Azadi Ka Amrit Mahotsav

CSAUAT, Kanpur
May 28-31, 2022

Book of Abstracts

National Conference on Climate Resilient and Sustainable Development of Horticulture

H.P. Singh • D.R. Singh • Babita Singh • H. Choudhary • J.S. Parihar

Organised By

Lt. Amit Singh

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14th Swadesh Prem Jagriti Sangosthi - 2022

National Conference on Climate Resilient and Sustainable Development of Horticulture

28-31 May, 2022
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Chandra Shekhar Azad University of Agriculture & Technology (CSAUA&T)
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चन्द्रशेखर आजाद कृषि एवं प्रौद्योगिक विश्वविद्याल
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Preface

Horticulture comprises, Fruits, Vegetables including tubers, floriculture, Spices, Plantation, Medicinal and Aromatic Plants, has emerged as vital for the socio-economic development of the country, to ensure nutritional security, environmental services, employment generation, health care and above all effective and productive land use. The emerging trend worldwide and also in the country is indicative of a paradigm shift in dietary preference with health consciousness and rise in expandable income. This change is demanding more horticultural produce. A trend of horticulture is development in the past, particularly during the last two decades, has been satisfying. The adoption of horticulture crops in the systematic manner has improved the quality of life of people in many regions, as farm profitability increased. The current challenges to the horticulture are investment, capital access to technology and initial learning for the development of acquired skills. Attempts to address many of these issues were made through mission mode approach, which brought a revolution in horticulture, referred to as **Global Revolution**. The initiatives provided access to technology and markers to enhance income and attract educated youth to the horticultural farming, considering that, it is economically rewarding and intellectually satisfying. However, in the last few years climate change has become one of the threats in achieving the goal of enhance production to meet the needs of growing population. The challenge in horticulture, thus, is much more than before. Wherein, we have to produce more with declining land and water availability in the scenario of climate change. This calls for climate resilient and sustainable development of horticulture through technological intervention, innovation and skill up-gradation. Therefore, **ASM Foundation** in association with **Chandra Shekhar Azad University of Agriculture & Technology, Kanpur-208002, Uttar Pradesh** is organizing a four days conference on **Climate Resilient and Sustainable Development of Horticulture**" May 28-31, 2022. The conference at CSAUA&T, Kanpur will also have also collaboration of the JISL, Jalgaon, the CHAI, New Delhi and the TAAS, New Delhi.

The conference seeks valuable inputs from all the stakeholders, through knowledge sharing for developing strategic recommendations to develop policy framework and understand the current status of horticulture. The conference will also analyze likely impact of climate change on production and productivity of horticulture crops and how these challenges can be mediated through various technologies. Accordingly, the conference will address the challenge of livelihood for rural development through knowledge sharing on climate resilient horticulture for sustainable development. It is expected to enhance knowledge, identify technologically viable, futuristic research for improved livelihood options. 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 session, 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 optimum time for sharing their views with power point presentation, to encourage the opinion and innovations, individual 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 adjured by team of experts and selected one will be awarded. The conference will also host many other important activities namely, Horticulture Expo-2022, National Level Essay Competition, Farmers 'Quiz and Distribution of quality Seeds & planting material to the farming Community and the Conferment of Awards and Post Conference Tours. The *Shodh Chintan*, will be published, where, there is an opportunity for sponsorship as well as showcasing activities through advertisements and participation in the Exhibition.

Themes of the Conference are To Analyze of Past Trend in Innovations for Climate Resilient and Sustainable Development of Horticulture for Livelihood and Nutritional Security. Envisioning the Challenges and Tasks for Achieving the Innovative System to Sustain the Gains and have New Gains, Understanding Smart Management System for Effective Utilization of Resources Aimed at Improving Factor Productivity, Designer Crops and their Management for Improving the Sustainability and Enhancing Input Use Efficiency, Biotechnological Innovations for Enhancing the Horticultural Productivity., Innovative Technology to Address the Challenges of Horticulture , Climate Smart System for Adoption and Mitigation to Climate Change for Risk Management and Sustained Farm Income, Enhancing Productivity of Inputs through Innovations in Efficient Management of Horticulture, Developing Farming Practices and Technologies to Produce More with Less, Paradigms in Innovations and its Application for Climate Resilient Horticulture, Human Resource Availability and Strategic Approaches for Development, Strategies for Skill and Knowledge Empowerment of the Farmers

Expected Outcome are Enhanced Understanding on Techniques for Enhancing Production of Horticultural Crops with Less Land and Water and in the Scenario of Climate Change, Understanding of the Needs for Strategic Approaches and New Innovations for Sustainable Horticulture Development, Inputs for Policy Formulation on Resource Management for Shaping Future Sustainable Horticulture, Improved Farm Practices and Technologies for Enhancing Farm Output for Climate Smart Horticulture, Envisioning the Technological Changes and Innovations, which can Succeed in Achieving the Goals of Food and Nutritional Security, Identification of Technologies and Training Needs for Addressing the Challenges to Improve the Horticulture Productivity for Improving Farm Profitability, Integration of Approaches of Production and Marketing of Diversified Products, Developing Approaches for Innovative Development of Horticulture, Understand and Address the Need for Water quality and its Management in Horticulture.

The conference has been structured to deliberate and discuss the issues systematically through Plenary Lectures, Keynote Lecture, Oral and Poster presentations and finally adopt recommendations in the plenary session to provide policy guidance for its adoption to achieve accelerated growth of Indian agri-horticulture. The Plenary lectures will be delivered by reputed theme leaders in their respective field. Specific technical sessions include - Paradigms in Climate Resilient and Sustainable Development of Horticulture - Challenges and Options,Technological Challenges and Approaches for Climate Resilient Development of Horticulture, Innovations in Production Systems Management of Perennial Horticulture for

Climate Resilient and Sustainability, Innovations in Production System Management for Vegetables, Tubers, Spices and Flowers for Climate Resilience and Sustainability, Innovations for Climate Smart Production Systems in Horticulture for Resilience to Climate Change, Varietal Improvement for Resilience to Climate Change and Sustainability in Production, Water Management for Enhancing Resilience to Climate Change, Nutrient Management for Enhancing Resilience to Climate Change, Plant Health Management for Resilience to Climate Change and Sustainability in production, Human Resource Development and Diffusion of Knowledge for Technological Changes for Climate Resilient and Sustainable Development of Horticulture, Digital Horticulture for resilience to Climate Change and Sustainability, Post harvest management Access to Market and Value Chain Management for Sustainable Production of Horticulture Crops, Farmers' Participatory Discussion for Climate Resilient and Sustainable Development of Horticulture, Knowledge Empowerment of Farmers through Quiz, Student's Participatory Presentation and Discussion on Climate Resilient and Sustainable Development of Horticulture. Each technical session will have Keynote Lecture in thematic area followed by oral presentations of selected papers and poster presentations. The best oral and poster presentations will be adjudged by a committee and awards will be given in Plenary and Award function sessions.

This Book of Abstracts contains extended summaries of plenary lectures, abstract of keynote lectures, oral and poster presentations according to the theme area of technical sessions. These abstracts will provide insights into innovations for enhancing water productivity in agri-horticulture. The organizers would like to thank all the Keynote Speakers, Presenters and Poster contributors for their participation, support and submission of abstracts. I, as the Chairman of Local Organizing Committee would like to thank Dr. H.P. Singh, Chairman, CHAI and his team for compiling, editing and organizing the abstracts according to thematic area for its presentation in this Book of Abstracts. I am sure you will find this book informative and knowledge oriented as reference book. I also thank all those who have been associated in compilation and editing of this Book of Abstracts, directly or indirectly. I am confident that the Book of Abstracts shall be useful to all the stakeholders associated with enhancing water productivity in agri-horticulture ecosystem.

(D.R. Singh)
Vice-Chancellor,
CSA Univ. of Agric. & Tech., Kanpur
&
Chairman, Local Organizing Committee

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SUPPLEMENTARY ABSTRACTS

(Received late)

PLENARY SESSION-1

PARADIGMS IN CLIMATE RESILIENT AND SUSTAINABLE DEVELOPMENT OF HORTICULTURE - CHALLENGES AND OPTIONS

1.1 Plenary Lecture

1.1.1Climate Resilient and Sustainable Development of Horticulture-Options and Opportunities

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Agriculture often referred to as culture has played a critical role in the Indian economy and society for thousands of years, evident from sophisticated irrigation and water storage structures built in 3000 BC, during the Indus Valley Civilization. The Kallanai, an ancient dam built on the Kaveri River, around the first century AD, is considered the oldest in–use water regulating structure in the world. In fact, agriculture is deeply ingrained in the Indian cultural ethos. Since medieval times, agriculture has remained the predominant occupation of the populace. It satisfied a village's food requirements, besides providing raw materials for industries like textile, food processing, and crafts. During the late middle ages, till the start of colonial rule, construction of water works and improvement in irrigation techniques brought about economic growth. The colonial era was not particularly good for agriculture as it saw frequent famines and growth rate of 0.1 percent in production during 1900 to 1947. The country gained Independence a few years after the Great Bengal Famine (1942 to 1943), The agricultural scenario, post–Independence, was quite challenging and agriculture continued to remain the mainstay of the economy. Despite many initiative of the Government, growth in food production was inadequate to meet the consumption needs of the growing population and food imports became essential in India till the mid–1960s. India responded to the challenge by reorganising research and undertaking agricultural activities, creation of institutions, price support mechanism to the produce.

All these steps led to a quantum jump in the productivity of crops such as wheat and rice, a phenomenon christened the Green Revolution in 1968. The efforts continue to bear fruit today to put the progress since 1950 in perspective — food grain production has increased 6 times; horticulture 13 times, and oilseed and milk production is up six times. Organisational initiatives like Technology Missions were introduced, resulting in a rapid rise in horticulture production. Despite liberalisation, and the growth in services and manufacturing, the role of agriculture remains vital to the overall development and well–being of the nation accounting for a little over 13.5 percent of gross domestic product, and employing the largest proportion of the workforce (about 45.5 percent), agriculture remains a strong lever of growth for the Indian economy. Ensuring food and nutritional security becomes a challenging task, especially with increased nutritional intake, greater urbanisation, and stagnant (or declining) cultivable area. With stagnating production and increasing demand, guaranteeing food and nutritional security will continue to be a challenge. This will further strain the already–under–stress urban infrastructure. Finally, the widening income disparity between the non–agrarian and agrarian segments could cause social unrest. Therefore, we have to envision the challenges and options for food and nutritional security along with better aggravating economy.

The past revolutions (green revolution, white revolution, yellow revolution and Golden revolution together the rainbow revolution) have been possible due to technical interventions, new cultivars and production technology, which are also evident from the fact that area has remained static to 142±2 million hectare for the last 40 years, but production has increased manifold, not only of cereals but of all the agricultural produce, from the same land area. Pressure on the cultivable land for agriculture continues to be high as Indian agriculture supports 17% of world population and 11% of livestock only from 2.4% of global land and 4.5 % of water. At global level also, meeting the food and nutritional needs of population, which will be about 10 billion in 2050 is a cause of concern and is being debated across the globe. Looking into population growth, declining land and water coupled with challenges of climate change, has created much greater concern to feed the growing population. Thus, the challenge before us is much greater than before, and has to be addressed with strategic approaches utilising innovations in science and technology. Efforts made through research and development have been a key driver for this development.

1.1.2 Role of Integrated Aquaculture – Crop/ Horticulture - Livestock Systems (IACHLS) in Improving Family Farm Production and Income and Addressing Food Security

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This review explores the beneficial traits and contributions of IACHLS to food security, social, environmental and economic benefits, and resilience, and proposes strategies to adopt IAHLSs in low and medium-income countries (LMICs). One in nine people does not have sufficient protein and energy in their diet. Out of these 50% are smallholder subsistence farmers and 20% are landless families in the low-and medium-income countries In Asia, China accounts for approximately 50% of the world's smallholders, followed by India with 23%, and Indonesia, Bangladesh, and Vietnam. These smallholders account for 380 million farming households, hold roughly 30% of the agricultural land, contribute up to 70% of the food calories produced in LMIC, and are responsible for 53% of the global food calories production for human consumption. The diversified cropping systems in IACHLS can improve the productivity of the principal crop as well as enhance food security through increasing nutritional indicators such as food consumption score and household dietary diversity. IACHLS, therefore, could be a key to achieving food and nutritional security and environmental sustainability both in the short and long term. Besides, the system also reduces risk factors due to the presence of multiple food production components. Fish is known for its non-consumptive water use while aquaculture in undeniable earthen ponds also facilitates the harvest of rain and floodwaters and holds it for multipurpose use including recharging of depleting groundwater table. Pond water is used for domestic purposes and for rearing livestock animals. All these make the IACHLS highly suitable for farming households of India and other LMICs. While IACHLS practices have increased over time, there are still adoption challenges due to lack of investment, sustainable awareness, lack of skills by the producers, and market competition. Further, successful implementation of IACHLS also requires organisational and/or institutional support, government policies and educational services to subsistence farmers. Above all our agricultural education system need to introduce IACHLS courses to enable the agricultural scientists to take up challenges to provide fundamental and credible information to integrate aquaculture, crop, horticulture and livestock production systems

thereby increasing resilient agricultural production compatible with food and nutrition security. The paper presents major advantages and disadvantages of INCHES and measures for mainstreaming.

1.1.3 Secondary Agriculture: An Approach for Sustainable Development in Horticulture

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Secondary agriculture plays a significant role in making a positive impact on the country's economy. The increasing demand of consumers for value added goods like nutraceuticals and functional foods in both domestic and international markets drifted the development of secondary metabolite based food supplements. Secondary agriculture includes all food and non-food bioresource- based products for human and industrial use. It ensures better utilisation of renewable agro- bioresources either through value addition or waste utilization. At present, the total value added by the food processing in India is only about 8 per cent of the total production. Among food crops, major post-harvest losses (25–30%) occurs in fruits and vegetables; their waste being rich in several bioactive compounds and many other valuable components like pigments, phenolic, fibres, sugars and minerals that can be extracted and utilised. Horticultural crops contain range of secondary metabolites like flavonoids, alkaloids, coumarins, limonoids, carotenoids, phenolic acids and volatile compounds which provides a rational basis for various biological activities. In fruits like citrus, flavonoids exhibit more bioactivities compared to other secondary metabolites. The peel of fruits is a good source of valuable compounds like vitamins, phenolics, pectin and pigments. They are also found to be rich source of essential oil having excellent antimicrobial properties. Essential oils are being used in the pharmaceuticals, foods and other industries as preservatives, and it's generally regarded as safe (GRAS). The goal is not only to increase the yield of the targeted compounds to the maximum, but also to avoid any deterioration/ loss of the functionality of the compound. Extreme variations in environmental factors viz. temperature, light, water, etc. influence the secondary metabolites. The adoption of advanced technologies, equipments, and processes would enable enhanced secondary agriculture practices giving range of materials of better quality, yield, nutrition, and convenience. Hence, the potential of secondary metabolites and bioprocessing could be strong boost to the economy, sustainable development, societal status and environmental protection.

PLENARY SESSION-2

PARADIGMS IN CLIMATE RESILIENT AND SUSTAINABLE DEVELOPMENT OF HORTICULTURE - CHALLENGES AND OPTIONS

2.1 Plenary Lecture

2.1.1 Horticulture – A Panacea for Current Challenges of Farmers, Consumers and Ecology

Dr. Ashok Dalwai

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Against the backdrop of a paradox, wherein the farmers are suffering from low average incomes, the consumers are not nutrition-secure and the ecology has been rendered vulnerable despite high volumes of agricultural production in the country, the felt need today is the remanding of the country's agricultural production system. The desired reorientation at both science and policy levels is to promote a diversified agricultural production system, that will provide greater space to the new engines of growth, namely, horticulture. diary & livestock and fisheries. Of course, this is to be achieved without a dip in the output of cereals & pulses which can be secured by realising higher per hectare yields. Since the adoption of the National Horticultural Mission (NHM) in 2005 which now is operated more robustly as Mission Integrated Development of Horticulture (MIDH), the country has shown enviable growth of the sector. There is increase in area under horticulture, and the production growth has been more than proportionate to the area-increase, thanks to better productivity than before. For the first time in the history of agricultural sector in independent India, the horticultural output equalled that of food gain output in the year 2013-14, and came to surpass it in due course. The year 2021-22 registered a horticultural output of 326 million tons in comparison to 309 million tons of food grains.

The rationale for accelerating the pace of growth in horticulture persists and will remain so for many more decades, on account of the multiple advantages that this sector offers. The sector is broad-based with six components of fruits, vegetables, flowers, plantations, medicinal and herbal plants each of which is amenable to a range of climatic zones from the temperate to the arid, and therefore can be adopted across the country in synch with the local agro-climatic characters. The produce of all these is high in value, and therefore brings greater returns to the farmers on their investment. The fruits and vegetables are rich in minerals & vitamins, which are essential for balancing the diet of the consumers. Large section of the country's consumers is suffering from hidden hunger which can be overcome by ensuring better access of fruits & vegetables at affordable prices. There is urgent need to emphasize on enhancing the per capita consumption of these commodities as prescribed by the nutritionists. This suggests the importance of nutrition security, which entails increasing further the production for greater availability, strengthening the distribution system for accessibility, imparting efficiency to the marketing system for creating affordability, and undertaking awareness through nation-wide nutritional-education. This approach where both supply and demand sides of the horticultural sector are simultaneously addressed, a win: win situation is created to the advantage of the farmers and consumers. Further, intensifying horticultural production is environmentally sound, as the sector helps in dividing the production risks for the farmers, improving resource use efficiency as nutrients & water are utilised from varying levels of soil profile, and simultaneously perennials sequester the atmospheric carbon into soil and build soil organic carbon.

It would from every perspective be appropriate to adopt a twenty-five-year perspective plan for the horticultural sector comprising all of its six components. The perishable nature of most of the horticultural produce must be borne in mind as the production levels are pushed up continuously. Hence, the critical role of agri-logistics including primary processing, pack houses, integrated cold chain system deserves priority attention. Further, the importance of food & non-food processing cannot be gainsaid. The primary and by-produce generated in the sector can be and need to be processed to integrate farm gates with the demand centres over space and time. While promoting consumption of fresh produce, the surplus will need to be processed into both food (for humans & animals) & industrial goods for capturing greater value for the farmers. With advancements in bioprocessing, bioengineering and biotechnology, there exists scope for using horticultural produce (both primary & by-produce) to output bio-materials, bio-fuels, bio-medicines, bio-pesticides and bio-enzymes. Such an integration of processing to the primary production segment of the horticultural sector bear the potential for generating the much needed jobs and incomes for the farmers, as also other stakeholders.

2.1.2 Applications of Artificial Intelligence for Climate Resilient and Sustainable Development of Horticulture

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The climate change is becoming an increasing threat and a major challenge to agricultural system as it creates progressively hostile conditions like erratic and unpredictable rainfalls, drought cycles and floods. The emergence of modern digital technologies and their applications in agriculture sector has tremendous potential to create innovative digital solutions that support the climate resilience of agriculture. Some of the digital technologies that find extensive application for climate resilience in agriculture are artificial intelligence, machine and deep learning, Internet of Things, big-data analytics, block chain technology, satellite imagery, hyper-spectral imagery and mobile communications. The information about local rainfall, weather forecast and other relevant climate parameters can be locally disseminated through existing mobile networks for localized and scalable agricultural services. The digital and telecommunication infrastructures along with cloud computing have significant potential to strengthen the climate resilient agriculture. The weather predictions, farm advisories and warnings can be generated and sent to local farmers of horticultural and field crops using big data analytics, artificial intelligence, machine learning and deep learning algorithms. This can help them to take corrective measures in anticipation to protect the crop under erratic climatic conditions and to ensure large crop production.

2.1.3 Integrating Systems of Livestock and Horticulture

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The ever-growing human population entails increase in per capita intake of animal protein globally through 2050 necessitating intensive animal production systems leading to adverse impact on the ecosystem

because the animals are not integrated with other agricultural and forestry-based practices. Thus, improving and sustaining the livestock sector is critical to advancing the Sustainable Development Goals (SDGs) of the United Nations, especially SDG #1 (No Poverty), SDG #2 (Zero Hunger), SDG #6 (Clean Water and Sanitation), and SDG #13 (Climate Action). The conventional agriculture entailed integration of livestock systems with crop production systems because of the obvious benefits recognized much earlier. However, integration of livestock into agriculture (including fruit and vegetables) also results in undesired outcomes, *viz.*, (i) food safety concerns, (ii) crop and infrastructure damage, and (iii) livestock predation. The food safety concerns can be overcome by minimizing the pathogen contamination by following "Good Agricultural Practices (GAPs)" and "Good Animal Husbandry Practices (GAHPs)" as well as following the prescribed food safety norms pre- and post-harvest. Further, understanding the socioeconomic feasibility and trade-offs involved in mixed crop-livestock farming systems – ones that specifically incorporate fruit and vegetable crops – has been the globally recognized international research which attracted major fundings. In this context, it becomes imperative for us to investigate the effects of livestock keeping on food safety, weed control, and soil health for fruit and vegetable farms to generate sufficient data over a period of time which can guide the decision making for integration of livestock component with horticultural crops.

2.1.4 Strategic Research and Technological Changed for Climate Resilient and Sustainable Horticulture

Dr. Janakiram
VC, DrYSRHU,Venkataramannagudem, A.P.

PLENARY SESSION-3:

PARADIGMS IN CLIMATE RESILIENT AND SUSTAINABLE DEVELOPMENT OF HORTICULTURE - CHALLENGES AND OPTIONS

3.1 Plenary Lecture

3.1.1 Milk-Fruits Based Composite Products: Novel Approach for Harnessing the Therapeutic Virtues of Milk and Fruits

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The wide-spread prevalence of malnutrition and emergence of life-style associated diseases among children, women and other vulnerable groups is becoming a serious concern. According to an estimate about 194 million children are stunted, wasted and suffering with micronutrient deficiency disorders. Malnutrition is responsible for 15% of the disease burden, 4% loss in GDP and about 8% loss of

productivity. One of the prime reasons of malnutrition is lack of diversity in our diet resulting in inadequate intake of certain key nutrients. Our ancestors in Palaeolithic era used to derive their daily food requirement from almost 500 different plants, whereas at present 80% of nutrients are derived from only 17 plants and 50% of calories from 8 food grains across the globe. On the other side well-off strata of the society need to address the health issues primarily due to the changing life-style and food habits. Milk is considered as unique source of nutrients as well as physiologically active components, but milk also lack some micronutrients (iron, copper and certain vitamins) and fiber. Therefore, there is obvious need for supplementing milk with necessary micronutrients as well as health promoting components form suitable sources. As regards the supplementary sources of nutrients and health factors for the milk several options including fruits & vegetables, cereals, millets, legumes and certain oilseed crops, could be adopted. Term "composite food" is usually applied to any diet produced by using the ingredients obtained from unrelated food categories. However, combining any commodity with milk often results in significant changes in physico-chemical characteristics and disturbs the equilibrium. Fruits and vegetables are major sources of micronutrients, antioxidants and wide arrange of phytochemicals. Compounds like carotenoids, anthocyanins, flavonoids, flavones, glucosinolates, soluble fibers, polyphenols etc. have a well-documented health benefits. Moreover, the greater diversity in fruits and vegetables offer an opportunity in developing novel food formulations in combination with milk having an array of bioactive components derived from them. Milk based beverages have emerged as one of the most promising segment among value added dairy products. Dairy industry must exploit the opportunities to keep pace with the changing pattern of product consumption and increasing demand of health foods. Fruit juice based acidified milk beverages are an exciting and growing market in the beverage world. These beverages combine the tart flavor of fruit with the creamy texture of milk. This category includes mainly two types of beverages, Fermented Milk/Yogurt Drinks and Directly Acidified Milk-Juice Drinks. Traditionally, milk shakes, smoothies etc. are examples of milk-fruit based beverages. Fruit ice-cream, desserts, yoghurt and even traditional sweets specially those made with fresh fruit pulp/juice are appearing in Indian market and becoming popular. However, need is felt to improve the quality and stability of such formulations. Development of whey-fruit beverages is an effective approach for bringing back valuable whey nutrients into human food chain. Fruits contain pigments which have ability to replace chemically synthesized colourants in processed composites. Carotenoids, anthocyanins and chlorophyll extracts act both as colourant and anti-oxidants in composite dairy products. More than 1000 plant metabolites present in fruit and vegetables have potential in developing functional foods and nutraceuticals along with milk/milk ingredients. There is need to expand the research and development on composites with unique health characteristics and health benefits. It is expected that milk-fruit composites may modulate immunity, improve gut health, enhance vision and alleviate the free radical/reactive oxygen species (ROS) mediated cellular degeneration process. Scientific validation through in-vivo and clinical trials could be an appropriate strategy for promoting the commercialization of these products,

3.1.2 Drones for Crop Protection – Standard Operating Protocols for Enhanced Productivity and Sustainability

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Commercial application of agrochemicals (pesticides, fungicides and herbicides) using Unmanned Aerial Vehicles (UAVs) popularly known as drones is now well established as a crop protection technique in several countries including China, USA and Australia. The brief but intense evolution and adoption of

drone technology in agriculture has been disruptive in the crop protection industry. In this backdrop two interesting events occurred in India during the last couple of years: (i) Drones morphed into an affordable technology for field application by small and marginal farmers, and (ii) Relaxation of norms by DGCA for registering and operating drones by various stakeholders. However, farmers are unprepared on how to choose quality drones from such a wide array of models and configurations with unstandardized spray systems, suitable crops, appropriate pesticide molecules and lack of guidance on crop specific standard operating spray practices, to achieve effective crop protection. This presents challenges to correct and safe use of pesticides for aerial spray with drones, particularly at low or ultra-low water spray volumes (15 to 40 L/ha with drones compared to 500 to 750 L/ha with conventional knapsack and tractor mounted boom sprayers) and high pesticide concentrations. Most concerning is how to maximize droplet coverage, spray accuracy and distribution while minimizing spray drift, and maximizing control and working efficiency under dynamic environmental, crop growth, and pest biology conditions. For example, currently pesticides containing the active ingredient of chlorantraniliprole, an IRAC (Insecticide Resistance Action Committee) classified Group 28 mode of action insecticides are among the most commonly used crop protection products sprayed via drones worldwide to control insect pests of rice, sugarcane, maize, soybean, vegetables etc. Drone end users are challenged with the lack of trained and certified pilots and applicator experience that is far beyond basic drone operations but involves comprehensive understanding of the multiple variables affecting drone spray quality and pesticide efficacy. Hence, PJTSAU during the past three years researched and developed crop specific (rice, maize, cotton, red gram, groundnut and sesame) standard operating protocols (SOP) for proper application of pesticides using drones. The objective was to optimize the insecticidal attributes by maximizing spray application quality, however, these SOP's will apply to most other pesticides including fungicides and herbicides. A holistic approach was employed with cross-disciplinary considerations from biological, chemical, and engineering perspectives along with complex environmental variables. The SOPs were developed considering monitoring and identification of pests, pest thresholds, pest resistance management strategies, adjuvant processes that maximize the effectiveness of applied chemical, guidelines to spray preparation and proper tank mixing sequence, calibration of UAV spray system, variables affecting accurate drone spraying viz., flight height, flight speed, effective swath width, nozzle type, nozzle flow rate, land topography, spray volume, droplet density, droplet deposition, droplet coverage, crop height, spray drift and weather conditions (wind speed and direction, temperature and relative humidity) to ensure a quality agrochemical application that maximizes spray deposition on the target crop and uniformity of distribution along the crop canopy and to deliver an accurate amount of crop protection product (pesticide, fungicide or herbicide) so that farmers receive the full benefits from new spray technology and improved pesticide chemistry. These SOPs may begin to mitigate the many challenges and variables that affect a quality spray by UAV aerial application of agrochemicals, but numerous knowledge gaps still exist that require further research to continually improve future best management guidance.

3.1.3 Innovative Cutting Edge Technologies for Intensive and Integrated Sustainable Management of Horticultural Farm.

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There is more need for direct attention and continuous monitoring of Horticultural crops per plant than arable crops, to ensure optimal crop management. The innovation in technology for intensive and integrated farm management resulted in automated and optimized farm operations with precision and reliability that were previously performed manually. Recent innovative technologies like digital scouting applications for mobile devices, the use of drones for pest and disease identification and management, use of drones for pest and disease identification management, Symbiotic organisms and plant defenses: Biocontrol and Precision agriculture for weed control, soil health, and better yields. On one hand, digital scouting devices provide a better monitoring platform for the registration of diseases and offer biological solutions for horticulture, other hand Drones/Unmanned Aerial Vehicles (UAVs) with better sensing and imaging capabilities can identify pest and disease 'hotspots' in crops and then accurately disperse beneficial insects from the air better than man-handled equipment. Hydroponics has emerged as a better solution to the high demand for natural resources like water and land for more crops. Applying beneficial microorganisms through seed coating has proven to advocate the activation of the plant defense system to grow stronger. Precision horticulture where automation avoids over-application of agrochemicals reduces spill-over to the wider environment and predictive technologies can help customize crop varieties for improved performance, is also in current trends in horticulture. In this presentation, the exploration of standardized cutting-edge technologies which are helpful in making horticulture farming more sustainable is reviewed with scientific means and practices.

Keywords: digital scouting, Drone, hydroponic, biocontrol, precision horticulture

3.1.4 Three Decades of Horticulture Research and Development in Haryana

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The crop diversification is necessity for agriculture-based economy in Haryana to enhance income level of farmers specially small and marginal. The agricultural diversification towards fruits and vegetables in Haryana started in early nineties when State has less than 1% area under horticulture which now has increased to 6.35% with aim to increase it to 15% by 2030. To provide nutritional security department has aligned with Sustainable Development Goals and has initiated many interventions in horticulture technologies to make horticulture a diversified sustainable activity. Haryana is budgeting roughly around

Rs. 800 Cr. annually for promotion of horticulture in Haryana. Many innovative programs were initiated namely crop data management, price protection, horticulture insurance, vertical farming, hi-tech mushroom production, unique integration modal of farm water pond with plantation & MI and crop cluster development program. Technology demonstration and transfer to the farmers are other major interventions by establishment of 11 centre of excellence and 128 village of excellence including skill development by starting three months skill qualification packs at training institute. Department has collaborated with CCSHAU, MHU, CPRI, NCIPM, CIP and other international agencies for technology introductions and demonstration. Promotion of more than 700 farmer producer organizations and creation of supply chain in the form of pack houses and market development are other major initiatives of the Haryana Govt. in the horticulture sector.

TECHNICAL SESSION 2:

TECHNOLOGICAL CHALLENGES AND APPROACHES FOR CLIMATE RESILIENT DEVELOPMENT OF HORTICULTURE

2.1 Keynote Presentation

2.1.1 Approaches for Climate Resilient and Sustainability Development of Horticulture in Gujarat

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Climate change refers to change in climate over time, whether due to natural variability or as a result of human activity. It also refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods. Significant variation in the mean state of the climate, persisting for decades or longer is referred to as climate change. Climate change is the negative creation of global warming. The alteration of different meteorological parameters or drastically changes in the system of different climatic parameters like temperature, light, humidity, rainfall, sunshine, wind velocity etc are known as "climate change". The intensity of meteorological parameters increased or decreased or become more fluctuate due to climate change. Horticulture is also key sector to provide three securities to mankind viz., food security, nutritional security & health security. The horticulture has also a great role to become even more enhanced in bringing farmers of country out of poverty. In Gujarat Horticulture crop is grown in an area of 18.31 lakh hectare area with production of 237.83 lakh tonnes. However impact of climate change is observed. The paper discusses the impact of climate change and developing strategies to manyachive achieve sustainable production of horticultural crops in Gujarat

2.1.2 Strategies Approaches for Climate Resilient and Sustainable Development of Horticulture – A Case Study of A.P.

Chiranjiv Choudhary
Principal Chief Conservator of Forests, Forest Dept., A.P.

2.1.3 Strategic Development of Horticulture in Telangana for Resilience to Climate Change

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Climate change reflects long term changes in temperature, relative humidity, rainfall and other climatic variables. The horticulture crops are exceedingly prone to climate change owing to long economic life of the plant which requires huge initial investment and cultivating these crops has made farmers more vulnerable to climate change. There is a demand for climate smart horticultural practices or interventions which are customized to suit local needs. Strategies like conservation agriculture, natural resources conservation, reforestation, checks on population growth and pollution, reduction of greenhouse gas emissions, breeding drought resistant crops, tolerant to pests and diseases, early maturity, etc. are the need of the hour

2.1.4 Challenges and Opportunities in Horticulture

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Horticulture (fruits including nuts; vegetables including potato, tuber crops, mushroom; ornamental plants including cut flowers; spices; plantation crops and medicinal & aromatic plants) play important role in Indian agriculture. It has become a key driver for economic development in many of the states in the country. Presently, horticulture alone contributes about 30.4 per cent to GDP of agriculture. India has emerged as the second largest producer of fruits and vegetables in the world and largest producer of crops like mango, banana, coconut, cashew, papaya, and pomegranate. Many states in India like Maharashtra, Andhra Pradesh, Himachal Pradesh, Jammu Kashmir, Uttarakhand, etc. are focusing on horticulture to improve the productivity and farm income. India is the largest producer and exporter of spices at global level and also has recorded highest productivity in the world in many crops like grape, banana, cassava, peas and pomegranate. Keeping the future challenging issues in mind, such as fast increasing global population, food & nutritional security, reducing land & water resources, ill effects of climate change & pollution, unemployment etc., horticulture has enormous potential to address such challenging issues. However, there will be urgent need to focus on key factors, in order to succeed in

future. Top ten issues, namely Quality Planting Material; Alternate Production Technologies; Efficient Input Management; Toxin free & quality of Produce; Effective Post Harvest Management; Mechanisation, Tools/ Equipment and Artificial Intelligence; Successful Models and Stories; Farmers friendly market link; Knowledge management with focused R& D and Education; Innovations in Horticulture. There are number of agencies, universities and institutions etc. which are excellent seat of knowledge for horticultural science. Number of new concepts are developed, proven with data & experimentation. However, when it comes to address the challenges, or solve any problem on ground, most of our findings prove to be either a failure or not sustainable. This happens because our approach to tackle the problem is only in bits and pieces. There is strong need to switch over to technology development, from science development approach. This will give complete solution package to the challenges, and also help to boost innovation in horticulture.

2.1.5 Regenerative Agriculture Including Horticulture for Resilience to Climate Change and Sustainability

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Regenerative Agriculture is a holistic approach of conservation and farm management practice that improves soil health by rebuilding soil organic matter and restoring degraded soil biodiversity, crop resilience and nutrient density. This results in increased biodiversity both above and below the soil surface, as well as increased water holding capacity and carbon sequestration at greater depths, lowering climate-damaging CO2 levels in the atmosphere. Inoculating soils with compost or compost extracts to restore soil microbial community population, structure, and functionality, as well as restoring soil system energy (compounds as exudates) through full-time planting of multiple crop intercrop plantings, multispecies cover crops, and borders planted for bee habitat and other beneficial insects, are all important in increasing biological ecosystem diversity. Growing a diverse crop mix protects against pests and diseases, provides a diversified income stream and habitats for more pollinators, and improves soil health.

Perennial horticulture, which includes fruits trees, plantations, and some spices crops, does not require replanting each year as they exhibit long root systems that can retain water, improve soil porosity, sequester more carbon, and improve soil health, thereby improving ecological, animal, and human health through improved micro-nutrients availability and better dietary balances. Planting native-to-a-region crops, plays an important role in improving biodiversity and are utilised as the main cash crop, incorporated into conservation buffers, or used as cover crops. Diversity and perennially are the essential components of regenerative agriculture, therefore, promoting perennial horticulture can help build healthy soils, restore clean surface and groundwater, and enhance the resilience of our food system. As a result, in order to counteract climate change, it is critical to support an agriculture system that is both ecologically and economically viable. However, India's current economic and political structures are geared toward monocultural production, and for this type of perennial horticulture to prosper, appropriate socio-political and economic systems must be in place to support such system. In horticulture production system, there are various examples which states that with effective soil management, soil health can be improved and the crops can be grown with minimum inputs. The paper discusses this concept in detail.

Keywords: Regenerative agriculture, horticulture, climate change, perennial, biodiversity

2.1.6 Diversification of Alliums in View of Present Climatic Conditions in India

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Export trade from Mumbai and Kandla port mainly to Gulf countries predominantly during November to April coincides with harvest of rainy seasons (*kharif*) and late rainy seasons (*Rangda*) crops. This market forces have influenced domestication and diversification to great extend. Demand for highly pungent and pink skinned bulbs from Gulf countries made farmers of Western India to select such type of plants, which can produce seeds under Indian conditions. This kind of adaptations made the crop plant to become annual. This phenomenon resulted in loss of short dormancy of bulbs. This fascinating aspect of onion domestication in Western India had gone unnoticed and unrecorded. Among the cultivated species of *Allium*, onion (*A. cepa* L.), leek (*A. porrum* L.), shallot (*A. ascalonicum* L.) and chives (*A. schoenoprasum* L.) are well known vegetable crops grown in different part of India. Field surveys and exploratory studies have confirmed to utilization of wild *Allium* species in the Garhwal and Kumaon regions of Himalaya for edible purposes . Generally, all plant parts have edible value and consumed raw or as cooked vegetables. Young leaves of many wild species are preferred over the mature ones in the form of vegetable, in soups or for raw consumption given in following table. Freshly harvested leaves or bulbs are occasionally sold in village markets. The leaves and tuberous/fibrous roots are rich in carbohydrates, vitamins and minerals. Bulb/pseudostem of *A. clarkei*, *A. griffithianum*, *A. pratii* and *A. victorialis* are consumed raw, cooked or pickled. Cloves or bulbs of *A. ampeloprasum* and *A. chinense* are pickled. In Pithoragarh region of Uttarakhand Himalaya, India, young leaves of *A. stracheyi* are used as potherb or cooked mixed with potato. Fleshy fibrous roots of *A. hookeri* are consumed as vegetable in the north-eastern hill region or in soups and pickles in same way as *A. stracheyi* in the north-western Himalaya. In Bhutan, *A. fasciculatum* is generally used as vegetable (leaves and scape), salad and in soups (young inflorescence).

Keywords : ALLIUMS, Diversification, onion breeding,

2.2.1 Rainfall Variability and Probability Analysis for Estimating Onset of Cropping Season at High Rainfall Tract of Northern Agro-Climatic Zone of Kerala

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Kerala divided into five agro climatic zones, the districts Malapuram, Kozhikode, Kannur and Kasaragode are falls under Northern Agro climatic zone. There lies a high rainfall tract in parts of Kozhikode and Kannur districts, where ICAR-IISR Experimental Farm, Peruvannamuzhi is located (11^{O}.34'N, 75^{O}.48' E

and 60 m MSL). Crop production is mainly depends on climate and weather particularly in the event of climate change. The objective of this study was to analysis the rainfall variability and prediction of onset of planting season with probability analysis. The monthly and annual rainfall data of 42 years (1980-2021) and weekly data for 31 years (1991-2021) were used for calculating summary statistics of rainfall (annual, seasonal, monthly and weekly), initial and conditional probabilities in MS Excel. The results indicate that annual average rainfall of this tract is 4594mm with range of 2893mm – 6413mm having CV of 16.8%. ($y = 8.3392x+4414.8$ $R^2 = 0.0167$). The probability of getting 3976.4mm annual rainfall is 75% and it was predicted that chance of receiving 4000mm rainfall per year is 77.86%. Annual rainy days varied between 112 and 174 with a mean of 148days. South west monsoon contributed 74.3% to the annual rainfall and July month had received maximum monthly rainfall (1130mm). The rainfall between 1 (1-7 Jan) to 13 standard meteorological weeks (SMW) (26 March – 1st April) was less than 20mm and not suitable for planting rainfed crops, from 14th SMW (2-8 April) rainfall receipt gradually increased and up to 47th SMW (Nov 19-25) and rainfall received was above 20mm during this period with highest weekly mean of 306.8mm during 29th SMW (16-22 July) and this week alone contributed 6.6% of rain to annual rainfall. The rainfall analysis indicated that annual, seasonal and monthly rainfall are in normal range however, there was a positive trend in annual and summer rain was noticed but it was not significant. The probability of receiving 20mm during April second week (09-15 April, 15th SMW) is 60% and land preparation activity may be initiated. Planting of rhizomatous and tuber crops can be started during 19th SMW (May second week, 7-13 May,) as probability of getting 50mm rain is 60% and completed during 22 SMW (28 May – 03 June) as chance of receiving 75mm and 100mm is brighter with 69.71% and 63.53% probability respectively and subsequent weeks are assured rainfall periods.

2.2.2 Cocoa (*Theobroma cacao* L.) the Agro-forestry Crop and its Resilience to Palm based Cropping Systems

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Cocoa (*Theobroma cacao* L.), the beverage crop of the world was introduced into India in 1798 as an agro forestry/plantation crop in western ghats hills and plains. Further it adapted to palm based cropping systems, covering arecanut, coconut and oil palm gardens, effectively utilising the available space, shade, sunlight in palm groves, enriched the environment through its canopy cover and litter fall, enhanced the productivity and profitability of farms, also provided healthy and happy food, the chocolates. Govt.of India, identified the domestic and export potential and encouraging area expansion of cocoa in non-traditional belts to meet the demand of Indian chocolate industry of 60,000MT against the current production of 25,000MT. CPCRI with its four decades of cocoa research, conserving genetic diversity, developed varieties, cropping models, scientific production, protection and processing technologies. To test the adaptability of cocoa in different environments/cropping systems and to identify multi-purpose and site-specific varieties, selective clones were evaluated in four southern states. Thirteen cocoa genotypes including parental clones and hybrids were planted under arecanut in Karnataka (3m x 3m spacing), under coconut in Kerala (3m x 3m) and Tamil Nadu (7.5m x 3m) and under oil palm in Andhra (9.0m x 2.5m) with 2 replications with 6 trees per plot and were assessed for their performance. In Karnataka, the clones VTLC-5, VTLC-66 and VTLC-1, in Kerala, VTLCH-2, VTLCH-1 and VTLC-30, in Tamil Nadu, VTLCH-1, VTLCH-2 and VTLCH-4, in Andhra Pradesh, VTLCH-4, VTLC-1 and VTLC-9 had

high dry bean yields contributed by more no. of pods, no. of beans per pod and bean size. They also had industrial value with less shelling, high nib recovery and rich fat content. These best performing clones should be multiplied as clonal orchards for supply of quality planting material for the sustainability of the region specific cropping systems with cocoa.

Keywords: cocoa, clones, regions, palms

2.2.3 Seasonal Variation (Summer and Rainy Season) in Oil Content and Fatty Acid Composition in Oil Palm Hybrids?

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Oil content and fatty acid composition in three different sources of oil palm hybrids *viz*., Malaysia, Deli x Ghana and Deli x Nigeria were analysed during two seasons, rainy and summer. Seasonal variations in fruit weights (4.9 – 13.6 g), oil content (69.3 – 81 %) and moisture (30.2 – 43.9 %) were observed among hybrids. The fruit weight and mesocarp contents were higher in all the hybrids during summer compared to that of rainy months, while oil content was high during rainy months in the oil palm hybrids studied. The oil to dry mesocarp content was high in Deli x Ghana hybrid followed by Malaysian and Deli x Nigeria hybrid sources. Saturated fatty acids like myristic acid (0.67 – 1.32 %) and palmitic acid (41.9 – 49.6 %) showed higher levels during summer season, while stearic acid (3.67 – 4.86 %) increased during rainy season. Palmitic acid levels were high in oil palm hybrids belonging to Malaysian source followed by Deli x Nigeria and Deli x Ghana sources. Unsaturated fatty acids like oleic (36.5 – 44.1 %), linoleic (5.58 – 8.57 %) and linolenic (0.22 – 0.56 %) increased during summer and decreased during rainy months. Oleic acid levels were high in oil palm hybrids belonging to Malaysian source followed by Deli x Ghana and Deli x Nigeria sources. The study confirms that oil content and fatty acid composition is influenced by temperature and rainfall during rainy and summer months.

Key words: Fatty acid composition, mesocarp oil, moisture, monounsaturated fatty acids (MUFA), oil palm, poly-unsaturated fatty acids (PUFA), saturated fatty acids (SFA).

2.2.4 Climate Change and its Effects on Horticulture and Agriculture Crops in Uttar Pradesh

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Climate Change has brought disruption all around us. Agriculture and Horticulture are one of the few sectors affected by it, however, are receiving less attention, despite having significant economic

implications. The rising temperature continue to affect the agriculture and horticulture crops. Different crops have been impacted differently in terms of some getting costly to grow, soil quality getting depleted, temperature change, etc. Climate change and several supporting factors such as drought, hailstorms, excessive or no rainfall have affected the agriculture and horticulture crops and the overall production. In Uttar Pradesh, the crops that require specific climatic conditions for them to grow and cultivate have been suffering lately, such as banana, papaya, mango, etc. Here in this paper, we discuss the agriculture and horticulture crops that have been poorly affected by climate change in Uttar Pradesh. This study used secondary sources of key research studies, articles, journals to discuss the impact of climate change on the agriculture and horticulture crops in Uttar Pradesh with a special focus on the cultivation of papaya and banana.

2.2.5 Effect of Global Warming Specially on Horticulture Crop

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The effect of global warming is now visible in many parts of the world. Abnormality in climate patterns, induced by accelerated warming, has started to affect a catchment-specific hydrologic cycle. Higher temperatures lead to a high rate of evaporation and dry conditions in some areas of the world. Severe weather events are now more common. Scientists believe that rapid warming in the last several decades is mostly due to human-induced changes in the atmosphere, on top of some natural variations. Impacts of climate change are complex as they can be both direct and indirect, the biggest casualty being natural resources such as agriculture. Agriculture is a carefully manipulated ecological system, the productivity of which could increase because higher levels of carbon dioxide in the atmosphere could allow a higher rate of photosynthesis. However, many interacting factors are at work. At higher levels of warming, estimated monetary impacts generally become negative, and studies, allowing for disastrous possibilities, can reach high negative outcomes. Moreover, the perennial plants (mostly fruit plants) are at more risk than annuals or seasonal.

2.2.6 Climate Change and Adaptation Strategies in Horticultural Crops

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If agriculture is the main stay towards the emission of greenhouse gases induced climate change, horticultural crops have a much bigger role to play in countering the negative consequences of climate

change by providing a better carbon trade and carbon sink. One of the most ominous physiological responses that accrue in response to climate change is the shortened growing period, causing distinctive reduction in production of fruits and vegetables. These responses will leave negative impact on growth and development of horticultural crops due to terminal heat stress and deprived soil water availability. Interventions seeking climate-smart horticulture are, therefore, felt an unwarranted necessity integrating location-specific and knowledge-intensive premise for improving production under such challenging environment. Crop-based adaptation strategies are needed keeping in view the nature of crop, its sensitivity level and the agro-ecological region. Simultaneously, keeping an eye on carbon sink potential of different horticultural crops vis-à-vis annual field crops will further aid in developing a blue print for redressal of climate change related issues.

2.2.7 Nutritional and Therapeutic Values of Methi (*Trigonella foenum graecum*)

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Fenugreek is a valuable medicinal plant belongs to Leguminous Family with potential for multipurpose use and also as a source for preparing raw materials of pharmaceutical industry, especially steroidal hormones. It is grown for seeds, leafy vegetables and fodder. It is one of the most promising medicinal herbs, known from ancient times and shows antioxidant, anticarcinogenic, antidiabetic, hypocholesteromic, hypoglycemic and lactation induced properties. Recent studies have revealed that fenugreek is a valuable herb having medicinal properties and thus, can be used for preparing different products of medical.The seeds are a rich source of polysaccharide, galactomannan, saponins such as diosgenin, yamogenin, gitogenin, tigogenin, and neotigogens. Other bioactive constituents of fenugreek include mucilage, volatile oils, and alkaloids such as choline and trigonelline which has been shown to lower blood sugar and prevent diabetes induced cataract and these are alsoused as tonic and possessemollient, carminative, demulcent,diuretic, restorative, aphrodisiac and vermifugal activity . Its leaves contain biologically active substances (protein, amino acids, biogenic elements, lipids and fatty acids), and they are used in traditional medicine, as functional food and in the cosmetics industry.Nowadays, fenugreek is widely cultivated as a drug plant.Recent studies have revealed that fenugreek is a valuable herb having medicinal propertieswhich could have beneficial health effect for human beings.

Keywards- Fenugreek, Hormone, Therapeutic Value, Traditional Medicine.

2.2.8 Wetland Horticulture: Potential Future Crops

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Transitional lands between terrestrial and aquatic ecosystems with a water table usually at or near the surface, or the lands covered by shallow water are termed as wetlands. These are marginal wastelands

along irrigation canals, floodplains of rivers, submerged areas, marshes, tidal plains, natural lakes, barrages, etc which are not being utilised for agrarian activities since the substrate is predominantly undrained hydric soil. India boasts of 757,000 wetlands accounting for about 4.7% of the total geographical area covering 15.3 million Ha. 37 of these wetlands in India are declared Ramsar sites. The subsurface soil strata in these areas is saturated with water or covered by shallow water at some time during the growing season of each year and periodically, the land supports predominantly hydrophytes. They are typically shallow waterbodies where sunlight can penetrate the surface to facilitate subterranean photosynthesis, making these ecosystems one of the most biologically productive areas on the planet. Horticultural crops form an important component of the wetland flora which can be consumed by humans and thus, need to be explored.

A large number of edible plant species are found growing naturally in the wetland sites since ancient times and many of these form a part of the traditional diet of societies inhabiting adjoining areas. With the increasing pressure of urbanisation encroaching upon arable lands wetland sites offer a potential for cultivation of alternative plant species of commercial importance for food, nutrition, medicine as well as ornamentals. Commonly Wild Rice*(Zizania sp. aquatica),* Rice *(Oryza glaberrima; Oryza sativa),* Watercress *(Nasturtium microphyllum)* , Water Pepper (*Persicaria hydropiper),* Water Spinach (*Ipomoea aquatica),* Wasabi (*Wasabia japonica),* Water Chestnut (*Trapa natan* var *bispinosa)*, Chinese waterchestnut (*Eleocharis dulcis,),* Makhana (*Euryale ferox*)*,* Lotus (*Nelumbo nucifera* Gaertn), Cocklebur (*Xanthium strumarium* L), Wild capegooseberry (*Physalis minima*), Water Lily (*Nymphaea alba* L) etc are among the many acquatic species which are consumed as part of the diet in certain societies. These acquatic plants are a rich source of minerals and other bioactive molecules which have high antioxidant activities and are immuno protective. However, besides water chestnut and Fox nut most of these plants are still ignored and their potential is underexploited. A wide germ-plasm of water-chestnut (*Trapa natans* var *bispinosa)* has been documented in the northern plains of Uttar Pradesh. However over a period of time, with increasing market farmers have limited cultivation to fewer varieties. Which have larger sized fruits and better kernel quality. The fruit of water chestnut is sold in the local market as fresh or boiled fruit and is available from December/ January. It is processed into flour after drying the fruit. It has immense potential for phytoremediation and contributes in improving soil and water health. Thus, wetlands and wetland flora contributes in the livelihood of humans and numerous services from wetlands and can play a significant role in overcoming the problem of food security.

TECHNICAL SESSION 3

INNOVATIONS IN PRODUCTION SYSTEMS MANAGEMENT OF PERENNIAL HORTICULTURE FOR CLIMATE RESILIENT AND SUSTAINABILITY

3.1 Keynote Presentation

3.1.1 Technological Options for Sustainable Horticultural Production Management System in Wastelands

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Land represents an important component of natural resources for survival and sustenance of continental life directly. The land degradation is a temporary or permanent decline in the productive capacity of the land or its potential for environmental management. The Inter-Governmental Panel on Climate Change (IPCC) defined land degradation as 'a negative trend in land condition, caused by direct or indirect human-induced processes including anthropogenic climate change, expressed as long-term reduction or loss of biological productivity, ecological integrity, or value to humans'. Land degradation is a serious issue which affect food and nutritional security of the country. There is need to intensify the efforts for restoration of degraded lands to ensure food security and livelihood support to people. Different technological options are available now for restoration and reclamation of degraded lands. However, most of these are costly and time taking measures. Thus, there is need for systematic and long-term research programmes for understanding the most effective land management option. Use of region specific and problem specific crops, irrigation management options, land management practices, microbial consortia etc. have shown promise. Organic farming and natural farming are new dimensions in agriculture & horticulture which great potential not only in enhancing the income but also utilise the degraded wastelands.

Keywords: climate change, sustainable development, waste land management, horticulture, production management

3.1.2 Knowledge Diffusion for Sustainable Development of Horticulture

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Today, India is not only self-sufficient in respect for food, but is also a net exporter of agri-products occupying sixth position globally. It is one of the top producers of cereals, pulses, fruits, vegetables,

spices, plantation crops, medicinal & aromatic plants. India's agricultural exports touched their highest ever mark by crossing $50 billion in the financial year 2021-22. National Agriculture Research System has succeeded in development of several technologies and many of them have been adopted. But in present context of impact of environmental and pest challenges, knowledge driven agriculture will play an important role in shaping future of agriculture. We are facing challenge for increasing yield and lower average cost; therefore it needs to upgrade technology in many priority crops such as oil seeds, pulses, fruits and vegetable crops. Present day farming is required to be ameliorated from low tech to high-tech (high density planting in fruit crops, root stock technology, green house cultivation, poly houses & poly tunnels, mechanisation, micropropagation, precision farming will reduce average cost of production, enhance farmers income and address disabilities for upscaling them. Further, without improving efficiency of water use in agriculture through modern method of irrigation (drip, sprinkler, sensors) the country cannot address stress on water use and meet future water requirement. Role of frontier technologies such as biotechnology, nanotechnology, drone technology, ICT etc. has emerged as important tools in accelerating agricultural growth and address the issues. In the changing scenario of food, nutritional and health security, agriculture including horticulture is required to be made more vibrant and competitive based on novel approaches and initiatives which are primarily knowledge driven.[1]

Social, economic, and environmental aspects are three dimensions to sustainable development. In all spheres, knowledge sharing is critical to supporting these dimensions through advisory services. Extension system therefore is key for linking scientific research, field-level innovations and innovators, markets, education, and other service providers. Farm advisory services are crucial to putting farmers' needs at the centre of rural development, ensuring sustainable food security and dealing with risks and uncertainty. The knowledge sharing mechanisms should focus on critical areas aligned with sustainable development goals including safeguarding natural resources, more efficient farming processes, value addition in horticulture, marketing skills, food, nutrition and health security.

Although most people can see the benefits of using a more precise approach to manage crops with additional information, the tools provided by precision farming and other information technologies have not yet moved into mainstream agricultural management. The increased complexity of the systems inhibits easy adoption and makes calculations as to the financial benefits uncertain. These issues can be resolved by improving the decision making process though better Management Information Systems, improved data interchange standards and clear management methods. Knowledge based precision farming has been seen as a technology that demands the development of information systems in agriculture. Therefore, the strategies in which farmers communicate and cooperate in the adoption of precision agriculture needs to be worked out. The question before us is that how we can ensure that farmers have information, skills, markets, technologies, and other services. Here extension and advisory services can improve the quality, diversity and volume of food production.

Knowledge diffusion happens through extension system in India mainly comprise of 731 Farm Advisory Centres (KVK's) located in different agro-ecological regions, play a critical connecting role as knowledge dissemination centres in food and agricultural innovation systems. Apart from extension of latest technical know-how such knowledge centres should help local communities to meet their needs and link them to scientific research and input and output markets also. In the present scenario of climate change when we think about enhancing income of farmers the system should help them to respond to expected climatic changes, environmental degradation, and market volatility. The role of extension goes far beyond technical and production functions, and includes the whole social and cultural background. It should connect science to users in a healthy relationship that not only provides reliable, honest, and timely information to farmers, processors, marketers, and farmer producer organisations, but also gives solid feedback to scientists and researchers about users' own innovations, insights, problems encountered, and opportunities uncovered. Knowledge sharing is critical for sustainable development. More and better agricultural extension and advisory services are a legacy outcome that allows knowledge-based

infrastructure to adapt to changes in agriculture. Whether it is better meeting of nutritional needs, promoting health and financial security, improving the efficiency of water use, reducing land use, or any of the other competing demands on farming services, they are best met through improved practices based on knowledge.

The pandemic situation has set new normal and has put Indian agriculture into the framework of global food provider. Accordingly, there is need to examine competitiveness of some selected agricultural crops in the light of empirical evidence of domestic and international prices, the world commodity situation and the structure of the global market for agricultural commodities. Need is felt for predictive analysis models for Real Time Information Systems for forecasting of yield and later price discovery in the event of export or import. At this juncture the role needs to be re-oriented in the light of changing environment and requirements to meet the new challenges and also to harness new opportunities from local to global. This will require a shift in our approach and thinking which should be knowledge based.

3.1.3 Strategies and Approaches for Climate Resilient and Sustainable Production of Litchi

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Litchi is a speciality fruit whose flavour and taste are beyond compare. The delicious fresh fruit is preferred during the hot summer months whereas processed products are available throughout the year. There has been a substantial increase in area, production and productivity of litchi in the past 75 years after independence. It is estimated that in the past 30 years (1991-92 to 2021-22), an increase in the area has been more than 80 per cent, while production increased during the same period is to the tune of above 150 per cent. Productivity also recorded an increase of approx. 50 per cent during the same time. Despite its popularity, litchi stands only at the 13th position among fruit crops in terms of both area as well as production in India. One reason for non-spread of litchi area with greater pace in the Indian subcontinent could be speculation that litchi is very fastidious in soil and climatic requirements for successful growth. In recent past, lot many efforts have been made to test the crop performance in various regions of the country with successful outcomes. Litchi yield and fruit quality is very much affected by environmental parameters like temperature, photoperiod intensity, moisture content in the soil, humidity in the atmosphere and chilling requirement. Climatic change affects the litchi plant growth as well as reproductive phase *viz.* panicle emergence time and flowering behaviour.

In an era of dynamic climatic changes, there is a need to adopt climate-resilient strategies for sustained production of litchi. Identifying potential areas for litchi cultivation in different states and strategic planning for area expansion in a phased manner is a way forward to bring more acreage under litchi cultivation. Any climate-resilient adaptation strategies to be implemented for higher productivity in litchi should aim at efficient nutrient and water management as per the tree growth stages, canopy management and integrated pest management. Improved technologies for better crop management under changing climatic scenarios include high-density planting, quality planting material of improved varieties, canopy architecture management, rejuvenation of old unproductive orchards, orchard floor management and utilisation, girdling of main branches to ensure regular crop, tree covering and fruit bagging, introducing honey bees as potential pollinators and using windbreaks for avoiding damage by the heavy windstorm. Adopting better harvesting practices and timely disposal of produce to reduce post-harvest losses could

be another important strategy for a non-climacteric fruit like litchi. The smart use of adaptation strategies at an appropriate time is the key for success and overcoming the ill effects of climatic change and sustained production of litchi in India.

