nashik, during the kharif seasons of 2020, 2021, and 2022 on the onion variety Agrifound Dark Red. The aim was to minimize the incidence of twister disease through sequential spraying of various bio-agents and fungicides. The experiment followed a Randomized Block Design with three replications and seven treatments, including chemical and bio-pesticides, to identify the best treatment combinations. The bed size was 3.0m x 1.2m. The data revealed that treatment T4 (spraying Mancozeb 63% + Carbendazim 12% WP at 2.0 g/L at 30 DAT, Ps. fluorescens at 5.0 g/L at 45 DAT, Propiconazole at 2.0 g/L at 60 DAT, and Tebuconazole at 2.0 g/L at 75 DAT) proved to be the most effective. This treatment combination resulted in the lowest twister disease incidence (21.11%), the highest gross yield (168.45 q/ha), and the highest marketable yield (157.38 q/ha).

Keywords: onion, twister disease, integrated management of diseases

8.3.7 Iris Yellow Spot Virus disease management in onion seed crop

M.K. Pandey, S. Pandey and P.K. Gupta
Regional Research Station (RRS),
National Horticultural Research and Development Foundation (NHRDF),
Nashik - 422 003 (Maharashtra) India,
E.mail: manojpandeysln@gmail.com

Onion (Allium cepa L.) is one of India's most significant vegetable crops. Onion seed crops face various threats from pests and diseases, particularly foliar diseases such as Purple Blotch, Stemphylium Blight, Iris Yellow Spot Virus, and Twister, which affect a large number of seed growers. Among these, the Iris Yellow Spot Virus poses the greatest threat, causing substantial damage and yield losses in onion seed crops. This tospovirus is transmitted by Thripstabaci, a significant pest in onion cultivation. To address this challenge, a field study was conducted at RSS, Nashik, over three consecutive years (2019-2024), on the onion variety NHRDF Fursungi. The objective was to identify an effective spray schedule for managing the Iris Yellow Spot Virus in onion seed crops. A Randomized Block Design was used, with three replications and seven treatments. All recommended cultural practices were followed throughout the trial period.The data indicated that treatment T1, which consisted of T. viride at 5 kg/ha at planting time in the soil, followed by sprays of Fipronil (1 ml/L) and Propineb (2 g/L) at 45 DAP (days after planting), Carbosulfan (2 ml/L) and Copper oxychloride (3 g/L) at 60 DAP, Profenophos (1 ml/L) and Mancozeb (2.5 g/L) at 75 DAP, and Cypermethrin (1 ml/L) and Carbendazim (1 g/L) at 90 DAP, was the most effective. This treatment resulted in the lowest incidence (18.33%) and intensity (0.95%) of Iris Yellow Spot Virus at 90 DAP, as well as the highest seed yield (5.97 q/ha).

8.3.8 Effect of Coloured Sticky Traps in Monitoring of Onion Thrips

M.K. Pathak, Purushothaman. S., B.K. Dubey and P.K. Gupta
Regional Research Station
National Horticultural Research and Development Foundation (NHRDF)
Karnal, Haryana 132001, (India)
Email: karnal@nhrdf.com

Thrips attack onion crops at all stages of growth, with their numbers significantly increasing from bulb initiation through to development and maturity. Both nymphs and adults damage crops directly through feeding and indirectly by transmitting lethal plant viruses. Onion growers consistently face challenges with thrips infestations throughout the year, and effective alternatives for controlling thrips remain scarce. To understand the color preferences of onion thrips, a study was conducted using yellow and blue sticky traps during the rabi seasons of 2019-20 and 2020-21 on the onion variety NHRDF Red. The study took place at the Regional Research Station (RRS) of the National Horticultural Research and Development Foundation (NHRDF) in Karnal, Haryana, India. The experiment was organized with 10 treatments and three replications, following a Randomized Block Design on plots measuring 10 m². Each plot had a two-meter isolation zone, and the sticky traps were replaced every 10 days. The thrips caught on the traps were counted every 10 days with a hand lens before changing the sticky traps. The results showed that the highest number of thrips (11.53 thrips per trap) was recorded in treatment T4 (four yellow sticky traps). The lowest thrips population (3.43 nymphs per plant) was found in treatment T10, where the insecticide Fipronil was sprayed at a concentration of 1.0 ml/L. The same treatment also achieved the highest gross yield (359.45 q/ha) and marketable yield (348.25 q/ha), with a benefit-cost (B:C) ratio of 9.06:1. However, all sticky trap treatments showed a negative benefit-cost ratio due to their high costs. Additionally, treatment T10 yielded the highest B:C ratio, while the control treatment had the highest thrips population and the lowest yield. In conclusion, while sticky traps are effective for monitoring thrips populations in onion crops, they are not economically viable for thrips control and can harm natural enemies.

9. TECHNICAL SESSION-9 (HALL NO. 2)

TECHNOLOGY DIFFUSION AND ENTREPRENEURSHIP DEVELOPMENT IN HORTICULTURE

9.1 Keynote Lecture

9.1.1 Harnessing the Horticulture's Export Potential for Prosperity of Indian Farmers

Anjani Kumar
Principal Scientist, International Food Policy Research Institute, New Delhi
Email: anjani.kumar@cgiar.org

During the last three decades, policy makers have laid significant emphasis on promoting high value agriculture in India, particularly horticulture.Several factors drive this emphasis on horticulture, including the growing recognition that India's farmers-most of whom cultivate less than two hectares of land -would be unable to realise sufficient returns from traditional staple crops such as rice and wheat.Increasing water stress in many states is also pushing the promotion of diversification in agriculture and a shift to less

water-intensive horticultural crops.Horticultural crops also have higher potential to generate more jobs in rural areas and can be more effective in reducing rural poverty and ensuring food and nutrition security.While increased incomes and urbanisation are contributing to rapid growth in India's domestic demand for horticultural produce, there is considerable interest among Indian policy makers and entrepreneurs in expanding participation in lucrative international horticultural markets.Trade expansion is expected to accelerate growth and employment in this subsector and thereby help reduce poverty in rural India.Horticultural crops occupy about 8 percent of India's gross cropped area and account for more than 30 percent of agricultural gross domestic product (GDP).Horticultural exports from India increased significantly over the last two decades.India's horticultural exports were valued at about $ 5.74 billion in TE 2020 and accounted for 2.38% of global horticultural exports (Table 1).Among horticultural products, India's share in world exports is highest for cucumbers and gherkins (preserved), fresh and dried onions, fresh coconuts, shelled cashew nuts, cumin seeds, turmeric, and dried capsicum/pimenta.Although India exports a wide variety of horticultural products, only a handful of commodities or products account for the bulk of this trade.India is the second-largest producer of fruits and vegetables in the world (following China).India produces about *6* percent of the world's fruit and 11 percent of its vegetables.It is the world's largest producer of mangoes, bananas, peas, and cut flowers and the second-largest producer of a broad range of vegetables.Very little of this massive production is traded internationally.Substantial proportions of output-ranging from 15 to 40 percent for most crops-are not sold or consumed at all but lost or spoiled in the stages from harvest to transport and storage. Despite being a massive producer and consumer of fresh horticultural produce, for most individual products India has not yet become a major player in international markets.This paper would assess how India can become ready to compete on and profit from the world horticultural stage? And how the dominant structure of horticultural production and marketing can be aligned with existing opportunities, standards, and supply chain management requirements?

9.1.2 Relevance of Digital Tools in Modern Horticulture for Entrepreneurship and Profitability

Vishal Nath, Saheb Pal, Narendra Singh, Krishna Prakash and Pankaj Kumar Sinha

ICAR-Indian Agricultural Research Institute,
Gauria Karma, Barhi, Hazaribagh, Jharkhand-825405

India has become the second-largest producer of horticultural crops, trailing only behind China, thanks to a significant increase in production. However, the ongoing reduction of arable land, exacerbated by rapid population growth, necessitates the adoption of advanced techniques to enhance productivity.Additionally, shifts in climate parameters frequently lead to unpredictable weather events such as floods, droughts, and earthquakes, causing considerable losses in both crop quantity and quality. Digital horticulture, which involves the use of digital technologies to boost the efficiency and productivity of horticultural crops, offers a solution. This broad field includes a variety of technologies such as sensors, automated systems, data analytics, and artificial intelligence, which help monitor and manage growing environments by assessing factors like temperature, humidity, light intensity, and soil moisture. By leveraging these technologies, digital horticulture holds significant potential to transform the production and management of horticultural crops through sophisticated data collection and analysis.

9.1.3 Horticulture is the New Paradigm for Entrepreneurship Development in Agriculture

D.K.Varu
Principal and Dean, College of Horticulture, JAU, Junagadh
Email: dkvaru@jau.in, principalcoh@jau.in

The horticulture sector is gaining lot of importance because of its nutritional value and for its higher export potentiality exist in the trade of many perishable horticultural produce. There is lot of business opportunity in horticulture that needs to be tapped properly to improve the economy of India. Horti-buisiness is encouraged also by World Trade Organization (WTO) agreements in the country. As such, increasing opportunities have emerged for developing entrepreneurship in horti-business sector especially horticulture, floriculture, pomology, olericulture, post-harvest sector etc.Entrepreneurs are born by the understanding a problem, assessing a need, generating idea, an inner urge and zeal of the candidates.Horticulture presents several avenues available for entrepreneurship activities.In this regard, an entrepreneur can play an important role on post harvest management including the business of pack house, artificial ripening, cold storage, packaging, etc.of fruits and vegetables.Similarly, fresh produce handling, minimal processing, processing of horticultural produce, nursery business, horticultural consultancy, dry flower produces, secondary horticulture, tissue culture, seed production, horticulture tourism, vertical farming, etc.Keeping this in view, this conceptual article has been put forth for the use readers as well as future entrepreneurs.

Keywords: Entrepreneur, entrepreneurial opportunities, horticulture, vertical farming

9.1.4 Entrepreneurship Development with Production of Bioenhancers for Horticultural Crops Production

R.A. Ram
Ex- Principal Scientist & Head, Crop Production, Central Institute for Subtropical Horticulture Rehmankhera, Lucknow-226101
Email: raram_cish@yahoo.co.in

Imbalanced use of agro-chemicals, especially nitrogenous has resulted in some regions manifesting adverse effects on the environment, polluting soil and ground water resources.Soil quality, especially that of organic matter and micro-nutrients deficiencies are becoming ubiquitous threatening sustainability and quality of produce impacting nutritional security.Soil organic carbon content in most of the cultivated land has been reduced to >0.5 per cent.Under these circumstances, maintenance of soil fertility and crop productivity are the major constraints in horticulture production.After closely working with Organic Farming Systems more than two decades, I am of the view that “on farm production organic inputs could be a cheap and alternative tool to resolve many issues.In various organic farming systems viz; biodynamic, natural, Natueco, Rishi Krishi and homa organic farming inputs are produced with cow products and locally available materials.Biodynamic compost, cow pat pit, BD-500, 501, biodynamic liquid pesticides, vermiwash, Amritpani, Panchagavya, Jeevamrita, Beejamrita, Ghan Jeevamrita, Agni Astra, Brahmastra, Dashparni Ark, Amrit Jal and other various preparations are rich source of microbial consortia, macro, micronutrients and plant growth promoting substances including immunity enhancers.In this study, we have isolated, characterized and test microbial isolates from various organic inputs against few selected pathogens.

In general these are utilized to treat seeds/seedlings, enhance decomposition of organic materials thereby enrich soil and induce better plant vigour”.In organic farming systems, few effective preparations such as

BD-500, BD-501, Cow Pat Pit, biodynamic liquid manures/pesticides, Jeevamrita, Beejamrita, Amritpani, Panchagavya etc., are effective tools can be used in organic production of horticultural crops as well as development of entrepreneurship.It is interesting to note that in all these preparations, the basic ingredients are cow based products.In order to give generic name, hence forth, these are named as "Bio enhancers".

Based on the study, it is proven that bio-enhancers are cheap source of agriculturally important microbes which possess multifarious PGPR and biochemical activities.These microbes have potential for nitrogen fixing, IAA production, P, K, Zn solubilisation properties.Isolated microbes have shown inhibition properties against *C.gloeosporioides, C.fimbriota* and *F.oxysporum*.Therefore, these formulations can be effectively used for nutrient, insect and pest management in organic production system.

9.2 Oral Presentation

9.2.1 Unique IT initiatives at ICAR- Directorate of Cashew Research, Puttur for Management and Dissemination of Cashew Information

Mohana, G.S., Vanitha, K., Rajashekara, H., Shamsudheen, M., and J.D.Adiga
ICAR- Directorate of Cashew Research, Puttur
Puttur-574202, Karnataka
Email : mohangs2007@gmail.com

The Cashew app is designed with principles of farmer-friendliness, nationwide information accessibility, comprehensiveness, and ease of use.Developed by ICAR-DCR, Puttur in collaboration with AICRP-cashew centers spread across India, this app facilitates rapid information exchange among stakeholders, enhancing cashew production and productivity.Available on the Google Play Store, the app provides detailed information on cashew nursery management, cultivation practices, plant protection, post-harvest processing, market trends, and e-marketing all in one place, benefiting farmers, researchers, developmental agencies, and processors.

9.2.2 Effect of FeedingProtein-Energy Rich Diet Among the Children to Cure Malnutrition in Rural Area

Minaxi K. Bariya, Kiran Chandravadia and Hansa Gami
[1]*Asso. Professor, College of Agriculture, JAU, Mota Bhandariya (Amreli),*
[2]*Assistant Professor, College of Agricultural Information Technology, AAU, Anand*
[3]*SMS (Home Science), KVK, Ambuja Foundation, Kodinar*
Email: minaxibariya@gmail.com

Protein-energy malnutrition encompasses a spectrum of pathological conditions resulting from insufficient intake of both proteins and calories, predominantly affecting infants and young children.A primary manifestation of this condition is stunted or halted growth.Protein Energy Malnutrition (PEM) commonly afflicts infants during the weaning process and preschool children in developing nations.Kwashiorkor represents one end of this spectrum, characterized by protein deficiency despite sufficient energy intake.On the other end lies nutritional Marasmus, typically occurring before the age of one, resulting from severe and prolonged deprivation of all food sources, including energy and essential nutrients like protein.Ninety children between the ages of 1 to 5, afflicted with protein-energy malnutrition, were chosen to assess the impact of a protein-energy-rich diet.Selection was based on underweight and nutritional deficiencies

identified using growth charts available at Anganwadi centers in the village.Equal numbers of children were randomly assigned to three treatment groups for three-month duration.Among the treatments, the third group showed the most significant improvements in average weight and height, with increases of 1.50 kg and 1.77 cm respectively.The second treatment exhibited moderate improvements, with gains of 0.88 gm and 1.44 cm respectively.Comparatively, the control group only experienced increases of 0.517 gm in weight and 1.33 cm in height.

Keywords: *protein-energy malnutrition, Kwashiorkor, Marasmus, pathological condition*

9.2.3 Entrepreneurship Opportunities for Commercial Production and Cultivation of Brinjal (*Solanum melongena* L.) Grafts by Standardizing Fertilizer Use Efficiency

S.Praneetha and Ndereyimana Assinapol
Department of Vegetable Science
Tamil Nadu Agricultural University, Coimbatore
Email: prejan27@gmail.com

A study was undertaken in grafted brinjal (*Solanum melongena* L.) to standardize spacing, fertigation levels and fertilizer use efficiency (FUE) for commercial cultivation of brinjal grafts.A strip plot design was adopted with four levels of spacing (1 m x 1m, 2 m x 1 m, 1.5 m x 1.5 m and 0.6 m x 0.6 m) and three levels of nutrition (75, 100 and 125 per cent RDF) replicated four times in the main and ratoon crops.The information available for management of brinjal grafts, by adopting the optimum spacing and fertigation level is not sufficient for commercial cultivation.From the study, outstanding performances of grafts over seedlings were recorded for growth parameters, earliness for flowering and days to first harvest and fruit, yield characters, shoot and fruit borer damage over seedlings.

The results obtained under main crop indicated that the 1m x 1m spacing along with the 100 per cent RDF had the FUE of 245.00 kg /kg with benefit cost: ratio of 2.62: 1 for the main crop.In the seedlings, the fertilizer use efficiency of 118.26 kg/ kg with benefit: cost ratio of 1.53: 1.Under main crop evaluation, the cost economics worked out revealed increases of 236.00 per cent for net income, 56.95 per cent for benefit cost ratio and 86.27 per cent for fertilizer use efficiency in brinjal grafts over seedlings.FUE of 245.00 kg/kg in main crop while in ratoon crop the fertilizer use efficiency was 132.04 kg /kg.The more profitability of this treatment in both crops might be due to increased yield per hectare and limitation of fertilizers as per the quantity required by the plant without excess requirement Based on this study the robotics could be engaged to produce brinjal grafts with choice varieties as a well-architected Artificial Intelligence (AI).

9.2.4 Entrepreneurship Development in Horticulture through Climate Resilient Baby Corn Production Technology

Kumari Rashmi[1], Sanjay Sahay[2], S.S. Mandal[1], B. Singh[1], Ravi S. Singh[1], Swapnil[1] and Bal Krishna[1]

[1]Departmentof Plant Breeding and Genetics, Bihar Agricultural College, Sabour, Bhagalpur
[2]Deptt.of Horticulture (Fruit & Fruit Technology),
Bihar Agricultural College, Sabour, Bhagalpur-813210
Email: versatilerash@rediffmail.com

Baby corn is not a separate type of corn like sweet corn and pop corn but any corn type which has characteristics of earliness and prolificacy can be used as baby corn.Baby corn is the ear of maize plant.Young, fresh and finger like green ears are harvested before fertilisation just at the silk emergence and is eaten as salad, used in preparation of soup, manchurian, mixed vegetables, pickles, pakora and other eatables.The crop is harvested at 60 to 65 days.This makes it possible to take more number of crops from the same piece of land.Baby corn cultivation is an alternative for the crop diversification, value addition of maize as well as the growth of food processing industry.Baby corn is similar to other vegetables and is comparable with cauliflower, cabbage, tomato and cucumber from nutritional point of view.Baby corn ears have been found to contain 1.5 per cent protein, 8.2 per cent carbohydrate and 89 per cent water.It also contains considerable amount of vitamin A and C.Baby corn cultivation would result in generating employment for both skilled and unskilled workers.Harvesting and post-harvest handling of baby corn produce requires lot of labour.It has great potential as canned product and industries for packing, canning, processing, transportation and storage would also develop.It has high export potential.The important benefit of baby corn cultivation is that it would help promote dairy farming.After picking baby corn ears, farmer would get good quality of fresh, green and nutritious fodder for dairy cattle.

Keywords: baby corn, earliness, prolificacy, climate resilient, employment, export

9.2.5 Use of ICT in Horticulture Extension

N.B. Jadav*

** Director of Extension Education, Junagadh Agricultural University, Junagadh – 362001*
Email: dr_nbjadav@jau.in

ICT in agriculture is an emerging field focusing on the enhancement of agricultural and rural development in India.The information and Knowledge gap arising out of the failure of traditional models and tools, needs to be filled through exploring other options of alternate extension service delivery mechanisms. Information communication technology (ICT) plays a crucial role in modernizing horticulture extension services.However, challenges such as digital literacy, infrastructure limitations and affordability need to be addressed to ensure equitable access and maximize the potential of ICT in horticulture extension.Information and Communication Technologies (ICTs) have delivered horticultural extension information with greater efficiency, more rapidly and with higher accuracy. ICT tools facilitate the timely and relevant dissemination of information to farmers, resulting in increased sustainability and productivity.The farmers are expected to use various ICT platforms viz., expert system, mobiles, web portals, information kiosks, e-markets, e-Nam and e-farm applicationsfor the development of farming and marketing their farm produce, leading to improved productivity, efficiency and income generation.The ICT platforms add farming and market knowledge to give farmers greater confidence in understanding the demand and enhance ability to the control

production and manage supply chains.Encouraging sustainable practices, increasing agricultural output and empowering farmers all depend on horticulture extension using Information Communication Technology.The diverse ICT tools available offer innovative solutions for disseminating knowledge, building capacity, and fostering collaboration within the horticultural community. By leveraging the potential of ICT, horticulture extension services can address challenges, adapt to changing environments, and contribute to the growth of the agricultural sector.

Keywords: ICT, Horticulture Extension, Expert System

9.2.6 Scope of Digital Marketing in Horticulture

C.D. Lakhlani*, H.Y. Maheta and Kalpesh Kumar****
**Principal and **Assistant Professor, PGIABM, JAU, Junagadh*
Email: chetanlakhlani@jau.in

In our rapidly changing world, digitalization and the internet have revolutionized various aspects of life.One significant area that has witnessed transformation is agriculture *vis a vis* horticulture.Farmers now have unprecedented opportunities to connect with a broader audience of potential buyers and secure better prices for their produce, thanks to digital marketing.Digital marketing plays a pivotal role in helping new horticulture ventures take root.As technology adoption increases, young farmers are now embracing digital platforms.The rising literacy rate in rural areas and improved agribusiness infrastructure contribute to this trend.The pandemic has catalyzed change.Farmers, once hesitant, are now open to digital marketing.They recognize its potential to enhance their reach and profitability.With the establishment of the "e-NAM" platform by our honorable Prime Minister Shree Narendra Modi, farmers can sell their horticultural goods through various online marketplaces.Platforms like iKISAN, NAPANTA APP, NAFED, e-Choupal, and AGMARKET facilitate direct transactions.Farmers, along with farmer associations and F.P.Os (Farmer Producer Organizations), leverage information and communication technology (ICT).Android phones serve as gateways to the internet, WhatsApp, Facebook, Twitter, and YouTube enabling connections with national and global markets.Digital marketing is a powerful tool that transforms horticulture, fostering growth, efficiency, and equitable access to quality produce.

Keywords: Digital Marketing, Agri-Business, Horti-products, Conventional Marketing.

9.2.7 Agrivoltaic System: A Sustainable Method of Farming Horticultural and Vegetable Crops

M.S. Dulawat[1*] and P.M. Chauhan[2]
[1]Assistant Professor, Department of Renewable Energy Engineering, College of Agricultural Engineering & Technology, Junagadh Agricultural University, Junagadh (Gujarat), India-362001
[2]Professor, Department of Renewable Energy Engineering, College of Agricultural Engineering & Technology, Junagadh Agricultural University, Junagadh (Gujarat), India-362001
E-mail: dulawat@jau.in

Agrivoltaics system is a new way to get profitable income as this system allows crops cultivation and energy generation simultaneously on the same piece of land at the same time.This system enables the farmers to gain several benefits such as optimized land use, productivity improvement in the energy and

water saving, economic benefits, etc.India receives ample supply of energy from the sun.This study evaluates the performance of a 13.5 kWp SPV power plant that was installed in the field of the REE department of the College of Agriculture Engineering and Technology, JAU, Junagadh (21.5 N, 70.1 E).The Solar Photovoltaic system was evaluated for the whole year.Under the Agrivoltaic system, the output of vegetable and horticultural crops evaluated, the shade, which is provided by panels as they allow sufficient solar radiation passage for photosynthesis.The shade provided by Agrivoltaic system creates a microclimate suitable for practicing cultivation in arid regions.Some of the crops like cucumber, tomato and broccoli etc.showed better response under the Agrivoltaic system and found enhanced growth, yield, and quality compared to conventional farming.The electricity generated by PV would improve the farmer's socio-economic status, and land productivity.

