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Technical Session 1: Golden Jubilee Celebration of ISMPP (1970–2021)

SPS Issues, Pest Management Strategies and Export Sustainability of Agricultural Produce

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Agriculture production has shown consistent increase during the last about five decades in India. Over 316 million tonnes (MT) of food grains, 333 MT of fruits and vegetables and 199 Mt of milk production during 2021-22 is marvelous achievement which turned the nation as an agri-exporter country. Presently, USA, China, EU, Bangladesh, UAE, Vietnam, Nepal, Iran, Saudi Arabia, Malaysia and Indonesia are main countries for export of wheat, rice, millets, fresh vegetables, banana, mangoes, grapes, oranges and spices from India. Although with 7.5 per cent export, the country is among top 10 agricultural produce exporters but in recent years, rejection of export consignments of food particularly from US and European Union on ground of contamination remains to be an issue of serious concern. The problem becomes more severe when certain countries particularly EU set higher food safety standards than even those set by the *Codex Alimentarius Commission* (CAC), an international organisation, mandated to fix such norms and maximum residue limit (MRL) for chemicals in various products. Implementation of such stringent standards leads to rejections by the importing countries. For such reasons, India faced as many as 42 rejection related notifications on export of basmati rice only for not meeting the EU food safety standards between 2000 and 2016.The trend is continued which needs serious concern of plant protection scientists. Basmati rice is an important commodity for export from India however; its export has suffered because of pesticides residue exceeding the MRL set by the importing countries particularly belonging to EU. Besides some such notifications due to the presence of aflatoxins (*Aspergillus flavus* and *A. parsiticus*), chloropyriphos, bromide, profenofos, more rejection notifications have happened due to the presence of carbendazim, acephate, hexaconazole and triazophos. The issue of presence of residue of tricyclazole in Indian rice was also raised by the US but it was more serious and cause of concern for drastic reduction in exports to EU which reduced its MRL from the norms set by the CAC. The EU lowers the MRL for different chemicals frequently and many Middle East countries are also now adopting EU-at par norms, it requires to be debated for want of scientific reasons and research data behind such decisions to protect the export of rice. It is most appropriate to raise such issues by India with G 20, an international forum of 19 countries and EU, of which it is president for 2023. Restrictions on acceptance of "organic basmati rice" consignments by EU due the presence of carbendazim need serious attention by the Export Inspection Agency (EIA) to maintain reliability of organic export from the country. For solving SPS issues, foremost important is to ensure conformity to the standards of importing countries. Following good agricultural practices such as reducing the use of pesticides, particularly those banned in importing countries, global best practices necessary to maintain food hygiene, refining testing procedures and undertaking corrective measures regularly are important to remain relevant in competitive global market. Establishing reliable product traceability system supported by proactive measures with adequate forecasting system for the expected problems and undertaking corrective measure is the most successful way of resolving a number of SPS issues. It is desirable to reduce pesticide use through implementation of other procedures of pest management. It includes application of knowledge attained in molecular biology with higher level of exploiting Marker Assisted Selection (MAS) for developing crop varieties with resistance genes and Microbe Associated Molecular Pattern (MAMP) for using own acquired immune system of plants. Genetic Modification (GM) by transgenesis and Gene Editing (GE) technology, technically CRISPR-based gene correction by tweaking own genes have fathomless immense potential to control problematic pest and pathogens and improve farm production. CRISPR/cas9 is relatively easy to design and implement with huge success rate, more versatility and less expensive. However, development of crop based integrated pest management modules has its own value forproducing pesticide free agricultural produce.

LL 01: Plant Health Management in the Natural and Organic Farming Systems

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Organic farming is an ecological production management system that promotes and enhances biodiversity, biological cycles, and soil biological activity. There are different components in organic farming like crop rotation, utilization of crop residues as manure, application of organic manure like FYM, green manure and compost, application of biopesticides, biofertilizers and vermicompost which will improve the fertility of soil. Natural farming (NF) defined as a chemical-free alias traditional farming method considered as agroecology based diversified farming system which integrates crops, trees and livestock with functional biodiversity. The