Keywords: Litchi cultivation, Climate resilient technology, Sustainable production

3.1.4 Strategies for Climate Resilient and Sustainable Development of Oil Palm

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Oil palm is a humid tropical crop and it is native of West Africa. It is highly adaptive to climatic variations and because of this, its cultivation has spread even to South-East Asian countries; its cultivation is reported in more than 40 countries. In India, it is largely cultivated as an irrigated crop due to its perennial nature with indeterminate growth habit. However, rain-fed cultivation with limited irrigation is also possible in locations with mean annual rainfall of >1800 mm having even distribution of rainfall of at least in 8–10 months. As per climate change prediction estimates, higher altitude areas may become more suitable in 2050 and 2100 as there will be improvement in mean temperatures and eventually minimum temperatures too. Therefore, it is imperative to develop adaptation and mitigation strategies to areas presently suitable and to concentrate on higher altitudes for developing production technologies to successfully grow oil palm in a sustainable manner. This paper deals with the impacts of climate change on oil palm productivity, shift in suitable locations and development of climate resilient strategies to combat climate change impacts.

3.1.5 Climate Resilient and Sustainable Production of Mango and Guava in India

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Climate change impacts are going to be positive in general for fruit crops because of their resilient to withstand the harsh climates. In the light of possible global warming, more emphasis has to be given on the development of climate resilient varieties, identification of potential gene/genes for biotic and abiotic stress in the wild relatives and land races which can be introgressed on the commercial varieties background and development of rootstocks for biotic and abiotic stresses. The development of technologies on management of canopy architecture, efficient utilisation of water and nutrients to adapt to warmer environmental conditions. There is need for regional level planning for resource allocation, including land, water, and horticultural developments by considering the climate change into account. The continuation of current and new initiatives to research potential minimises the effects of climate change at farm, regional, national and international level and will help to provide a more detailed picture of how world horticulture and agriculture could change. Hence, a comprehensive plan covering R &D aspect

for all horticultural crops is must and convergence of scientists, policy makers and public is the need of the hour for marching ahead and take the horticulture in to next level.

3.1.6 Strategic Approaches for Climate Resilient and Sustainable Production of Plantation Crops in India

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Plantation crops like coconut .oil palm, cocoa, rubber arecanut coffee ,and tea are high value commercial crops and play a vital role in the indian economy in earning foreign exchange .These crops are likely to be more vulnerable due to excessive use of natural resources particularly water with poor adaptive mechanisms. Climate change might worsen existing regional disparities as it will reduce yields mostly in lands located at lower latitudes, where many developing countries are situated. The water requirement is estimated to increase by 10 per cent for every 1°C rise in temperature. Under such situations, when yield decreases, small and marginal oil palm growers would be affected most. Hence consequences of climate change could be severe on livelihood and social security of the poor in the absence of better adaptation strategies. Strategies to enhance local adaptation capacity are therefore required to reduce climatic impacts and maintain regional stability in oil production. At the same time, plantation crops offer several opportunities to mitigate the portion of global greenhouse gas emissions that are directly dependent upon land use and land-management techniques. This paper reviews issues relating to impacts of climate change with special emphasis on adaptation and mitigation strategies for climate resilient production of plantation crops. Adaptation and mitigation strategies in oil palm could be carried out to alleviate the potential negative effects of climate change. However, important synergies need to be identiûed as mitigation strategies may compete with local agricultural practices aimed at maintaining production. The specific research priorities for plantation crops to combat climate change have also been highlighted.

3.1.7 Innovations in Value Chain Management of Arid Fruits and Vegetables

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Arid horticultural crops cultivated in the western regions of India possess greater nutritional, medicinal, and organoleptic qualities compared to their counter crops cultivated in the tropical and subtropical regions of the country. However, the supply/ value chain of these arid horticultural crops are highly effected by the challenges of severe postharvest losses caused by long and fragmented transport chains, dependency over the intermediaries, poor infrastructure facilities relating to transport and storage, inefficient mandi system, high cost of the packaging system, poor quality of distribution, *etc*. This has resulted in poor price realisation by the growers and exorbitant retail prices to be paid by the end-consumers.

The Indian economy is primarily agriculture based and thus there is an urgent need for development of proper value chain models for increasing the shelf life of perishable commodities in order to reduce the postharvest losses and wastages. This would also increase the farmers returns, and generate employment opportunities for the rural unemployed youth for improvement of their livelihood. Various new initiatives such as adoption of basic production factors, an optimal crop management system, developing post-harvest infrastructure, entrepreneurial management and expertise, logistical infrastructure and finally by improving post-harvest operations related to handling, transport, storage and marketing of produce would go a long way to benefit the farmers with good remunerative price and consumers with good quality produce and also will reduce the losses incurred due to poor post-harvest management and thereby ensuring adequate supply to the consumers.

3.1.8 Climate Resilient Approaches for Sustainable Coconut Production

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In recent years, the long term changes in weather parameters are well established and it has become necessary to work upon an action plan to cope with these changes in every facet of life. The climate change is manifesting itself, and is projected to be intensified in terms of severe weather events such as an Increase in temperature and number of warm days; reduction in summer-monsoon precipitation; long-duration dry spells and resulting droughts; rise in seas levels; and frequent cyclones. As agriculture is one of the most vulnerable sectors to climate change, research approaches needed to be continuously refined to address changing requirements. The possible impact of climate change on coconut production in India has been studied using the 'InfoCrop' model and results indicate an increase in overall production, but in certain coconut growing tracts where at present the precipitation is less and frequency of droughts increasing may become unsuitable in future. It is crucial that, existing technologies such as moisture tolerant varieties, soil and water conservation methods, drip irrigation/fertigation, appropriate cropping systems, and pests and diseases management are scientifically adopted to achieve sustainable coconut production. Based on physiological, biochemical, and anatomical characteristics, ten released varieties/ hybrids were identified as moisture stress tolerant. However, molecular screening techniques are to be developed to obtain more reliable results. This is more relevant for coconut as it is highly heterozygous. To augment the supply of planting material, farmer participatory identification of mother palms showing tolerance in drought-affected areas is to be made as a part of the All India Coordinated Research Project on Palms. It is important to monitor the effect of climate change on natural resources such as soil nutrients, water availability, and microbiome. Techniques based on IoT, AI, and robotics will be of much use in this regard. Aberrations in the weather will bring disequilibrium in the ecosystem which can alter the pattern of incidence and spread of pests and diseases. The changes in crop will further add complexities in this regard. Studies on understanding the unpredictability of pest incidence, preparation of contingency plans, developing robust cropping systems, and dissemination and skill development of crop protection techniques are some of the suggested strategies. To evolve a robust cropping system, the evaluation should include adaptation to climate change (increase in temperature and CO_2 level), energy saving, reduction in emission of greenhouse gases, carbon sequestration, and reduction in pests incidence. It is important to document in detail how coconut based cropping systems are capable of enhancing carbon sequestration and achieving net emission zero, which were the two important commitments made at COP26.

Keywords: Coconut, climate resilient, production, technological production against disease.

3.1.9 Post-Independence Scenario of Table Grape Cultivation in India

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Grape is a high value export oriented fruit crop which has gained significance in India due to location specific suitable modifications. Now it is being practiced in almost all climatic conditions from tropical to temperate and spread over different states of the country. Grape cultivation on a commercial basis is about seven decades old in India and now considered as most remunerative amongst all fruit cultivation in the country. In India around 78-80% of grape is produced for fresh consumption and about 17-20% for raisin making and around 2% collectively for juice and wine production. If we looked 75 years back, the country has shown implausible progress in the grape production. The endeavors of Indian research institutes and innovative grape growers in respect of varietal development, adoption of grape rootstocks and modification of grape cultivation practices pertinent to Indian climatic conditions has made India prominent table grape producing country in the world next to China. To lead global market of table grapes, India needs indigenous grape cultivars with better fruit quality, varieties with vivid aromas/ flavors, wider adaptability, climate resilience and inherited tolerance against biotic as well as abiotic stresses. Besides widening of varietal base and development of abiotic stress tolerant rootstocks some important areas needs to be look into like adoption of protected cultivation, off-season availability and mechanization friendly crop husbandry techniques for enhancing the export potential of the country.

3.1.9 Phenophase Based Inputs for Enhanced Physiological Activity Parameters Contributing Towards Productivity

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3.1.10 Climate Resilient Sustainable Technologies of Dryland Fruits for Economic and Health Security

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India is home land of many dry land fruit crops and the most of them is limited to its growing region only. In spite of their high nutritional and medicinal properties their commercial cultivation is lacking. Most of semi-arid fruits are in the core recipes of many

ayurvedic formulations. 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 semi-arid fruit crops can be a solution of health and nutrition security, poverty, and unemployment. The consumption of semi-arid fruit crops can provide nutrition to the poor and needy masses by meeting the nutrient requirements of vulnerable groups. These 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. Such fruit 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. Many semiarid 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.

3.1.11 Physiological Understanding of Abiotic Factors in Production of Subtropical Fruits

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Fruit crop production, is strongly dependent on orchard environmental conditions. Adoption of fruit crops is becoming essential to meet the ever increasing demand of nutritious food and herbal medicines for the burgeoning population. Abiotic stresses prevalent in subtropical region drastically affect micro-environment of orchards. Among the abiotic factors affecting tree growth and productivity occurrence of moisture stress at important phenological stages is a key factor reducing tree growth and leading to yield reduction. Experiments were conducted to find out sustainable and cost effective moisture management strategies in mango. Three sprays of melatonin (N-acetyl-5-methoxytryptamine) at fruit set stage, pea stage and marble stage respectively were applied @ 20 µM, 50 µM, 100 µM, and 150 µM were applied to replace the three irrigations usually practiced by mango growers in sub tropical region. Three foliar sprays of melatonin @ 00, 20, 50, 100 and 150 ìM were applied at three phenological stages (fruit set, pea and marble stage) in mango trees. To compare with irrigation a set of trees was given 3 irrigations and un-irrigated trees were maintained as negative control. Consecutive three year observations

point out that old leaves were comparatively less affected by moisture stress than the new flush of leaves. Total chlorophyll content in mature leaves of un-irrigated trees was 50% less as compared to melatonin treated trees. In contrast, activities of catalase, peroxidase, superoxidase dismutase and glutathione reductase in leaves were 40-50% less in trees treated with melatonin @ 100 ìM as compared to un-irrigated trees. In the irrigated and melatonin treated plants difference in activities of these enzymes was found to be non-significant. A drastic difference was found in the yield of 'A' grade fruits (fruit weight e" 250g) in melatonin treated trees (@ 100 ìM) and negative control plants (un-irrigated). Application of melatonin in micro molar concentration might be a viable strategy to manage the moisture stress in mango.

Keywords: Abiotic stress, canopy architecture, light availability. moisture stress, shading, temperature.

3.1.12 Emerging Tropical Fruit Crops for Domestic and International Markets

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India is the 2nd largest producer of fruits in the world with the share of 11.3%. The country is also the largest producer of mango, banana, guava, papaya and lemon. Apart from potential traditional fruit crops like litchi, custard apple, pineapple, sapota, jackfruit, aonla, etc. exotic tropical fruit crops such as dragon fruit, avocado, persimmon, rambutan, mangosteen, etc. are also getting place in the fruit basket of the country. The fruit industry of India is characterized with substantial increase in the production. However the share of fresh fruits in total export of horticultural produce is merely 10%. On the other hand, the contribution of processed products is more than 76%. The export of fresh fruit is mainly dominated by grapes, orange, pomegranate, mango and banana. However emerging fruit crops like dragon fruit, avocado, rambutan and mangosteen possess good export potential. Export plays a key role in enhancing economic growth. However with the participation of traditional and exotic fruit growers, the scope of fruits will be enhanced. India is blessed with different types of agro-climatic regions which offer diverse climate for emerging crops like litchi, custard apple, pineapple, dragon fruit, jackfruit, avocado, rambutan, etc. Change in the dietary pattern further increases the potential of fruit crops like, jackfruit, jamun, aonla and tamarind. Pigment rich fruits such as red-bulb jackfruit (carotenoid and lycopene), jamun (anthocynin) and red-fleshed dragon fruit (betalains) have great export potential as they possess high anti-oxidative property. Additionally, tamarind (polyphenols), rose apple (quercetin), bael (carotenoid) and aonla (ascorbic acid) also possess great export potential. Of late utilization of unripe jackfruit for culinary purpose has increased many folds since the product has low glycaemic index, which make it suitable for diabetic patient. Nowadays, the breeding approaches focus on nutritional aspect and in turn different varieties of tropical fruits have been developed. The Indian Institute of Horticultural Research has identified red bulb jackfruit varieties viz. *Sidhu* and *Shankara* which may be exploited for their export potential. Similarly, Arka Sahan and NMK-01 are promising varieties of custard apple possessing export potential. Nowadays geographical indications (GIs) are increasingly viewed as a potential tool foe economic exploitation of crops. GI tags for fruit crops: litchi - Sahi and Tezpur, pineapple - Tripura Queen and Vizhakulam and custard apple - Beed will also be instrumental in enhancement of export potential. The export potential of emerging fruit crops is also high owing to the availability of export market such as Bengladesh, Nepal, Arabian countries and Southeast Asian countries.

3.2 Oral Presentation

3.2.1 Sustainable Production Moringa for Improving the Immunity system

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The mineral packed, vitamin rich, nutritious vegetable called the Miracle tree or drumstick or horse radish tree or West Indian Ben is botanically *Moringa oleifera* Lam. is a tropical crop which can be cultivated in tropical and subtropical climates due to its quick adaptability to drought and frost conditions. All the parts of moringa plant possesses human value. The Ayurvedic Scripts revealed that the Moringa leaves are capable of preventing 300 diseases that the human normally faces in his routine". Once Moringa was eaten by ancient Indians, Greeks and Egyptians. Moringa oleifera leaves have been used in traditional medicine passed down for centuries in many cultures. More recently, the modern scientific community has begun to validate many of these claims with over 1300 studies and research publications on Moringa. While discussing the health benefits of Moringa, the list is exhaustive and unending. It contains around 20 type of amino acids, 46 antioxidants, 36 anti-inflammatory compounds and more than 90 nutrients which make it one of the best nutritional supplements. It is an excellent source of minerals like iron, calcium and vitamins A, B, B1, B2, B3, B6, C, E as well as macro nutrients, trace minerals and phytonutrients. Besides these, it is a good source of quality protein and dietary fibre. (Gopalan *et al.*, 1981). These vivid green leaves are nature's superpower food. It has the power to cure the world from malnutrition. We can use Moringa as part of our daily diet and to aid in our healthy living. Different part of this plant such as the bark, leaves, immature pods, roots, fruit, flowers and seeds serve as cardiac and circulatory stimulants, possess antitumor, antipyretic, antiepileptic, cholesterol lowering, antihypertensive, anti-inflammatory, antispasmodic, antiulcer, diuretic, antifungal, antibacterial hepatoprotective, antioxidant, antidiabetic activities. Traditionally, they serve for the treatment of different ailments in medical system. Phytochemical's such as tannins, sterols, terpenoids, flavonoids, saponins, anthraquinone, alkaloids and reducing sugar are also present along with anti-cancerous agents like glucosinolates, isothiocyanate, glycoside compounds and glycerol-1-9-octadecanoate . A variety of food items with proper proportion of protein, carbohydrates, fats, minerals and vitamins etc. constitute the balance diet. It provides all the required nutrients for the healthy body and a strong immune system. Each and every part of Moringa has miraculous beneficial properties, so Moringa is a very simple and readily available natural source to boost the immune system of human beings.

Keywords*: Moringa, immunity booster*

3.2.2 Role of Melatonin in Flowering, Fruit Set and Fruit Ripening in Fruit crops

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Melatonin is an animal hormone that plays a role in a variety of regulatory processes, including sleep. Phytomelatonin, a form of melatonin found in plants, was identified in 1995. Melatonin is involved in a wide range of physiological functions in plants as well. Melatonin causes a blooming delay by stabilising DELLA proteins and promoting FLC transcription. Melatonin has the ability to promote parthenocarpy during fruit set. Melatonin stimulates fruit ripening and delays senescence. The formation of a melatonin peak during the intermediate phases of flower growth has been described, and a protective role for melatonin during flowering against stressful circumstances like light and temperature has been suggested. In fruit set, the most significant role of melatonin is its capacity to induce parthenocarpy. This effect in pear is the consequence of the induction of GA biosynthesis, producing fruits similar to those originated by hand pollination, promoting cell division and mesocarp expansion. Melatonin is primarily involved in stress situations in plants, but it also plays a role in germination, plant growth, and senescence, as well as serving as a protective agent that improves important processes like photosynthesis, CO_2 uptake, cell water economy and primary and secondary metabolism. Changes in the majority of plant hormones have been linked to melatonin.

Keyword: Flowering, Parthenocarpy, Transcription, Melatonin, Quality fruits, Ripening, Senescence.

3.2.3 Gross Return Maximization through Inclusion of Vegetables Crops as Intercrops and Application of Bio-agents in Sole Crop of Banana in District Lakhimpur-Kheri of U.P.

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A field study has been conducted during 2019-2021 in district Lakhimpur Kheri at farmer's field regarding scope of intercropping in sole crop of banana from five locations in Sub division of Nighasan .As the main crop banana planted in double row with spacing of six fit. The remaining inter space can be utilized to increase per unit area profit. The main crop as well as inter crops fed with organic manure 25 tons/ ha. The farmer also using bio agents during land preparation such as Trichoderma @ 2.5 kg/ha, Pseudomonas @ 2.5 kg/ha and PSB culture. After that they had planted cauliflower, potato, garlic and chilies as inter crop in double row of banana. Farmers generally takes banana as sole crops, but if planted such a way that the various vegetable crops can be grown during winter season as inter crops and can be benefited by selling their produce and for own consumption. Farmer's only cultivated

banana crop as sole with double row at a spacing of six feet and realized approximately gross return of Rs.165000.00 per hectare and after inclusion with winter vegetable crops they had obtained approximately gross return of Rs. 210000.00 per hectare.

Keywords: Banana , intercrop, vegetables crop, gross return

3.2.4 A Super Future Fruit of India: Dragon Fruit

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In India, Dragon Fruit is introduced as super fruit and have medicinal properties to cure a disease. Dragon fruit has attractive in colour, edible black seed inside the pulp. This Fruit is also known as strawberry pear. The advantage of crop is that once planted, it will grow about 20 years. It yields from 14-16 months after planting of stem of cutting. Dragon fruit has high nutritional quality and rich in Vitamin C, Vitamin B group, fibers, calcium, phosphorus flavonoids and antioxidant properties. It has a property to fight against cardio vascular disease, hypertension, diabetes, obesity, cancer etc and beneficial biological activities against pathogenic microbes such as fungi& virus. Dragon fruit is also helps in reducing blood sugar level, lowering cholesterol level, reinforce the bones, tissue formation, treat the bleeding problems of vaginal and also help in digestion. The dragon fruits have good nutritional nutraceutical properties and so many benefits.

Keywords: Dragon fruit, health benefits, nutritional property, nutraceutical,

3.2.5 Viticultural Practices to Prevent Bunch Compactness and Improvement in Quality and Colour Development in Grapes cv. Red Globe

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Red Globe is the most important table grape cultivars which is known for its prolificity in bearing, compactness of bunches and inadequate colour development, which ultimately lowers its export quality in international market. This study was started with the aim to improve berry size and better cluster compactness along with uniform colour development, to improve the bunch quality with application of different viticultural practices *viz*., berry thinning at 8mm stage, ethrel dip (500 ppm), basal leaf removal

and bunch covering either alone or in combinations which was compared against untreated control. This experiment was conducted during two consecutive seasons in a vineyard located in Block-I, Division of Fruit Crops, ICAR-Indian Institute of Horticultural Research, Bengaluru. The bunch compactness was evaluated according to the following classification: very loose, medium loose, and very dense bunches. The quality characteristics of bunches and colour improvement were also evaluated. The medium and lower number of berries per bunch was recorded in thinned bunches, whereas, in control maximum number of berries per bunch recorded with more compactness. The better cluster compactness (1.45 and 1.24), berry diameter (25.27 and 27.56 mm) and 50 berry weight (479.5 and 585.2 g) were recorded in combination of berry thinning, ethrel and basal leaf removal treatments, respectively. Highest Brix-acid ratio (85.89 and 80.06), colour intensity (2.50 and 3.37) and total anthocyanins content (2.80 and 4.54 mg/g FW) showed a similar pattern under treatment combination of berry thinning, ethereal and basal leaf removal as compared to control, respectively in season-I and II. Berry thinning along with ethrel dip and basal leaf removal in 'Red Globe' was efficient for reducing bunch compactness. These results suggested that the treatment with combination of berry thinning, etherial dip and basal leaf removal is effective in improving the bunch and berry quality attributes in Red Globe.

Keywords: Compactness, thinning, ethrel, colour, Red Globe

3.3 Poster Presentation

3.3.1 Neem Tree - A Must for Every Household for Sustainable Development

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The most popular and beneficial tree since ages , Neem (*Azadirachta Indica*) is a large evergreen tree under family Meliaceae . A very common and worthy eco friendly tree neem is used in several manners , almost every part of the tree i.e. leaves ,twigs , fruits ,flowers , seeds and bark is utilized . It contains around one thousand chemicals out of which more than hundred are terpinoids . Neem kernels contain 30-40% oils, 2.5 to 3.0% teripinoids and 0.2-0.65 % azadiractin . Neem is a fast growing tree that grows best in semi arid tropical regions , usually flowers in March- April . Several traditional medicines are made with the leaves , root, seeds and barks etc. The fresh juice of leaves is beneficial in typhoid , urinary disorders , leprosy , intestinal worms , jaundice , skin problems and several other diseases .Soft twigs are used as brush for teeth cleaner .

Eating 8-10 fresh leaves daily in morning develops resistance power in body . Neem oil is used for soap and Pharmaceutical products now days , neem based products are widely used in organic farming / agriculture , still dried leaves are used for safe grain storage in rural areas . Neem has a major role in ITK as well as neem based products are widely used for our livestock health and hygiene , It heals the injuries , protecs the environmental pollutions , provides fuel , timber and fodder . Fatehpur one of the aspirational districts of identified 112 Districts in India is also covered under vrihad vriksharopan abhiyan, the mass plantation abhiyan shall be very crucial and beneficial in all the development blocks of district . Definitely

these approaches shall help to reduce the pollution level for the benefit of the rural mass and farming community.

Keyworks: Aspirational district, Neem, Environment, Abhiyan, Terpinoids

3.3.2 Intercropping of Azad Dhaniya-1 in Banana Plantain Crop

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Banana is fourth most important crop grown in the world. The productivity per unit area, beetle infection and gestation period may be reduce by adopting coriander as intercrop during rabi season. Intercropping of coriander may break the life cycle of beetle, reduced weed population as well and farmers received extra income from it. Banana is planted at distance of 6×6 sq/ft. apart during June. K.V.K. has organized off campus training on scientific production of banana at village level and conducted FLD at farmers field during 2017-18 and 2018-19 with objective maximum utilization of natural recourses, reduce insect infection and got the extra income.

S.No.	Particulars	Banana + Coriander	Banana
1	Method of sowing/plantation	Ten rows of coriander between banana row	6×6 sq/ft
2	Seed rate + number of plant (per/ha.)	4.25+ 3150	3150
3	Land use and intercrop (%)	62.5	37.5
4	Cost of cultivation (Rs/ha.)	203750 + 7750 = 211500	211750
5	Saving in term of irrigation, weedicide, insecticide, cultural operation etc. (Rs. per/ha)	12550	-
6	Yield (q./ ha)	875.25 + 5.10	879.5
7	Gross profit (Rs/ha)	842400 + 35700+12550 = 890650	813500
8	Net profit (Rs. per ha)	679150	601750
9	B:C Ratio	4.21	3.84
10	beetle infection (%)	4.56	12.33

The average two year data presented that land use and intercropping percentage was (62.5%) in intercrop field and (37.5%) in control field. beetle infection (4.56%) was observed on one spray of insecticide in intercropped field while (12.33%) in control field. It was also observed that intercrop may also save Rs.12550.00 / ha. in term of saving of irrigation schedule, weed population and cultural operations. Total cost of cultivation was Rs. 211500.00 /ha. and Rs. 211750.00 /ha., gross profit Rs. 890650.00/ha. and Rs. 813500.00/ha respectively. Net profit Rs. 679150.00 and Rs. 601750.00 was obtained in intercropped filed and control field, respectively.

3.3.3 Effect of Temperature Rise on Crop Growth & Productivity in Central Plain Zone in Uttar Pradesh

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Crop growth and development is mainly a function of temperature if water is available to the optimum satisfaction. Although weather and climate had never been constant and they had always experienced changes either positive or negative but recent atmospheric warming was unprecedented. An increasing global warming trend started in 1940s after industrial revolution and it had no end. During the last century, the temperature increase was noticed around 0.7^0C which has been surpassed by the first decade of 21st century scoring about 1^0C average global rise. Also it ranked as the warmest decade ever recorded over the surface of earth and it brought numerous anomalies in the processes of the climate system in the form of frequent floods, droughts, heat/cold waves, localised heavy downpour and highly variable weather patterns in different parts of the world. India also suffered similar happenings which occurred mainly due to rise in temperature leaving the serious challenges for sustainable food production. Day and night temperatures in India have followed a significant increase during the last 30 years due to which heat stress on plant growth and development has also enhanced. Higher night temperatures have given rise to increase in respiration hence reducing the net gain in the form of grain yield. Sudden shoot up of air temperatures in early spring when wheat and other winter crops were at reproductive stage of their life cycle caused significant reductions in the grain yield despite affecting the apparent health of the crops. Current rise in temperature is likely to continue during this century and extreme events associated with rise are also expected to increase in frequency, intensity and persistence increasing the uncertainty in sustainable crop production. We have to grow more by adopting a multidisciplinary approach to meet the food demand of ever increasing population of India with fewer amounts of available land and water resources in a highly hostile climate. Increased temperature will affect the physiological processes necessary for crop growth and development of crops and ultimately crop yields are most likely to drop over the present level. Climatic anomalies will play an important role in increasing the uncertainties in crop production.

3.3.41 Economic Impact of Agro-meteorological Advisories Services (AAS) on Onion and Garlic Crop under Fatehpur District of UP

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The present study was undertaken to know the usefulness of AAS and assessing the economic benefit through its adoption in day to day farming operation by the farmers. The District Agromet Unit located

at Krishi Vigyan Kendra (KVK) Fatehpur serves as a nodal center of AAS for the farming community of the district. The Agro-meteorological Advisory Service (AAS) provided by India Meteorological Department mainly aims to enhance the farmers' income by proper utilisation of inputs and adopting suitable management practices according to the weather condition. The study was conducted at ***Fatehpur*** district of Uttar Pradesh for *onion and garlic* crop which is predominantly grown in the region during 2021-22 *Rabi* season. A group of farmers following AAS regularly provided through DAMU were selected randomly from different village under different block of *Fatehpur* district and farmers not following the same were also identified for the study. The economic impact and usefulness of block level AAS has been assessed through analyzing the data collected from the selected farmers. The result showed from the study that most of the cases forecasted data is well matched with actual data and hence those farmers who have adopted AAS timely in their farming operation realized more net income on an average of Rs 8,428.57/ha by saving the cost of irrigation, insecticides, proper plant protection measures and date of harvesting etc. as compared to non AAS farmers having the same crop grown in their village. Thus it can be concluded from the study that AAS is an effective tool for minimizing the crop losses caused due to aberrant weather and played a significant role in enhancing the production and farmers income.

Keyword: Economic impact, AAS, Onion, Garlic, Fatehpur

3.3.5 Doubling Farmer's Income through Intercropping of Garlic with Sataver *(Asparagus racemosus)*

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Satavari *(Asparagus racemosus)* is an important indigenous medicinal crop. It has many medicinal properties like breast milk, aphrodisiac, dysentery, tuberculosis, diabetes, immune diseases, energy providing etc. It is estimated that in India more than 500 tonnes of sataveri roots require for various medicinal preparation. Intercropping can contribute to sustainability, intensification, increasing productivity, agro-ecosystem, reducing intercultural operational, employment generation and crop intensity etc. Sataveri has long gestation period (14-16 months) thus intercropping of different crops is must for optimum utilization of land.

A field observation was taken in 2017-18 from the village Madra block Bejham of district Lakhimpur-Kheri. Satavari variety Tanakpur peeli has planted at 60x60 cm. apart in the month of September and garlic variety G-2 was sown in month of November at 15x15 cm. apart between two rows of satavari. It was observed that yield of satavari 37.5(q./ha.) dry and garlic 24.25 (q./ha),respectively obtained. The gross cost, gross return and net return was Rs. 250500.00/h, 606500.00/h and 356000.00/h, respectively, of both crops (Satavari & Garlic). It is also observed that extra income Rs. 71000.00/h obtained through garlic as intercrop in the four month period of initial stage of Satavari field.

Keywards: Intercrop, Garlic, Satavar, Economic, medicinal

TECHNICAL SESSION-4

INNOVATIONS IN PRODUCTION SYSTEM MANAGEMENT FOR VEGETABLES, TUBERS, SPICES AND FLOWERS AND SUSTAINABILITY

4.1 Keynote Presentation

4.1.1 Climate Resilient and Sutainable Development of Vegetables

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The agriculture play major role for livelihood of poor farming community. About 54% total India workforce is engaged in agriculture and allied sectors. Among the agriculture, vegetable sector is most important due to its recognitions as essential food and nutritional security. Although, India is 2nd largest producer of vegetables in the world after China. The per day requirement of vegetables are about 350 g, whereas availability is about 280g per day per person. According to an estimate, India will need to produce 300 million tonnes of vegetables by 2050 to meet the requirement of increasing population. Therefore the major challenges are to increase the productivity on sustainable basis to manage the food and nutritional security of the country in the regime of climate change. In addition to natural climate variability observed over comparable time periods a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere is called "Climate change" (UNFCC, 1992). Vulnerability of any system to climate change is the degree to which these systems are susceptible and unable to survive with the adverse impacts of climate change. According to Fahad et al., 2007, due to climate change, drought, and heat stress have become the most important limiting factors to crop productivity and ultimately the food security. Increase in temperatures, unpredictable rainfall and declining in some region, more frequent extreme low and high temperature, more droughts, elevated level of Co_2 and emergence of new pest and disease are the changes that took place in the climate gradually over decades. Average global combined temperature of land and ocean surface has increased by 0.85^0C between 1880 and 2012 (IPCC, 2014). Among the vegetable crops, few are adopted to stress conditions but maximum have sensitivity to climate change. Due to climate change, many new diseases and pests are emerging and becoming the threat for the farmers. About 60 vegetable crops are being cultivated in the country from north to south and east to west. The production of vegetable crops are constantly threatened by environmental stresses, including biotic and abiotic factors that reduce crop yield and quality. During the growing season, vegetable crops are facing many unacceptable environmental conditions, like drought, heat, salinity, flooding, heavy metals, and change in soil pH. These stresses have negative impact on plants survival, biomass production and estimated up to 82% loss of final yield. In recent years, with changes in the cropping systems and climate, and introduction of highly input intensive high yielding varieties/hybrids, a shift in pest status has been observed. Climate-resilient agriculture (CRA) is an approach that includes sustainably using existing natural resources through crop and livestock production systems to achieve long-term higher productivity and farm incomes under climate variabilities. Apart from the regular insect pests *viz*., whitefly (*Bemisia tabaci* (Genn.), fruit fly (*Bactrocera cucurbitae* Coq.) particularly in cucurbits, serpentine leaf miner (*Liriomyza trifolii* (Burgess), mites and other sucking pest, there is a paradigm of shift of insect pests in recent years. Emergence/re-emergence of

insect pests has occurred in the vegetables. Occurrence of melon weevil, (*Acythopeus curvirostris citrulli*) as a serious pest was recorded from sponge and ridge gourds. About 70-80 per cent fruits and 30 per cent shoots of sponge gourd were severely damaged by this weevil. The white plume moth (*Sphenarches caffer* (Zeller)) was observed as an emerging and serious threat in bottle gourd. Larvae of plume moth, *S. caffer* damaged the leaves and buds of bottle gourd by scraping the chlorophyll portion and damage was more severe when they fed on the emerging buds resulting in restricted growth of the plants. Recently serious incidence of a mirid bug, (*Nesidiocoris cruentatus* (Ballard)) was observed on tender leaves and young fruits of bottle gourd. Brown puncture spots with on the rind with sap oozing out from the tender fruits was the characteristic symptoms of this sucking pests. The affected fruits often failed to fetch a good market price. Cucumber moth or pumpkin caterpillar (*Diaphania indica* (Saunders)) has become an emerging pest of vegetable crops especially bitter gourd, cucumber, pointed gourd and gherkin. Light green larvae feed chlorophyll portion of the leaves by webbing them together. They also feed the reproductive parts of the plants *viz*., flowers and young fruits causing serious damage (Rai *et al*., 2014). As most of the cucurbits are grown during summer season, the severity of red spider mite is also increasing day by day. The ability of a crop to withstand a particular stress is directly related to its survival and productivity. Other example are chilli gall midge (Asphondylia capparis) in parts of Tamil Nadu and Andhra Pradesh, solenopsis mealy bug (Phenacoccus solenopsis) in brinjal, tomato, okra and cucurbits; Hadda beetle (Henosepilachna vigitioctopunctata and Epilachna dodecastigma) on cowpea and bitter gourd. In recent years, blossom blight- *Choanephora infundibulifera* (30%), bacterial wilt and angular leaf spot -*Erwinia* spp. (10%), Cucurbit *aphid borne yellows virus* (46%), downey mildew- *Pseudopernospora cubensis* (32%), gummy stem blight- *Didymella bryoniae* (50%), leaf spot (*Cercospoara* and *Colletotrichum*), 18- 23%, powdery mildew- *Erysiphe cichoracearum (28%*), *root knot nematode- Meloidogyne* spp. (5%), *Tomato leaf curl New Delhi virus* (22-47%), wilt (*Fusarium* spp.), Zucchini *yellow mosaic virus* (10%), became major emerging problem for the cultivation in India under abrupt weather condition / changing climatic scenario. These diseases are more severe under protected cultivation when the temperature rises above 30°C and humidity 80%. In general temperature and moisture play important role for fungal and bacterial pathogen biology such as survival, germination, infection and disease development. High moisture favours incidence of soil borne pathogens such as Phytophthora*, Pythium, R. solani, Macrophomina* and *Sclerotium rolfsii*. Due to fluctuation in temperature and high vector population the dynamics of virus infestation are changing very fast. In a survey of curbitaceous crops in Uttar Pradesh; poty virus, tospo viruses, begomo viruses, tobamo virus, polerovirus and cucumovirus were detected in the samples. The maximum percent of incidence was recorded for begmovirus (93.33%) followed by poty virus (39.44) and tobamovirus (38.33%). The extent of damage was found maximum in cucumber, snake gourd, watermelon and ridge gourd. These types of viruses adapt rapidly to changing conditions. Screening of germplasms for various abiotic and biotic stress and using those identified resistance lines in a breeding programme is one of the way to combat climate change. Advanced biotechnological technologies will also be helpful in development of durable tolerant cucurbits varieties/hybrids which will be suitable for fluctuating climatic condition. There are tremendous genetic diversity among the crops, and the range of adaptation for different vegetable species includes tropical and subtropical regions, arid deserts, and temperate regions. Screening and evaluation of diverse collection of accessions may provide an opportunity to broaden the genetic base and a boost to current breeding program. Resistance sources are generally present in landraces and wild relatives. For developing multiple biotic stress resistant lines, validity of already available molecular markers with established linkage may be tested in order to examine their feasible use in breeding programme for development of parental lines. Conventional breeding as well as molecular approaches are used for development of new varieties/lines. CRISPR-Cas9 and gene editing new technology are being used for development of new lines with targeted gene. The development of hybrid/varieties with better adaptability under stress conditions should be undertaken. For developing multiple biotic stress resistant lines, validity of already available molecular markers with established linkage may be tested in order to examine their feasible use in breeding programme for development of parental lines. Other strategies are development and adoption

of water-smart technologies like a furrow-irrigated raised bed, micro-irrigation, rainwater harvesting structure, cover-crop method, greenhouse, laser land levelling, cultivating less water requiring varieties, alteration in planting and sowing dates can support farmers and adopting zero-tillage to decrease the effect of variations of climate.

4.1.2 Climate Smart Horticulture

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Agriculture, horticulture and live-stock production are subjected to climate change. Hence, there is necessity of adopting the climate smart horticulture practices in order to increase the productivity/farm income, enhance resilience and reduce the emissions.The growth of horticulture in India started with a share of 5% GDP of agriculture 3-4 decades ago to 30.4% now; and production from 25 MT (1950-51) to 334.60MT(2020-21). It is national imperative now to maintain the same trend of horticultural growth to address the nutritional, environmental and economical well being of the people.

The climate change is posing threat to sustainable development of horticulture sector. It is right time to develop the resilient horticulture by adopting holistic approach with short and long term planning viz. understand the impacts and relevant adaptation strategies to sustain the productivity and profitability of horticulture crops in the climate change scenario and synthesis of current knowledge to develop strategies for adaptation and mitigation to achieve climate-resilient horticulture.

The suggestive adaptation and mitigation strategies based on current knowledge are in case of extreme heat use heat tolerant varieties; promote crops/plantations and/or crop varieties with a higher heat tolerance and/or optimal heat range, short cycle varieties; reduce the effect of heat stress at key phenological phases (germination and flowering) and improve final yields &reduce plants' exposure to heat by shortening the growing cycle.

Optimal crop calendars based on historical climate data and seasonal forecasts to support decision-making avoiding heat-stress conditions at crop's sensitive phenological phases; selecting crop practices based on timing of sensitive stages and-critical damage temperature relative to the probability and risk of extreme temperatures; determining the planting date for minimising the potential of extreme temperatures.

Rows of trees can protect crops/plantations by breaking strong winds, reducing soil erosion, increasing crop yields, and protecting plantations from heat and cold conditions.

Adoption of water saving irrigation methods such as drip irrigation (surface/subsurface); and/or partial-root zone drying (PRD) that maximises water use efficiency by adding water only on half of the root zone

Real time irrigation water management that considers the farm specific weather, crop, soil and irrigation system in real time and enable to apply water with precision; and in turn reduces soil erosion and macronutrient losses from leaching, promotes weed control as water is precisely applied when, where and how-much needed and reduce the risk of diseases that occur under damp-conditions. Examples include PhuleIrrigation Sceduler, a mobile based decision support system developed by MPKV, Rahuri

Use IoT enabled automatic irrigation systems that not only enable to apply water remotely with precision but also use water resources more efficiently and avoids permanent-wilting point as well as saturation,

reduce losses from direct evaporation by providing opportunities to apply water-when evaporation rates are lowest (dawn and/or dusk). Example includes Auto-Phule Irrigation Scheduler (weather based) and Phule Soil Moisture Irrigation Scheduling System (moisture based) developed by CAAST-CSAWM, MPKV under ICAR-NAHEP Project.

Soil organic carbon: Conservation agriculture technologies (reduced tillage, crop rotations, and cover crops), soil conservation practices (contour farming) and nutrient recharge strategies can refill soil organic matter by giving a protective soil cover.Integrated nutrient management that deals with the application of organic and inorganic fertilizers, in addition to farmyard manure, vermi- compost, legumes in rotation, and crop residue for sustaining soil health for the long term is required.Developing the early warnings and issuing tailor made alerts and advisories that are farm specific to farmers by promoting the establishment of Smart Weather Stations at village level to begin with and then to farm level as the prices start decreasing.Development of climate-resilient technologies for horticultural crops would be essentially required to insulate horticultural production from weather vagaries.

4.1.3 Impact & Improvement Strategies for Climate Resilience and Sustainability in Onion & Garlic

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Climate change is global, but its impact and extent varies in different region and crops. There is an urgent need to take up suitable possible measures to cope with the challenges due to climate change in future. One of the strategy is to screen the onion germ-plasm under hot spot areas or simulate within climate change condition and to identify photo and thermo neutral genotypes which can sustain climate change for year round supply. Production technology also plays major role in sustaining onion production, but now focus on research shall be to standardise the technology to face the climate change by manipulating irrigation, fertigation, crop geometry, identification of suitable anti-transparent during drought or high temperature. Critical stages affected by changing climate and various factors are required to be studied systematically. Focus shall be towards development of technology for precision farming in onion bulb as well as seed crop. Systematic studies are required on impact of climate change on insurgence for development of new pest and disease including the effect on existing one along with development of management practices. There is a need to develop area specific intelligent forecasting modular with farmer friendly management strategies. In view of the potential impact of climate change on onion production, a critical analysis, planning, management and precise knowledge of most erratic abiotic climatic factor in a given ecosystem is highly essential. There should be area specific intelligent forecasting modular in advance with farmer friendly management strategies. Innovative methods are needed to be developed for making simulation models for onion crop and must be validated in different agro-climatic zones. Thus, various improved adaptation strategies and mitigation technologies could be worked out and farmers awareness will successfully helps in overcoming this environmental disasters and thereby saving crop.

4.1.4 Strategies Approaches for Climate Resilient and Sustainable Production of Seed Spices

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The impact of global warming shows its presence in many parts of the planet including Indian subcontinent during last few years. Similar to other agricultural and horticultural crops seed spices also facing the pressure of climate change. Different biotic factors (insect pest and diseases) and abiotic factors (temperature, photoperiod, rainfall, sunshine hours, cold & hot winds, hail storms, thunder storms etc.) influence different physiological growth stages like flowering, fruit setting, fruit development, seed setting and final reproductive or vegetative yield of seed spices directly or indirectly. High and/or untimely rainfall and humidity invite sucking pests and diseases like blight, stem gall, root rot, powdery mildew, gummosis in almost all the seed spices (cumin, coriander, fennel, fenugreek, nigella, ajwain, etc.). High temperature with low rainfall resulting into drought conditions influenced reduced plant growth, pollination and flower & seed development. Besides plant growth and seed yield, the quality of the produce also influenced negatively by the stress environmental conditions. Development of climate resilient varieties and technologies is the need of the hour in seed spices sector. Research works on drought tolerance studies has been initiated through conventional as well as modern breeding tools to find better ideotypes. Thrust is also being given on the development of area specific crop management technologies such as alteration in sowing dates and crop geometry, line sowing, use of micro irrigation system and water conservation, IPM, IDM & IWM, organic management, mulching, site specific cropping and farming system etc. to mitigate the influence of climate change in seed spices. Cultivation of seed spices under protected structures, walls (plastic/cloth/gunny bags) against cold winds in winters and under shade nets in summers also proved to minimise the impact of hail, frost, snow, hot winds and drought.

Keywords: Climate change, Strategies and approached, Climate resilient varieties and technologies, Sustainable production, Seed spices

4.1.5 Strategic Approaches for Climate-resilient and Sustainable Production of Potato

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Potato is a crucial crop for global as well as national food and nutritional security. The consequences of changing climate on potato production are multifaceted and coupled with warmer winters, shortening potato growing window, extreme weather events, and changing diseases and pest scenarios. Breeding varieties with high yield and early maturity, tolerant to abiotic stresses (heat, drought, and salinity), resistant to biotic stresses (Late blight, emerging insect pests, viruses, nematodes, bacterial wilt, etc) can ensure wholesome potato production in traditional areas and potential new areas (tropicalisation) in the future. Enhancement of nutrient and water use efficiency is a significant challenge and seeks the

focused attention of researchers. For sustainable potato production, adopting suitable measures at farm levels is the key. Improving precision in nutrient and water as well as in pest management with the use of DSS, sensors and drone will add to climate resilience and economic sustainability in potato production system. GAP promotion is vital for ecological equilibrium and quality potato production. Drones has been demonstrated for rational use of agrochemicals on potato crop, technology needs to be expanded to larger area. With the broader use and application of information technology tools like smartphones and the internet, a straightforward adaption of mobile-based apps, DSS etc., can be targeted and attained for precision farming. Region-specific improvement in the local technologies in line with the farmer's needs and establishing a reliable and steady supply chain between producer, processor, and policymakers driven by the market is crucial for sustainability. Produce more with minimal and judicious use of resources is the key strategy for climate-resilient and sustainable potato production.

4.1.6 Strategies Approaches for Climate Resilient and Sustainable Production of Onion and Garlic

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Climate change presents one of the greatest challenges to the productivity and sustainable growth of onion and garlic. The climate change may negatively affecting the production and productivity particularly vulnerable to smallholder farmers in near feature is due to extreme events such as droughts and floods as well as abrupt changes in temperature and increased frequency of pest and diseases have resulted negatively affecting the onion and garlic crops are grown mostly as irrigated crops in semi-arid regions of the country and are very sensitive to moisture stress. The adaptation approaches are having to be recognized as an essential intervention to reduce vulnerability and negative impacts from changing climate. The onion and garlic farming community requires local specific climate adaptation strategies for reducing the negative impacts of changing climate and sustainable production. To reduce vulnerability and improve resilience of production activities, the practices methods should be look at adaptive and can be withstand the sudden shocks of climate change. These practices must be flexible enough to prepare and only the climateresilient agriculture can be achieving by the enhanced productivity by the introducing and adaptation of abiotic and biotic stress resistance new onion and garlic varieties, improve soil health is a key property in building crop resilience, water management by sensor based micro irrigation, crop rotation, intercropping, farm mechanization, management of pests and diseases and post – harvest management by construction of large scale low cost storage structures, on farm storage facilities, cold storages with subsidy rates and marketing intelligence.To facilitate these effective and successful approachesimplementation consists of farmer-to-farmer learning approaches, extension networks, maintaining a community exchange system and access to market information by use of smart phones and gender smartness.

Keywords: climate change, garlic, onion, resilient-agriculture, smart farming, vulnerable

4.1.7 Approaches for Climate Resilient and Sustainable Production of Cut Flowers

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Among the horticultural crops, ornamental crops are emerging as high value crops that can spur more business opportunities and generate more household income than conventional crops, such as rice, wheat and maize. Farmers associated with horticulture crops, having shorter maturity time spans compared to conventional crops such as cereals, hence flower crops are more attractive in the unreliable climatic conditions. Further, with demographic pressure and shrinking land sizes, significant areas are being converted to residential estates. Due to urbanisation the use of flowers, especially cut flowers has increased to a greater extent. Farmers has opted horticultural farming adopting new technologies such as greenhouses, which produces more with less land. Commercial production of cut flowers particularly grown under open field conditions like gladiolus, tuberose, rose, chrysanthemum will be severely affected by climate change leading to poor flowering, improper floral development and colour. For instance, chrysanthemum which is a short-day plant, the flowering round the year in open field condition is not possible. The higher ambient temperature can have direct impact on volatile fragrances that the flowers emit, deterioration of pigments leading to dull shades, shift in insect pest and disease outbreaks, absence of winter chilling will reduce flowering, reduced post-harvest life, poor pollination and seed set. The spikes of the cut flowers like gladiolus and tuberose remain short, thin and having fewer florets of inferior quality. The spikes of gladiolus become zig-zag in shape. The paper discusses the impact of climate change and suggest strangles to reduce the negative impact

4.1.8 Strategies and Approaches for Climate Resilient and Sustainable Development of Ornamental Horticulture

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Floriculture is a multifaceted enterprise in India. It is characterized by growing traditional flowers (loose flowers) and cut flowers under open field conditions and protected environment conditions respectively. India also has a strong dry flower industry, with substantial contribution (>70%) to floricultural exports. Other floricultural segments like fillers, indoor plants, landscaping plants, seeds and planting material, turf grass and value added products also contribute their share in the overall growth of the sector.

The traditional flower cultivation, comprising of growing loose flowers mostly for worship, garland making and decorations, forms the backbone of India floriculture, which is mostly in the hands of small and marginal farmers. About 305000 ha of area is under floriculture producing 2301000 MT of loose flowers and 762000 MT of cut flowers annually (2019-20 second advanced estimates-NHB).The major production comes from Karnataka, Tamil Nadu, Andhra Pradesh, Uttar Pradesh, Rajasthan, West Bengal,

Bihar, Jharkhand, Kerala and Telangana while the major markets are in Chennai, Bengaluru, Kolkata, Hyderabad, Kadiyam, Pune, Mumbai and Delhi. A small portion of loose flowers is being exported to Middle East, UK and USA for the expatriate Indians.

Floricultural exports from India comprise of fresh cut flowers (to Europe, Japan, Australia, Middle East and USA) loose flowers (for expatriate Indians in the Gulf) cut foliage (to Europe) Dry flowers (To USA, Europe, Japan, Australia, Far East and Russia) Potted Plants (Limited to Middle East) besides seeds and planting material. Dry flowers alone contribute nearly Rs.320 crores (70%) of total exports valued at Rs.575 crores (2020-21).

The main global challenge facing the floriculture industry today is the impact of climate change and the issue of carbon footprint. IPCC-GCM projections for India indicate that the annual temperature will increase by 2 to 3.5^0C. Similarly annual precipitation is expected to increase by 10-20% but, the seasonal variations would range from deficits to excesses of the annual precipitation.

The higher ambient temperature has a direct impact on i. volatile fragrances that the flowers emit; ii. deterioration of pigments leading to dull shades; iii. reduced production and productivity under open and protected environment; iv. shift in insect pest and disease outbreaks; v. absence of winter chilling will reduce flowering v. reduced post harvest life; vi. poor pollination and seed set due to changes in insect behavior. Similarly higher rainfall would increase anaerobic stress at the root zone leading to yellowing, poor growth and even mortality.

It is expected that the hitech floriculture units are likely to be buffered to an extent from direct effects of climate change as most of the flower production is carried out in greenhouses. Small-scale players who depend on rain-fed floriculture will be extremely vulnerable to climate change because of their direct impact. Hitech growers are also not entirely immune as the industry depends heavily on natural resources like water availability and its quality besides the vagaries like drought and floods that are likely to cause havoc in flower production.

A number of flowers like chrysanthemum, poinsettia and carnation are either photo sensitive or thermo sensitive or both. Changing pattern in photoperiodism and thermoperiodism would greatly alter the blooming pattern in such flower crops. Climate change is expected to enhance the global temperatures by 2-3^0C by 2050. This would alter the chilling requirement of some of the temperate flower crops. The insect pest and disease dynamics would bring about a change in use of pesticides in open and protected environments. Increase in temperature would alter the relative humidity levels that would have profound impact on disease incidence and its spread.

The paper outlines the impact of climate change on Indian floriculture and summarizes important strategies to be adopted to mitigate the challenges.

4.1.9 Economically Important Endangered, Rare and Threatened Medicinal Plants and their Conservation

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About 85% of the people in the world's developing countries rely on traditional medicine for their primary health care, and about 85% of traditional medicine involves the use of plant extracts. India has 2.4% of world's area with 8% of global biodiversity and it is one of the 12th mega diversity hotspot countries of the world with a rich diversity of biotic resources. The rich resource is disappearing at an

alarming rate as a result of over-exploitation. Therefore, the management of traditional medicinal plant resources has become a matter of urgency. An ever increasing demand of uniform medicinal plants based medicines warrants their mass propagation through plant tissue culture strategy. Tissue culture technology is potent and has opened extensive areas of research for biodiversity conservation. Plant in vitro regeneration is a biotechnological tool that offers a tremendous potential solution for the propagation of endangered and superior genotypes of medicinal plants which could be released to their natural habitat or cultivated on a large scale for the pharmaceutical product of interest. Tissue culture protocols have been developed for a wide range of medicinal plants, which includes endangered, rare and threatened plant species. Some of these endangered medicinal plants are Bacopa monnieri, Berberis aristrata, Celastrus paniculata Ginkgo biloba, Glycyrrhiza glabra, Gymnema sylvestre, Holostemma, Nardastchy jatamansi, Oroxylum indicum, Picorrhiza kurroa, Rauwolfia serpentine, Rheum emodi, Salaca oblonga, Saussaurea lappa; Swertia chirata Taxus baccta, Tinospora cordifolia, Tylophora indica,. Conventionally, there are two methods of conservation: in situ and ex situ conservation, both are complementary to each other. In situ methods allow conservation to occur with ongoing natural evolutionary processes ex situ conservation via in vitro propagation also acts as a viable alternative for increase and conservation of populations of existing bioresources in the wild and to meet the commercial requirements. A review highlighting various in vitro protocols developed for selected medicinal plant species of India has been done to highlight the significance of ex situ conservation in cases where regeneration through conventional methods is difficult to undertake and species are left with low population in the wild. Thus in vitro cell and tissue culture methodology is envisaged as a mean for germplasm conservation to ensure the survival of endangered plant species, rapid mass propagation for large scale re-vegetation and for genetic manipulation studies.

Almost all civilisation has a history of medicinal plant use. Approximately 85% of the people in the world's developing countries rely on traditional medicine for their primary health care, and about 85% of traditional medicine involves the use of plant extracts (Vieira and Skorupa, 1993). India has 2.4% of world's area with 8% of global biodiversity and it is one of the 12th mega diversity hotspot countries of the world with a rich diversity of biotic resources. Out of 34 hotspots recognised, India has two major hotspots - the Eastern Himalayas and the Western Ghats. The bio-geographic position of India is so unique that all known types of ecosystems range from coldest place like the Nubra Valley with 57°C, dry cold deserts of Ladakh, temperate and Alpine and subtropical regions of the North-West and trans-Himalayas, rain forests with the world's highest rainfall in Cherrapunji in Meghalaya, wet evergreen humid tropics of Western Ghats, arid and semiarid conditions of Peninsular India, dry desert conditions of Rajasthan and Gujarat to the tidal mangroves of the Sunderban which harbours about 47000 species of plants of which 17 000 are angiosperms (Bapat *et al.,* 2008). India is also rich in medicinal plant diversity with all the three levels of biodiversity such as species diversity, genetic diversity, and habitat diversity (Mukherjee and Wahile, 2006). Across the country, the forests are estimated to harbour 90% of India's total medicinal plants diversity. Only about 10% of the known medicinal plants of India are restricted to non- forest habitats (Wakdikar, 2004). Concerning the total number of flowering plant species, although only 18,665, the intraspecific variability found in them makes it one of the highest in the world. Out of 18,665 plants, the classic systems of medicines like Ayurveda, Siddha, and Unani make use of only about 3000 plants in various formulations (Schippmann *et al.,* 2006). Although, there is no reliable figure for the total number of medicinal plants on Earth, and numbers and percentages for countries and regions vary greatly but estimates for the numbers of species used medicinally include: 35,000-70,000 or 53,000 worldwide (Schippmann *et al.,* 2002); 10,000- 11,250 in China (Pei, 2002); 7500 in India (Shiva, 1996); 2237 in Mexico (Toledo, 1995); and 2572 traditionally by North American Indians (Moerman, 1998). The World Health Organization (WHO) has estimated that the present demand for medicinal plants is approximately US $14 billion per year. The demand for medicinal plant based raw materials is growing at the rate of 15 to 25% annually, and according to an estimate of WHO, the demand for medicinal plants is likely to increase more than US $5 trillion in 2050. In India, the medicinal plant-related trade is estimated to be approximately US $1 billion per year (Kala *et al.,* 2006). According

to Schippmann *et al.* (1990), one fifth of all the plants found in India are used for medicinal purpose. The world average stands at 12.5% while India has 20% plant species of medicinal value and which are in use. But according to Hamilton (2003), India has about 44% of flora, which is used medicinally. Although it is difficult to estimate the total number of medicinal plants present worldwide, the fact remains true that India with rich biodiversity ranks first in per cent flora, which contain active medicinal ingredient (Mandal, 1999).

A total of 560 plant species of India have been included in the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened species, out of which 247 species are in the threatened category. On a global basis, the IUCN has estimated that about 12.5% of the world's vascular plants, totalling about 34 000 species are under varying degrees of threat (Phartyal *et al.,* 2002). IUCN recognises the following categories: extinct, extinct in the wild, critically endangered, endangered, vulnerable, near threatened, least concern, data deficient and not evaluated. Species with small populations that are not at present endangered or vulnerable but are at risk are called rare. (Singh *et al.,* 2006). Many of them are facing extinction. In the past few decades, there has been an ever-increasing global inclination towards herbal medicine, followed by a belated growth in international awareness about the dwindling supply of the world's medicinal plants (Bodeker, 2002). The plants used in the phyto- pharmaceutical preparations are obtained mainly from the naturally growing areas. The genetic diversity of medicinal plants in the world is getting endangered at alarming rate because of ruinous harvesting practices and over-harvesting for production of medicines, with little or no regard to the future. Also, extensive destruction of the plant-rich habitat as a result of forest degradation, agricultural encroachment, urbanisation etc. is other factors, thus challenging their existence (Gupta *et al.,* 1998). In view of the tremendously growing world population, increasing anthropogenic activities, rapidly eroding natural ecosystem, etc the natural habitat for a great number of herbs and trees are dwindling and of *per capita* consumption has resulted in unsustainable exploitation of Earth's biological diversity, exacerbated by climate change, ocean acidification, and other anthropogenic environmental impacts (Rands *et al.,* 2010). A large sum of money is pumped every year to replenish the lost biodiversity and large numbers of protocols are available at present. Unfortunately, we are not witnessing any improvement in the status of these plant species in nature and the number of threatened plant species is increasing gradually (Tripathi, 2008). In order to safeguard this knowledge, it should be documented, preserved and patented (Mukherjee, 2009). Even the United Nations Conference on Environment and Development (UNCED), held recently at Rio de Janeiro, Brazil helped to place the loss of biodiversity and its conservation on the global agenda. Therefore, the management of traditional medicinal plant resources has become the matter of urgency. Hence, conservation of such a buffer is considered fundamental and provided priority in all sectors of global development (Tandon *et al.,* 2009). Although species conservation is achieved most effectively through the management of wild populations and natural habitats (*in situ* conservation) but most of the medicinal plants either do not produce seeds or seeds are too small and do not germinate in soils. Even plants raised through seeds are highly heterozygous and show great variations in growth, habit and yield and may have to be discarded because of poor quality of products for their commercial release. Likewise, majority of the plants are not amenable to vegetative propagation through cutting and grafting, thus limiting multiplication of desired cultivars. Moreover many plants propagated by vegetative means contain systemic bacteria, fungi and viruses which may affect the quality and appearance of selected items (Murch *et al.,* 2000). Thus mass multiplication of disease free planting material becomes a general problem. In order to overcome these barriers, *ex situ* techniques can be used to complement *in situ* methods and, in some instances, may be the only option for some species (Sarasan *et al.,* 2006; Negash *et al.,* 2001). Therefore, conservation of medicinal plants can be accomplished by the *ex situ*, that is, outside natural habitat by cultivating and maintaining plants through long-term preservation of plant propagules in plant tissue culture repositories (Rands *et al.,* 2010).