Keywords: Agrivoltaic system, Photovoltaic, Horticultural crops, Shading, Microclimate

9.2.8 Kodur Sathgudi–A Elite Sweet Orange Clone Suitable for Cultivation in Andhra Pradesh

L. Mukunda Lakshmi[1]*, R. Naga Raju, D. Srinivas Reddy, M. Kavitha, Sreedhar Gutam, Prakash Patil, L. Naram Naidu and T. Janaki Ram

ICAR-AICRP on Fruits, Dr.YSRHU-Citrus Research Station, Tirupati 517502, Andhra Pradesh, India

Email: lmukunda@gmail.com

Six varieties released from SAUs and ICAR-CCRI, Nagpur were evaluated with an objective to select new alternative to currently cultivated sweet orange cv.Sathgudi for high yield and fresh fruit markets under tropical conditions of Andhra Pradesh. The experimental orchard was planted at Dr YSRHU- CRS, Tirupati, Andhra Pradesh in 2011with 6 sweet orange cultivars *viz.,* Phule Mosambi, M_3, M_8, M_4, Kodur Sathgudi, and Shamouti Orange along with check Sathgudi budded on Rangpur lime root stock (*C.limonia* L.Osbeck).The experimental design was randomized block with three replicates and two trees per plot planted at 6 X 6m spacing.M8 and Kodur Sathgudi sweet orange trees greatly differed from other cultivars duly producing heavy canopy over the evaluation period of 11 years (2011-2023).The Kodur Sathgudi produced higher yield (176 fruits/plant, 25.47 kg/plant, 7.06 t/ha) with 10.06 % increase over check followed by M8 with 9.36 % (7.01 t/ha) increase.Though maximum juice and TSS were recorded in Sathgudi but Kodur Sathgudi showed thin rind fruits (2.92mm) while higher TSS to acid ratio was noticed in Phule Mosambi clone (19.39).Over all acceptability of the fruit was found highest in Kodur Sathgudi (7.75) followed by Check (7.66) and Phule Mosambi clones (7.38).The new clones comparatively had less infestation of psylla i.e.M4 (4.66), Kodur Sathgudi (6.66), M3 (7.33), check Sathgudi (9) and Phule Mosambi (9.33).Hence the new clone seems to be a alternative to the existing cultivar under the current problem faced by the citrus industry and also at field level by citrus growers as the economic life of orchards has been slowly reduced due to recent surge in citrus greening.

Keywords: sweet orange, elite clone, Kodur Sathgudi, Andhra Pradesh

9.2.9. Strategies for Development of Horticulture Through Active Participation of Farmer Producer Organizations (FPOs) in India

Priyam Singh and L.Shivarama Reddy
NH Consulting Pvt Ltd
No.136, Rider house, Sector-44, Gurgoan, Haryana-110049
Email: priyam.singh@consultingnhc.com

Department of Agriculture, Cooperation & Farmers' Welfare (DAC&FW), Ministry of Agriculture and Farmers' Welfare, Govt. of India hassanctioneda dedicatedpro-farmerschemenamed Central Sector Scheme for creation of 10000 FPO sinthe countrywithasinglevision "*Formation and Promotion of Farmer Producer Organizations (FPOs) withbusinessentity*" forimplementationacrossthecountry.The scheme has been implemented by identified Implementing agencies such as NCDC, NAFED, NABARD, Small Farmers Agri-Consortiums (SFACs), Central Agricultural University (CAU)-Manipur, etc through various empaneled ClusterBasedBusinessOrganizations (CBBOs). Among the CBBOs, NH Consulting Private Limited (NHCPL), is one of the most reputed and prestigious organizations working PAN INDIA having wide experience in the field of Agriculture, Horticulture, Rural Development, Forestry and allied Sectors, besides, handling projects on Capacity Building, Market Research, Environment & Climate Change and Skill Development has been identified as one of the CBBOs for promotion of FPOs in different states.NHCPL has been involved in formation and promotion of FPOs in the states of Haryana, Bihar, Odisha, West Bengal, Tripura, Manipur and Nagaland.The major crops/ commodities identified in these states are horticulture crops such as Litchi, Makhana; Cereals, Pulses, Oilseeds, Honey, Fishery and other potential crops. Horticulture sector has gained an important role by attracting more farmers, especially women and youth, due to its high/viable returns per unit area.Further, to supplement the increased demand for consumption of horticulture produce especially fruits and vegetables both in rural and urban areas.There is also a growing demand for these produce for processing of value added products as well as for export markets.Thus, a well planned partnership among the farmer members in the FPOs to pursue a common strategy for rebuilding the agricultural sector is envisaged. Changes to the agricultural sector are addressed, and to boost the country's agricultural potential, which have far-reaching effects on poverty reduction, employment generation, health, social stability, sustainable development, and environmental protection.As a result, this sector is increasingly gaining priority.Intended goals pertaining to a sustainable development of the agricultural sector are clearly aligned with the conditions and the ambitious plan of decentralization.

Some of the potential projects related to development of horticulture proposed to be promoted through active participation of Farmer Producer Organizations across the country are a) High Density Planting Systems (HDP system) in Mango, Guava & Litchi, b) Cultivation of strawberry under hydroponic system and c) Cultivation of high value vegetables like tomato, Cucumber and capsicum; flowers like Roses, Gerbera, Anthurium and Dendrobium orchids under Greenhouse conditions.

9.2.10 Role of ICAR-CIRCOT R-ABI Centre in Fostering Indian Startups in Digital Horticulture, AI and IoT Sector

Jyoti Prabhakar Dhakane-Lad*, Ashok Kumar Bharimalla, , and Kirti Jalgaonkar
ICAR-Central Institute for Research on Cotton Technology, Mumbai-400019
Email: jyoti.dhakane@icar.gov.in

ICAR-Central Institute for Research on Cotton Technology (ICAR-CIRCOT), Mumbai is one of the premier institutes under Indian Council of Agricultural Research serving in the post-harvest technological aspects of cotton.The institute has a strong connection with farmers as well as industry which helped it to comprehend the exact demand from the stakeholders and to bridge this gap with innovative technological interventions.The institute has strong history in technology transfer earlier through Zonal Technology Management and Business Planning & Development Unit and presently through Agri Business Incubation Center to propagate institutional research through aspiring entrepreneurs and to provide incubation support to startups.Considering the efficient technology transfers, since, January 2019 a funding component under the RKVY-RAFTAAR scheme was added to the already established Incubation ecosystem.CIRCOT RKVY-RAFTAAR Agri-Business Incubator (CIRCOT R-ABI) has incubated more than 100 Agri startups out of which 60 Agri startups have got a sanction of ₹ 841 lakhs as grant-in-aid.CIRCOT R-ABI provides Incubation support to startups in agri and allied sectors which include start-ups from IoT, precision farming, and artificial intelligence to support them to commercialize their innovative ideas/products e.g.IoT based irrigation system (Lysimeter), sensor-based horticulture crop monitoring system, smart spraying machines, digital platforms for consumer-farmer linkages, pest prediction system, AI based quality assessment.

Keywords: ICAR-CIRCOT, agri-business incubation, startup, grant-in-aid

Poster Presentations

9.3.1.Seed Production and its Distribution at Subsidized Rate to the Farmers by Junagadh Agricultural University, Junagadh: A Success Story

J.B. Patel, C.A. Babariya, J.R. Sondarvaand D.V. Savaliya
Department of Seed Science and Technology
College of Agriculture, Junahadh Agricultural University, Junagadh - 362001
Email: jbpatelvasai38@jau.in

Considering the availability of quality seed locally as a crucial factor in increasing the production of pulses as well as oilseeds, Department of Agriculture and Farmers Welfare, Government of India, has taken initiative to ensure quality seed availability locally through creation of Seed- Hubs projects, "**Creation of Seed Hubs for Increasing Indigenous Production of Pulses in India"** for pulses and **"Creation of Seed-Hubs for Enhancing Quality Seeds Availability of Major Oilseed Crops"** for groundnut were approved and allotted to Junagadh Agricultural University, Junagadh from 2016-17 and 2019-20, respectively under the umbrella of AICRP on Pulses and AICRP on Groundnut.Certified seeds of newly released varieties under these Seed Hubs projects produced by the university more than the target as given in the projects right from its inception.The distribution of certified seeds produced under the Seed Hubs done by the university on a Single Window System directly to the farmers of Gujarat in general and of Saurashtra in particular with the benefit of seed distribution subsidy as per the norms of NFSM and NMOOP under the RKVY project "**Seed Replacement Rate Enhancement**" and JAU, Junagadh is the only SAUs in India giving the benefit of incentive for the purchase of certified seeds to the farmers.Under this project farmers get the benefit of subsidy of Rs.5.93 crore from 2017-18 to 2023-24.In addition to that, certified seed producers (farmers) of university also getting the benefit of seed production subsidy under the project **"Certified seed production of groundnut under NMOOP" in groundnut and "Certified seed production under NFSM-pulses**" in pulses.The details of certified seed production, seed distribution subsidy, incentives to certified seeds producers, mode of working of all these projects makes the success story at JAU, Junagadh is given in these paper.

9.3.2 Domestication of *Citrus grandis* L.Osbeck (Pummelo) in Andhra Pradesh- Suitability and Yield is the Key

L.Mukunda Lakshmi[1]*, R.Naga Raju, D.Srinivas Reddy, T.Rajasekharam, Prakash Patil Priya Devi, L.Naram Naidu and T.Janaki Ram
ICAR-AICRP on Fruits, Dr.YSRHU-Citrus Research Station, Tirupati517502, Andhra Pradesh, India
Email: lmukunda@gmail.com

Despite the health and nutritional benefits of Pummelo (*Citrus grandis* L.Osbeck) a larger fruit in citrus group, has not attained the commercial importance in Andhra Pradesh, a traditional citrus growing region with highest cultivable area of lime and sweet orange.Hence work was initiated under ICAR- AICRP Fruits at Tirupati centre during 2011-23by duly establishing a separate block with9 varieties(PTF- 1,2,3,4 from IIHR, Banglore and NRCC Pummelo 1,2,3,4 and 5 from CCRI, Nagpur) and a check, Pummelo Pink.This research was conducted using randomized design, replicated thrice with two trees per plot at 6 X 6m spacing.NRCC Pummelo -5 clone seems to be suitable for cultivation in Andhra Pradesh climatic conditions with 58.88 % increase in yield (89fruits/plant, 23.93 t/ha) and significantly higher yield efficiency (10.01kg/ m^3) over check (6.41 t/ha).In terms of quality parameters, viz.highest juice (29.30%), maximum TSS content (11.78 ^{o} Brix) were also recorded in NRCC Pummelo-5 clone with low acidity (0.72%).

Keywords: Citrus, Pummelo, Andhra Pradesh

9.3.3 Competence of Farmers in Adopting Digital Technologies for Pomegranate Crop Management in Saurashtra

J.V.Chovatia[1], B.N.Kalsariya[2] and B.H.Tavethiya[3]
[1]Assistant professor, Dept.of Agril.Extension, COA, JAU Junagadh*
[2]Professor & Head, Dept.of Agril.Extension, COA, JAU Junagadh
[3]Assistant professor, Dept.of Agril.Extension, COA, JAU Junagadh
Email: jvchovatia@jau.in

The cultivation area dedicated to pomegranates is expanding annually.Despite this growth, the average yield remains lower than the potential output. The primary cause of this shortfall is attributed to a lack of familiarity with digital practices in pomegranate production technology among growers.This study was conducted with specific aims: examining personal, socio-economic, communicational, situational, and psychological factors influencing pomegranate growers' understanding of digital technologies in production.Additionally, it investigated the correlation between pomegranate growers' knowledge of digital production technologies and their respective characteristics.

To achieve the study objectives, a sample of 120 farmers was chosen from 12 villages spanning 4 talukas in Jamnagar and Bhavnagar districts within the Saurashtra agro-climatic zone.This selection process involved a combination of purposive and simple random sampling techniques. Data were gathered through personal interviews utilizing a structured interview schedule.The result of the research study indicated that the majority of pomegranate growers were middle-aged (56.16%), with primary school education levels (44.16%), medium-sized land holdings (58.50%), higher annual income levels (48.50%).Whereas, moderate farming experience (48.84%), social participation (62.00%), engagement in extension programs (66.67%), exposure to mass media (55.50%), cosmopolitan attitudes (55.83%), innovativeness levels (49.16%), risk orientation (49.67%), market orientation (63.34%), pomegranate cultivation area (58.84%), and yield index (63.00%).

Approximately three-quarters (73.50%) of the farmers exhibited a moderate level of knowledge, while 17.67% had a high level and 8.83% had a low level.Positive and significant associations were observed between knowledge level and factors such as education, social participation, annual income, mass media exposure, innovativeness, risk orientation, market orientation, cosmopolitanism, and yield index.Conversely, a negative and non-significant association was found between knowledge level and age

Keywords: *competence; digital technologies; pomegranate*

TECHNICAL SESSION-10 (HALL NO. 3)

NATIONAL WORKSHOP- 2

National Workshop on the Dynamics of Coconut Production and Utilization, and Strategies for Addressing Challenges in Amrit Kaal

29th May 2024, JAU, Junagadh, Gujarat

Coconuts have been integral to human civilisation, for centuries,, originating from Southeast Asia and becoming vital to the livelihoods of coastal communities across the tropics.They are deeply embedded in the cultures of many countries, celebrated not only for their nutritional benefits but also for their religious and traditional significance.Coconut farming, processing, and trading provide livelihood opportunities for millions, contributing significantly to economies with a focus on sustainable practices.Despite 89.7% of coconut production being concentrated in Kerala, Tamil Nadu, Karnataka, and Andhra Pradesh, India faces challenges in meeting domestic demand and overcoming obstacles in coconut farming. This necessitates the adoption of innovative and precision farming techniques.Institutions like the Central Plantation Crop Research Institute Kasargod and the Coconut Development Board, Kochi, play pivotal roles in research, development, and technology dissemination. The workshop aims to showcase the various facets of coconut cultivation, processing, and utilization, promoting sustainable practices and knowledge exchange within the industry.It serves as a platform for stakeholders to collaborate, exchange ideas, and leverage digital horticulture to transform the coconut sector.Through technological advancements and innovation, the workshop seeks to drive sustainable growth and enhance the competitiveness of coconut production, processing, and marketing.

Accordingly, The Confederation of Horticulture Associations of India (CHAI), in association with the Coconut Development Board, Kochi and Central Plantation Crops Institute, Kasargod with the support of Junagadh Agricultural University, Junagadh, Jain Irrigation Systems Ltd (JISL), Jalgaon, and the Lt Amit Singh Memorial Foundation, is organising this pivotal National Workshop.It focuses on the dynamics of coconut production and utilization, with an emphasis on sustainable farming practices, value addition, and addressing the challenges facing the sector. The workshop will feature 4 technical sessions (Panel Discussion) covering various thematic areas, with introductory and valedictory sessions.Each session will host a panel of experts, including scientists, farmers, policy planners, industry representatives, and field functionaries.Identified experts will introduce the subjects in each session, followed by moderated discussions aimed at reaching logical conclusions.The event expects participation from over 150 farmers, offering them a platform to gain expert advice and insights.

I am delighted to invite you to this National Workshop on the 29th May 2024.Your valuable inputs will be instrumental in developing strategic recommendations to address emerging issues in coconut production and utilization.Your cooperation is highly appreciable in tackling these vital issues.

This revision aims to clarify the focus on coconut production, correcting the initial confusion with potato production, and emphasizing the workshop's goals, participants, and organizing bodies.

I have immense pleasure in inviting you to this National workshop being organised on 29th May, 2024 to provide your valuable inputs for developing strategic recommendations, which can go a long way in addressing emerging issues in banana,I solicit your kind cooperation in addressing vital issues in potato production and utilisation.

Dr H P Singh

Chairman, CHAI, New Delhi

Theme of the Workshop

- Understand the dynamics of changes in coconut research and development, especially production of quality planting material and diseases and pests management, with changing cropping pattern and emerging effect of climate change.
- Diagnosis of technological gaps, it's validation and work towards new paradigm which will effectively address the challenges of producing more with less

Expected Outcome of the Workshop

- Diagnosis and identification.of the associated issues, which require redressal in regionally differentiated manner, considering the changing dynamics in crop and weather, and strategic planning for effective system.
- Develop model in a new paradigm of smart management system of seed production in potato and enhance productivity of inputs through innovations and precision management

PANEL DISCUSSION 1

ENVISIONING PRODUCTION AND UTILISATION OF COCONUT IN SCENARIO OF CHANGING CROPPING AND WEATHER COUPLED WITH ENHANCED DEMAND

10.1.1 Keynote Lecture

10.1.1.1 Seedling Information System' in Coconut: An Innovative Platform to Produce and Distribute Authentic Coconut Varieties to Stakeholders

Rajesh M.K.1,2, Samsudeen K.1, Regi Jacob Thomas3, Albin Sam1, Ashwitha K.M.1, Harshapriya M.1, Mohammed Rasin U.K.1, Sabana A.A.1 and Muralikrishna K.S.1

ICAR-Central Plantation Crops Research Institute, Kasaragod, Kerala, India 2 ICAR-Central Plantation Crops Research Institute, Regional Station, Vittal, Karnataka, India 3ICAR-Central Plantation Crops Research Institute, Regional Station, Kayamkulam, Kerala, India

Email: mkraju.cpcri@gmail.com

Quality planting material is one of the most important input in the realization of potential of high yielding coconut varieties.In many instances, the quality of the planting materials is compromised due to the lack of a data system to ensure the authenticity of the seedlings being distributed.To overcome this bottleneck, an user-friendly 'Seedling Information System' has been developed in coconut, that can be used to monitor all stages of coconut seedling production and distribution.In addition, the platform can also auto-generate

QRcodes for individual seedlings which contains information on all stages of their production.The platform has two modules.The first module facilitates the data entry pertaining to the entire pollination process, seed nut details and seedlings traits.Once the data entry is complete for the first module, the information system generates an unique ID for individual seedlings.In the second module, microsatellite-based fingerprint data is added to the unique ID generated in the first module, which would enable the authentication of hybrid seedlings.Scanning the QR code, affixed to the labels tagged on individual coconut seedlings, will enable farmers' to reach ICAR-CPCRI's website, where the authentic characteristic features of each seedling distributed by the Institute can be accessed.

10.1.1.2 Biotechnological Applications for Crop Improvement in Coconut

Anitha Karun
Former Director, ICAR-CPCRI, Kasaragod
Email: anithakarun2008@gmail.com

Coconut improvement programmes are mainly centered around mass selection (for development of varieties) and hybridization, primarily to produce hybrids between dwarf and tall cultivars.Higher copra yield and number of nuts (for tender coconut purpose) were the major economic characters of concern, nevertheless other characters such as resistance to diseases, suitability for ball copra, inflorescence sap production and moisture-deficit stress tolerance were also the part of breeding objectives.Compared to other horticulture crops, varietal improvement in coconut has not witnessed rapid strides chiefly due to less genetic variability, long juvenile phase, high degree of heterozygosity, large generation interval and low reproductive rate.Biotechnology interventions are applied in coconut breeding to support conventional breeding approaches but their real potential in accelerating coconut genetic improvement is perceptible only when molecular breeding and molecular biology tools are adopted.

Creation and maintenance of genetic variability is fundamental for breeding programmes.Bioversity/FAO recommends exchange of coconut germplasm in the form of zygotic embryo cultures for phytosanitary issues.Coconut zygotic embryo culture protocol developed at ICAR-CPCRI was verified in different international laboratories and yielded satisfactory results.Following this international level inter-laboratory comparison, the technique has been widely employed for germplasm exchange since 1994.Another application of this protocol is embryo rescue from rare palms such as coconut characterized with sweet kernel.

Standardization of cryopreservation protocol for coconut zygotic embryos provided a complementary method for long term conservation of coconut germplasm.The protocol has two phases: First, the embryos kept in a 0.6M sucrose medium for three days followed by culturing in PVS3 solution for 16 h, rapid cooling in liquid nitrogen, rewarming, and unloading in 1.2 M sucrose liquid medium for 90 minutes.Thereafter the embryos are stored in liquid nitrogen at -196^{o}C.Using this protocol, germplasm accessions are being cryo-conserved in National Cryo Gene Bank at ICAR-NBPGR, New Delhi.

The coconut pollen cryopreservation protocol of CPCRI finds its application in hybridization programme, especially in farmer participatory breeding for root(wilt) disease resistance.For cryopreservation, first the extracted pollen is kept in aluminium foil and wrapped as strip, which is then inserted into acryovial and plunged into liquid nitrogen for long term preservation.

Limited success is only reported in coconut tissue culture worldwide.One of the most responding explants for vegetative propagation in coconut is the plumule (meristem of germinating zygotic embryo).This in vitro regeneration protocol finds utility for developing homogeneous coconut population.Another responding explant is from 2-12 cm spathe, but the sampling is a destructive process.

Different molecular markers, biochemical (proteins, polyphenols, and isozymes) and DNA-based markers are being investigated with coconut, but not have been translated into any successful technology except the marker for hybrid authenticity, which is based on a RAPD-derived SCAR marker.Molecular markers were used mainly to study the genetic diversity of coconut populations.Attempts were reported on identification of genes associated with different characteristics. For instance, fourteen putative genes including CLAVATA1 (CLV), WUSCHEL (WUS), and WRKY were observed to be involved in somatic embryogenesis (plumule explant).Much progress in this area is expected on utilizing the whole genome sequencing data available for different coconut varieties.Large-scale resequencing adopted in other tree crops requires to be emulated in coconut to identify genomic and genic markers linked to traits of economic importance.The future breeding programmes then need to be genomic assisted.Consequent to this, genotyping, adoption of genome editing approaches to develop future-ready palms, and precision phenotyping to complete the genetic approaches are the way forward.

10.1.1.3 Under utilized Palms of India - Potentials and Way forward

B.Augustine Jerard*, Sumitha.S., K.Rajendra Prasad, P.C.Vengaiah and Beena Nair Singh
ICAR-AICRP on Palms, ICAR-CPCRI, Kasaragod 671124 Kerala
Email: jerardba@gmail.com

Several underutilized palms still remain neglected, and grow in wild naturally or semi-wild conditions, providing livelihood and nutritional support to small and marginal farmers, tribes and children.Palms such as *Borassus flabellifer* (Palmyra palm),*Caryta urens*(fishtail palm),*Corypha umbraculifera* (Talipot palm), *Hyphaene* spp.(Real fan palm), *Nypa fruticans* (Nipa palm),*Phoenix sylvestris* (Sugar date palm) and *Raphia* spp.(Raffia palm)are of great economical importance owing to their diversified applications in several industries such as sago,sugar and handicraft products.Most of these sap/fruits are harvested directly from trees growing wild or semi wild in forests, marginal forest lands and homestead gardens by local people.Underutilized palms provide food, fuel, fodder, nutrition, and substances to the native communities and are an additional source of income.Many underutilized palm species have not yet been utilized to full potential in spite of their economic and therapeutic values.Genetic resources management of underutilized palms has not been given desired attention due to their less commercial importance, unavailability of post-harvest products and limited research on genetic improvement and production technology.There is an urgent need to realize the socio-economic value of these palms in communities and adaptive capabilities of plants to changing climate.Besides, minor crops have high genetic diversity, low pest-risk, multipurpose uses and enormous scope for value addition.Moreover, they are well-tuned to traditional farming practices with low inputs, and provide food and nutritional security to rural community.It is, therefore, advocated to encourage participation of farmers and tribal communities in conservation efforts of these palm by supporting and providing them good planting material, training them in better cultivation practices, motivating communities to protect and use their own plant species, facilitating marketing options and empowering them with available public support systems.However, changing dietary patterns amongst new generations particularly the fruit rich in nutrition, natural sugar and health promoting bioactive compounds are increasing, so this opportunity needs to be grabbed for commercialization of these crops.