products of natural farming are Beejamrit, Jeevamrit, Whapasa, and for plant protection practices Neemastra, Brahmastra, Agniastra, Dashapani Ark or Kashaya. The ingredients used in the components of natural farming practices are *viz*., cow dung, cow urine, lime, jaggery, pulses' flour, botanicals extract like, neem leaves, karanj leaves, custard apple leaves, datura leaves, mango leaves, tobacco powder, green chilli, garlic paste, turmeric powder, ginger paste, asafoetida, milk, curd and etc. There are major initiatives taken by NITI Aayog, Government of India (GoI) through the concept of Zero Budget Natural Farming (ZBNF) in Andhra Pradesh, Chhattisgarh, Himachal Pradesh, Uttarakhand, Kerala and Karnataka and implemented ZBNF- the farmers in these states are treating seeds with Agniastra, Brahmastra and Neemastra. Indigenous microorganisms (IMs) are a group of innate microbial consortium that inhabits the soil and the surfaces of all living things inside, and outside which have the potentiality in biodegradation, bioleaching, bio composting, nitrogen fixation, improving soil fertility and as well in the production of plant growth hormones. IMOs-based technology was developed and introduced by Dr. Chou Hankyu in 1960s.Natural farming with IMO Technology is a distinctive approach in organic farming and it has been practiced in more than 30 countries in their home gardens and on a commercial scale. Effective microorganisms (EMs)are cultured mixture of beneficial microorganisms. The main difference between them is that IMOs are naturally made, while EMs is laboratory made, but these are very much the same with one another in all aspects. There are many successful effective microbes namely, *Trichoderma* spp. arbuscular mycorrhizal fungi (AMF), Actinobacteria, *Pseudomonas* spp*.,* and *Bacillus* spp. These species are identified as a dominant microbial community as such from soil which inhibit the growth of soil borne pathogens and induce resistance in host against pests. The applications of more microbial load of these Ems are very useful in the biological management practices of plane pest management and the impact of the root microbiome on plant health is evidenced most clearly in disease-suppressive soils. Presently with the upcoming organic and natural farming research, microbes are gaining importance both for crop growth and protection. The change in attitude towards the non-chemical food has laid a foundation of microbial application in the agriculture. We need to be very specific in research and practical field application so that good agricultural practices are available for the quality production and protection of the crops. The consortium research on microbes is further giving us high hopes in managing the crops by introducing the effective microbial solutions.

LL 02: Seed Health in Food Security

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The devastating effects resulting from plant pathogens/ diseases introduced along with planting material, agricultural produce and products during international movement are well documented. The Irish famine of 1845, which of course forced the people to migrate *en masse* from Europe, was the result of almost total failure of potato crop due to epidemic caused by late blight (*Phytophthora infestans*) introduced from Central America. Downy mildew (*Plasmopara viticola*) of grapes was introduced in succession into France in mid nineteenth century from North America resulted in extensive damage to the grapevines-based industries. Coffee rust (*Hemileia vastatrix)* appeared in Sri Lanka in 1875 and the disease caused severe significant reduction in yield from 400 million pounds in 1870 to just 5 million in 1889. The disease entered India in 1876 from Sri Lanka and within a decade, badly affected the coffee Industry of South India. *Tilletia indica* (Karnal bunt of wheat) from India to USA in 1996 etc. The glaring examples of international spread of bacterial pathogens are bacterial canker of tomato (*Clavibacterm ichiganensis* subsp. *michiganensis*) got introduced in the United Kingdom during 1942 from USA and in 1943 it spread further in localities, bacterial blight of soybean (*Pseudomonas savastanoi* pv. *glycinea*) introduced with seed into Scotland from Sweden; bacterial blight of beans (*Xanthomonas axonopodis* pv. *phaseoli*) appeared in epiphytotic proportion for the first time in New Zealand during 1970 as a result of bean seed imported from the Netherlands in 1969 etc. These migrated pathogens/ diseases have led to profound economic and social consequences in the past. ICAR-NBPGR imports every year ~100,000 samples including germplasm of agri-horticultural crops, international trials and transgenic material for research use both by public and private sector. Critical quarantine examinations of importing materials result in interception of a large number of exotic pests in various crops from different parts of the world. The interception of quarantine pathogens for India included *Monograph ellanivalis* in wheat, *Fusarium oxysporum* f. sp. *cucumerinum* in cucumber, *Peronospora manshurica* in soybean, *Diaportheeres* in Black locust, *D. longicolla* in soybean and sunflower, *Uromyces beticola* in sugar beet etc.; viruses such as maize chlorotic mottle virus, wheat streak mosaic virus, barley stripe mosaic virus, bean pod mottle virus, broad bean mottle virus, broad bean stain virus, broad bean true mosaic virus, cowpea severe mosaic virus, cowpea mottle virus, tomato ringspot virus, etc. and insects such as *Anthonomus grandis, Callosobruchus rhodesianus, Sitophilus granaries*, *Trogoderma variabileetc*. Crop seeds are the most important mode of carryover crop pests and pathogens from one season to another and also the easiest mode of long-distance dissemination. The seed-borne pests primarily result in germination loss; seed discoloration and shriveling; spread of disease to new areas; distribution of pathogens or their new strains/physiological races along with the seeds to new countries or areas; and development of plant disease epidemics. A large number of fungal (~1500 species), bacterial (~300 species) are known to be seed-borne/seed-transmitted in 534 crop species and 53 viruses of about 124 plant species of economic importance. Such interceptions of large number of quarantine pests on a wide range of crops from different countries emphasize the importance of seed health. So, ascertaining seed health becomes more relevant in preventing entry and spread seed-borne/ seed-transmitted pests harmful to