In vitro techniques have been increasingly applied for mass propagation and conservation of germplasm as it has superiority over conventional method of propagation and offer some distinct advantage over

alternative strategies. Some of these are as follows: (1) collection may occur at anytime independent of flowering period for each species (this assumes that seed material is not required), (2) there is the potential of virus elimination from contaminated tissue through meristem culture, (3) clonal material can be produced where this is useful for the maintenance of elite genotypes, (4) rapid multiplication may occur at any time where stocks are required using micropropagation procedures, (5) germination of difficult or immature seed or embryo may be facilitated for breeding programmes, and (6) distribution across the border may be safer, in terms of germplasm health status using *in vitro* cultures. Some more general positive advantages of *in vitro* techniques include the fact that storage space requirements are vastly reduced compared with field storage. Storage facilities may be established at any geographical location and cultures are not subject to environmental disturbances such as temperature fluctuation, cyclones, insect, pests, and pathogen (Shibli *et al.,* 2006). In this regard the micro-propagation holds significant promise for true to type, rapid and mass multiplication under disease free conditions. Besides, the callus derived plants exhibit huge genetic variation that could be exploited for developing superior clones/varieties particularly in vegetatively propagated plant species. Tissue culture has emerged as a promising technique for multiplying and conserving the medicinally important species within short period and limited space, which are difficult to regenerate by conventional methods and save them from extinction. In recent years, *in-vitro* cell and tissue culture methodology is envisaged as a mean for germplasm conservation to ensure the survival of endangered plant species, rapid mass propagation for large-scale re-vegetation and for genetic manipulation studies under precisely controlled physical and chemical conditions. Combinations of *in vitro* propagation techniques (Fay, 1992) and cryopreservation may help in conservation of biodiversity of locally used medicinal plants (Singh *et al.,* 2006).

4.1.10 Strategic Approaches for Climate Resilient Production of Mushrooms

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It takes approximately 13 weeks (90 days) for button mushroom to complete an entire production cycle, from the start of composting to the final cook out after cropping has ended. For this work, a mushroom grower can expect anywhere from 25 kg to 35 kg per 100 kg compost in a period of 4-6 weeks of cropping. Final yield depends on how well a grower has monitored and controlled the temperature, humidity, pests, and so on. All things considered, the most important factors for good production are experience plus an intuitive feel for the biological rhythms of the commercial mushroom. The production system used to grow a crop can be chosen after the basics of mushroom growing are understood. The international competition has forced mushroom producers to minimize costs and at the same time increase yields per unit weight of compost and improve quality levels. As the upsizing of mushroom farms continues with the change from family scale to industrial scale, logistic and labour/energy saving alternatives will play a more important role in automation. Automatic climatic control will be an obligatory investment for survival in the competitive mushroom industry in days to come. Indian Mushroom industry has witnessed exponential growth during the last couple of years; however, considering the agro-climatic conditions, availability of raw materials and man power, there is tremendous scope for expansion of mushroom industry in the country.

4.1.11 Strategies for Climate Resilient and Sustainable Poduction of Spices

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Spices are high value and low volume crops, grown in an area of 4.2 million ha with a production of 39.6 million tonnes. Cumin, chillies, coriander, garlic, mint, turmeric, black pepper, ginger and fenugreek occupies major area. In terms of production garlic, ginger, chillies, turmeric, cumin, coriander, fenugreek, tamarind, fennel, black pepper and mint are contributing maximum for total spices production. India exported around 1.76 million tonnes of spices and value added products to the value of around Rs.31,000 crores during 2020-21. The demand for spices and its products are increasing and sustaining their production in the era of climate change is a great challenge. The temperature is raising temperature, rainfall is erratic and frequency of extreme weather is increasing. Creating soil resilience, practice of organic farming, growing climate resilient varieties, water harvesting and recycling, efficient irrigation systems and fertiliser use techniques, use of bio-controls, growing multiple cropping with integrated farming system, following crop advisories for timely operations, protected cultivation, mechanisation for planting, intercultural operations and harvesting and institutional support would help sustainable spice production in the changing climate in India.

4.1.12 Recent Progress in Vegetable Grafting - a Tool to Combat Biotic Stress

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Biotic stress causes considerable losses in crop productivity thereby inflicting economic as well as nutritional insecurity. One of the greatest challenges faced by the scientific community in the next few years is to minimize the yield losses caused by pests and diseases. Introgression of pest and disease resistance traits into high yielding genotypes has been a challenge to plant breeders. Vegetable grafting using rootstocks has emerged as a rapid tool in tailoring plants to tolerate biotic stress. Grafting applications have expanded mainly in Solanaceous and cucurbitaceous crops, which are facing serious threat by pests and diseases. Experiments were carried out at the Department of Vegetable Science, Horticultural College and Research Institute, Coimbatore to study the root-shoot interaction and rootstock-driven resistance to pests and diseases in brinjal, tomato, and bittergourd. Grafting brinjal genotypes with wild *Solanum* species was done to mitigate root-knot nematode (*Meloidogyne spp*.) and dry root rot (*Macrophomina phaseolina*) incidence. Presently the Department is producing grafted brinjal plants and supplying to the farmers. In tomato a grafting study was conducted with three rootstocks viz., *Solanum torvum*, *Solanum sisymbrifolium* and *Solanum capsicoides* and two scion viz., TNAU tomato hybrid CO

3 and Shivam. Success percentage was more in graft combination of Shivam with *Solanum sisymbrifolium* on 30th and 45th day. The highest plant height was observed in Shivam grafted with *Solanum torvum* rootstock, whereas total number of branches per plant, days to first flowering, per cent fruit set and yield per plant was high in TNAU tomato hybrid CO 3 grafted with *Solanum sisymbrifolium* rootstock. The combination of TNAU tomato hybrid CO 3 grafted with *Solanum sisymbrifolium* rootstock performed well under field condition for yield and yield contributing characters. Similarly in another experiment, a total of ten cucurbitaceous rootstocks and two bitter gourd scions were screened against Fusarium wilt pathogen under *in vitro*. Results on screening against Fusarium wilt revealed that *Citrullus colocynthis*, *Cucumis metuliferus* and *Cucurbita moschata* exhibited no symptom and manifested as resistant to Fusarium wilt and the least percent incidence of 21.62, 37.44 and 48.90 was observed in *Luffa cylindrica* followed by *Momordica charantia* var. *muricata* rootstock (23.58, 42.18 and 50.34) at 30, 45 and 60 days after inoculation. From this study it was found that the cucurbitaceous species viz., kumatikai (*C. colocynthis*), African horned cucumber (*C. metuliferus*) and pumpkin (*C. moschata*) with high or moderate levels of biochemical constituents suffered less for Fusarium wilt pathogen and these rootstocks served as the best rootstocks for grafting with bitter gourd scions followed by mithipakal (*M. charantia* var. *muricata*) and sponge gourd (*L. cylindrica*). Hence, in the present day situation of unprecedented climate change leading to biotic stress, research impetus on grafting of vegetable crops can offer potential solution.

Keywords : Brinjal- tomato-bittergourd - perennial rootstocks – disease resistance

4.2 Oral Presentation

4.2.1 Identification of CMS-S Male-sterile Cytoplasm among the Bunching Onion (*Allium fistulosum* L.) Collections

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The Bunching onion (*Allium fistulosum* L.) species collections were assessed for identification of male-sterile trait among the germ-plasm, as a resultant identified a male sterile line, phenotypically and which was confirmed by the *orf725* gene and *orf501* gene-specific markers conferred linkage for male sterility cytoplasm of S and normal (N) cytoplasm. The manifestation of the male-sterile trait in Bunching onion genotypes could be attributed to the *ms* genes expression. Phenotypically male-sterile plants produce flowers, does produce pollen grains they were lacking in the anthers. The anthers are slightly green at an immature stage, and yellowish trans-lucent at the mature stage, without pollen grains spores inside the anther sac, matured anthers were shrivelled, empty and fused anther sacs. Soon, the male-sterile line will be used as parental material in hybridisation for heterosis breeding to boost Bunching onion.

Keywords: Bunching onion; Male sterility; *orf725*; *orf501*; S/N cytoplasm; Heterosis

4.2.2 Underutilized Vegetables for Nutritional Security

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Under-utilised Vegetables: are those vegetables which are not grown commercially on large scale, cultivated, traded and consumed locally are termed as under-utilised fruits. Because of in-efficient use of locally available under-utilised fruits and vegetables, a gap is formed between nutritional status and optimal use of natural source of nutrients i.e. under-utilised fruits and vegetables. Increased production of indigenous and under-utilised fruits and vegetables can be a better way towards eradicating global malnutrition. These are rich source of many of vitamins and minerals which helps in proper functioning of human body, lack of proper supply of these components in human body results in specific nutritional deficiencies i.e. zinc deficiency, iron deficiency anaemia, vitamin-A deficiency, calcium deficiency etc. A dietary approach, rather than the medicinal (supplementing pills) approach, is the most economical and sustainable way to correct micronutrient deficiencies (Ali and Tsou, 2000). India, being blessed with diverse climatic conditions, has a wide array of edible green leafy vegetables (GLV) some of which are locally grown and utilised from ancient periods as source of food as they contain many nutrients and minerals which can nourish the ever growing human population and help to attain nutrition security. Many of these GLV are found as weeds in the crop fields which are resilient, adaptive and tolerant to adverse climatic conditions. Out of these weeds one very popular weed is Bathua (Chenopodium album) that grows in waste places and with other cultivated crops. It occurs throughout the tropical regions of world. Human are consuming its leaves and seeds for time immemorial. In per hundred grams of edible Bathua leaves there is about: Water 84 grams, energy 44 kcal, carbohydrate 7g, fat 0.8 g, protein 4.3 g, fibre 2.1 g, iron 4g, Calcium 280 mg, Phosphorous 81 mg, Vitamin A 11,300IU, thiamine 0.15 mg, Riboflavin 0.4 mg, niacin 1.3 mg and Vitamin C 90 mg. Surprisingly in spite of having. Keeping nutritional properties of Bathua in mind and to enhance the use Bathua powder was prepared and used by admixing in different recipes like puri, raita, pua (meethi puri), paratha, thickening agent in curry, flavouring agent in dhokla and mathari etc. Acceptability in three point quantum and sensory evaluation was assessed. Results of the study revealed that mathri was liked very much by 67.00 percent whereas, pua is liked by 45.00 percent respondents. Texture of curry was smooth, while colour is pleasant yellowish green. As far as over all acceptability is concerned all the products were accepted by more than 55.00 percent respondents. It is suggested scientific bathua cultivation should be started and preserved in some manner so that it will be available to each and everyone all along the year.

Keywords: Nutritional security, under-utilised, fruits and vegetables, Chenopodium album, bathua.

4.2.3 Effect of Weather Parameters on Yield and YVMV Incidence in Okra

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India is the leading producer of Okra with 73% share in world production with a productivity of 11.6 tons per hectare. It is grown extensively throughout the country, both in tropical and sub tropical

regions and also in warmer parts of temperate region. Andhra Pradesh ranks first in production and productivity and second in area in Okra cultivation .With regard to nutritional value, Okra has rich source of vitamin A and folic acid, besides carbohydrates, phosphorus, magnesium and potassium. Andhra Pradesh is the leading okra producing state which has a production of around 1184.2 thousand tons followed by West Bengal. The major threat in okra is YVMV disease. The present study was conducted to assess the influence of weather parameters, viz., temperature (minimum and maximum), sun shine hours, rainfall, number of rainy days, humidity and sun shine hours on yield and incidence of YVMV disease in okra variety Arka Anamika. The study revealed that, relative humidity (morning), sun shine hours, wind speed and evaporation had positive correlation on yield of Arka Anamika variety, where as minimum temperature, relative humidity in the evening, rainfall and number of rainy days had negative correlation with yield. The correlation of weather parameters on YVMV incidence in okra revealed that, relative humidity in the evening, rain fall, number of rainy days and wind speed had positive correlation, where as temperature, (both maximum and minimum) and yield had negative correlation with YVMV incidence. The negative correlation of yield to YVMV incidence indicates the impact of disease on yield potential of the crop. The study indicated the impact of weather conditions on yield and YVMV incidence of okra crop in Guntur district of Andhra Pradesh and may help in developing forecasting models based on climatic conditions.

Keywords: Okra, YVMV incidence, weather parameters

4.2.4 Characterization of Wild Relatives of Tomato

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The present investigation was outlined to characterize five wild *Solanum* species viz., *Solanum pimpinellifolium, Solanum chilence, Solanum cheesmaniae, Solanum lycopersicum* var. *cerasiformae* and *Solanum peruvianum employing* 17 morphological qualitative characters and 28 different quantitative characters including different plant and fruit characters, fruit quality and physiological characters. Indeterminate growth habit was the characteristic feature of all the wild *Solanum* species. Less leaf let segments was the characteristic feature of the wild *Solanum* species. Leaf and inflorescence characters of *Solanum peruvianum* were distinctly different than the other *Solanum* species. Lobed leaf let and bipartite inflorescence was the characteristic feature of *Solanum peruvianum*. Style position was inserted inside the anther cone in *Solanum pimpinellifolium* and *Solanum lycopersicum* var. *cerasiformae.* Exserted stigma was the characteristic feature of *Solanum chilence, Solanum cheesmaniae* and *Solanum peruvianum*. Fruits were small and round to slightly flattened in shape with flattish-round blossom end in all the *Solanum* species. *Solanum pimpinellifolium* and *Solanum lycopersicum* var. *cerasiformae* were the only ture red-fruited wild species. Ripe fruits of *Solanum cheesmaniae* was orange-red and that of *Solanum chilence* was yellow. Ripe fruits of *Solanum peruvianum* remained light green. The wild species was characterised by their very high fruited ness and this character can be utilised to develop high fruited tomato genotype. Yellow fruit colour of *Solanum chilence* was not the indicator of high â carotene content in the ripe fruits. *Solanum pimpinellifolium* and *Solanum lycopersicum* var. *cerasiformae* can well be utilised in breeding tomato for improving ascorbic acid, total sugar and lycopene content in the fruits.

Keywords: Characterisation, wild relatives, tomato

4.2.5 Manifestation of Heterosis for Different in Fruit Characters Tomato

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The study was conducted employing 14 parental lines showing divergences in different characters were crossed to produce 23 F_1 hybrids. Manifestation of heterosis was studied for fruit characters namely, fruit weight, equatorial diameter, polar diameter, pericarp thickness, and locule no. /fruit. Of the 23 hybrids, only 9 hybrids manifested significantly positive heterosis for fruit weight ranging between 8.82 – 48.30 % over the mid parent (H1) and of them; only 6 hybrids surpassed their respective better parent for fruit weight. Out of 23 hybrids studied 13 manifested significant heterosis for equatorial diameter of fruit over the mid parent ranging between 3.08-24.46% and out of them 9 hybrids had fruits with higher equatorial diameter than the respective better parent. Only 4 hybrids registered significantly higher polar diameter ranging between 0.63 to 4.66% over the mid parental value. From the study of fruit shape in the hybrids high propensity of round or flattish-round fruit in hybrid was also recorded. Pericarp thickness in 15 hybrids manifested significant positive heterosis over mid parental value and 12 of them even surpassed their respective better parent for pericarp thickness. This result suggested that high fruit weight in the hybrid was basically realised through high pericarp thickness in the hybrids. Locule no. $fruit^{-1}$ as expected, 13 out of 23 F_1 hybrids registered significant heterosis over the mid parental values which ranged between 4.68-35.45%. Extent of manifestation of heterosis in the 4 top ranking hybrids in this investigation viz., BCT-109 x BCT-115, BCT-82 x BCT-110, BCT-90 x BCT-110, BCT-90 x BCT-109 was analysed with reference to of genetic divergence and *per se* performances of the parents. Medium x Low or Medium x High cross combination with respect to *per se* performance of the parents emerged as the best parental combinations for developing high performing hybrids.

Keywords: Heterosis, Hybrids, Fruit characters, Tomato

4.2.6 Brunt of Climate Change and Spice Crops: Community Participation and Resilience

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The brunt of climate change on living organisms are going to be exponential and millions of hectares of land ecosystem are to offset the consequent vagaries. In spite of direct negative impacts, a well-designed expansion, socialization and institutionalization of spice cultivation and consumption can come up as a great saviour in this huge crisis. The spices in India are mostly grown in natural ecosystem alongwith in cultivated lands. Exploring the possible niches of spices cultivation, acculturation and accommodation into the existing cropping sequence are the need of hour by addressing the issue in a realistic manner. This would definitely help in making our ecosystem refresing, resilient and reinforced. The community

gene bank inventorization of traditional knowledge, socialization of adaptive technologies and reengineering of cultivation tools and techniques will be as efficient and dynamic as we can perceive and predict. This would ensure an opportunity for family and community level healthcare through consumption of locally available spices and by including them into the everyday food plates not by imposition, but by self exploration, the gamut of new age approach will create a paradigm wherein ecology, economy and climate will move with perfect orchestrations by setting aside all clichés and prejudices of conflicts and noncooperation between man and nature.

4.2.7 Grafting Eggplant Cultivars on Rootstock of Cultivated Variety can Increase Yield, Extend Harvest Period and Impart Yield Tolerance in Bacterial wilt Infected Field

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Bacterial wilt (BW) causes extensive loss (4.24 to 86.14%) in eggplant (*Solanum melongena* L.) in the tropics. Grafting commercial cultivars onto selected rootstocks is an effective approach to control wilt disease without requiring extensive breeding to develop resistant varieties. Plants developed through grafting bring 2 different genotypes together and shows effective interaction of rootstock (R) × scion (S) × environment (E), thereby determining positive and negative influences of rootstocks on plant performance (vigor, crop duration and yield) and fruit quality of the scion. We have screened 22 wild and 4 cultivated eggplant accessions for tolerance to BW disease (*Ralstonia solanacearum* Biovar IIIA) in artificially created infested beds in the Gangetic plains of West Bengal, India. Two each of *S. torvum* Sw. accessions (BCB ST 1 and IARI ST 1) and cultivated varieties 'Utkal Anushree' and 'Utkal Madhuri' were identified as most compatible rootstocks. Two widely cultivated, susceptible cultivars, 'Bidhan Suphala' and 'Bidhan Supreme' were grafted as scions on identified rootstocks and reproductive growth, fruit quality and disease incidence of grafted plants in bacterial wilt infected experimental plot and grower field recorded. Although grafted plants had lower mortality and higher yield, quality of fruit (Total sugar and chlorogenic acid contents) was not improved. *Solanum torvum*-grafted plants exhibited some negative effects on yield and economics compared to cultivated rootstocks, suggesting reduced compatibility. The 'Bidhan Suphala' grafted on the cultivated rootstock 'Utkal Anushree' had the highest yield and economic return than those grafted on wild rootstocks. 'Utkal Anushree' could be effectively used as a rootstock for controlling eggplant wilt through grafting. Rootstock of cultivated varieties of eggplant could be useful for large-scale production of grafted plants. Grafting eggplant cultivars on rootstock of cultivated variety increased yield, extended the harvest and was effective in reducing crop loss caused by BW disease.

4.2.8 Performance of Tomato (*Solanum lycopersicum* L.) var. *Arka rakshak* for Growth and Yield under Polyhouse in Tehri Garhwal, Uttarakhand

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A field demonstrations of tomato were conducted during *kharif* season 2021at NICRA village Kaleth and Dabri, Tehri Garhwal District, Uttarakhand under protected cultivation (Poly house). The demonstrations were conducted in two conditions i.e. under poly house (control condition) and open field for Tomato (variety Arka rakshak). Tomato is the one of the crop of NICRA villages in *kharif* season and also considered as important economic vegetable crop. The present study was mainly conducted for evaluation of growth and yield attributes of tomato under different growing condition (poly house and open field) under Garhwal Himalaya region of Uttarakhand. The results of demonstration revealed that *Arka rakshak* variety performed well under poly house with respect to growth as well as yield compared to open field. The marketable fruit yield was obtained 970 kg/ nali under poly house and 615 kg/ nali in open field. Beside this at both growing condition this variety proved the best with respect to disease resistant i.e. bacterial wilt, leaf curl virus and early blight.

Keywords- Arka rakshak, NICRA, Growth and Yield, Poly house

4.2.9 Assessment of Yield of Okra [*Abelmoschus esculentus* (L.)] Yariety VL Bhindi- 2 Under Improved Agronomic Practices in Western Himalaya of Uttarakhand

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A Front Line Demonstrations of improved variety of okra [*Abelmoschus esculentus* (L.)] along with farmers' practices were conducted during 2020-21 to 2021-22 at farmer's field of Kaleth village under NICRA project of KVK, Tehri Garhwal district of Uttarakhand. The fresh fruits of okra are important on account of its taste, flavor, and nutritional values. It is rich in protein, carbohydrates, minerals, and vitamins. Therefore, young fruits of okra have reawakened beneficial interest in bringing this crop into commercial production but low production of the small and marginal farmers of the hills is due to the limited and minimal use of inputs, especially lack of improved varieties and scattered and uneven land holding. Hence, an attempt was made to recommend a variety, which performs better under the climatic

conditions of NICRA village Kaleth. The impact of improved production technology on the performance of okra VL Bhindi-2 was demonstrated and compared with the local varieties and practices usually adapted by the farmers. The results of improved agronomic practices revealed that the yield of okra variety VL Bhindi-2 varied from 88.45 q ha^{-1} to 115.60 q ha^{-1} with the average yield of 102.02 q ha^{-1} as compared to local variety, i.e., 50.80 q ha^{-1} to 72.12 q ha^{-1} with the average yield of 61.46 q ha^{-1} during the year 2020-21. The yield was varies from 91.50 q ha^{-1} to 122.60 q ha^{-1} with the average yield of 107.05 q ha^{-1} as compared to local variety, i.e., 51.20 q ha^{-1} to 73.50 q ha^{-1} with the average yield of 62.35 q ha^{-1} during the year 2021-22. The percent increase in the yield was 39.75 % and 41.75% during the year 2021-22 and 2021-22 respectively. Higher production of this crop is possible by cultivation of high-yielding varieties or genotypes which show remarkably enhanced returns, compared to locally grown cultivars under the same climatic conditions and inputs applied.

Keywords: Okra, High-yielding varieties, technology demonstration, Tehri Garhwal

4 .2.10 Kharif Chickpea: A New Crop for theVegetable Purpose

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Chickpea (*Cicerarietinum* L.) crop is widely cultivated throughout India primarily in the *rabi* season (October-February). However, there is a very good potential of growing it in the *kharif* season (June-August) in some parts of India because of the average temperature ranging between 20-30^{o}C with average rainfall of 200-250 mm during June to August with well-drained soil are available for kharif chickpea flowering and pod setting. Thus, suitability of both the critical components of chickpea cultivation i.e., rainfall and temperature makes it possible for *kharif* chickpea cultivation in the region. Preliminary investigations, which were carried out to explore feasibility of *Kharif*chickpea have enabled us to identify some of the promising chickpea genotypes such as IPCO-6-11, ICE 15654-A, JG-11, Vishal, JG-16, ICCV 92944, JG-14, ICC 4958 and Vijay. Studies also revealed that *Kharif* chickpea can be harvested by 60-70 days under rainfed condition. The raw green pods yielded about 3.0-3.5 t ha^{-1} whilethe raw green plants with pods yield ranged between 11 to 13 t ha^{-1}.Thus*Kharif chickpea has* advantages such asadditional yield and income within a short duration. In addition, it can be used as vegetable purpose. However,there is a need to bridge the knowledge gaps with respect to adaptability, cost benefit ratio, extension and policy to promote *kharif* chickpea.

Keywords: Income, *Kharif* Chickpea, New Crop, Off-season, Pod set, Vegetable

4.2.11 Orchid based multi-cropping/ Vertical farming

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In natural habitat orchids attach themselves to the bark of trees, or the surface of other plants. In playhouse, they are generally planted in pots and are kept on top of iron/bamboo benches. Thus the walls of playhouse and the ground space underneath benches remain empty this space can be utilised for planting of different crops. Keeping this in mind an initiative was taken to utilise the walls of the polyhouse for vertical farming and the space beneath the benches was used for planting ornamental plants, spices and some leafy vegetables. So as to generate extra income for the farmers. Crops planted include coriander, fenugreek, chausur, toria, mustard leaf and pea etc. We have found that fenugreek performed best followed by coriander.

4.2.12. Ultra High Density Planting of Potato by using Sprouted Eye pieces under Tropical Climate

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Potato (*Solanum tuberosum*.L) is an important temperate tuber crop around the world that performs best in cool climate between 15 and 18^{o}C. After introduction of heat tolerant varieties, the growers in the tropical regions have taken the advantage of the availability of such cultivars and its short duration nature, to trap its production in the prevailing short winters. The major factors limiting potato production in warm tropical regions are scarcity of seed tubers, high transport cost and poor quality of seed tubers. Thus, the development of technologies to aid in overcoming such limitations to expand potato cultivation in the warm areas of the tropics has special significance. Keeping this in view, a study was conducted to evaluate the tuber production pattern of potato single eyes on raised beds at different spacings under open field conditions at Horticultural Research Station, Adilabad, Telangana State during Rabi season 2021-22. Breeder seed of Kufri Chanda Mukhi cultivar was procured from CPRI, RS Gwalior. In this study, sprouted seed tubers of each 100 g were selected and sprouted eyes were scooped with small portion (4-5g) of tuber attached and the remaining tuber portion was used for extraction of starch powder. Fungicide (DM-45) treated eyepieces were planted on raised beds at 4 different spacings *viz*., 10x8cm, 10x10cm, 15x10cm and 15x15cm. Experiment was laid in simple RBD with four treatments and six replications. Results revealed that the spacing of 10x8 cm significantly outperformed the other treatments in tuber yield. On an average, planting of single eyepieces at 10x8 cm provided a higher benefit of 1.72, 2.03 and 2.7 times the yield over 10x10cm, 15x10cm and 15x15cm respectively, besides starch yield of 200g in each treatment. Moreover, 10x8 cm spacing recorded highest tuber yield of 55.25kg per square meter followed by 10x10 cm (31.46kg), 15x10 cm (27.95kg) and 15x11 cm (19.17 kg). The economics of ultra high density method of spacing of 10x8cm was compared with standard method of planting (whole tubers each weighing 100 g) at 50x30cm in tropical region and found 2.2 times higher net profit over standard method of planting.

Keywords: Potato, propagation, tubers, sprouted eyes, high density planting and ultra high density planting

4.2.13 Evaluation of Different Onion Varieties for Growth, Yield Attributes and Yield

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A field experiment was conducted ascertain the production potential to different onion varieties and to select the most suitable high yielding varieties with better growth, yield and quality. This experiment was carried out during rabi season of 2019-20 at research farm, RLBCAU, Jhansi. Ninteen onion varieties were evaluated in randomized block design with three replications. The results revealed that there were significant differences among all parameters studied. It was observed from the data that among the different onion varieties, NHRDF Red-4 recorded maximum plant height (75.88cm), leaf length (74.39cm), equatorial diameter of bulb (7.48cm),yield per plot (22.79 kg) yield per ha (182.32 q). While highest number of leaves (16.07), Polar diameter of bulb (5.02 cm), leaf diameter (17.4 mm) were recorded in the variety Pusa Sona.

Kewword: Evaluation, growth, onion, verities, yield

4.3 Poster Presentation

4.3.1 Field Evaluation of Happy Seeder with Conventional Sowing (farmer practices) in CRM Adopted Village-Jirauli Kala District Hathras.

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Conservation agriculture involving zero- or minimum-tillage and innovations in crop residue management (CRM) to avoid straw burning should assist in achieving sustainable productivity and allow farmers to reduce nutrient and water inputs, and reduce risk due to climate change. High yields of the irrigated rice-wheat system have results in production of huge quantities of crop residues (CRs). The present project was undertaken in-situ crop residue management on happy seeder for wheat crop under rice-wheat cropping system in Vill- Jirauli Kala, district Hathras. In this project the performance evaluation of the happy seeder with conventional method showed its effectiveness over the conventional sowing technique. The performance evaluation was done from the basis of field capacity, field efficiency, actual field capacity, fuel consumption and cost of operation, no of tillers/m length, yield, length of earhead, no of grain/earhead, the comparision of economics of operation of happy seeder with conventional method of sowing wheat in combined harvested paddy field. The field efficiency of happy seeder and seed cum

ferti drill were 41.4% and 55.62% respectively at operating speed of 4.0 kmph. The higher grain and straw yield (47.35q/ha & 66.15q/ha) were found in case of happy seder and lower in seed cum ferti drill (43.3q/ha& 59.75q/ha). The average value of thousand grain weight was less (41.15 g) in treatment T1 compared to treatment T2 (42.24 g). The total cost of cultivation per hectare by happy seeder was Rs. 34000 and cost of cultivation per hectare by seed drill + tillage operations was Rs. 38000. Therefore the cost of cultivation per hectare with happy seeder was more economical as compared to seed drill by Rs. 4000 per hectare and also happy seeder is unique technique for sowing wheat in combine harvested paddy field to avoid residue burning.

4.3.2 Front Line Demonstrations for Computing Yield and Yield Gap of Wheat Productivity in Hardoi District of U.P.

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Wheat (*Triticum aestivum*) is one of the major Rabi cereal in Hardoi district of U.P. Major constraint for lower productivity in the district is low adoption of improved technologies. Front line demonstrations are the better means for increasing productivity of wheat crop in the district over the existing one. KVK, Hardoi conducted 98 demonstrations in 32.0 hectare area on wheat varieties DBW 17, Unnat Halna and HD 2967 on farmers' fields to demonstrate the production potential and advantages of improved techniques namely proper seed rate, line sowing, integrated nutrient management and timely weed management for five consecutive *Rabi* seasons i.e 2016-17, 2017-18, 2018-19, 2019-20 and 2020-21 in 18 villages spreading over 5 blocks. On an average over years about 32.7 percent yield increase was observed in demonstrations over farmer's varieties. The mean yield of 35.1 q/ha was recorded under demonstrations over the farmers' practices of 26.4 q/ha. The extension gap, technology gap and technology index were observed to be 7.7 q per ha, 5.5 q per ha and 10.9 %, respectively. The improved technologies resulted higher mean net income of Rs.51115/ha with a benefit cost ratio of 2.83 as compared to local practice (37866/ha, 2.44).

Keywords: Demonstration, economics, gap analysis, grain yields, wheat.

4.3.3 Dynamics of Organic Indian Spices to Meet the Nutritional Security during Pandemic Covid-19

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Due to diverse agro-climatic conditions, more than 60 spices are grown in India, which is considered as "Land of Spices". India ranks first in terms of production, consumption and trade. One area where India

is making steady progress in organic spices. Organic spices demand is increasing rapidly and it is predicted to double in the next upcoming five years.Recently, during global pandemic Covid-19 demands of organic spices has increased in international market owing to immune boosting properties of spices. In India, north-eastern states have great potential where variety of spices like large cardamom, ginger, turmeric, bay leaf and black pepper are grown organically. One of the main reason to grow organic spices is that the production method does not involve any synthetic chemicals or pesticides instead relying on organic manure and bio-fertilizers. Another thing which is linked with organic and non-organic spices is that all nonorganic spices are sterilized through fumigation and irradiation before coming the market. In fumigation, harmful chemicals such as ethylene oxidase are used to killed bacteria and microbes, which is extremely toxic for human being. The irradiation method is also hazardous, this have several negative effect on the spices as its chemical composition is disturbed. Spices Board of India is also playing very important role to promote organic spices in country through providing trainings and certificates on organic produces to the farmers. Subsidies on organic inputs, scaling up the organic production strategies, and the development of well-connected market will upgrade production and export of organic spices.

4.3.4 Role of Vegetable crops in Doubling Farmers' Income

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Approximately, 70 per cent of the marginal and small farmers dwelling in India are devoid of sufficient land to cultivate and some of them are also landless (*FAO*, 2018). To improve their condition over such a resource less situation, vegetable crops seems to be one of the answer for this. These crops can be seen as optimal option in crop diversification and adoption of modern approach; farmers can not only enhance productivity but also can improve their socio-economic condition. Horticultural cropping can optimize the space, time, B:C ratio and finally, can improve the productivity from the same piece of land. The productivity of vegetable was noticed 17.11 tonnes per hectare in India during 2017 (*Kumar and Tripathi,* 2020). The country recorded its highest ever horticultural production of 320.77 million tonnes from an area of 25.66 million hectare. Also, it is expected to hike 326.58 lakh million tonnes from an area of 27.17 lakh hectare by 2023, (*Ministry of agriculture and farmers welfare*, 2021). Keeping in view the huge potential and role of horticulture sector in increasing farmers' incomes, there is need to promote the holistic growth of sector in the country.

Keywords: doubling income, vegetable, socio-economic, marginal farmers.

TECHNICAL SESSION-5

INNOVATIONS FOR CLIMATE SMART PRODUCTION SYSTEMS IN HORTICULTURE FOR RESILIENCE TO CLIMATE CHANGE

5.1.1 An Experience in Vegetable Nursery for Sustainable Development of Horticulture – A Case study Haryana

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Recognizing the importance of planting material for higher productivity and quality production, Horticulture Department, Haryana has started creating infrastructure since 2011 for production of grafted fruit plants and vegetable seedlings. At present department has state of art nursery infrastructure at eight locations for production of more than 5 lakhs grafted plants and 4 crore hybrid vegetable seedlings to cover more than 7000 acres annually. The positive impact of this intervention led to increase in productivity level by 4 to 5 MT per ha. in the last few years. The introduction of vertical and high-density plantation with precision farming has led to sustainable development of horticulture.

5.1.2 Design and Development of Vertical Horticulture and Greenhouse Technology for Production of Vegetables and Flowers

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5.1.3 Protected Cultivation Technologies: Play A Key Role for Climate Resilient and Sustainable Development of Horticultural Crops

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Protected structures act as physical barrier and play a key role to minimized biotic and a biotic stress to the crop experiments were conducted two yea i.e. Cucumber (miniangal),Tomato (var. *ID-37*) and Capsicum (var. Indra) under three different type of polyhouse designs *i.e. **1**. Double Dore Malty Spain*

Naturally ventilated type (all side height ventilation and roof ventilation), ***2***. *Double Dore Malty Spain fain-pad/semi ontroled* type (side ventilation and roof ventilated) and ***3.*** *Double Dore* Quonset type Insect Proof Net-house (complete covering by IP net) during August to May in the year of 2013–2014 at the CPCT farm, IARI, New Delhi. All greenhouse designing are installed under 1000 m^2 area with the help of GI Pipes and covered by 200 micron thick U.V. stabilized transparent polythene and 40-50 mess size insect proof net. The experiments were laid out under Randomized Block Design (RBD). The Hi-value vegetable crops *i.e* cucumber, capsicum and tomato were transplanted during August month in all the years. During the experiments we have used standardized recommended agronomical package of practices with drip irrigation/fertigation to grow the crop. The cucumber crop was taken three time (August-Nov.-Feb.May). The better growth, fruit setting, maturity, picking, higher marketable quality, fruits yield (12.50kg, 11.50kg, 13.70kg/m^2) and minimum percentage (10.75%) incidences of disease and pest were found significantly better under *Double Dore Malty Spain fain-pad* type as compare to others type polyhouses. This greenhouse/polyhouse was maintained 4 to 5 degree centigrade higher temperature (in day and night) during winter season and exhibited early fruit setting and harvesting as compared to all other design of polyhouses. The average temperature maintained in different greenhouses was 4–6 ^{0}C higher than the ambient temperature. The electric consumption was not required for energy conserving in any greenhouse, hence cultivation cost of all vegetable crops was relatively high as compared to naturally ventilated polyhouse/greenhouse.

The cost of cultivation of cucumber, capsicum and tomato were ranges from Rs.52.75 to Rs. 55.50/m^2 in all types of polyhouse/greenhouse design. The maximum net return (Rs.102.5, 150.50, 70.50/m^2) and cost: benefit ratio (1: 4.20, 1:3.50 and 1:2.50) was obtained for cucumber, capsicum and tomato respectively in *Double Dore Malty Spain fain-pad Polyhouse/greenhouse*. Considering the cost of cultivation, production of cucumber, capsicum and tomato are economically feasible to farmers using 1000m2 size *Double Dore Malty Spain* naturally ventilated polyhouse/greenhouses and IP Net-house for plain condition in India.

5.1.4 Strategic Approaches for Climate Resilient and Sustainable Production of Potato Seed

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The very foundation of potato seed production is based on climate, soil ,vectors and pest & diseases. Cool clim ate is considered ideal for potato seed production due to less vector pressure and slow rate of degeneration .Potato in India is grown under subtropical conditions which are not suited for potato seed production. Infact, potato is primarily a temperate crop and requires mild temperatures. It is for this reason the potao cultivation started late in India and could pickup only after 1950 which coincided with the establishment of Central Potato Research Institute in 1949. Initially, Hilly regions were used for production of potato seed because of their advantages of low temperatures and high winds. It was a successful initiative and worked well for some time. But due to certain technical reasons, especially the physiological age of hill grown seed and expanding seed requirement, a need was felt to expand seed production to Indo-gangetic plains. To meet this requirement a new system of seed production known as Seed Plot Technique was deve loped. It is based on concept of Tuber Indexing coupled with field multiplication in four stages. Based on climate and presence of diseases and pests, certain areas were declared not suitable for seed production. To take care of the long field exposures for 7 years and reduce

them to three field exposures, a tissue culture based system of potato seed production has been developed. Protectected cultivation of G0 and some times G1 seed is part of this new system. Climate is changing and increase in temperature in the years to come will pose big challenges to potato seed production. It calls for total overhauling of the seed system. To start with, short duration varieties need to be developed to take care of the ever shrinking seed production window. The seed agronomy need s to be changed with respect to fertigation and seed preparation before the actual planting .Production of early generation seed under protected condition needs to be adopted. Number of field multiplication needs to be reduced taking advantage of the tissue culture and aeroponics technologies. Vector management needs to be improved and avoidance based of sound cultural practices needs to be adopted. Time has come to put more focus on Diploid breeding for developing sound seed system based on TPS.

5.2 Oral Presentation

5.2.1 Performance of Apple Ber on Different Training Systems

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Ber is an indigenous and common fruit in India. Apple Ber cultivar is gaining momentum in subtropical and tropical climate of West Bengal, Telangana, Andhra Pradesh, Maharashtra, Rajasthan and Gujrat in India is due to its precocity in bearing, fruit size, and crisp texture. Unlike Indian jujube, its name signifies size and appearance of fruit. Many factors including training practices affects vegetative growth and fruit quality. Due to higher fruit weight of cultivar, breakage of branches or complete tilting of plants, uneven fruiting, reduced fruit set and higher fruit drop is common in Apple ber. Considering its appealing fruit taste and quality, different training systems were tried to study its performance on three-year-old apple ber. Plants were trained with two training systems i.e. Y- Shape, Espalier training systems and control. The regular management practices were followed in orchard. Observations were recorded on vegetative and fruit quality parameters. Collected data revealed that the vegetative growth, fruit quality including yield was significantly influenced by training system. Vegetative parameters like leaf area and physical and quality attributes viz., fruit weight and size, TSS, ascorbic acid, yield and B:C were recorded better in Y-Shape training system. Thus Y-Shape training system can be used for yield and quality improvement in apple ber.

5.2.2 Effect of Seedling Uprooting Time and Pruning on Yield and Related Traits in Onion (*Allium cepa* L.)

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The seedlings of the short-day onions (*Allium cepa* L.) grown in the different parts of the India are commonly uprooted and pruned before the transplanting. We conducted a study at ICAR-Directorate of

Onion and Garlic Research, Rajgurunagar, Pune, Maharashtra during late *kharif*-2019 to evaluate the effects of seedling uprooting and pruning on yield and related traits in onion variety Baswant-780. The trial was conducted in randomized block design. In the experiment 1, treatments undertaken were uprooting of seedlings 7 days before transplanting to seedling uprooting on the same day of transplanting. The results indicated that yield obtained was highest in treatment, seedling uprooting on the same day of transplanting (62.76 t/ha). In another experiment, leaves and roots were pruned from 7 days before transplanting to without pruning. The results showed that, yield was more in the treatment pruning of seedlings on the same of transplanting (60.48 t/ha). Thus, it was concluded that 45 days old seedling can be transplanted on the same of uprooting and pruning can be done on same day of transplanting for better yield and other traits in onion.

5.2.3 Scientific Nursery Raising of Directly Sown Cucurbitaceous Crops: A Way to Enhancing Income

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Zaid crops have usually been observed, to ensure adequate food supply and distribution in cities and support livelihoods of farmers. If any crop comes some days early in market, it will receive good margin comparing to the time when market is flooded with such vegetables. In order to enhance germination of seedlings in vegetables, one can opt for protected structure but due to high cost of such structures it's impossible for many farmers to go for. However raising nursery in polythene bags under small polythene huts or other covered structures is very good technique for farmers. Technical guidance and support to farmers regarding nursery production was provided both at the field and telephonic viz: seed &soil treatment water scheduling, protection against insect pest and diseases khair block of Aligarh District. Support of Social media like WhatsApp was also taken to provide immediate support a group was formed and day to day advisories were sent seeds of muskmelon and other cucurbits were sown in polythene bags of 15 × 10 cm size and 100-gauge thickness, in the end of January and seedlings were transplanted by the end of February at the stage when 2-3 true leaves were developed. The transplanted crop matured early by 15-25 days than the direct sown crop, technique also checks the attack of red pumpkin and thus produced higher yields and economizes seed cost, especially in hybrid cultivars where seed cost is high. Farmers obtained Rs. 3.0 - 4.0 lakh from the expenditure of Rs. 70.00 to 80.00 thousand only. The cost benefit ratio was also recorded higher i.e. about 1:6 as compared to cost benefit ratio of direct sown i.e.1:3. The nursery Grower got benefits by two ways as they sold their seedlings to other fellow farmers at good rate and secondly they transplanted seedlings at their own field, and got early crop and higher yield. As a result they got about 200% extra benefit as compared to direct seed sowing practices because of higher and early yield.

5.2.4 Effect of Gamma Irradiation on Induction of Novel Colour in Chrysanthemum (*Chrysanthemum morifolium* Ramat.)

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In chrysanthemum induced mutants account for over 50% of all the commercial cultivars. Increasing demands to new forms of chrysanthemum leads to research for obtaining new varieties. Some characters of this species make the application of mutation breeding techniques fully justifiable are hexaploid nature of plant and vegetative propagation, which makes it difficult to conduct hybridisation. Performing mutation on an established cultivar is an effective method to fulfil the shortcomings (colour, shape, size, etc) in the existing cultivar. The maximum used irradiation method is by physical mutagen through gamma radiation. In order to induce novel variation/colour an experiment was conducted using chrysanthemum Accession No. 3 (White colour), which is very popular as loose flower. The rooted cuttings were irradiated with 15, 20 and 25 Gy at Bhabha Atomic Research Centre, Trombay, Mumbai. The experimental results revealed that there was a gradual and significant reduction in vital plant growth parameters viz. plant height (20.92%), plant spread (29.16%), number of flowers per plant (11.53%), flower diameter (11.64%) and yield per plant (21.77%) with increase in doses (control and at 25 Gy). However, parameters like number of primary and secondary branches per plant showed increasing trend and there was a delay in days to bud, colour break and days to flower opening. Maximum plant height (59.75 cm), plant spread (54.65 cm) was recorded in control and least (47.26 cm and 38.71 cm) at 25 Gy. Higher dose delayed the bud initiation (by 11.01 days), colour break (10.56 days) and days to flower opening (8.79 days). However, the number of buds and flowers per plant was non-significant with regard to increase in dose. In the study, a novel yellow coloured flower branch appeared at the irradiation dose of 20 Gy which was subsequently isolated. Based on the first year of evaluation the Gamma Mutant was found similar to parent in terms of morphological and other traits, except flower colour. The mutant was comparable for other traits and found better than the parent in terms of flower yield (0.96 % more) over the control. It can therefore be inferred that irradiation with Gamma rays (20 Gy) had a potential to create variation in chrysanthemum.

Keywords: Gamma Irradiation, Mutation, Dose, Accession, Chrysanthemum.

5.2.5 Strategies for Uniform Colour Development in Grapes under Tropical Conditions

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Grape is one of the major important fruit crop grown in tropical regions of India. As per an estimate total grape production in country was 3125 thousand tons from an area of 140 thousand ha during the year 2019-20. Grape growing in India is mainly concentrated in Maharashtra and Karnataka states and about 95% grape is produced from this region only. Market demand in changing very fast and changes in

consumer preferences are being recorded. To earn well from market, there is need to supply grapes according to market. In last few years, demand of coloured grape varieties is increasing in domestic as well as in export markets. However, under tropical conditions, uniform colour development is a main problem. Significantly high anthocyanin accumulation is recorded in grape skin at 20 °C than at 30 °C. Under tropical conditions of India, various stage of berry always passes through temperature of more than 20 °C and it is reflected in poor and uneven colour development. To achieve early and uniform colour, about one week before harvesting, growers remove berries from bunches. This practice is known as "Neating" and about 8 to 10% of total produce is discarded and resulted in economic loss to grape growers. Application of growth bioregulators especially ABA and ethrel is recorded in uniform color development. Same time improvement in overall grape quality is also recorded. To avoid the application of bioregulators, inactivated yeast-based product is good option. Foliar application improves phenolic maturity in grapes. The expected changes in phenolic content of treated berries could also be explained by a vine-pathogen interaction, as yeasts are recognised as pathogens and activate plant defense mechanisms. Hence, application of inactivated yeast results in early and uniform colour development in coloured grape barriers.

5.2.6 A Successful Tissue Culture model of Banana

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Fruit thinning is known to improve fruit quality in many crops including banana. Stage of fruit thinning affects the fruit development of the remaining fruits. In this study effect of banana hand thinning was studied in variety Grand Nain to understand its effect of fruit quality. Banana hand thinning was performed at six intervals keeping 8, 9, and 10 hands. Each interval had a gap of one week. Observations were recorded for fruit length and fruit weight. Maximum fruit length of the upper hand was recorded to 10.5 inch, fruit weight 220 gms in bunch maintaining 8 hands thinned after one week of the complete hand emergence. Minimum fruit length of 8.3 inch and weight 175 gms were recorded maintaining 10 hands thinned after six weeks of emergence.

Keywords: Banana, tissue culture, productivity

5.2.7 Efficacy of Agro Charger as Yield enhancer in cumin and coriander

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An experiment was conducted during two consecutive *rabi* seasons of 2018-19 and 2019-20 to study the efficacy of Agro Charger as yield enhancer in cumin and coriander. The results of field experiment showed maximum seed yield (495 kg/ha) of cumin recorded in treatment receiving Agro Charger @ 2 ml/litre. Seed yield increased by 17.29 % and 43.89 % over control and Agro Charger @ 4 ml/litre

respectively with the use of Agro Charger @ 2 ml/litre in cumin. The maximum essential oil (4.15%) in cumin recorded with treatment receiving Agro Charger @ 5 ml/litre. In coriander, maximum seed yield (797 kg/ha) was registered with Agro Charger @ 3 ml/litre. Seed yield increased by 29.80 % over Agro Charger @ 2 ml/litre with the use of Agro Charger @ 3 ml/litre. Agro Charger @ 2 ml/litre and @ 3 ml/litre in cumin and coriander respectively is better and eco-friendly source of nutrition in order to achieve safe and sustainable yield of cumin and coriander.

Keywords: Efficacy, Agro Charger, cumin, coriander, yield

5.2.8 Effect of Fruit Thinning on Fruit Quality in Banana Variety Grand Nain

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Fruit thinning is known to improve fruit quality in many crops including banana. Stage of fruit thinning affects the fruit development of the remaining fruits. In this study effect of banana hand thinning was studied in variety Grand Nain to understand its effect of fruit quality. Banana hand thinning was performed at six intervals keeping 8, 9, and 10 hands. Each interval had a gap of one week. Observations were recorded for fruit length and fruit weight. Maximum fruit length of the upper hand was recorded to 10.5 inch, fruit weight 220 gms in bunch maintaining 8 hands thinned after one week of the complete hand emergence. Minimum fruit length of 8.3 inch and weight 175 gms were recorded maintaining 10 hands thinned after six weeks of emergence.

Keywords: Grand Nain, fruit thinning

5.2.9 Light Emitting Diodes A New Reality in Horticulture

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Light is one of the indispensable constants for the plants necessary for their development beginning from planting, to emergence till harvesting. Production of high value indoor plants especially leafy vegetables and ornamental plants have increased significantly over the years. However, in greenhouse cultivation, sunlight is one of the most limiting factors that is affecting production, especially during winters when the days are short and light intensity is comparatively low. Light emitting diodes (LEDs), having known for their efficacy at converting electricity into light, is playing a vital role in such domain, by increasing plant photosynthetic and metabolic activities, growth and controlling flowering. Studies have shown that for every 10% increase in light, there is 7-10% increase in growth in plants. Many

works done on various ornamental plants such as petunia, salvia, dianthus, impatiens and rose have shown that using LEDs as sole lighting system or in combination with white light or other lighting system have efficiently increased the performance of the plants. Blue light has been reported to play a dominant role in regulating extension growth and pigment concentration that influences leaf colour and secondary metabolites. Supplementing the light requirement through light emitting diodes will enhance production by delivering at least 60-100 $\mu mol \cdot m^{-2} \cdot s^{-1}$ of blue light for ornamental crops and operated 12 to 20 hours per day and providing such light to seedlings will give greener and sturdier plants. Even higher intensities can be justified for fruit and vegetable crops. Researchers have put that LEDs are what growers would be using in the next few years due to its provision of giving right light for required plant growth, its efficiency, higher quality plants, uniformity and predictability. The cost for installation of LEDs are comparatively lower as various companies have been taking initiatives to put more light fixtures with high efficacies to enable the growers to utilize LEDs for more efficient production. While the benefit of targeting specific wavelengths of light may be negligible against ambient light, the relatively high energy efficiency and long lifespan of most LEDs remain desirable attributes. Additionally, with applications such as intracanopy and sole-source lighting becoming increasingly popular, the utilization of wavelength specificity provided by LEDs will only increase as their manufacturing costs continue to decrease while their electrical efficacy continues to increase.

Keywords: LED, ornamental plants, light.

5.3 Poster Presentation

5.3.1 Effect of Intercropping of Vegetable Crops as well as Rice Crop by Changing the Spacing in Sugarcane Crop in Mid-plains of Uttar Pradesh”

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Sugarcane one of the most important crop in district Lakhimpur-Kheri, but by changing the spacing pattern in sowing of same there is possibilities of inclusion of different crops .A study has been conducted at farmer’s field during rainy season of 2019-21. During the course of study it has been found that average intercrops yield were ladies finger-8.5q/0.1ha,turmeric-09q/0.05ha, rice-15.5q/0.5ha, cowpea-12.2q/0.1ha,bitter gourd-6.3q/0.05ha and bottle gourd-10.2q/0.05ha. In monetary term average gross return were from different crops approximately Rs.12000, Rs.20000, Rs.17600, Rs.24000, Rs.18000 and Rs.10000 respectively. The average total gross return was obtained Rs.101600 from intercrops. The data had been collected from crop area of 1.4 hectare from seven locations. CEY were obtained with reference to sugarcane, as per area acquired by each intercrops and their produce value in term of rupee as mentioned earlier 36.92q, 61.54q, 54.15q, 73.85q, 55.38q and 30.77q.

Keywords: Intercropping, Sugarcane, Mid plains, CEY,

5.3.2 Environmental Sustainability through New System of Compositing

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The General Practice adopted by farmers in villages particularly in Uttar Pradesh is to store cow dung in open and on flat surface, which leads to loss of nutrients. Looking into the large number of livestock's it is imperative to educate the farmers in the innovative systems of composting like Nadep compost, Vermi compost etc. through On Farm Trails.

An adaptive research was conducted in Fatehpur District on farmer's field. The experiment was conducted during winter (Rabi) season in Fatehpur district. Verification trails were conducted on large size plots on cropping sequence, soil fertility and yield stability. Application of 125 q/ha of Nadep compost at the time of last ploughing with 50% recommended dose of fertilizers wheat crop resulted into 4.39 q/ha of more crop yield. The soil was sandy-loam soil (sand, slit and clay 68.25, 14.75 and 16.0% respectively). Application of 50% of recommended dose of fertilizers (60 kg N, 30kg P, 20 kg K) with Nadep compost gave the highest economic return.

Application of 125 q/ha Nadep Compost + 25q/ha vermin-compost (without use of any fertilizers) resulted in good productivity (52 q/ha wheat, variety PBW-343) and increased soil moisture and crop growth as compared with no application of compost. Application of NADEP compost built up the fertility status of the soil and maintained soil health.

Keywords: Cropping sequence, Moisture, Soil fertility, Yield stability

5.3.3 Evaluation of Bio-efficacy of Oxyfluorfen 20% + Clodinafop- Propargyl 5% DF Against Weed in Onion Crop

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This experiment was conducted for evaluation of bio-efficacy of oxyfluorfen 20% + Clodinafop- Propargyl 5% DF against major weeds in onion crop at Crop Research Farm, NawabgangC.S.Azad University of Agriculture and Technology, Kanpur during *Rabi* 2018-19 and *Rabi* 2019-20. The herbicide formulation oxyfluorfen 20% + Clodinafop- Propargyl 5% DF at different concentration viz. @ 800, 1000, 1200 and 2400 g ha^{-1} was evaluated for its bio-efficacy on weed flora in onion crop and were compared with control. The experiment was laid out in Randomized Block Design with three replications and onion variety Nasik N-53was used. The outcome of the above experiment was indicated by the data taken at 15, 30, 45 and 60 days after application which is higher weed control efficiency against different weeds was recorded in weed free followed by oxyfluorfen 20% + Clodinafop- Propargyl 5% DF @ 2400 g ha^{-1} followed by oxyfluorfen 20% + Clodinafop- Propargyl 5% DF @ 1200 g ha^{-1} and oxyfluorfen 20% +

Clodinafop- Propargyl 5% DF @ 1000 g ha^{-1}, respectively. The onion bulb yield recorded in experiment was ranged from 8.69 t ha^{-1}- 18.28 t ha^{-1}, significantly higher mean bulb yield was recorded in oxyfluorfen 20% + Clodinafop- Propargyl 5% DF @ 2400 g ha^{-1} followed by oxyfluorfen 20% + Clodinafop- Propargyl 5% DF @ 1200 g ha^{-1} and oxyfluorfen 20% + Clodinafop- Propargyl 5% DF @ 1000 g ha^{-1} (18.28 t ha^{-1}, 17.89 t ha^{-1} and 17.41 t ha^{-1}), respectively and lower bulb yield was recorded in weedy check (8.69 t ha^{-1}).

Therefore, on the basis of two season studies it was observed that oxyfluorfen 20% + Clodinafop- Propargyl 5% DF did not produce and phyto-toxic symptoms and also it may be concluded that oxyfluorfen 20% + Clodinafop- Propargyl 5% DF @ 1000 g ha^{-1} can be used for effective control weeds in onion crop along with ultimate increase in yield.

5.3.4 Cost Benefit Analysis of Vegetables in Kanpur Region

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The study "Cost benefit analysis of vegetables in Kanpur Region" analyzed 100 vegetable growers from Kanpur nagar and Kanpur dehat; 50 from each district. The data was collected with the help of specially tested schedule by personal interview method, using multistage random sampling method for the year 2019-20 in twenty villages of four blocks viz., Kalyanpur and Bilhaur from Kanpur nagar and Akbarpur and Maitha blocks from Kanpur dehat. The study revealed that the average per hectare cost of cultivation of Rabi vegetables was Rs. 182340.47/ha which gives net returns of Rs. 55393.91/ha. Among rabi vegetables tomato was the most profitable crop with highest net returns of Rs. 84748.30/ha. The average per hectare cost of cultivation of Zaid vegetables was Rs. 159996.96/ha which gives net returns of Rs. 62305.84/ha. Among Zaid vegetables sponge guard was the most profitable crop with highest net returns of Rs. 92805.2/ha. It represents that vegetable cultivation is a profitable venture and can be a possible solution in improving socio-economic condition of the farmers.

Keywords: Rabi, Zaid, Vegetable Cultivation, Cost and Returns.

5.3.5 Role of Vegetable Crops in Doubling Farmers' Income

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Approximately, 70 per cent of the marginal and small farmers dwelling in India are devoid of sufficient land to cultivate and some of them are also landless (*FAO*, 2018). To improve their condition over such

a resource less situation, vegetable crops seems to be one of the answer for this. These crops can be seen as optimal option in crop diversification and adoption of modern approach; farmers can not only enhance productivity but also can improve their socio-economic condition. Horticultural cropping can optimize the space, time, B:C ratio and finally, can improve the productivity from the same piece of land. The productivity of vegetable was noticed 17.11 tonnes per hectare in India during 2017 (*Kumar and Tripathi,* 2020). The country recorded its highest ever horticultural production of 320.77 million tonnes from an area of 25.66 million hectare. Also, it is expected to hike 326.58 lakh million tonnes from an area of 27.17 lakh hectare by 2023, (*Ministry of agriculture and farmers welfare*, 2021). Keeping in view the huge potential and role of horticulture sector in increasing farmers' incomes, there is need to promote the holistic growth of sector in the country.

Keywords: doubling income, vegetable, socio-economic, marginal farmers.

5.3.6. Enhancing Farmers' Income by Adopting Integration of Different Agricultural Enterprises

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The present study used multistage random sampling technique and a total number of 50 farmers were selected randomly from the universe of 5 villages on the proportion of the farmers falling in each village under different size of group in the study area of District Banda. The average operation cost and average overhead cost of paddy, wheat and onion crop was Rs.35316.46 and 7568.41 respectively. The main product obtained from different crops i.e., paddy, wheat and onion crops was in quintal 35.43, 40.73 and 192.34 respectively. Average total cost of different land holding of marginal, small and large farmer of different enterprises like cow, buffalo, goatary and poultry was in Rs 24718.77, 35472.68, 8101.57 and 1942.45 respectively. The average input-output ratio of different enterprises was 1:2.07. therefore, we can see that integration of agriculture enterprises leads to a profitable deal and will be a key for the lead to increase farmers' income.

Keywords: farmers income, onion, wheat, paddy

5.3.7 Studies on Floral Biology in Different Cultivars of Guava (*Psidium guajava* L.)

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The experiment was conducted at Madhadi baug, Fruit Research Station, Department of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) during the year 2020. The experiment was laid out in a Randomised Block Design with four different treatments and five replications. The treatments

comprised of different cultivars *viz*., Allahabad safeda, Bhavnagar red, L-49 (Sardar), Yogi (Sarangpur selection). The observations on Anthesis, dehiscence, pollen viability, pollen germination and stigma receptivity were recorded during Mrig Bahar (winter) crop of guava.The result revealed that optimum time for anthesis was found from 6:00 a.m. to 7:00 a.m. and dehiscence was from 7:00 a.m. to 8:00 a.m. in all the cultivars. Maximum pollen viability per cent (94.06 %), pollen germination per cent (85.75 %) and stigma receptivity per cent (83.08 %) were observed in L-49 (Sardar) cultivar of guava. Among the all cultivars under study, L-49 (Sardar) gave the best result in relation to pollen viability and pollen germination during Mrig Bahar (winter) crop of guava.