10.1.1.4 Advances in Nutrient Dynamics in Coconut

Ravi Bhat, S. Neenu, Jeena Mathew, V. Selvamani and P. Subramanian
ICAR-Central Plantation Crops Research Institute
Kasaragod – 671124, Kerala
Email: bhatravi@gmail.com

Coconut (*Cocos nucifera*) is a perennial monocot belongs to the family Aracaceae. The coconut plant is an unbranched tree with adventitious root system, grows to a depth of 1.5-2 metre and a horizontal spread of 4-5 m. It has a lot of primary roots which bear a number of rootlets.The root tip is the actively growing point and at the rear it is the absorbing area. Like other plants coconut palms also require balanced amount of nutrient for the production of nuts.

Generally plants require at least 18 nutrients for growth and development. Among that carbon, hydrogen and oxygen are mainly obtained from air and water. Nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B), molybdenum (Mo), chlorine (Cl), Nickel (Ni) and Cobalt (Co) are other plant nutrients obtained from the soil, fertilizer or manures.Sodium and silicon are essential for known as beneficial elements and are essential for some plant species.

Nutrient dynamics is a term used to explain the temporal and special changes in nutrient concentrations in soil due to the never ending bio-geochemical processes which has a positive or negative role in sustaining the profitable crop production.There are many mechanisms to explain the nutrient dynamics in soil.The major mechanisms include sorption-desorption, dissolution-precipitation, mineralization-immobilization and oxidation-reduction reactions.The nutrient dynamics in soil is strongly influenced by the soil –root interactions.The availability of nutrients mainly depends on the chemical, physical and biological properties of the soil.The uptake of nutrients depends on the nutrient availability as well as the root architecture.Many soil parameters affect the nutrient availability to plants.At the same time the root architecture also influence the availability of nutrients from soil.The inherent soil properties like acidity/alkalinity, soil texture, parent material etc have strong influence on nutrient dynamics in soil.

Being 'Kalpa Vriksha' to the human kind with its innate ability to supply food, feed, fibre, timber, fuel and other essential amenities to human kind, it is essential to understand the magnitude of nutrients being tapped in the system.It is reported that anadult palm yielding 40 nuts and producing 12-13 fronds in a year absorbed 321 g N, 69 g P,406 g K, 196 g Ca and 72 g Mg.The extent of removal of nutrients from the T x T hybrids was 116.79 kg N, 14.02 kg P, 245.43 kg K, 40.47 kg Ca and 33.66 kg Mg.In addition, the amount of micronutrients removed from the system was of the magnitude 1.14 kg iron, 0.63 kg manganese, 0.13 kg copper, 0.44 kg zinc and 0.26 kg boron per ha per year.This indicates that coconut palms are potential nutrient reserves and palm residue recycling can also contribute to the nutrient pool of the soil.It can also be regarded that if the nutrient removed from the system through the periodical and systematic harvest of nuts as well as through the removal of palm components from the basin, there is every chance of occurrence of specific nutrient deficiency symptoms in coconut.

The dominant phosphorus fraction in the coconut basin at 0-30 cm depth was Ca-P and the trend is as follows: Ca-P> Fe-P> RS-P>Al-P>ES-P.However, at 30-60 cm depth, Fe-P became the dominant fraction and the trend is Fe-P>Ca-P>RS-P>Al-P>ES-P.Long-term phosphorus fertilization would facilitate the accumulation of soil Ca-P, and thus improve soil P availability.In the interspaces, Fe-P was the dominating fraction in both the depths followed by Ca-P and RS-P.The difference in P fractions in fertilized and non-fertilized plots clearly showed that the fertilized plots have high content of all the inorganic phosphorus fractions in both the depths.Application of mineral P along with forking in basin showed a high concentration of all the inorganic P fractions compared to other fertilizer applied treatments.

Studies on potassium buffering capacity from a long term fertilizer cum manurial experiment indicated that it is low in fertilized soil than non manured soil.Among the soil potassium fractions in the littoral sandy soils under different nutrient management practices, lattice potassium content was observed to be in the range of 93 to 97 percentage of the total K, followed by non exchangeable K which was ranging between 2 to 4 percentages of total K content.exchangeable fractions of K was observed to be 0.3 to 0.9 percentage and water soluble K was 0.5 to 1.3 percentage of total K content.Among the different potassium fractions studied in the soil under Coconut based high density multi species cropping system under organic and integrated management, non-exchangeable potassium content (57% of total K) was the highest which was followed by the exchangeable potassium (34% of total K) and the least content was water soluble potassium fraction (9% of total K).Potassium content of all the soil fractions found to be low under fully organically managed soil compared to the soil under INM practices.

Soil organic matter is the key factor for making the soil a living entity.It improves the water and nutrient holding capacity of soil as well enhances its buffering capacity.A threshold level of 1% organic carbon for coconut soils is suggested.Studies conducted by Growing leguminous cover crops such as *pureria phaseoloides*, *mimosa invisa* and *calapogonium mucunoides* in the basins of coconut is adopted as a means of supplementing organic matter to the soil.Application of green manures caused a high level of zymogenic response by the different specific and non specific group of microorganism due to the availability of easily decomposable source of energy and carbon.It also increased the activity of soil dehydogenase, phosphatase and urease.Sowing cowpea @ 100 g per palm after the application of first dose of fertilsers and later the incorporation of plants just after the commencement of flowering can supply 150-175g nitrogen along with the addition of 25 kg biomass.It is also recommended to apply 50kg organic manure per palm to supplement the chemical fertilizers.Palm residue recycling measures such as husk burial, coconut leaf vermicomposting, coir pith composting and leaf mulching can enrich the organic matter status.

There are many factors which affect directly or indirectly affect the dynamics of nutrients in soil.The major factors include climate, parent material, vegetation, topography, soil organisms etc.The absorption of mineral nutrients by the plants starts with their movement from the adjacent soil to root surfaces.There are mainly three main mechanisms in which nutrients reach the root surface from various sources like mass flow, diffusion, and root interception.Other minor mechanisms are ion exchange and donnan's equilibrium.

The nutrient dynamics is entirely depending on the source of nutrients to the soil as well as the loss of nutrients from the soil.Source of nutrients includes fertilizers and manures, decomposition, weathering, N-fixation, atmospheric deposition, sediment deposition etc.Similarly the loss of nutrients includes processes like run off, leaching, erosion, gaseous losses and plant removal by uptake.The soil nutrient pool consists of organic matter, surface adsorption, cation exchange capacity, mineral matter, soil organisms etc.

The major processes responsible for the nutrient dynamics in cultivation soils include the litter fall, decomposition, fertilizers and manures etc.Nutrient cycling is the major processes to explain the nutrient dynamics mechanisms.The addition and loss of nutrients continuously happened to the system through the processes of nutrient cycling.The rate and extent of the nutrient cycling depend on dynamic external factors and some of the inherent factors.Nutrient balance may account for all types of nutrient flow into and out of the system.Generally the nutrient removal due to the harvest of the crop is taken into account for fertilizer application.

10.1.1.5 Advancement for the Commercial Production in Coconut

D.K.Varu
Principal and Dean, College of Horticulture, JAU, Junagadh
Email: dkvaru@jau.in, principalcoh@jau.in

India is one of the world's leading producers of coconuts with 22 lakh ha.and 13.28 million tonnes. The crop is with a long history of coconut cultivation and utilization.The crop is also with good potentiality in Gujarat with 25000 ha.area with highest productivity. In recent years, there has been a significant advancement in the commercial production of coconuts in the country. It highlights key aspects of this advancement, focusing on technological, agricultural, and market-related developments.Advancements in agricultural technology have played a crucial role in enhancing coconut production in India.Modern farming techniques, such as drip irrigation, precision farming, and integrated pest management, have improved yield and quality while reducing resource consumption.Additionally, the adoption of mechanized harvesting and processing equipment has increased efficiency and productivity in coconut plantations.Farmers have embraced innovative agricultural practices to boost coconut production.This includes the use of high-yielding coconut varieties, optimized planting techniques, and effective nutrient management.Furthermore, the promotion of organic farming methods has led to sustainable coconut cultivation practices, meeting consumer demand for eco-friendly products.The commercialization of coconut products has expanded significantly, driven by increased demand both domestically and internationally.India's coconut industry has diversified its product range to include coconut oil, coconut water, coconut-based snacks, and value-added products like coconut milk and coconut sugar. This diversification has opened up new market opportunities and enhanced the competitiveness of Indian coconut products in the global market. Government initiatives and support programs have also played a vital role in the advancement of commercial coconut production. Subsidies for farm equipment, research and development funding and market promotion schemes have encouraged farmers to adopt modern practices and improve product quality.Additionally, the establishment of coconut development boards and cooperatives has facilitated knowledge sharing, skill development and market access for coconut growers. Despite the progress made, challenges such as climate change impacts, pest and disease management, and market volatility remain areas of concern for the coconut industry. However, ongoing research and innovation in coconut cultivation, processing, and marketing are expected to address these challenges and drive further growth in the sector. The future of commercial coconut production in India looks promising, with a focus on sustainability, quality, and market diversification.

Keyworld: Coconut, innovation, adoption, equipment, safety, irrigation, market, global, etc.

10.1.1.6 Production of Coconut Hybrid Seedling: Efforts at JISL

Avinash Chauhan, Amol Chaudhari, Anitha Karu, Bal Krishna
Jain R&D, Jain Irrigation Systems Ltd, Ellaymuthur, Udumalpet, Tirupur, TN.

Coconut is chiefly cultivated in four southern states in India, but a lion share of coconut palms in these areas are old and senile and need to be replanted in a phased manner for which good quality planting material of high yielding varieties are required.Farmers prefer dwarf x tall coconut hybrid seedlings with a green collar region that authenticates its trueness, as they are of dual purpose (copra and tender coconut) and relatively short in stature. Hybrids with Malayan Yellow Dwarf as female parent are widely used for production of coconut hybrids in most of the coconut producing geographies.For instance, the Kalpa Sreshta (MYD X Tiptur Tall), Kalpa Samruddhi (MYD X West Coast Tall), and MAWA hybrid (MYD x West African Tall) were recommended by various agencies for cultivation (in different regions).Keeping in view of the wide

adaptability and combining ability of MYD, the JISL had established a mother palm block in Elayamuthur, Tamil Nadu during 2005.Out of 1050 trees in this plot, 547 are observed to be typical MYD palms, further expansion of the mother palm area is underway.Pollen from 20 selected WCT palms are used for producing the hybrids.A performance evaluation trial of these hybrids is in progress: Their performance in the early ears is very good.To provide pest- and disease-free hybrid coconut seedlings, a nursery facility is created.The centre is equipped with a pollen processing and viability testing laboratory.New techniques like ground pollination (from ICAR-CPCRI), hydraulic platform for easy emasculation, and hi-tech nursery techniques are being explored to achieve quality hybrid seedling production with high efficiency.

10.1.2 Oral Presentation

10.1.2.1 Assessment of Yield Performance of Coconut Based Multispecies Cropping Systems Under Coastal Littoral Sandy Soil of Konkan Region of Maharashtra

K.V.Malshe, S.l.Ghavale, S.M.Wankhede, B.Augustine Jerard and Sumitha, S.
All India Coordinated Research Project on Palm
Regional Coconut Research Station, Bhatye, Ratnagiri (MS) 415612
Email: kvmalshe@gmail.com

The field experiment was conducted at Regional Coconut Research Station, Bhatye, Ratnagiri to assess the effect of intercrops on the productivity of coconut under coastal littoral sandy soil.The experiment was laid out in split plot design comprising three cropping systems (CS1: Coconut + *Garcinia indica* + Vegetable Crops (Rainy season), CS2: Coconut + *Garcinia indica* + Pineapple and CS3: Monocrop of coconut) *as main plots and three sub plots of nutrient management (*N1: Green manuring + biofertilizers + organic recycling +FYM -as per package of practices, N2: Green manuring + biofertilizers + organic recycling +Soil test based nutrient (chemical fertilizers) application and N3: Green manuring + biofertilizers + organic recycling +100% RDF).The yield of the coconut as well as intercrops were recorded.The economics of the systems were also estimated.*Garcinia indica* was in juvenile phase.However, the vegetable yield was maximum 101.33 kg/plot in CS1N3.The maximum yield of pineapple (229.67 kg/plot) was recorded in CS2N3 system.The yield of the coconut was not significantly altered due to intercrops and nutrient management.The significantly highest biomass production (10.68 t ha^{-1}) was obtained in CS1N2 system) Coconut + *Garcinia indica* + Vegetable Crops with Green manuring + biofertilizers + organic recycling +Soil test based nutrient).The highest B : C ratio was recorded in CS2N3 (Coconut + *Garcinia indica* + Pineapple with Green manuring + biofertilizers + organic recycling +100% RDF) system.

Keywords : *Coconut, Vegetable Crops, pineapple, biomass production, B : C ratio*

10.1.2.2 Evaluation of Tall x Tall Coconut Hybrids under South Gujarat Condition

Q. P.Bhalerao*, B.A.Jerard and Sumitha S.
Project In-charge, AICRP (Palms), Regional Horticultural Research Station
ASPEE College of Horticulture, Navsari Agricultural University, Navsari (Gujarat)-396 450
Email: pankaj5bhalerao@nau.in

The field experiment entitled "Evaluation of Tall x Tall coconut hybrids under South Gujarat condition" was laid out under RBD with four replications and five different treatments (hybrids) *viz.,* BENT x ADOT; LCT

x ADOT; ECT x LCT; WCT x TPT and ADOT x ECT having spacing of 7.5m x 7.5m during the year 2013-14 at Regional Horticultural Research Station, ASPEE College of Horticulture, Navsari Agricultural University, Navsari (Gujarat).The results obtained on growth and yield performances as well as insect-pest incidence of Tall x Tall hybrids are revealed that, significantly minimum stem/trunk height (3.85 m) with maximum stem girth (101.00 cm), annual leaf production (11.50 numbers), total numbers of leaves on the crown potential in te(32.50 numbers), leaf scare in 1 m length of trunk (14.40 numbers), inflorescence production per annum (10.75 numbers), number of female flowers per palm (248.00), fruit setting (30.83 %) and nut yield per palms per year (76.25 nuts) with minimum age at first flowering (39 months) was noted in treatment BENT x ADOT (T_1) whereas, maximum leaf length (519.00 cm) with petiole length (151.00 cm) were recorded in ADOT x ECT (T_5) treatment.In case of fruit with copra characteristics, significantly maximum fruit weight (1114.75 g), husked fruit weight (555.50 g), kernel weight (267.00 g), copra content (140.50 g/nut), copra yield (10.72 kg/palm) and tender nut water (422.75 ml) with minimum per cent husk weight (49.65 %) were recorded in treatment BENT x ADOT (T_1).However, maximum weight of husk (596.25 g) and kernel thickness (1.13 cm) was recorded in WCT x TPT (T_4).Regarding to reaction of biotic stresses, BENT x ADOT (T_1) T x T hybrid observed minimum per cent of incidence with respect to insect-pest as compared to rest of hybrids.

Keywords: Biotic, coconut, hybrids, growth and yield.

10.1.2.3 Performance of Released Coconut Varieties in Bastar Region of Chhattisgarh

Beena Singh*, K.P.Singh[1] and Rajesh Patel[2]

**Scientist, AICRP on Palms, S.G.College of Agriculture & Research Station, Jagdalpur*

[1]Scientist, K.D.College of Horticulture & Research Station, Jagdalpur

[2]JRF, AICRP on Palms, S.G.College of Agriculture & Research Station, Jagdalpur

Email: beena.nair1985@gmail.com

The present investigation was carried out at the All India Coordinated Research Project on Palms S.G.College of Agriculture and Research Station, Jagdalpur, Bastar, Chhattisgarh.It comes under the Zone VII Eastern Ghat and Plateau Zone of Indian Agro climatic Zone identified by Planning Commission, GOI.Chhattisgarh lies within 17^0 45' to 20^0 34' N latitude and 80^0 15' to 82^0 15' E longitude with an altitude ranging from 550 to 850 meters above mean sea level (MSL).The State covers a geographical area of 1,37,360 sq km.Nearly 65.90 % of the total area is covered by tribals and hence it is often said as tribal dominated State.The annual rainfall ranges from 1200 to 1600 mm.Jagdalpur comes under the subtropical, sub humid region that lies in the southern direction of Chhattisgarh.Rainfall is the major source of ground water recharge in the area and receives maximum (85%) rainfall during the southwest monsoon season.The winter rainfall is meagre (10 - 15%).The zone receives high rainfall coupled with comparatively lower temperatures and higher humidity.The soil of Bastar region is majorly Entisol, Inceptisol and Alfisol wherein organic material like FYM or compost improves the water retention and storage capacity of soil with a pH range between 5.5 and 6.8.

Ten released coconut varieties viz, Kalyani Coconut-1, Gautami Ganga, Konkan Bhatye Coconut Hybrid-1, Kalpa Dhenu, Kera Keralam, Kalpa Pratibha, Kalpa Mitra, Kalpa Raksha, Kahikuchi Hybrid-1 and a local check Kera Bastar were planted in 2012.Perusal of data showed that Kalpa Mitra recorded the maximum plant height (3.0 m) while the girth was the maximum in the variety Kalpa Dhenu (184.5 cm).With regard to the number of leaves at crown, annual leaf production, maximum number of inflorescence and number of harvested nuts variety Gautami Ganga recorded the maximum value in comparison to the other varieties (22.3, 9.2, 8.2 and 52 respectively).The variety Gautami Ganga also recorded the maximum dehusked nut

weight and weight of husk (479.2 and 586.6 g respectively) among the other varieties.However, the copra content and tender nut water was the maximum in the variety Kalyani Coconut-1 (141.3 g and 287.6ml respectively).

With regard to the insect incidence the variety Kalpa Dhenu (7.2) recorded the maximumrhinoceros beetle incidence (%) while the red palm weevil incidence (%) was the highest in Kalpa Mitra and Kera Keralam (9.9 respectively).The incidence and intensity (%) of rugose spiriling whitefly were the maximum in Gautami Ganga (38.2 and 26.2 respectively) followed by Kalpa Pratibha (33.0 and 21.6 respectively) variety.

10.1.2.4 Integration of Goat in Coconut Based Cropping System for East Coastal Region of Tamil Nadu

N. Senthil Kumar[1], R. Babu[1], M.Surulirajan[1], R. Arun Kumar[1], P. IreneVedhamoni[1], S.Sumitha[2] and B. Augustin Jerard[2]

[1]Coconut Research Station,Tamil Nadu Agricultural University
Veppankulam-614906, Thanjavur District, Tamil Nadu
[2]ICAR-Central Plantation Crops Research Institute, Kasaragod, kerala
Emial: senthil.n@tnau.ac.in

Integrated Farming System (IFS) approaches is holistic, multidisciplinary, dynamic, problem solving, location specific and farmer needs oriented, which make a vital contribution to sustainable development by adding consideration of economic, ecological and social objectives to the essential business of agricultural food production.Coconut (*Cocos nucifera* L.) is an important perennial crop of humid tropics and is mainly grown in the southern states of Kerala, Karnataka, Tamil Nadu and Andhra Pradesh, secures a top position by holding over two-thirds of the total production and area of cultivation in the country (CDB, 2020).Since the adult palm of sole crop of coconut spaced at 7.5 m × 7.5 m apart, effectively uses only 22.3 per cent of land area, while the average air space utilised by the canopy is about 30 per cent and solar radiation interception is 40-45 per cent (Maheshwarappa et al., 2013).Thus coconut garden offers excellent opportunities for inclusion of suitable components to maximize the returns. The present investigation was undertaken to compare the performance of coconut-livestock (Tellichery goat) based Integrated Farming System with coconut mono cropping system during 2016 to 2021.The experiment was laid out in old coconut garden spaced at 7.5 m x 7.5 m.Two treatments *viz*., T1: Coconut + Fodder trees+Pasture crops +Tellichery goat (IFS), T2: Mono crop of coconut are compared with each other in non-replicated trials in an area of 0.40 ha each.The fodder crops: CN grass Co (BN 5) and Desmanthus were sown in the inter space of coconut at the ratio of 3: 1.Fodder trees of *Sesbania grandiflora*, *Leucaena leucocephala* and Glyricidia were planted around the border of the field. The experiment results revealed that the IFS plot has produced the highest average value (four years) with respect to yield of nuts per palm per year (10428 nos./ha/year), Gross return (Rs.2,71,934/ha) and net return (Rs.1,42,650/ha) and also B: C ratio (1.98). The experiment showed that the integration of goat in coconut based cropping system is the best way.Besides, the model also generated more manure and added more nutrients to soil compared to monocrop of coconut.

Keywords: Coconut, Integrated farming system, Fodder, Pasture, Tellichery goat, Economics

10.1.2.5 Performance of Popular Varieties of Banana as Intercrop for East Coast Coconut Eco-system

N. Senthil Kumar, R.Babu, M.Surulirajan, R.Arun Kumar, and P.Irene Vedhamoni
Coconut Research Station, Tamil Nadu Agricultural University
Veppankulam-614 906, Thanjavur District, Tamil Nadu

Coconut plantations have valuable land for other purposes, such as for intercropping system implementation. There are many opportunities to solve the problem of in efficiency of coconut cultivation, such as optimizing the land with intercropping.For effectiveness of intercropping it is necessary to consider the kind of intercrops in developing coconut- based farming system tolerant for environmental limitation especially light.Among other intercrops, growing banana under coconut is the most popular among coconut growers. The reasons attributed being easily availability of planting materials, their quick growth, ready market and high returns.The performance of eight banana varieties (Red banana, Neipoovan, Rasthali, Poovan, Monthan, Karpooravalli, Nendran and Grand niine) were evaluated under coconut intercropping system during 2019 to 2022 at Coconut Research Station, Veppankulam. This field experiment was comprised of eight treatments (banana varieties) with three replications laid out in RBD.The plot size was four plants per plot. The banana suckers were procured from ICAR-NRCB, Trichy and planted at spacing of 2.5 m x 2.5 m spacing in between two rows of coconut palms. The plants were irrigated with drip system.The growth characters *viz*., plant height, stem girth at base, no.of leaves, length and breadth of third leaf, were recorded at the time of shooting and yield attributing characters *viz.,* bunch weight, number of hands / bunch and total number of fruits / bunch were also recorded.Monthan variety (16.16 kg) was found to be best suited for intercropping in coconut both in terms of bunch weight and leaf production.The net income (Rs.3,72,000/ha) was also found to be higher in this Monthan variety. This was followed by Poovan (15.54 kg) and Karpooravalli (12.78 kg).The same trends of results were observed in main crop as well as in the first and second ratoon. Bract mosaic virus incidence ranges from 42 to 70% in the following banana varieties *viz.,* Neipoovan, Rasthali, Poovan and Nendran whereas in Karpooravalli and Monthan were showed mild symptoms.Red banana and Grand nine were highly susceptible to banana bunchy top disease. The variety Poovan (48%) was more susceptible to banana mosaic virus.