the crops for agricultural biosecurity into the country, otherwise huge losses would occur due to introduced pests/ diseases.

LL 03: *Trichoderma* spp. in Management of the Biotic and Abiotic Stresses in Plants, Their Commercialization for Use in Sustainable Agriculture and For Rural Prosperity

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Bioagents *viz., Trichoderma viride, T. harzianum,T. asperellum etc*. have been found quite effective in mitigating biotic stresses *i.e.* seed and soil-borne diseases of crops *viz.*, wilt (*Fusarium* spp.), root rot (*M. phaseolina*, *R. solani*), collar rot (*A. niger*) *etc*. which may cause huge quantitative and qualitative yield losses in crops. These bio-agents also mitigate the abiotic stresses of plants caused by extreme temperatures, drought, salinity, oxidative, *etc*. These bio-agents are efficient colonizers in their habitats, promote plant and root growth, trigger SAR and ISR. Besides, these also decompose farm and urban organic wastes with cell wall degrading hydrolytic enzymes and making the nutrients available to plants. The use of bio-agents to manage plant health is the present day need for eco-friendly and sustainable crop production; remunerative return of agricultural produce; generation of employment through their commercialization. *Trichoderma* spp. as bio-agents, bio-stimulants, are in huge demand in agriculture to manage the stresses. Thus, it is the best sector for improving socio-economic conditions of farmers and nations to become prosperous. Mass production technologies of *Trichoderma* spp. *i.e.* fermentation, formulations, *etc*. have been developed. Commercial production of these bio-agents has now emerged as a potential sector for employment generation, where millions of skilled persons will be required at different levels in near future particularly in developing world, where unemployment among the youths are the emerging problem. In India, ICAR, SAU's have introduced ELP's for the students to become entrepreneurs. The KVK's, NIPHM, *etc*. impart trainings to entrepreneurs/ farmers for establishing bio-agents production units. Being a Sun rise sector, the funding agencies, Central and State Govt., *etc*. need to support farmers, entrepreneurs, NGO's, SHGs, *etc*. for hands-on training in the production process and to establish production units of the bio-agents. There is a need to establish 'Bio-resource complex' for production, training and guidance of needy HR; establishing collaborative research groups, nation-wise as well as globally for innovative outcomes of the product development of the bioagents for the efficient use in the agriculture.

LL 04: Balance Use of Molecular and Biological Tools for the Confirmation of Seed Transmission of *Begomovirus*

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Begomoviruses are seed transmitted or not is still a complex puzzle. The presence of *Begomoviruses* in the seeds, especially the *Mungbean yellow mosaic virus* (MYMV) in mungbean seeds was first time detected in 2010 by our group from Navsari, Gujarat (India). However, its seed transmission was not observed, therefore, proposed its indirect route in 2015 by using whiteflies. Overlooking the differences between seed-borne and seed-transmission, a team from South Korea in 2015 claimed that *Sweet potato leaf curl virus* in sweet potato, and in 2016, the *Tomato yellow leaf curl virus* (TYLCV) in tomatoes are seed transmitted. Principally TYLCV was not the seed transmitted as required whiteflies for transmission. They used a cage to demonstrate it which needed validation. TNAU, in 2016 discussed that MYMV was seed-transmitted, but the emerging seedling remained asymptomatic. Why it was asymptomatic needs either correction or scientific justification. This overlooked fact has led to many claims of the erroneous first report of seed transmission of *Begomovirus* which has been thoroughly researched and rejected in 2020 and 2021. Misunderstanding needs clarification. Seed-borne term merely indicated that the pathogen and seed are associated, however, does not guarantee that the diseased seedling will be produced. It will be known as seed-transmitted if a seed-borne pathogen can give rise to infected seedlings. All the seed-transmitted viruses are seed-borne; however, all seed-borne viruses are not seed transmitted. Accordingly, *Begomovirus* has been detected in the seeds, however, it has not been firmly explained that it can give rise to infected seedlings. Therefore, *Begomoviruses* are seed borne but not seed-transmitted viruses and must be corrected in the future citation. Erroneous claims of seed transmission of *Begomoviruses* were results of more on dependence molecular tools instead of balance use of biological and molecular tools. Molecular tool does not prove viability of the seed, therefore, we developed callus from the different parts of the seeds and find the presence of MYMV in the callus developed from the cotyledon. Subsequently, the biological tools were used for the confirmation.