Keywords: Guava, floral biology, anthesis, dehiscence, pollen viability, pollen germination and stigma receptivity

TECHNICAL SESSION-6

VARIETAL IMPROVEMENT FOR RESILIENCE TO CLIMATE CHANGE AND SUSTAINABILITY IN PRODUCTION

6.1.1 Fruit Breeding in India: Achievements and Way Forward

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Breeding of perennial fruit trees is quite different than breeding of annual crops. Besides, there are several constraints impeding fast testing and release of varieties. In addition, there are several inherent problems insome fruits crops such as structural differences in floral biology, apomixes, parthenocarpy, cross incompatibility, number of seeds per fruit and large acreage required for meaningful assessment. While a lot of geneticvariability has been collected and maintained in a number of fruit crops, major emphasis in fruit breedinghas so far been laid only on developing varieties with high yield and superior fruit quality. Time has come tohave a fresh look on breeding priorities and strategies to harness the full potential of fruit breeding. Followingrecommendations are made to achieve the desired objectives: While a lot of genetic variability has been collected and maintained in a number of fruit crops, majoremphasis in fruit breeding should be given for systematic evaluation of germplasm of fruit crops. Collection of wild germplasm, endangered species and other gene sources should be taken on priorityand their descriptive evaluation is of utmost importance.There is urgent need to do basic research on inheritance of characters which will ease the choice ofparents in hybridization programmes. There is need to clearly define objectives and priorities of breeding of fruit crops for different regions.Furthermore, the work should be assigned to different centres on the basis of their human resource capabilities and available facilities. Rootstock breeding of commercial fruits like mango, citrus, grape, pomegranate etc; indigenous fruits like Bael, jamun should be taken at priority. In view of climate change, breeding work should be taken at priority for developing climate resilient varieties and rootstocks. There should be integrated breeding approaches involving traditional and modern molecular methodsfor the improvement of fruit crops. Marker aided selection and enriching the genome resources of fruitcrops should be taken on priority.There is dearth of manpower for fruit breeding programmes keeping in view the number of crops andaspects requiring attention.

6.1.2 Biotechnological Approaches for Climate Resilient Vegetable Crops Development

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Human society has reached a point where climate change is turning more and more inevitable. From rising earth temperature, melting glaciers, disastrous flooding and erosions, to undermined food production, climate change has resulted in an unprecedented global percussion strike. It has also challenged the worldwide agricultural productivity and nutritional food security. Food and commodity prices are escalating every day and are expected to increase more and more due to uncontrolled climatic situations. These conditions have aroused more inclination towards the utilization of CWRs in agriculture and development of climate-resilience crops with the ability to cope with array of climatic stresses such as heat, drought, flood, cold, salinity, submergence, and help to deliver increased productivity of quality food while ensuring high nutritional security. The selection objectives to enhance crop resilience to the impacts of climate change are required to address more genetic variability. Besides this, unraveling the genome repository of wild germplasm is imperative to the crop improvement program. To achieve this, next-generation breeding technology appears to be convincing in improving crop responsiveness and adaptability to climatic stresses by tracing the underlying alleles and genes/QTLs from diverse genetic resources and their successful introgression into the new genetic background. Biotechnological approaches have supplied fruitful results to plant breeders in enhancing multiple stress tolerance in crop plants. Molecular breeding, genomics-assisted breeding, plummeting costs of high-throughput sequencing techniques and advances in phenotyping platforms have completely transformed the scenario of plant breeding. The importance of vegetables in human nutrition as well as ensuring global security cannot be undermined. In view of this, the present article elaborates the prospects and progresses in biotechnological approaches for enhancing climate resilience in vegetable crops. The emerging concepts and challenges to minimize climate-induced risks and productivity-related losses to the farmers are also discussed.

Keywords: Biotechnology; Climate resilience; Genomics assisted breeding; MAS; Next-generation sequencing; Pan-genomes; Phenomics; Artificial intelligence; Vegetables.

6.1.3 Innovations in Vegetable Breeding for Improving Resilience towards Climate Change

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Nutritional requirement of human beings for good health, productivity and longevity are obtained from various food systems. Among food crops, vegetables being rich sources of various health promoting substances, especially vitamins, minerals, micronutrients, dietary fibres and other phytochemicals. They offer unique advantage to nutrition security, tackle malnutrition and dietary deficiency diseases. High yielding varieties and hybrids with novel traits have been developed which had enhanced the productivity and ensured year round availability of many vegetables throughout the country. Climate change is one of

the most prominent global environmental problems, and evaluation of its impact on many production sectors, including agriculture, is relevant. Major environmental challenges that humans are facing are primarily due to climate change and the predicted future shortage of fossil fuels, e.g. in the agriculture sector. Vegetable crops are supposed to have better resilience towards changing climate as diverse varietal wealth and concerted efforts of breeding programme could lead to development of varieties with improved tolerance to higher temperature and many diseases. Technology for year round cultivation of cauliflower, carrot, radish and palak were developed by integrating suitable varietal development for specific temperature regime as per seasonal variation along with standardized agronomical practices. Developing shorter duration varieties of different vegetable crops as well as varieties suitable for different seasons/maturity periods based on prevailing environmental temperature has ensured growing and supply of vegetables almost round the year for many of them and helped in improving water productivity as well. Of late, few varieties/hybrids of tomato, cucumber, bittergourd, melons have been specifically designed and developed for protected cultivation where these are being grown under vertical system of farming and accommodating 4 to 6 times higher number of plants per unit area and producing 8 to 10 times higher yield than open field and even their produce are available beyond the normal growing season which helps farmer to realise better economic gain as well. At the same time a lot of input in terms of water and nutrients are also saved due to its supply though drip irrigation/fertigation system. Most of the high-yielding varieties of vegetable crops have been developed for maximizing yield under irrigated conditions of enough water availability and many of these varieties do not possess suitable traits for yield and productivity under drought or water-limited conditions. Stresses are always complex in their nature and controlled by networks of different factors (e.g. genetic and environmental) that impede crop plant breeding strategies as well. Recently, technological advances in functional genomics have been made and they have helped to reveal the numerous gene families and processes that alter adaptation to abiotic stresses and thereby improve yield. Biotechnological innovations and tools have been employed to speed up the breeding programme. 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. Marker assisted selection (MAS) has been successfully utilized for introgression of disease resistance genes and gene pyramiding against leaf curl (Ty1, Ty2, Ty3), bacterial wilt, nematode and late blight diseases of tomato. Multiple disease resistant varieties and hybrids with combined resistance against different diseases have been developed by many institutions. Molecular markers have been developed for many resistance genes in other crops as well like Fusarium wilt of melon, black rot of cauliflower. Genomic assisted breeding has successfully utilized for incorporation of gynoecious trait in tropical Indian cucumber variety from exotic cucumber lines which will improve its productivity. Molecular mapping of many important horticultural traits involving Indian germplasm lines have been completed which will be useful for trait specific breeding including fruit quality. Haploid breeding for development of inbreds in shorter time has been utilized in snowball cauliflower and few hybrids could also be developed. It can be concluded that many special traits have been incorporated in different vegetables to make them grow out of season, having resistance against diseases and pest for growing safe vegetables by minimizing chemical use, with enhanced shelf life and long distance transportation ability, better nutritional content, overall quality and higher consumer acceptability and better adaptability to changing climate as well.

6.1.4 Bio-technological Approaches for Resilience to Climate Change in Sub-Tropical Fruits

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6.1.5 Biotechnological Approaches for Improving Horticulture Productivity

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Over a few decades, technological developments have grown concomitantly. Advances in biotechnology have been used as a tool to increase food production.Specifically, advances in genetic engineering have made possible the manipulation of crops to increase production for the increasing world population. Fruits are one of the major sources of vitamins, essential nutrients, antioxidants and fibres in human diet. During the last two–three decades, genetic engineering methods based on the use of transgenes have been successfully adopted to improve fruit plants and focused mainly on enhancement on tolerance to biotic and abiotic stresses, increased fruit yield, improved post-harvest shelf life of fruit, reduced generation time and production of fruit with higher nutritional value, edible vaccines etc. However, the development of transgenic fruit plants and their commercialization are hindered by many regulatory and social hurdles. One successful example is transgenic papaya expressing coat protein of papaya ring spot virus (PRSV) against PRSV developing two cultivars 'SunUp' and 'Rainbow'. Nowadays, for genetic modification of plants new genetic engineering approaches i.e. cisgenesis or intragenesis receive increasing interest. In this abstract, we attempt to summarize the recent progress achieved on the genetic engineering in fruit plants and their applications in crop improvement for increasing production.

Keyword- production, transgenic, fruit, improvement etc.

6.2 Oral Presentation

6.2.1 Performance of F1C3 Potato clones in West-Central Plain

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Potato (*Solanum Tuberosum* L.) has established as one of the major food crop in India. The main reason for this have been the improved varieties and technology developed by CPRI and the establishment of the National seed production programme. West central plains accounts for about thirty five percent of the total potato production of the country. The varietal requirement of this region is high yielding,

medium maturing (90-100) varieties possessing resistance to late blight and having good keeping quality. The present study was conducted at experimental field of ICAR-Central Potato Research Institute, Regional Station, Modipuram, Meerut during crop season of 2019-2020 to investigate the yield performance of 80 genetically diverse F1 C3 clones of 18families. The material was planted in multiple row trial (120 tuber trial) along with two check varieties namely, Kufri Bahar and Kufri Mohan at 90 days crop duration, significant differences among genotypes were recorded for tuber yield and tuber attributes like plant vigour (1-5 scale), foliage maturity (1-5 scale), specific gravity and tuber matter (%). At harvest, based on tuber yield and desirable tuber attributes. 18 promising clones of 11 families were selected. Among the 18 clones selected, four clones namely, MS/17-1055 (43 t/ha), MS/17-379 (40 t/ha), MS/17-379 (40 t/ha) and MS/17-739 (38 t/ha) were top yielder as compared t check Kufri Bahar (38 t/ha) but lower than the check Kufri Mohan (49 t/ha). The high specific gravity and tuber dry matter (%) were recorded in five clones namely, MS/17-198 (1.088 and 22.02%), MS/17-629 (1.068 and 1834%). MS/17-621 (1.068 and 17.88%), MS/17-739 (1.064 and 17.04%) and MS/17-975 (1.064 and 16.93%) the further evaluation of these clones would help to identify suitable varieties for sub-tropical plains of India accounting nearly 90& area of the country.

6.2.2 Evaluation of Papaya lines for PRSV Tolerance and Horticultural Traits

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Papaya Ring Spot Virus (PRSV) is one of the major impediments in papaya cultivation, which recorded yield loss ranging from 80-100%; and has threatened commercial cultivation across the globe. The various options for managing viral diseases are vector management, planting in areas with negligible/less virus-inoculum, rogueing, and host-plant resistance. Vector control for managing PRSV is not an economic viable option. The transient aphid-vector acquires and transmits the virus within seconds. The popular hybrid variety (Red Lady) with red fleshed has good market demand but at the same time, it is highly susceptible to PRSV. Till date, there is no conventional variety resistant/tolerant to PRSV as well as with red/pink flesh variety. ICAR-IARI Regional Station, Pune has come up with some papaya lines *viz*., PS-1, PS-2, PS-3 & PS-5 tolerant to PRSV. ThesePS lines are showing consistently tolerance to PRSV (from 2014-2021).Over the years the disease intensity was less than 30%in all PS-lines and among them Pune Selection-5 showed the least (15.43%). The yields of Pune Selection lines persistently showed higher yields in comparison to the commercial check (Red Lady) and local check (Phule Vijaya).Under severe stress condition and disease pressure PS-lines yielded more than the commercial check 'Red Lady' as well as other varieties like Pusa Nanha and Phule Vijaya. Pune Selection-3 is pink fleshed line with TSS ranging from 9 to 11° Brix depending upon the season of harvest. PS-lines can well be used for biennial crop cycle; and harvest is for both table and vegetable purpose. All these lines have been registered with Plant Germ-plasm Registration Committee, NBPGR, New Delhi.Therefore, these lines are suitable for table, culinary as well as for industrial purposes; and advocate to take up these lines for commercial cultivation.

Keywords: Papaya, pink flesh, PRSV, tolerance, yield

6.2.3 Studies on Evaluation of Chilli (*Capsicum chinense* Jacq.) Genotypes with High Yield and Capsaicin for Industrial Purpose.

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The Capsicum genus is native to tropical Central and South America and comprises 27 species, though only five of these are domesticated viz., *Capsicum annuum*, *Capsicum chinense*, *Capsicum pubescens*, *Capsicum frutescens* and *Capsicum baccatum*. Among these, *Capsicum annuum* with its diversity of market types of pungent and non-pungent fruits is the most widely commercially cultivated worldwide. Capsicum fruits are grown mainly for use as a fresh vegetable (hot and sweet peppers), for drying as spice (paprika, chilli powder), for extraction of food colourings and flavourings, and extraction of other compounds for medicinal or industrial uses. The present investigation was carried out using six genotypes of chilli (*Capsicum chinense* Jacq.) during 2020-21 to evaluate the genotypes for yield and capsaicin content to suit the industrial purpose. The study was conducted at the College orchard, Dept. of Vegetable Science, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. The experiment was conducted in a Randomized Block Design with three replications. The genotypes included CC-CBE-001, CC-CBE-002, CC-CBE-003, CC-CBE-004, CC-CBE-005 and CC-CBE-006. Observations on biometric, yield and quality parameters viz., Plant height (cm),number of branches per plant, days to first flowering, days to 50% flowering, number of fruits per plant, average green fruit weight (g), average dry fruit weight (g),single fruit weight (g),fruit length (cm),fruit girth (cm),fresh fruit yield/plant (g), dry fruit yield/plant (g), capsaicin content (SHU), capsanthin content (ASTA colour value) and oleoresin content (%) were recorded. Among the genotypes evaluated, CC-CBE-003 was the earliest to flower (27.5) and the days to 50% flowering were 32.75. The highest plant height (171.67cm) and the number of branches per plant (5.47) were recorded in the genotype CC-CBE-003. Similarly the maximum number of fruits per plant (262.20) and the highest fresh fruit yield per plant (620.37 g) was recorded in CC-CBE-003. The highest capsaicin content (170264 SHUs) was found in the genotype CC-CBE-003. The capsaicin content of commercially cultivated *Capsicum annum* ranges between 15,000 to 20,000SHU. Since the capsaicin content recorded in the present study is high, it can be concluded that the genotype CC-CBE-003 with highest capsaicin content and oleoresin content can be recommended for industrial application.

Keywords: *Capsicum chinense* - biometric, - yield and quality parameters - industrial application

6.2.4 Breeding for Improved Yield in Bottle Gourd

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Bottle gourd (*Lagenaria siceraria* Standl.) is a widely cultivated crop of the gourd family Cucurbitaceae. Bottle gourd is mostly grown in tropical parts of the world for its tender fruits. It is a creeping vine

which is grown in both rainy and summer seasons. This species represents the largest variation in fruit shape and fruit size due to thousands of years of selection in isolated areas. Preference for certain shapes and sizes resulted in reduction in trait variation in bottle gourd. Plant breeders rely on genetic diversity to improve yield. It is important to discover more genetic diversity, in order to identify cultivars which can be used by plant breeders for bottle gourd improvement. Also, the yield and fruit quality are seriously affected by fusarium wilt caused by *Fusarium oxysporum* f sp. *lagenariae*. A local collection HABOG-38 showed resistance to fusarium wilt with photo insensitiveness, high yielding and cylindrical fruits. Therefore, to improve the fruit yield this line HABOG-38 was used as female parent in cross with Swarna Sneha, which showed moderate resistance to fusarium wilt. F_1 was cylindrical fruit shape with wilt resistance and individual plant selection was followed. Three F_4 segregants with wilt resistance were selected having different fruit shapes. Thus, the genetic diversity of land races can be utilized for the improvement of bottle gourd.

Keywords: bottle gourd, fusarium wilt

6.2.5 Biotechnological Interventions for Oil Palm (*Elaeis guineensis* Jacq.) Crop Improvement

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Oil palm (*Elaeis guineensis* Jacq.) contributes nearly 40 percent in production of edible vegetable oil throughout the world. Oil palm is a highly heterogeneous crop and to achieve homogeneous and improved yield parameters, *in-vitro* somatic embryogenesis is very much required. For the first time, institute developed a robust *in-vitro* regeneration protocol in oil palm. The results showed that it is highly dependent on genotype and also auxin concentrations. High callusing percentage was obtained with Y3 media in comparison to MS and N6 media. Genomics approaches helps in improvement of several crops like oil palm. We developed first microsatellite database of oil palm, OpSatdb, using PHP and MySQL database. It is simple and systematic web based search engine for searching SSRs based on repeat motif type, repeat type, and primer details. Identified SNP based markers for sterility trait in dura germplasm through genotyping by sequencing method. These SNP markers are able to clearly differentiate the sterile and fertile dura germplasm. We also identified SNP based molecular markers for SHELL gene which are able to differentiate oil palm fruit forms at early stage and SSR marker for dwarf trait. At present we are focussing on genomic selection model development in strengthening our molecular breeding programmes for selection of high oil yield and oil quality parameters at early stage to reduce the breeding cycle.

Keywords: Oil Palm, in-vitro somatic embryo genesis, genotyping by sequencing, SSRs, genomic selection

6.2.6 Marker Assisted Selection of Dwarf Traits in Oil Palm (*Elaeis guineensis* Jacq.)

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Oil palm (*Elaeis guineensis* Jacq.) is perennial vegetable oil yielding crop with high oil yield as compared to other annual oil yielding crops. Due to perennial nature, this crop can stand for more than 25 years and harvesting of fresh fruit bunches (FFB) will be done fortnightly interval. Harvesting is major problem due to more height of the palm. Upto 15 years harvesting can be done through chisel and pole attached with sickle and the height of the palm reached more than 20 feet, pole harvesting is also very difficult for balancing pole. To solve the harvesting problem in oil palm, we can go for mechanization in harvesting FFB, but this is not a permanent solution. Marker assisted selection can give solution for identification dwarf genotypes and by this we can develop dwarf hybrids by reducing breeding cycle of oil palm by early detection through SSR markers. In germplasm block, we have recorded height of the palm and categorised into 3 categories based on annual height increment i.e. dwarf (<30 cm), medium height increment (30-45 cm) and tall (>30 cm). By using this data, identified SSR markers and these markers were used for further utilization in breeding programme. The marker was identified based on bulk segregants analysis, association mapping and bioinformatics analysis and the marker was located in chromosome 14. This will ultimately leads to rapid breeding and developing dwarf hybrids, ease of harvesting and economic life span of plantation can extend for another10 years.

6.2.7 Mapping of Quantitative Trait loci (QTLs) for Bunch Traits using SSRs in African Oil Palm (*Elaeis guineensis* Jacq.)

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Oil Palm (*Elaeis guineensis*) is also known as golden palm, the largest vegetable oil yielding perennial crop (4-6 t oil/ha/ year). One acre of oil palm plantation is able to produce up to ten times more oil than other leading oilseed crops. Large gap exists between availability and actual utilization of the oil palm germplasm. Extensive use of fewer and closely related parents in oil palm crop improvement could result in inbreeding depression and narrow genetic base. The evaluation and characterization of existing oil palm germplasm have resulted in identification of genetically diverse trait-specific germplasm lines meeting the needs of oil palm breeders for use in developing high yielding cultivars with a broad genetic base. Oil yield is the most important trait for oil palm production and increasing yield is the primary goal for improving trait specific oil palm. Quantitative trait loci (QTL) have been mapped to study oil yield-related traits in oil palm. A total of 50 progeny lines from 44 CD x 435 CD were used for genotyping and

phenotyping and also for identification of QTLs of important traits. Whole genome wide 458 microsatellite markers were used for linkage mapping studies in oil palm for important bunch parameters. One QTL for bunch number, two for Oil to dry mesocarp and one for oil to wet mesocarp were identified on chromosome one. Highly significant QTL was identified for Oil to dry mesocarp at an LOD value of 13, which explains 4% phenotypic variance. The ultimate goal is to identify QTL and closely linked markers that can be used for molecular breeding to improve oil palm oil yield production.

6.2.8 Performance of Ajwain (*Trachyspermumammi* L.) Genotypes for Growth and Seed Yield in Different Locations Across the Country

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Ajwain (*Trachyspermum ammi* L.) also known as Bishop's weed is an annual herbaceous plant belonging to family Apiaceae bearing grayish brown fruits. The major ajwain producing countries are India, Persia, Iran, Egypt, Afghanistan, Pakistan and North Africa. Thirteen ajwain genotypes were evaluated for various plant growths, seed yield attributing traits and essential oil content during 2016-17 to 2018-2019 at six (Hissar, Guntur, Jobner, Jagudan & Faizabad) AICRP centres including ICAR-NRCSS, Ajmer, India. The significant differences were obtained for all the parameters studied. Plant height ranged from 118.8-121.1 cm, number of primary branches 18.0-18.8, umbels per plant 265.6-298.8, umbellate per umbel 24.0-27.4 and seeds umbellate 19.0-19.5. On the basis of mean seed yield (1652.45 kg/ha.) of three years (2016-17 to 2018-2019) at ICAR-NRCSS,Ajmer, the maximum seed yield was recorded as 1652.45 kg/ha in AA-73 followed by IA-1(1406.91 kg/ha) showing an increase of 88.06 & 57.03 % higher seed yield over Ajmer Ajwain -2 and Ajmer Ajwain -1 (checks),respectively.Seeds of AA-73 contains 9.15% total oil and 6.38% essential oil which is higher (39.26 and 17.27 percent respectively) as compared to Ajmer Ajwain-2, national check.

Key words: Ajwain, Genotypes, Essential oil, Growth parameters, Seed yield

6.2.9 Screening of Turmeric Germplasm for Resistance to Rhizomerot, Leaf Spot and Leaf Blotch Diseases under Field Conditions

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Field trials were conducted with 88 turmeric varieties and germplasm lines to screen against rhizome rot, leaf spot and leaf blotch diseases during 2017-18. Under field conditions, out of 28 short turmeric lines screened, 4 lines viz, Dhindigam, IC-420606, IC-319341, PTS-8 were found resistant to rhizome rot disease which showed 0.0% disease incidence. IC-211402, IC-181919 were found susceptible to rhizome rot disease.One short duration variety T. Sundar found resistant to leaf spot disease whichshowed 0.0% incidence. Ennachand, IC-332957 (2.55), IC-416941 (9.55) and Kasturi Anidi (16.54) showed moderately resistant reaction to leaf spot. Five short duration varieties viz., TenaliKasturi, GS, NB 60, IC-033007 showed 0.0% resistance against leaf blotch. Dhindigam (5.58), IC-420606 (2.54) and PTS-8 (5.54) were moderately resistant to leaf blotch.Under field conditions, out of 21 medium turmeric varieties screened, Ochira variety was found resistant to rhizome rot disease and showed 0.00% disease incidence. One medium duration variety CLI-317 was found resistant which showed 0.0% leaf spot disease. Pratibha, BSR-2, TCP-129, Rajpuri, RH-80 and PTS-55 were moderately resistant to rhizome rot disease.BSR-2, Rajpuri, CLI-325, CLI-335, Rashmi, Ochira, RH-80, KTS-6 and KTS-7 were found to be resistant to leaf blotch which showed 0.00 infection.Out of 39 long duration turmeric lines screened, 5 varieties - CL-9,Ranga, Salem-2, CL-8 and KTS-9 found resistant to rhizome rot disease which showed 0.00% infection.CL-9, Wagon and Roma were found resistant to leaf spot disease which showed 0.00% infection. Chintapalli local -2, Vontimitta, Duggirala, CL-11, CL-17, CL-5, North East C. amada, Wynad Local, KTS-9 and KTS-8 were found resistant to leaf blotch disease which showed 0.00% infection. Wagon (17.58%), CL-2 (35.77%), PTS-38 (49.55%) were found susceptible to leaf blotch disease. Highest yield was recorded in Short duration variety – Tenali Kasturi (25.21t/ha), medium duration variety -BSR-2 (22.42t/ha) and long duration variety – KTS-8 (27.39 t/ha)) and Salem (25.10 t/ha).

Keywords: Turmeric, screening, rhizome rot, leaf spot, leaf blotch

6.2.10 Evaluation of Garden Pea: its Proximate Composition and Physiochemical Properties Analyzed by New Technology

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Legumes in the Fabaceae family are the second most important crops after cereals. The common pea (*Pisum sativum* L.), including field pea and garden pea, is one of the oldest domesticated crops, cultivated for either human foods or livestock feeds. Pea plants can tolerate low temperatures during germination and growth and their cultivation provides an excellent cool season alternative for regions not suitable for soybean or bean production. The garden pea is mainly consumed as a green vegetable with its immature pods and seeds, whereas the field pea is marketed as dry grains and dominates global pea production and commercial pea products. Several market classes of field pea, such as yellow, green, marrowfat, and maple pea, are available in world pea markets. Since field pea and garden pea have significant differences in their genotypes, harvest stages and final products, this review mainly covers the recent research progress on protein composition, properties and utilization of field pea. Field pea is one of the most important leguminous crops over the world. Pea protein is a relatively new type of plant proteins and has been used as a functional ingredient in global food industry. Pea protein includes four major classes (globulin, albumin, prolamin and glutelin) in which globulin and albumin are major storage proteins in pea seeds. Globulin is soluble in salt solutions and can be further classified into legumin and vicilin. Albumin is soluble in water and regarded as metabolic and enzymatic proteins with cytosolic functions. Pea protein has a well-balanced amino acid profile with high level of lysine. The composition and structure of pea protein, as well as the processing conditions, significantly affect its physical and chemical properties, such as hydration, rheological characteristics, and surface characteristics. With its availability, low cost, nutritional values and health benefits, pea protein can be used as a novel and effective alternative to substitute for soybean or animal proteins in functional food applications.

Keywords: Protein content, amino acid, functional property etc.

6.2.11 Evaluation of Fenugreek Genotypes for Leafy Purpose

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Fenugreek (*Trigonellafoenum-graecum*) is an annual plant belongs to the family Leguminosae. Since ancient times, green leaves of fenugreek are consumed as foodstuff in view of its medicinal value. Leaves contain about 86.1% moisture, 4.4% protein, 0.9% fat, 1.5% minerals, 1.1% fiber, and 6% carbohydrates. The mineral and vitamins in leaves include calcium, zinc, iron, phosphorous, riboflavin, carotene, thiamine, niacin and vitamin C. Hence, exploration of fenugreek germplasm lines for its suitability to leafy

purpose is essential. A total of 60 accessions collected from various parts of the country were evaluated for leaf yield and its attributes at HRS, LAM, Guntur during Rabi season of the year 2021-22. The accession LFG-7 recorded highest fresh yield at 7 and 14 DAS followed by LFG-2. The highest shoot length, root length, leaf length and width were also recorded with the accession LFG-7. The accession LFG-7 recorded 15.34% higher yield than the check variety (HisarSonali).

Keywords: Fenugreek, germplasm evaluation, leaf purpose

6.2.12 Evaluation of Promising Coriander Genotypes for Yield and Quality

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Coriander(*Coriandrum sativum* L.) is an annual plant belongs to the family Apiaceae. Coriander occupies a prime position among various seed spices grown in India.It is mainly cultivated for the seeds (fruits) that contain essential oil, fatty acids, coumarins, flavonoids, and polyphenols. Availability of diversified varieties in market is essential for growers and traders for revenue generation. In view of this, the present study of varietal evaluation on coriander was conducted for three years(2018-21) with 19 entries *viz*., COR-174, COR-175, COR-176, COR-177, COR-178, COR-179, COR-180, COR-181, COR-182, COR-183, COR-184, COR-185, COR-186, COR-187, COR-188, COR-189, COR-190, COR-191, COR-192 and one check variety Susthira.

The pooled data indicated that the highest plant height (cm), number of primary branches, number of secondary branches, umbel per plant, umbellets per umbel, number of seeds per umbellet, number of seeds per umbel and seed yield (kg/ha) were recorded with entries COR-189, COR-174, COR-190, COR-190, COR-174, COR-190, COR-179 and COR-185 respectively. It was also observed that 28.5 percent increase in yield was recorded with variety COR-185 over check, exhibiting the suitability for cultivation in Andhra Pradesh. Among the entries, highest essential oil content was recorded in Susthira (0.60 % v/w).

Keywords: coriander, varietal evaluation, suitability, Andhra Pradesh

6.2.13 Inducing Variability through Physical And Chemical Mutagens and Screening of Mutants in Gladiolus Cultivar Prince of Orange

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The present investigation was carried out in the Model Floriculture centre of the university to induce/ release genetic variability and to isolate desirable mutants in the commercial gladiolus cultivar Prince of

Orange. The standard size corms of were treated with different doses of gamma radiations (4.0 to 5.5 Kr) and Ethyl Methane Sulphonate (EMS) (0.2 to 0.6% for 6 hours). The EMS treated corms were thoroughly washed with distilled water and dried under shade before planting. The gamma radiation facility of RITL, CBSH College was utilized. The treated corms were planted immediately after the exposure with mutagen. The crop was raised under uniform and standard cultural practices in the gladiolus block. The results envisaged a reduction in survival percentage of plants with higher doses of gamma rays. The gamma irradiation showed an inhibitory effect on vegetative characters such as plant height, number, length and width of leaves. The early flowering and increment in blooming duration were recorded at 4.5 and 5.5 Kr with a few mutants showing colour modifications. The number of tillers increased with increased doses of gamma rays whereas number and size of floret, spike length, rachis length, vase life, weight and size of corms and cormels were reduced. With increased concentration of EMS, an increase in plant height was obtained over control, with ethe tallest plant height, spike length, and rachis length recorded at EMS (0.6%). Moreover, more tt(#<. lodging resistance was obtained as the EMS doses were advanced. However a decrease in survival percentage was obtained with the increment in the doses. As many as 09 mutants have been obtained which will be studied for stability in vM_2 and subsequent generations

6.3 Poster Presentations

6.3.1 Assessment of High Yielding Varieties of Mustard through Front Line Demonstration in District Hathras

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Assessment of Front Line Demonstration on Mustard Crop in Hathras District of Uttar Pradesh. The domestic requirement of oil seed had been manifold of a modern livening standard which has been fulfilled through the import that lead to imbalance the Indian economy. The aim of this study was to evaluate the influence of mustard varieties and year of production in relation of weather condition on seed yields, oil content and its quality with a focus on human nutrition value through a field study carried at three different locations in Hathras. The seed yield was significantly affected by the year of production the location and the variety. The environmental factors that negatively affected seed yield are temperature in summer, water shortage, wet and cold soil in spring. The highest seed yield reached at mid-heavy soil in the region with lower precipitation amount.R.H-749 would we recommendable for Hathras environmental condition. R.H.-749 variety gave the significantly highest oil yield.

6.3.2 Genetic Variability, Heritability and Correlation Coefficient in Cucumber (*Cucumis sativus*)

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An experiment was carried out to study about 10 diverse genotypes of cucumber during the year of 2019-20. The investigation was conducted at vegetable Research Farm of Department of Vegetable Science, C.S. Azad University of Agriculture and Technology, Kanpur, U.P. The spacing was maintained at 2.5 m x 0.40 m with the plot size 2.5 m x 4.0 m. The experiment was carried out under Randomised Block Design. The experiment material viz. CoE 19-1, CoE 19-2, CoE 19-3, CoE 19-4, CoE 19-5, CoE 19-6, CoE 19-7, CoE 19-8, CoE 19-9 and Kalyanpur green. All the genotypes were maintained at Vegetable Research Station, Kalyanpur, Kanpur. Eleven characters of cucumber were observed viz. Days to male flower opening, days to female flower opening, first fruit set knot, length of fruit (cm), girth of fruit (cm), average fruit weight (gm), number of fruits per plant, length of main branch (cm), number of leaves per plant, fruit yield (gm) and crop duration in days. Significant differences were recorded for all the traits and according to the present investigation, it may be concluded that wide range of variation were found in cucumber strain for all the traits studied. COE 19-1 is found highly significant for most of the traits viz. Days to female flower opening, First fruit set knot, length of fruit, number of fruits per plant, average fruit weight, fruit yield per plant and crop duration in days.

6.3.3 Studies on Varietal Trial with Different Genotypes of Onion (*Allium cepa* L.)

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A field experiment was conducted at Vegetable Research Farm Kalyanpur, Chandra Shekhar Azad University of Agriculture & Technology Kanpur, Uttar Pradesh during the Rabi season. Nine genotypes i.e. RVB20-02, RVB20-04, RVB20-06, RVB20-08, RVB20-10, RVB20-011, RVB20-013, RVB20-15& RVB20-17 were used with three Replication of Randomized Block design (RBD). The character were taken Bolting %, Neck thickness (cm), marketable & total yield (q/ha.), average bulb weight(gm), total soluble solid (%), days taken to maturity and days to harvesting. The highest total & Marketable yield (213.5 q/ha & 190.75 q/ha) were recorded in genotype RVB 20-15 followed by RVB 20-13 (211.00 q/ha & 188.75 q/ha) respectively. The minimum Total & Marketable yield (180.75 q/ha & 166.58 q/ha) were recorded in genotypes RVB 20-08. The minimum bulb rotting percentage (3.93%) were found in genotypes RVB20-15 and highest total soluble solid percent (12.84%) were found in RVB 20-11. The above genotypes will be use of making crosses for the highest yield and TSS.

6.3.4 Adoption Level of Improved Varieties of Vegetables

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The district Lakhimpur Kheri falls in the tarai region of Uttar Pradesh where sugarcane is the most prominent growing crop, still farmers grow vegetables viz. cow pea, okra, tomato, potato, brinjal, and seasonal cucurbits to consume as well as to sell. In this regard to measure the varietal adoption of improved varieties of vegetables in the district of Lakhimpur Kheri, a sample of 100 farmers was collected randomly with a structured schedule method from the villages of Kumbhi, Bankeyganj and Phoolbehed blocks in the year 2020-21. These vegetable growers were having different size of lands. After the analysis of the collected data, it was revealed that 73 per cent farmers grew newly released varieties (within 3 years) among them 17 per cent changed their varieties with a new ones to enhance their vegetable production in per unit areas.

6.3.5 Varietal Performance of Table Potato (*Solanumtuberosum*. L)in the central UP

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The suitability of crop varieties in a particular location determines the productivity of crops. A field experiment was conducted from October to February 2019-20 & 2020-21 at Vegetable Research Farm Kalyanpur, Chandra Shekhar Azad University of Agriculture & Technology Kanpur to evaluate the growth and productivity of potato varieties. The treatments were arranged in Randomised Block Design (RBD) with 5 replications and seven potato varieties were used viz. K. Bahar, K. Khyati, K. Pukhraj, K. Lima, K. Ganga, K. Mohan and K. Surya evaluated yield and related characters i.e., plant emergence, plant height, no. of shoots/plant, foliage senescence percent, tuber dry matter percentage under central zone of Uttar Pradesh conditions. The results revealed that the highest total & marketable tuber yield was produced by K. Mohan (48.63 t/ha & 41.16 t/ha) followed by K. Khyati (48.06 t/ha & 40.51t/ha), tuber dry matter percentage were found in K. Surya 20.50 % followed by K. Pukhraj 19.03 %. Therefore, variety K. Mohan in respect to higher growth as well as productivity of potato is recommended for farmer's based on present field experimentation.

6.3.6 Genetic Divergence and Selection of Genotypes in Bottle Gourd (*Lagenariasiceraria*)

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Genetic divergence studies were performed for eight characters in bottle gourd (*Lagenariasiceraria*) based on 40 diverse genotypes which were grown on Vegetable Research Farm, Kalyanpur, C. S. A. U. Agri. & Tech., Kanpurduring spring season of 1915. All the genotypes were sown in single row of 3m long spaced at 3.0 m x 50cm planting distance in randomized compact block design replicated thrice. All the recommended package and practices were adopted to raise a good crop. The data recorded on five randomly selected plants for eight characters viz. days to first male flowering, number of branches, length of vine, days to first female flowering, weight fruit per plot single fruits weight number of fruit per plot and fruit yield per plant. The genetic analysis was done using Mahalanobis's D2 and Rao (1952). The analysis of variance showed highly significant differences of all the characters under study. All the genotype were grouped in five diverse clusters, One contain maximum 13 genotypes followed by cluster III (9), cluster II (8) and cluster IV (7) while cluster V had only three genotypes respectively. The maximum inter cluster distance was observed between cluster II and V followed by I & II indicating broad spectrum of diversity The lowest inter cluster distance between II & IV followed by I & III showed close relationship, hence not suitable for hybridization programme. Cluster III exhibited maximum mean value of cluster mean of weight of single fruit days of male and female flower and number of fruit per plot which were desirable for these characters and strains suitable for hybridization programme for improvement of these traits. Cluster V showed maximum mean value of cluster mean of weight of single fruit, day's male & female flowers, number of fruit per plot which were desirable for these characters and strains suitable for hybridization programme for improving these traits. Cluster II showed maximum mean value of cluster mean for weight of single fruit, days of male and female flower which were desirable for these characters and strains suitable for hybridization programme for improvement of these traits.

6.3.7 Performance Evaluation of Different Varieties of Tomato's at Farmer's Fields of Aligarh District of Uttar Pradesh

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An on- farm trail was conducted in district Aligarh of Uttar Pradesh during 2020 and 2021 to compare the production potential and Economics of four varieties of tomato viz. Pusa Hybrid-2, Pusa Hybrid8, Arka Rakshak, Arka Abhijit against Pusa Ruby (Local check) at farmers field under by Krishi Vigyan Kendra Aligarh and National Agriculture Research Centre, Kalai, Aligarh. Data collected were average fruit weight, fruit shelf life and fruit yield/ha. The mean data of all the observations over two years were

pooled and statistically analysed. The results of the trial revealed that highest fruit weight (92.50g), shelf life (16.5 days) and fruit yield (75.60t/ha) were recrded of variety Arka Rakshak, followed by Arka Abhijit fruit weight 68.50g, and fruit yield 62.80t/ha whereas shelf life of Pusa Hybrid-8 was observed 12.5 days. Fruit weight of Arka Abhijit and Pusa Hybrid-8 were found statistically at par with each other. Maximum fruit yield and production efficiency was recorded in Arka Rakshak followed by Arka Abhijit) compared with local check "Pusa Ruby" with minimum fruit weight (62.15g), and minimum fruit yield 29.60t/ha. Gross income (Rs. 353500.00/ha), net profit (Rs.231560.00 /ha), B:C ratio (3.40) were found highest for Arka Rakshak in comparison with Local Check.

6.3.8 Studies on Genetic Variability Correlation and Path Analysis in Brinjal (*Solenum melongena* L)

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An experiment on genetic variability correlation and path analysis in brinjal (*Solenum melongena* L)" was conducted at Vegetable Research Farm, Department of Vegetable Science of C.S. Azad University of Agriculture & Technology, Kanpur during Kharif season of 2020-21 to evaluate the 50 genotypes of brinjal in RBD with three replications for yield. The observation were based on eleven characters viz. plant height, number of branches per plant, days to 50% flowering, days to first picking, fruiting span, number of fruits per plant and fruit yield (q/ha). The phenotypic coefficient of variation was higher than genotype coefficient of variation. The PCV was observed high for the average fruit weight followed by average fruit yield per plant and average fruit per plant. All the character under study showed high value of heritability. Genetic advance was also high for character like fruit diameter while moderate value was shown by fruit length, number of branches per plant and plant height. Characters like plant height, number of branches for plant, days to first picking, fruiting span, number of fruits per plant, fruit length and average fruit weight exhibited high significant positive correlation with average fruit yield per plant. Study of path coefficient analysis revealed that the all characters like plant height, number of branches per plant, days to 50% flowering, days to first picking, fruiting span, number of fruits per plant, fruit length and average fruit weight exhibited positive direct effect on average fruit yield per plant while fruit diameter showed negative direct effect on average fruit yield per plant. Analysis of genetic divergence by D^2 grouped the 50 genotypes of 8 clusters. Out of them, cluster 1 has maximum number of genotype (9), followed by cluster 3(8) and cluster 2,4 and 6 (7 each). The cluster 5,7 and 8 had 4 genotypes each. Cluster 1 has shown maximum inter cluster distance with cluster 8, followed by cluster 7 and 6 and cluster 2 has shown maximum inter cluster distance with cluster 8, followed by cluster 7 and cluster 6. The maximum intra cluster distance was shown by cluster 7, followed by cluster 8.

6.3.9 Evaluation of Garlic (*Allium sativum* L.) Genotypes for Yield and its Contributing Trails

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Twenty six different germplasm of garlic (*Allium sativum* L.) were evaluated for yield and yield parameters at Vegetable Research Farm, Chandra Shekhar Azad University of Agriculture & Technology, Kalyanpur, Kanpur (U.P.) during 2019-20 & 2020-21.Yield parameters like plant height, no of leaves/plant, leaf length, leaf width, pseudo stem length, polar diameter, equatorial diameter, no. of cloves, avg. bulb weight and avg. weight of 10 cloves, total soluble solid, total yield and marketable yield were recorded in both years. It was observed that KLG-19 gave maximum total & marketable yield (99.0 q/ha & 92.0 q/ha) respectively, followed by (89.0 q/ha& 83.0 q/ha) in KLG-10. The minimum total& marketable yield (42.0 q/ha & 38.0 q/ha) was recorded in genotypes KLG-17. All the characters were significantly correlated to yield parameters except plant height (44.40 cm), no. of leaves/plant (7.55), leaf length (27.52 cm), pseudo stem length (10.65 cm), polar diameter (3.0 cm), equatorial diameter (3.20 cm), no. of cloves (26.40), avg. bulb weight (29.50 gm) and average weight of 10 cloves 12.50 gm. On the basis of present findings KLG-19 in respect to higher growth as well as productivity of garlic is recommended for farmer's based on present field experimentation.

6.3.10 Performance of Banana Genotypes Under Gangetic Alluvial Zone of West Bengal

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Performance of banana genotypes under Gangetic alluvial zone of West Bengal were conducted to evaluate the growth, yield, quality and biotic stresses during 2002-2021 in the experimental field of ICAR-AICRP on Fruits, Mohanpur of Bidhan Chandra Krishi Viswavidyalaya under the Gangetic alluvial zone of West Bengal. In present study 159 banana germplasm (elite clones, land races, primitive, reference cultivars and hybrids) of different genomic groups {AA, AB, BB, AAA, AAB, ABB (Dessert), ABB (Cooking), AAAA, AAAB, and AABB} were evaluated for two successive planting as Plant Crop (PC) and first Ratoon Crop (RC-I). All the plants under investigation were subjected to uniform cultural practices. 10kg FYM and full of phosphate were applied as basal in the pit. The fertilizer dose was NPK @ 300:50:350g/plant. Ridge and furrow method of irrigation was applied. Weeding, earthing up and plant protection measures were taken as per recommendations of Bidhan Chandra Krishi Viswavidyalaya. Observation were recorded on growth, crop duration, yield and quality characters under twelve parameters like height, girth, leaves/plant at shooting, days to shooting and bunch harvest, crop duration, bunch weight, yield, hands/bunch, fingers/bunch, finger weight and TSS were estimated. Data were analyzed following the standard procedure. In genomic groups of AA and AB plant growth and yield were observed to be minimum compared to all other groups. Among the BB genomic group, maximum plant height (5.50m), bunch weight (47.8kg) and TSS content (26.7°Brix) were noted in Bechakala-III (seeded

banana). BB genotypes also recorded maximum tolerance to major pest and diseases. Under AAA genomic group, maximum bunch weight (26.7kg) was found in Dwarf Cavendish followed by Barjahaji (23.2kg) and maximum TSS (25.8°Brix) in Red Banana. Dudhsagar under AAB genomic group produced minimum bunch weight (23.2kg) followed by Alpan-Manhar (19.4kg). The TSS content in the dessert type of ABB group was noted higher ranging from 18.1 to 26.5° Brix and Kanthali Clone –I produced maximum bunch weight (25.4kg) followed by Bagda (25.3kg). ABB (Dessert type) is very famous because of its use in different festivals and rituals in Bengal. Cooking-I under ABB (Cooking type) genomic group showed maximum crop duration (315days) and Baish Chhara recorded maximum bunch weight (23.6kg), yield (47.2t/h), hands (15.9) and fingers (224). Baish Chhara is suitable for kitchen garden as the hands can be harvested in staggered manner from top to bottom. FHIA-17 and 23 under AAAA, FHIA-01 (Gold finger) under AAAB and FHIA-03 (Sweet heart) under AABB genomic group were performed well and FHIA-03 (Cooking type) is gaining popularity as the pulp do not develops blackish colour in the curry.

Keywords: *Banana, biotic stress, cooking banana, dessert banana, FHIA, genomic group, qualitative traits.*

6.3.11 Use of NBPGR-PDS (Passport Datasheets) APP: a Precision Tool in Management of Plant Genetic Resources

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Plant exploration and germplasm collection is a tedious on field activity in plant genetic resource management. Manually entering of records in passport data book while collecting germplasm is inconsistent, has room for errors, managing GPS device to get location details and time consuming effort. In modern digital era, data collection with accuracy has been made possible using a precision tool, NBPGR-Passport DataSheet (PDS) works that functions as a digital field book for users to manage germplasm records in systematic manner with live location details viz., Longitude and Latitude in offline manner and enhance the functionality of collection of germplasm records in efficient manner with autofill text format. Bulk of records are stored in SQLite Database which is stored inbuilt of the application. It is freely hand handled app which works offline and standalone manner with 9 M.B. size after installation. This application was developed on android platform which supports android version 4.1 (API 16) to version 10.0(API 30) smartphones which covered around 98% android users with using offline inbuilt SQLite DB, Core Java program code in Android Studio Platform. This tool provides room for large quantum of data particularly passport details of collection which includes around 23 fields with photographs stored in a systematic manner, has customized digital application and transferability mode in MS Excel format for the target customers. NBPGR-PDS application developed in Android studio also provides a unified environment where it is possible to build for Android phones, tablets, Android Wear, Android TV, and Android Auto. While developing this tool, the data collected in fields was developed during explorations undertaken in 2021 and presently found very useful and effective not only save time, reduce chance of error, more reliable, high definition image capturing but also to get live location in offline manner. The current version of the application is in English, and their conversion to local languages of different States of India would make it more user friendly along with efforts on popularization. Further modifications as suggested by the users have been included after validation. However, continued updation viz., route map for explorer is being done for further refinement of the application functionality. Creating awareness amongst the sorts of explorers are expected to yield dividends in the era of 'Digital India'.

TECHNICAL SESSION-7

WATER MANAGEMENT FOR ENHANCING RESILIENCE TO CLIMATE CHANGE FOR SUSTAINABLE DEVELOPMENT OF HORTICULTURE

7.1.1 Enhancing Water Productivity for Resilient and Sustainable Development of Horticulture

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Climate change, a global phenomenon, is a concern for food and nutritional security of growing population, expected to be 9.6 billion at the end of 2050, and has attracted global, regional and national dialogues for mitigation and adoption strategies. 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. Resilience to climate change could be trough resilient crop, varieties and technologies. 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 m3, compared to 1700 m3/ 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 maximisation 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, climate resilience and Precision Horticulture

7.1.2 Strategies Approaches in Micro irrigation for Climate Resilient and Sustainable Horticulture

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Water is crucial input in agriculture and changing climate is increasing challenging its effective utilization in agriculture as agriculture is its largest consumer. Efficient utilization of available water resources is crucial for a country like, India, where per capita availability, in terms of average utilizable water resources, is expected to dwindle down to less than 1000 m^3 by the year 2050. Micro irrigation which is by far the most efficient water application method for agriculture, has evolved over time and is still being researched intensely for further improving its effectiveness in water saving to mitigate and offset negative effects of reduced water availability for agriculture owing to increasing population, industrialization and climate change. Precision irrigation system came to India in seventies but its adoption started only in late eighties. Government started making efforts to promote precision irrigation through part financial support to offset its high initial cost syndrome. Initial researches included the comparisons of precision irrigation system with conventional systems in terms of water savings and yield enhancements. After establishing the superiority of such irrigation systems, the focus of research shifted to estimate water requirements, modifications of crop geometry and fertigation for realizing the potential benefits of the system. With passing time that is in nineties the emphasis gradually shifted to different hardware and software aspects for cost reduction, design modifications and fertigation scheduling and chemigation. Latest researches include oxigation and pulse irrigation. The article presents latest advancements in technological and strategic developments in micro irrigation for its increased adoption for climate resilient and sustainable agriculture/ horticulture.

Keywords: micro irrigation, advancements, strategic approaches

7.1.3 New Paradigms in Micro irrigation for Enhancing Water Productivity and Achieving nutritional security

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Water is one of the most critic inputs for Agricultural development. However, the present scenario of decreasing availability of fresh water along with changing climate is the biggest issue. The Task Force on Micro Irrigation had estimated a potential of 69.5 Mha under micro irrigation in India, whereas the area covered so far is only about 10.3 Mha. The innovative cluster based Community Irrigation projects

for Micro irrigation coverage should be encouraged. The research should also be emphasized to develop low cost and user friendly smart/automatic irrigation controller to overcome the issue of labor shortage in agriculture. The increasing demands of water from various sectors has resulted in over-withdrawal of groundwater. The groundwater table is declined at an alarming rate. The groundwater pumped from deeper depth is of poor quality and consumes higher energy. The India has total 7500 km coastal belt length, in which the groundwater quality has been deteriorated due to seawater intrusion to 20 km width of coastal belt area. The needs to be promoted to control the pollutions of groundwater and environment to sustain the higher water productivity for the future. Presently less than 1% of the total area under MIS are adopting the sensors and IoT based smart automatic irrigation system due to unavailability of technical expertise and higher initial cost. The only adoption of MIS is not enough, but the efficient and frequent operation of the system and application of water at the rate of crop water requirement is also desired. Human interventions and lack of technical knowledge of farmers make wastage of water by applying more water than the requirement. To overcome the wastage and losses of the water, the AI and IoT based automatic irrigation system is the dire need of the present. The empirical results showed that cotton, maize, wheat, sunflower, sugar beet and potato are well suited to deficit irrigation practices, with reduced evapotranspiration imposed throughout the growing season using MIS. It was also found that common bean, groundnut, soybean and sugar cane where reduced evapotranspiration is limited to certain growth stages. With a 25 percent deficit, water productivity (WP) was 1.2 times that achieved under normal irrigation practices. Adoption of mulching along with MIS influences water productivity of crops by affecting the hydrothermal regime of soil, which may enhance root and shoot growth, besides it helps in reducing the evaporation (E) component of the evapotranspiration. MIS helps to increase the dissolved oxygen through aerated water. Sprinkler irrigation saves 20 to 30 percent water, while drip irrigation saves 30 to 40 percent water as compared to flood irrigation. There is a 20 to 40 percent gain in productivity due to the use of micro-irrigation. Saved water can be used to increase cropping intensity. Adoption of MIS resulted in 32 percent increase in cropping intensity. Studies revealed significant fertilizer savings of 20-60% and 8-41% increase in yields of horticulture and vegetable crops due to fertigation was achieved. Micro-irrigation improves the quality of produce which helps to get better market price. Micro-irrigation also improves micro-climate, reduces problems due to weed growth, soil erosion and the cost of cultivation in labour-intensive operations. Reduced water consumption due to micro irrigation also helps to energy saving and quality product ensures good nutritional status of produce.

7.1.4 Micro Irrigation – An Option for Sustainable Use of Water for Horticulture Development

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Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) – Andhra Pradesh Micro Irrigation Project (APMIP), an unique and comprehensive project, is being implemented in the state since it's inception. The objective is to enhance the crop productivity by improving the water use efficiency through micro irrigation systems for the benefit of the farmers. State Government has established special purpose vehicle i.e., APMIP with staff structure till Mandal level for effective monitoring and utilisation of micro-irrigation scheme. The objectives of APMIP is to to increase the area under micro irrigation through improved technologies, to enhance water use efficiency through drip system. of irrigation, to increase productivity

of crops and farmer income, to save energy in agriculture sector and to achieve higher fertiliser use efficiency through drip. So far, an area of 13.43 lakh ha.has been covered under MI in all the 13 districts in the state since inception i.e., from 2003-04 to 2020-21, benefitting 11.90 Lakh farmers. There is a potential area of 8.24 lakh ha., to be covered under MI in all the 13 Districts, as on 31-03-2021. NABARD Consultancy Services (NABCONS) and Institute for Development Studies, Andhra Pradesh (IDSAP)) during the evaluation of project, observed that 18-20 percent additional area has been brought under irrigation and productivity has increased by 35-60 percent. There is a saving of 35-40 per cent on energy, 40-45 percent in fertiliser, 35-40oer cent n labour 18 per cent on cost of cultivation and above all 75 percent increase in net income Micro irrigation increased crop diversification from traditional crops to high value remunerative crops like vegetables, melon, banana, papaya, pomegranate etc.

7.2 Oral Presentation

7.2.1 Adoption of Drip Fertigation is a need of hour for Bumper and Export Quality productions of Horticulture crops

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Climatic conditions in India is suitable to grow all fruits, vegetables, flowers and spices crops. Total area under Horticulture in India is 27.23 Million ha with production of 329.86 Million tons. Area under fruit crops is 6806 Million ha and productivity is just 15.1 tons / ha, Area under vegetable crops is 10803 Million ha and productivity is just 18.7 tons / ha. Area under flower crops is 315 Million ha and productivity is just .4 tons / ha n Area under Spices crops is 4487 Million ha and its productivity is just 2.35 tons/ ha. Productivity of Fruits, Vegetables, Spices crops in India is low due to their traditional farming, efficiency of most important inputs used water and fertilizers use efficiency are 30 - 40 %. Total consumption of fertilizers in India is 610 Lakh MT and its Fertilizer use efficiency is just 30 - 40 %, Water and nutrients can not be fulfilled as per crop growth stages in traditional cultivation. There is need of to improve efficiency of water and fertilizers. For this adoption of drip irrigation and Fertigation is needed for all Horticulture crops.

Maharashtra is a leading state in adoption of drip irrigation n fertigation technology on large scale. Andhra Pradesh, Gujarat, Karnataka, Tamilnadu, Madhya Pradesh are also adopting drip irrigation on large scale. Around 57.7 Lakh ha area including all crops is brought under drip irrigation in a country. In Horticulture crops cultivation irrigation and nutrition are two important factors which contribute more for yield and quality. Most of the farmers are irrigating the land and not necessarily crops. Also about fertilizers, it is not applied precisely in effective root zone as per the physiological stages of the crop. Mostly fertilizers are applied to soil, not covered properly. Application of water soluble fertiliser with pressurised irrigation method is technology is known as FERTIGATION. Fertigation is the best technology to improve efficiency of water and fertiliser as well as improves crop yields and quality.

Hence - Adoption of drip irrigation and fertigation in Fruits, Vegetables, Flowers and Spices crops farming is need of hour to get bumper and export quality production.

7.2.2 Effect of Dosage and Frequency of Fertigation on Production, Productivity and Quality of Mango (*Mangifera indica* L.) cv. Banganpalli.

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The present investigation effect of dosage (T_1 –NK @ 100% RDF, T_2 - NK @ 80% RDF, T_3 - NK @ 60% RDF ,T_4 - NK @ 50% RDF) and frequency of fertigation (F_1 - One time at marble stage, F_2 - Daily fertigation) on FUE (Fertilizer Use Efficiency), fruit growth, development, yield and quality characters of mango cv. Banganpalli was carried out at Fruit Research Station, Sangareddy, SKLTSHU, Telangana state during two succeeding seasons *i.e.,* 2015-16 and 2016-17. The results of the experiment revealed that the application of daily fertigation with 100% RD of NK + micronutrient mixture (D_1F_2) has recorded the maximum number of fruits per panicle at the time of fruit set (9.96), maximum number of fruits per tree at the time of harvest (223.81), maximum fruit weight (540.31 g), maximum yield per tree (120.95 kg), per unit (m^3) canopy volume (1.50 kg) and per ha. (18.87 t) due to increase in the soil and leaf macro (N (kg/ha), K (kg/ha)) nutrient levels. The same treatment has resulted in highest fertilizer use efficiency (120.95 kg/kg) and was found more economical with a net return of 304393.32 Rs/ha. and BC ratio of 4.17. Fruit quality characters were also significantly improved with this treatment (D_1F_2) recorded maximum fruit TSS (17.12 ^{0}Brix), specific gravity (1.11), reducing sugars (6.96%), sugar acid ratio (85.08) and improved flavour with minimum titratable acidity (0.20 %) and maximum shelf life (15.13 days) of fruits. However, the treatment daily fertigation with 80% RDF (D_2F_2) resulted in optimum value of net returns of 242030.89 Rs/ha. and BC ratio of 3.34 compared to other levels of fertigation. From the experimental results it can be concluded that application of fertilizers in the form of daily fertigation (D_1F_2) during fruit development stage of mango will improve the yield and quality parameters.

7.2.3 Fertigation Practices in the Scenario of Climate Change

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8. TECHNICAL SESSION-8

NUTRIENT MANAGEMENT FOR ENHANCING RESILIENCE TO CLIMATE CHANGE AND SUSTAINABLE PRODUCTION

8.1.1 Climate Smart Nutrient Management in Fruit Crops

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Soil is an environmental medium, playing crucial role in global C cycle (soil C pool as the second biggest carbon pool), mainly through changes in soil fertility. Soil is, therefore, viewed as a part of climate change problem, but it can be a better part of the solution. Besides elevated CO_2, changes in rainfall pattern and increase in average temperatures brought about by climate change with inflict over-riding effects on soil fertility changes vis-à-vis crop performance. Synergism between the effect of CO_2 and nutrients is stronger under no water limiting conditions. However, such short term changes in fertility dynamics do not portray the long term effect either on soil fertility or on production responses, unless supported by defined analogues of soil and climate. Different fruit crops sequestering 24 – 109 tons CO_2/ ha display their ability to moderate climate change-related issues on one hand, and elevate the crop fertilising ability for improved plant nutrition, besides water-use-efficiency, on the other hand. Therefore, response of different fruit crops under elevated CO_2 condition is a function of nutrition status of the crop. Our studies demonstrated the maximum nutrient demand at fruit set stage (March-April for winter crop and August-September for summer crop under sub-humid tropical climate of central India). As per crop ontogeny unless there is some mitigation strategy available. Of late, certain citrus growing pockets of central India irrespective of orchard nutrient status (possibility of disturbed K metabolism), exhibited abnormal fruit growth (greater growth along equatorial than radial axis), the exact cause and effect relation still remains to be established. A large difference in fertility of two sites (Ustorthent versus Haplustert) indicated by a much greater increase in yield response at the low fertility soil site (Ustorthent) than the high fertility soil site (Haplustert), when added nutrient augmented to the same optimal fertility. But with climate change, such responses will be caused by nutrient limitation that can develop in poor fertility sites having shallow rooting depth. The recommended dose of fertilizers (RDF) worked out in 1990 – 91 is no longer effective now (2010 - 2015), due to rise in average temperature by 1.5 – 2.0 ^{0} c during fruit set stage, necessitated addition of 25% more K to moderate such temperature stress in citrus. How does RDF behave in the long run in different crops?