Keywords: Coconut, Banana, Varieties, Intercrop, Bunch weight, Ratoon

10.1.2.6 Studies on Nutrient (N&K) Requirement and Method of Application to East Coast Tall Coconut Nursery

N.Senthil Kumar, R.Babu, M.Surulirajan and R.Arun Kumar
Coconut Research Station, Tamil Nadu Agricultural University
Vepankulam-614906, Thanjavur District, Tamil Nadu

Coconut nursery is not usually supplied with fertilizers on the assumption that there is sufficient stored food inside the seed nuts and that the intrinsic quality of the seed material measured in terms of the seedling growth characters may be vitiated by fertilizer application.Foale (1968) found that the contribution of nutrients from the endosperm to the growing seedling was reduced from the fourth month after germination there by necessitating fertilization of seedling vigour is to be maintained in the nursery.The possibility of selecting vigorous seedlings during early stages and the fertilizer requirement of nursery were also looked into.However, experimental findings on effectiveness of methods of manuring are very limited.Hence this study was undertaken to work out on optimum fertilizer schedule and method of application for the ECT coconut seedlings in the nursery.Field experiments were conducted during December 2018 to March 2021 at Coconut Research Station, Veppankulam, Thanjavur, Tamil Nadu to study the nutrient (N&K) requirement and method of application to East Coast Tall coconut nursery.The experiment was comprised of eight treatments with three replications laid out in Randomized Block Design.The treatments consist of soil application of four levels of N&K (40, 80, 120 and 160 kg/ha each) applied in three splits during 5th, 7th and 9th month after nut sowing and foliar application of N and K at three concentrations (1%, 2% and 3% each) applied during 6th, 7th, 8th and 9th month after nut sowing along with a absolute control.For all the treatments except control plot, P @ 80 kg/ha was applied as basal dose.The observation on seedlings growth characters *viz.,* plant height, collar girth, number of leaves, percentage of splitted leaves and root characters were recorded at 10th month after nut sowing.Based on the two year data, soil application of NPK @ 160: 80: 160 kg/ ha, at fifth, seventh and ninth month after sowing recorded higher plant height (147.3cm), collar girth (14.5 cm), number of leaves per seedling (8.2) and percentage of seedlings with splitted leaves (14.1%).Likewise, the number of roots per seedling (13.4), root volume per seedling 97.5 cc), root dry weight per seedling (20.1g) and outturn of quality of seedling (92.2 %) were associated with soil application of NPK @ 160: 80: 160 kg/ha, at fifth, seventh and ninth month after sowing.Basal application of phosphorus at 80 kg/ha and foliar spray of N and K even at 3 per cent failed to exert significant results.

Keywords: Coconut nursery, Fertilizers, Soil application, Foliar spray, Vigorous seedling

10.1.2.7 Effect of Fertigation on Yield, Quality and Winter Effect in Coconut in Sub Tropics of Bihar

Ruby Rani*[1], Mukesh Kumar[1], Ahmar Aftab[2], S. Sumitha[3] and B.A. Gerard[3]

Department of Horticulture (Fruit& Fruit Technology)1
Department of Food Science and Post Harvest Technology2
Bihar Agricultural University, Sabour, Bhagalpur, Bihar
CPCRI, Kasargod, Kerela[3]
Email: rruby92@yahoo.co.in

Experiment was conducted to study the effect of fertigation on flowering and winter effect in coconut palms in sub tropics of Indo -gangatic plane of Bihar with an objective to assess the flowering pattern, winter effect and yield of coconut under different fertigation level during 2021-22 and 22-23.The experiment was conducted under ICAR-All India coordinated research Projects on, Palms (Coconut) laid out in RBD with six treatments i.e fertigation with no fertilizer application, 25%RDF, 50% RDF, 75 % RDF, 100% RDF as fertigation and 100%RDF as soil application with three replications in variety Sakhi Gopal.Significant effects of treatments were observed on initiation of flowering after winter, the extent of winter injury and yield.Application of T_5 (75 % RDF through fertigation) exhibited maximum number of inflorescence (9.5 /plant) which was at par withT_4 (100% RDF fertigation).The minimum inflorescence (6.0per plant) was noted in control i.e T_1 (without fertigation).Fertigation levels also influenced the extent of winter effect with maximum leaf affected under no fertilizer application (T1) and least effect of leaf injury of winter effect was observed with T_5 (75 % RDF through fertigation).Similarly,T_5 (75 % RDF through fertigation) had highest number of fruit set (9.2 per inflorescence) and fruit yield (59.8per plant) also which was at par with T_4 (100% RDF fertigation).Initiation of spathe emergence was observed by the end of April in all treatment and inflorescence emergence was started earliest inT_5 (75 % RDF through fertigation) i.e 2nd week of June and latest (1st week of July) was under no fertilizer application (T1).Similarly maximum nut yield of 59 nuts per palm was observed in T_5 (100 % RDF through fertigation) followed by T_4 (75 % RDF through fertigation) and least yield of 362 nuts /palm was recorded in palms without fertigation.

Keywords: Coconut, flowering, Cold effect, yield

10.1.2.8 Effect of Soil Media and Containers on the Germination and Growth of Palmyrah Seeds

Ahmar Aftab[1*], Ruby Rani[2], Vinod Kumar[1], S.Sumitha[3], B.A Gerard and Ravi Bhat[3]
Department of Food Science and Post Harvest Technology[1]
Department of Horticulture (Fruit& Fruit Technology)[2]
Bihar Agricultural University, Sabour, Bhagalpur, Bihar
CPCRI, Kasargod, Kerela[3]
**Email: aftab_ah96@rediffmail.com*

Palmyra palms is now considered as fruit for future as it is very hardy and have multifarious uses including nutri-rich compounds in *neera*, immature and matured fruits.There are many variations in morphological and qualitative traits in Palmyra palm and fruits.Thus it is essential to have palms with desired traits which are propagated by seeds.Thus an experiment was conducted to evaluate the effect of soil media and containers on the germination and growth of Palmyra seeds using three types of containers ie.PVC tube/pipe, black poly bags and bamboo tube and six types of soil mixtures as rooting media consisting of 100% soil (T1),soil with scarified seed (T2), soil + sand +FYM (T3), soil + sand + vermicompost (T4) and soil + sand + poultry manure (T5), and soil+ sand +composted coir (T6) in the proposition of 2: 1: 1.All the seeds of palmyrah were treated with imidacloprid @ 6gm / lt, followed by GA3@1gm/lt solution before putting them into the rooting media.

Significant effect of treatments was observed regarding seed germination and seedling growth.The maximum seed germination (100%) was noted in PVC pipe with rooting media soil + sand +FYM (T3) followed by 75% germination with soil + sand + poultry manure (T5) in black poly bags.The bamboo container was not found suitable with lowest seed germination.The highest number of leaves after 210 days of sowing was recorded in PVC container with rooting media of soil + sand +FYM (T3) and soil + sand + poultry manure (T5).

Thus the rooting media consisting of soil+sand+FYM (T3) as well as soil+sand+poultry manure (T5) in a proportion of 2: 1: 1 was found superior to other treatments both in PVC tube and black poly bag.

Keywords: Palmyra palm, Seed, Germination, Container, rooting media

PANEL DISCUSSION-2

DYNAMICS OF VALUE CHAIN MANAGEMENT IN COCONUT FOR HARNESSING THE POTENTIAL

10.2.1 Keynote Lecture

10.2.1.1 Opportunities and Technology Updates on Post-harvest Technology in Coconut

M.R.Manikantan and R.Pandiselvam
ICAR – CPCRI, Kasaragod, Kudlu
Email: manicpcri@gmail.com

Coconut often referred to as the "tree of life," holds significant economic and cultural importance in many tropical regions worldwide.Its versatile applications in food, cosmetics, medicine, and industry have positioned it as a valuable commodity in global markets.However, the full realization of its economic potential hinges not only on efficient cultivation practices but also on effective post-harvest management.This abstract explores the opportunities and technological advancements in post-harvest technology for coconut.In recent years, the coconut industry has witnessed a surge in innovation aimed at enhancing the quality, shelf-life, and value-added products derived from coconut.These advancements encompass various stages of post-harvest processing, including de-husking, de-shelling, drying, and storage.

Transitioning to virgin coconut oil, recent advances in production methods have optimized extraction processes, enhancing yield and quality.Characterization techniques such as gas chromatography and mass spectrometry enable precise analysis of virgin coconut oil's fatty acid profile, ensuring product consistency and authenticity.The versatility of virgin coconut oil extends beyond culinary use to cosmetic, medicinal and functional applications.Infusing it into hair creams and moisturizers capitalizes on its moisturizing and nourishing properties, catering to the growing demand for natural skincare products.Moreover, coconut by-product utilization has led to the development of extrudates, offering novel textures and flavours.Characterization studies elucidate their nutritional composition and functional properties, paving the way for diverse applications in the food industry.Coconut milk-based dairy analogues have emerged as alternatives to traditional dairy products, offering lactose-free options with comparable taste and texture.Flavoured coconut milk, ice cream, *paneer*, and yogurt showcase the versatility of coconut milk in creating dairy-free alternatives.Furthermore, coconut-based dried and baked products such as chips and cookies capitalize on coconut's unique flavour and texture.Incorporating coconut flour and oil enhances their nutritional profile and sensory attributes, appealing to health-conscious consumers.The exploration of value-added products from coconut inflorescence sap highlights its potential in creating novel culinary delights.From coconut water-based blends to squash, jelly, and vinegar, the versatility of coconut water offers endless possibilities for culinary innovation.

Key opportunities also lie in the development of mechanized solutions to streamline labour-intensive processes, thereby improving efficiency and reducing costs.Cutting-edge technologies such as automated husking and de-shelling machines, advanced hybrid drying system, and controlled atmosphere storage systems have shown promise in maintaining the quality of coconut products while extending their shelf life.Furthermore, advancements in packaging and transportation logistics play a crucial role in ensuring that coconut products reach markets in optimal condition, thereby maximizing their value and minimizing post-harvest losses.Innovations in eco-friendly packaging, such as biodegradable films and recyclable plastics, address sustainability concerns while maintaining product integrity.

Moreover, technological updates in processing techniques have opened avenues for the development of value-added coconut products catering to diverse consumer preferences.From coconut water to virgin coconut oil and coconut-based snacks, the array of innovative products underscores the versatility of this tropical fruit.

Additionally, digitalization and data-driven approaches offer opportunities for enhanced traceability and quality control throughout the post-harvest supply chain.IoT (Internet of Things), sensors and block chain technology enable real-time monitoring of environmental conditions, ensuring compliance with quality standards and facilitating transparency in product sourcing.

In conclusion, the evolving landscape of post-harvest technology presents abundant opportunities for stakeholders in the coconut industry to optimize production processes, improve product quality, and expand market reach.Embracing these technological advancements is essential for sustaining the growth and competitiveness of the coconut sector in the global marketplace.

10.2.1.2 Application of Drone Technology for Pest and Disease Management in Palms

Vinayaka Hegde, Daliyamol, Sujithra M.and Merin Babu
ICAR-Central Plantation Crops Research Institute, Kasaragod 671 124, Kerala
Email: hegdev64@gmail.com

Diseases, pests and disorders are one of the major constraints in the sustainable production of coconut and arecanut. Though diseases and pests attacking these palms have been studied and integrated pest and disease management practices developed over the last few decades, 15 to 20 per cent annual loss occurs due to biotic and abiotic stresses.Regular monitoring and surveillance for pests and disease attacks and taking up timely control measures are very crucial to save these palms.One of the major reasons for the prevalence of diseases and pest attacks in a severe form in coconut gardens is the difficulties faced by farmers in timely diagnosis and implementing management strategies.Visiting individual coconut gardens and looking and documenting for pest and disease incidence by observing the individual tree from the ground is time-consuming and in tall palms, it is difficult to observe the crown region at the initial stage of pest and disease attack. Diagnosing the pest and disease at the early stage (i.e.disease or pest attack on one or two palms in a large coconut plantation)and targeting the delivery of pesticides to the affected crowns only will help in taking up timely eco-friendly control measures to save the palm.The use of advanced unmanned aerial vehicles (UAV) or drone technology is one of the options available to overcome these difficulties.Considering this, we at ICAR-CPCRI initiated the development of a UAV-based pest and disease surveillance system and targeted delivery of pesticides for the management of major pests, diseases and disorders of coconut.

UAV for Surveillance/diagnoses of pests and diseases of coconut

ICAR-CPCRI in collaboration with M/s General Aeronautics Pvt Ltd, Bangalore, a start-up company took up a project on “Pest and Disease Surveillance on Coconut using Unmanned Aerial Vehicle” with financial support from the Coconut Development Board during 2019-2021.Aerial images of coconut palms in ICAR-PCRI farm at Kasaragod and Kayamkulam, Kerala were captured with a high-resolution RGB camera and a multispectral camera mounted on a UAV at different seasons to document the pest and disease symptoms.The images were processed and machine learning algorithms were developed for the identification of healthy and diseased coconut trees, rhinoceros beetle-infested trees, root wilt, leaf rot and bud rot-affected trees.A total of 4320 aerial images of coconut palms in CPCRI farm at Kasaragod and Kayamkuam, Kerala were captured at different seasons to document the pest and disease symptoms.Based on the typical signature images of the symptoms of different pests and disease attacks, all the images were annotated for damage symptoms of rhinoceros beetle, leaf-eating caterpillar, bud rot, leaf rot, and root wilt diseases of coconut. The images were processed and machine learning algorithms were developed for the identification of healthy and diseased coconut trees, rhinoceros beetle-infested trees, root wilt, leaf rot and bud rot-affected trees. Finally, the AI algorithms developed could estimate the total number of palms in the garden, the number of healthy palms and the number of palms affected by rhinoceros beetle, root wilt, bud rot and leaf rot diseases and geo-tagging of each palm helped to locate the affected palms in the garden.

An end-to-end pipeline for the identification of coconut tree crowns and getting prediction for its classes, i.e.Healthy, rhinoceros beetle-infested and root (wilt) diseases was designed.The complete procedures/ protocols for getting the image through a drone, training the CNN model, crown detection and segmentation from the image, image stitching and GPS tagging have been developed.This developed pipeline can be used for the diagnosis of different diseases or pest infestation.

For validation of the AI models, field testing was done for two coconut plots at the CPCRI Kasaragod campus where images were captured using an RGB camera mounted on the drone.The output analysis gave the GPS location for each tree detected by the algorithm.The validation was done by physically going to the GPS location provided by the algorithm.For a given plot, the detection of 'Healthy' coconut crowns had an accuracy of 87.5% and the detection of rhinoceros beetle-infested coconut crowns had an accuracy of 83.4%.For the detection of root (wilt) disease, the crown classification model was trained for two classes: `Healthy' and 'Root wilt affected".A total of 20% of the dataset was used for the test where the classification model achieved an accuracy of 77.81%.

UAV for Spraying

The manual spraying to protect the tall coconut palms from pests and diseases is one of the major challenge.In ordert to addres this difficulty in manual spraying, ICAR-CPCRI carried out an experiment to standardize the spraying parametes for coconut pams.Results indicated that the spray height (ranging from 1 to 3 meters) and spray time (ranging from 5 to 11 seconds) significantly affect droplet size, spray coverage, and deposition.Specifically, spraying from 2 m above the canopy for 5 sec and 8 sec, and spraying from 3 m above the canopy for 5 sec and 8 sec demonstrated optimal droplet sizes ranging from 50 to 400 μm across all layers of the coconut tree canopy.Notably, spraying from 2 m above the canopy for 8 sec achieved the highest penetration efficiency at 34.41%, outperforming other combinations significantly.Based on the comprehensive analysis of these parameters, the study identified the combination of a 2-meter spray height and an 8-second spray time as the most effective for UAV spraying operations in coconut trees.This optimal combination not only ensures adequate droplet size and coverage but also maximizes penetration efficiency, thereby offering a superior alternative to manual spraying methods.The findings underscore the potential of UAV technology to revolutionize pesticide application in coconut farming.By drastically reducing application time, and labor requirements, and improving the safety of coconut farmers, UAV-based spraying systems present a promising solution to enhance productivity and sustainability in coconut plantations.Further research and implementation of UAV spraying in coconut farming are warranted to capitalize on these benefits and address the challenges associated with traditional manual spraying methods.

The attempt to manage whitefly infestation in coconut trees using drone-based spraying of insecticide imidacloprid 17.8% SL, as well as other treatments such as different concentrations of imidacloprid, neem oil, and water spray, alongside manual application methods, yielded varied results.Spraying with the drone was not effective compared to manual spraying for controlling whiteflies in coconut. The inefficiency observed in drone spraying may be attributed to the unique habitat of whiteflies, which reside on the undersurface of coconut leaflets, particularly in the outermost whorls of leaves.This positioning presents a challenge for spray droplets to effectively reach the target area due to the canopy structure of coconut leaves. The dense canopy and intricate leaf arrangement may hinder the penetration of spray droplets to the lower leaf surfaces where whiteflies typically inhabit, resulting in reduced efficacy of drone-based spraying compared to manual application methods.These findings underscore the importance of understanding the specific characteristics and behaviour of pests, as well as the structural features of the crop canopy when designing and implementing pest management strategies using drone-based spraying.Further research and refinement of pesticide application techniques is necessary to optimize the efficacy of drone spraying for controlling pests such as whiteflies in coconut plantations.

10.2.1.3 Sustainable Coconut Production Strategies for the North Eastern Region

Alpana Das
Principal Scientist
ICAR CPCRI RC, Kahikuchi, Assam
Email: alpanad2012@gmail.com

Coconut is not widely cultivated in the Nort Eastern Region despite demand and a favourable weather.Assam, Tripura and Nagaland are the major North Eastern states having coconut cultivation, covering an area of 26,480 ha and a production of 175.88 million nuts during 2020-21.The coconut sector in the North Eastern region of India has exhibited notable growth patterns over the past two decades.The average productivity of coconut in these three states (Assam, Tripura and Nagaland) is 6642 nuts per ha, which is much below the national average of 9430 nuts per ha.Other north eastern states viz., Arunachal Pradesh, Sikkim, Manipur, Meghalaya and Mizoram also have a small area of coconut cultivation.There is ample scope for enhancing the area under coconut cultivation in the North Eastern Region which has a congenial agro-ecological situations pertaining to climate and soil.The regions of Manipur, Meghalaya, and Mizoram exhibit significant potential for coconut cultivation.In Manipur, promising areas for this endeavor encompass Pherzawl, Jiribam and Tamenglong districts.Meanwhile, Meghalaya, renowned for its exceptionally high annual rainfall averaging 11,000 mm, offers conducive conditions for coconut cultivation, particularly in West Garo Hills, East Garo Hills, South Garo Hills, South-West Garo Hills, North Garo Hills, and Ri-Bhoi districts.Similarly, Mizoram presents favorable prospects for coconut farming, with potential areas identified in Mamit, Kolasib, and Lawgtlai districts.It is reported that NE states may have advantages in coconut cultivation in the wake of climate change.

The expansion of coconut cultivation in NE region is hindered by several constraints like non-availability of quality planting material and lack of knowledge and skill among farmers on scientific cultivation.

Addressing the challenges associated with seedling production requires a multi-faceted approach involving both public and private stakeholders.More investment is required to strengthen the infrastructure facilities for coconut seedling production.Training programs and workshops should be conducted to enhance the knowledge and skills of farmers involved in seedling production.Efforts should be made to raise mother palm orchards of improved coconut varieties in nurseries and farms under public sector agencies.Decentralized community coconut nurseries can be established with the active involvement of Farmer Producer Organizations (FPOs).This approach will not only enhance the availability of coconut seedlings but also empower local communities and promote sustainable agricultural practices.

The observed growth patterns in coconut cultivation in Assam, Tripura, and Nagaland underscore the resilience and potential of the coconut sector in the North Eastern region.The significant expansions in cultivation area and production levels reflect efforts towards enhancing productivity and promoting coconut cultivation as a viable agricultural enterprise.

Expanding coconut cultivation in the North Eastern states holds immense promise for enhancing agricultural productivity and improving the livelihoods of farmers in the region.However, the relatively low contribution of these states to the national coconut production highlights the need for strategic interventions and policy support to further bolster the coconut sector in the region.

Strategic interventions and policy support aimed at addressing existing challenges and harnessing opportunities could pave the way for a more robust and sustainable coconut cultivation landscape in the North Eastern states.

10.2.1.4 Value Chains of Coconuts in India: Experiencing a New Paradigm in the Dynamic Trade Environment

Jayasekhar, S.
Principal Scientist (Ag Econ)
ICAR-Central Plantation Crops Research Institute, Kasaragod, Kerala
Email: jaycpcri@gmail.com

The growing vulnerability of small coconut holders in the country to the declining and fluctuating profitability of coconuts is an area of grave concern.Our field-level insights indicate that, of late, the number of farmers who are solely dependent on coconut farming for their livelihood is declining.Therefore, we need to examine how Indian coconut farmers are actively diversifying their livelihoods.It is also important that, while we look at the sector as a whole, along with farmers, the livelihoods of other significant players like labourers, traders, processors, and intermediaries are also put into perspective.

Not ignoring the fact that the integration of international and regional coconut markets indeed in a big way influenced the demand and price movement in India, posing an important challenge to the millers with respect to the cheaper raw materials from neighbouring countries.In this context, there is a larger ongoing 'crisis narration' wherein we argue that the cheap import of palm oil is the major cause of the price instability of the coconuts in India.Though it is partially true, we need to conduct a thorough investigation of this aspect.There have been umpteen pre-existing and proven advocacies to address such issues, like tariff restructuring, cluster formation, group synergy, and value addition.On the contrary, most importantly, we need to seriously address the issue of labour scarcity, which demands novel policy interventions.Moreover, we need to address the issues largely felt at the meso and micro levels, like disorientation from coconut farming, the regional patterns of coconut cultivation, the domestic consumption patterns of coconut and coconut products, the functioning of domestic coconut value chains, etc.The way in which the labour market is socially structured may prove challenging for newly trained climbers, wherein, for them, it would be difficult to access regular employment.The field-level findings necessarily validate this argument.

Currently, coconut farmers face increased vulnerability to economic risks and uncertainties due to the significant volatility in prices.In order to enhance the future viability of a sustainable coconut sector, it is imperative to reduce the industry's dependence on coconut oil and boost the manufacturing of a wide range of value-added products.Furthermore, it is critical to improve the coconut industry's value chain by implementing appropriate measures for both forward and backward integration.This will help safeguard the livelihoods of those who rely on this sector.Coconut production is hindered by high production costs and low competitiveness due to low family labour participation rates and a higher share of wage labour in production costs.

The inherent rigidity in the cost structure makes it difficult to adjust when prices fall, indicating that farmers will refrain from coconut cultivation unless and until they find the enterprise profitable.Keeping pace with productivity alone cannot ensure success or even survival in an activity vulnerable to unmediated global competition.It is imperative to think beyond the periphery of production and productivity, especially when a wide range of other issues plague the coconut sector.Recalibrating the import duty structure is necessary, and enhancing the tariff rates for both crude and refined palm oil imports within permissible limits is crucial to safeguarding the interests of coconut growers.

Farmer participatory integrated training and awareness programmes are crucial interventions in strengthening the sectoral value chains of coconuts.The consumption pattern of coconut in India reveals that about 30 percent of raw nuts are used for industrial purposes, mainly as desiccated coconut (50%), frozen/grated coconut (38%), and virgin coconut oil (10%).It would be pragmatic to make concerted efforts to increase this utilisation percentage in a phased manner.Even a target of a two percent increase in five years would facilitate a vibrant coconut economy, wherein the spread of the increase should be reflected across increased product lines, including 'neera' and coconut milk/cream.We need to capitalise on the regional differences in coconut cultivation across the country and concentrate on regional production hubs, where large-scale commercial integration is possible with adequate farmer participation.