Better responsiveness of soil microbial biomass over chemically available nutrient pool to nutrient input, has led to renewed interest in measuring the quantum of nutrients held micro bialy. Long term data accrued on response of organic manuring versus inorganic fertilizers demonstrated that important soil quality indices like soil microbial diversity, soil microbial biomass nutrient (C_{mic}, P_{mic}, and N_{mic}) and organic carbon partitioning displayed significant changes, but without much difference in quantum of fruit yield. The efficacy of microbial consortium (*Micrococcus yunnanensis, Bacillus pseudomycoides, Paenibacillus alvei, Acinetobacter radioresistens* and *Aspergillus flavus*) was tested successfully in both nurseries as well as well grown-up orchards as best management practice to cut down the rate of CO_2 release compared to inorganic fertilizers for storing larger proportion of plant-derived C in long term pools in the soil and reducing the exposure of such stored C to lesser decomposition, in addition to better post-harvest shelf life of citrus and other fruits. The other approaches involving multiple microbial

inoculation along with enrichment of organic manures through inorganic fertilizers known as substrate have further been highlighted to provide an understanding of mechanism involved in C stabilisation in soils for regulating soil C sequestration and associated nutrient dynamics under INM-based production system in perennial fruit crops. Crop-based adaptation strategies are needed keeping in view the nature of crop, its sensitivity level and the agro-pedological setup. Simultaneously, keeping an eye on carbon sink potential of different fruit crops vis-à-vis annual field crops will further aid in developing a blue print for redressal of climate change related issues.

8.1.2 Complimenting Nutritional Needs of Horticulture Crops and the Use of "Wealth" Biostimulants as Supplements

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Nutrients are an essential component of plant health to increase the productivity, which depend on balance use. The bio stimulant "Wealth" has been used in Banana, Grapes, Vegetable, Cereals and other fruit crops, which increases yield ranging from 20-50% with improved quality and marketability of produce. Various farming systems have been suggested throughout the last few years with biostimulants being a novel and sustainable approach towards horticultural crop production, especially under biotic and abiotic stress. Therefore, there is increasing interest in the farming sector for new and effective biostimulant products and a lot of research is carried out in this gradually evolving sector of the industry. There are several commercial products available, which are currently applied on various crops within the context of sustainable and organic farming. Biostimulant "Wealth" is very unique and is extracted from Sapropel peat, a natural organic substance formed by deposition of dying plants and microorganisms with limited access of oxygen, found on the bottom of freshwater bodies. Sapropel is rich in the following nutrients: sodium, potassium, phosphorus, various vitamins (B, E, C, D, and P), amino acids, and enzymes. It consists of mineral humic substances, natural organic compounds with bioactive properties. Application of biostimulant "Wealth" increases the root and shoot growth, improves resistance against stressors, rehabilitation of degraded soil and reduction in nitrogen fertilizer inputs are some of the most noteworthy benefits. The research reports suggest that it is highly beneficial. The paper discusses the details.

8.1.3 Organic Farming A Way Forward for Climate Resilient and Sustainable Horticulture

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Ten to twelve per cent of global greenhouse gas emissions are due to human food production. In addition, intensive agriculture has led to deforestation, overgrazing and widespread use of practices that result in soil degradation. These changes in land use contribute considerably to global CO_2 emissions. Organic agriculture is claimed to be the most sustainable approach in food production. It emphasizes recycling techniques and low external input and high output strategies. It is based on enhancing soil fertility and diversity at all levels and makes soils less susceptible to erosion. Organic farming links productivity with ecology and creates livelihoods in rural areas. Grower community is trying to find out an alternative sustainable farming system, which is ecologically sound, economically and socially acceptable. Sustainable production is unifying concept, which considers ecological, environmental, philosophical, ethical and social impacts, balanced with cost effectiveness. Traditional organic production practices, which are based on natural and organic methods of farming offer several effective, feasible and cost effective solutions to most of the basic problems being faced in conventional production of fruit crops. Organic fruit cultivation helps in climate mitigation, carbon fixation, soil fertility improvement and water conservation. In present scenario, shifting from conventional to organic, maintenance of soil health and insect pest management will be major challenges which can be taken care of with adaptation of complete organic package of practice in fruit production.

As per FiBl survey (2018), 2.6 million farmers across the world and 178 countries are now growing organically produced commodities on more than 57.8 million hectares of agricultural lands. In India, 8,35,200 farmers are engaged in organic production of various crops. Total world trade of organic produce was 90 million US dollars during 2016. In India total area under organic cultivation is 7.2 million hectares which is 0.4 % of the total area under organic cultivation. 4.2 million hectares is under wild collection. Sporadic attempts for organic production are now being attempted by some enthusiasts in horticultural and plantation crops like tea, coffee and cardamom in certain pockets in India. By default, many regions in the north eastern states of the country are pursuing organic horticulture which needs to be consolidated and promoted.

Horticultural perennial crops as carbon sink vis-a-vis environmental cleansing

Organic farming practices are so far the most appropriate approach for mitigation and adaptation to climate change it represents a positive example of how farmers can help mitigate climate change and adapt to its predictable and unpredictable impacts. It can serve as a benchmark for allocating development resources to climate change adaptation, or to measure progress in implementing climate related multilateral environmental agreements (FiBl, 2007). Food grain crops land and permanent pastures lose soil carbon through mineralization, erosion and overgrazing. Global arable land loss is estimated at 12 million hectares per year, which is 0.8% of the global crop land area (1513 million hectares).

Organic farming has lower global warming potential

The global warming potential (GWP) of agricultural activities can be defined as greenhouse gas (GHG) emissions in CO_2 equivalents per unit land area or per unit product. The global warming potential of organic farming systems is considerably smaller than that of conventional or integrated systems when calculated per land area . This difference declines, however, when calculated per product unit, as

conventional yields are higher than organic yields in temperate climates. Under dry conditions or water constraints, organic agriculture may out perform conventional agriculture, both per crop area and per harvested crop unit. Organic farms do not only produce cash crops, but they use arable fields for temporary grass-clover and fodder production for livestock. A part of the grass-clover yields and nutrients is used to fertilize arable crops and soils. Depending on the methodology and the calculations used, the results can differ substantially:

Benefits of organic farming

The benefits of organic farming regarding climate change can be summarized as follows:

1. Organic agriculture has considerable potential for reducing emissions of greenhouse gases.
2. Organic agriculture in general requires less fossil fuel per hectare and kg of produce due to the avoidance of synthetic fertilizers. Organic agriculture aims at improving soil fertility and nitrogen supply by using leguminous crops, crop residues and cover crops.
3. The enhanced soil fertility leads to a stabilization of soil organic matter and in many cases to a sequestration of carbon dioxide into the soils.
4. This in turn increases the soil's water retention capacity, thus contributing to better adaptation of organic agriculture under unpredictable climatic conditions with higher temperatures and uncertain precipitation levels. Organic production methods emphasizing soil carbon retention are most likely to withstand climatic challenges particularly in those countries most vulnerable to increased climate change. Soil erosion, an important source of CO_2 losses, is effectively reduced by organic agriculture.
5. Organic agriculture can contribute substantially to agro forestry production systems.
6. Organic systems are highly adaptive to climate change due to the application of traditional skills and farmers' knowledge, soil fertility-building techniques and a high degree of diversity.

8.1.4. Drip-Fertigation Technology Assisted Precision Farming-Future of Horticultural Crop Production

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In a simple analysis, the picture is as follows: India grows crops on a gross land surface of 195.8 million ha (with net area 140.9 million ha and 55.0 million ha with crops grown more than once) (Min. Agri. Directorate of Economics & Statistics); while the ultimate irrigation potential (if developed) is 139.9 million ha (Central Water Commission). The country will NEVER have complete irrigation cover for all the gross cropped area unless we do something about the way water is consumed for irrigation.The actual status is not that simple and direct. Though the net irrigated area steadily increased from 1950-60 till present, the growth rates estimated every 10 years started dropping after 1990. There are various reasons like lower public investment to less attention to rehabilitation of irrigation schemes of the past etc. But the major issue is found to be a failure in effectively managing the water resources. Management and maintenance of irrigation canal net works and field channels is becoming a major challenge for institutions. The net result is lower irrigation efficiencies resulting in a situation where expansion of irrigation to more land surface is difficult. One of the very positive benefit to a farmer from adopting drip irrigation is the direct yield enhancement of the crop; a factor that has been proved in India in almost all the crops, both horticultural and agricultural. These yield improvements are noted by research institutions and universities also. We at Jain irrigation have been monitoring our client farmers' crops and collecting

data over a number years. Performance of 45 different crops to drip irrigation or related other micro irrigation systems adopted by the farmers of various states of the country is presented.

8.2 Oral Presentation

8.2.1 Effect of Biofertilizers Inoculation on Onion Yield, Nutrient Uptake and Soil Fertility Status

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A field experiment was conducted to study the effect of bio- fertilizer inoculation on onion yield, nutrient uptake and soil fertility status during 2019-20 and 2020-21. The experiment consisted of 8 treatments; it includes two fertiliser levels (82.5:30:45:22.5 kg NPKS/ha and 110:40:60:30 kg NPKS/ha) and four bio-fertilizers (control, phosphorus solubilizing bacteria (PSB), vesicular arbuscular mycorrhiza (VAM) and *Piriformospora indica*). The experiment was laid out in split plot design and each treatment was replicated three times. Onion and nutrient uptake were affected by fertilizer levels, biofertilizer inoculation and their interactions. The results revealed that application of mineral fertilizer (110:40:60:30 kg NPKS/ ha) with *Piriformospora indica* or PSB inoculation increased onion bulb yield significantly compared to the control. Application of 110:40:60:30 kg NPKS/ha and *Piriformospora indica* increased onion yield by 14.6% and 13.9% in 2019-20 and 2020-21, respectively compared to the control. PSB inoculation with 110:40:60:30 kg NPKS/ha increased onion yield by 9.0% and 9.4% compared to the control in 2019-20 and 2020-21, respectively. However, VAM inoculation did not increase onion yield significantly. In addition, PSB and *Piriformospora indica* inoculation increased NPKS uptake significantly in comparison to the control. Inoculation of biofertilizers did not affect soil available nutrient contents significantly. This result indicated that inoculation of PSB and *Piriformospora indica* has potential to increase onion production and nutrient use efficiency.

Keywords: Piriformospora indica, Fertiliser level, Onion yield, Nutrient uptake

8.2.2 Performance of Traditional Rcented rice (*Oryza sativa* L.) Varieties Followed by Broccoli (*Brassica oleracea* var. italica) under Organic Mode of Cultivation

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Agricultural production is now facing the major challenges of high cost of production and degradation of natural resources which can be efficiently managed by adoption of different organic management

practices. A field experiment was conducted at N. E. B Crop Research Centre G. B. Pant University of Agriculture & Technology, Pantngar U. S. Nagar Uttarakhand. Field experiment was carried out using Randomized Complete Block Design with three replication involving ten rice (*Oryza sativa* L.) varieties V_1 Kubri Mamhani, V_2 Kudrat-5, V_3 Chinar-20, V_4 Kesho Pohu, V_5 DRK, V_6 Kudrat-1, V_7 Pusa-1121, V_8 Type-3, V_9 Taraori and V_{10} Tilak Chandanvarieties followed by Broccoli (*Brassica oleracea var. italica*) with the following eight treatments T_1 Control, T_2 50% Beejamrit+ Jeevamrit+ Ghanjeevamrit + 50% FYM & Vernicompost, T_3 25% Beejamrit+ Jeevamrit + Ghanjeevamrit + 75% FYM & Vermicompost, T_4 75% Beejamrit+ Jeevamrit + Ghanjeevamrit + 25% FYM & Vermicompost, T_5 100% Beejamrit + Jeevamrit+ Ghanjeevamrit, T_6 100% FYM, T_7 100% Vermicompost, T_8 INT. (50% Organic+ 50% Inorganic) and T_{10} 50% Pantnagar Ark + 50% FYM & Vermicompost. Results of the study revealed that higher yield attributes and grain yield & straw yield as well as Nitrogen, Phosphorus and Potassium uptake and hulling, milling percentage were recorded maximum with the varieties Kudrat-5 & Kudrat-1. DUS characteristics were determined for all the varieties. So, both the varieties i.e. Kudrat-5 & Kudrat-1 shows promising results although in terms of quality attributes varieties Kudrat-5 & Kudrat-1 also shows the most promising result. While results showed that in Broccoli (*Brassica oleracea var. italica*) maximum no. of leaves per plant, plant height at harvest (cm), days required for curd initiation (days), days required for curd maturity (days) curd weight (g) and curd yield (kg/ha) was reordered highest with the treatment combination T2 50% Beejamrit+ Jeevamrit+ Ghanjeevamrit + 50% FYM & Vernicompost which was followed by treatment combination T_8 INT. (50% Organic+ 50% Inorganic)

Keywords: *Organic Agriculture*, *Varieties, FYM, Vermicompost, Rice, Cauliflower*

8.2.3 Yield and Economics of Coriander under Organic Farming

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Continuous use of chemical fertilizers has resulted in nutritional imbalance, depletion of soil organic matter and adverse effect on biodiversity as well as on human health. Supplying of nutrients through organic components can be opted for avoiding the hazardous effects of chemical fertilizers. Organic components like FYM, vermicompost and microbial consortium may play a major role in supplementing the crop nutrients through their direct addition, improvement in soil condition, nitrogen fixation and solubilisation of fixed forms of phosphorus & zinc in soil.

A field experiment on sole organic and in conjunction with inorganic sources of nutrient management in coriander cv. Pant Haritima was conducted at Vegetable Research Farm of C.S. Azad University of Agriculture and Technology, Kanpur during 2015-16 and 2017-18 in sandy loam soil. Six different treatments of organic and in combination with inorganic inputs were tested against Conventional practices. The experiment was conducted in fixed layout during all the three years in randomized block design with a plot size of 3.60m x 3.60m. Based on pooled data of three years, application of 100 % recommended dose of nitrogen through vermicompost + microbial consortium @ 12.5 kg/ha (PP with organic methods) recorded highest marketable green leaves yield of 92.60 q/ha. It was followed by conventional practices (recommended FYM + fertilizer + PP chemicals) + microbial consortium @ 12.5 kg/ha and safe production practices (recommended FYM + fertilizer + PP with organic methods) + microbial consortium @ 12.5 kg/ha. The B:C ratio of 2.69 was also maximum under the treatment of application of 100 % recommended

dose of nitrogen through vermi compost + microbial consortium @ 12.5 kg/ha (PP with organic methods). Results of the study revealed that the organic farming of coriander is feasible and economic under Central Plain Zone of Uttar Pradesh.

8.2.4 Effect of Foliar NPK (19:19:19) and Micronutrient Application on Seed Yield and Quality of Vegetable Pea

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A field experiment on foliar application of NPK and micronutrient vegetable pea crop was conducted at Vegetable Research Farm of C.S. Azad University of Agriculture & Technology, Kanpur during 2018-19 and 2020-21 in sandy loam soil. Ten different treatments viz., recommended NPK + foliar spray of NPK @ 1% before flowering, recommended NPK + foliar spray of NPK @ 2% before flowering, recommended NPK + foliar spray of NPK @ 1% before and after flowering, recommended NPK + foliar spray of NPK @ 2% before and after flowering, recommended NPK + foliar spray of IIHR micronutrient mixture @0. 25% before flowering, recommended NPK + foliar spray of IIHR micronutrient mixture @0. 25% before and after flowering, recommended NPK + foliar spray of IIHR micronutrient mixture @0. 25% before flowering + foliar spray of NPK @ 1% before flowering, recommended NPK + foliar spray of IIHR micronutrient mixture @0. 25% before flowering + foliar spray of NPK @ 2% before flowering, recommended NPK + foliar spray of IIHR micronutrient mixture @0. 25% before and after flowering + foliar spray of NPK @ 1% before and after flowering, recommended NPK + foliar spray of IIHR micronutrient mixture @0. 25% before and after flowering + foliar spray of NPK @ 2% before and after flowering were tested against control (recommended NPK) in randomized block design replicated three times with a plot size of 3.0 m x 3.0 m. The crop variety used in the experiments was Azad Pea – 3. Results of the experiment revealed that the application of recommended NPK + foliar spray of IIHR micronutrient mixture @ 0.25% before and after flowering + foliar spray of NPK @ 2% before and after flowering recorded significantly highest no. of pods/plant (10.80), pod thickness (13.92 mm), pod length (9.62 cm), no. of grains/pod (7.58), grains weight/plant (12.12 g) and grain yield (26.40 q/ha). It was followed by recommended NPK + Foliar spray of IIHR micronutrient mixture @ 0.25% before and after flowering + foliar spray of NPK @ 1% before and after flowering in terms of yield attribute and grain yield. In case of vigour index-I, the highest value of 1550.00 was found in recommended NPK + foliar spray of NPK @ 2% before flowering followed by recommended NPK + foliar spray of IIHR micronutrient mixture @ 0.25% before and after flowering with 1493.00. Whereas, the highest vigour index-II of 32.78 was found in recommended NPK + foliar spray of NPK @ 2% before and after flowering. The minimum values of yield attributes and grain yield were observed in control (recommended NPK). Based on three years pooled data, it may be concluded that the application of recommended NPK + Foliar spray of IIHR micronutrient mixture @ 0.25% before and after flowering + foliar spray of NPK @ 2% before and after flowering may be recommended for higher seed yield and return in vegetable pea for Kanpur region.

8.2.5 Effect of Major Nutrients (Nitrogen, Phosphorus and Potassium) on Yield and Quality of Rainy Season Onion (*Allium cepa L.*) Raised from Seedling

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An investigation was carried out at the vegetable research farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during *rainy season* of 2018 and 2019. The soil of the experimental field was sandy-loam with uniform topography**.** A field experiment was conducted to determine the N, P and K rates for yield attributes i.e. total yield, diameter of bulb, double bulb, bolting percentage neck thickness and T.S.S. as quality parameters of onion. A factorial combination of three rates of N (50,100 &50 kg /ha), two rates of P (40 & 80 kg/ ha) and potash two level (50 &100 Kg/ha) were used for the experiment. Treatments were laid down in a Randomized Complete Block Design (RCBD) in a factorial combination with three replications. Two years trial with Cv. Agrifound Dark Red and results of this study revealed that the application of nitrogen showed significant effect in most of studied characters. Higher levels of nitrogen increased the yield significantly over all the treatments. Different levels of phosphorus and potassium did not affect the quality parameters of onion. Phosphorus and potassium did not show any significant alteration on yield and yield attributes and quality. The application of 150 kg N +80 kg P2O5 +100 Kg K2O/ ha was most appropriate combination of nutrients with respect to yield and quality of the rainy season onion crop propagated through seedling.

Keywords: Onion, Yield , Quality, Nitrogen, Phosphorus, Potash

8.2.6 Effect of Foliar Application of Micro Nutrients on Growth Yield and Quality of Onion (*Allium Cepa* L.)

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An experiment to study the "Effect of Foliar Application of Micro Nutrients on Growth Yield and Quality of Onion (*Allium Cepa* L.)" was conducted in rabi season during 2019-20 at Department of Vegetable Science, Kalyanpur. The experiment was laid out in randomized block design with three replications and nine treatments with two concentrations each boron and Zinc and their combination with different concentrations, each of T_1 (B 0.2%), T_2 (B 0.3%), T_3 (Zn 0.3%), T_4 (Zn 0.5%), T_5 (Boron 0.2%+Zn 0.3%), T_6 (Boron 0.2%+Zn0.5%), T_7 (Boron 0.3% + Zn 0.3%) ,T_8 (Boron 0.3% + Zn 0.5%)and T_9 as control. The observation of different characters at different stages has been taken. On the basis of data observation for growth characters *viz*. plant height (59.66 cm), Leaf length (47.46cm), number of leaves per plant (10.80) were recorded the highest with the treatment T_6 (Boron 0.2% + Zn 0.5%), while the plant height (45.13 cm), leaf length (33.26 cm) and number of leaves per plant (7.53) were recorded lowest in T_9 control. Number of days taken for harvest (70% neck fall) found earliest (117.26 days) also in T_6 (Boron 0.2%+Zn0.5%). The bulb characters *viz*. polar diameter of bulb (7.0cm), equatorial diameter of bulb(7.13 cm), neck length (7.06 cm), neck diameter (3.33cm), fresh weight of bulb (118.66 g) and

dry weight of bulb (14.06 g) were recorded the highest with the application of 0.2% boron and 0.5 andZn (T_6),whereas polar (3.93cm), equatorial diameter (4.06 cm), neck length (5.06 cm), neck diameter (1.88 cm), fresh weight of bulb (77.86 g) and dry weight of bulb (8.60 g) were observed lowest in control (T_9). The yield per plot (17.3 kg), per hectare (382.0q)and dry matter percentage (15.6) were recorded highest in T_6 (Boron 0.2% + Zn 0.5%). The quality characters *viz*. TSS (12.20^{0}brix), ascorbic acid content (13.26 mg/100 g) and total soluble sugar (6.93%) also recorded maximum in T_6 (Boron 0.2 % + Zn0. 5%).

8.2.7 Yield and Quality Status of Aonla Cv. NA-7 as Influenced by Integrated Nutrient Management

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Aonla, also known as Indian gooseberry (*Emblica officinalis* Gaertn.), member of family Euphorbiaceae. Due to its hardy nature, more medicinal value with a greater number of uses, high productivity per unit area, the area under aonla cultivation is increasing rapidly day by day in the century and it is also considered as a most ideal crop for arid and semi-arid regions. Because of many medicinal uses, it is famous as "Amrit Phal". Its fruits are commonly used for the preparation of different value-added products such as candy, chyawanprash, barfi, pickles, etc. and also an important ingredient in various medicinal preparations.

The continuous application of chemical fertilizers affects the fruit quality, soil health and generates soil pollution too. The integrated nutrient management paves a way to overcome from these problems. Plant nutrients can be supplied through different sources *viz.,* organic manures, crop residues, bio-fertilizers and chemical fertilizers, but for better utilization of resources and to produce more yield with less expenditure, INM is the best way. The present experiment was carried out in the Department of Horticulture, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, (U.P.), using nine treatments, replicated thrice in RBD. From the experiments it is reported that the fertilization of plants with 75% NPK + 4kg vermicompost + 100g *Azotobacter* + 100g PSB resulted significantly maximum fruits set (40.56%), fruit retention (34.64%), number of fruits (3776 fruits/plant), fruit yield (170.68 kg/plant) with maximum fruit length (3.70 cm), width (4.60 cm), weight (50.32 g), volume (42.89 cc), pulp weight (48.05 g) and seed weight (2.27 g) along with minimum fruit drop (65.35%).

As far as the quality parameters are concerned, fertilization of plants with 75% NPK + 4kg vermicompost + 100g *Azotobacter* + 100g PSB also resulted highest TSS (11.90 ^{0}Brix), total sugars (7.10%), ascorbic acid (550.92 mg/100g pulp), TSS: acid ratio (5.08) with minimum titratable acidity (2.28%) contents. These observations suggest that for getting substantial higher yield with superior quality of fruits, the plants of aonla should be fertilized with an integrated dose of 75% NPK + 4kg vermicompost + 100g *Azotobacter* + 100g PSB in the plains of northern India.

8.2.8 Effect of Organic Inputs and Biofertilizers on Growth and Flower Yield of African Marigold *(Tagetes erecter* L.)

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A field investigation on " Effect of organic inputs and Biofertilizers on growth and flower yield of African marigold *(Tagetes erect'*L.)" was conducted during the year 2018-2019 at College of Horticulture, Anantharajupeta, YSR Kadapa Dist. AndhraPradesh to study the effect of organic manures along, with biofertilizer mixture (Azospirillum, PSB and Frateuria aurantia). The experiment was laid out in Randomized Block Design (RBD) with seven treatments replicated thrice. The observations on vegetative parameters revealed that, application of FYM + Biofertilizer mixture recorded maximum plant height (55.57 and 56.37 cm) at 60 DAT and 90 DAT, maximum number of branches (33.47) at 60 DAT, maximum stem girth (1.121 cm) at 60 DAT. Among floral parameters, application of FYM + Biofertilizer mixture took minimum number of days for first flower bud initiation (30.27), 50 % flowering (48.30), maximum duration of flowering (69.87), *flowers per* plant (53.07), flower diameter (7,30 cm), flower yield per plant (2.23 kg), flower yield per plot (24.69 kg), days taken to 50% flower wilt (3.33) and shelf life (6.67).

8.2.9 Impact of Organic Manures, PGPR and Micro Nutrients on Physiological Aspects, Yield, Quality and Nutrient Uptake in Ajwain (*Trachyspermumammi*L)

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There is a wide scope to check the performance of Ajwain with organic nutrient sources along with plant growth promoting rhizobacteria and micronutrient sprays and restructuring of nutrient doses for getting economic yields with sustainable soil health. Accordingly, this study was carried out at College of Horticulture, Anantharajupeta, Y.S.R. Kadapa District, Andhra Pradesh during 2017-19 to investigate the influence of organic manures, PGPR and micronutrients on physiological aspects, yield, quality and nutrient uptake of ajwain. Farm yard manure (FYM) and vermicompost (VC) were used as organic sources at 50% and 75% recommended dose of nitrogen (RDN) as basal dose. PGPRs namely *Azospirillum lipoferum*, *Bacillus megaterium* and *Frateuria aurantia* were used for seed priming. Micronutrients namely ZnSO4 and Fe were applied thrice as foliar application @ 0.5% first before flowering, second at 50% flowering and third during grain formation. The results revealed that maximum crop growth rate, highest number of umbels plant^{-1}, umbellets umbel^{-1}, number of fruits umbellet^{-1}, seed yield plant^{-1}, seed yield hectare^{-1}, straw yield, biological yield, test weight of seeds and essential oil yield were recorded with the application of 50% RDN through VC, which was on par with 50% RDN through FYM, seed priming with *Azospirillum* and foliar application of zinc with respect to their individual

effect. However, highest leaf chlorophyll content and total phenol content of leaves were recorded in treatment received 50% of RDN through FYM which was on par with treatment received 50% of RDN through VC, seed priming with *Azospirillum* and spraying of iron at 0.5 %. Maximum essential oil content, fixed oil content and thymol content were also observed in case of application of 50% RDN through VC, seed priming with *Azospirillum* and foliar application of zinc individually. The nutrient uptake reports revealed 50% of RDN through VC and 50% of RDN through FYM, were found superior in N, P and K uptake by both biomass and grains. Among the PGPR, seed priming with *Azospirillum* was found significantly superior in N-uptake, *Bacillus megaterium* in promoting P uptake and *Frateuriaaurantia* in promoting K-uptake by the plant andgrains .Soil nutrient analysis after the harvest of crop revealed the higher residual nutrient content showing that lesser exhaust of nutrients and effective nutrient recoupment with the substitution of inorganics through organic source of nutrients and application of PGPR. However, foliar application of micronutrients could not make any significant influence on enhancing the N, P and K content in the soil. Highest Benefit Cost Ratio (BCR) of 3.33 was recorded with combined application of 50% of RDN through FYM along with seed priming with *Azospirillum* and foliar spray of Zn at 0.5%.

Keywords: Azospirillumlipoferum, Bacillusmegaterium, Frateuriaaurantia,thymol

8.2.10 Effect of Stage Specific Fertigation Schedules on Growth and Yield of Parthenocarpic Cucumber under Naturally Ventilated Polyhouse

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An experiment on stage specific application of fertilizers through fertigation was conducted in parthenocarpic cucumber under naturally ventilated polyhouse at Centre of Excellence for Protected cultivation, Dr.Y.S.R.Horticultural University, Venkataramannagudem, West Godavari District, Andhra Pradesh during 2019-20 to standardize fertigation schedules for parthenocarpic cucumber. Among different combinations of N, P and K fertilizers scheduled based on the plant growth stages maximum vine length (345.80 cm) was recorded with 180 : 60 :120 (N:P:K) kg ha^{-1}which was on par with the treatments 140 : 90 : 80 (N:P:K) kg ha^{-1} (337.50 cm), 140 : 90 : 120 (N:P:K) kg ha^{-1}(339.70 cm) 180 : 60 :80 (N:P:K) kg ha^{-1}(341.35 cm), 180 : 90 : 80 (N:P:K) kg ha^{-1}(343.55 cm) and 180 : 90 : 120 (N:P:K) kg ha^{-1}(342.45 cm), while maximum internodal length (7.62 cm) was recorded with180 : 60 :120 (N:P:K) kg ha^{-1}which was on par with140 : 90 : 80 (N:P:K) kg ha^{-1}(71.93 cm), 140 : 90 : 80 (N:P:K) kg ha^{-1}(72.82 cm), 140 : 90 : 120 (N:P:K) kg ha^{-1}(74.86 cm), 180 : 60 :80 (N:P:K) kg ha^{-1}(75.49 cm), 180 : 90 : 80 (N:P:K) kg ha^{-1}(77.67 cm), and 180 : 90 : 120 (N:P:K) kg ha^{-1}(75.48 cm), while maximum leaf area at harvest (489.69 cm^2) was recorded with the treatment 180 : 60 :120 (N:P:K) kg ha^{-1} which was on par with180 : 90 : 80 (N:P:K) kg ha^{-1} (486.91cm^2) and 180 : 90 : 120 (N:P:K) kg ha^{-1}(488.60cm^2) Maximum number of fruits per plant (36.76) was recorded with the treatment 180 : 60 :120 (N:P:K) kg ha^{-1} which was on par with 180 : 90 : 80 (N:P:K) kg ha^{-1} (35.61) and180 : 90 : 120 (N:P:K) kg ha^{-1}(35.08) maximum yield per plant (5.46 kg) was recorded with180 : 60 :120 (N:P:K) kg ha^{-1} which was on par with 180 : 60 :80 (N:P:K) kg ha^{-1}(4.98 kg), 180 : 90 : 80 (N:P:K) kg ha^{-1}(5.23 kg) and 180 : 90 : 120 (N:P:K) kg ha^{-1}(5.05 kg). Highest yield (87.31 t/ha) and B:C ratio (1.91) were also recorded in 180 : 60 :120 (N:P:K) kg ha^{-1}.

Keywords: Parthenocarpic cucumber, fertigation, naturally ventilated polyhouse

8.3 Poster Presentation

8.3.1 Effect of Agri-Lime, Molybdenum and Sulphur Application on Green Pod Yield of Cowpea (*Vignaunguiculata*)

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A field experiment was conducted at Vegetable Farm Kalyanpur, C.S.A.U. of Agri. & Tech., Kanpur in Kharif season during 2012-13 to 2014-15 to study the effect of agri-lime, molybdenum and sulphur application. The experiment was carried out under randomized block design with three replications. Ten treatments vizmolybdenum 50 ppm (three spray, T1), molybdenum 25 ppm, (three spray –T2), Sulphur 15 kg./ha (T3), Sulphur 20 kg./ha (T4), Sulphur 25 kg./ha (T5), T1+T5(T6),T2+T3(T7), Agri-lime @1 T/ha (T8), T2+T5+T8 (T9) and control (T10) were applied to the cowpea variety T-5269 (semi-indeterminate habit). The result revealed that the highest average yield of 91.47 q/ha with C: B ratio of: 2.10 was recorded in T-9 treatment (T2+T5+T8) followed by T6 (T1+T5) as yield of 79.75q/ha with C: B ratio of 1:1.99 and lowest yield found in control (T10) 37.63q/ha with C: B ratio of 1:086.

8.3.2 Replacement of Inorganic Fertilizer with Organic Fertilizer for Higher Yield and Quality of Okra

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Okra (*Abelmoschus esculents* L. moench) belonging to the family malvaceae is a herbaceous annual with bisexual flowers and erect vegetable growth with or without branches. Okra cultivation was mainly practiced traditional package and practices in U.P. majority of farmers applied synthetic fertilizers and pesticides. During 1960s and 1970s the ever increasing population in India along with several natural calamities led to severe food security,in the country and millions of poor Indian died of hunger in the mid 1970s, for increasing food security the"green revolution" was introduced. Thereafter, the natural and organic farming were replaced to chemical farming, has resulted harmful effects on soil fertility and health and crops. In chemical farming the vegetables cultivation affected more, especially Okra crop because it is grown throughout the year except in frost and severe winter affected area . As a green vegetable, okra has been used throughout the year, therefore,it directly affect to the human health. For promoting and enhancing agro-ecosystem, human health, biodiversity, biological cycles and soil biological activity, a programme for organic farming has been planed .The study was land out in villages, Taripathakpur, Manpur, Akbarpur Seng,Garhbedipur and Gadanpur Ahar of Disst. Kanpur Nagar U.P.

The study was carried out during 2017-18 and 2018-19 area of 48 hectare. The soil was sandy loam, having pH 7.5-8.1, organic carbon 0.23-0.51 %, available phosphorus 8.00-33.00 kg./ha^{-1} and available

potash 170.00-222.00 kg.ha^{-1}. Thus, the organic carbon vary from low to medium in the operational area. Hundred twenty farm families participated in this program of five village in Disst. Kanpur nagar of U.P. The okara was seeded after green manuring of dhaincha. The PSB culture 6.25 kg + *Rhizobium* culture 6.25 kg+ Trichoderma 5 kg. mixed in 250-300 kg FYM, moistened with water and covered with Jute bags. After 4-5 days the micro organism increased their population in the material. The prepared material broadcasted in a hectare area before last ploughing in the experimental fields. Trichoderma checked the stem rot , root rot , damping off, wilt, blight etc. In Okra Neem Leaves powder @ 50 kg./ ha^{-1} dusted after turning of dhaincha for control of termite, cutworm and other soil insects. After well rotten of dhaincha, the field was prepared. The crop was sown in the first week of July and first picking was done after 40 days of seeding and last picking followed in the end of September. The cultivar Azad bhindi-1 was planted at the distance of 45x30 cm. 100 kg N,60 P_2O_5 and 84 kg K_2O ha^{-1} was given to Okra crop. The application of PSB culture before the sowing of green manure crop, increased the availability of P_2O_5 by 30 kg ha^{-1}. No additional fertilizers ware given to the crop of okra. The other recommended package of practices were fallowed in Okra cultivation. Irrigation were given as when required. The average yield of green fruits of Okra was recorded 128 q.ha^{-1} The family labors specially women were engage in the picking of green fruits of Okra .In forthcoming days the developed organic farming system will prove an asset to the nation and farm families will harvest the fruit of this generated technology.

8.3.3 Scientific Method in Raising Nursery of Direct Sown Cucurbitaceous Crops: A Way for Enhancing Income

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Ziad crops have been observed, to ensure adequate food supply and distribution in cities and support livelihoods of farmers. If we grow early crop we got more profit but in early crop we face germination problem in seedlings. In order to enhance better germination of seedlings in vegetables, we opt for protected structure such as poly house, but due to high cost of establishment farmers do not get chance to adopt it. As implementation of protected culture is very high for a farmer. However, Nursery raising in polythene bags under small polythene huts or other covered structures is a very good technique for farmers. Being extension experts, guidance and support to farmers' production are carried out both in the field and on phone. started to provide technical support like seed treatment/soil & water management and protection against environment /insect pest and diseases to farmers who are vegetable Grover in khair block of Aligarh District. Social media such as WhatsApp is also used to provide immediate technical guidance to obtained an early crop, sowing of muskmelon and other cucurbits is done in polythene bags of 15 × 10 cm size and 100-gauge thickness, in end of January. The seedlings are transplanted into the field in end February when they have developed 2-3 true leaves. The transplanted crop matures earlier by 15-25 days than the direct sown crop, escapes the attack of red pumpkin beetle, produces higher yields and economizes seed cost, especially in hybrid cultivars where seed cost is high. Regarding for this, farmers obtained Rs. 3.0 -4.0 Lakhs from expenditure of Rs. 70.00 to 80.00 thousand. The cost benefit ratio of these farmers was also recorded much higher *i.e.* about 1:6 as compared to cost benefit ratio of those farmers who grown their crop through direct seed sown whose cost benefit

ratio was recorded 1:3 which is very low. The nursery Grover farmers get benefits by two ways first of all they sell their seedlings to other fellow farmers at higher rate and other way is that, they transplant seedlings in their own field, and due to early crop and higher yield, they get about 200% extra benefit as compared to direct seed sowing practices because of high rate of crop yield.

8.3.4 Effect of Foliar Application of NAA, GA_3 and Zinc Sulphate on Fruit Drop, Growth, Yield and Quality of Ber cv. Banarasi Karaka

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The ber belongs to the family Rhamnaceae, is an important indigenous fruit of India and China but it is more associated with the Indian culture since ancient times. This is grown commercially in certain states like Madhya Pradesh, Bihar, Punjab, Haryana, Uttar Pradesh, Rajasthan, Gujarat, Maharashtra and Andara Pradesh. In U.P, ber orchards are found around Varanasi, Aligarh, Faizabad, Agra and Raibarelli districts. Among the sub-tropicals fruits, it is one of the most common and ancient fruit of India. Being of hardy nature and heavy bearing, it is cultivated widely in drought and other diversified soil and climatic condition. It is known as "King of Arid Fruits".Ripe fruits are eaten fresh and utilized in the preparation of jam, jelly, preserve and candy and it can be dried to prepare a product similar to "chuhhara". Ber juice can be prepared from the fresh fruit and can be used for making squash.

Plant bioregulators and micronutrients plays a significant role in increasing fruit, prevention of pre harvest fruit drop, regulation of flowering, inhibition of growth, thinning of flowers and fruits. Use of NAA increased fruit set, decreased fruit drop and brought beneficial change in quality of many fruits, whereas use of gibberellins has been mainly used for manipulating in many physiological events and are commercially used to improve the quality of fruit, delayed fruit senescence, increases fruit set and decreases fruit drop. Zinc is considered necessary for the growth and development of fruits as it is one of the essential elements for the formation of chlorophyll and hence useful towards photosynthetic activities. Keeping these in view the present experiment was carried out in the Department of Horticulture, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, (U.P.), using ten treatments, replicated thrice in RBD. From the experiments it is reported that thespray of GA_3 20 ppm at fruit setting stage proved significantly effective in increasing initial fruit set (159), fruit weight (15.68g), length of fruit(4.71), fruit volume (15.64cc)and width of fruits()2.76. The quality attributes *i.e.,* TSS(14.09^0Brix), total sugars(9.98%) and ascorbic acid content (99.00 mg/100g)and the yield attributes *viz.*, weight of fruit pulp (14.64g), howeverfruit yield (52.23 kg/tree) were improved with $ZnSO_4$ 0.6 % application in the plains of northern India.

8.3.5 A Case Study: Assessment and Management of Sodic land Reclamation Impact at District level

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A field experiment was conducted at UP Sodic Land Reclamation Project-III Fatehpur, UP during the year 2016-17. A case study was under taken to attempt the assessment and management of sodic land reclamation impact in five villages of sodic category 'C' of district Fatehpur. Soil salinity passes serious threats for sustainable agricultural production out of 6.73 million ha salt effected soil in India nearby 3.8 million ha is occupied by sodic land. Government of Utter Pradesh through U.P. Bhumi Sudhar Nigam has been executing a project for reclamation of sodic land UPSLRP III Project unit Fatehpur district of U.P. has been assigned the responsibility of project in 2012-13 of sodic land reclamation at village level. Reclamation to assess the impact of sodic land reclamation after three year randomly selected 5 villages reclaimed in the year 2016-17.

The result of reclamation thus implacable the sustainability of sodic land reclamation on taken up under project.

Keywords: Soil sodicity, soil reclamation, sustainability and crop production

8.3.6 Promoting Organic Farming: A Low-Cost Method to Increase Agricultural Productivity

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Every technology or product in the natural ecosystem has its own side effects and from last half a century we are using the pesticides and herbicides indiscriminately to raise crops, but now its ill effects are being visible to us. Natural farming or natural agriculture is an extremely low-cost farming method that completely eliminates and discourages farmers from using any type of chemical fertilizers and pesticides. It is considered as an agro-ecology based diversified farming system which integrates crops, trees and livestock with functional biodiversity. In India, Natural farming is promoted as **Bharatiya Prakritik Krishi Paddhati Programme (BPKP)** under centrally sponsored scheme- **Paramparagat Krishi Vikas Yojana (PKVY)**. BPKP is aimed at promoting traditional indigenous practices which reduces externally purchased inputs. In order to achieve a more eco-friendly and safe agricultural environment a study was undertaken with farmers in Bharatpur village of Haswan block, Thariyaon Fatehpur where farmers were motivated to adopt natural methods like vermincompost, cowdung manure, etc. to increase farm productivity and reduce adverse effects to health and environment.

Keywords: Natural Farming, Organic Farming, Health, Productivity.

8.3.7 Response of Boron and Sulphur on Growth and Yield of Cucumber (*Cucumis sativus* L.)

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Cucumber (*Cucumis sativus* L.) is a common cucurbitaceous summer vegetable. It is generally called Kheera and its second largest cultivated cucubit in the world after china. In India, cucumber is noticed at least 3000 years ago and during 100 B.C. in china. The immature fruit of cucumber is often raw or eaten vegetable without cooking and also used as salad, making pickles and pahari rayta etc. Cucumber contains 96% of water which is good for summer season. Cucumber is also excellent source of molybdenum, vitamins and potassium. It is traditionally used for facial of face and cure of skin problem. To increase the farm income achieve food and nutritional security an experiment was conducted by KVK Farrukhabad at the farmers field to assess the response of boron and sulpher on growth attributes and fruit yield of cucumber (Kheera) during 2020-21. The crop was cultivated in pit with spacing of 1.2x1.2 meter in RBD design with three replications in different location. The treatment combination was as followed T1 Farmers practice (NPK-80:40:40), T2 FP (NPK+B 6.25 Kg/ha), T3 FP (NPK+S 12.50 Kg/ha) and T4 FP (NPK+B 6.25 Kg/ha+ S 12.50 Kg/ha) for experimental study. The farmers practice for NPK was 80:40:40 Kg/ha where the boron and sulphur was applied individually with faramers practice and combined. One Sixth of Urea, DAP, MOP and Boron and Sulphur were added as basal dose for the pit before transplanting of seedlings. The rest amount was added in soil as five equal installments. The treatment (T4) was performed better in term of plant height (265.60cm), numbers of branches per plant (9.40) and higher number of fruits per plant (29.50) with maximum male and female flower. The application of boron and sulpher has a remarkable effect on growth and yield of cucumber crop.

8.3.8 Integrated Management of Yellow Mosaic Virus of green gram (*Vigna mungo*) under Pulse-wheat Cropping System in District of Hathras (U.P.)

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Hathras district related to Agro-Climatic Zone of Uttar Pradesh was studied during 2018-19 considering district as its agricultural zones as unit of investigation because of a marked variation prevails in soil, climate, cropping pattern, area and productivity which divide in seven blocks. In technology-3 with shikha (IPM410-30) resistant variety with an average mean yield (7.0 q/ha) as against a yield with a mean of 5.0 q/ha recorded under farmer's practices. The incidence of MYMV was recorded 1.5% in technology-3 but the disease incidence was highest 25% in farmers practice. The results were found highly significant increase in yield and growth attributes of green gram on resistant variety of MYMV disease with integrated disease management technologies and reduced disease incidence as comparison to farmer practices. The technology index was 26.6%, while 30 % maximum technology index was in technology-3. The high yield and disease resistant varieties with disease management technologies were found the main factors to give the high achievement on black gram production while farmers were

unaware about these resistant varieties and disease management practices. Farmers were convinced due to performance of technologies and accepted the ones but farmers want availability of new technologies inputs timely at local market.

8.3.9 Effect of Foliar Spray of Nutrient and Plant Growth Regulators on Yield and Quality of Winter Season Guava Cv. Allahabad Safeda

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Guava (*Psidium guajava* L.) is one of the most important fruit crops grown well under tropical and sub-tropical conditions,popularly known as 'Apple of Tropics' or 'Poor man's apple' belongs to the family Myrtaceae. It is native of tropical America. The foliar application of nutrients and plant growth regulators possess great potentialities in improving fruit set, yieldand quality parameters of guava fruits. Nitrogen is essential for plant growth, zinc for growth and development, potassium is necessary for photosynthetic activities and translocation of photosynthates influencing the quality attributes. NAA induces more fruiting, promotes flowering, whereas GA_3 increases fruit retention. Combination of different plant growth regulators and different nutrients increases economic yield facilitating harvesting.

Thus, keeping these in view the present investigation was carried out in RBD with three replications and ten treatments in the month of August, 2019 at Department of Horticulture C.S. Azad University of Agriculture and Technology, Kanpur.The maximum fruit set (61.82 %), fruit retention (59.69 %), fruit yield (63.36 kg/tree), fruit length (7.69 cm), fruit width (7.72 cm), fruit weight (128.25 gm), fruit volume (115.07 cc), specific gravity (1.167), TSS (11.18 ^{0}Brix), Ascorbic acid (175.67 mg/100 gm), total sugars (6.86 %),reducing sugar (3.84 %), non-reducing sugar (3.45 %) was found infruits which were produced from the plants treated with Urea 1 % + NAA 100 ppm,while the minimumfruit set (47.45 %), fruit retention (39.18 %), fruit yield (46.16 kg/tree), fruit length (6.55 cm), fruit width (6.62 cm), fruit weight (99.74 gm), fruit volume (93.69 cc), specific gravity (0.933), TSS (7.80^{0}Brix), Ascorbic acid (154.16 mg/100 gm), total sugars (6.08 %),reducing sugar (2.90 %), non-reducing sugar (2.92 %) was found in the fruits which were produced from the plants kept under control. Minimum acidity (0.506 %) was found in fruits which were produced from the plants treated with Urea 1 % + NAA 100 ppm, whereas maximum was found in control. Therefore, combined spray of Urea 1% + NAA 100 ppm can be advocated to guava growers for securing higher yield and better quality of guava fruits.

8.3.10 Studies on Macro-Nutrient Requirement of Potato (*Solanumtuberosum*. L)

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The field study wasconducted at the Vegetable Research Farm, Chandra Shekhar Azad University of Agriculture & Technology Kalyanpur, Kanpur.The treatments were arranged in Randomized Block Design (RBD) with 3 replications during 2020-21. The used of different doses of NPK fertilizers with 12 treatments viz. T_1(0:80:150), T_2(120:80:150), T_3(180:80:150), T_4(240:80:150), T_5(300:80:150), T_6(240:0:150), T_7(240:40:150), T_8(240:120:150), T_9(240:80:0), T_{10} (240:80:50), T_{11}(240:80:100) and T_{12}(Control)with taken the characters plant emergence, plant height, number of shoots/plant at 50 days after planting, graded wise 0-25g, 25-75g and more than 75g. Number and yields, tuber dry matter, fresh and dry haulm, yield bio marsh yield and economics. The results observed that significant highest tuber yield of 37.64 tone/ha was recorded in treatment, 240:120:150kg/haof NPK followed by 240:80:100kg/ha of NPK (35.95 t/ha). The minimum tuber yield of 15.54 t/ha was recorded in Control. The maximum net returns of Rs. 147227.00/ha was obtained in 240:120:150kg/ha of NPK with B:C ratio of 1:2.19. The maximum dry matter (20.50%)was recorded in 0:80:150 applied of NPK treatment.

8.3.11 Organic farming Towards Improving Farmer Socio-Economic Profile

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Organic farming is an agricultural system that uses fertilizers of organic such as compost manure, green manure, and bone meal and emphasis on techniques such as crop rotation and companion planting. Australia has the largest organic agriculture area (35.6 million ha) followed by Argentina (3.4 million ha) and China (3 million ha), (*IFOAM, 2016*). In 2017, 2.9 million organic producers were reported, which is 5% more than 2016. India continues to be the country with the highest number of producers (835200) followed by Uganda (210352) and Mexico (210000) etc**.** As on 31st March 2018, total area under organic certification process (registered under National Programme for Organic Production) is 3.56 M ha, 2017-18. This includes 1.78 million ha (50%) cultivable area and another 1.78 million ha (50%) for wild harvest cultivation. Among all the states, Madhya Pradesh has covered largest area under organic certification followed by Rajasthan, Maharashtra and Uttar Pradesh. During 2016, Sikkim has achieved a remarkable distinction of converting its entire cultivable land (> 76000 ha) under organic certification. A total of 68.8 million ha were organically managed at the end of 2017. Representing, a growth of 20 percent 11.7 million ha over 2016. So, a proper infrastructure, technology imbursement, training etc is required to develop the backbone of the economy. There is very broad scope of organic farming towards development of socio-economic profile of the marginal farmers a.w.a. the whole economy.

Keywords: organic farming, socio-economic, economy

8.3.12 Influence of Zinc, Boron and Molybdenum on Yield Attributing Characters and Seed Yield of Mung Bean [*Vigna radiata* (L.)

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A field experiment was conducted during *Zaid* season of 2020 at Crop Research Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kalyanpur, Kanpur, (U.P) to study the "Influence of Zinc, Boron and Molybdenum on Seed Yield Attributing Character and Seed yield of Mung Bean [*Vigna radiata* (L.) Wilczek]". The experiment was laid out in Randomized Block Design with three replications. The experiment consisted of twenty seven treatment combinations comprising of three levels of Zinc (0, 10 and 25 kg Zn ha^{-1}), three levels of Boron (0, 5 and 10 kg Bo ha^{-1}) along with three levels of Molybdenum (0, 5 and 10 gm Mo kg^{-1} seed treatment). The experimental results revealed that the most of the treatments significantly affect the seed yield. The basal application of Boron @ 5 kg ha^{-1} registered value for significantly higher in yield attributes character such as number of cluster/plant (10.07), number of pod/cluster (4.72), number of pod/plant (50.59) and number of seed/pod (10.93). Significantly highest seed yield enhanced by the Boron @ 5 Kg ha^{-1} (947.37 Kg ha^{-1}) followed by the Zinc @ 10 kg ha^{-1} (931.40 Kg ha^{-1}) and lowest enhanced by Molybdenum @ 5 gm kg^{-1} seed treatment (917.84 Kg ha^{-1}) as compared to control. The combined application of Zinc @ 10 kg ha^{-1} and Boron 5 kg ha^{-1} with the Seed treatment of Molybdenum (5 gm Mo kg^{-1} seed) significantly improved all the yield attributing characters such as number of cluster per plant, number of pod per cluster, number of pods per plant, number of seeds per pod and seed yield ha^{-1} of mung bean. The synergistic influence of these three micronutrients helped augmenting growth and yield of the crop.

TECHNICAL SESSION-9

PLANT HEALTH MANAGEMENT FOR RESILIENCE TO CLIMATE CHANGE AND SUSTAINABILITY IN PRODUCTION

9.1.1 Climate Resilient and Sustainable Development of Horticulture

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Climate-resilient farming systems are very important to promote the sustainability of agriculture at global level. Horticultural crops are particularly sensitive to climate changes because of their high water demand and temperature requirements. Increased or decreased rainfall and temperature results in drought or flooding, lack of water for irrigation, pests and diseases epidemic can affect the suitability of areas for growing horticultural crops. Understanding the impacts of climate for given crop under specific conditions is a key to support further development of horticulture sector. Climate changes significantly

affects the performance of horticultural crops across climatic zones and that countries need to be better prepared to address these effects. Horticulture covers myriad crops (including fruits and vegetables), which are affected by climate changes in different ways. Agriculture which is highly affected by climate changes is devolved to the States; as such, policies relevant to it are expected to be implemented at State level. In this regard, Push–Pull Technology (PPT) is an ecological approach to a farming system that aims to improve the climate resilience of producers in a smallholder mixed farming system. PPT is primarily designed to control pests and weeds in an ecofriendly approach, to improve soil fertility, to improve livestock feed, and to increase farmers' incomes. Digital climate resilience services can directly impact the resilience of smallholder farmers such as open satellite data, low-cost sensors, big data and machine learning. Mobile network operator (MNO) assets provide the basis for further innovation, facilitating localization and scale-up of these services. The role of agri-drones for spray of fertilizers and pesticides is all the more critical for precision spraying while saving water. The propagation of drone technology across our Nation will be the key in Sustainable Development of Horticulture. Agricultural financial services, such as credit, enables farmers to access inputs and assets to support climate-smart agricultural practices, while agricultural index insurance provides a safety net for those affected by adverse weather events.

9.1.2 Innovations in Pest Management System for Resilient and Sustainable Development in Horticulture

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Horticulture sector is recognised to have the potential to raise the farm income, provide livelihood security and earn foreign exchange. Horticultural crops viz., fruits, vegetables, ornamental plants, spices, medicinal & aromatic and plantation crops, have vast scope of value addition which provides additional employment to farm family. It is the back bone of Indian agriculture which contributes about 30% of agricultural gross domestic product (GDP). The fruits and vegetables, which are extremely nutritious horticultural produce with tremendous human health benefits, are attacked by various insect, pests and diseases resulting in standing crop and post-harvest losses as well as highly perishable and are readily prone to spoilage during storage, resulting in a decrease in quality attributes and induced food loss. Significant amounts of fruits and vegetables produced globally go to waste owing to improper management of insect & pests and diseases, improper handling, transportation, post-harvest operations and lack of processing, etc. Such losses could be ameliorated by adopting effective management strategies, enhanced post-harvest research, development, management and processing of horticultural produce. Creating and adopting innovative approaches and policies, for reducing global fruit and vegetable losses, that are accessible to small-scale farmers in developing countries could substantially prevent such amount of losses. The reduction of losses can help to achieve sustainability in balancing economic, social and environmental dimensions. Intensive focus must be put on to the development of advanced technologies to boost up global food security by enriching the world's agricultural economy with minimal losses of consumable fruits and vegetables. Some of the new initiatives like focus on planting material production, cluster development programme, credit push, formation and promotion of farmer producer organisations (FPOs) are the right steps in this direction. The new technologies in recent years such as drone camera, remote sensing, aerial Ultra-low volume (ULV) applicators, drone sprayers and aerial unmanned vehicles used in present scenario has been adjusting the ways that farmers treat crops and manage fields. Whereas,

advance technologies like nanotechnology, ecological engineering and push pull strategy are cost effective, smart and sustainable. These are thus the necessary steps towards the development of safe, economical and sustainable methods of pest management in horticultural crops, as well as food security, for the future.

Keywords: Horticulture, GDP, Insect & Pests, Post-harvest Technologies, FPOs

9.1.3 Bio-intensive Management of Insect Pests in Horticulture Crops

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Agriculture sustainability, soil degradation, biodiversity, impact on human health and the environment as a whole are some of the concerns that are raised against the current chemical-based strategy. The search for alternatives with a focus on the long-term sustainability of agriculture has been enhanced in the last decade. There are practices which have evolved as alternatives to chemical use in agriculture keeping in view the increasing demand for green agriculture products across the world. Bio-intensive pest management is a systems approach based on an understanding of pest ecology that ensures ecosystem services. It begins with steps to accurately diagnose the nature and source of pest problems and then relies on a range of preventive tactics and biological controls to keep pest populations within acceptable limits. It emphasizes proactive measures to redesign the agricultural ecosystem to the disadvantage of insect pests and the advantage of its parasite and predator complex but at the same time, shares many of the same components as conventional IPM. Natural control and Bio diversity below and above the ground are highly emphasized and find priority in Bio-intensive pest management. In order to achieve these, various practices have been recommended. BIPM may be most useful in situations where potentially effective natural enemies have become ineffective due to biotic or abiotic factors and the pests cannot be satisfactorily (economically and/ or environmentally) controlled by other methods. It may be most popular among organic growers and has potential, especially in orchards There are certain researchable issues in bio-intensive pest management which have been elaborated in the paper. The benefits of implementing BIPM can include reduced chemical input costs, reduced environmental impacts, and more effective and sustainable pest management and such reductions will benefit the grower and in turn the society.

9.1.4 Recent Trends in Developing Molecular Diagnostics for Virus/ Virus-like Pathogens Infecting Horticultural Crops and their Novel Management Strategy

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Diseases caused by Virus/ Virus-like pathogens **(**VLPs) are considered as an important limiting factor for sustainable development of horticulture industry particularly in vegetatively propagated horticulture

crops in India. What were previously described as virus diseases of crop plants are actually an array of plant pathogens which include viroids, spiroplasma, phytoplasma and different groups of plant viruses. The economic importance of these group of pathogens derives largely from their ability to cause systemic diseases and to persist in vegetative parts of the plant for as long as these remain alive. Unlike bacterial and fungal diseases where chemotherapy is possible in field conditions, virus elimination from infected field trees is virtually impossible. Thus, losses are not only confined to season in which infection occurs and the plant that is infected, but continue as long as the infected line is in culture and thus serves as source of secondary spread of the disease.

Citrus and banana are two most important fruit crops in India and are infected by several Virus/ VLPs. In citrus, where mandarin, sweet orange and acid lime are grown as commercial crops, five pathogens viz. citrus tristeza virus (CTV), Indian citrus ringspot virus (ICRSV), citrus yellow mosaic virus (CYMV), citrus exocortis viroid (CEVd) and *Candidatus* liberibacter asiaticus causing citrus greening disease (HLB) are of major concern. All three commercial citrus cultivars are infected by these pathogens either singly or as mixed infection resulting into gradual decline of citrus orchards. These pathogens are transmitted by infected budwoods and/or insect vectors. Bio-diagnosis, sero-diagnosis and nucleic acid based diagnostics have been standardized for sensitive and reliable detection of these pathogens. A multitude of molecular diagnostic techniques *viz*. PCR, RT-PCR, duplex PCR, real time PCR, LAMP, RPA etc are being used routinely for detection of these pathogens in citrus plant samples as well as their potential insect vectors. Similarly genomes of these major pathogens have been cloned, sequenced and their variability, phylogenetic and evolutionary relationships has been established. Standardized molecular diagnostic tools has been successfully utilized to implement citrus budwood certification program and to develop certified virus-free planting material every year for the citrus growers of India. However, effective and economical management of these systemic and graft transmissible pathogens infecting a vegetatively propagated important fruit crop like citrus or banana are likely to be developed based on integrated strategies involving host resistance to the pathogen(s) and vectors; inoculum exclusion, removal or reduction of pathogen load; vector control; cultural practices; and new novel approaches that includes transgenic virus resistance through future research.

9.1.5 Effective Management of Insect Pests for Sustainable Development of Horticulture

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Large scale crop monocultures encourage the proliferation of pest and pathogens on cultivated crops. several studies highlight the impacts plants diversification upon pathogens and insect pests. It also helps in increasing the population of beneficial organisms in horticultural ecosystems. Habitat manipulation techniques as intercropping, relay cropping, crop rotation and boarder cropping can significantly assist the farmers in management of pests and diseases. The concept of crop diversity recent insights and mechanisms underlying crop diversity and its potential to increase or improve sustainable horticulture practices has been well documented. The phytobiomes resulting from increased crop diversity are increasingly recognise for their contribution to disease and pest management. Understanding the interaction between pest and pathogens with their host phytobiome may lead to novel options for crop protection. Recent advances in horticultural systems embraced, understanding the mechanisms of interactions between crop species and genotypes, ecological interactions in horticultural ecosystems and the role of local landscape or habitat variations in horticultural systems in necessary to effectively suppress pest

and pathogens. Intercropping and mixed cropping of different crops or varieties or traditional practices that have long been used for preventing disease and pest infestations across different regions worldwide.