Numerous obstacles plague the coconut sector in the country.Nevertheless, prospects exist for overcoming the challenges and steering the sector towards a viable, sustainable, and profitable trajectory.The successful implementation of interventions for the sustainable development of the coconut sector requires coordinated efforts from research, development, and extension agencies, active involvement of coconut growers, and a supportive policy environment.

10.2.1.5 Ultra Sonication process for shelf life extension of tender coconut water

Hemalatha B.[1] and Dr.V.K.Chandegara[2]

Associate Professor, Processing & Food Engg.Department
College of Agril.Engg.& Technology, Junagadh Agricultural University
Junagadh - 362 001
Email: vkchandegara@yahoo.com

Tender coconut water (TCW) is incredible healthy drink and the best one to hydrate the body.Tender coconut water (TCW) starts to deteriorate once it is exposed to the air and stored at ambient temperature due to microbial contamination as well as oxidation reactions.Preserving the TCW with its wholesome natural property, nonthermal processing techniques treated tender coconut water (ultrasonication) and packed in 200ml glass and PET bottles under refrigerated condition (4±2!), and withdrawn a weekly interval to checked the quality and stability of TCW.The effect of ultrasonication treatment time (10,20,30 min), and packaging materials (glass bottle, PET bottle) on different characteristics of tender coconut water *viz.*biochemical, enzyme activities and sensory characteristics of tender coconut water were studied.Ultrasonication treated TCW was found at 20min treatment time and packed in glass and PET bottle under refrigerated condition, which gave the experimental values of TSS 5.17 and 4.93p Brix, TA 0.08 and 0.10 %, pH 4.87 and 4.68, EC 5.24 and 5.15 mS/cm, TDS 4.03 and 4.62 ppm, TS 4.37 and 4.63 %, TPC 2.43 and 1.77 (mg GAE/ml), Total plate count 1.718 and 2.418log (CFU/ml), Yeast and Mould count 2.579 and 1.384log (CFU/ml), POD 0.014 and 0.021, PPO 0.017 and 0.021(" O.D./min/ml) and Overall acceptability 8.13 for after 4th week of storage period.

Keywords: Tender Coconut Water, Ultrasonication, glass bottle, PET bottle

10.2.2 Oral Presentation

10.2.2.1 Response of Coconut Varieties in Relation to Different Seasons for the Eriophyid Mite Damage

N.M. Kachhadiya, G.S.Vala, V.R. Ahir, B.V. Patoliya, M.K. Ghelani and Y.H. Ghelani
Email: nileshmk.aau@gmail.com

The present research on "Response of coconut varieties in relation to different seasons for the eriophyid mite damage" was carried out at Agricultural research station (Fruit crops), Junagadh Agricultural University, Mahuva, during 2014-15 to 2016-17.The results of experiment were revealed that the infestation of eriophyid mites was significantly higher damage in dwarf green variety and less damage in west cost tall (WCT).Comparison between to hybrid variety concluded that significantly higher damage found in D X T as compared to T X D.

Keyworld: coconut, eriophyid mite

10.2.2.2 Plant Protection and Marketing Problems of Coconut with Special Reference to Saurashtra Region

B N. Kalsariya, B.H. Tavethiya, J.V. Chovatia and S.J. Parmar
1.Professor & Head, Dept.of Agril.Extension Education, CoA, JAU, Junagadh
2.& 3.Assistant Professor, Dept.of Agril.Extension Education, CoA, JAU, Junagadh
4.Associate Professor, CoA, JAU, Khapat, Porbandar
Email: bnkalsariya@jau.in

The study was conducted in Saurashtra region of Gujarat state.Three districts viz.Gir Somnath, Bhavnagar and Porbandar were selected purposively due to coastal as well as which cultivate amount of coconut in these districts.From these district, 160 coconut growers were selected as a sample.The farmers who cultivate the coconut in the districts have to sell the produces either directly in the market or to the merchant in the locality.But most of the farmers sell their coconut the merchant in the local area or sell directly in the neighbouring market.Further, the farmers face number of problems in cultivating and marketing of coconut in the study area.The white fly and eriophyid mite were the major problems faced by the farmers.Lack of awareness about control measure to white fly and eriophyid mite, lack of modern spraying to control the white fly.High cost of insecticide and pesticide, unremunerative price for tender nuts and mature nuts, neighbouring farmers do not spray insecticides to control eriophyid mite so difficult to get good result, complicated method and delay / insufficient facilities of loan and subsidies, lack of emphasis on value addition training.problem of spraying insecticide while taking intercrop, intercropping increase weed.problem and lack of knowledge about coconut-based industry were the important problems faced by the coconut plantation growers.

It is reported that the farmers could not able to get adequate price for the coconut in many occasions.It makes the farmers economically weak which leads to increase in the borrowings of the farmers year by year.Many farmers of coconut in the study area, face similar issues in marketing the coconut cultivated.Nobody takes care of the framer's problem in marketing the coconut in the study area.

Keywords: Plant Protection, Marketing Problems and Coconut growers

10.2.2.3 Knowledge Level of Coconut Growers Towards Coconut Production Technology in Saurashtra Region

B.N. Kalsariya, J.V. Chovatia, B.H. Tavethiya and P.S. Gorfad
[1]*Professor & Head, Dept.of Agril.Extension Education, CoA, JAU, Junagadh*
[2&3]*Assistant Professor, Dept.of Agril.Extension Education, CoA, JAU, Junagadh*
[4]*Associate Professor, CoA, JAU, Khapat, Porbandar*
Email: bnkalsariya@jau.in

The present investigation was conducted in Una and Veraval talukas of Gir Somnath and Mahuva taluka of Bhavnagar districts of Gujarat state.The total 160 coconut growers from two districts as sample size. The Knowledge is the understood information poses by coconut growers. A person's familiarity with facts, dexterity or effects leading to improved understanding is referred to as knowledge.The knowledge of sustainable farming relates to specific ecological regions, processes, practices, policies, conservation, or environmental problems. The result of the research study indicated that the majority (63.75 per cent) of the coconut growers had medium level of knowledge regarding recommended practices of coconut, followed by high (19.38 per cent) and low (16.88 per cent) level of knowledge.Thus, it can be concluded that 80.63 per cent of coconut growers had medium to high level of knowledge regarding recommended practices of coconut.

The relational analysis stated that, in respect to knowledge, it was found that independent variables *viz.,* education, area under coconut, scientific orientation, mass media exposure, innovativeness, land holding, experience in coconut cultivation, annual income, yield index, risk orientation and extension participation had positive and significant correlation with knowledge level of coconut growers regarding recommended production technology of coconut crop. The variables *viz.,* age, social participation, market orientation and showed non-significant relationship with knowledge level of the coconut growers.

Keywords : Knowledge, Coconut growers

10.2.2.4 Ultra Sanitation Process for Shelf Life Extension of Tender Coconut Water

Hemalatha B.[1] and V.K.Chandegara[2]
Associate Professor, Processing and Food Engg.Department, CAET, JAU, Junagadh
Email: vkchandegara@jau.in

Tender coconut water (TCW) is incredible healthy drink and the best one to hydrate the body.Tender coconut water (TCW) starts to deteriorate once it is exposed to the air and stored at ambient temperature due to microbial contamination as well as oxidation reactions.Preserving the TCW with its wholesome natural property, nonthermal processing techniques treated tender coconut water (ultrasonication) and packed in 200ml glass and PET bottles under refrigerated condition (4±2!), and withdrawn a weekly interval to checked the quality and stability of TCW.The effect of ultrasonication treatment time (10,20,30 min), and packaging materials (glass bottle, PET bottle) on different characteristics of tender coconut water *viz.*biochemical, enzyme activities and sensory characteristics of tender coconut water were studied.Ultrasonication treated TCW was found at 20min treatment time and packed in glass and PET bottle under refrigerated condition, which gave the experimental values of TSS 5.17 and 4.93p Brix, TA 0.08 and 0.10 %, pH 4.87 and 4.68, EC 5.24 and 5.15 mS/cm, TDS 4.03 and 4.62 ppm, TS 4.37 and 4.63 %, TPC 2.43 and 1.77 (mg GAE/ml), Total

plate count 1.718 and 2.418log (CFU/ml), Yeast and Mould count 2.579 and 1.384log (CFU/ml), POD 0.014 and 0.021, PPO 0.017 and 0.021(" O.D./min/ml) and Overall acceptability 8.13 for after 4th week of storage period.

***Keywords*: Tender Coconut Water, Ultrasonication, glass bottle, PET bottle**

11. TECHNICAL SESSION-11 (HALL NO-3)

NATIONAL WORKSHOP 2

National Workshop on Paradigm in Production Dynamics and Utilization of Mango in Amrit Kaal

May 29, 2024, : Junagadh Agricultural University (JAU), Junagadh

Mango (*Mangifera indica* L.), renowned as the king of fruits, plays a vital role in the agricultural landscape of tropical and sub-tropical regions, especially in India, the world's leading producer and exporter.Despite India's substantial contribution of 24.7 million metric tonnes annually to global mango production, the country's average yield falls short of the global average due to various challenges such as diseases, pests, extreme weather, and suboptimal cultivation practices.These issues, along with the risk of losing traditional varieties, highlight the critical need for enhancing the mango sector's productivity and sustainability.

To address these pressing issues, the Confederation of Horticulture Associations of India (CHAI), in collaboration with ICAR-Central Institute for Subtropical Horticulture, Lucknow, AICRP on Fruits, Bangalore, with support from JAU, Junagadh, Jain Irrigation Systems Ltd (JISL), Jalgaon, and ASM Foundation, is organizing a national workshop.This event aims to tackle the challenges faced by the mango industry, ranging from production and disease management to climate change adaptation and market access.It will also showcase innovative practices and technologies aimed at enhancing cultivation methods, productivity, and sustainability.The workshop will consist of four technical sessions featuring panel discussions led by experts from various disciplines, facilitating knowledge exchange among farmers, researchers, policymakers, and other stakeholders.

We extend a warm invitation to you to participate in the National Workshop on "Paradigm in Production Dynamics and Utilization of Mango in Amrit Kaal." Your expertise and insights are invaluable as we collectively strive towards a prosperous and sustainable future for mango cultivation.

Dr. H.P. Singh
Founder and Chairman, CHAI
Former DDG (Hort), Indian Council of Agricultural Research, New Delhi.

Theme of the Workshop

- Understand the dynamics of changes in mango production and utilisationwith changing cropping pattern and emerging effect of climate change.
- Identify and validate technological gaps, and actively pursue new paradigms to effectively tackle the challenges associated with mango production and utilization.

Expected outcomes of the Workshop

- Diagnosis and identification of the associated issues, which require redressal in regionally differentiated manner considering the changing dynamics in crop and weather and strategic planning for effective system.

- Establish a model for a novel paradigm of smart management systems in mango production, aimed at enhancing productivity through innovative and precision-based management techniques.

PANEL DISCUSSION -1

ENVISIONING CHALLENGES & OPPORTUNITIES IN MANGO PRODUCTION AND UTILISATION

11.1.1 Keynote Lecture

11.1.1.1 Advancement for the Commercial Production in Mango

D.K.Varu
Principal and Dean
College of Horticulture, JAU, Junagadh
Email: dkvaru@jau.in, principalcoh@jau.in

Mango is the king of fruit with possessing the pleasant and unique characters.India is one of the largest mango producers globally, with a diverse range of mango varieties grown across different states like Uttar Pradesh, Andhra Pradesh, Karnataka, Bihar, Gujarat, and Maharashtra with 23 lakh ha and 21 million tonnes production.Gujarat is also shining state for the mango cultivation.Productivity is the serious issue of mango in the state and country.Climate change is the real time challenge to reduce the productivity of mango.In recent years, there have been significant advancements in the commercial production of mangoes, driven by various factors such as technological innovations, improved agricultural practices, and market demand.These advancements have led to increased productivity, better quality fruits, and enhanced profitability for mango growers and stakeholders across the supply chain.Technological innovations in mango cultivation, such as the use of high-yielding and disease-resistant varieties, precision agriculture techniques, drip irrigation systems, and mechanized harvesting equipment, have played a crucial role in boosting production efficiency and reducing losses.Furthermore, improved agricultural practices, including proper orchard management, pest and disease control measures, balanced fertilization, and post-harvest handling techniques, have contributed to higher yields, improved fruit quality, and extended shelf life.The state has been making efforts to increase mango production through the adoption of modern agricultural practices, improved irrigation systems, and the promotion of high-yielding mango varieties.The growing global demand for mangoes, both fresh and processed, has also encouraged farmers to adopt modern production methods to meet quality standards, comply with food safety regulations, and access international markets.Overall, these advancements in commercial mango production have not only benefited growers in terms of increased yields and profitability but have also contributed to the overall growth and sustainability of the mango industry on a global scale.

Keyworld: Mango, innovation, adoption, equipment, safety, market, global, etc.

11.1.1.2 Abiotic Stress Management for Mango Production in Coastal Regions

C.R. Patel[1] and Ashish Yadav[2]
[1]*Associate Research Scientist (Horticulture)*
AICRP on Fruits, Agriculture Experimental Station
Navsari Agricultural University, Paria (Gujarat)
[2]*Principal Scientist (Horticulture), Central Institute for Subtropical Horticulture, Lucknow (UP)*
Email: priaaesfrts@gmail.com

Mango (*Mangifera indica* L.) is one of the major fruit crops of Asia and recognized as national fruit of India, Pakistan, Haiti, the Phillipines and national tree of Bangladesh.India is the largest producer of mango in the world with an area of 22.9 lakh hectares and 204 lakh MT production (productivity 8.92 T/ha).Major mango growing states are Andhra Pradesh, Uttar Pradesh, Karnataka, Bihar, Gujarat and Tamil Nadu.Gujarat occupies 1.66 lakh ha area under mango with 12.22 lakh MT production and 7.34 MT/ha productivity.Low productivity is one of the biggest issues in mango cultivation in India.The major reasons are old and senile mango orchards, poor soil, nutrient and water management, wide planting distance, low fruit set with high fruit drop and abiotic stresses like salinity and drought.Among these, soil and water salinity becoming major problem in mango cultivation especially in coastal regions due to their long-term negative effects on plant growth and production.

Salinity is defined as the presence of excessive concentration of soluble salts that affect the normal functions of plant growth.Total salt affected soils in India has been reported to be about 6.73 million hectares out of which 1.24 million hectares is coastal saline soil and 3.78 million hectares is sodic soil and the rest 1.71 million ha is inland saline soil.Soil salinity is increasing rapidly and doubled in the past two decades.Gujarat has about 2.22 million hectare of salt affected soils and large areas are affected by different levels of salinity along the coastal belt on which very few fruit crops can be grown commercially.Higher salinity conditions inhibit growth by reducing uptake of nutrients due to nutrient imbalance, causes leaf injury and as a result the plants become stunted.Accumulation of soluble salts in the root zone reduces growth and development of the plants due to the decrease in osmotic potential leading to restricted absorption of water that caused cellular dehydration, resulting in water stress and nutritional disorders.Secondary salinization in fertile irrigated land is also increasing due to non-judicial use of irrigation water along the canal causing serious problems related to soil and water management.

Being a salt sensitive crop, mango suffers under salinity stress especially during early stages of growth.Several strategies such as leaching, sub-surface drainage, application of good quality irrigation water, tillage, amendments of coarse organic matters, application of gypsum, etc.are being adopted with varied success to maintain the soil and plant health under saline stress condition.However, these strategies are temporary, laborious and cost intensive.Moreover, many of these strategies involve use of good quality irrigation water which is very scanty in coastal regions.One of the long-term, sustainable and cheaper option to mitigate salinity stress in mango is the use of salt tolerant rootstocks which can play an important role in enhancing mango production and productivity especially under salt stress conditions.Polyembryonic rootstocks like 13-1 and Gomera-1 have demonstrated tolerance to salinity and successfully used for raising mango orchards under salt affected regions in many countries including India.

11.1.1.3 Emerging Technologies in Mango Production

Ashish Yadav*, Parul Sagar and T.Damodaran
ICAR-Central Institute for Subtropical Horticulture,
Rehmankhera, Kakori, Lucknow, Uttar Pradesh
**Email: ashish.yadav1@icar.gov.in*

The mango (*Mangifera indica* L.) is one of the major fruit crops of tropical and sub-tropical regions of the world.Mango is very closely related with the culture and ancient history of India.Mango is the source of livelihood for millions of farmers.Mango is cultivated in an area of about 2400 thousand hectares with a production of 21.79 million MT in India.India has exported 27,330.02 MT of mangoes worth USD 47.98 million dollars during 2023-24.India exported around 49% of its mango to gulf countries (UAE, Oman and Qatar).However, 17% mango was exported to UK while only 7% reached to USA.Uttar Pradesh is leading state in mango production.However, it exports only 0.011 % of its total production.

Mango productivity in India is quite less as compared to the world's average mango productivity.Besides biotic and abiotic stresses, mango production is affected due to change in climatic conditions, less-availability of climate resilient mango hybrids/varieties, lack of training and pruning practices, dearth of high density orcharding, poor orchard mechanization etc.There are several emerging technologies in mango production which may play vital role in managing biotic and abiotic stresses, extending the mango farming areas and create new jobs for the local community and strengthening the mango industry around the globe.

Naturally Biofortified/Nutri-Smart Mango Hybrids

Mango is well recognized as a health-fruit, it possesses multiple bioactive components with a variety of health advantages, establishing mango as an economical functional fruit.Aside from vital nutrients, organic acids, dietary fibre, vitamins, and minerals; Indian mango varieties also contain significant amounts of non-essential phytochemicals.Recent research has revealed that Indian mangoes are high in two bioactive compounds with high pharmacological value: mangiferin and lupeol.ICAR-CISH is working on the development of naturally biofortified /nutri-smart mango hybrids.Previously developed CISH-Ambika and CISH-Arunika mango hybrids are exceptionally rich in mangiferin, lupeol and â carotenes.There are several promising mango hybrids in the advance stage of evaluations.

Mango Leaves as Nutraceuticals

Mango leaves are rich in nutritional and medicinal properties and are one of the most valuable parts of the mango tree. Mango leaves are used in traditional medicine to treat various ailments such as fever, diarrhoea, and respiratory disorders. Mango leaves contains antioxidants, flavonoids, tannins and phenolic compounds. Polyphenolic compounds and related bioactivity in the fruit are higher in peel than pulp and highest in mango leaves and stem barks. There are various polyphenols in mango, but Mangiferin, is abundant and bioactive.Synergy among various polyphenols and micro-elements in mango extracts is responsible for their high bioactivity as compared to pure isolated compounds.

Mango Training Systems

Traditionally, mango plants are not trained and pruned.Due to which after 20-25 years trees develop large and tall canopy.The fruiting zone confined on the upper periphery of the tree, due to which harvesting, nutrient and growth regulator application on targeted leaves become difficult.Mango can be trained well in different canopy models which lead to minimum or no microclimate development favourable for disease and pest development.The newly developed canopy models are climate resilient and suitable for growing mango under high density planting system in which fruit bagging can be easily done for increasing quality fruit production.

Ultra-High-Density Planting (UHDP)

Ultra-high-density planting is a new technology, commonly practiced for mango cultivation and combined with other sustainable agricultural techniques, has the potential to yield 200% more produce than that of the traditional method.The ultra-high density mango planting is a technique which has utilized all the resources optimally and thus, increased the production per unit area as well as raises profit margin of mango farmers.

Mango Fruit Bagging

Bagging is one of the most successful mangoes IPM technologies, the process of wrapping individual mangos in paper bags is helpful to protect mango fruits from pre-harvest insects, viz., fruit flies, fruit borers and thrips etc.Bagging also protect fruit from diseases such as anthracnose.

Drone Technology

The evolving role of drone technology in fruit crop management, providing a comprehensive overview of its applications, benefits, and existing challenges.Drones, or Unmanned Aerial Vehicles (UAVs), equipped with advanced sensors and imaging capabilities, have revolutionized the way farmers monitor and manage fruit crops.Aerial surveillance enables high-resolution imaging of orchards, allowing for early detection of diseases, pests, and other stress factors that can impact crop health.The data collected by drones facilitate precise and targeted interventions, optimizing resource use and enhancing overall crop productivity.

11.1.1.4 Next Generation Plant Management Techniques in Mango

Bal Krishna, Amol U.Chaudhari, Rajender Kumar and Anil V. Dhake
Jain Irrigation Systems Ltd.Jalgaon, MH, India
Email: yadav.balkrishna@jains.com

Plant architecture management for improved productivity and efficient orchard management is important in fruit trees.Most of the tree crops, especially temperate fruits, have progressed from traditional large trees in the early 20th century to small trees under very high density with the help of canopy management techniques, spur genotypes, dwarfing rootstock and tree support system (trellis).This revolution happened in the last 100 years.

Mango is the king of tropical fruits and the commercial interest of farmers is reducing day by day due to relatively low income and profit margin in comparison to other fruit crops like banana and citrus.To increase per acre productivity and income it is necessary to improve the productivity and quality of mango which is not possible without development and adaptation of new technologies.High density (300-600 plants/ha) and ultra high density (1250-2500 plants/ha) has been under trials for the last 50 years.In the past few years farmers, especially in non-traditional mango growing areas showing great interest in ultra high density mango plantation besides high density has become the mainstream plantation technology now in mango.Our study indicates that there are at least 1000 hectares under ultra high density plantation system.We have been practicing ultra high density on large scale from the last 15 years and have been very successful in increasing productivity 8 to 25 tons /ha depending on cultivar's bearing habit (shy/prolific).

In absence of dwarfing rootstock or scion this technique requires a significant amount of pruning after harvest which is a great loss for basic plant production.Past eight years we have been testing various trellis systems in mango and the results indicate that planting mango in vertical trellis with 3x2 or 2x2 meter spacing has a potential to improve productivity beyond the ultra high density.Similar experiments with new generation cultivars in Australia have also shown promise.We believe that this can play a significant role in increasing mango productivity. However further research to develop dwarfing rootstock and having varieties with high fruit to wood production ratio will further enhance the mango productivity.

11.1.2 Oral Presentation

11.1.2.1 Investigating the Impact of Low Storage Temperature and Storage Media on Various Parameters of Pollen in Mango *(Mangifera Indica* L.)

D.N. Dhamsaniya[1] and D.K. Varu[2]
1.Senior Research Fellow, Directorate of Extension Education, J.A.U., Junagadh - 362001
2.Principal and Dean, College of Horticulture, J.A.U., Junagadh – 362001
Email: dishitapatel97@gmail.com

Mango is a vital fruit crop in tropical and subtropical regions, faces challenges like irregular flowering and low fruit yield due to limited pollen availability.A Flowering times vary widely among mango cultivars and environments, creating challenges for effective pollination.Pollen storage techniques can enhance pollen longevity, enabling its use in pollination to overcome barriers caused by differences in flowering times among cultivars.This study aimed to investigate the influence of storage media and temperature on pollen storage behavior in different mango varieties during the year 2019-20.The experiment involved four mango varieties (Kesar, Alphonso, Mallika, and Dudhpendo), three storage media (n-hexane, paraffin oil, and no media as control), and four storage temperatures (-20p C, -4p C, +4p C, and room temperature).Significant variation was observed among varieties for all pollen parameters.Kesar exhibited maximum pollen viability at 7, 14, 21, 49 and 56 days of storage, while Mallika showed peak viability at 28, 35 and 42 days of storage.In vitro pollen germination as well as pollen tube growth was highest in Kesar and Mallika at different storage durations.Storage media significantly influenced pollen viability, germination, and pollen tube growth, with n-hexane and paraffin oil performing better than no media.Similarly, storage temperature significantly affected these parameters, with the best results observed at -20p C followed by -4p C.Room temperature storage led to a rapid decrease in pollen viability, germination, and pollen tube growth, making it unsuitable for long-term storage.The interaction of variety, media, and temperature also significantly affected pollen parameters.Overall, Kesar pollen stored in n-hexane at -20p C exhibited the best performance throughout the experiment.These findings provide valuable insights for improving mango pollination practices and enhancing fruit yield and quality.

PANEL DISCUSSION -2

DYNAMICS OF VALUE CHAIN MANAGEMENT IN MANGO FOR HARNESSING THE POTENTIAL IN POTATO

11.2 Keynote Lecture

11.2.1.1 Value Addition and Marketing of Mango

R.B.Tiwari
Division of Post Harvest Technology & Agriculture Engineering
ICAR-Indian Institute of Horticultural Research, Hessaraghatta Lake (PO)
Bangalore -560 089, INDIA

Mango (*Mangifera indica* L.) is one of the most economically important tropical fruits with high popularity among consumers due to its pleasant aroma, juicy texture and sweet taste and is known as ‘the king of tropical fruits'.With rich source of phytonutrients including carotenoids, it is a fruit with potential health-promoting attributes.Fresh mango, fresh -cut mango chunks.Some of the common processed products from mango fruit include pulp (puree), juice concentrate, ready-to-drink juice, nectar, wine, jams, jellies, pickles, smoothies, chutney, canned slices, chips, leathers, and powder.Mango production in India suffers from abnormal weather conditions, rains & wind etc.which results in dropping of huge quantity of fruits which sometimes become unmarketable causing economic loss to farmers.Apert from this, about 30-40 % of harvested mangoes are discarded due to uneven ripening, misshapen, sourness, fineness including minor damage to raw fruits.The technologies to convert such inedible fruits which mostly are discarded is discussed in this paper with an aim to make mango production and consumption more sustainable.combined processing techniques involving deacidification, vacuum impregnation, osmotic infusion, freezing, drying was adopted to convert unmarketable raw mango fruits into ready-to-eat snacks.

Fresh Mango quality

Maintenance of mango fruit quality during the supply chain depends on many aspects, including adequate orchard management practices, harvesting practices, packing operations, postharvest treatments, temperature management, transportation and storage conditions, and ripening at destination.Consumer demand for a convenient, nutritious, and uniquely flavored fresh-cut mango products are also in great demand.Fresh-cut products should be free from defects, at optimal maturity and ripeness stage, and have a fresh appearance.At the time of purchase appearance freshness, texture and flavor (aroma and taste) are the main quality of fresh-cut products.Hence, from the point of minimal processing visual and textural quality of the fresh-cut products should be assured.

Processed mango products

Processing of mango fruit into diverse shelf-stable products makes the seasonal fruit conveniently available to consumers all year round.Over the years, research and food product development have contributed substantially to a number of unique and diverse processed mango products with specific qualities and nutritional attributes that are in demand by a wide array of consumers.These mango products are derived from appropriate food processing and value-addition technologies that transform fresh mango into shelf-stable products with ideal organoleptic, nutritional, and other quality attributes.

Pulp

As intermediate product, both pulp and puree are primarily preserved by chemical preservatives, canning, or aseptic processing/packaging, and occasionally by freezing.Pulp and puree serve as a base for a variety of processed mango products, e.g., nectar, beverages, jam, jelly, and leather.Mango pulp can also be used to enrich or flavour secondary products such as yoghurt, ice cream, beverages, and soft drinks.Depending on the cultivar, mango pulp constitutes about 40–60% of the total fresh fruit weight, and is the main consumable part of the fruit due to the presence of nutritional and functional compounds

Frozen mango products

Frozen mangoes are packaged in flexible pouches of retail and bulk sizes, while dried mangoes are mostly packaged in individual-serving size bags. Active packaging with antimicrobial properties is extensively used for processed food products to reduce spoilage and contamination.Mango can be processed using osmo-dehydro freezing technique to make a free flowing stable mango product with very good shelf life.

Mango Juice (RTS)

Mango pulp can be mixed with a specific ratio of water to produce mango ready-to-serve beverages of a final TSS ranging between 15 to 20 °Brix and 0.3 acidity.The mango juice can be used as a single strength juice or blended with other fruit juices as juice blends or incorporated in fruit smoothies/shakes.

Mango Squash

Mango squash is a concentrated drink consisting of 25% juice, 55% TSS and 1.1 to 1.2% acidity with either sulfur dioxide or sodium metabisulfite as a preservative.

Dehydrated mango products

Dried mango products (slices or flakes) are generally prepared from ripe mangoes and dehydrated using a variety of methods including solar, hot-air cabinet, vacuum, spray, or freeze dryers.The dehydrated mango products are intended for either direct market or used in other formulations such as mango leather and powder.

Osmotically dehydrated mango slices and chunks

The production process for dehydrated mango slices, dices, and chips are similar, other than the shape and size of the product.The ripe mango fruits are washed, peeled, pitted, and the pulp is sliced longitudinally into uniform thickness.The slices are then subjected to osmotic treatments with 50 to 70° Brix sugar syrup with added preservatives.Osmosed slices are then dried at a temperature of 50–55 °C to about 15% moisture content.About 7-10 kg fresh fruits are required to make one kg of osmo-dried mango slices.Pulpy mango varieties such as Alphonso, Totapuri, Dasheshari are suitable for osmotic dehydration.

Mango Bar

Mango Fruit bar are dried sheets of fruit pulp which have a soft, rubbery texture and a sweet taste.Mango leather is made by addition of sugar and additives and preservatives followed by drying in mechanical or solar dryers to a final moisture content of 15–20%.Solar drying can also be used for making mango bar.It could be possible to make mango bar from very sweet mango varieties such as Arka Uday and Arka Suprabhat without added sugar.

Application of combined processing techniques for upcycling of unmarketable mango fruits

Various combined processing techniques involving deacidification, vacuum impregnation, osmotic infusion, freezing, drying was adopted to convert unmarketable raw mango fruits into ready-to-eat snacks.Raw Totapuri fruits were used to develop crispy snack bars which was highly acceptable.Dehydrated crispy bars using grated raw Totapuri with infusion of ripe mango juice of variety Alphonso and Amrapali improved colour flavour and carotenoids content. Raw Banganpalli mango slices infused with ripe Alphonso mango juice resulted in product with intense colour, mild to intense flavour & desirable sweetness.Hence, it is concluded that through combination processing unmarketable raw and discarded mango fruits can be utilized for making nutritious and crispy snacks which in turn can make mango production more sustainable.

Mango Powder

Mango powder is used as a flavor enhancer in various foods and beverages such as in ice cream, yoghurt, and the bakery and confectionery industries.Dried mango powder is processed by dehydrating mango pulp to a moisture content of 3% moisture using spray, freeze, vacuum, or drum dryers.

Pickles : Pickles are made mostly from green mangoes are categorized as salty, oily, or sweet pickle based on the type of preservation used.They can be produced from peeled or unpeeled fruit with or without stones and with different kinds of proportions of spices.

Marketing of fresh mango and processed products

Harvested mangoes go through de-sapping, washing, sizing, and grading prior to packing.Minimum label information for most of the domestic wholesale markets in include the cultivar, class (local criteria), gross weight, and grower/suppliers name.

11.2.1.2 Innovative Bio-intensive Approaches for Mango Pest and Disease Management

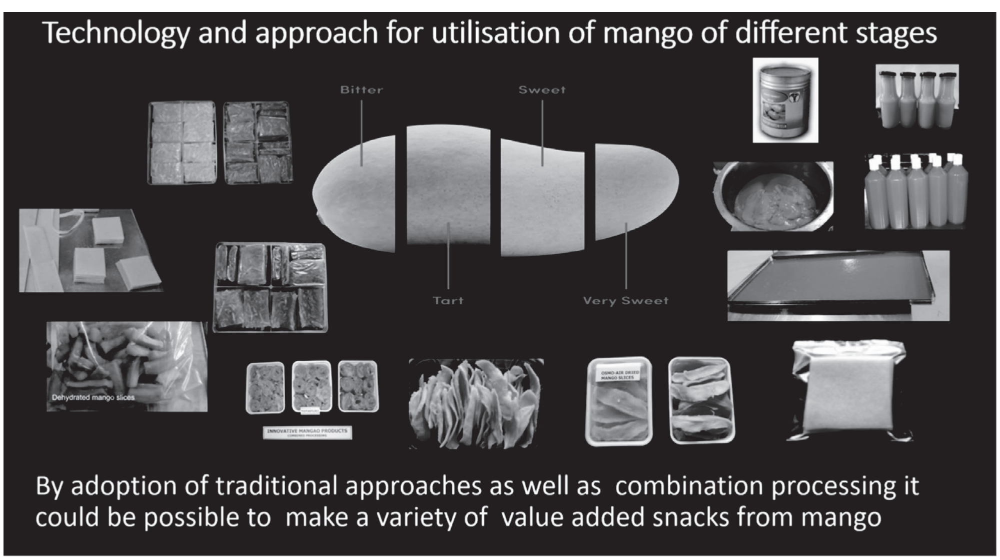
H.S. Singh, P.K. Shukla and Snehashish Routray
Division of Crop Protection,ICAR: Central Institute for Subtropical Horticulture
Rahmankhera, PO Kakori, 226101
Email: singhhs211965@gmail.com

The use of chemical fertilizers and pesticides has played a positive role in increasing agricultural productivity and in making India self-sufficient in food production but this has offered many problems.The effort of searching for alternatives with a focus on the long-term sustainability of agriculture is accelerated in the last few decades.Keeping in view the increasing demand for green agriculture products across the world, there are certain practices which have been evolved as alternatives to chemicals in agriculture.

Bio-intensive IPM, a part of conventional IPM, emphasizes proactive measures to redesign the agricultural ecosystem to the disadvantage of insect pests and the advantage of its parasite and predator complex.

Mango crop has different kind of ecological and phonological system as compared to field crops.Being semi permanent ecosystem, the possibility of success of bio-intensification is higher in orchards.Elderly trees, located in many areas have a well-developed large canopy area with considerable height where the distribution pattern of different insect pests varies horizontally and vertically within the canopy area.It remains a challenge to provide an efficient low-cost high capacity power sprayer to growers who normally do not spray the top of the canopy for any pest in tall trees.

Natural enemies have no limitation to tree size, hence; can get easy access to even huge and tall canopy.There are pests (hard and soft scales, stationary mealy bugs, trunk borer, red-banded mango caterpillar, and psylla) that are not adequately or cost-effectively controlled by other means including pesticides.Conceptually, if human intervention is reduced in the ecosystem and natural enemies are nurtured/applied, the pest population will seldom exceed the threshold level contrary to seasonal /annual ecosystem ttherefore, some of the innovative approaches of bio intensification for pest control that are being evaluated in mango orchards are: Re-structuring of tree configuration for easiness in field operations including drone application.



11.2.1.3 Need for Innovative Technologies in Climate Resilience Mango Production

Shailendra Rajan
Former Director, ICAR-Central Institute for Subtropical Horticulture, Lucknow

Mango cultivation is a pivotal element in Indian horticulture, providing sustenance, driving economic growth, and enabling international trade.However, it faces numerous challenges including complex production dynamics, quality management, pest and disease control, value addition, and the urgent need for climate resilience.Climate change looms as a significant threat, particularly impacting critical growth phases such as pollination.Varieties like Dashehari are especially vulnerable to erratic temperature shifts and extreme conditions, which can disrupt fruit set.Unpredictable weather patterns not only compromise fruit quality but also exacerbate pest issues and disease prevalence, threatening the market value and economic sustainability of mango farming.Addressing these challenges requires strategic policy interventions and the adoption of climate-smart agricultural practices.Techniques such as mulching, efficient irrigation management, and the cultivation of resilient mango varieties are crucial for enhancing the industry's resilience.Moreover, understanding the specific impacts of climate change on mango cultivation is essential but currently underexplored.This knowledge gap hinders the development of effective mitigation and adaptation strategies.Enhancing research to close this gap can lead to the creation of innovative, climate-resilient agricultural technologies and mango varieties that can withstand climatic adversities.Policy recommendations should aim to incentivize climate-resilient practices, strengthen research and extension services, and encourage collaboration among stakeholders.Integrating proactive pest and disease management strategies, which reduce reliance on chemical pesticides and preserve ecological balances, is also vital.Additionally, efforts to restore and conserve pollinator habitats will support efficient pollination and sustainable mango cultivation.By implementing these strategies, the mango industry can mitigate the adverse effects of climate change, reduce dependency on chemical pesticides, and ensure the long-term sustainability and prosperity of mango cultivation in India

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11.2.2 Oral Presentation

11.2.2.1 Management of Mango Stem Borer (*Batocera rufomaculata*) Using 'Arka Borer Control'

R.V. Kadu, M.H. Shete, S.B. Jadhav, S.S. Dighe, R.B. Kadu and Prakash Patil
All India Coordinated Research Project on Fruits, Department of Horticulture,
Mahatma Phule Krishi Vidyapeeth, Rahuri-416 722 Dist.Ahmednagar (MS).
Email: ranjitkadu81@gmail.com

The field experiment was conducted to evaluate the efficacy of 'Arka Borer Control' for the management of mango stem borer (*Batocera rufomaculata*) at All India Coordinated Research Project on Fruits, Department of Horticulture, MPKV, Rahuri (MS) during 2021 and 2022.The Arka Borer control product, provided in a semi-solid paste form by IIHR, Bengaluru in both 2021 and 2022, was applied according to the prescribed protocol.Observations regarding stem borer damage were documented for both years, with zero percent stem borer infestation at the time of application for all treatments.Pooled results revealed that the treatment T1 (ABC) proved highly effective in preventing mango stem borer infestation, with 0.00 percent infestation at 3 months and a minimal 10.00 percent infestation at 6 months post-application.The following treatment, T3 (Chloropyriphos 20 EC @ 2 ml + Neem oil @ 10 ml + COC @ 4 g/lit.), also

demonstrated significant effectiveness, showing no stem borer infestation at 3 months and a slightly higher 16.67 percent infestation at 6 months after application.Conversely, the untreated control exhibited the highest stem borer infestation, with 23.33 percent and 40.00 percent recorded at 3 and 6 months post-application, respectively.

Regarding the count of live holes in the stems, insignificant results were observed three months after the application of treatments.However, when evaluated after six months, treatment T1 (ABC) was notably effective, recording the lowest number of live borer holes per stem (0.17 holes per stem).This performance was on par with T3 (Chloropyriphos 20 EC @ 2 ml + Neem oil @ 10 ml + COC @ 4 g/lit.), which reported 0.23 live borer holes per stem.In contrast, the untreated control exhibited a significantly higher count of live borer holes, with 1.80 holes per stem, at the six-month mark post-application .

The duration of effectiveness of applied product was monitored, revealing that the color of the Arka Borer paste applied to the tree trunk partially faded within the initial 3 months due to heavy rainfall.However, it remained unchanged for the subsequent 6 months, as observed in both 2021 and 2022.

Keywords: Arka borer, mango stem borer, chloropyriphos, neem oil, COC

12. TECHNICAL SESSION-12 (HALL NO. 3)

DIGITAL HORTICULTURE IN POST HARVEST MANAGEMENT, FOOD SAFETY AND MARKETING

12.1 Keynote Lecture

12.1.1 Digitalization of Post-harvest Management to Reduce Losses and Ensure Quality

S.N. Jha and K. Narsaiah
[1] DDG (Engineering); [2] ADG (Process Engg); ICAR, KAB-II, New Delhi 100102
Email: snjhajae@gmail.com

The integration of digital technologies is poised to significantly enhance the sustainability and efficiency of horticultural produce management. These technologies are set to address key challenges such as optimizing resources, adapting to climate change, and increasing food production demands. As the field of horticulture continues to evolve, advancements in the supply chain are expected, marked by the integration of engineering and digital technologies with various appliances, machinery, and tools.However, the current trend of rapidly deploying digital applications and gadgets without adequate validation poses potential risks to Indian horticulture. It is often the case that many claim to offer comprehensive digital solutions for agriculture, yet only develop limited applications. Properly assigning tasks to appropriately skilled experts at the right time is crucial. Engineers should be at the core of the digital framework, supported by experts from other agricultural fields to provide essential insights. This collaborative approach is vital for meaningful advancements in digital horticulture, aiming to minimize losses in both pre- and post-harvest operations.This paper examines the role of digital systems in the post-harvest management and processing of horticultural produce.

12.1.2 Potential of Digital Technologies in Production and Trade of Spices

R. Dinesh, V. Srinivasan, and Lijo Thomas
ICAR- Indian Institute of Spices Research, Kozhikode, Kerala
Email: rdinesh21@yahoo.com

The spices have proved its vital role in the agricultural export sector owing to its high value of output (26%) of the volume and 50% of the export value of horticultural exports from the country and spices export occupies the 5th place in terms of value during 2023.This contributes 7.2% to the total agricultural products export.Spices are cultivated in an area of 4.43 mha with a production of 11.15 mt during 2022-23 (E).The export of spices/spice products from the country has been 1.40 mt valued at 3.95 billion US$ during 2022-23.The technology and innovation ecosystem in spice crop is the backbone of the production system keeping upbeat the trends in trade of spices.The health and vibrancy of the innovation ecosystem in crop sector is important in determining the profitability and sustainable viability of spices.Spice trade is evergreen and there is a greater demand for spices produced from India.Besides, there are very strong R & D institutions in India *viz*., ICAR- Indian Institute of Spices Research (ICAR-IISR), Kozhikode, ICAR- National Research Center for Seed Spices (ICAR-NRCSS), Ajmer and the All India Coordinated Research Project on Spices (AICRPS) connecting 39 SAUs/ institutes, Directorate of Arecanut and Spices Development, Calicut, Spices Board, Kochi etc.The consumption of spices is growing in the country with increase in purchasing power.It is envisaged that everyone in India would be consuming one spice or the other with a high per capita consumption.This may increase further due to rapid technological developments which need spices as natural food preservatives.Ninety percent of our spices production is consumed within India which is an indication of the huge domestic market.Use of the precision production technologies such as adoption of high yielding varieties, quality seed and planting material production, better cropping systems and management, plant health management, aided with the ICT/ AI technologies for appropriate delivery of agri inputs like fertilizers for increasing their use efficiency in addition to processing and value addition to sustain the spices production in the country are imperative.

12.1.3 Use of Digital Technologies in Post Harvest Management of Horticultural Crops

H. Usha Nandhini Devi[1], L. Pugalendhi[2] and B. Madhumetha[3]
[1]Associate Professor (Hort.), Centre for Post Harvest Technology, Agricultural Engineering College and Research Institute, Tamil Nadu Agricultural University, Coimbatore
[2]Former Dean (Hort.), Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore
[3]Research Scholar, Department of Vegetable science, Horticultural College and Research Institute Tamil Nadu Agricultural University, Coimbatore
Email: drushajana@rediffmail.com

Post-harvest technology plays a crucial role in enabling industries to provide consumers with safe, nutritious, and fresh horticultural products, bridging the gap from farm to table.The substantial food wastage occurring in the post-harvest period could be mitigated through enhanced research, advancements, and education in post-harvest processes.Currently, numerous innovative technologies and techniques are being deployed to minimize losses experienced during harvesting, packing, transportation, wholesale and retail markets, and delays at different handling levels.There are several types of digital technology used in post harvest management of horticultural crops such as artificial intelligence, the Internet of Things, block chain, Big Data, robotics and smart sensors.These technologies can be used by the entire supply chain, from farm or field to the fork (F2F).The main objective of these technologies is to improve productivity, reduce food safety risks and enhance the sustainability of the entire supply chain.Efforts are needed to further refine these approaches, reducing losses effectively and maintaining cost-effectiveness for widespread application across diverse economic levels.Enhancing post-harvest practices can also help cut down expenses associated with additional processing steps.Post-harvest innovations and the greening of food value chains can have a big impact on preventing food loss, slowing down food loss, and recovering food value.It implies that decision-makers and policy makers must consider these approaches, especially as they significantly enhance food security, reduce the effects of climate change and create job possibilities.Future research should focus on integrating emerging technologies with post-harvest practices, and improved methods should be incorporated into existing value chains and marketing systems.

Keywords: Post-Harvest Technology- innovative technologies - minimize losses- Value Chain-sustainability.

12.1.4 Value Chain Management of Fruits Through use of Digital Technologies

Dinesh Kumar and Anamika Thakur
Division of Food Science & amp;amp; Postharvest Technology
ICAR - Indian Agricultural Research Institute, Pusa – New Delhi – 12
Email: dineshscn@gmail.com

In summary, digital technologies offer a transformative potential for the agri-food industry, providing substantial benefits in terms of efficiency, food safety, sustainability, and transparency.The growing integration of Internet of Things (IoT), artificial intelligence (AI), blockchain, and robotics in agri-food processing demonstrates successful implementations and anticipates a promising future.However, to fully realize the benefits of these technologies, addressing key challenges is essential.Issues like cost, accessibility to technology, technical expertise, and resistance to change present significant barriers that require collaborative efforts from all stakeholders in the agri-food sector.Looking ahead, targeted advancements in specific digital technology domains such as big data and analytics, autonomous systems, 3D printing, virtual and augmented reality, and blockchain hold immense promise for the industry.Through continuous innovation and collaboration, the agri-food sector has the opportunity to foster sustainability, efficiency, and transparency, benefiting farmers, food processors, and consumers alike.

12.1.5 Digital Image Processing of Horticultural Produce

M.N. Dabhi
Research Engineer, AICRP on PHET, Processing and Food Engineering Department
College of Agricultural Engineering and Technology
Junagadh Agricultural University, Jungadh
Email: mndabhi@jau.in

Increase in fruits and vegetables production requires timely supply in market.To cop up with the supply chain Labour shortage have need of mechanization in sorting and grading.Awareness of consumers is increased for improved quality of fruits and vegetables.Together with the high labour costs, inconsistency and variability

associated with human inspection accentuates the need for objective measurements systems.Digital image processing is a technology used in manufacturing and quality inspection industries as a substitute for the human vision function.The flexibility and non-destructive nature of this technique also help to maintain its attractiveness for application in the fruit and vegetable processing industry.A revolution has occurred due to this technology and much more is still awaited in the field of horticultural science and technology.

12.1.6 Innovations in Digital Horticulture to Make Farmer Centric Value Chain with Special Emphasis in Trans Himalayan Region through Cooperatives and collectives The Agenda Ahead to Reverse Globalization

Binod Anand

CEO (Hon) Confederation of Horticulture association of India
Member, Hon'ble Prime Minister- High Power Committee on MSP and Agricultural Reforms, Government of India,
Executive President - World Cooperative Economic Forum,
Secretary General of Confederation of NGOs of Rural India and
National President: Rashtriya Kisan Progressive association
Email: binodanand@gmail.com

Cooperatives may become the powerhouse of equitable growth, jobs, and backbone to the nursery of entrepreneurship.These are universally acknowledged as major contributors to GDP and even larger contributors to exports and employment and play a crucial role in the Socio-economic profile of nations.With the implementation of DIGISTACK by GOI and the advent of Blockchain and other innovative technology, traceability of Food produce is not a distant reality.It will help the value chain by making it more farmer centric.There are around 300 large cooperatives globally that generate over $2.1 trillion in revenue.Integration of these with our Grassroots Coops with modern technology like Blockchain and E-trading can become the best tool to achieve the targets of SDGs especially for the goal of creating the social and solidarity economy.This model proposed through this paper can provide voice to over three million co-operatives spread over all countries.It can generate actionable insights with a view to helping the stakeholders not just navigate from the current challenges towards sustainable solutions but also shape the future of the co-operative economy, as it employs 10 per cent of the total workforce in the world.Finally, innovation has played a major role in poverty reduction, especially in the agricultural sector.Introducing ICTs through Cooperatives in remote areas not only allows for better productivity and connectivity with markets, but also can become tool for knowledge and information sharing.