Keywords: Crop diversity, Host Resistance, Phytobiome, Sustainability, Horticultural ecosystems

9.1.6 The role NRL, ICAR-NRC for Grapes, in Managing Pesticide Residues in Fruits and Vegetables

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ICAR-NRC Grapes is the designated national referral laboratory (NRL) in the field of pesticide residues. Its NRL status is recognized by ICAR, APEDA and FSSAI. In 2003-2004, the Indian grapes exported to the European Union countries faced a complete ban due to the presence of certain pesticide residues above the prescribed EU-MRLs. As a corrective action, the EU authority had advised India to establish a traceability monitoring system for controlling the pesticide residues in grapes for further initiation of grape export to the EU. As a repercussion to this, APEDA, Ministry of Commerce, Government of India recognized ICAR-NRC for Grapes as the National Referral Laboratory (NRL) to establish a traceability system for the control of pesticide residues in table grapes for export. Subsequently, FSSAI had recognized the institute as a gazette notified NRL for the purpose of any dispute resolution in relation to sample (domestic or imported) failures for non-compliances to the national MRLs. Over the past 18 years, the institute has significantly contributed to integrating all the stakeholders involved in export, and led the efforts of developing the internet based traceability system called GrapeNet, and HortiNet for fruits and vegetables. The institute has played a pivotal role in coordinating the efforts of the grower community, exporters, government-regulators, crop-protection industries, academic researchers, and policymakers in garnering, maintaining, and improving support for the judicious usage of agro-chemicals in vineyards. The institute scientists have been engaged in educating and promoting the growers, exporters, and other stakeholders, and through this extensive transfer of technologies, a pool of competent human resources has been developed to produce high quality grapes with MRL compliances. Under the GrapeNet system, ICAR-NRCG is serving the responsibility of suggesting the list of CIB&RC label-claimed agro-chemicals as a guidance document (Annexure 5) to the growers for the field level pest and pesticide residue management. With the active support of the institute, the number of suggested chemicals (with CIB&RC label claim) in Annexure 5 has been increased from 48 (2017-18) to 51 in 2018-19, to 61 in 2019-20, and to 70 in the 2021-22 grape season. The list of chemicals for monitoring has been increased from 98 pesticides in 2010-11 to 268 in 2021-22. The institute is conducting a lot of residue trials every year in collaboration with the agrochemical industries, and through this, the number of pesticides with CIB&RC label claim for grapes is steadily increasing providing expanded choice of chemicals for pest management. The institute is also coordinating with all stakeholders and deciding the monitoring list of pesticides in export consignments to cover all the chemicals that might appear in grapes through direct and indirect sources. Furthermore, the official control of pesticide residues has been extended to the export markets other than the EU, including Russia, China, GCC, Indonesia, Canada etc. in the same line.The fit-for-purpose residue analysis methods contributed by the institute have been adopted across the nominated laboratories because of their high accuracy and precision, simplicity, high-throughput, and cost-effectiveness, ensuring the quality of residue testing of the country having equivalent proficiency to the rest of the world. The institute is extensively contributing to the capacity building of the commercial testing laboratories by organizing field-level and lab-based training courses. NRL is an accredited laboratory under ISO 17025. It is also an accredited proficiency testing provider (ISO 17043) in the country on

pesticide residues. These accreditations endorse the technical competence of NRL and quality of its services to the grape industry, which is reflected in the increasing trend of export of horticultural commodities from the country.

9.1.7. Organic Crop Health Management in Herbal Plants: A Paradigm Shift in Agro-tourism in India

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Medicinal plants are found in the wild throughout the country and are used for various purposes including traditional herbal remedy and extraction of phytochemicals for homoeopathic and ayurvedic drugs, cosmetics, neutraceuticals/ dietary supplements, functional foods and aroma therapy oils. The history of cultivation and use of medicinal plants in India is quite ancient. In one way or other, many of these plants have been an integral part of Indian health and livelihood systems. The rich knowledge that developed in the region is well recorded in the earlier scriptures known as Vedas. The earliest references to medicinal plants can be found in Rig Veda and Atharva Veda, dating back to 5000 B.C. As a result of ancient knowledge and civilizations which flourished in India, that one of the earliest complete systems of health care was developed in the region, known as Ayurveda.

There are various estimates and guesstimates of the total number of plant species in medicinal use in India. More than 7000 plants species have known used as medicinal plants out of 17000-18000 flowering plants species in India. About 22% of the production sourced through cultivation. The annual per capita consumption of drugs in the country is around US$ 3, which is the lowest in the world, mainly because traditional medicines based on sound ancient system of medicine are still prevalent in the country (Sharma, 2000). Market value of medicinal plants in India according to findings in 2016 states it was 72 billion USD and by 2050 this is estimated to reached about USD 5 Trillion. Changes in climate, adoption of intensive cultivation practices in medicinal plant production posing serious threat of insects, mites, disease pathogens and nematodes. Most of the medicinal plants are consumed directly or used in the preparations of various formulations in traditional system of medicine and some of the active principles are extracts o isolated for the preparation of allopathic drug. The medicinal plants quantity and quality of biomass are adversely affected by various diseases caused by bacteria, fungi, nematodes, viruses and phytoplasmas threatening the yield, biomass, bioactive potential of medicinal plants of the sub-tropics. Currently, fungal diseases (root rot, wilt, leaf spots, blight/ anthracnose) and root-knot nematodes are common and important diseases during crop cultivation. Therefore, control of pests and diseases in medicinal and aromatic plants has to be taken seriously to avoid the adverse impact of pesticide residues or other chemicals. In general, medicinal and aromatic plants are very resistant to pests and diseases. However, organic farming

Organic farming, ecological farming, and biodynamic farming are the components of natural way of farming. It is self sustaining system provides the natural strength in plants to avoid, tolerate and resist against the disease and pests, reason being the medicinal and aromatic plants have wide adaptability. Organic farming and its aim is to create integrated, humane, environmentally and economically sustainable agricultural production systems, which maximize reliance on farm-derived renewable resources and the management of ecological and biological processes and interactions, so as to provide acceptable level of

crop, livestock and human nutrition, protection from pests and diseases and an appropriate return to the human and other resources employed.Organically grown medicinal and aromatic products are not only readily acceptableinglobal market but also fetch premium prices than those grown with conventional farming. Organic crop health or disease management is an important component of organic production of medicinal plants. Medicinal and aromatic plants perform better with organic manures, biofertilizers and mycorrhizal association. Weeds, insects-pests could be managed effectively with mulches and bio-pesticides, respectively. Many of the studies were carried out with different types of biopesticides in medicinal plants and crop performed better after using the biopesticides under biotic and abiotic stress.

Agricultural tourism has become a necessary means for many small farms' survival. By diversifying business operations, farm operators are able to ensure a more stable income. This is because agritourism activities can occur during times of the year that crops may not be in season, and by providing a completely separate stream of income. Some studies have found that agritourism operations often benefit their surrounding communities by drawing tourists to the area. The economic boost by the increase in traffic can be beneficial to rural areas in need of diversified streams of income. Cultivation of Flori-medicinal plants with good landscaping in rural as well as urban area would be best agricultural tourism and also ensure a more stable income to the farmers.

9.1.8 Diagnostic and Sustainable Management of Disease Sub-tropical Fruits

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9.1.9 Harnessing Plant Microbiome for Disease Management of Horticultural Crops: Changing Paradigms

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Plant health care through disease redressal is the primary service to horticultural crops to harness their ability to sustain human health . Plants and core microbiome diversity have co-evolved , while serving to each other in complementing crop production, which undergo transcriptional biochemical modifications in response to pathogen attacks by triggering the accumulation of defense proteins. With a major break though in successful management of crown gall pathogen *A. tumifaciens* through microbial intervention by using strain of *Agrobacterium radibactor K 84*, microbes have paved their way in disease management under organic and integrated crop management programmes. *Trichoderma* spp, *Bacilus* spp , Fluorescent Pseudomonads are considered as key players in crop health management in fruits and vegetables in terms of disease management vis -a- vis growth promotion. Various fungal antagonists, such as *Chaetomium sp*, *Aureobasidium* sp and *Phoma* spp. were also reported to inhibit the growth of apple scab fungus, while other antagonists such as *B. subtilis* and *T. koningii* have been effective in controlling

apple canker. Microbial antagonists are more suited for control of soil borne pathogenic genera represented by *Pythium, Phytophthora, Rhizoctonia, Fusarium* and *Sclerotium*, where microbial antagonists such as *Trihcoderma* spp., *Gliocladium* spp*, Verticillum* spp., *Bacillus subtilis*, *Agrobacterium radiobacter., Pseudomonas* spp proved their worth beyond any doubt. Bacterial wilt (*R. solanacearum*), fungal wilt (*Fusarium* spp.), damping off and root rot (*Pythium* spp, *Phytopthora* spp, *Rhizoctonia solani*), Anthacnose (*Colletotrichum* spp), Tropical race-4 of banana (*Fusarium oxysporum*) etc. are few examples of complex diseases with successfully managed through microbial antagonists under field conditions.Our experiences in northeast India greatly contributed to microbes mediated disease management as a part of Organic Horticulture through development of an array of bioformulations. Compatibility assay of different antagonistic microbes and entomopathogens such as *T. viride,P fluorescens, Bacillus* spp and *M. anisopleae* have been extremely successful , besides managing diseases through large number of field studies in crops like citrus, banana , tea, turmeric , ginger , capsicum , tomato, chilli, lettuce and patchouli using microbial antagonists, preferably in a consortia mode. Seed treatment of vegetable seeds with nano-bio formulation of *Trichoderma asperellum* and chitosan NP suppressed the growth of *F. oxysporum, Sclerotium rolfsii* and *Rhizoctonia solani.*

9.2 Oral Presentations

9.2.1 Management of Citrus Scab and Citrus Scan and Canker with Fungicides and Antibiotics in Sweet orange

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Citrus scab, caused by *Elsinoefawcettii*, and canker, caused by *Xanthomonas axonopodis*pv*citri*, are important diseases on sweet orange in Andhra Pradesh. Both the diseases cause blemishes on fruit that does not affect internal quality but reduce the exterior quality of fruits produced for the fresh market. Hasta bahar crop is more prone to disease because of higher per cent relative humidity during flowering and fruit setting. At early stage of infection both the disease symptoms appear similar. Five fungicides namely, Tridemorph(0.1%), carbendazim (0.1%), hexaconazole (0.2%), mancozeb (0.3%), copperoxychloride (0.3%) were evaluated for the control of scab and bacterial canker, streptocycline (streptomycin sulphate and tetracycline hydrochloride, 9:1 ratio) @ 100ppm was sprayed in combination. Three sprayings were imposed,first spray immediately after pruning diseased and dead wood, 2nd spray two weeks after fruit set and 3rd at fruit marble stage. Hexaconazole + streptocycline and hexaconazole found effective for scab control with 2.89 and 3.56 per cent disease index (PDI) on fruit, respectively. In case of canker, streptocycline in combination with hexaconazole, mancozeb, copperoxychloride recorded zero per cent PDI and copperoxychloride alone recorded 0.22 per cent which were significantly superior among the treatments. Hexaconazole and Hexaconazole +Streptocycline recorded maximum BC ratio of 3.5 and to conclude, Hexaconazole in combination with Streptocycline under field conditions is promising for scab and canker disease control.

9.2.2 Harnessing Pesticidal Efficacy of Rhizospheric *Bacillus* spp against *Oligonychus coffeae* of Tea, *Camellia sinensis*

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Oligonychus coffeae, popularly known as red spider mite (RSM), is one of the most destructive pests in all the tea producing regions of North East India causing a significant harvest loss of 17-46%. The present investigation was made to explore plant beneficial microbial genus Bacillus as environmentally safe alternative to chemicals against RSM. Three *Bacillus* spp *viz*., *B. amyloliquefaciens, B. velezensis* and *B. subtilis* were evaluated for their efficacy as entomopathogen against RSM in terms of adult mortality, repellent and ovicidal activity. The study showed that all the three bacterial isolates showed higher effectiveness compared to the control. Secondary metabolite profiling of the bacterial isolates demonstrated presence of pesticidal compounds. Scanning Electron Microscope (SEM) study of the dead mites further established entomopathogenic ability of *Bacillus* spp against RSM in tea. The study unravels the possibilities of using these bacterial species as environmentally safer alternative to insecticides against Red spider mite.

Keywords: Bacillus, Insecticides, *Oligonychus coffeae*, Secondary metabolite, SEM.

9.2.3 The potential Habitat of Onion Thrips, *Thrips tabaci* Lindeman in India under CMIP6 Projections

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Climate change impacts the spread of agricultural pests outside their dynamic range, severity, and invasion. Modelling the future potential habitat of pests using MaxEnt under different climatic scenarios is an effective method for prevention and management. Onion thrips, *Thrips tabaci* Lindeman is an economically important pest of onion in India and poses a significant threat to the domestic and export supply. In this line, a study attempted to predict the potential habitat of onion thrips *T. tabaci* under CMIP6 projections for better management plans based on two socio-economic pathways (SSPs) for 2050 and 2070. We analyzed *T. tabaci* occurrence data and 19 bio-climatic variables using the MaxEnt. We evaluated models performance using the area under the receiver operating characteristic curve (AUC) and the Jackknife test to determine the dominant variable. The model demonstrated higher accuracy, with significant AUC values in training and testing. Annual Mean Temperature (bio1), Annual Precipitation (bio12) and Precipitation Seasonality (bio15) are the main environmental variables that could determine the potential habitat of *T. tabaci* in India. A total of 678280.9 sq. km (20.64 %) of India's land area is high potential habitat for *T. tabaci*. Model predicted some new areas, especially higher latitudes as high potential habitat of onion thrips. However, prediction revealed that, in 2050 and 2070, high-potential areas projected to decrease for both SSP scenarios. Thus, the information generated is of paramount importance in framing monitoring and management strategies for one of the destructive pests of onion

9.2.4 Evaluation of New Insecticides Against Leaf Curl Virus Vector of Tomato (*Lycopersicon esculantum* Mill.)

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Tomato (*Lycopersicon esculantum* Mill.) is very remunerative vegetable crop of the country and provides balanced dietary source of the antioxidant lycopene, which is linked to many health benefits, including reduced risk of heart disease and cancer. It is grown for its edible fruits, which can be consumed either raw or in the form of various processed products such as paste, powder, ketchup, sauce, soup and canned whole fruits. Tomato is also a good source of vitamins A, B and C (Khoso, 1994). In India, the production of tomato was 21173 thousand MT on an area of 811 thousand ha with the productivity of 26.10 MT per ha during 2019-20. Majority of vegetable growers of district Etawah of Uttar Pradesh are cultivating tomato crop during all the seasons. But the farmers could not get the high benefit from this crop due to the incidence of leaf curl disease. The farmers of the district are not aware about its vector and effective management. Keeping in view of the economic losses due to disease, an on-farm trial was conducted during 2020-21 and 2021-22 on farmer's field with three treatments i.e. farmer's practice (spray of Imidachloprid), two spray of Diafenthiuron 50 % WP @ 250 g/ha and two spray of Thiomethoxam @ 120 g/ ha.

Results of the trial revealed that the spraying of Diafenthiuron 50 % WP @ 250 g/ha was found very effective and recorded 19.41% and 15.25 % higher yield in comparison to farmers practice during both the years, respectively. It was also found that the lowest leaf curl incidence of 4.20 and 3.95 % and lowest occurrence of vector white fly (1.05 and 0.94 per plant) in both the years under the treatment of spraying of Diafenthiuron 50 % WP. It was followed by spraying of Thiomethoxam @ 120 g/ha. The lowest yields of 340.23 and 352.24 q/ha, highest leaf curl incidence of 15.31 and 14.62 % and highest vector population (3.12 and 2.93 per plant) were observed under farmer's practice (spray of Imidachloprid) during both the years, respectively. The similar trend of fruit yield was also found in economic return. The highest additional net income of Rs. 134390 and Rs. 152176 was obtained in the Diafenthiuron treated fields whereas lowest of Rs. 101071 and Rs. 123032 under farmer's practice during bothe the years, respectively.

9.2.5 Evaluation of New Fungicides Against Black Scurf Disease of a Potato

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Potato (*Solanum tuberosum* L.; Family: Solanaceae) is one of the major food crop of the world. It is an important vegetable cash crop, which provides balanced source of starch, vitamins and minerals as staple food to millions of people in the world. Potato has emerged as fourth most important food crop in India after rice, wheat and maize. The total area under potato cultivation in India is about 1703988.4 hectare area with productivity of 253 q/ha. Uttar Pradesh producing potato on 571359 hectare with an average yield of 298.5 q/ha. In district Etawah potato is grown on about 16129 ha area. Among several

yield limiting factors, black scurf disease caused by *Rhizoctonia solani* Kuhn is predominant. The fungus limits the growth by forming cankers on sprouts, underground stems, and stolons, and makes tubers ugly by forming black scurf (sclerotia) on tuber surfaces. It not only reduces the quality of potato but also causes 5-40 per cent economic losses. On farm trial was conducted during 2020-21 and 2021-22 on 5 farmer's field with three treatments i.e. Farmer's practice without seed treatment (T_1), seed treatment with Thifluzamide 24 SC @ 750 ml/ha (T_2) and seed treatment with Penflufen @ 250 ml/ha (T_3), to assess the effect of these fungicides on disease incidence, tuber yield and economics. Penflufen @ 250 ml/ha gave the highest tuber yield 340.22 and 343.42 q/ha and the lowest infected tubers 11.20 and 10.59 % in 2020-21 and 2021-22, respectively. Thifluzamide 24 SC @ 750 ml/ha treated tubers wee also gave satisfactory yield (333.9 and 338.23 q/ha) and reduced infected tubers (13.05 and 12.45 %) in 2020-21 and 2021-22, respectively. The lowest yields (317.45 and 319.45 q/ha) and highest infected tubers (30.33 and 32.45 %) were recorded under untreated fields during both the year, respectively. The trend of economic benefits was also found similar to crop yield. The trend of economic benefits was also found similar to crop yield.

9.2.6 Management of Shoot and Fruit Borer of Brinjal through Bio-pesticides

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Brinjal or eggplant (*Solanum melongena* L.) is an important solanaceous crop. It is popular for vegetable purpose. Shoot and fruit borer *(Leucinodes orbonalis)* is a common problem in brinjal crop and farmers are using several chemicals indiscriminate manner to the management of this devastating problem. These chemicals are health hazards to human beings, arise the resistance power in pests, pollutants to the environment and are very costly also. So, keeping in view the importance of the problem, an experiment was conducted on five farmer's fields in natural conditions with the treatments as (T1) Five spray of Neem leaf extract (5%), (T2) Five spray of Neem Seed Kerenel Extract (NSKE) (5%), (T3) Five spray of Neem oil 1% EC (0.3%). (T4) Two spray of Indoxacarb 14.5 % SC (0.03 %) with alternation three spray of Neem leaf extract (5%) and also maintained untreated plots as control (T5). Spraying was carried out from 30 days after planting at 15 days intervals in all treatments except control. Observations on affected fruit percentage and yield were recorded. Data of experiment revealed that the all treatments were found superior over control. Average 29, 25, 24, 21 and 53% of affected fruits and 280, 302, 314, 322 and 195 q/ha average yield were recorded in T1, T2, T3, T4 and T5, respectively. Although, Two spray of Indoxacarb 14.5 % SC (0.03 %) with alternation three spray of Neem leaf extract (5%) was found most effective treatment but, other treatments mentioned with neem-based products like- neem oil, NSKE and neem leaf extract were also found suitable as chemical-free as well as less expensive option to management the shoot and fruit borer brinjal. Hence, the farmers can chose option Neem oil or NSKE or Neem leaf extract to protect the brinjal crop from shoot and fruit borer with economical and eco-friendly neem-based products.

9.2.7 Effect of Different Insecticides and Biopesticides Against Fruit Borer (*Helicoverpa armigera* Hubner) on Tomato crop

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Tomato is a one of the major vegetable crops in India, and India is the largest producer of tomato in the world. The crop is attacked by a number of insect pests fruit borer is the key of this crop. A field experiment was conducted in order to test the efficacy of biopesticides against fruit borer (*Helicoverpa armigera* Hubner) of tomato crop. The application of Malathion, Quinalphos and Neemarin effectively minimize the larval population of *Heliceverpa armigera* up to 1.33, 1.66 and 2.00 larvae per 10 plants after second day with 76.50, 70 67 and 64.66 per cent reduction over control respectively. Further these treatments decreasing the larval population up to 1.66, 2.00 and 2.323 larvae per 10 plants after 4 day of spraying followed by 68.85, 62.47 and 56.28 per cent reduction over control respectively. Again above treatments reduced the larval population 1.33, 2.00 and 2.33 larvae per 10 plants after 6 day with reduction percentage 80.03, 69.96 and 65.0 respectively. In continuous above the larval population decreases up to 1.33, 1.66 and 2.33 larvae per 10 plants after 10" day with reduction 81.00, 76.28 and 66.71 per cent respectively. Further above insecticides gave reduced 1.00, 1.33 and 2.00 larvae per 10 plants after 1" spray of 15 day followed by 86.35, 81.85 and 72.71 per cent reduction over control respectively. The use of Malathion, Quinalphos and Neemarin found highly by giving reduced L.33, 1.66 and 2.00 larval population per 10 plants after 2 day of 2 spray with 83.37, 79.25 and 75.00 per cent reduction over control respectively. Further these treatments decreasing the larval population up to 0.66, 1.00 and 1.66 larvae per 10 plants after 4" day of spraying followed by 92.07, 87.99 and 80.02 per cent reduction over control respectively. In continuous above the larval population decreases up to 0.66, 1.00 and 1.33 larvae per 10 plants after 10" day with reduction 92.66, 88.88 and 85.22 per cent respectively. Further above insecticides gave reduced 1.33, 1.66 and 2.00 larvae per 10 plants after 1" spray of 15" day followed by 86.23, 82.81 and 79.29 per cent reduction over control respectively. Above insecticides effectively minimize the larval population of *Helicoverpa armigera* up to 1.00, 1.33 and 2.00 larvae per 10 plants after second day with 90.31, 87.12 and 80.63 per cent reduction over control respectively. Overall results on fruit damage and yield of tomato crop revealed that the insecticides Malathion gave best performance and maximum protection against the pest in which received the minimum per cent of fruit damage and gave highest yield 160.00 quintal per hectare. However, Quinalphos and Neemarin were the next best and gave 148.33 and 147.50 quintal per hectare. The better fruit yield *i.e.* 133.33 quintal per hectare obtained in *Metarhizium anisopliae* as compared to control (101.66).

Keywords- Helicoverpa armigera, Tomato, Biopesticide.

9.2.8 Studies on the Population Dynamics of Fruit Borer, *Helicoverpa armigera* Hubner on Tomato, *Lycopersicon esculentum* Mill. in Relation to Abiotic Factors and Management with Natural Compounds.

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The present investigation entitled **"Studies on the population dynamics of fruit borer, *Helicoverpa armigera* Hubner on tomato, *Lycopersicon esculentum* Mill. in relation to abiotic factors and management with natural compounds."** were conducted in *Rabi* season during 2018-2019 and 2019-2020 at Students' Instructional Farm (SIF), Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.). Initial incidence of the pest was observed with a mean number of larvae to the tune of 0.05 and 0.15 in both the years, respectively. The fruit damage reached to peak by March 26, 2019 and March 24, 2020, respectively, with mean larval population of 2.88 and 3.25, respectively. The results indicated positive significant correlation association between the maximum temperature (r=0.503) & (r=0.402), minimum temperature (r = 0.613) and negative significant association with maximum relative humidity (r = -0.664) & (r = -0.692) in both the years, respectively. Linear regression equation observed that among various factors, humidity (y = -0.115x + 10.51) and rainfall y = (-0.040x + 0.977) were seen negative impacts on H. *armigera* population but maximum temperature (y= 0.113x - 2.032), wind speed (y = 0.523x - 1.118) and sun shine (y = 0.225x - 0.675) were found with positive impacts on H. *armigera* population. Similar results were observed in 2019-20. *Panchgavya* @ 50 l/ha. provided maximum yield of tomato in 2018-19 & 2019-20 in terms of 156.81 q./ ha. and 153.33 q./ha., respectively.

Regarding the bioefficacy of natural compounds in 2018-19 and 2019-20 against *H. armigera* cow urine + *neem* leaf extract 5% @ 50 ml/l. with 35.94 per cent reduction over control (PROC) proved best among all treatments by reducing mean number of larvae to the tune of 0.98 larvae/ 5 plants. The second prominent treatment applied to the tomato crop was *neem* leaf extract 5 % @ 50 ml/l, with 34.64 PROC with mean number larvae i.e. 1.00 larvae/5 plants. In a pooled data analysis cow urine + *neem* leaf extract as spray on standing crop provided maximum yield of healthy fruits with 14.84 kg / plot which was statistically at par with *neem* leaf extract which provided healthy fruit yield of 13.90 kg/ plot. In experiment related with organic amendments, the highest benefit cost ratio was recorded in *panchgavya* i.e. 1:12.06, which was superior over all treatments as incorporated in the soil before transplanting. The mean yield of tomato from *panchgavya* was 156.81 q./ha. in 2018-19 and 153.33 q./ha. with benefit cost ratio i.e. 1:9.55 in 2019-20 was recorded.

In another experiment related with efficacy of natural compounds, the highest benefit cost ratio was recorded in cow urine + *Neem* leaf extract i.e. 1:31.55 and 1:32.60 for the years 2018-19 and 2019-20, respectively, which was superior over all treatments as sprayed on standing crop. The mean yield of tomato from cow urine + *Neem* leaf extract was 295.66 & 294.12 q./ha and net profit obtained from the increased yield was Rs. 169625 & Rs. 175239 /ha. in both the years, respectively. The second effective treatment was *Neem* leaf extract that produced mean yield of tomato i.e.285 & 282.12 q/ha. for both the years, respectively, and benefit cost ratio (BCR) i.e. 1:31.01 & 1:31.76 in both the years, respectively.

Keywords- Population dynamics, Tomato, *Helicoverpa armigera* Hubner, Organic amendments.

9.2.9 Effect of Insecticides and its Combination for the Management of Insect and Diseases of Onion (*Allium cepa* L)

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A field experiment was conducted at Vegetable Research Farm, Kalyanpur, C. S. Azad University of Agriculture & Technology, Kanpur during 2020-2021 to evaluate new molecules and its combination for insect pests and diseases of onion. Eight treatments were arranged in Randomized Block Design (RBD) with three replications *viz*., T_1 (Cyantraniliprole 10.26 OD @ 0.9 ml/l), T_2 (Matiram 55% + Pyraclostrobin 5% WP @ 2.0 g/l), T_3 (Matiram 55% + Pyraclostrobin 5% WP + Cyantraniliprole 10.26 OD @ 0.9 ml/l- Tank mix), T_4 (Azoxystrobin + Difenconazole @ 1.25 ml/l) T_5 (Azoxystrobin + Difenconazole @ 1.25 ml/l + Cyantraniliprole 10.26 OD @ 0.9 ml/l- Tank mix) T_6 (Fipronil 5% SC @ 1ml/l (treated control), T_7 (Propiconazol 25% EC(treated control) and T_8 (Untreated Control). The data reveals that among eight treatments minimum average number of thrips were recorded (4.86/plant) in treatment T_3 (Matiram55%+ Pyraclostrobin 5% WP @ 2g/l + Cyantraniliprole 0.9 ml/l-Tank mix) followed by (5.03/plant) in T_5 (Azoxistrobin+ Difenoconazole @ 1.25ml/l + Cyantraniliprole 0.9 ml/l-Tank mix) and the maximum average number of thrips were observed (66.5) in T_8 (Untreated Control). The minimum number of mites/leaf were found (1.11) in T_5 (Azoxistrobin+ Difenoconazole @ 1.25ml/l + Cyantraniliprole@ 0.9 ml/l-Tank mix), followed by (1.22) in T_3 (Matiram55%+ Pyraclostrobin 5% WP @ 2g/l + Cyantraniliprole 0.9 ml/l-Tank mix). The maximum number of mites/leafs were recorded in Untreated Control (6.89). The minimum number of natural enemies/plant (Coccinellids and predators) were found (1.06) in T_5 (Azoxistrobin+ Difenoconazole @ 1.25ml/l + Cyantraniliprole 0.9 ml/l-Tank mix) followed by (1.2) in T_3 (Matiram55%+ Pyraclostrobin 5% WP @ 2g/l + Cyantraniliprole @ 0.9 ml/l-Tank mix) and the maximum number of natural enemies were observed in Untreated Control (2.4). The highest yield has been recorded (33.96 q/ha) in T_5 (Azoxistrobin+ Difenoconazole @ 1.25ml/l + Cyantraniliprole@ 0.9 ml/l-Tank mix). Besides this combination treatment T_3 (Matiram55%+ Pyraclostrobin 5% WP @ 2g/l + Cyantraniliprole @ 0.9 ml/l-Tank mix) are also effective to control purple blotch and stemphylium diseases of onion. On the basis of present findings it may be recommended that T_3may be used for the control of insect pests and diseases of onion.

9.2.10 Effect of Rhizobium and PSB Inoculation with Foliar Spray of Micronutrient on Yield and Quality Attributes of Kabuli Chickpea (*Cicer Kabulium* L.)

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A field experiment was conducted during Rabi season of 2020-2021 at the S.I.F. Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (Main Campus) U.P. India, on "Effect of Rhizobium and PSB inoculation and foliar spray of micronutrient on yield and quality attributes of Kabuli chickpea

(Cicer Kabulium L.)" in R.B.D. with three replications. The treatments comprised with 8 different treatment combinations, i.e. T1 – control, T2 – soil application of Rhizobium @ 1.5 kg ha-1, T3 – soil application of PSB @ 1.5 kg ha-1, T4 – seed treatment with Rhizobium @ 200 g/10 kg seeds, T5 - seed treatment with PSB @ 200 g/10 kg, T6 – Foliar application of micronutrients mixture before flowering @ 0.5 g/liter, T7 – Foliar application of micronutrients mixture after 50% flowering @ 0.5 g/liter, T8 – Foliar application of micronutrients mixture after 50% podding @ 0.5 g/liter. The soil of experimental field was slightly alkaline with 8.09 pH and 0.22 EC. The soil is low in organic carbon and low in available nitrogen (260 kg/ha), medium in potash (175 kg/ha). The chickpea crop (Shubhra) was sown on 29 November, 2020 at 30 x 10 cm spacing and harvested on 13 April 2021. The highest seed yield (17.33 q ha-1), biological yield (41.43 q ha-1) and harvest index (41.74%) were found when (seed Inoculated with Rhizobium @ 200 g/10 kg seed (T4), followed by the T6 – (Foliar application of micronutrients mixture before flowering @ 0.5 g/liter) seed yield 17.03 q ha-1, biological yield 40.90 q ha-1, harvest index 41.64%. whereas minimum value was in control, (seed yield 13.33 q ha-1, biological yield 31.43 q ha-1). The highest net return and B:C ratio was found in T4 treatment (Seed Inoculation of Rhizobium @ 200 g/10 kg seed) i.e., Rs 48,831 and 1.99 respectively, followed by T6 Treatment– (Foliar application of micronutrients mixture before flowering @ 0.5 g/liter) Rs 46,783 and 1.94 respectively. The lowest Net returns i.e., Rs 25,297 and B:C ratio i.e., 1.51 was found in T1 Treatment or control.

9.2.11 Management of Shoot and Fruit Borer of Brinjal on Farmers' Fields at Hathras District of Uttar Pradesh

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Brijal (*Solanum melongia* L.) is an important vegetable crop of India. India is a leading producer in the world and during 2018-19 the country produced 12890 lakh tones of from an area of 733 lakh hectares. Brinjal is cultivated in most of the states in India. however a state namely Uttar Pradesh,Punjab,Haryana is also major brinjal producing state in india.The districts of these state contributes 45% to production of total production .India produces 30% brinjal of the world production. In general, average productivity of brinjal continues to low (45 t/h) mainly due to heavy infestation of shoot and fruit borer. The shoot and fruit borer is the most destructive pest of brinjal. This result in total loss of affected production and quality of brinjal.Therefore, present study was under taken to assess the technology for management of shoot and fruit borer management. On farm trial were conducted at 25 farmer's field to assess the shoot and fruit borer management technologies comprising summer ploughing+neem cake 550kg/ha+soil application of carbofuran 1 kg *a.i*. at the time of transplanting around the base of the plant improved (variety Pusa Puple Long)+ selection of good seed+seed treatment(Imidacloprid 17.8 sl@3 ml/lit. of water)+3 drenching (carbofuran @3 ml/lit of water during kharif season of 2017-18 and 2018-19 in clay irrigated condition. Need based spray of animal origin insecticides cartap hydrochloride @500gm *a.i.*/ha.conducing with reproduction phase. The incidence of shoot and fruit borer was recorded only 12.57 per cent under integrated pest management as against 45.47 per cent recorded under farmers practices. The production of brinjal under integrated pest management technologies' ranged between 45.25 to 55.5 t/ha with mean yield of 50.37 t/ha as against a yield range between 30.23 to 40.35 t/ha with mean of 35.29 t/ha under farmers practice. The additional yield under integrated pest management technologies over local practice ranged from 15.02 to 30.15 with mean of 15.02 t/ha. In comparison to local check, there was an increase to 41.5, 30.24 and 35 per cent in production of brinjal under improved technologies in respective years. The higher productivity might due to effective management of shoot

and fruit borer of brinjal. The higher yield obtained under improved technologies as compared to local check due to effective management of shoot and fruit borer of brinjal.

9.2.12 Production and Management of Quality Planting of Fruits

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9.2.13 Screening of Promising Germplasm of Vegetable Pea Against Major Insect Pests

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Among twenty vegetable germplasm screened leaf miner, aphid and pod borer were screened as major insect pests. The population of leaf miner and aphid were observed 20 DAS while pod borer at 50 per cent of flowering till harvesting of the crop which ranged in leaf miner, aphid and pod borer from 12.2 to 23.4, 15.5 to 20.8 and 0.2 to 2.40/5 plant, respectively. Fifteen out of twenty germplasm screened against leaf miner fell under resistant category while five germplasm were found moderately resistant. All the twenty germplasm screened against aphid fell under moderately resistant category. Maximum pod borer population of 2.40/ 5 plant was found in germplasm KS 237 while lowest population of 0.20/ plant was recorded in germplasm KS 185, KS 231 and KS 240.

9.2.14 Impact of Climate Change on Potato Cultivars Against Late Blight Disease in Subtropical Plains of India

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Potato (*Solanum tuberosum* L.) is an important vegetable crop in India and world. This crop is affected by various diseases, among them late blight of potato is the most threatening for cultivation of potato. It may causes up to 85% yield loss under severe conditions. The late blight disease caused by *Phytophthora infestans* (Mont) de Bary, is a climate driven disease. As fluctuations of weather factors are being changed day by day or in long term climate change are being observed. Potato cultivar how would respond in climate change condition with their resistance/susceptibility against *P. infestans*. Whether resistance level of the cultivars would enhance or break down due to climate change. Three back

grounds of potato cultivars 2 susceptible (Kufri Bahar & K. Sindhuri), three moderately resistant (K. Mohan, K.Garima and K Chipsona I) and two highly resistant (K. Girdhari and K. Himalini) were evaluated at three dates of planting (17 Oct, 2 Nov & 17 Nov) during four consecutive years (2017-21). The results revealed that these three sets of varieties showed different level of AUDPC (Area Under Disease Progress Curve) and rAUDPC (relative AUDPC) in three dates of planting and among the varieties. On the basis of mean AUDPC, maximum AUDPC was recorded on 2 Nov date of planting (985.73 on K. Bahar) followed by 17 Nov (871.96 on K. Bahar). Minimum AUDPC was recorded (802.25 on K. Bahar) on 17 Oct date of planting. Under lab study, by detached leaf method mean lesion area of the four years (2017-21), indicated that maximum lesion area was observed on the 2 Nov, date of planting except K.Garima and K. Himalini on 17 Oct date of planting. It was also observed that highly resistant cv K Himalini showed more AUDPC than the moderately resistant cvs. These variations in AUDPC may be due to genetic makeup of the varieties and environmental condition existed during different dates of planting. It may be said that at higher temperature & rain fall, different level of resistance varieties will behave different ways against *P. infestans*.

9.2.15 The Management of Common Scab Disease of Potato (*Solanumtuberosum*. L) in Central U.P.

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An experiment was conducted at the Vegetable Research farm of Chandra Shekhar Azad University of Agriculture & Technology Kalyanpur, Kanpur with five replications and four treatments viz,T_1 (Control), T_2 (Tuber dip treatment with 3% boric acid for 20 minutes before storage), T_3(Tuber treatment with *Trichoderma* formulation (8g/kg seed) at the time of planting), T_4 (Tuber dip treatment with 3% boric acid for 20 minutes before storage and tuber treatment with *Trichoderma* formulation (8g/kg seed) at the time of planting)for the control of common scab disease of potato in central plain zone of UP during last two years 2019-20 and 2020-21. Percent disease incidence (number of tubers infected by common scab) and Percent disease index (tuber surface area covered by common scab)were calculated following standard procedure was recorded at time of harvesting. All treatments significantly reduced common scab severity (3.0 to 5.0%) compared to 7.4% observed in control. The treatment T_4 was the best, resulting in minimum severity (3.0%) followed by treatment T_2 (4.6%). The Number of infected tubers by common scab in treatment T_4 (3.80%) was minimum followed by treatment T_2 (4.6%) and highly infected tubers in T_1(Control 13.2%).Ttuber surface area covered by common scab was minimum in treatment T_4 (3.0%) and maximum in control (7.4%).

9.2.16 Application of Silver Nanoparticles for the Management of Fusarium Wilt of Tomato Caused by *Fusarium oxysporum* f. sp. *lycopersici*

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Tomato (*Lycopersicon esculentum* Mill.) is the world's most important vegetable crop and is known as protective but productive food both because of its high nutritional value and also of its wide spread production. It is the second most consumed vegetable in the world. Fusarium Wilt of Tomato Caused by *Fusarium oxysporum* f. sp. *lycopersici* is one of the most important limiting factors for tomato production, its management being strongly dependent on agro-chemicals, but existing plant disease management relies predominantly on toxic pesticides that are potentially harmful to human being and the environment. Nanoparticles are materials that range between 10 to 100 nanometers (nm), it's have the potential to be directly applied as seed treatment, spray on foliage, or roots for protection against several pest and pathogens, such as fungi, bacteria, viruses and insects *etc*. On the account of eco-friendly in nature, to evaluated the possibilities of using silver nanoparticles instead of commercial pesticides. Usually, to evaluate the effect of silver nanoparticles against Fusarium wilt of tomato disease causing pathogen at four various concentrations 50 ppm, 100 ppm, 150 ppm and 200 ppm to determined antifungal activities *In-vitro* and *in-vivo* condition. The application of 200 ppm concentration of silver nanoparticles produced maximum inhibition rate on radial mycelial growth as well as conidial germination as compare to control under *In-vitro* condition. Under field condition, seedling treated with 200 ppm concentration of silver nano-particles were reduced highest disease incidence level of Fusarium wilt of tomato and least incidence reduced seedling treated with 50 ppm concentration of silver nano-particles. The highest antifungal activities were observed in the case of treatment with 200 ppm silver nanoparticles in *In-vivo* condition and same concentration of silver nanoparticles under *In-vitro* condition. Therefore, the results clearly demonstrated that the silver nanoparticles have the effective potential to inhibit their normal vegetative growth and conidia germination of the fungal pathogen *Fusarium oxysporum* f. sp. *lycopersici* in field conditions as well as under controlled environment condition.

Keywords: Nanoparticles, Fusarium, agro-chemicals, mycelial, incidence and conidia *etc*.

9.2.17 Comparable Study on Coloured Sticky Traps for Onion thrips

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The experiment was carried out to find out the efficacy of different colour sticky traps of onion thrips. Thrips attack on onion was observed at all the stages during crop cycle but their count increases from bulb initiation and remain high up to bulb development and maturity. Both nymphs and adults cause damage directly and indirectly through the transmission of lethal plant viruses. Preference of insects

towards specific colour is a much known phenomenon. Most often yellow colored sticky traps are used to trap aphids and whiteflies. Onion growers faces miserable problem of thrips infestation around the year. There is virtually no effective alternative to tackle the menacing effects of thrips in onion. To understand the preference of colour by the onion thrips study was conducted using yellow and blue sticky trap during *rabi* 2019-20 and 2020-21 on onion variety NHRDF Red at RRS, National Horticultural Research and Development Foundation (NHRDF), Karnal, Haryana (India) with E $76^0$56'46" and N $29^0$44'55". The experiment was arranged of 10 treatments with 3 replications in Randomized Block Design and plot size 10 m^2 each plot should have an isolation of two meters and sticky trap would be changed after 10 days interval**.** The thrips population count on sticky trap was counted with the help of hand lance 10 days intervals before change of sticky trap. Result showed that over all highest thrips stuck on the sticky traps (11.53thrips) were recorded in treatment (4 No. yellow sticky trap). The overall average lowest thrips population (3.43nyphs/plant) was recorded in treatment (Standard check spray of insecticide Fipronil 1.0ml/L). The highest gross yield (359.45q/ha) and marketable yield (348.25q/ha) was recorded with standard check (B:C:9.06:1) was negative in all sticky trap treatments due to their cost. Significantly highest thrips population and lowest yield was recorded in control treatment. The sticky traps only effective for monitoring of thrips population in onion crops and not for management of thrips.

9.2.18 Management of Sclerotinia Blight of Brinjal

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Sclerotinia blight of brinjal caused by *Sclerotinia sclerotorum* is an important disease which causes loss in quality and quantity brinjal fruits. The present investigation entitled "Management of Sclerotinia blight of Brinjal" was carried out in the Department of Plant Pathology and at the Student's Instructional Farm (SIF), College of Agriculture, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P) during 2019-2020. Typical disease symptoms appears as circular to elongated water soaked lesions closer to the inflorescence followed by watery soft rot appearance. Seven days after last spraying, plant disease severity was recorded in all the treatments and calculated the disease reduction in each treatment, per cent disease control. All recommended agronomical practices were followed. Effects of 7 treatment *viz.,* T_1- *Trichoderma harzianum* (0.4%), T_2- *Pseudomonas fluorescens* (0.5%), T_3- Carbendazim 50 WP (0.1%), T_4- Inter cropping with Fenugreek, T_5-Neem leaf mulching, T_6- Foliar Spray with Panchgabya, T_7- Control (Untreated) was measured against Sclerotinia blight of brinjal. All the treatment were found significantly superior to untreated check. The result shows minimum per cent disease severity 9.50% in Carbendazim-50 WP (0.1%) followed by 11.99 % in *Trichoderma harzianum* (0.4%), *Pseudomonas fluorescens* (0.5%) with (14.88%), and maximum (26.25%) disease severity was found T_7 (control).

9.2.19 Efficacy of Some Plant Extract Against Banana PseudostemWeevil, *Odoiporus longicollis* Oliver

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Banana is one of the most popular fruit crops cultivated throughout the world. In India, banana ranks first in production and third in area among fruit crops. It accounts for 13 per cent of the total area and 33 per cent of the production of fruits. Banana pseudo stem weevil, *Odoiporus longicollis* is considered as a predominant and also a major constraint for the production of banana on worldwide basis, especially in India. A preliminary investigation was carried out in Post graduate laboratory, Department of Entomology, Assam Agricultural University, Jorhat during the year 2019-20 to determine the LC_{50} values of plant extracts *viz. Xanthium strumarium*, *Lantana camara, Clerodendron infortunatum, Melia azaderach* and *Azadirachta indica* along with imidacloprid as standard check. In case of Solvent plant leaf extracts, the LC_{50}values of *X. strumarium* was found to be 32.507, 30.19 and 21.082, for *L. camara* it is 14.454, 11.65 and 9.741 % after 24, 48 and 72 hours after treatment. In case of aqueous plant leaf extracts, LC_{50} values were found to be 75.881, 58.708 and 39.02 % in case of *X. strumarium*. Similarly, *L. camara* showcased 21.863, 17.829 and 15.791 %.. Based on LC_{50} values, order of toxicity was Imidacloprid > *Lantana camara* > *Azadirachta indica* > *Clerodendron infortunatum* > *Melia azaderach* > *Xanthium strumarium* in case of both aqueous and solvent leaf extracts.

Keywords: Banana, *Odoiporus longicollis,* LC_{50}, solvent extract, aqueous extract

9.2.20 SeasonalAbundance of Banana Leaf and Fruit Scarring Beetle (*Basilepta subcostatum*, Jacoby)

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An extensive study was carried out in the Horticulture Experimental Farm, Assam Agricultural University, Jorhat during May, 2020 to April, 2021 to assess the abundance of leaf and fruit scarring beetle, *Basilepta subcostatum* Jacobyassociated with banana on a weekly basis on the variety *Dwarf Cavendish* locally known as *Jahaji*. The beetle population was co-related with different meteorological parameters *viz*., maximum and minimum temperatures (^{0}C), morning and evening relative humidity(%) and total rainfall(mm). The mean beetle population was highest during August, 2020 (52.51 beetles/plant) when the maximum temperature was 32.2^{o}C, minimum temperature 24.9^{o}C, morning relative humidity 97%, evening relative humidity 85% and rainfall 12 mm and the least was during January, 2021(5.62 beetles/ plant) when the maximum temperature was 24.6^{o}C, minimum temperature 15.2^{o}C, morning relative humidity 98%, evening relative humidity 92% and with no rainfall. The population of the beetle showed positive and significant correlation with various meteorological parameters *viz*. maximum and minimum temperatures, evening relative humidity, total rainfall except morning relative humidity where it showed negative correlation. Multiple regression analysis of the beetle population with different meteorological factors showed 85.5 per cent shift in population due to the combined effect of various meteorological parameters.

Keywords: beetle ,*Basilepta subcostatum,* population, meteorological parameters

9.3 Poster Presentation

9.3.1 Studies on Host Preference of Pulse Beetle, *Callosobruchus chinensis* L. and its Ecofriendly Management

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The present investigations under the title **"Studies on host preference of pulse beetle (*Callosobruchus chinensis* L.) and its eco-friendly management"** were conducted during 2019-20 in the Department of Entomology and Seed Technology Section (Seed entomology) laboratory, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, during 2019-20. The host preference studies on different five pulses namely cowpea, pigeonpea, chickpea, kidney bean and kabuli chana of *C. chinensis* were made under laboratory condition showed that cowpea and chickpea were most preferred host with developmental period: 27.8 and 31 days; adult emergence percent: 92.5 and 85; fecundity: 92.25 and 74.4; seed damage percent: 95.33 and 93.30; and weight loss percent 41.60 and 39.89 respectively. In kidney bean egg laying occur but there is no emergence of adult may be due to hard seed coat. In case of eco-friendly management highest germination, lowest seed damage and weight loss was observed in seed treated with Neemazol (Azadirachtin 1% EC) @ 5ml kg $^{-1}$ seed followed by Neem oil @5 ml kg $^{-1}$ seed ,Custard apple leaves powder @5 gm kg $^{-1}$ seed, Castor oil @5 ml kg $^{-1}$ seed, Coconut oil @5 ml kg $^{-1}$ seed and Tobacco leaves powder @5 gm kg $^{-1}$ seed as compared to Check (Deltamethrin 2.8 EC (check) @ 0.04ml kg $^{-1}$ seed). Per cent seed moisture was depends on nature of seed protectants and storage period. Thus seed protectants Neemazol (Azadirachtin 1% EC) may be used to protect the pigeonpea seed from bruchids (*C. chinensis*) for long period under ambient condition.

Keywords- Screening of pulses, *Callosobruchus chinenesis* L., management with botanicals

9.3.2 Studies of the Infestation Caused by Mustard Aphid, *Lipaphis erysimi* Kalt. and Mustard Sawfly, *Athalia lugens proxima* Klug. and their Safer Management on Mustard, *Brassica campestris* L.

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A study was made in the year 2017-18 to observe the seasonal abundance of important insect- pests of mustard crop *i.e,* mustard aphid, *Lipaphis erysimi* Kalt.,and mustard sawfly, *Athalia lugens proxima* Klug. and their safer management. L. *erysimi* appeared on mustard crop during Ist week of January and reached at it's peak during IIIrd week of February and continued till the end of March. Its abundance of population and infestation were found to be significantly positive association with environmental factor

(R = 0.5686). The mustard aphid, *Lipaphis erysimi* Kalt. infestation was ranged from 18.43 to 73.00 adult per plant from Ist week of January to IVth week of March. The environmental factors were negatively associated with the incidence and infestation of insect pest. The infestation of mustard sawfly A. *lugens proxima* was varying 1 to 2.36 larvae/plant during IInd week of December to IVth week of January. The effect of environmental factor on this insect pest population and infestation is highly significant positive association during the crop growing season. These insect pests were observed as the pest of regular Occurrence in this region. Thy can effectively be managed with the use of any one insecticide *i.e.,* imidacloprid 17.8 SL @0.25 ml/lit. or acetamiprid S @ 0.15 ml/lit or dimethoate 30 EC @ 1 ml/lit solution spray with two sprayings at fortnightly intervals.

Keywords- Mustard, *Lipaphis erysimi* Kalt., *Athalia lugens proxima* Klug., Safer management

9.3.3 Evaluation of Newer Insecticides Against Major Insect Pests viz- Yellow Stem Borer, *Scripophaga incertulas* walk., Green Leaf Hopper, *Nephotettix virescens* Dist. Gundhi Bug, *Leptocorisa acuta* Thon. and Rice leaf Folder, *Cnaphalocrocis medinalis* Gn. and their Effective Management on Rice

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An investigation was carried out to Evaluation of newer insecticides against major insect pests, yellow stem borer, *Scripophaga incertulas* Walkar, green leaf hopper, *Nephotettix virescens* Distant, gundhi bug, *Leptocorisa acuta* Thonberg and rice leaf folder, *Cnaphalocrocis medinalis* Guenee for their effective management on of rice (*Oryza sativa* Linn.) was conducted during kharif 2017. Rice variety Pusa Basmati 01 was transplanted at SIF farm department of Agronomy Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. Rice crop was infested by many noxious insect but the infestation of four important insect pest rice Viz. yellow stem borer, *Scripophoga incertulas* Walkar green leaf hopper, *Nephotettix virescens* Distant, gundhi bug, *Leptocorisa acuta* Thonberg and rice leaf folder, *Cnaphalocrocis medinalis* Guenee, were studied during Kharif 2017. Efficacy of insecticides (chlorpyriphos 20 EC, fipronil, imidacloprid, spinosad) one botanical pesticide (neemarin 1500 ppm) and one biopesticide dipel 8L. (B.t.) were and all the treatments were found significantly effective in reducing the infestation of major insect pest of rice and increasing the yield comparison to control. Application of imidacloprid was the most effective in reducing the major insect pest's infestation at all the observational interval resulting highest grain yield (28.20 q/ha). which was closely followed by fipronil and chloropyriphos, spinosad, neemarin and dipel (B.t.).

Keywords: Newer insecticides, Insect pest complex of rice, Management

9.3.4 Development of IPM Module for the Management of Major Insect Pests of Sesame

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IPM module T4 (Seed treatment with imidacloprid @ 5g/kg seed with spraying (30 DAS) of profenofos and second spraying (45 DAS) of neem based commercial formulation recorded lowest population of shoot webber*, Antigastra catalaunalis* (0.19 larva/ plant, leaf hopper (0.17 hopper/ plant) and phyllody incidence (1.0 per cent) with minimum capsule damage and maximum seed yield 8.69 q/ha with B:C ratio (2.41) followed by T5 (seed treatment with imidacloprid 600 FS (5g/kg seed with spraying (30 DAS) of neem based commercial formulation and second spraying (45 DAS) of profenofos @ 2ml/litre.

9.3.5 Flowering, Fruiting, Yield and Quality Parameters of Papaya as ipInfluenced by Integrated Nutrient Management

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Papaya (*Carica papaya* L.), a member of family Caricaceae, is a fast growing, typically single-hollow stemmed, herbaceous, evergreen, dicotyledonous, perennial plant. It is a cheap and rich source of vitamins and minerals in the daily diet of millions of people. The ripe papaya fruits are also used in the preparation of different value-added products such as syrup, jam, jelly, nectar, soft drinks, candy, ice-cream, flavouring crystallized fruit, dehydrated flakes and baby foods etc. Papaya has a wide range of adaptability and high economic returns per unit area.

INM or integrated nutrient supply system in papaya refers to the maintenance of soil fertility and plant nutrient supply chain to an optimum level for sustaining the desired crop productivity and fruit quality through optimization of benefits from all possible sources in an integrated manner. Organic manures mostly enhance the nutrient availability in order to improve the soil structure, texture, tilth and better environment for root development and aeration. Bio-fertilizers like *Azotobacter* and *Phosphate Solubilising Bacteria* (PSB) results an increased availability of nitrogen and phosphorus nutrients in the soil.

An experiment was carried out in the Department of Horticulture, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.), India, using eighteen treatments comprising *Azotobacter*, PSB and vermicompost with graded dose of RDF including one control, replicated thrice in randomized block design on Sapna cultivar. Plants were planted on 20th March at a spacing of 2.0 x 2.0 m. The data of experiment clearly shows that during both years of experimentation significantly lesser number of nodes (25.87 and 25.79, respectively) and days taken to first flowering (85.33 and 87.78 days, respectively), fruit developmental period (140.25 and 141.37 days, respectively) with reduced fruit drop (48.32 and 47.23 %, respectively) and maximum fruit retention (51.33 and 51.33 %, respectively) with higher fruit yield (63.76 kg, respectively), fruit weight (1460.00 and 1379.66 g, respectively) and

volume (1385.00 and 1310.75 cc, respectively) were recorded in the plants which were fertilized with RDF 75% + *Azotobacter* 100 g + PSB 100 g + vermicompost 2 kg/plant, whereas uninoculated plants results in higher number of nodes to first flowering (34.89 and 34.84, respectively) along with more days (122.67 and 124.35 days, respectively) taken for the appearance of first flower, took maximum fruit developmental period (164.00 and 163.26 days, respectively), results maximum fruit drop per cent (63.90 and 63.10 %, respectively) and minimum fruit retention per cent (36.10 and 36.90 %, respectively) along with minimum yield of fruits (22.34 and 23.49 kg, respectively) which are lighter in weight (700.26 and 795.36 g, respectively) and volume (695.20 and 740.37 cc, respectively) during both years of experimentation.

As quality parameters of fruits are concerned fruits having maximum pulp per cent (86.66 and 85.14%, respectively), total soluble solids (13.95 and 14.00 ^{0}Brix, respectively) and total sugars (7.85 and 7.86 %, respectively) contents and minimum peel per cent (9.78 and 9.85 %, respectively), titratable acidity (0.101 and 0.102 %, respectively) contents were recorded in fruits which were produced from the plants fertilized with RDF 75% + *Azotobacter* 100 g + PSB 100 g + vermicompost 2 kg/plant, whereas uninoculated plants results in minimum pulp (75.69 and 74.90%, respectively) per cent, total soluble solids ((8.98 and 9.01 ^{0}Brix, respectively) and total sugar (7.85 and 7.86%, respectively) contents and maximum peel per cent (21.34 and 20.79 %, respectively), higher titratable acidity (0.198 and 0.197 %, respectively) contents during both years of experimentation**.**

Keywords: Papaya, Integrated Nutrient Management, Flowering, Fruiting, Yield and Quality parameters.

9.3.6 Integrated Disease Management of Leaf Curl Virus of Chilli on Farmers' Fields of Hathras District

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Chilli leaf curl virus and low yield potential diseases susceptible varieties, indiscriminate use of insecticides for leaf curl virus management are the major limiting factors, which cause substantial yield loss in chilli. Present investigation on resistant varieties having higher potential with integrated disease management proven technologies reveled that chilli higher yield could be achieved by adopting these technologies. Among the technologies, the highest yield and net return and less leaf curl virus incidence was found in technology-3, Kashi Early+ raise Marigold (tall African variety golden age bearing yellow and orange flowers) nursery 15-20 days before chilli nursery+ One week after germination of seeds, spray the seedlings with (Imidacloprid 200 SL @ 0.3 ml/l or Thiomethoxam 25 WP @ 0.3 g/l)+Apply Neem cake 250 kg/ha ridges at the time of preparing land+ Dip the roots of seedlings (do not dip the foliage as it may cause burning of leaves) with Imidacloprid 200 SL @ 0.3 ml/l or Thiomethoxam 25 WP @ 0.3 g/l for 5 minutes. Fifteen days after planting spray Imidacloprid 200 SL @ 0.4ml/l or Thiomethoxam 25 WP @ 0.3g/l for leaf curl vector (whitefly) control+ Destroy leaf curl and other virus affected plants as soon as the symptoms appear in a few plants to minimize their spread followed by technology-2 as compared to farmers' practices.

Keywords: Chilli, leaf curl disease, on farm research, insecticides

9.3.7 Relative Abundance of Natural Enemies in Rice Eco System

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The relative abundance of natural enemies with interaction effects were studied at three growth stages of irrigated Basmati Rice at NDUA&T Kumarganj Ayodhaya. during July to November, 2015 & 2016. Several different natural enemies were collected from the rice fields and recorded. The population of natural enemies was highest in tillering stage and lowest in seedling stage. The relative abundance of natural enemies as coccinelid (adults and grubs) >long jawed spider>wolf spider>damselfly>carabid beetle>green mirid bug>lynx spider>dragon fly>ear wig> ground beetle> *Trichogramma* spp. Populations of all natural enemies were like ladybird beetle, wolf spider, long jawed spider, lynx spider, damsel fly, dragon fly, green mirid bug, carabid beetle and earwig in good numbers.

Keywords: Natural enemies; Relative abundance; Rice ecosystem

9.3.8 Management of Potato Black Scurf

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Rhizoctonia disease of potato (*Solanum tuberosum* L.) is caused by *Rhizoctonia solani*, also infect potato stems. The pathogen is widespread in all potato growing countries around the world (Anderson, 1982; Powelson et al., 1993; Jeger et al., 1996). In recent years, it has become the most important potato disease in District Hardoi, resulting in considerable economic losses. The typical disease symptoms include death of pre-emerging sprouts, cankers on underground stem parts and stolons, diminished root systems, and sclerotia formation on progeny tubers (typical black scurf symptoms). Field experiments showed that *Trichoderma harzianum* and FYM amendment applied in furrow could reduce black scurf incidence in organically grown potatoes. Incorporation of *T. harzianum* applied to the soil surface had a relatively small effect compared to the in-furrow treatment. Application of two isolates i.e. *T. harzianum* 1.0% WP local made (Hardoi) and *T. harzianum* 1.0% WP (Strain No. IIHR-TH-2 Accessions No. ITCC 6888 significantly reduced the incidence of infected tubers in field experiments. Hence, treatments significantly reduced disease incidence and severity thus total yield was unaffected. *T. harzianum* local made (Hardoi) and *T. harzianum* 1.0% WP (Strain No. IIHR-TH-2 Accessions No. ITCC 6888 reduced the incidence of black scurf on daughter tubers the demonstration was conducted on naturally infested soil and contaminated seed tubers.

9.3.9 Role Bio-agents in Integrated Pest Management

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Several numbers of bio-agents such as predator, parasitoid, fungi, bacteria, virus predacious nematodes, protozoan, etc. are reported for managing the insect-pests' populations. A number of exotic parasitoids were also introduced into India between 1970 and 1980. Of these, *Copidosoma koehleri* Blanchard, an exotic egg/larval parasitoid, gave 28.4- 60.8% parasitization in Maharashtra. At Shimla, *Aphelinus* sp has been found to parasitize 100 per cent *M. persicae* under glasshouses conditions Trichogrammalids for bringing out most effective, most affordable and most acceptable technology for farmers to adopt. The spraying of the biopesticide, *Bacillus thuringiensis* gives a good control against many insects**.** Several strains of the bacterium, *Bacillus popilliae*, have been found that attack white grubs. This bacterium is picked up by feeding grubs and it causes the body fluids to turn a milky-white before grub death. Entomogenous fungus, *Metarrhizium anisopliae* Meld is best known fungal control of white grubs. *Beauveria brongniartii* Sacc. is also very effective against white grubs. There are thirteen fungi that are able to infect the cysts, out of which frequency of occurrence was maximum for *Dactylaria* (31.6%) followed by *Aspergillus* spp. (14%), *Humicola grasea* and three other non-sporulating fungi in the frequency range of 7.2 to 1.75%. Entomophilic nematode, *Stinernema* (Neoaplectana) sp. are also well known as dominant regulatory factors for cutworm populations from various parts of the country. A nuclear polyhyedrosis virus on *H. armigera* was recorded during February-March**.**

Keyword: Copidosoma koehleri, Bacillus thuringiensis, Stinernema, Metarrhizium anisopliae

9.3.10 Management of Black Scurf of Potato Caused by *Rhizoctonia solani* Kühn Through Fungicides and Fungal Antagonists at Farmers' Field

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Black scurf of potato caused by *Rhizoctonia solani* Kühn that has been one of the biggest problems of the potato cultivation and is an important disease of potato in the category of soil and tuber borne diseases. It affects roots, stolen, stems and tubers. The disease has two phases, *viz.* stem canker and black scurf. Stem canker phase is the girdling on the stem with brown colour and sometime upward rolling of the leaves also observed. Black scurf phase is formation of sclerotia on the surface of the tubers. A field trial was conducted at tree farmers field of district Aligarh, in this trial, it was aimed to determine the effect of three commercial formulations of *Trichoderma* spp. *i.e. T. harzianum, T. virens*, and *T. viride* and one fungicide Thiram used as seed treatment @2g/litre water and tested against this disease. The bioagents was integrated with FYM in two different doses *i.e.* (i) Mix 1kg of *Trichoderma* spp. formulations in 100 kg of farmyard manure (ii) Mix 2kg of *Trichoderma* spp. formulations in 100 kg and cover it for 7 days with polythene. Sprinkle the heap with water intermittently. Turn the mixture in every 3-4 days interval and then broadcast in the field. Biocontrol efficacy and per cent yield increase

by these antagonists were estimated in this experiment, and results showed that in Seed treatment with Thiram @2g/litre water and soil application of *T. harzianum* @ 2kg with 100 kg FYM were the most effective with 73.9% reduction in disease incidence, as well as 25.50% yield increase and 1:4.20 Benefit cost ratio respectively as compared to farmers practice where no treatment. Soil treatment showed higher efficacy than the Potato seed treatment when both ways (Soil treatment and Seed Treatment) separately used with fungal bioagents and fungicides to manage the black scurf of potato. Seed treatment Thiram @2g/litre water and soil application of *T. virens* were the least effective with 45.9% reduction in disease incidence, and 08.50% increase in tuber yield with lowest Cost Benefit ratio (1:2.5).

9.3.11 Role of Granular Insecticides in the Management of Sucking Pests in Potato (*Solanumtuberosum*. L)

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A field experiment was conducted at Vegetable Research Farm, Kalyanpur, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur during 2020-2021 to study the effect of granular insecticides in the management of potato sucking pest (Aphid, White fly and leaf hopper). The six treatments were arranged in Randomized Block Design (RBD) with 5 replications. Five granular insecticides with untreated control *viz*., T_1 (Cartap hydrochloride 4G @ 20 kg/ha), T_2 (Cartap hydrochloride 4G @ 25 kg/ha), T_3 (Fipronil 0.3 G @ 20 Kg/ha), T_4 (Fipronil 0.3 G @ 25 Kg/ha), T_5 (Phorate 10 G @ 15 kg/ha) and T_6 Control were used at different dosages. Significantly higher per cent reduction in aphid population (35.50 %) and white flies population were recorded in (35.64 %) in the treatment T_2 (Cartap hydrochloride 4G @ 25 kg/ha) at 40 days after planting however leaf hoppers population reduction were obtained (14.20, 19.30 & 13.10%) at 20, 30 and 40 days after planting, respectively in same treatment T_2 (Cartap hydrochloride 4G @ 25kg/ha).

9.3.12 Effect of Sowing Dates and Cultivars on Late Blight Disease and Yield of Potato

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Potato is one of the important vegetable and nutritious sources of food, grown throughout the world. The crop suffers from a number of diseases. Among the fungal diseases, late blight caused by *Phytophthora infestans* is one of the most important diseases of potato. Alternation in sowing dates affects late blight disease in potato and other crops. Therefore, the experiment was conducted at farmer's field in natural conditions to assess the effect of sowing dates on severity of late blight disease and tuber yield of potato. To conduct field trail four farmers selected for each cultivar namely **K. Chipsona-1, K. Mohan, K. Khyati and K. Bahar during 2019-20 and 2020-21.** Crops were planted on five different dates with exact 10days gap from first *viz*. 10 October (first), 20 October (second), 30 October (third), 10

November (fourth) and 20 November (fifth) along with recommended package of practices during both the years. Data on disease severity were recorded at weekly intervals from appearance of the disease up to harvesting. Yield was also recorded in q/ha. The sowing dates had significant effect on late blight disease and yield during the both years. Late blight disease was escaped in sowing date first and second in both years in all cultivars. Maximum disease severity (48.22 and 57.46 percent) was recorded on K. Bahar followed by K. Chipsona-1 (42.85 and 46.95 percent) in sowing date fifth. Minimum disease severity 22.11 and 24.29 percent was recorded in sowing date third in K. Khyati during study period. In case of K. Mohan, disease severity was ranged between 25.11 and 41 .29 percent in sowing date third to fifth during both the testing years. Maximum tuber yield of 306 and 295 q/ha in K. Khyati were recorded in second sowing date during 2019-20 and 2020-21, respectively which was significantly superior to rest of the cultivars. Based on the experiment, it is concluded that the 20 to 30 October sowing time is suitable to higher yield and avoid losses from late blight of potato.

9.3.13 Economics and Fungicidal Management of Phomopsis Blight and Fruit Rot of Brinjal

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Brinjal is an important vegetable crop in India and its production is mainly constrained up to 30 per cent due to the seedling and fruit rot caused by fungus, *Phomopsis vexans*. This disease appears as damping off, tipover and seedling blight in the nursery and fruit rot in the harvesting crop. KVK Aligarh conducted on-farm trial to evolve a suitable management strategy against this pathogen. These trials were conducted at five farmer's fields using five fungicidal treatments *viz.,* Difenoconazole 25 EC (0.1%), Carbendazim 50 WP (0.1%), Propiconazole (0.1%), Carbendazim 12% + Mancozeb 63% WP (Sixer) and Mancozeb 75 WP (0.25%), as compared to farmers practice where indiscriminate use of pesticides after appearance of heavy disease incidence. In this trial brinjal variety "Pusa Purple Long in 3m x 4 m plot size at 50 cm x 60 cm row to row and plant to plant spacing each in completely randomized block design. The results of field test with four fungicides seed treatment with Sixer@ 2g/kg seed + 2 foliar sprays with Carbendazim @ 0.1% recorded least disease intensity (7.50 per cent) and 87.50 percent reduction in disease with highest fruit yield of 220.50 q/ha and registering 31.25 per cent increase in yield over control with cost benefit ratio 1: 5.10. Next best treatment was seed treatment with Sixer @ 2g/kg seed + 2 foliar sprays with Propiconazole recorded 10.10 per cent disease intensity with 201.50 q/ha fruit yield and benefit cost ratio (1:4.80). The maximum per cent disease intensity 38.50 with Lowest percent reduction in disease and minimum fruit yield (181.00 q/ha) and cost benefit ratio (1: 3.80) was recorded in case of Seed treatment with Sixer @ 2g/kg seed + 2 foliar sprays of Mancozeb, when compared with farmers practice where disease intensity (60.10 per cent), fruit yield of (160.35 q/ha) and cost benefit ratio (1: 2.50) were recorded.

9.3.14 Studies on Effectiveness of Different Insecticides for the Control of Shoot and Fruit Borer, *Leucinodes orbonalis* G. on Brinjal

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Brinjal (*Solanam melongena* Linn.) var. Type-3 was grown to studies on effectiveness of different insecticides for the control of brinjal shoot and fruit borer (*Leucinodes orbonalis*) and assessment of yield and cost benefit ratio in the association of various treatment at the insectary, Department of Entomology, C.S. Azad University of Agriculture and Technology, Kanpur during kharif 2017. The effect of various treatments like imidacloprid 17.8 SL @ 1.0 ml/lit., fipronil 5SC @ 1.5 ml/lit., indoxacarb 14.5 SC @1 ml/lit., malathion 50 EC @ 1ml/lit, Spinosad 45 SC @ 0.4 ml/lit, azadirachtin 1500 ppm @ 3 ml/lit. was determined and an untreated control was also maintained to compare with treatment. Imidacloprid 17.8 SI. was found most effective in treatment reducing the infestation of shoot and fruit borer followed by fipronil 5 SC and indoxacarb 14.5 SC, they had also given promising fruit yield *i.e.* 180.35 q/ha, 174.60 q/ha and 166.45 q/ha, respectively and proved most effective insecticide. Imidacloprid may be recommended for effective management of brinjal shoot and fruit borer, *Leucinodes orbonalis* G.. The best incremental cost benefit ratio was obtained with imidacloprid 17.8 SL (1:25) and fipronil 5 SC (1:20).

Keywords: *Leucinodes orbonalis* G*;* Brinjal, Management.

9.3.15 Efficacy of Different Insecticides and Biopesticides against Tomato Fruit Borer (*Helicoverpa armigera* Hubner) on Tomato

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A field study was undertaken at Insectary, Department of Entomology, C.S.A. & T. Kanpur, during Rabi season, to evaluate different insecticides viz. Indoxacarb 14.5SC, Fipronil sosc, Malation 50EC, Imidacloprid 17.8SL and biopesticide viz. Spinosad 45SC and Neemarin 1500 ppm against H. armigera on Tomato crop in comparison with seqrential application of Insecticides *i.e*. Indoxacarb 14.5SC @lml/lit. and Fipronil 5SC @ Im/lit. were found most effective. Results showed that all the insecticide significantly increased the yield of marketable fruits over control. The maximum yield (226.02 q/ha) was recorded in Indoxacarb followed by Fipronil (209.66 q/ha) and Malathion (196.54 q/ha) respectively. The minimum yield was recorded in Neemarin (168.09) q/ha) The best incremental cost benefit ratio was obtained in Indoxacarb 14.5SC (1:27.61) and among biopesticides, Spinosad 45SC (1:9.98).

Keywords: Indoxacarb; Spinosad; *Helicoverpa armigera*; Tomato. 2022-4-11 17:00

9.3.16 Application of ZnO NPs for the Management of Late Blight of Potato Caused by *Phytophthorainfestans*(Mont.) de Barry

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Potato (*SolanumtuberosumLinn*.) is the most important vegetable crop in the world, belonging to the family Solanaceae and considered as "King of Vegetables". It is major source of nutrition and income to many population and communities. The major potato growing countries in the world are China, followed by India (2.173 million hectares area with a production of 50.190 million metric tonnes). In India, potato is extensively cultivated in Uttar Pradesh, West Bengal, Bihar and Madhya Pradesh*etc*.According to National Horticulture Board, the production of potato in Uttar Pradesh for the 2019-2020 fiscal was 14 million tones as against the 15 million tones produce during the corresponding period in 2018-19.Late Blight of Potato caused by *Phytophthorainfestans*(Mont.) de Barryis one of the most important limiting factors for potato production, its management being strongly dependent on commercial fungicides. But existing plant disease management relies predominantly on toxic pesticides that are potentially harmful to human being and the environment.One of the new recent emerging developments the concept of nano-particles(NPs), it comes support to the new search for alternative, non-hazardous, eco-friendly and non-chemical plant disease control strategies.Nanoparticles are materials that range between 10 to 100nanometers (nm), it's have the potential to be directly applied as tuber treatment and spray on foliage for protection against several pathogens, such as fungi, bacteria and viruses *etc*. On the account of eco-friendly in nature, to evaluated the possibilities of using ZnO NPs instead of commercial pesticides. Usually, to evaluate the effect of ZnO NPsagainst Late Blight of Potato disease at various concentrations (75ppm, 100ppm, 125ppm and 150ppm) to determined antifungal activities *In-vitro* and *in-vivo* condition. The application of 150 ppm concentration of ZnONPs produced maximum inhibition rate on radial mycelial growth as well as conidial germination as compare to control under *In-vitro* condition. Under fieldcondition, tuber treated with 150ppm and foliar spray as same concentration of ZnO NPs were reduced highest disease severity of Late Blight of Potatoand least disease severity reduced tuber treated with 75ppm concentration ofZnO NPs. The highest antifungal activities were observed in the case of treatment with 150ppm ZnO NPs in *In-vivo* condition and same concentration of ZnO NPs under *In-vitro* condition. Therefore, the results clearly demonstrated that the ZnO NPs have the effective potential to inhibit their normal vegetative and reproductive growth of the fungal pathogen in field conditions as well as under controlled environment condition.

Keywords: ZnO Nanoparticles (NPs), Potato, *Phytophthorainfestans*, disease severity

9.3.17 Application of Drip fertigation to Guava Trees Enhanced Soil Enzymatic and Microbial Activity in Orchard

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Irrigation water can well enough manipulate the soil-plant root environment and thereby changes the status of soil microbial population including soil enzymatic activities. North India has started facing the water scarcity from the month of November to March which is likely to be extended upto April – May. Therefore, the objective of this field experiment was to standardize the drip irrigation and fertigation doses supplemented with silver-black plastic mulch guava plants orchard. The execution of experiment was confined under randomized block design in which total nineteen treatments were replicated four times referring to NPK fertigation doses 100%, 80% and 60% recommended dose of fertilizers (RDF), drip irrigation (DI) levels (100%, 80%, and 60%) and plastic mulching (with and without silver-black plastic mulching). The results revealed that silver- black plastic mulching significantly increased the fugal as well as bacterial count of the soil, respectively while as minimum was under non mulched plants. Likewise maximum soil dehydrogenase, acidic soil phosphatase, respectively was observed under MDI_2F_1 (i.e. trees which are under mulch, received irrigation at 80% CPE level and 100 % NPK level) treatment while as alkaline soil phosphatase was highest under MDI_2F_2 (i.e. trees which are under mulch, received irrigation at 80% CPE level and 80 % NPK level).

9.3.18 Eco-friendly Management of damping-off, Wilt and Another Soil born Diseases of Vegetable Crops by Bio-char Application in Soil

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Now days, Climate change is threatening food security in worldwide. Several countries facing this problem, India are also more vulnerable in view of the tropical monsoon climate and poor coping capacity most of the small and marginal farmers. Several agricultural practices likes' unrulled, banned and indiscrimination using of agro-chemicals and agricultural crop residue burning contribute to emission of greenhouse gasses (GHGs) leading to warming of the atmospheric climate. One of the new recent emerging developments the concept of bio-char, a carbon containing product derived from some organics and agricultural wastes, it 'comes support to the search for alternative, non-hazardous, eco-friendly and non-chemical plant disease control strategies. Generally, a wide range of bio-char effective against the control of root and foliar fungal pathogens through modification of root exudates and the induction of

plant defence compounds, by bio-char in roots to also reduce foliar disease causing fungi due to the activation of stress hormone responses, and it also changes in active oxygen species are indicative of a coordinated hormonal signalling within the plant. Bio-char promotes changes in the soil microbial population and also influencing on motility, colonization and spore production against soil born disease causing pathogens and also fungi belong to class oomycetes, by the induction of systemic plant defence mechanisms. Since bio-char exert multifaceted and distinct modes of action for the control of plant pathogens. So it's directly contributing to suppression of plant diseases.

Keywords: Bio-char, non-hazardous, damping-off, agro-chemicals and oomycetes *etc*.

9.3.19 Effect of Soil Amendments with Inorganic Chemicals for Reducing the Disease Severity and Incidence of Common Scab of Potato [*Streptomyces scabies* (Thaxter) Waksman and Henrici]

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Potato (*SolanumtuberosumLinn*.) is the most productive vegetable crop in the world's belonging to the family Solanaceae and provides a major source of nutrition, income to many population and communities. When freshly harvested, it contains about 80 percent water and 20 percent dry matter content.IDM practices significantly reduced the disease severity and disease incidence of common scab of potato as compared to control in field condition. Among all the treatments show that the minimum disease incidence of common scab of potato with the value of 7.19 % was recorded in T_4 [Soil amendments with Elemental Sulphur @ 5q/ha + Tuber treatments with *T. harzianum*@ 5gm/kg of tuber+ Foliar spray of Copper Oxychloride with Streptocycline (3:1)] treatment followed by T_5 [Soil amendments with SSP @ 10q/ha + Tuber treatments with *T. harzianum*@ 5gm/kg of tuber+ Foliar spray of Copper Oxychloride with Streptocycline (3:1)]treatmentsshowing with the value of 8.89%, at the time of harvesting. The minimum disease severity of common scab of potato with value 1.64, 5.53, 8.26, and 10.89 % was also recorded at 45, 60, 75 and 90 DAS in T_4treatment, followed by T_5 treatment showing with the value of 2.48, 6.78, 10.52 and 13.13% was recorded at 45, 60, 75 & 90 DAS, respectively.From the results, it is cleared that all IDM practices were able to reduce the disease severity andincidence of common scab over control.

9.3.20 Production Potential of Hookah Tobacco + Vegetable Pea Based Intercropping Systems in U.P.

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A field experiment was conducted for two years during *rabi* 2016-17 to 2018-19 at Tobacco Research Station Araul, C S Azad University of Agriculture and Technology Kanpur (UP) with objective of increasing economic returns per unit area. The experiment comprising of five treatments was laid out in a randomized

block design with four replications. Vegetable pea was intercropped with tobacco (main crop) in additive series @ 1:1, 1:2 and 1:3. The pooled results revealed that plant height, leaf length, leaf width, no. of curable leaves per plant and cured leaf yield significantly influenced with 1:1 row ratio. Tobacco + Vegetable pea in 1:1 row ratio recorded higher values of tobacco cured leaf equivalent yield (44.07 kg / ha), gross return (207129 INR/ ha), net profit (126220 INR/ha) with the cost benefit ratio of 2.56 over the rest of the treatments.

9.3.21 Assessment of Suitable Measure for Management of Fruit and Shoot Borer in Brinjal

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Brinjal fruit & shoot borer **(***LEUCINODES ORBONALIS***)** is a serious pest for brinjal plant. This fruit and shoot borer only infest on all kinds of egg plants or brinjal and it feed internally damaging the tender shoots and fruits. Damage to the plant is caused mainly by the larvae, which bores through the terminal part of the mid rib of large leaves and tender shoots to cause "dead hearts". Later on it also enters into flower buds and fruits. It plugs the entry hole by its excreta. The infested terminal shoots and fruits ultimately drop out. The pest can cause 70 to 100% damage to the crop. The regular pesticides application through sprays may not help in managing the shoot and fruit borer. Highly systemic poisons are generally used to kill the pest which makes the vegetables unsafe to consume. On the other hand insect may develop tolerance to the pesticides and making it difficult to manage..Hence KVK Kanpur Dehat made an attempt to control this deadly pest two traps i.e. Sun agro and PCI Traps with @ 25/ ha + 2 spray of Emamectin Benzoate (5% SG) @ 0.03% have been tested for their efficiency against farmers practice of 10 sprays of Chlorantraniliprole (18.5 SC) @ 0.03%. Results of the study reveal that 12 fruit/ shoot per 5 plants were found affected with PCI Traps + @ 25/ ha + 2 spray of Emamectin Benzoate (5% SG) @ 0.03% with Sun agro Traps + @ 25/ ha + 2 spray of Emamectin Benzoate (5% SG) @ 0.03% only 8 fruit/ shoot per 5 plants were found affected. Since infestation was higher in PCI Traps obviously the yield get affected, 6.6% less yield was recorded with PCI Traps. So it is recommended to farmers to adopt Sun agro Traps + @ 25/ ha + 2 spray of Emamectin Benzoate (5% SG) @ 0.03% for effective control of fruit and shoot borer in brinjal.

TECHNICAL SESSION-10

HUMAN RESOURCE DEVELOPMENT AND DIFFUSION OF KNOWLEDGE FOR TECHNOLOGICAL CHANGES FOR CLIMATE RESILIENT AND SUSTAINABLE DEVELOPMENT OF HORTICULTURE

10.1.1 Strategies Approaches for Knowledge Dissemination to Achieve climate Resilient and Sustainable Horticulture

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10.1.2 Horticulture Based Integrated Farming System for Improving the Profitability of the Farm and Farmer's Income – A CASE study

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Integration of farming components considering the resource budgeting in the existing ecosystem provides a best alternative for overcoming the problems of low remunerative monocropping systems mostly followed by the small and marginal farmers in the country. Adoption of Integrated farming systems by selecting suitable accomodative components based on the agro climatic situation proved to be best solution for low farm income due to mono-cropping, increased pests and diseases, miss match to market demand/price etc. One of the best alternatives for increasing the efficiency of food production system is to use an integrated farming system. The end or by-product of one farming system can be used as raw material to the other farming system. The main goal of an integrated farming system is to maximise yields and sustainability. The term "optimization" refers to lowering the cost of production while also increasing agricultural and animal productivity.KrishiVigyan Kendra, Venkataramannagudemhas intervened in the existing farming situations of tribal mandalsand implemented the Integrated Farming System as per the resources available with the tribal families. IFS system has resulted in the sustainabilityof production with nutritional, economic, employmentand environmental security, alleviating the povertyamong these small and marginal farmers.These IFS systems were effective towards utilisation/ recycling of organic matter from one to other farming situation for achieving higher profitability with reducing cost of production. Better management practices and introduction of improved varieties / breeds has augmented the farm productivity thereby increasing the income, employment throughout the year and improvement in socio-economic status.

Keywords: Integrated farming system, Agriculture, Horticulture, Livestock, fishery, diversified crops

10.1.3 Horticulture for Women Enterprise to Address the Challenges of Women Health

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Women empowerment can be considered a change in the contest of a woman's life that enables increased capacity to lead a fulfilling human life, characterized by external qualities such as health, education and awareness, status in the family participation, in decision making and level of material security as well as internal qualities such as self-awareness and self-confidence (Ackerlay, 1995). Gender equality is, first and foremost, a human right. A woman is entitled to live in dignity and freedom. Empowering women is also an indispensable tool for advancing development and reducing poverty. Empowered women contribute to the health and productivity of whole families and communities and improved prospects for the next generation. The importance of gender equality is underscored by its inclusion as one of the eight Millennium Development Goals. Gender equality is acknowledged as being a key to achieving the other seven goals. Dr. YSR Horticultural University strongly believes the fact that without equal priority to women, cannot achieve the targets and reach the unreached. With a view to address the Educational needs of the rural and tribal women to promote women entrepreneurs Dr.YSRHU is continuously organising in skill development programmes through its Processing and Horticultural Skill Training Centre at KVK, Venkataramannagudem and Citrus Research Station Tirupati. The trainees has successfully adopted the technologies and started Horticultural based enterprises like nutri gardens, terrace gardens, IFS, fruit and vegetable processing, beekeeping, milliet hort productsDry flower technology etc. Not only provided the remunerative employment but also addressing the challenges of mal nutrition and hidden hunger among the vulnerable groups in rural and tribal villages. Linking community nutri garden programme with Anganwadis and Schools has ensured supply of fresh greens and vegetables for their supplementary nutrition programmes and mid-day meal programmes. A total of Three hundred and fifty five women & youth were trained in abover skill modules and started earning their livelihood there by supporting the families and children specially to give good education to the children, health to the family members and improved standards of living in the society. Dr.YSRHU – KVK, Venkataramannagudem intervened tribal women farmer Smt. T. Ramana of Rekulakunta village received ICAR award "Pandit Deen Dayal Upadhyay Anthyodaya Krishi Puraskar-2019" at zonal level for her excellent contribution towards IFS model adoption. Tribal farmers namely Smt.Madakam Venkayamma, Dasiyyapalem village has received "Udyana Ratna Award" for best tribal enterprising women farmer and Smt S. Dhansmma of East Rekulakunta village received IARI innovative farmer award for her contribution in raising Community Nutri Garden with the help of feliw women as a group. With the intervention of KVK, V.R.Gudem Smt.P.Bullemma, tribal women transformed into millet processing entrepreneur and supplying multi grain biscuits to 26 tribal welfare schools under ITDA-K.R.Puram.

10.1.4 Fruit Based Cropping / Farming System for Higher Productivity and Profitability

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10.2 Oral Presentation

10.2.1 Performance of Cucurbitaceous Demonstrations in Central Plain Zone of Uttar Pradesh, India

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Integrated Crop Technology (ICT) based demonstrations were conducted on cucurbitaceous with improved technologies against farmers practices on farmer's fields during 2017-18 and 2018-19 in central plain zone of Uttar Pradesh. The demonstrations were conducted in form of half-field demonstration. Each demonstration had an area of 0.2 ha, in which half area (0.1 ha) was kept under conventional system and rest half (0.1 ha) under improved techniques of crop production demonstrated side-by-side. Under improved techniques, integrated crop technologies approach was demonstrated included interventions *viz.*, use of improved variety with optimum seed rate, optimum plant stand, optimum dose of fertilizer application, use of plant growth regulator and proper weed management. Under conventional system, farmers used old varieties with high seed rate, without seed treatment, imbalance use of fertilizer application, without plant growth regulator and no proper weed control. The demonstrations were conducted on bottle gourd (30), bitter gourd (28) and cucumber (35). The results showed that improved techniques increased yield over farmers practices by the margins of 130.16 q/ha or 52.43 % in bottle gourd, 45.64 q/ha or 38.87 % in bitter gourd and 77.58 q/ha or 68.93 % in cucumber. Net profit of Rs. 81,788.0/ha in bottle gourd and Rs. 53,512.0/ha in bitter gourd realized by farmers. Lowest of Rs. 35,204.5/ha net profit was increased in cucumber. There was wide technology gap, which need to bridge by promoting the scientific production and protection technologies of cucurbitaceous crops in central plain zone of Uttar Pradesh.

10.2.2 Feasibility of D*esi* Poultry Farming in Litchi, Mango and Apple Orchard

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Under free range farming, the animals, for at least part of the day, can roam freely outdoors, rather than being confined in an enclosure for 24 hours each day. In Bihar and Uttar Pradesh the residents rear *desi*

birds under backyards under confined and restricted spaces. We can integrate horticulture (fruit cropping) with poultry and earn the benefit of rearing chicks under free ranges under these fruit crops. The high density planting in litchi (4.5 x 4.5m) and after revitalization of rejuvenated block with proper canopy management where *desi* chicks (4-6 weeks old) of *Vanaraja*, *Shipra* and *Kadaknath* were released in the orchard and after achieving body weight of 1.5 kg the adult chicks were sold and fresh batches were provided after 2 month of initial batch and the cycles were continued. The available N per ha was enhanced to 294 kg per ha (against 200 kg per ha), likewise P_2O_5 content improved to 13.71 kg per ha (against 9.14 kg per ha) and soil content of K as also increased to 116 kg per ha (against 83.00 kg per ha) after six month of intervention. The level of leaf webber infestation is reduced to 50 %, red weevil to 9.75 % against 11.11 % in normal orchard. The September month onward, the survival rate is higher (>70 %) in comparison to June (63.15 %). The survival percentage is highest in *Vanaraja* followed by *Kadaknath* and *Shipra.* 10-20 % of feed can be replaced with crushed seeds of litchi and its dried peel. Due to Ca deficiency the shell thickness of egg was reduced by 50 % which was compensated with mixing (5 %) crushed snail shell in the feed. The fruit yield and size was also improved.

In mango orchard certain bird strains such as *Kadaknath* exhibited high flight and fed on hoppers and *leaf webber* insect situated on upper canopy of mango and litchi, there is reduced weed population, owing to integration of *desi* poultry. Each bird in a mango orchard used to supplement 45 kg manure in the form of droppings in its entire life cycle. Orchard having flock size of 500 birds gets around 225 quintal of poultry manure. The mango orchardists have realized the net returns of Rs. 1.72 lakhs per acre by integrating *desi* poultry in mango orchard which was higher in comparison to non integrated orchards (Rs. 0.12 lakhs per acre).

In the orchard of apple, the *Vanaraja* birds have shown tremendous performance in Kashmir valley fields and have raised hope of transforming the economy of rural Kashmir. 300-500 *Vanraja* birds of one moth old can be released in 0.5 ha of apple orchard. Now apple orchardists are satisfied with the concept and there is increased demand for the birds to be reared under this innovative concept. The net profit/ha/year with rearing 400 birds in apple orchard was recorded upto Rs. 1,01,850. Therefore, the land of litchi, mango and apple if exploited for integrated farming will yield better profitably. With this backdrop the rearing of high technology birds in orchards can be thought of.

10.2.3 Knowledge and Attitude of Farmers towards Organic Farming: A Study of Aligarh District of Uttar Pradesh

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Prolonged and over-application of chemical fertilizers and pesticides in farming have started showing hazardous effects on soil, water, human health and on environment. Increasing cost of cultivation, stagnation in productivity, deterioration in soil health and degradation in the quality of human food are the side effects of modern agricultural practices. To address these issues, at present organic farming is being promoted as a way of balancing nature with human needs, predominantly for conserving natural resources and avoiding the negative effects of indiscriminate use of inputs in agriculture. For policymakers

and managers, organic farming is about making better earth for sustained living, for the consumer it is about health and wellness while for farmers sustaining the family and maximising farm income are the primary concerns. In this situation, farmers' knowledge about organic farming practices and attitude toward organic farming will play a vital role in accelerating the adoption of organic farming practices. Keeping these facts in view present study was conducted in Aligarh district of Uttar Pradesh to assess the knowledge level of farmers about organic farming and their attitude towards it. For assessing the farmers' attitude towards organic farming a 5 point Likert scale was used and to assess the knowledge level a test was developed based on the package of practices for organic farming. Based on the finding of the study the present paper discusses an extension strategy for promoting organic farming in District Aligarh in particular and in similar areas in general.

10.2.4 Message Designing for Agricultural Information Sharing through Social Media

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As per an estimate average public extension services only reach 6.8 per cent of farmers. Another survey indicated that of the 40.6 per cent of households who received extension assistance, only 11 per cent of the services came from physical government machinery extension agents, Krishi Vigyan Kendras and agricultural universities. Information and Communication Technologies (ICTs) mediated extension has the potential of minimizing this gap. ICTs are reviving agricultural extension and advisory services around the world. In the present scenario, social media has emerged as a powerful tool for information sharing. Social media are web-based tools of electronic communication that allow users to personally and informally interact, create, share, retrieve, and exchange information and ideas in any form (text, pictures, video, etc.) that can be discussed upon, archived, and used by anyone in virtual communities and network. There is a vast diversity in the social, cultural and farming situation of the farmers of India. A single message cannot cater the information need of all the farmers. There is a need to keep in view the socio-psychological and agro-ecological profile of the farmers before designing messages on farm advisory. The first step in designing the message is situation analysis. First of all extension agent must analyse the situation of the farming community with whom he/ she is going to share the farm advisory. Tools like Participatory Rural Appraisal (PRA), Focused Group Discussion (FGD), In-depth Interviews etc. can be used for situation analysis. After analyzing the situation extension agent must identify the best suitable and available technology to address the problem or information need of the particular farming community. The next step is to give the most preferred treatment to the message identified for sharing through social media. There is a need for pre-testing the message before sharing it. After sharing the message through social media, the next step is assessing the overall effectiveness of the message. In this way, we can harness the full potential of social media for sharing farm advisories with the farmers. The present paper discusses in detail the procedure for message designing for agricultural information sharing through social media.

10.2.5 On-Farm Crop Response to Plant Nutrients in Predominant Cropping Systems and their Impact on Crop-livestock-Human Continuum.

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A filed study was conducted during 2018-19 and 2019-20 on farmers filed under on-farm research at Tharion, Fatehpur to assess the response of major crop to nutrients in predominant cropping system in central plain zone of U.P. The experiment was executed in Randomized block design with seven treatments i.e. (1) control (2) N, N (3) N P, N P_6 (4) N K , N K (5) N P_6K, N P_6K_4 (6) N P_6K_4+ ZnS, N P_6K_4 (7) Farmers' practice. All the treatment were tested at 24 farmers field at different locations. The study results of both the years revelled that highest yield of paddy, wheat and system productivity was recorded with 150 kg N + 60 kg P_2O_5 + 40 kg K_2O + 25 kg $ZnSO_4$ in paddy and 120 kg N + 60 kg P_2O_5 + 40 kg K_2O in wheat crop during both the years. The highest Rice Yield Equivalent, Net return and B:C ratio was also observed with the treatment T_6. The highest nutrient concentration and uptake of nutrients in grain and straw of both paddy and wheat crops was also recorded with T_6. It is interesting to report that more than sufficient nutrients concentration of NPK & Zn in grain and straw of paddy and wheat crop was registered with T_6 i.e. balance fertilizer NPK & Zn. On the basis of result it can be concluded that balanced application of major nutrients NPK and minor nutrient Zn enhance the productivity, profitability and quality of paddy and wheat crop as it is helpful to secure livelihood security of farm house hold in central plain zone of U.P.

10.2.6 Diversification of Existing Farming System Under Marginal Household Conditions

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In IFS system, OFR-Centre, Tharion, Fatehpur, average family size of three members including two adult and one child. Farmers deriving their family livelihood from 0.4 hectare of land in his native village Jalala. The most prevalent farming system in his door was Crop + Dairy + Horticulture. The average annual rainfall of the region was **940 mm.** During the bench mark survey in October, 2016, it was found that farmers growing Rice (0.16 ha), Cauliflower (0.24 ha) in Kharif, wheat (0.40 ha) in Rabi and Moong (0.16 ha) in summer. The productivity of all grown crop was low as compared to potential yield. The major constraints for low productivity were identified as no application of potassium and Zinc, higher dose of nitrogenous fertilizers; higher seed rate and weed infestation. In addition to crop production, farmers maintained two murrah buffalos and two goats. Total milk production of both the buffalos was 1500 litre / year which were very low as compared to potential milk production. The major constraints in low milk yield were poor nutrition, improper feeding and health care and poor shelter. He was getting total annual income of **Rs. 51073.00/ year** from crop and livestock for their family survival. On–farm research experiment entitled **"Diversification of existing farming system under marginal household**

conditions" under OFR, Centre Tharion, Fatehpur, running under C. S. Azad University of Agriculture and Technology, Kanpur. On–farm research is being conducted in system mode through participatory approach by identifying the module – wise constraints and addressing the same with no or low-cost interventions and new innovations.The major constraints in crop module were addressed by applying no cost, low cost and knowledge based interventions like supplying of MOP and Zn, recommended dose of Nitrogen – fertilizer with recommended seed rate, weed management and timely sowing etc as well as year round green fodder availability, diversification of chari in 0.08 ha area was done. Diversification of mustard in 0.16 ha area was also practiced to save marketable expenditure on oilseed. In fallow area of summer, Green gram in 0.16 ha area was also practiced to fulfil their pulse requirement. The additional income of **Rs. 77,479.00/year** was fetched after interventions and diversification in crop module in comparison to bench mark stage.Similarly, in livestock component, the main constraints were addressed by making availability of green fodder by growing Chari crops, supply of mineral mixture and de-wormer (Penacure). In addition to this, knowledge on clean milking, sanitation of shelter and timing of proper feeding schedule was imparted. These interventions resulted into additional milk yield of **300 lit./ year.** The total milk production was increased from 1500 Litre to 1800 litre which recorded **20 %** additional benefits over benchmark status.

Under product diversification, a nutritional kitchen gardening was promoted to fulfil their fruit and vegetable requirement. 200 Sqr. Metre area was allocated for organic kitchen gardening. Vegetable seeds of Okra, Bitter gourd, palak, pumpkin, cucumber along with saplings of Nimboo, Karounda, Papaya and Banana were provided for sowing & planting. Total 65 kg of vegetable were produced and total consumed by their family. The fruit plants in kitchen garden are under progress. Under the capacity building programme, trainings on improved practices of kharif and Rabi crops, rearing of animal, goat rearing and NKG were conducted to in rich practical knowledge of farmer. At the time of bench mark, the farmers were getting the annual average income of **Rs. 51,073.00 per year.** After interventions and innovation in crop, live stock and capacity building. He obtained the annual income of **Rs. 77,479.00 per year.** Additional income of **Rs. 26,406.00** was obtained due to interventions and innovation in different farming system modules.

On the whole, the farmers of village of Jalala under Malwan block Distrct- Fatehpur adopting farming system approach of crop cum livestock cum horticulture fetched total income of **Rs. 77479.00** in comparison to benchmark income of **Rs. 51073.00** which is **51.70%** higher than the benchmark. The income fetched by adopted farmer will surely improve living standard of his family. If it is continued, the total income is bound to stepped up for improving his livelihood further.

10.2.7 Role of Women in Safe Seed Storage by Domestic Method

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Farm families work very hard to grow as much grain as possible from their marginal lands. Farmers facing seed problem, he cannot purchase seed .seed availability is very less and it is costly, therefore, as much as 15 percent of what they keep for seed is damaged or lost in storage. Considering that farm families store about 70 percent of the seeds they produce this amount to a considerable loss. But something can be done about these loses. Generally there is a gap 7-10 months from the time of harvest until the next sowing of seed crop's. Depending on the crop, the seed produced on one season must be saved for planting in next season. The quality of seed at time of sowing depends on the quality of seed

that entered storage and how well it was stored. The village Jalulla and Dhamauli of district Fatehpur were selected with the purpose to save seed from the incidence of pulse beetle, khapra beetel by Krishi Vigyan Kendra, Thariaon, Fatehpur, Chandra Shekhar Azad University of Agrculture & Technology, Kanpur.In the first step a group of 100 women was trained in each village through training programme organized on "Store Grain Pest Control with Domestic Method". The farm women were advocated to dry the pulses for seed thoroughly by spreading it uniformly over a clean and on Pucca Floor made of stone, Bricks and cement. The clean kernels of pulses from dust and debris were treated with oils through mixing. The edible oil of mustard @ 5g/kg of kernels of grams, pea, urd and moong were mixed by hand, which stored for domestic uses. The edible oil of *Taramira* and non edible oil of Neem @ 5 g/kg kernels Parad Tikri 10 Pi US/ghi to use of aforementioned pulses were used in seed materials. Both type treated materials storage in air tight store or Bakhari. It was observed that both the materials were saved from the incidence of pulse beetel and Khapra beetle up to six months. No harm full effect was observed on the germination of seed. This generated technology spread in the pilot area like to forest fire. Now a days farm families of the adopted village growing seed by seed filled technique harvesting the fruits of technology and adopted store grain pest control with successful domestic method.

Keywords: Awareness, Sustainable Agriculture, Health

10.2.8 Nutri Garden – A Way Forward for Enhancing Farmer's Income and Household Nutritional Security

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Community and nutrition gardens can play an important role in enhancing national food security and dietary diversity to combat malnutrition. Nutrition gardens enhance dietary diversity by providing micronutrients through constant supply of fruits and vegetables sufficient to meet the family requirements. Thus, nutrition gardens can prove to be a sustainable model for providing food security and diversity to combat malnutrition at the household or community level. The study was undertaken by the KVK, Hardoi-I. In villages of Hardoi district, the major problems are poor health status, malnutrition causing growth retardation, reduced work output and high morbidity and mortality rate among the population. In order to improve food and nutritional security of family members, KVK, Hardoi-I demonstrated- FLD on kitchen gardening during 2018-19, 2019-20 and 2020-21. The present study was conducted in 11 villages namely Bagha, Barkera, Rukmanapur, Darbeshpur, Mujahidpur, Tatyora, Maraipurwa, Barbitapur, Habibpur, Kalyani, Devipurwa to improve the nutritional security of the family members through development of kitchen garden near to their houses. A total of 30 numbers of families were selected constituting 30 farm women. It was found that the production of vegetables of respondents increased by 586.2 per cent resulting increase in consumption of vegetable by 48.81 per cent and subsequently vegetable purchasing decreased by 32.1%. It was also seen that apart from economic saving on vegetable consumption, kitchen gardening also provided them a livelihood support enterprise for fighting against malnutrition and poverty by providing them an additional income and empowerment of women. Likewise, intake of energy, protein and iron increased significantly after introduction of Nutri garden (p£0.05).

Keywords: Nutrition, Health Status, Malnutrition, Kitchen Gardening

10.2.9 Indigenous Cattle Must for Natural Farming

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Natural resources, environment and particularly agriculture are under intense pressure, due to ever increasing demand for the food grains. Natural farming is a chemical free, traditional farming method, it is considered as agro ecology based diversified farming system which integrates crops, vegetables, fruits, trees and livestock with functional biodiversity. In the zero budget natural farming (ZBNF) nothing has to be purchased from outside. As natural farming works on the principle that there is no shortage of nutrients in the soil, air and water, and healthy soil biology can unlock these nutrients. All the nutrients required for the growth of plant are available around the root zone of the plants. There is no need to add anything from outside, as our soil is prosperous and full of essential nutrients. The nutrients in the soil are in the unavailable form, i.e. they are in the form of grains not chapatti or roti. The roots cannot take it in this form. This non-available form is converted into available form by the millions of micro-organisms. These valuable micro-organisms are destroyed by continuous and heavy uses of chemical fertilizers, insecticides, weedicides, etc. To obtain proper availability of micro-organisms we have to re-establish them in the soil and it is possible only by applying precious cow dung / urine of Indian cattle in the form of farm yard manure, jeevaamrit , dhanjeevamrit, bramhastra, agniastra, beejamrit etc prepared from dung and urine of Indigenous cow. The cow dung is a miraculous culture as one gram of cow dung contains about 300 to 500 crores beneficial and effective microbes. Thus, once again as mentioned in Vedas importance of Indian Cow with hump has proved beneficial and worthy for the betterment of soil, agriculture, horticulture, environment and health of society.

Keywords*: Natural farming, Indian cattle, Cow dung, Micro-organisms, jeevamrit,*

10.2.10 Doubling Farmers'.Income in Lakhimpur-Kheri District of Uttar Pradesh: Challenges and Solutions

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In the earlier efforts, the production of cereals, pulses, fruits and vegetables were successfully produced by the farmers of the district but they never got remunerative price for their produce. Farmers were forced to sell their produce in low price because of food processing units and cold storage structures are not well establish in district. The quality inputs i.e. seed and pesticides were not available. Irrigation facilities are lacking in many places and farmers are dependent on canal and rains for successful farming. Many times, unpredictable weather damages crops leading to economic losses. Thus, efforts to improve economic conditions of farmers must lay due emphasis on improving the basic infrastructure related to farming in this regard Government of Uttar Pradesh started Farm Machinery Bank like Scheme to improve the efficiency of small and medium farmers which is appreciable but small and medium food processing industries should be established in district level to ensure proper disposal of produce at remunerative prices.

Keywords: Agriculture, Income, Industries, Infrastructure, Food Processing

10.2.11 Four Golden Pillars: Generating More Than Doubling Income of Farmer

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Our farmers are facing problems for generation of income. But there is one hope ray for enhancing the more than doubling income of farmers through construction of palladium building on four golden pillars. i.e. (1) Low-cost cultivation: by natural farming, organic farming, zero budget farming, cow based farming, Vedic farming etc. (2) Post harvest management, Processing and value addition of farm produces: Post harvest technology and processing have potentiality to create rural industries. We can minimize the post harvest loss and increase the shelf life of fresh as well as processed products of horticulture through post harvest management and value addition. Operations after harvesting like trimming, curing, sorting, washing, grading, chemical treatment, packaging, storage, transportation and marketing are very useful for enhancing quality of fresh as well canned products. We can prepare and preserve so many value added products like jam, jelly, candy, preserve, squash, syrup, cordial, RTS, ketch-up, sauce, chutney, nectar, pickle, marmalade etc. through canning, bottling, freezing, dehydration, drying and ionization methods. There is no limit for enhancing the income through post harvest management and value addition in horticultural industries. Today we know that there is no need of more production, but there is a need of value addition of our farm produce. We also know that some times the price of one kg lime is Rs.5.00 only in local market. But we can earn Rs. 500 from one kg lime by making different value added product like lime syrup (from lime juice-Rs150), lime pickle or chutney from lime fruit peel after extraction of juice (Rs. 100), lime seedlings from lime seed 30-40 (Rs. 300-400). There are so many examples of this type of value addition of horticultural as well as other farm produce. So, there is no need for waiting five years for doubling the income, we can earn more than doubling income in one season or in one year through post harvest management, processing and preservation of different value added products from fresh horticultural as well as other farm produces. (3) Self marketing: Selling of my value-added farm produces by means of me. Selling through local Mandy, vegetable & fruit market, family farmer concept, home delivery, Fruit and vegetable mall khedut hat, my own retail shop, internet website etc. (4) Export: India is the second largest producer of the fruits and vegetables in the world after China. Nothing good this for us! Because our export and processing share in worldwide is nearly about one percent. More than 50% world mango production in our country. But we can't export our mango more than 1%, reason is that yet our farmers have not knowledge about how can we produce worldwide quality produce? But it is possible by Production according to international standards/ norms using GLOBALGAP, GMP, GHP and NPOP etc.

10.3 Poster Presentation

10.3.1 Awareness of Sustainable Agricultural Practices for Better Health of Women Farmers in Fatehpur

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Agriculture is one of the largest and the most important sector for the masses in India. Most of the rural livelihood in India is dependent on agriculture either directly or indirectly. Due to lack of proper knowledge and awareness about the various agricultural practices sustainable agriculture is now becoming a matter of great concern for all stakeholders. The challenges faced by the farmers are mostly due to agro-climatic, social and economic factors, apart from lack of awareness and adoption level of Climate Resilient Agricultural practices especially in small villages. Since women farmers are majorly deprived of enhancing knowledge and decision making, their health is the worst affected. In order to understand these health effects this study was undertaken in village Usraina of block Haswan, Thariaon, Fatehpur where major health effects of women farmers were observed and precautionary measures were suggested. The results revealed that 90.0 per cent of the farm women perceived that physiological problems like fatigue, a major problem in agriculture.

Keywords: Awareness, Sustainable Agriculture, Health

10.3.2 Awareness, Availability and Utilization of Moringa among Farm Families in Kannauj (U.P.)

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The present research was conducted in Nutri- Smart villages Pachpukhra and Pachaipurva of Jalalabad block in district Kannauj selected under NARI programme of ICAR in year 2021-2022. Main objective of study was to assess awareness, availability and utilization of Moringa plant and its different parts for nutritional and medicinal benefit among farm families and to transfer the relevant technology to combat the gap. Multi -stage purposive sampling technique was used to select 30 households having nutritional garden from each village. Thus, total sample for the study comprises of 60 households. The data was collected on pre –coded interview schedule by using personal interview method and female member taking care of family was taken as key respondent for the study. The results of the study reveal that only 23.33 percent respondents were aware about the nutritional value of different parts of moringa plant, 18.33 percent were aware about medicinal benefit of its leaf, seed, flower, root and oil, 28.00 percent farm families were aware about its use as a forage plant for livestock and none of the families were aware about its use as growth enhancer. Study further reveals that moringa plant was available only in 16.66 percent household and out of that only 10 percent were using its leaf for saag making and 3.33 percent were drying its leave for use in badi or mathri making. There was no use of different parts of moringa plant in regular diet. To combat the gap of low awareness, availability and utilization of moringa

plant in farm households, 300 moringa planting materials from horticulture unit at Krishi Vigyan Kendra Kannauj were distributed (5 each household) to plant it in or near nutritional garden of selected households. Online advisories through WhatsApp groups were sent to farmers and farm women during lockdown period and method demonstration of various value-added products like moringa powder, moringa soup, moringa juice, moringa leaf paratha etc. were conducted through on campus and off campus training programs during Poshan Maah 2021 to enhance its utilization at ground level for fighting against malnutrition.

Keyword: Moringa, Awareness, Malnutrition, Nutritional, Poshan Maah

10.3.3 Kitchen Garden- A Road Map for Enhancing the Health of Girl Children

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Health and nutrition are the most important contributory factor for human resource development in the country. The nutrition is a burning issue in India which leads to malnourished problem in girl children and paramount anemic patients can be seen in the rural area. There are several reasons like lack of knowledge, economic problem and lack of education with regards to balanced diet. The study was undertaken by the KVK, Hardoi in collaboration with the ICDS and allied departments. A total of six villages were selected from 2 blocks of Hardoi district. Only severe malnourished girl children were identified from these villages and thus 16 families could be identified. Vegetable seed kits were provided to these families along with the scientific layout of kitchen-garden. The physical parameter age, height and weight were also calculated for enhancing the health status of the girl child in rural area. The impact of the KVK activities was assessed in terms of before and after intervention followed by the per cent change in malnutrition by calculating BMI. The study showed that daily consumption of vegetables in daily diet enhanced the health status and help in minimizing the malnutrition problem to maximum extend. Kitchen garden which contents all types of vegetables can play a vital role especially in rural area where consumption of vegetable is not in practice, hence for habituating them for incorporating vegetables in their daily diet. Kitchen garden is excellent weapon. It could be a cheapest source for rural people specially girl children for overcome the malnutrition problem.

Keywords: Kitchen Gardening, Malnutrition, BMI (Body Mass Index).

10.3.4 Prevalence of Various Medicinal Herbs in the Kitchen Gardens in Urban Kanpur Region

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Healing with medicinal plants is as old as mankind itself. The term "**medicinal plants**" includes various types of plants used for medicinal purposes. The word "**herb**" has been derived from the Latin

word, *"herba"* and an old French word *"herbe"*. Now a days, herb refers to any part of the plant like fruit, seed, stem, bark, flower, leaf, stigma or a root, as well as a non-woody plant. These medicinal plants are also used as food, flavonoid, medicine or perfume and also in certain spiritual activities. Medicinal plants are used as traditional herbal remedies for some illnesses and disorders such as diabetes, respiratory illness, sweating and bleeding, wound and infections, regulation of the menstrual cycle, heart diseases, stomach pain, inflammation, and toothache etc. There are some medicinal herbs being used by common population mostly present in their gardens such as Turmeric (Curcuma longa), Tulsi (Ocimum sanctum), Alovera (Aloe barbadensis), Brahmi (Bacopa monnieri), Lemon grass (Cymbopogon), Pudina (Mentha), Marigold (Tagetes), Sadabahar (Catharanthus roseus), ginger (Zingiber officinale). Total 50 kitchen gardens in urban Kanpur area were included in this study. In all the gardens, higher number (more than 60%) were ornamental plants, 20 to 30 % were vegetables while approximately 10 % plants were medicinal herbs. Tulsi plant was highly dominating, it was prevalent in 30 gardens (60 %), followed by Sadabahar (35%), Alovera & marigold each (25%), Lemongrass (20%), Pudina 5%, Brahmi 2% while turmeric and ginger plants were not found in any garden. This study reveals that, there is less awareness in urban population regarding the medicinal herbs, although Tulsi is most dominant medicinal herb in most of the kitchen gardens, this might be due to medicinal as well as some religious factors associated with this plant.

10.3.5 Growth Performance of Growing Goat Kids under Field Condition in Lakhimpur-Kheri district

Nagendra Kumar Tripathi[1], Sanjay Singh[2], Pradeep Kumar Bisen[3], Mohd Suhail[4], Santosh Kumar Vishwakarma[5] and Jiya Lal Gupta [6].

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The present study was conducted to assess the effect of supplementary feeding (locally made concentrate mixture) on growth performance of kids under field condition in Lakhimpur-Kheri district of Uttar Pradesh. Thirty healthy nondescript local male kids having body weight 4.25±0.10 kg (4 month of age) were selected and randomly distributed into three equal groups viz. T_1 (Control i.e. farmer's practice), T_2- Grazing and supplementary feeding of locally made concentrate mixture, T_3- Grazing plus feeding of locally made concentrate mixture and two times de-worming. The control (T_1) group was maintained solely on grazing for 6-8 hr on local grazing land, kids of T_2 and T_3 groups were fed locally made concentrate mixture @ 3.5% of body weight along with grazing for 240 days. An additional de-worming of kids (T_3) was done two times at 90 days of interval. The results showed that the average daily gain (g/day) of kids were significantly ($P<0.05$) difference between T_2 and T_3 groups. Similarly, the dressing percent and meat yield of T_3 (49% and 7.78 kg) and T_2(49% and 7.66 kg) group was higher than T_1(46% and 5.63 kg).Therefore, it was concluded that feeding of locally made concentrate mixture along with grazing and two time de-worming improved the growth performance of growing male kids.

Keywords: Growing kids, Growth Performance, De-worming.

10.3.6 Demonstration on Grampriya Variety of Chicks under Tribal Poultry Production in Lakhimpur-Kheri District, Uttar Pradesh

Nagendra Kumar Tripathi[1], Sanjay Singh[2], Pradeep Kumar Bisen[3], Mohd Suhail[4], Santosh Kumar Vishwakarma[5] and Jiya Lal Gupta [6].

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Low Cost poultry production in tribal areas of Indo Nepal region, improving the family nutrition of Tharu tribes and also improves the overall agricultural income of the tribals. In the present study the performance of Grampriya variety of chicken under the low cost poultry farming in Lakhimpur-Kheri district, Uttar Pradesh was demonstrated. Day old chicks of Grampriya variety were supplied to farmers and the performance of birds in terms of mortality up to 8 week of age, age at first laying, body weight at the age of 20 week, annual egg production and economic returns were assessed. Results revealed that mean chick mortality up to week was about 5.5% while the body weight at the age of 20 week in male and female birds was 2.68±0.17 and 2.2± 0.12 Kg, respectively. The mean age at first laying was observed as 189±3.2 days and the annual egg production per bird was 12 ±3.2. In case of economic returns it was found that by rearing a unit of 25 birds per household can generate an income of about Rs 15800/-. Thus it may be concluded that Grampriya variety of poultry bird perform very well under tribal areas of Indo Nepal region and also reared in areas where demand of brown shelled eggs (Desi Egg) was more.

Keywords: Tribal Farmers, Grampriya, Performance, Poultry.

10.3.7 Effective Extension Strategies and Mobilisation of FPO's to Market:

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Small holder farmers are have to suffer market uncertainties as most policies and institutional supports favours large and progressive farmers and smaller farmers are devoid of them increasing wider gap between producers and consumers. In such situation Farmer Produces Organization plays an important role in promoting and strengthening member based institution of farmers. This business form allows 10 or more producers to form an organization as per its memorandum of association. FPO's can link smallholder's farmers to local, regional, national and international markets effectively if there is no political interference. FPOs which are formed as Farmer Producer Company (FPCs) allow its member to access financial and other input services. To surpass this effective and viable profit making FPCs

needs to be competent with other companies and rivals in the market and has a huge potential to capture the future food retails not only in India but in the world.

Keywords: Agriculture, FPCs, market, strengthen, agriculture etc.

10.3.8 Health Benefits of Plants Based Antioxidants - A Review

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Antioxidants are found in certain foods and may prevent some of the damage caused by free radicals by neutralizing them. These include the nutrient antioxidants, vitamins A, C and E, and the minerals copper, zinc and selenium. Other dietary food compounds, such as the phytochemicals in plants, are believed to have greater antioxidant effects than vitamins or minerals. These are called the non-nutrient antioxidants and include phytochemicals, (such as lycopenes in tomatoes and anthocyanins found in cranberries). Some ill effect of free redials Inflammation of the joints (arthritis), damage to nerve cells in the brain, which contributes to conditions (such as Parkinson's or Alzheimer's disease), and increased risk of coronary heart disease etc. There is increasing evidence that antioxidants are more effective when obtained from whole foods, rather than isolated from a food and presented in tablet form. A well-balanced diet, which includes consuming antioxidants from whole foods, is far better than having a supplements tablet. Plant foods are rich sources of antioxidants. They are most abundant in fruits and vegetables, as well as other foods including nuts, whole grains and some meats, poultry and fish. To meet your nutritional needs, as a minimum consume fruit and vegetables daily. Although serving sizes vary depending on gender, age and stage of life. On an average 300 gm vegetables and 150 gm fruit are recommended by ICMR for proper body functioning. Antioxidants are known to play a key role in the protective influence exerted by plant foods Gey KF (1990), Gey KF et al. (1991) Willett WC (1991), Liyana et al. 2006). Consuming fruits and vegetables has been linked to a lower rate of chronic diseases. The recommendations based on epidemiological studies are: fruits and vegetables ensure the best protection against the development of diseases caused by oxidative stress, such as cancer, coronary heart disease, obesity, type 2 diabetes, hypertension and cataract. Do not use antioxidant supplements to replace a healthy diet or conventional medical care, or as a reason to postpone seeing a health care provider about a medical problem. it is suggested to have plenty of fruits and vegetable to receive natural antioxidants instead of going for supplementation

Keywords: Food, Vegetables & Fruits, Antioxidants, chronic disease, Cancer, free radicals, supplements

10.3.9 Nutritional Assessment and Diet Formulation of Elderly of Hathras (Rural) District

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Nutrition is one of the key factors associated with the health and overall wellbeing of every individual. Considering the elderly population which has increased on account of demographic transition, it has been observed that there has been a transition in terms of care giving and living arrangement. Although there's uniformity in institutional setting, heterogeneity in terms of social, economic, physical and psychosocial factors affect the dietary intake among the elderly population. The assessment of the nutritional status is an important component of geriatric evaluation. In the present study the nutritional status of 150 elderly aged above 60 years of rural area of Hathras district was assessed with the help of Mini Nutritional Assessment (MNA) tool. Respondents were classified as 'well-nourished', 'at-risk' and' malnourished' on the basis of MNA scores. Data on dietary intake for three days was collected by the 24 hours dietary recall method and mean intake of nutrients per day was calculated and compared with RDA. A questionnaire was developed to observe the factors contributing to the nutritional status of elderly. It is evident that the proportion of 'at risk' and 'malnourished' elderly classified by MNA were 18.67 and 13.33 percent respectively. This could be attributed to decreased nutrient intake with advancing age. According to BMI, Maximum numbers of elderly males and females were normal (45.33% and 41.33%) whereas 28% and 29.34 % were obese as elderly male and female respectively. RDAs. . The average iron intake was lower than recommended value in both males and females. They consumed iron significantly lesser than their RDA i.e. -13.33% and -40.00% respectively. The average per cent intake of vitamin A was lower than the recommended values in both males and females. The average percentage consumption of dietary fibre intake is very low from the recommended values in both males and females. The females had significantly ($p=0.05$) higher per cent adequacy for dietary fiber compared to males. The intakes of all the nutrients were significantly less in malnourished group in comparison to well-nourished group. Half of the elderly subjects consumed more calories than the RDA. It is concluded that as the age advances there is corresponding decline in the nutritional status of elderly men and emphasis needs to be given on diet, health care and associated factors.