This paper will dwell upon the opportunities and challenges for internationalization of cooperatives and making the value chain more democratic and farmers centric through Digital Innovation especially in Horticulture.Cooperatives can play a critical role in the economic and social development of emerging markets especially for trans Himalayan region and their role needs to be strengthened further in view of their contribution towards fostering equitable growth and employment generation.It is imperative to enhance Cooperative competitiveness, which requires the creation of an enabling legal, regulatory, and administrative environment, access to finance and capable institutional structures and most importantly, human capital.To transform the traceability issue through Block chain, Cooperative can become the agent of reverse Globalization, not only at policy level but also at farm level.Efforts should be made to take full advantage of opportunities made available by changing global order.This is possible only through enhancing efficiency and taking Cooperatives to a level where they can take advantage of digital Technology.

Keywords: Reverse Globalisation, Policy, models, Innovation, Sustainability, Social good, Macrolevel, E-trading, Digital Horticulture, Temperate Zones, Trans Himalayan

12.1.7 Applications of Sensors in Food and Nutrition Industry: Agri-Business Prospects

K. Muralidharan* and S.V. Ramesh
**Principal Scientist, ICAR-CPCRI, Kasaragod*
kmurali.cpcri@gmail.com

The food processing sector is one of the critical drivers of India's economic growth.The sector recorded a market size of Rs.2,802,750 crores in 2023 and is expected to grow at an 8.8% CAGR in the coming years from 2024 to 2032, according to the Market Research Company, Reports and Consulting Services (IMARC) report.During the period from 2014-15 to 2022-23, exports of processed food showed an increase of 150%.In terms of contribution to total agricultural exports ($53 billion), processed food accounts for 23% during the current year, up from 13% in 2014-15.India ranks 7th in food exports in the world during the year 2022-23.The sector has several untapped potentials as the country is either number one or two in the production of food grains, horticulture produce, dairy, and meat.Currently, less than 10% of the agricultural output is processed in India: Fruits (4.5%); vegetables (2.7%); milk (21.1%); meat (34.2%) and fishery (15.4%).Other key driving factors of market growth include favorable government initiatives, a vibrant startup ecosystem, research and development support for technology advancement and agribusiness incubation, and rising consumer awareness of processed foods.

Chiefly there are five industry segments in food processing viz., (i) grains, cereals, and pulses, (ii) fruits and vegetables, (iii) meat and poultry, (iv) dairy products, and (v) Ready to Eat (RTE) processed foods.Typically, a food processing protocol will have one or more of the following components: preparation, processing (direct, use of processing aids, concentration, enrichment, fortification, extraction), preservation, packaging, and quality control.Another important activity in food processing is waste management.Supply chain management with forward and backward linkages is most fundamental for sustainability of food processing units.

Monitoring the quality of food for safe consumption and ensuring nutrition at various stages of the value chain is a significant concern.This process typically necessitates trained personnel, advanced equipment, and a significant time investment.Such procedures are most effectively carried out at processing sites and by the law enforcement agencies. However, for rapid assessments at the retailer and consumer level, quick analytical techniques are ideal. Sensor-based analytical procedures offer a convenient solution for rapid, sensitive, and reliable testing.

Sensor applications in the food industry encompass various functionalities such as process monitoring, critical parameter control, shelf-life studies, and quality control.Sensors play a crucial role in determining proximity to undesired materials, as well as monitoring parameters such as temperature, humidity, pressure, pH, and gas levels.Biosensors are specifically designed to measure the concentration of specific analytes.With advancements in nanotechnology, nano-sensors have emerged, offering faster and more accurate detection of microbes, microbe-derived toxins, and adulterants.Nano-sensors also find utility in the detection of vitamins and antioxidants.Additionally, electronic nose (e-nose) technology is utilized to effectively identify flavors and volatiles in food products, while electronic tongue (e-tongue) systems mimic the gustatory system of human beings, enhancing sensory analysis capabilities in the food industry.

Despite the wide spectrum of sensor applications in the food sector, their commercial use is currently limited to selected items and brands.Additionally, only a few food sensor technologies have been successfully converted into commercial products, indicating significant potential for production and marketing growth in this field.Conventionally, a sensor comprises four components: the target analyte, recognition element, signal transducer, and processor. Analytes may include biological substances such as allergens, toxins, and pathogens, or non-biological contaminants like heavy metals and pesticides.The recognition element must be specific, sensitive, stable, and safe for use with food substances. Once the recognition event occurs, it is converted into a signal and displayed through a processor. The challenge lies in developing sensors tailored to different foods and analytes, as well as integrating them cost-effectively with information and communications technology (ICT) for optimal use in the small and medium enterprise segment.The application of two-dimensional materials (2DMs) for developing intelligent sensor systems for food spoilage detection with high viability, simplicity, cost-effectiveness, and the integration of carbon quantum dots (CQDs) in sensing platforms with food packaging offer exciting prospects for real-time monitoring of the food quality change.

The market forecast for sensors, both in general and specifically for food applications, is promising. Research and development in the field are instrumental for the anticipated surge in sensor development and commercialization. Among various sensor types, biosensors with applications in the food and health sectors are expected to lead the market from 2023 to 2032.Factors such as significant lifestyle changes, stringent regulations in the food and beverage industry, increasing demand from the healthcare sector, and the expansion of cold chain logistics are some of the driving factors for upward demand for sensors.

12.1.8 Advancements in Subtropical Horticulture: Navigating the Interplay of Tradition and Digital Technology

Shailendra Rajan
Former Director, ICAR-Central Institute for Subtropical Horticulture, Lucknow
Email: srajanlko@gmail.com

The blend of tradition and innovation propels an exploration into the transformative impact of cutting-edge technologies on subtropical horticulture.This narrative envisions a promising trajectory where ancient horticultural practices seamlessly integrate with modern technology, notably the Internet of Things (IoT) and Artificial Intelligence (AI), to propel the field forward.At the forefront of this transformation is the transformative potential of state-of-the-art technologies, with a particular emphasis on IoT and AI, optimizing resource usage and revolutionizing crop management.Intelligent horticultural technologies, functioning as vigilant overseers, leverage soil sensors and satellite imagery in tandem with IoT, achieving unparalleled precision in resource utilization.Mobile applications and digital platforms emerge as transformative catalysts, fostering instantaneous information exchange and creating a network that transcends geographical limitations.This digital transformation positions small-scale farmers as central players in the global marketplace, equipped with knowledge and opportunities previously beyond reach.Amidst this evolution, the narrative recognizes the nuanced interplay between optimism and vulnerability, particularly regarding the digital literacy of farmers.Inherent vulnerabilities such as technology access disparities, infrastructure gaps, and data privacy concerns are acknowledged within this transition.Opportunities unfold as e-commerce platforms become gateways to untapped markets, digital extension services connect to global horticultural best practices, and the soil itself becomes a foundation for horticultural entrepreneurship.Resilience emerges as a driving force for sustainable development, viewing obstacles as opportunities for growth.However, challenges persist, including the digital divide symbolizing inequality and seasonal weather patterns posing ongoing obstacles.Acknowledging this complex landscape, strong policy frameworks are deemed crucial for navigating the intricacies of technological progress. Envisioning the integration of tradition and technology, the narrative unfolds a future where the advantages of digital horticulture, fueled by IoT and AI capabilities, contribute to a thriving ecosystem. This harmonious coalescence of innovation and tradition resonates as a melody echoing through time.In conclusion, this presentation invites readers to envisage a world where technology seamlessly integrates into subtropical horticulture, promising endless possibilities for growth and transformation. This future, far from an idealistic notion, stands poised to unfold, with the catalysts for change already set in motion.

12.1.9 Value Change Management in Banana for Domestic Market and Export

K.B. Patil and Yogesh Patel
Jain Irrigation Systems limited, Jalgaon, Maharastra
Email: patil.kalyansing@Jains.com

With growing global and domestic demand for high-quality, safe bananas, there is a pressing need to develop production system management that maximizes the yield of superior produce.This approach not only satisfies consumer expectations but also ensures lucrative returns for banana producers.At Jain Irrigation Systems Limited, we have pioneered a strategic value chain management system tailored to these needs.Our system offers a comprehensive guide that encompasses selecting optimal locations, utilizing tissue culture planting materials, and implementing effective mat and bunch management practices.Our modern methodologies extend to advanced water and nutrient management systems, and meticulous processes for harvesting, handling, de-handling, washing, hygienic packaging, ripening, and delivery to the customer.This system guarantees exceptionally high-quality fruits to consumers and significant income for farmers by addressing every link in the production-to-consumer chain concurrently, benefiting all stakeholders involved in the value chain.Furthermore, we have digitised the entire system and adhere to best agricultural practices to ensure product safety and traceability.We are also in the process of integrating blockchain technology to bolster consumer confidence.The use of automation, drones, and robotics for various operations underscores our commitment to cutting-edge technological integration.Our upcoming presentation will highlight this ideal value chain model for bananas, setting a benchmark in the industry.The structure for clarity and impact, emphasizes the advanced technologies and comprehensive strategies implemented by your company.

Keywords: JISL, export of banana, value chain management, production system in banana, drones and robotics, block chain technology

12.2 Oral Presentation

12.2.1 Evaluation of the Fruit Characteristics of Some Accession of Palmyrah Palm Grown in Pandirimamidi of Andhra Pradesh

P.C.Vengaiah* K.R. Prasad, S. Sumitha, and B.A. Jerard
ICAR-AICRP Palms,
Dr. YSRHU-HRS, Pandirimamidi, Andhra Pradesh
Email: pcvengaiah@gmail.com

Palmyrah (*Borassus flabellifer* L.) belongs to family Arecaceae has great economic potential and every part of the palm is useful in one way or other.The inflorescence sap, tender fruits, fruits, tubers of palmyrah palm are used as food and trunk, leaves, petiole, leaf base and roots are used for making various non edible products. It is grown as wild, without much care needed, and can be grown in agricultural field bunds and wastelands as fence or demarcation of land.Very few or no data available on the fruit characteristics of Palmyrah palm as palms grown in wild.Only ICAR-AICRP centres were cultivating systematically and observing data. The data from HRS Pandirimaidi germplasm may be useful further research as well as value addition work in palmyrah palm.

From the results, it may be concluded that the few accessions were found best regarding fruit weight, pulp weight, the weight of peel etc.The findings can be used to develop an index for the selection of best accession in breeding programmes in the future.

Keywords: Palmyrah palm, accession, fruit characteristics

12.2.2 Optimization and Characterization of Pectin Extracted from Palmyrah Palm(*Borassus flebellifer* L.) Fruit Pulp using Response Surface Methodology

P.C. Vengaiah* K.R. Prasad, S. Sumitha, and B.A. Jerard
ICAR-AICRP Palms, Dr.YSRHU-Horticultural Research Station,
Pandirimamidi – 533 288, Andhra Pradesh, India
Email: pcvengaiah@gmail.com

Palmyrah palms is wild and naturally available everywhere in southern India and massive amount of fruit pulp generated with nutritionally rich. Pectin is a polysaccharide that is isolated from fruits and has been attributed to various applications in food and other industrial use. By proper utilization of wild fruits and the use of efficient methods for retrieval of pectin from fruit would benefit from resource management.This study has aimed at the extraction of pectin from palmyrh fruit pulp. Pectin extraction from palmyrah fruit pulp was done by hot water extraction.The influence of temperature, time, and pH on extraction yield and anhydrouronic acid content was analyzed using software. The optimum operating conditions such as temperature, time, and pH to achieve maximum yield (13.46%) and anhydrouronic acid (71.27%) were determined as 75°C, pH 2.5, and 55 min, respectively.Physicochemical assets of the extracted pectin, such as moisture, ash, protein, degree of esterification, and acetyl value, were determined as 7.6 ± 0.24%, 5.40 ± 0.64%, 3.26 ± 0.04%, 71.24 ± 0.03% and 0.46 ± 0.12%, respectively

Keywords: anhydrouronic acid, hot water extraction, palmyrah, pectin

12.2.3 Development of Lemon Grading Protocol through Image Processing Technique

G.D.Gohil, P.R.Davara and G.S.Kharadi
Dept.of Processing and Food Engineering
College of Agricultural Engineering and Technology
Junagadh Agricultural University, Junagadh – 362001 (Gujarat, India)
Email: gunvantsinh@jau.in

The grading system provides various pieces of information, encompassing size, color, shape, defects, and internal quality.The objective of the proposed research is to categorize lemons of varying sizes and colors into three main groups: Immature stage, Intermediate stage, and Mature stage.The research is conducted in three phases: the creation of a lemon dataset, derivation and analysis of features, and grading simulation.To create the lemon dataset, images of lemon samples are captured in a controlled environment, adhering to constraints such as capture height, background color, resolution, and views. The simulation is implemented using the MATLAB environment.Image pre-processing operations, including image binarization and cropping, are applied to the selected samples.Feature extraction is performed on the cropped lemon images, and based on these features, thresholds are derived for grading lemons according to size: small (<=183), medium (>183 &&<=240), and large (>240).Additionally, color-based classification is carried out, defining immature lemons with rH>16, intermediate state lemons with 0.6<rH<16, and mature lemons with rH<=0.6. The developed protocol successfully grades lemons into different classes, meeting commercial requirements.This methodology provides an effective means of classifying lemons based on both size and color, contributing valuable information for various applications.

12.2.4 Utilization of Different Agricultural Wastes for the Cultivation of Oyster Mushroom (*Pleurotus Sajor Caju*)

S.V.Lathiya*, J.R.Talaviya, J.C.Dhingani, U.M.Vyas and D.S.Kelaiya
Department of Plant Pathology, College of Agriculture, JAU, Junagadh, Gujarat
Email: svlathiya@jau.in

Oyster mushroom is probably most suitable fungus for producing protein rich food from cellulolytic wastes with simple cultivation technology.Moreover its capacity of growing on any type of ligno cellulosic substrate without any prior treatment of base materials gives it an advantage over other cultivated mushroom, where aerobic fermentation of substrate is pre-requisite.Nutritions provided by the substrate is the single most important factor affecting the nutritional and biochemical properties of mushrooms.Considering this in the proposed experiment, effect of different seven wastes as substrate for mushroom cultivation will be evaluated for its direct or indirect effect on nutritional and biochemical properties of oyster mushroom (*Pleurotus sajor caju*).The five per cent spawn rate and three kg sugarcane substrate gave higher sporophore production (1065.11 g) and biological efficiency (35.50 %) of oyster mushroom (*Pleurotus sajor-caju*) compare to the other waste product used as a substrate.Sporophore produced with sugarcane bagasse substarate contain higher amount of Total soluble sugar (9.54%), total protein (7.75%) and crude fiber (0.75%) compare to the other treatments.Therefore,For the higher sporophore production (biological efficiency) with better nutritional and biochemical properties of oyster mushroom (*Pleurotus sajor-caju*) use the sugarcane bagasse as substrate with 5 per cent spawn rate.

12.2.5 Enhancing the Sales Potential of Prickly Pear Juice Through Enzymatic Clarification

P.R. Davara, A.K.Varshney, V.P. Sangani
Dept.of Processing and Food Engineering
College of Agricultural Engineering and Technology
Junagadh Agricultural University, Junagadh – 362001 (Gujarat, India)
Email: prdavara@jau.in

Prickly pear juices are considered as valuable ingredient for sports and energy drinks due to its higher amino acids contents and minerals.In addition to this, prickly pear juice is also considered as valuable source for enhancing colour in fruit juice blends.Theclarity of juice is a basic quality requirement from the consumers' point of view.The research work was carried out to standardize the process technology for extraction and clarification of prickly pear juice for enhancing its sales potential.The procedure was standardized for the extraction of prickly pear juice and processing parameters were optimized for improving the clarity and appearance through enzymatic clarification.The process parameters *viz.,* enzyme concentration, incubation temperature, and incubation time were optimized through response surface analysis.The enzymatic treatment increased the juice yield, clarity, TSS content, overall acceptability and decreased its viscosity as well as turbidity.The optimum treatment conditions were found to be, 0.056% enzyme concentration, 47 °C incubation temperature, and 155 min incubation time.The developed process is suitable for producing the clear and stable fruit juice by preventing the separation of juice into two layers thus eliminating the 'shake before drinking'.Improved clarity and appearance of prickly pear juice will enhance its sales potential and fetch the better prices in the market.

12.2.6 Effect of Foliar Application of Biostimulants and Silicon on Post-harvest Parameters of Mango (*Mangifera indica* L.) cv.Kesar

Jigar M.Aal[1], K.M.Karetha[2], K.R.Ganvit[3] and K.R.Zala[4]
[1]Department of Fruit Science, [2]Department of Post-Harvest Technology, [3]Department of Agronomy, [4]Department of Floriculture and Landscape Architecture, Junagadh Agricultural University, Junagadh, Gujarat
Email: jigardesai57@gmail.com

The present investigation entitled "Effect of foliar application of biostimulants and silicon on post-harvest parameters of mango (*Mangifera indica* L.) cv.Kesar" was carried out at Fruit Research Station, Sakkarbaug, Junagadh Agricultural University, Junagadh during 2020-21 and 2021-22.The experiment was laid out in Randomized Block Design with Factorial concept consisting two factors with three replications.The treatment comprised with biostimulants *viz*., without biostimulant, humic acid (1.5 %), panchagavya (3 %), seaweed extract (0.2 %), novel organic liquid fertilizer (2 %) and silicon *i.e*., without silicon, potassium silicate (0.2 %) and orthosilicic acid (0.2 %). The results of the study indicated that among the different biostimulants application of humic acid 1.5 % and among the different silicon application of potassium silicate 0.2 % was recorded with maximum fruit firmness (4.41, 4.54 and 4.47 kg/cm^2), marketable fruits (20.91, 21.56 and 21.24 %), shelf life (13.32, 13.42 and 13.37 days) and minimum physiological loss in weight (13.27, 12.85 and 13.06 %), spoilage (82.06, 81.78 and 81.92 %) was recorded during the year 2020-21, 2021-22 and in pooled analysis.It can be concluded that for improved post-harvest parameters with foliar application of humic acid 1.5 % along with potassium silicate 0.2 % at initiation of flowering, pea and marble stage.

Keywords: Biostimulants, Silicon, Mango, Kesar, Post-harvest

12.2.7 Boosting Market Potential by Standardizing Drying Conditions for Green Chili Powder Production

V.P.Sangani[1], V.S.Kachhadiya[2], J.N.Koshiya[3], H.D.Sakhiya[4]and P.R.Davara[5]
1 and 5, Assistant Professor, Department of Processing and Food Engineering, CAET, JAU Junagadh, Gujarat (India)
2,3,4, B.Tech.Scholar, College of Agricultural Engineering and Technology, JAU, Junagadh
Email: vpsangani@jau.in

Green chilli *(Capsicum annuum L.)* is a highly versatile crop that serves multiple purposes, including food, ornamental decoration, and traditional medicine, owing to its rich nutritional profile.It contains 108 mg of ascorbic acid per 100 g of edible portion, making it a vital source of this essential vitamin.Drying green chilli powder is an effective means of preserving this seasonal vegetable and making it available to consumers throughout the year.In this study, green chilli fruits were blanched in hot water at a fixed temperature of 80°C for 1 min before being dried at varying temperatures (50°C, 55°C, and 60°C) and different thicknesses of chilli paste (2mm, 3mm, 4mm, and 5mm).The green chilli paste was dried in a tray dryer at three different temperatures and1.0 m/s air velocity. The objective of the experiment was to investigate the impact of the drying temperature and paste thickness on the quality of the dried green chilli powder.The findings showed that drying at 55°Cwith a thickness of 2mm chilli paste yielded the highest quality dried green chilli powder, with optimum levels of ascorbic acid, chlorophyll, and capsaicin content and the highest sensory

score.Therefore, this study recommends the combination of blanching at 80°Cfor 1 min and drying at 55°Cwith a 2mm thickness of the dried chilli paste as the most suitable treatment for producing high-quality dried green chilli powder.

12.2.8 Effect of Blanching Time, Slice Thickness and Drying Temperature on Antioxidant Activity and Curcumin Content of Turmeric Rhizome(*Variety Salem*)

Ravina G.Parmar[1] and Mukesh N.Dabhi[2]
Processing and Food Engineering Department, College of Agricultural Engineering and Technology, Junagadh Agricultural University, Junagadh –362001
Email: mndabhi@jau.in

Freshly harvested turmeric rhizomes of Salem variety were procured from a farmer's field.Turmeric rhizomes were cleaned, peeled, and sliced to 2, 3, 4, 5, and 6 mm thickness.Sliced turmeric rhizomes were blanched at 100 °Cfor 15, 30, 45 and 60 min in autoclave.These blanched turmeric rhizomes sliced were further dried in a tray dryer at 30, 40, 50, 60 and 70 °C temperature.Effect of slicing, blanching and drying temperature on antioxidant activity and curcumin content were evaluated.Response surface methodology was used for analysis.It was found that linear terms of blanching time, slice thickness and drying temperature were affected significantly for antioxidant activity and curcumin except drying temperature was not significant for curcumin content.Interactions effect of all three variables were non-significant for antioxidant activity and curcumin.Quadratic effect of blanching time was negatively significant for antioxidant activity whereas quadratic effect of all the three variables were negatively significant for curcumin content of the dried turmeric rhizomes.

Keywords: Drying, Turmeric, Blanching, Slice, Antioxidant activity, Curcumin

12.2.9 Evaluating the Suitability of Different Rose Genotypes for Value Addition

Ganesh B. Kadam#, T.N.Saha, D.V.S. Raju, S.P. Jeevan Kumar and K.V. Prasad
ICAR-Directorate of Floricultural Research, Pune, Maharashtra
Email: ganesh.kadam@icar.gov.in

Rose is important flower crops grown for loos flower and cut flower production.The area under open field cultivation of roses is increased and there is demand for varieties suitable for cultivation under open field conditions.Therefore thirty rose (*Rosa* × *hybrida* L.) genotypes were evaluated for important economical traits under open field conditions.The taller plants were recorded in genotype Rose Sherbet (156.8 cm), followed by Edward (154.8 cm), Folklore (147.3 cm), Acc No 3 (132.2 cm), Juleshwari (120.0 cm), Queen Elizabeth (117.6 cm) Kakinada (116.3 cm), Acc No 5 (116.1 cm) and Pusa Alpana (114.7 cm).Similarly wide spread plants and good branching were observed in genotypes Rose Sherbet (218.3 cm and 19.89), Acc No 3 (219.9 cm and 22.44), Kakinada (211.1cm and 11.44) and Edward (251.0 cm and 25.00).

Based on the flower characteristics like flower colour, number of petals and perpetual flowering ten genotypes (Local Accession-1, Local Accession-3, Local Accession-4, Edward, Rose Sherbet, Neptune, Night Time, Royal Canadian, Pusa Bahadur and Christian Dior) were taken forward to evaluate for value

addition purpose.The biochemical parameters like Anthocyanin (mg/l), total Flavonoids (mg/g), total Phenols (mg GAE/g), antioxidant activity (%), protein (mg/g), TSS (°Brix), moisture (%) and ash (%) was estimated.Based on the estimation of biochemical parameters genotype Rose Sherbet were found to be with higher anthocyanin content (68.29 mg/l)and antioxidant activity (66.53 %) and also found rich in total phenols (33.97 mg GAE/g) content.Genotype Local Accession-4 were found to be rich in total flavonoids content (8.65 mg/g).Royal Canadian genotype found with maximum content of protein (2.99 mg/g) and TSS (10.48°Brix).The value addition in rose is an important avenue for entrepreneurship development in rural youth.