10.3.10 Major Challenges Faced By Vegetable Growers in Lakhimpur Kheri

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Falling in the Tarai region of Uttar Pradesh the district Lakhimpur Kheri has important area under sugarcane but some farmers grow vegetables round the year mainly cow pea, potato, tomato, brinjal,

cucurbits having marginal to small land holding of good quality cultivable soil but they face lots of challenges. In this regard a sample of 50 farmers was interviewed randomly for collection of relevant data from the villages of the Lakhimpur, Mitauli and Mohammdi blocks of the district Lakhimpur Kheri.

The results of collected and valid data revealed that majority i.e. 58.00 per cent farmers faced the challenges due to unavailability of quality seed, 52.00 per cent responded facing the challenges because of high seed price while 42 per cent high infestation of insect's pests and diseases and the least 24.00 per cent came into challenges of market unavailability.

10.3.11 Analyzing the Use of Medicinal Plants by Rural Women Uring COVID-19 Pandemic

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This study was conducted among 100 rural women of Fatehpur district to elucidate the use of medicinal plants by rural women during COVID-19 pandemic. SARS - CoV-2 virus, is the causative agent of COVID-19 pandemic worldwide with huge mortality and morbidity. In COVID pandemic most of the death occurred due to severe respiratory illness or multi organ failure It was also noticed that most of the patients COVID positive were suffering from other illnesses like diabetes or weak immunity. There is no effective antiviral drug for the treatment of this disease. In Indian tradition medicines there are many herbs, might be effective to improve the immunity to fight against the disease causing pathogens. Some important herbs being used by rural Indian population since a long time are- Tulsi (Ocimum sanctum), Neem (Azadirachta indica), Giloy (Tinospora cordifolia), Turmeric (Curcuma longa), ginger (Zingiber officinale), Dalchini (Cinnamomum verum), Laung (Syzygium aromaticum), Aloevera (Aloe barbadensis), Aonla (Phyllanthus emblica), Ashwagandha (Withania somnifera) etc. In this study Out of total 100 women maximum 90 % used ginger followed by Tulsi leaves 55%, Turmeric with milk 30%, Aonla in the form of powder, juice or chyawanprash 20%, Dalchini & laung 15%, Alovera 5 %, while Neem Giloy & Ashwagandha was used by only 2% of women in their routine life during pandemic. Most of the herbs were used in form of Kadha (hot extracts of herbs) while ginger was used directly with tea.

10.3.12 Mushroom: Health and Wealth Together

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Proteins are the building blocks of life. Every cell in the human body contains protein. The basic structure of protein is a chain of amino acids. People need protein in their diet to help their body repair cells and make new ones. Protein is also important for growth and development in children, teens, and pregnant women. Mushrooms are one of several vegan-friendly sources of protein. While they're often

referred to as vegetables, they're actually fungi. Mushrooms have an earthy; umami flavor allows them to be easily used in place of meats. Certain mushrooms also have nutrients that are typically found in meat products, like iron, vitamin B12 and vitamin D. Keeping in mind nutritional importance of mushroom, Front line demonstration on two verities of oyster black and white were conducted by KVK Kanpur Dehat in 120 selected farm families of Anooppur, Rudapur, Majhiyar and Aurangabad Village of Maitha Block of District Kanpur Dehat. Three bags were given to each family, 3.87 kg average production/ bag was recorded if taking production on spawn basis it was observed 22.17kg production / Kg of spawn. Gross cost, Gross Return, Net return and B:C ratio were calculated as Rs. 3600, Rs. 18576, Rs. 14976 and 1:5.16 respectively. The fresh produce was available up to 67 days to the farmers while they process their produce and made Achar, vadi, Dry mushroom, mushroom powder, and Mushroom papad.

10.3.13 Assessment of Diversity in Regional Cropping System and its Effect on Diversity in Dietary Intake of Rural Families

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The cropping system of district Kannauj is based on potato, wheat, rice, onion, tomato, moong beans and the crop sequence as: Maize-potato-Maize, Maize-potato-groundnut, Groundnut-potato-vegetables, Rice-Wheat, Maize-mustard-wheat, etc. The other seasonal and indigenous crops also produce at minimum. The regional crop production is directly affected to the food selection, habits and dietary intake of their people. The diversity in diet is a key of complete wellness and healthy life. It is a system in which all food categories included with their different variety in it in daily diet not in monotonous form. Dietary diversity is a qualitative measure of food consumption and also a proxy for nutrient adequacy of the diet of individuals. The cropping system of a rural Kannauj district had surveyed and assessed. That reflects the dietary diversity of its population. 56 households (HHs) were randomly selected from Rautamai village of district. To assess the desired information an approved questionnaire was adopted in a longitudinal study to investigate the dietary intake and diversity. The common crops of this region were found as: potato, maize/ corn, onion, tomato, peanuts, rice and wheat. It was found that most of the HHs (73.83%) was used locally available regional crops in daily diet. The mean dietary diversity score of individuals was 0.68 (<1) showed very poor performance. Maximum (83.66%) HHs used potato daily as main vegetable in all schedule of a day. Only red gram and moong gram have been frequently consumed by respondent's family. Therefore it suggested to increasing diversity in regional cropping system and thereby the diversity can possibly be added in daily diet of local population.

Keywords: Diversity, local crop, cropping system, households, indigenous, wellness

10.3.14 Role of KVK Home Scienntist in Empowering farm women in Mainpuri District

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Women empowerment in agriculture is not an easy task where all policies are still dominated by the false view that farmers are men and women are only housewives. There is a conceptual inability to define women's work inside the house and outside the house. Generally, in rural areas, women perform 70 to 80 per cent of manual farm operations for crop production or livestock raising but being illiterate and ignorant about new farm technologies, they have no access to new advances made in farm sector. Therefore, for empowering women in agricultural sector, it is important that linkages should have been made between technology generation, technology dissemination and technology receiving systems otherwise women's problem will continue to grow and work efficiency of women will show a declining trend which by all means need to be safe guarded. Key Words : Empowering, farm women, Technologies, Farm operations, Rural areas.

10.3.15 A Brief on Philatelic Education in Climate and Global Environment in Connectivity with Horticultural Diversity

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Philately is a unique approach to learn more about any country in the world. It provides a method towards the connectivity by education and knowledge management and this role may not be denied in the contemporary global environmental changes withal. Philately is the hobby of collecting and studying postage and revenue stamp, first day cover, special cover, postal stationeries and souvenir. But it involves more than just stamp collecting as it includes the study of relevant history withal. Where ever communication takes place, it has definitely some content of knowledge. Such a content to be communicated for understanding environmental features of a country also. It, therefore, may serve in a role in the communication process and management aspect. Philately has highlighted country's various phenomenon including culture, heritage, biodiversity, agriculture, industry, various occasions and other aspects of national life from time to time. Keeping these in view, an extensive philatelic survey on the documents and items of world postage stamps on climate and crops has been carried out by content analysis pertaining to the date of issues, their denominations, and their descriptions with special reference to commemoratives, special and definitive stamps along with their brochures. The present work is the brief account of the communication on global environmental changes depicted in world of philately along with its horticultural diversity in the recent past.

Keywords: Climate resilient, global environmental change, horticultural diversity, philately

TECHNICAL SESSION-11

WORKSHOP ON DIGITAL HORTICULTURE FOR RESILIENCE TO CLIMATE CHANGE AND SUSTAINABILITY

11.1 Keynote Presentation

11.1.1 Paradigms in Digital Horticulture-Options and Opportunities

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Exponential advancement in horticulture coupled with digitalization, use of censors, ICT, remote servicing and robotics for different type of farming and horticulture business is becoming important referred to as Digital Horticulture. In the digital horticulture digital images and censors are used and integrated, and robotics and machine learning are adopted. Digital horticulture aims to improve industrial metrics such as, yield, profit and sustainability and to transform the sector's commodity trading, purchase of inputs, and traceability of product. 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 to be used to capture, organize, and validate data in almost every aspect of Digital Horticulture, which needs IoT based data collection. This also includes contract and certificates that can be executed. Blockchain makes complex transaction quicker and cheaper to execute, which benefits the stakeholders. This also offers accurate and early traceability of all the produce from the exact spot, where it was harvested to the retail outlet. Accurate accountability becomes quick and easy and appropriate action take place. IoT (Internet of Things) is the network of physical devices that collect, connect and exchange data. The devices measure variability of parameters at multiple places for effectively managing the crop. The crop management is tailored on information. Edge computing and machine learning capability are essential to improve data from IoT devices. The secure data storage can safely accommodate the large amount of data which is generated by the physical devices. A well architected Artificial Intelligence (AI) helps in achieving higher yields while optimizing resources efficiency, hence enabling farm to be more sustainable, viable and profitable. Next revolution of horticultural practices will be dominated by AI and human wisdom in future. However, AI (Artificial Intelligence) has to be integrated with IA (Information Architecture). Digital marketing, referred as online marketing is a promotion of brands to connect with potential customers using the internet and other form of digital communication. This includes use of all the digital platform. The digital marketing of horticultural activities could be a platform of content marketing, search engine optimization (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 management and value chain management using various types of data driven platform for decision making. Therefore, Digital horticulture provides a lot of opportunities and also the challenges. The paper discusses the details.

Keyword: Digital Horticulture, AI, IA, blockchain, digital marketing, content marketing and resource optimisation

11.1.2 Current and Future Climate Suitability prediction for Plantation Crops (Coconut and Arecanut) Using Maxent and Adaptation Strategies for Sustainable Production

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Prediction of suitable climate for the cultivation of perennial plantation crops is essential for their sustainable production under changing future climate. Coconut and arecanut are the two important plantation crops grown in coastal and hilly regions and are highly vulnerable to climate change. In order to predict the climate suitability of the current cultivation region under future climate, maxent model was employed with two scenarios of Rcp 4.5 and Rcp 8.5 for the years 2050 and 2070. Amongst the variables, Bio 4 (temperature seasonality) for coconut and Bio 19 (precipitation of the coldest quarter) for arecanut is the major environmental contributor for habitat suitability. Model projected results showed that the contraction in suitable climate area size of coconut and arecanut might be small however there is shift in area from high to moderate and low suitable in different regions. Southern interior regions where there is extensive cultivation of coconut and arecanut which is at present high to moderate suitable may shift to moderate to low suitable while some areas may become very low suitable. Similarly in north east, Assam where arecanut is predominantly cultivated under current climate may become low suitable, while suitability may shift to neighbouring Meghalaya and Tripura under future climate. This understanding helps in devising appropriate policies for its cultivation in newer areas and to device adaptive strategies in vulnerable regions so as to have sustainable cultivation and production under future climate.

Keywords: Coconut, Arecanut, Climate change, Maxent, Prediction

11.1.3 Integration of Horticulture and Engineering for Climate Resilience and Sustainability Development of Horticulture

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11.1.4 Geomatics Applications for Climate Resilience in Horticulture

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Geomatics comprising remote sensing, geographic information system, positioning system in association with information and communication technology has emerged as powerful tool for integrated use of variety of data. Satellite images of earth surface and observations of earth atmosphere provide regular information about the earth resources and environment. Such information coupled with in-situ observations have been found useful in survey, monitoring and management planning in many fields. Agriculture particularly crop inventory and production forecasting received attention globally from the beginning of multi-spectral imaging of earth from satellites in 1970's. Indian space programme since its inception has been focused towards harnessing societal benefits of technology. Fittingly first application of remote sensing in the country began study of coconut root-wilt disease in Kerala 1960's. Priority for applications in agriculture continued and no. of studies were conducted under the Indian Remote Sensing Satellite – Utilisation Programme (IRS-UP) launched in 1983. Among these crop production forecasting targeted estimation of crop area using satellite images and production forecasting. Initial success resulted in appreciation of user community and demand for developing a programme to cover most of the crops. Accordingly Crop Acreage and Production Estimation (CAPE) project was developed to cover wheat, rice, rabi-sorghum, rapeseed/mustard, groundnut, cotton and sugarcane crops. At the behest of Ministry of Agriculture estimation of potato and onion were also included subsequently. The success of CAPE resulted in need for regular and multiple in-season forecast of crop production, applications in horticulture development and management planning etc. The Technology Mission on Integrated Development of Horticulture in North-Eastern States including Sikkim, popularly known as technology mission led to major development of geomatics applications in horticulture. Applications for crop area estimation and production forecasting of horticulture crop, crop disease detection, site suitability analysis, planning for post-harvest support infrastructure etc. have been addressed. The experience gained and expertise developed is being harnessed in the programme "Coordinated Horticulture Assessment and Management using geoiNformatics" (CHAMAN) project. The project being implemented by Mahalanobis National Crop Forecast Centre (MNCFC) is meeting all the information needs from geomatics. With the expertise developed and availability of open access and free of cost satellite data there are immense possibilities for developing newer applications to meet the requirements of new normal. This paper provides a glimpse of procedure development implementation and operationalization of geomatics applications in the country.

11.1.5 Engaging the Multi Stakeholders for Empowered Human Resources at Grassroots to address Challenges of Climate Change Sustainably

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"In the universe are billions of galaxies, in our galaxy are billions of planets, but there is Only One Earth". In Stockholm again with this theme the globe is steering towards a new horizon post 5th June 2022".India has emerged as a ray of hope in the global efforts to tackle the menace of climate change. The world once used to see India as a challenge to climate change because of its huge population but now has emerged as an opportunity and has become the leader of climate justice and is a big force against a formidable crisis. India is moving ahead with a lofty global vision like the founding of International Solar Alliance for realizing the vision of One Sun, One World, One Grid and the Coalition for Disaster Resilient Infrastructure initiative and have stood up as the top 10 countries of the world in the Climate Change Performance Index. Without empowered and engaged Human resources the dream to fulfill the targets of COP 26 won't be possible. We will be able to give a safe environment to our coming generations only when all of us make a united effort to maintain the balance of water, air and land. *C%M5@ *B0M5@-5 i.e., May the whole earth, the whole environment be most advantageous for all of us and give an opportunity to our dreams. In the scenario, where the climate change is the reality attempted has to be both for mitigation adaptation. Horticulture, which has emerged as prime mover of the economy with diversity of crops and wider adaptably, is also affected by climate change increasing temperature strength maturity and other variability has the impact on the various phenological process. Crops like coconut is likely to benefit from the climate change due to increase concentration of CO_2. Looking to the advantage and disadvantage of the climate change with the preparedness we can convert these challenge into the opportunity. Which requires drought tolerant cultivars, Product management system, effective management and strategic value chain management which necessities the development of Human resource having the skill of managing the climate change, the resilience and sustainability.

Keywords- Sustainability, Climate Justice, Targets of Cop26, Global efforts.

TECHNICAL SESSION-12

POST HARVEST MANAGEMENT ACCESS TO MARKET AND VALUE CHAIN MANAGEMENT FOR SUSTAINABLE PRODUCTION OF HORTICULTURE CROPS

12.1 Keynote Presentation

12.1.2 Post Harvest Management for Sustainable development of Horticulture

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Competing pressures of meeting agricultural demand, sustaining livelihoods, and ensuring economic development underline the importance of the need for systemic solutions that can maintain livelihoods, food security and economic resilience. With the advancement in lifestyle of people, demand for high-quality horticultural products is rising. Sustainable horticultural practices are necessary in order to conserve natural resources, enhance our environment, provide economic opportunities, and meet our nutritional needs. Balancing food preservation and safety requirements with sustainability goals is an increasingly important objective for food producers, processors, distributors, and retailers. At each stage of post-harvest handling (viz. cleaning, processing, packaging, transportation, storage, and marketing, the produce or product has the threat of contamination or spoilage, both leading to postharvest losses and food safety issues. A number of methods (Physical, chemical and microbiological)exist to mitigate losses and improve food safety. Cold storage, refrigerated transport, pasteurization, and specific handling, processing, and packaging protocols reduce the transmission of pathogens. Increased understanding of respiration physiology or artificial ripening protocols has proven useful in extending shelf life of fresh produce. For sustainability, processed products are highly required commodities as these raise the overall value of the product. Sustainable postharvest management practices pursue the goals of minimizing losses and contamination in ways that increase efficiency and limit the use of energy and nonrenewable resources.

Fresh fruits and vegetables (F&V) are important part of human diet. India is the second largest producer of fruits and vegetables accounting for 97358 thousand MT and 184394 thousand MT respectively (Horticulture Statistics at a Glance 2017-18). Despite being one of the leading country in production of horticulture commodities, huge post Harvest losses to the tune of 25 – 30 per cent losses occur due to improper handling and storage. The losses also occur because of poor facilities, lack of know how, poor management and market dysfunction. Proper storage condition, temperature and humidity are required to extend the shelf life and maintain the quality. The extent of processing in the country is less than 10 per cent which needs to be increased in the near future. The major processed items in this segment are fruit pulps and juices, fruit based ready-to-serve beverages, canned fruits and vegetables, jams, squashes, pickles, chutneys and dehydrated vegetables. The new arrivals in this segment are vegetable curries in retortable pouches, canned mushroom and mushroom products, dried fruits and vegetables and fruit juice concentrates. These industries generate voluminous quantities of waste. These horticultural wastes/ rejections are rich source of nutrients and may be used as raw material for getting a number of value

added products. In economic terms these losses may work out to be more than Rs. 5000 crores. These waste can serve as raw material for a variety of value added products thus reducing pollution, generating employment and increasing profitability.

12.1.2 Branding, Labelling and Certification for Maximising Profits in Horticulture Produce

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Horticultural crops in India form a significant part of total agriculture. production in the country and contribute to about 34 per cent of the agricultural GDP. According to the first advanced estimate for the year 2021-22, the production will be a record 333.25 million tonnes from an estimated area of 27.56 million ha. Though the production is continuously increasing, post-harvest losses are the major issue. Therefore, there is a need for effective value chain management, including infrastructure development at the farm level. This will ensure that losses can be reduced and quality produce be generated, which will contribute to higher exports from horticulture, thereby adding money to the farmer's pocket. India, with its diverse climate, harvests various types of horticultural produce round the year and therefore can take advantage of this exclusivity and supply quality produce throughout the world. For obtaining a premium price for the produce and generate increased demand in domestic and international markets - branding, labelling and certification is key.

Branding helps identify a business, product, or service as unique and different from its competitors. A effective branding strategy is not only visually appealing, but also establishes consumer recognition of the brand's meaning. Products and services, that are labelled or certified provide specific, condensed information about the quality aspects, usually through a symbol or logo. This makes the products produced under certain protocols stand out to other stakeholders in the supply chain, including producers and consumers. Thus, labelling and certification of products and services that meet certain standards can be utilised as a strategy for achieving sustainable development. This paper will discuss a case study of Rainforest Alliance (RA) Certification, which has played a significant role in driving sustainable supply chains in both production and consumption. The certification process of RA help farmers produce better crops, adapt to climate change, increase their productivity, and reduce costs.

Keywords: Horticulture, supply chain, value chain, branding, labelling, certification

12.1.3 Linking Farmers with Markets for Enhanced Horticulture Productivity and Food Safety

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The food system in India has been undergoing a paradigm shift, and one of the most visible market phenomena in India is the emergence of an integrated food supply chain. This paradigm change is

attributed to the country's increasing income, growing urbanization, expanding female employment, and gradual integration with the global economy. These developments, in addition to food security goals, have led the dietary transition from food grains to high-value commodities such as fruits, vegetables, livestock, marine, and processed products. However, this dietary transition has put additional pressure on supply chain integration. In this context, contract farming (CF) has emerged as one of the most viable instruments to facilitate integration between farmers and markets. In contract farming, agribusiness firms' contract with external farmers to receive goods at a fixed price with the certainty of delivery of a specified quality and quantity at a specified time. Rather than owning farms themselves, the firms rely on these smallholders to produce and provide their goods.

In this backdrop, this paper attempts to quantify the benefits of contract farming (CF) on farmers' income and compliance with food safety measures, It also investigates the determinants of participation in CF. The study is based on a survey of farmers engaged in cultivation of baby corn, onion, okra and pomegranate cultivation. The study, using 2-Stage Least Squares method and propensity score matching approach, reveals that CF ensures significant higher returns for smallholders and improves the compliance with food safety measures substantially. Access to institutional credit, extension services, farm size, personal ownership of transport and migration significantly affected farmers' participation in CF. The empirical evidence of the benefits of CF for high-value export commodities should encourage government policies to promote and scale up the use of CF in India.

12.1.4 Prospects of Post Harvest Management, Value-addition and Waste utilization in Citrus Fruits

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Citrus fruits are grown all around the world in tropics and subtropics regions. In India, the estimated total production increased to about 13.976 '000 MT in 2019-20 from 7.45 '000 MT in 2010-11. Approximately 15-20% of this production is destined to the juice processing industry and about 80%–85% of the total production is destined for the fresh market either local or international. In this scenario, for the fresh fruit market; the quality and appearance of the rind, absence of damage or deteriorations are the essential attributes for the market and consumer's acceptance. Although the production of citrus has increased when compared with the statistics, the overall profitability of the industry has been limited by high postharvest losses (25-30%) due to the lack and/or use of proper postharvest handling system of fresh fruit. Postharvest technology encompasses a number of techniques, processes, and treatments related to handling, processing, storage, transport, etc. of the fruit, aimed to prepare them for market requirements, to extend their commercial life, and to reduce the losses during the whole chain, from harvest to the consumer table. Post-harvest treatments such as curing, washing, wax coating with fungicide, eco-friendly coatings, plant extracts, biocontrol agents, GRAS compounds, etc. along with packaging containers like CFB box, LDPE-HDPE packaging, nano-packaging, shrink wrap packaging material have been developed, trialed and has proved successful to minimize the post-harvest losses and also in maintaining the quality of citrus fruits for long term storage. The experiment was conducted with an aim to study the effectiveness of new postharvest fungicides viz. azoxystrobin and propiconazole alone and along with edible coatings viz. shellac and stayfresh in quality retention and extension of shelf-life of Nagpur mandarin (*Citrus reticulata* Blanco) fruits under ambient storage conditions. Maximum

juice recovery (42.52%), total soluble solids (13.10° Brix), vitamin C (21.99mg/100ml) was recorded in shellac coated fruits. The coated fruits also recorded minimum physiological loss in weight of 14.98% and minimum rate of spoilage of 3.17% in comparison to the control fruits. The results revealed that shellac formulations can prove an eco-friendly, cost effective and non-hazardous technology effective in storage and transport of fresh fruit from its cultivation site to distant markets and ultimately to consumers. While, many challenges in the area of postharvest are still to be tackled, the current state of postharvest losses can be minimized by application of the principles of postharvest management. The purity of pectin isolated from Kachai lemon was confirmed by analyzing physico-chemical properties like anhydrouronic acid, degree of esterification, equivalent weight and methoxyl content. The isolated pectin contained methoxyl content 7.25%, degree of esterification 59.60% and jelly grade 160. The oil recovery was 0.043% by cold press method and 0.59% by hydro distillation method. Khasi mandarin cold pressed and hydro distilled oil were also characterize using GC-MS. Citrus peels can be explored in commercial production of pectin and oil alongside with other citrus sources and has potential industrial applications for use in manufacture of different value added products. By understanding and using the developed technologies, there is need to create public awareness on the importance of citrus fruit which will help to improve the profitability of citrus industry.

12.1.5 Post-harvest Management of Sub-tropical Fruits

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Horticulture sector plays a very important role in maintaining nutritional security of the country's population, as these crops are rich source of carbohydrates, minerals, vitamins, dietary fibers, and many vital components. Farmers with the help of horticultural scientists and government have played vital role in enhancing production of horticultural crops and taking it to 331 million metric tons in 2021-22 showing an increase of 3.35 from 2019-20 of which fruits contribute 102 million metric tonnes. (Indian Horticulture statistics, National Horticulture Board, 2021). Sub-tropical fruits contribute a major share to the country's fruit basket but is still lacking in on-farm implementation of scientific technology and post-harvest infrastructure facilities. The major fruits in this category are Mango (*Mangifera Indica*), Litchi (*Litchi chinensis*), Pomegranate (*Punica granatum*), Guava (*Psidium guajava*), Jamun (*Syzygium cumini*), Aonla *(Phyllanthus emblica*), Ber (*Ziziphus mauritiana*, Bael (*Aegle marmelous*) etc. Post-harvest management of these fruits is critical to maintain quality, enhance post-harvest life, reduce post-harvest losses, increase farmers income, generate employment, create ancillary industries and enhanced entrepreneurship opportunities for rural and semi-urban youth thereby also facilitating in preventing migration to big cities. Maintenance of end to end supply chain from harvest to consumer will serve a long way in realizing these objectives and will entail the establishment of produce specific post-harvest infrastructure including pre cooling units, pack houses, cold storage, ripening chamber, refrigerated transportation and retail management.

12.1.6 Sustainable Development of Horticulture through Beekeeping in Varied Climatic Conditions

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Climatic conditions plays important role in beekeeping in terms of health of bees, hive temperature, availability of flora, foraging performance, production of honey & other beehive products, etc. Based on these factors, it is advisable to select suitable species of bees, type of beehive, location of apiary, etc according to weather conditions of particular region/ area. Bees are subjected to numerous biotic and abiotic stresses (e.g. loss of food resources, exposure to various chemicals, invasive species, pest & diseases, etc.) and the impact of climate change on honeybees requires further attention. Honeybees have a strong temperature tolerance and have adapted to live in many parts of the world where there are extreme temperatures. In India, honeybees in temperate climates, such as European honeybees, store larger amounts of honey than other subspecies, as they need to maintain a certain temperature inside the nest to survive during winter. Further, National Bee Board (NBB), Ministry of Agriculture & Farmers Welfare, Govt. is implementing a central sector scheme entitled National Beekeeping & Honey Mission (NBHM) under Aatamnirbhar Bharat Announcement to achieve the goal of Sweet Revolution in the country and doubling the farmer's income. The scheme NBHM covers almost all aspects relating to beekeeping, including R&D on climate resilient and sustainable development of beekeeping. ICAR has also developed technologies and strategies for beekeepers to adapt with climate change and possibly contribute to mitigate climate conditions, including the design of beehives, color of bee boxes, equipments, technologies and management protocols.

12.1.7 Innovations in Coconut Production System: Role of Kalpa® Agri-Business Incubator

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To catalyze agribusiness and promote entrepreneurship, under National Agricultural Innovation Project, ICAR established Agribusiness Incubation Centers (NIABI). The Kalpa® Agri-Business Centre at ICAR-CPCRI, Kasaragod was established in 2013. The main activities of the Centre include conducting structured and formal entrepreneurship programmes, technology backstopping, financial guidance and technical consultancy. It extends facilities for the production of virgin coconut oil, desiccated coconut, coconut chips, coconut sugar, vegan coconut frozen delicacy, Kalpa Krunch, bean to bar chocolate and activated carbon to its incubatees. Besides in-house incubation, on-site incubation services such as production of organic inputs, arecanut tissue culture, and value added products are provided to over 50 licensees of the Institute technologies. The DPR of institute technologies are readily made available and marketing support and promotion of products are made through participation in exhibitions and bringing out publicity

literature. The technology awareness programmes and entrepreneurship development programmes conducted by the ABI proved to be beneficial for many farmer groups to start their own input production units. This has escalating advantages in the production system in terms of reduced cost of production, ready access to inputs, and providing rural employment. Thereby it supports to create a perfect ecosystem for 'Atmanirbar Krishi'. The scope of ABI had further expanded with the government's policy initiatives in agriculture sector especially in food processing and creation of 10000 Farmer Producer Organisations. Towards promoting and motivating entrepreneurship in rural sector, the ABI is conducting several unique programmes such as Rural India Business Conclave, Agri-Tech Hackathon, Dream Big Kalpa Interface, and Kalpa Green Chat in association with other stakeholders such as Kerala Startup Mission, ABI network, and Commodity Boards. Through its proactive functioning and efficient networking, the Kalpa Agribusiness Centre, so far has assumed an important role in refining the innovation system in coconut sector.

12.1.8 Recent Advances in Post-harvest Management of Mangos

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Mango is the third most important fruit in the tropics due to its nutritional properties and delicious flavour. The fruit is exceptionally perishable due to its climacteric nature, which decreases the quality and shelf life. The fruit is susceptible to various post-harvest diseases such as anthracnose and physiological disorders, including chilling injury, spongy tissue and lenticel spot. Unfortunately, these individual problems or their combination may result in post-harvest losses as well as the loss of revenue for the producers and everyone involved in the post-harvest value chain. A significant proportion of losses of mango occur during storage and transportation as a result of poor handling and improper facilities. Preserving fruit quality and preventing losses during post-harvest is one of the critical solutions in sustaining human dietary demands. Post-harvest treatments such as 1-Methylcyclopropene, nitric oxide, edible coatings, hot water treatment, hot air treatment, UV-C radiation, ionizing radiation, and vapour heat treatments have shown to be effective in preserving fruit quality. However, developing environmental-friendly post-harvest technologies that ensure the safety of consumers remains a challenge. Gaseous ozone, controlled atmosphere (CA), Dynamic-CA technology, and pulsed electric field (PEF) are some of the emerging technologies with great potential for the mango fruit industry. The use of such technologies has been demonstrated to be effective in maintaining the sensory, nutritional, and physicochemical quality of the mango fruit. However, the mode of action of the emerging technologies is not yet understood. This paper provides of an overview of various postharvest techniques used to preserve mango fruit quality. The potential of the emerging postharvest technologies to maintain mango fruit quality during storage and shelf-life is also discussed.

12.2 Oral Presentation

12.2.1 A Study on Organoleptic and Biochemical Evaluation of Mango-Papaya-Ginger Based RTS Beverage

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India is the second-largest producer of fruits in the world. FAO (Food and Agriculture Organization) declared year 2021 as the international year of fruits & vegetables to reduce the loss and increase the awareness about the importance of fruits and vegetables.

Mango (*Mangiferaindica*) is the most important fruit of India as well as the world which has unique popularity among all fruits, due to its peculiar taste, aroma and considerable amount of nutritional profile as carbohydrates, protein, fiber, vitamin-A, $B_{1,}$ C. It has got the status of "King of Fruits" due to their prodigious characteristic it also has a great opportunity in the processing sector. Papaya is the third important fruit after mango and banana that is distributed in the tropical and subtropical areas of countries. papaya is an inexpensive fruit and easily available in all parts of the country round the year. Ginger (*Zingiberofficinale*) is a herbaceous perennial aromatic plant which has been mostly used as a spice and as herbal medicine from ancient times It is a rich source of various types of biochemical compounds such as phenolic compounds, polysaccharides, organic acids, fiber and lipids. These compounds have antioxidant, antimicrobial, anti-inflammatory properties. Therefore, value addition of fruits can reduce post-harvest losses during peak period.

The present study was conducted with the objective to develop Mango(M)-Papaya(P)-Ginger(G) based Ready To Serve (RTS) beverage. The juice(J) and pulp(P) of experimental fruits were blended in six different combinations T_0Control-(100% MP), T_1(90%MP+5%PP+5%GJ), T_2 (80% MP +10% PP +10% GJ), T_3 (70% MP +15% PP +15% GJ), T_4 (60% MP +20% PP +20% GJ), T_5 (50% MP +25% PP +25% GJ). All the treatments were standardised as 10% blend juice, 10°Brix and 0.3% acidity. The Total Soluble Solids(TSS) acidity present in different blend combinations were determined through hand refractometer and titration method respectively. Organoleptic evaluation of the RTS was conducted by using nine point hedonic scale.

The score of overall acceptability, flavour and appearance was recorded highest in T_1 followed by control (T_0) but in colour and texture highest value was recorded in T_0 followed by T_1. Maximum value of ascorbic acid content was observed in T_5 (5.7mg/100ml) and minimum in T_0 (1.6mg/100ml).

Keywords: Mango, Papaya, Ready To Serve(RTS), Organoleptic evaluation

12.2.2 Backward and Forward Linkages Developed by Farmer Producer Organizations in Lakhimpur-Kheri

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An attempt was made to find out the forward and backward linkages developed by farmer organisations especially for Banana, Sugarcane and vegetable production and marketing. Based on maximum number of farmer producer organizations (FPOs), Lakhimpur-Kheri district from northern Uttar Pradesh was purposively selected. Five blocks i.e., Sadar, Kumbhi Gola, Metauli, Muhammadi and Isanagar. There are total Five FPOs engaged in production and marketing of Banana, Sugarcane and vegetables were selected. From each selected block, twenty per cent respondents were randomly selected, constituting a total sample size of 375 respondents and asked to indicate their response regarding source of assistance for getting finance, procuring inputs, seed production, post-harvest, value addition etc. These functional relationships with other stakeholders were considered as linkage under the study. The responses were recorded using percentage. The results of study revealed that member farmers had developed backward linkages with SAUs, Government Organization and KVKs scientists for technical guidance, and with cooperative Societies for getting loans. FPO members had developed forward linkages with Mandi Parishad, Marketing Board and Sugarcane Industries for marketing whereas, linkages with private sector were developed for Insecticides, pesticides, Seed, Storage of Crop, processing and their value addition. The findings revealed that small and marginal farmers can have strong forward and backward linkages with both private and public sectors that can lead to their overall economic development.

Keywords: FPO, Linkages, Vegetables, Sugarcane, Banana.

12.2.3 Economics of Penconazale I.I% + Mancozeb 50% DF Formulate Fungicides Against Powdery Mildew and Anthracnose Disease in Mango

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The experiment was conducted for valuation of bio-efficacy of Penconazale I.I% + Mancozeb 50% DF formulate fungicides again powdery mildew and anthraconose disease of mango at horticulture nursery during Rabi 2018-19 and 2019-20. The formulated fungicides and different concentration *viz;* Penconazale I.I% + Mancozeb 50% DF @ 20, 30 and 40 g/ 10 lit. of water along with Penconazale I0% EC @ 5ml/ 10 lit water, corbandism 12% +Mancozeb 63% WP @ 15g/10lit. of water, Mancozeb 75% WP @20g/ 10lit. of water and untreated control. The treatments were randomly located in 3 times. The mango yield was recorded in experimental trees ranged from 84.98-17.45 kg/tree significantly higher yield was recorded in Penconazale I.I% + Mancozeb 50% DF @ 40g/10lit.of water (117.45k/tree) followed by Penconazale I.I% + Mancozeb 50% DF @30g/10 lit. of water (108.70kg/tree). Among market checks

the highest mean yield was observed in Penconazale 10% EC @5l/10 lit. o water (106.76kg/tree) during both the season followed by corbondism 12% + Mancozeb 63 % WP @15g/10lit. of water (99.36kg/tree). The untreated control (84.98kg/tree) recorded least yield than all the other treatments. The Penconazale I.I% + Mancozeb 50% DF @ all the doses where given better net return and pr rupee investment. The highest cost benefit ratio was observed in Penconazale I.I% + Mancozeb 50% DF @ 30g/10lit. of water (1:1.52 during first season 1:1.92 during second season) followed Penconazale I.I% + Mancozeb 50% DF @ 40g/10lit. of water. Among the standard check highest cost benefit ratio was observed in Penconazale 10% EC @ 5ml/10lit. of Water (1:1.40) during first season and (1:1.78) during second season. Form the above study it is clear that Penconazale I.I% + Mancozeb 50% DF at all the doses given effectively control against all the disease available in the field along with significant increase in yield as well as net income and cost benefit ration

Keyword: Mango, fungicides, disease.

12.2.4 Sun Dried Oyster Mushrooms for Food Fortification to Enhance Its Consumption in Rural Community

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As the WHO (2016) exposed for malnutrition status in Indian population that 44 % children (<5 years) are underweight and have protein deficiency. Oyster Mushroom (consumable) is one of the indigenous food ingredient, rich in good quality protein and other immunity boosting nutrients. Recently its cultivation has increases in India, due to great agricultural efforts. In case of oyster mushrooms India becomes third largest producer on worldwide. Research studies are reported the poor consumption of mushrooms have been in practice especially among the rural population of India. The causes behind this poor eating practice are ignorance about its product development and utilization in fortification and so on.

The selected rural women of Kannauj distract were trained under the training programme, regarding sun drying of oyster mushroom and its incorporation in different prevalent starchy food products. The pre-post research design was adopted to investigate the impact of training on consumption practices of oyster mushroom. It was recorded in present investigation that 89.67% rural women were unknown to products formed by oyster mushroom. The post test scores on consumption practices had increased significantly. Therefore it is a prime need to aware and trained the people to utilize this nutritious food in their daily dietary consumption to achieving good health of population.

Keywords: Oyster mushroom**,** consumption pattern, training programme, malnutrition, fortification.

12.2.5 Modified Food Products of Underutilized Vegetables Towards Nutrition Security

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In India, most of the most of the vegetables are available as weeds in the crop fields with higher nutritional value but are not fully utilised. To see the prevalence of high level of micronutrient, to overcome malnutrition in different vulnerable sections and nutritional disorders. Green leafy vegetables (GLVs) are rich sources of micronutrients such as iron, calcium, vitamin, protein, fiber, antioxidant, beta carotene, flavonoids and minerals to nourish the human population and help to attain nutrition security. It is described as poor man's vegetables. Although they can be raised at lower management costs even on poor marginal lands, they have remained underutilized due to lack of awareness and popularization of technologies for utilisation. It is essential that the locally available green leafy vegetables which are less expensive and easy to cook, be used in the diets to eradicate micronutrient malnutrition. Green leafy vegetables are used in different ways such as powder, puree, soup etc and make it to be used in the formulation of modified foods (Pasta, Meggi, biscuits) with high nutritional or biological values and sustainable, culturally acceptable, rational applicable, feasible, cost effective and suitable approach to attain nutrition security and combat to nutritional deficiency.

Keywords: Green leafy vegetables, Nutritional security, modified food, antioxidants

12.2.6 Doubling the Income of Farmer Through Post Harvest Management and Value Addition of Horticultural Produces

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India is the second largest producer of the fruits and vegetables in the world after China. Nothing good this for us! because there is 25 to 40% post harvest loss of our total horticulture produces due to lack of post harvest facilities. Not more than 2% processing is done of our total horticulture commodities. Our horticulture export share in the global market is less than 1%; much lesser than small countries. Due to these, our farmers facing problems for generation of income. But there is one hope ray for enhancing the more than doubling income of farmers through post harvest management and value addition of horticulture produces. Post harvest technology and processing have potentiality to create rural industries. We can minimize the post harvest loss and increase the shelf life of fresh as well as processed products of horticulture through post harvest management and value addition. Operations after harvesting like trimming, curing, sorting, washing, grading, chemical treatment, packaging, storage, transportation and marketing are very useful for enhancing quality of fresh as well canned products. We can prepare and preserve so many value added products like jam, jelly, candy, preserve, squash, syrup, cordial, RTS,

ketch-up, sauce, chutney, nectar, pickle, marmalade etc. through canning, bottling, freezing, dehydration, drying and ionization methods. There is no limit for enhancing the income through post harvest management and value addition in horticultural industries. Today we know that there is no need of more production, but there is a need of value addition of our farm produce. At present the price of one kg lime is Rs.5.00 only. but we can earn Rs. 500 from one kg lime by making different value added product like lime syrup(from lime juice-Rs150), lime pickle or chutney from lime fruit peel after extraction of juice(Rs. 100), lime seedlings from lime seed 30-40(Rs. 300-400). There are so many examples of this type of value addition of horticultural as well as other farm produce. So, there is no need for waiting five years for doubling the income, we can earn more than doubling income in one season or in one year through post harvest management, processing and preservation of different value-added products from fresh horticultural produces.

Keywords: Doubling Income, Post Harvest Management, processing, value added products.

12.2.7 Value Addition in Edible Palmyra palm Products Towards Commercialization

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The Palmyra is a tropical palm tree that grows indigenously in India, Sri Lanka, Malaysia, The Philippines, Indonesia and many parts of East Africa. It is widely available in the Tamil Nadu, a south Indian state where it was proclaimed as the 'state tree' in 1978, although it is also cultivated throughout India in Kerala, Andhra Pradesh, Orissa, Bengal, Bihar and along the entire west coast. It is easily cultivated and also found to grow wild. India stands first in the world in terms of its wealth of Palmyra palms with a population estimated to approximately 122 million trees. Palmyra palm has great economic potential and every part of the palm is useful in one way or the other. Palmyra is also known as toddy palm and sugar palm. The edible palm products such as Neera, Jaggery, Palm Sugar, Palm Candy, Palm toffee/ Chocolate, Nungu, Fruit, tuber etc. are rich in vitamin and minerals, dietary fibre and antioxidants, but products are not commercialised due to several reasons. The present work is intended to highlight the probable strategies to enhance the potentialities of this easy growing wild palm to encourage Entrepreneurship and also to generate rural income.

12.2.8 Nutrient Analysis and Acceptability of the Fruits Ladoo

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As per the NFHS – 5 it is estimated that a 17 % of children under the age of 5 years are stunted due to chronic under nutrition and 66% women under the age group of 15-49 years are anemic in rural Delhi

Micronutrient malnutrition is indeed affecting around 20% with serious public health consequences. The operational area of Krishi Vigyan Kendra, New Delhi covers rural and peri- urban area of NCT Delhi. NCT Delhi is a part of Indo-Gangetic plains that falls under semi-arid climatic zone with the annual average rainfall of 730 mm. Most of the arable area comes under irrigated condition. Unfortunately, available groundwater of the major area is of saline in nature. Therefore, the limited crops are grown in the area. There are some underutilized fruits and vegetables which can be grow on saline tolerant land like beetroot, ber and aonla are known as healthiest fruits and vegetables. These are rich in vitamins A and C beetroots have more iron than any other vegetable, including spinach. Beetroot helps in treating anemia, indigestion, constipation, gall bladder disorders, cancer, heart disease, piles and kidney disorders. Aonla fruit is highly valued among indigenous medicines. These indigenous foods neglected and derided by many in the agriculture and food industries as well as by urban consumers, can be an important component in alleviating hunger, malnutrition and protecting the environment. In view of on farm trial on usage of beetroot, aonla and ber is planned to use these in processed and preserved form.The On farm trial was conducted in the South West district of Delhi during *rabi* season of 2017-18, 2018-19 and 2019-20 among 30 farm women. The trial was laid with two treatments with an objective to prepare ladoo with addition of beet root and ber to aonla and to study its acceptability and nutritive value among farm women. The developed ladoo were sensory evaluated using nine point hedonic scale. The micronutrient in these ladoo such as like Iron, vitamin C and Beta carotene were calculated. Results showed that ladoo prepared with beet root, aonla and ber was highly acceptable as scored (8.0±0.09) whereas already established practice was least acceptable as scored (5.5±0.03). The nutrient analysis showed highest Iron, Vitamin c and beta carotene were observed in ber, beet root aonla ladoo sample i.e. 2.34%, 51.3%and 10.14% respectively. Addition of beet root, ber and aonla increased the iron, beta carotene and vitamin C contents proportionately to the level of substitution. Aonla, beet root and ber ladoo - was found most acceptable and was much appreciated when compared with aonla laddoo among farm women.

12.2.9 Effect of Poly-amines on Biochemical Parameters of Mango (*Mangifera indica* L.) cv. Kesar

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An experiment was conducted at P.G. laboratory, Department of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) during the year 2016-17, 2017-18 and 2018-19 to study the biochemical parameters of mango cv. Kesar. The treatment comprised with seven treatments. The experiment was designed in Completely Randomised Design (CRD) with three replication. The effect of polyamides was found significant on biochemical characters in all years as well as in pooled results. The better response for different biochemical parameters like TSS (^{0}Brix), reducing sugar (%), total sugar (%), non reducing sugar (%), ascorbic acid (mg/100g) and acidity (%) was recorded with fruit treated with T_5 175 ppm Putrescinedihydrochloridefor 5 minute for increasing shelf life and quality up to 12 days' storage at room temperature.

Keywords: Polyamides, Mango fruit and biochemical

12.2.10 Sweet Lime & Orange Peel: A Source of Mosquito Repellent Finish

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Finishing of cotton fabric with fruit peels give it special functional properties that ensure our-safety from mosquito borne diseases. Anti-mosquito repellent textiles with improved functionality find a variety of applications such as health and hygiene products. Organic mosquito repellents may be one of the most effective tools for protecting human from vector borne diseases such as malaria , dengue fever, chickengunia and filariasis .These repellents are eco-friendly, biodegradable, low cost and can be used with minimum care. The investigation was carried out to optimise the process of organic mosquito repellent finish with peels of sweet lime and orange . Optimisation of variables viz; concentration of organic mosquito repellent, finishing temperature and finishing time was done on the basis of optical density measured through spectrophotometer.Cotton samples were then finished with optimised process and mordanted. Wash durability of finished samples, mordanted with different concentration of citric acid for different time were checked upto 5 to 10 launderings.Finished and mordanted samples were tested for mosquito repellency in mosquito cage box. Finished cotton samples were also evaluated for fabric stiffness, tensile strength, crease recovery and drape co-efficient. Cotton fabric finished with orange fruit peel extract showed better mosquito repellent efficiency than sweet lime fruit peel. This peel extract protects the human beings from the bite of mosquito and there by promising safety from mosquito vector diseases when applied on cotton fabric. Thus it can be successfully utilised in apparel, mosquito net, window curtain and other home furnishings.

12.2.11 Under Exploited Vegetable Crops: Rich Sources of Various Vitamins and Minerals in Human Nutrition

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Vegetables are the major component of balanced human diet and also the main drivers in achieving global nutritional security by providing nutrients, This spectacular growth in vegetable production has increased and this was possible due to development of improved varieties, production and protection technologies through systematic research coupled with large scale adoption by the farmers. However, this tremendous production was contributed by only few major vegetables. Although, diverse agro climatic conditions of India permit to grow more than 60 cultivated and about 30 lesser known vegetable crops, not much attention has been given on underutilized vegetables known. The vegetable crops which are neither grown commercially on large scale nor traded widely may be termed as underutilized vegetable crops vitamins and minerals. The underexploited vegetables play an important part of food and nutrition of

local, tribal population. Since ancient time, they are used as medicinal, therapeutic and nutritional purpose. They are rich in various nutritive components, which can compensate for the dietary deficiencies of vitamins and minerals necessary for human diet. There are reports that indigenous vegetables (IVs) like Yam, beans, Colocasia, Moringa, Alocasia, Xanthosoma, Sword bean, Dolichos spp., Luffa spp., Amorphophallus, Cucurbits, leafy vegetables and numerous others are known to be good source of micronutrients, and also high in antioxidants and anti-microbial phytochemicals. Thus, these vegetables are not underutilized but undervalued due to limited information on their nutritional, anti-nutritional and nutraceuticals aspects etc. Efforts on conservation, utilization of underexploited vegetables and their popularization will bring immense prosperity among the growers. Since, the under exploited vegetable crops have a long history of consumption, the local people are aware about their nutritional and medicinal properties.

Keywords: Vegetables, underexploited, vitamins and minerals.

12.2.12 Compositions of Anthocyanin's in Different Gladiolus Varieties

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In present investigation of identification of anthocyanin pigments in gladiolus ten cultivars of were selected and HPLC analysis was carried out. In HPLC analysis 6 major anthocyanin peaks were identified. Chromatographic peaks were surveyed for 10 cultivars by HPLC analysis. Among these major six pigments were recorded in majority of the cultivars except pigment malvidin which was not detected in two cultivars and found in traces in two cultivars. The most dominantly distributed pigments are pelargonidin and peonidin in cultivars Deep Red, Pusa Suhagan and Shahnoda. The pigments cyanidin, peonidin and malvidin was dominantly distributed in cultivars Candyman, Pusa Urmi and Arka Pratham. The pigments cyanidin and peonidin was detected in cultivars Priscilla and Pusa Gunjan. The pigment malvidin was not detected in cultivars Deep Red and Pusa Gunjan and found in traces in cultivars White Prosperity and Yellow Stone. In cultivars White Prosperity and Yellow Stone all the pigments were found in traces. Based on the percentage of pigments detected the cultivars are classified into five groups (A-E). In group A, the average of pelargonidin and peonidin pigments was 72.02 % which as responsible for red colour to the florets in cultivars. In group B, the pigments detected were cyanidin, peonidin and malvidin. The average of these pigments was 68.10% which gave pink-violet florets colours. In group C, the average of cyanidin pelargonidin and peonidin pigments was 60.87 %. The three major pigments along with other pigments in traces were responsible for light orange petals with dark orange macule in cultivar Pusa Gunjan and white petals with dark pink edges in cultivar Priscilla. In group D, the pigments detected in HPLC analysis were cyanidin, pelargonidin delphinidin peonidin and petunidin whereas pigment malvidin was not detected in cultivars Deep Red and Pusa Gunjan. In group E, the cultivars White Prosperity and Yellow Stone are white and yellow in colours, respectively and all the pigments recorded were in traces in HPLC analysis. The presence of anthocyanin pigments in white and yellow coloured cultivars might be due to the reddish spots/strips present on the perianth of florets

Keywords: Gladiolus, Anthocynins, Pigments, Petals, HPLC.

12.3.1 Efficacy of Chlormequat Chloride on Vegetative Growth, Yield and Residues in Thompson Seedless Grape

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Efficacy of Chlormequat Chloride on vegetative growth, yield and Residues in Thompson Seedless Grapewas studied at lCAR- National Research Centre of Grapes, Pune during 2021-2022. Chlormequat chloride (CCC) is a highly stable gibberellin biosynthesis inhibitor that inhibits the vegetative growth and cell elongation. It is commercially more acceptable and commonly used to control vegetative growth in plants and improves its fruitfulness. The experiment was conducted in p Pl block design (RBD) having 4 treatments and 5 replication. The application of CCC also applied at 5, 7, 12 leaf stage during foundation and fruit pruning. Morphological observations were recorded at 45 days after foundation as well as fruit pruning. Application of Chlormequat chloride recorded reduced shoot length and Internodal distance while increased in cane diameters. The results showed that Treatment T_3 (CCC @ 2000 ppm) found minimum shoot length (101.18 cm) and maximum fruitfulness (78.94%), bunch weight (240.50 g), berry diameter (16.80 mm) and berry length (18.14 mm), yield/vine (10.90 kg) and yield/ ha (20.10 tonnes) as compared to untreated vines. The Berry samples was tested for residue study. The residues in all treatments of CCC were found below MRL (0.05 mg/kg).

Keywords: Chlormequat chloride, vegetative growth, residues, Thompson Seedless grape.

12.3.2 Efficacy of Acadian Gold Star on Growth, Quality and the Yield of Grapes

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The experiment was conducted at ICAR- National Research Centre of Grapes, Pune during 2021-2022, investigating on Efficacy of Acadian Gold star on growth, quality and the yield of grapes.Acadian Gold star is an exclusive mixture of beneficial bioactive compound (alginic acid, oligosaccharides, betaines, mannitol, fucose containing polymer, other carbohydrates and nutrients) from *Ascophyllum Nodosum* seaweed. This enhances natural processes within the plants by switching on gene expression and active compound production that stimulates plant growth and protects against environmental stresses. The experiment was designed in randomized block design (RBD) having 6 treatments and 4 replication. Viz. T_1 (0.25 kg/ha), T_2 (0.50 kg/ha), T_3 (0.75 kg/ha), T_4 (1.00 kg/ha), T_5 (1.25 kg/ha), T_6 (control).The application of Acadian Gold star also applied at 1-2 inch bunch, 14 days after 1st spray, 10 days after fruit set, 2 weeks after 3rd spray, 2 weeks after 4th spray, Version stage. The results showed that Treatment

T_3 (0.75 kg/ha) obtained higher chlorophyll contain (2.43 mg/ g at version stage), maximum bunch weight (216.16 g), 50 berry weight (125.78 g), berry diameter (14.46 mm) , berry length (19.80 mm) and yield/ ha (16.86 tonnes), TSS (21.05 Brix), Acidity (0.66%), whereas the skin thickness (0.30 mm) and pedicle thickness (0.17 mm) were found higher in treatment T1 as compare to untreated vines.

Keywords: Acadian Gold star, Efficacy, Grapes, Yield.

12.3.3 The Impact of Mepiquat chloride (MC) 5% AS on Yield and Quality Parameters and Residue Studies in grapes

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The experiment was conducted at lCAR- National Research Centre of Grapes, Pune during 2021-2022, to evaluate the impact of Mepiquat chloride on yield and quality parameters and residue studies in grapes. Mepiquat (N, N-dimethylpiperidinium) is a plant-protection product used intensively as a plant growth regulator in agriculture usually as the chloride salt, and it acts by inhibiting the biosynthesis of gibberellic acid. The effects of Mepiquat Chloride (MC) 5% AS application at different concentration on grapevine were examined on the vegetative growth, yield and quality parameters of Thompson Seedless grapes grafted on Dogridge rootstock. The experiment was designed in randomized block design (RBD) having 3 treatments and 7 replication. Viz. T_1 (50 g.a.i/ha (1000 ml)), T_2 (100 g.a.i/ha (2000 ml)), T_3 (control). The application of Mepiquat Chloride also applied at 3- 5 leaf stage and 5-7 leaf stage during foundation and fruit pruning. The results showed that Treatment T_2 (100 g.a.i/ha (2000 ml))found minimum shoot length (90.11 cm) and maximum fruitfulness (78.23%), bunch weight (245.20 g), berry diameter (17.11 mm) and berry length (19.84 mm), yield/vine (11.4 kg) and yield/ ha (20.55 tonnes) and TSS (20.90 Brix), Acidity (0.67%) as compare to untreated vines. The Significant differences were recorded with gas exchange parameters. The leaf, Berry and soil samples were tested for residue analysis and below MRL (0.02 mg/kg) were found in all samples. In this study it can be concluded that Mepiquat chloride 5% AS was found to be effective in controlling vegetative growth and eventually resulting for increasing per cent fruitfulness, yield, quality and MRL in Grapes.

Keywords: Plant growth regulator, Mepiquat chloride 5% AS, residues, Thompson Seedless grape.

SUPPLEMENTARY ABSTRACTS *(Received late)*

5.3.8 Impact of Startup on Production of Potato through Tissue Culture in Etawah: A Case Study

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Etawah is situated on of 26.81' latitude and the 79.03' longitude, delineated in south western semi arid zone of Uttar Pradesh. It is comprised of 5 Tahsils, viz., Bharthana, Etawah, Saifai, Takha, and Jaswant Nagar and 8 development blocks viz., Badhpura, Basrehar, Jaswantnagar, Mahewa, Saifai, Chakarnagar, Takha, and Bharthana. Average rainfall of the district is 620-750 mm and Maximum and minimum temperature are 45.6 ^{0}C 7.4 ^{0}C with average humidity is 60%.

The district is categorised in four agro ecol;ogical situation. On the basis of the natural features of AES, they are named as Pachar, Ghar, Karka and Par. Paddy, maize, pearl millet, potato, wheat, mustard and vegetables etc. are the major crops of district in Rabi season. Potato is one of the major crop and grown in area of 16129 ha. The productivity of potato in the district is 220q/ ha which is 50 % of the potential yield of improved varieties of potato recommended for central plain zone. Among several yield limiting factors, virus diseases are predominant and with poor availability of quality seeds of improved varieties.

To enhance the productivity and quality of potato KVK Etawah conducted on farm trials and FLDs on the farmer's field in village Navali of block Basrehar. Consequently the productivity enhanced by 52 % but the availability of seeds of improved cultivars of potato increased non significantly. In order to solve the problem of potato seeds, KVK initiated the seed production programme of potato by facilitating technical knowledge to Shivam Tiwari , an young farmer, native of village Navli, block Basrehar of district Etawah. He got advance training in seed production of potato from ICAR-CPRI, Shimla on recommendation of KVK Etawah and establish a tissue culture lab during 2018 and consequently started production of potato seed through tissue culture on large scale within 3 years. At present he is supplying the seed of potato of improved varieties viz., Kufri Sangam, Kufri fryom, Kufri Lima, Kufri Sukhyati, Kufri Khyati, Kufri Bahar, Kufri Mohan, Kufri Neelkanth. Kufri Chipsona and Kufri Laukar in Etawah district as well as other states *viz*., M.P., Rajasthan, Haryana, Chhattisgarh and Punjab. His annual income increased from Rs. 30.00 lakh to Rs.1.05 crore. His start-up has become source of inspiration for other unemployed youth in the district Etawah.

9.2.19 Efficacy of Some Plant Extract Against Banana Pseudostem Weevil, Odoiporus longicollis Oliver

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Banana is one of the most popular fruit crops cultivated throughout the world. In India, banana ranks first in production and third in area among fruit crops. It accounts for 13 per cent of the total area and 33 per cent of the production of fruits. Banana pseudo stem weevil, Odoiporus longicollis is considered as a predominant and also a major constraint for the production of banana on worldwide basis, especially in India. A preliminary investigation was carried out in Post graduate laboratory, Department of Entomology, Assam Agricultural University, Jorhat during the year 2019-20 to determine the LC50 values of plant extracts *viz*. Xanthium strumarium, Lantana camara, Clerodendron infortunatum, Melia azaderach and Azadirachta indica along with imidacloprid as standard check. In case of Solvent plant leaf extracts, the LC50values of X. strumarium was found to be 32.507, 30.19 and 21.082, for L. camara it is 14.454, 11.65 and 9.741 % after 24, 48 and 72 hours after treatment. In case of aqueous plant leaf extracts, LC50 values were found to be 75.881, 58.708 and 39.02 % in case of X. strumarium. Similarly, L. camara showcased 21.863, 17.829 and 15.791 %.. Based on LC50 values, order of toxicity was Imidacloprid > Lantana camara > Azadirachta indica > Clerodendron infortunatum > Melia azaderach > Xanthium strumarium in case of both aqueous and solvent leaf extracts.

Keywords: Banana, Odoiporus longicollis, LC50, solvent extract, aqueous extract

9.2.20 Seasonal Abundance of Banana Leaf and Fruit Scarring Beetle (Basilepta subcostatum, Jacoby)

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An extensive study was carried out in the Horticulture Experimental Farm, Assam Agricultural University, Jorhat during May, 2020 to April, 2021 to assess the abundance of leaf and fruit scarring beetle, Basilepta subcostatum Jacobyassociated with banana on a weekly basis on the variety Dwarf Cavendish locally known as Jahaji. The beetle population was co-related with different meteorological parameters viz., maximum and minimum temperatures (^{0}C), morning and evening relative humidity (%) and total rainfall (mm). The mean beetle population was highest during August, 2020 (52.51 beetles/plant) when the maximum temperature was 32.2 ^{0}C, minimum temperature 24.9 ^{0}C, morning relative humidity 97%, evening relative humidity 85% and rainfall 12 mm and the least was during January, 2021 (5.62 beetles/plant) when the maximum temperature was 24.6 ^{0}C, minimum temperature 15.2 ^{0}C, morning relative humidity 98%, evening relative humidity 92% and with no rainfall. The population of the beetle showed positive and significant correlation with various meteorological parameters *viz*. maximum and minimum temperatures, evening relative humidity, total rainfall except morning relative humidity where it showed negative correlation. Multiple regression analysis of the beetle population with different meteorological factors showed 85.5 per cent shift in population due to the combined effect of various meteorological parameters.

Keywords: Beetle, Basilepta subcostatum, population, meteorological parameters

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