Keywords: Rose, value addition, morphological traits, biochemical

12.2.10 The Influence of Amberlite XAD-16 Adsorbent on Bitterness and Sensorial Quality of Pummelo Fruit Syrup

Md.Shamsher Ahmad*, M. Preema Devi[1], Prodyut K. Paul[1], N. Bhowmick[1], N.Sahana[2], L. Hemanta[3] and M.W. Siddiqui

Department of Food Science and Postharvest Technology,
BAC, BAU, Sabour, Bhagalpur (Bihar)- 813210
[1]Department of Pomology and Postharvest Technology,
Faculty of Horticulture, UBKV, Pundibari, Cooch Behar (WB)-736165
[2]Department of Biochemistry, Faculty of Agriculture,
UBKV, Pundibari, Cooch Behar (WB)-736165
[3]Department of Horticulture, School of Agricultural Sciences and Rural Development,
Nagaland University, Nagaland – 797106
Email-shamsher73@gmail.com

Pummelo (*Citrusgrandis* (L.) Osbeck, is an important underutilized fruit crop grown mainly in the states of North Eastern region of the country.The fruit is an excellent source of many health promoting compounds and pharmaceutical ingredients.However, consumers dislike to consume fresh juice and processed products of pummelo juice due its intense bitterness.The main bittering compounds present in the pummelo juice are flavonoids (naringin, responsible for immediate bitterness) and limonoids (limonin, responsible for delayed bitterness) found in the fruit itself and get extracted along with the juice during juice extraction.The presence of bittering compounds is the major problem of people's dislike and a limiting factor for commercialization of processed products prepared from pummelo juice.The present investigation was therefore, aimed at reducing bitterness of juice by using adsorbent Amberlite XAD-16 prior to preparation of pummelo fruit syrup and evaluation of sensorial quality of the same.Treatment with Amberlite XAD-16 resin was found to be very effective in removing the bitterness from pummelo fruit juice.A 40% reduction in naringin and 88% reduction in limonin was recorded.It was interesting to note that Amberlite XAD-16 was more prominent in reducing limonin mediated delayed bitterness as compared to naringin mediated immediate bitterness.

Keywords: Pummelo fruit syrup, debittering, Amberlite XAD-16, sensorial quality

12.3.1 Poster Pressentation

12.3.1 Non-destructive Methods for Quality and Safety of Spices-a Review

Sachin A.J.*, Swapnil Bharti, R.B.Verma, Paramveer Singh and Avanish Kumar Singh
Department of Horticulture, Bihar Agricultural University, Sabour Bhagalpur, Bihar- 813210
sachinaj@bausabour.ac.in

Since ancient times, spices have been used in cooking and are regarded as a vital food source for phytochemicals that have both flavouring and therapeutic properties.Being a commercially important commodity the export and import of spices have opened doors for global business.One of the major commodities susceptible to food fraud and adulteration is spices.The necessity for spice authentication has grown as customer concerns about food safety and quality have increased.Authentication is a useful weapon in the fight against various forms of spice adulteration in the supply chain.The accepted laboratory analytical testing procedures for spices are both time-consuming and destructive.To overcome these restrictions, a look at non-destructive quality testing procedures that are both quick and exact has gained momentum in recent times.Non-destructive methods like spectroscopy, acoustic and ultrasound techniques, artificial sensing techniques (electronic tongue, nose and vision), data analytics and chemometric analysis have helped to authenticate the spices due to their feasibility and ease of operation.Spectroscopy examines electromagnetic radiation from substrates to identify their qualities, whereas artificial sensing replicates human sensory responses mechanically.Acoustic and ultrasound techniques determine the quality of spices by reflecting the sound waves similar to the absorption and reflection of light waves.This review discusses non-destructive quality testing methods for authenticating spices, including ascertaining provenance, identifying adulterants, and detecting impurities.

Keywords: e-sensing, Non-destructive, Quality, Spectroscopy, Spices

12.3.2 Pre-harvest Application of Methyl Jasmonate on the Quality and Storability of Mango (*Mangifera indica* L.) cv.Bombay

Zeenat Praween[1], Ankur Kumar Rai[1], Samik Sengupta[1], Manoj Kundu[1&2] and M.A.Aftab[1]
[1]Department of Horticulture (Fruit and Fruit Technology)
Bihar Agricultural University Sabour, Bhagalpur, Bihar, 813210
[2] Department of Fruit Science, College of Horticulture & Forestry, Rani Lakshmi Bai Central Agricultural University, Gwaliar Road, Jhansi, Uttar Pradesh, Pin -284003
Email: samik.sengupta@rediffmail.com

India is the largest producer of mango in the world.But the production of mango in the glut during peak harvesting period makes it less profitable to the grower as it is highly perishable in nature.Therefore, improvement of shelf life with better quality is one of the important challenge under the current scenario.Hence, an experiment was conducted to study the effect of pre-harvest application of methyl jasmonate on fruit quality and shelf life of mango cv.Bombay during 2022-23.It was observed that fruit weight increased significantly in pre-harvest application of 2.0 ppm methyl jasmonate at 20 days before harvesting (average wt.193.23 g) followed by 1.5 ppm spray of methyl jasmonate.Similarly, TSS, ascorbic acid, phenol and carotenoid content were recorded significantly higher in pre-harvest application of 2.0 ppm methyl jasmonate at 20 days before harvesting (20.35 °B, 40.63 mg 100 g-1 FW, 55.89 mg GAE g-1

FW and 4.82 mg 100 g-1 FW respectively), followed by 1.5 ppm methyl jasmonate spray of the same.Further, it was also observed that all the yield and fruit quality attributes increased significantly over control with the increasing concentration of methyl jasmonate up to 2.0 ppm and with further increase of methyl jasmonate concentration beyond 2.0 ppm, the same started to deteriorate.In addition, it was also observed that physiological weight loss as well as decay loss increased significantly with the increase in days of storage irrespective of treatment variation including control under both ambient and modified atmospheric packing condition (MAP); although decay loss started at 6^{th} day of storage under MAP condition while it was started to initiate from 9^{th} day of storage in ambient condition.Under ambient storage condition, TSS and total sugar content increased up to 6^{th} day and started to reduce thereafter, and on 6^{th} day it was recorded maximum in 2.0 ppm methyl jasmonate spray (23.26 °B and 16.88%, respectively) with at par value in 1.5 ppm spray (22.29°B and 16.11%, respectively).However, under MAP condition, these two parameters remain same till 12^{th} day of storage in 2.0 ppm spray of methyl jasmonate.Other fruit quality attributes such as ascorbic acid, total phenol and carotenoid content decreased gradually with the increasing days of storage.However, the rate of reduction of these parameters under MAP storage condition were significantly lower with 2.0 ppm methyl jasmonate treatment as pre-harvest spray.Hence, it can be recommended that pre-harvest application of 2.0 ppm methyl jasmonate at 20 days before harvesting is suitable for improving the yield, quality and shelf life of mango cv.Bombay significantly.

Keywords- Methyl jasmonate, deteriorate, physiological weight loss.

12.3.3 Long-Term Storage Strategies for Maximizing the Sales Potential for Prickly Pear Juice

P.R. Davara, A.K.Varshney and V.P. Sangani

Dept.of Processing and Food Engineering

College of Agricultural Engineering and Technology

Junagadh Agricultural University, Junagadh – 362001 (Gujarat, India)

Email: prdavara@jau.in

Prickly pear is a non-climacteric fruit and highly perishable.High pH and low acidity of this fruit make it more susceptible to microbial spoilage.Therefore, it is crucial to find methods to extend its shelf life.Limiting or preventing the growth of undesirable microbial flora in food products is one of the main goals of food preservation.The aim of the present study was to improve the shelf life of the clarified prickly pear juice and to study the physico-chemical and microbial changes during its storage.Effect of sterilization and sodium benzoate levels were evaluated in the study.The enzymatically clarified prickly pear juice was acidified and pasteurized at 95 °C for 20 min.The juice was added with sodium benzoate at different levels, filled in the glass bottles and sterilized at 121 °C for 10 min.The bottles were then stored for a period of 90 days at room temperature.The preservation of prickly pear juice after acidification with 0.1% citric acid followed by pasteurization at 95 °C for 20 min and addition of 200 ppm sodium benzoate was found to be suitable for extending the shelf life of the juice stored at room temperature in airtight condition for a period of 90 days.The developed process protocol for the increasing the shelf life of prickly pear juice will provide the opportunity to the entrepreneurs for maximize its sales potential through long term storage of juice.

12.3.4 Influence of Thermal Processing on Bioactive Retention in Selected *Cole Crops*

Alka Joshi[1], Darshayeeta Baruah[2], Anamika Thakur[1], Dinesh Kumar[1] and B.S. Tomar[3]
[1]*Division of FS & PHT, ICAR-IARI, Pusa, New Delhi, India*
[2]*Amity Institute of Food Technology, Amity University, Noida, India*
[3]*Division of Vegetable Sciences, ICAR-IARI, Pusa, New Delhi, India*
Email: alka.foodtech@gmail.com

Bioactive rich cole crops from brassicaceae family are well known and acceptable functional foods.For consumption, they are generally thermally processed which can alter the availability of bioactive compounds.To identify the best way of their processing and utilization in daily diet, a study was conducted in ICAR-IARI, Pusa, New Delhi.Coloured varieties of cabbage and broccoli namely 'Pusa Purple Cabbage -1 (PPC-1)' and 'Pusa Purple Broccoli -1 (PPB-1)'were compared with their commercial counterparts (control) for various antioxidant determinants.Under this study, effect of different processing techniques such as steam and water blanching, boiling, pressure cooking, atmospheric and air-frying, sautéing, grilling and microwaving on retention of antioxidants on these crops was assessed. Commercial importance of these crops is due to water-soluble anthocyanin pigment which is known for its GRAS status and helps in managing type-2 diabetics. Anthocyanin imparts attractive purple colour to cabbage head and broccoli curd.For coloured cabbage, anthocyanin was retained maximum in air-fried (84.38%), followed by grilled (74.35%), microwaved (71.69%) and sautéed (53.50%) cabbage.However, pressure cooking of coloured cabbage was least effective for bioactive retention (21.07%) in coloured cabbage.In case of coloured broccoli, anthocyanin was retained maximum when microwaved (86.68%), followed by air-fried (71.13%) and water blanched (63.11%), however, degraded maximum when fried (6.68%).In nutshell, dried cooking method such as air-frying and microwaving were found the best for maximum retention of bioactives in these crops which were validated through DPPH and CUPRAC activity quantified through ELISA plate reader.

Keywords: Processing method, Broccoli, Cabbage, Anthocyanins, Utilization, Bioactives

12.3.5 Performance Evaluation of Solar Tunnel Dryer for Local Spices

S.P. Cholera[1], M.S. Dulawat[2], G.V.Prajapati[3], P.M. Chauhan[4] and M. Ramani[5]
[1,3,6]*AICRP on PEASEM, Dept.of REE, College of Agril.Engg.& Tech, JAU, Junagadh*
[2,4]*Department of REE, College of Agril.Engg.& Tech, JAU, Junagadh*
Email: prajapati_girish@jau.in

India is one of the largest producers of spices in the world.Spices are also important foreign exchange earner for India.Drying of spice crops are very essential to remove excess moisture from the outer skin and neck to reduce storage rot and its shelf life also it's easy to use in dried form. Demand of dried spices is increasing all over the world. In India drying of spices is generally done by open sun drying. The initial moisture content of the spices is the main factor behind the post-harvest losses and open sun drying is the oldest technique that preserve the products by reducing the moisture contents.The reduced moisture content of agricultural products not only slow down the deterioration, but also increases the safe storage period.The main drawback behind the open sun drying is that the products remain unprotected from the environmental conditions like rain, dust, dirt, and infestation by birds and animals.All these factors affect the quality of food and sometimes the quality is degraded to an extent that it becomes inedible.The loss in quality of dried products affect market value and consumer acceptance.Solar tunnel dryer may be an alternative for rural

people to reduce the storage losses by drying their produce in a controlled and better environment.The performance evaluation of solar tunnel dryer was carried out under no load condition and load condition for turmeric and chilly drying and compared with sun drying method.It was observed that it reduce the drying time, drying space, minimize post-harvest losses during drying and handling, better quality as well as more recovery of the dried spices as compared to traditional sun drying method. They are also benefitted to fetch more market prices and get higher economic returns of their dried spices as compared sun drying method.

Keywords: Solar tunnel dryer, Chilli drying, Sun drying, Spices

12.3.6 Design and Development of Open-Core Downdraft Gasifier for Biochar Production and Gaseous Fuel

S.V. Kelaiya, J.M. Makavana, P.M. Chauhan and P.N. Sarsavadia
Department of Renewable Energy Engineering,
College of Agricultural Engineering and Technology
Junagadh Agricultural University, Junagadh, Gujarat, India -362 001

In this investigation, the researchers designed and developed an 80 MJ/h downdraft gasifier reactor and examined the gasification process of shredded cotton stalks.To assess the gasifier's performance, trials were conducted at flow rates of 18 m^3/h, 20 m^3/h, 22 m^3/h, and 24 m^3/h, respectively.The findings indicated the optimal performance of the gasifier at 22 m^3/h with an equivalence ratio of 0.32.Gasification efficiency was recorded at 75.59%, with a specific gasification rate of 192.32 kg/hm^2.Moreover, the specific gas production rate was determined to be 554.16 m^3/hm^2.The gasifier yielded residual biochar totaling 24.91%, condensed liquid of 35.23 g/Nm^3, and exhibited a calorific value of 1087.33 kcal/m^3.The fuel consumption rate was calculated at 7.64 kg/h.These results suggest that shredded cotton stalks hold potential as fuel in throatless downdraft gasifiers, leading to the generation of producer gas.

Keywords: *Biomass, Gasification, Biochar, Open core downdraft gasifier, Cotton stalk*

12.3.7 Preparation of High Protein Fasting Products using Extrusion Technology

P.P. Vora, S.P. Cholera and P.R. Davara
JAU, Junagadh, Gujarat

The present investigation is undertaken to develop extruded snacks for fasting purpose by utilizing peanut, amaranth, barnyard and tapioca pearls as a raw material.

Experiment conducted to optimize the proportions of defatted peanut flour, amaranth flour, barn yard flour and tapioca flours in the preparation of extruded products. The extruded products for optimized flour proportion were prepared by keeping the feed moisture content (16%), feeder temperature (60°C), barrel temperature (100°C), die temperature (135°C) and screw speed (250 rpm) at constant level. The optimized flour proportion was 18.33% defatted peanut, 22.96% amaranth, 10% barnyard and 48.71% tapioca based on sensory parameters. Experiment trials were again carried out to optimize the process parameters, viz.feed moisture content, screw speed and die head temperature by taking the flour proportion as optimized in the experiment for optimizing the flour proportion. The effect of feed moisture content (12,13,15,17,18 %), die head temperature (90, 102, 120, 138 & 150 !) and screw speed (200, 220, 250, 280, 300 rpm) on different machine and physicochemical characteristic of extruded product and overall acceptability was studied. Response Surface Methodology (RSM) was used in designing the experiment and optimization of processing parameters.

The optimized treatment condition was found to be, 131.73 E" 132°C die temperature, 255.19 E" 255 rpm screw speed and 14.43 E" 14 % feed moisture content. The analysis showed that an extruded product with torque of 21.17 nm, mass flow rate of 222.97 g/min, bulk density of 0.050 g/cm^3, expansion ratio of 4.31, moisture content of 8.68%, carbohydrate of 67.79%, protein of 16.24%, fat of 1.45%, ash of 1.43%, WSI of 10.69% WAI of 4.50 (g/g), hardness of 123.10 N, crispness of 354.95, calorific value of 349.23 kcal and overall acceptability of 7.55

***Keywords**: extrusion cooking, snack food, high protein*

12.3.8 Performance of Natural Convection type Solar Tunnel Dryer for Horticultural and Vegetable Crops

M.S. Dulawat[1*], K.C.Patel[2] and G.D. Gohil[3]

[1]Assistant Professor, Department of Renewable Energy Engineering, College of Agricultural Engineering & Technology, Junagadh Agricultural University, Junagadh (Gujarat), India-362001

[2]Director, IT Cell, Junagadh Agricultural University, Junagadh (Gujarat), India-362001

[3]Assistant Professor, College of Agricultural Engineering & Technology, Junagadh Agricultural University, Junagadh (Gujarat), India-362001

E-mail: dulawat@jau.in

This study assessed the efficacy of a semi-cylindrical walk-in poly house framed structure with UV-stabilized polythene covering.The study focused on the use of solar tunnel dryers, which significantly reduce the carbon footprint compared to conventional fossil fuel-based drying methods.The dryer's capacity of 250-300 kg was tested throughout the year for drying horticultural and vegetable crops such as garlic, chili, and spinach, based on their seasonal availability.It was observed that 15-30 ^{0}Cof higher temperature was obtained in solar tunnel dryer over the ambient temperature.A total drying time of 20 hours (2 - 2.5 Sunny days) was required for chilly drying to reduce the moisture content from 82.5 % (w.b.) to about 9.5 % (w.b.) compared to that of 46 hours (4-5 Sunny days) for open sun drying to obtain the same level of moisture contents resulting in a net saving in drying time of 56.52 per cent for solar tunnel dryer over open sun drying.The dryer reduces the moisture content of garlic from 64% (w.b.) to about 8.1% (w.b.) in 5 days and spinach from 85% (w.b.) to 7.6% (w.b.) in 3 days.The thermal efficiency of the dryer was found between 10.85 % to 19.75%.Additionally, products dried in the tunnel exhibited superior quality in terms of hygiene, microbial load, appearance, and acceptability compared to sun-dried counterparts.

Keywords: Solar Tunnel Dryer (STD), chilly, Horticultural, Vegetables, Solar dryer

12.3.9 Effect of Pre Harvest Applicaton of Hexanal and Salicylic Acid at Different Storage Temperatures on Fruit Quality and Shelf Life of Strawberry (*Fragaria ananassa*) CV.Winter Dawn

Ashok Sah[1], M. Madhavi[2], V. Sivakumar[3], P. Subbarammamma[4]
[1] M.Sc (Hort.), Department of Fruit Science, Dr.YSRHU, College of Horticulture, Venkataramannagudem, AP
[2] Associate Dean, Dr.YSRHU, College of Horticulture, Venkataramannagudem, AP
[3] Scientist (Hort.) and Head, Dr.YSRHU- Horticulture Research Station, Chintapalli, AP
[4] Associate Professor, Department of Plant Physiology
Dr.YSRHU, College of Horticulture Venkataramannagudem, AP
Email: ashoksah9558@gmail.com

Strawberry is one of the most liked fruits in the world due to its pleasant color, shape, aroma and vital source of many health promoting nutritious compounds.Inspite of having high demand from health aspect, it has shelf life only upto 4-5 days at normal room temperature and highly perishable and prone to postharvest losses.The investigation entitled **effect of pre harvest application of Hexanal and Salicylic acid at different storage temperatures on fruit quality and shelf life of Strawberry (*Fragaria ananassa*) cv.Winter Dawn** was carried out at Dr.YSRHU-College of Horticulture, Andhra Pradesh during the year 2023-24.The experiment was laid out in a factorial completely randomized design (FCRD) with three replications containing of ten treatment combinations which consists of two factors *viz*., pre harvest treatments at five levels (Control-Tap water, Hexanal 2mM, Hexanal 4 mM, Salicylic acid 2 mM, Salicylic acid 4 mM) sprayed two times i.e.15 days and 7 days before harvesting and storage temperatures at two levels (3 ºC and 6 ºC temperatures).The results showed that fruits treated with Hexanal 4mM (EFF 0.04%) and stored at 6ºC had prolonged storage life (20 days) as compared to control (12 days).Hexanal 4mM treated fruits stored at 6ºC maintained various quality attributes of strawberry fruits such as physiological loss in weight (20.46%), decay incidence (62.50%), firmness (3.26 kg/cm^2), TSS (6.98°Brix), titratable acidity (0.56%) total sugars (7.31%), ascorbic acid content (35.46 mg/100 g), total anthocyanins (22.21 mg/100 g), total phenolic content (295 mg GE/100 g) and antioxidant activity (26.29 %) at 20 days of storage.Hence from the above experiment it is concluded that pre harvest application of hexanal @4mM along with storage temperature of 6ºC can be used as an effective alternative for enhancing fruit quality and shelf life of strawberry.

Keywords: *Strawberry, shelf life, hexanal, salicylic acid, decay incidence*

TECHNICAL SESSION-13 (HALL NO. 1)
OPEN SESSION FOR KNOWLEDGE SHARING ON INTERNATIONAL POTATO DAY

On May 30th, we will celebrate the **International Day of Potato**, designated by the United Nations General Assembly in December 2023.This special day aims to raise awareness of the potato's multiple nutritional, economic, environmental, and cultural values, highlighting its role as an invaluable food resource and a source of income for rural families.The potato, a native crop of the Americas, has grown in importance globally, adapting to varied climates and soils, making it a versatile staple in numerous countries.Its cultivation requires less water than other major crops, positioning it as a sustainable choice in the face of climate challenges.Today, we not only celebrate the potato for its adaptability and nutritional value but also for its potential to strengthen food security and support sustainable development.Let us spread the word about this remarkable tuber on the International Day of Potat

13.1 Keynote Lecture

13.1.1 Digital Approaches for Seed Production of Potato

B.P. Singh
Ex-Director, Central Potato Research Institute Shimla & Sr.Consultant, Jain Irrigation Systems Ltd, Jalgaon
Email: birpals53@gmail.com

Like any other crop system, the potato seed crop requires both specific and general management practices to be efficient and cost-effective.The process begins with identifying suitable areas for both ware and seed crops, determining crop duration and scheduling, and selecting varieties to prevent admixture.It also involves the development and use of Precision Agriculture Tools for timely application and optimization of various inputs, disease management, vector control, and addressing issues related to pre and post-harvest operations, traceability, and storage.Knowing the optimal planting date, the most suitable variety, and the expected yield at different harvest dates is crucial for farmers to plan their planting and harvesting schedules, as well as choose which varieties to grow.Gathering this information through field experiments in diverse agro-climatic conditions is challenging.Below, we discuss digital agriculture approaches that address some of these issues.The first phase involves using the Viola-Jones algorithm on filtered action camera images to detect separate potato tubers on a conveyor belt.The second phase uses a method based on video capturing, employing Scale Invariant Feature Transform (SIFT) and Support Vector Machine (SVM) to isolate damaged tubers.Other variants have been developed for similar purposes.These new digital tools offer hope in reducing post-harvest losses.The Digital Agriculture Revolution is distinct from the previous three revolutions, which impacted production technologies, as it applies to the entire food chain.Paper explores use of digital technology in production of potato seeds.

14. TECHNICAL SESSION-14 (HALL NO.-1)

KNOWLEDGE EMPOWERMENT OF FARMERS THROUGH QUIZ.

The purpose of this session is to engage and stimulate the minds of farmers through strategic interactions focused on farm-related matters, facilitated by a quiz format.This interactive quiz is designed to enhance farmers' knowledge and understanding of crucial agricultural practices and concepts.The quiz will be conducted by professionally trained experts and overseen by observers to ensure a productive and informative experience for all participants.

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