LL 05: Millets Diseases and Their Management

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Millets are important crops in the semi arid tropics of Africa and Asia and are considered to be climate resilient. Millets cultivated in India are sorghum, pearl millet, foxtail millet, proso millet, finger millet, little millet, kodo millet and barnyard millet. These crops can survive and produce grain and fodder even on residual moisture. Even though millets are hardy or climate resilient, they suffer from several biotic stress *i.e.*, by insect pests and diseases, a major constraint to harvest the potential yield. Diseases which occur at seedling stage such as damping off, seedling blight, viral diseases and downy mildew are reported to affect the yield by reduced total plant stand. On the other hand, panicle diseases such as grain mold,

ergot, and smut are most important diseases as they influence directly the grain yield and quality. In foliar diseases, rust, anthracnose, downy mildew, leaf blight, leaf spots and even viral diseases were reported to affect the yield. With respect to root and stalk diseases, the crop suffers from an important soil borne disease called a charcoal rot which leads to lodging of the crop and poor grain filling. In addition, the crops also suffer from several viral diseases like mosaics, necrotic red stripe, maize stripe etc., The incidences of the viral diseases have increased over the last two decades and posing one of the major threat. Generally, viral infection leads to symptoms like mosaic, mottling, yellowing, chlorotic streaks or stripes, reddening of leaves, necrotic spots, dwarfing/stunting, delayed flowering, sterility and poor exertion of panicle. In addition to grain and fodder yield, they also reduce the protein, total soluble solid, digestibility (forage sorghum) and sugar yield in sweet sorghum. Many a times, early infection leads to stunting and eventually death of the plants without any grain yield. In recent times there is an increasing trend of these viral diseases on sorghum which might be due to intensive cultivation, change in weather factors, vector survival and host specificity. These viruses survive on a wide range of grassy weeds and transmitted by insect vectors *i.e.*, plant hoppers and aphids. Broadly, diseases of millets can be managed by cultural, chemical and by developing resistant cultivars. Regarding cultural practices, collateral and alternate hosts, weeds, volunteer crop harbouring pathogen should be removed to manage diseases like ergot, downy mildew, rust, blast, leaf spots and bacterial and viral disease. Deep summer ploughing and crop rotation can help in reducing inoculums of downy mildew, smut and charcoal rot. Maintaining optimum plant spacing and regulating nitrogenous fertilizer reduces incidence of blast, downy mildew and charcoal rot. In case of viral diseases, there are no direct method to control or manage. However, viral diseases can be minimized by altering the date of sowing (sowing in October) which will save the crop from exposing to high vector population. Need based application of botanical pesticides like neem seed kernel suspension 0.04% + soap can bring down the insect vector population. In biological control, soil-borne disease where adequate level of host resistance is not available, bio-control agents especially *Trichoderma* and *Pseudomonas* strains can be used. Chemical methods are not generally encouraged for millets looking into its cost and labour input. However, sometimes it becomes necessary to use chemicals like fungicides for seed treatment or foliar spray or combination of both to manage foliar and soil borne diseases. With respect to developing resistant cultivars, host-plant resistance provides the most economic and environment friendly method of managing diseases in general and could be the only viable option for economically poor farmers. To manage grain mold use of tolerant cultivars and harvesting the crop at physiological maturity followed by drying of grain is useful. Regarding charcoal rot, due to lack of high level of genetic resistance, drought tolerant, lodging resistant and non-senescing sorghum genotypes are supposed to have good tolerance. Overall, improvement of varietal resistance is considered to be superlative, economical and most effective way in managing diseases. But, sometimes use chemical in combination with resistant cultivar becomes necessary to manage the disease of millets. The work on developing resistant cultivars is going on as a continuous process. However, the activity needs to be continued further on identification of new resistance sources incorporating them into productive cultivars.

PP Singhal Memorial PI Industries Award Competition

PPSMA (S1) 01: Green Engineered ZnO Nanoparticles: Its Synthesis, Characterization, Study on Mammalian Toxicity and Use for Plant Disease Management

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In nanotechnology, scientist try to understand and control of matter at dimensions between 1 and 100 nm, where unique phenomena enable novel applications. At nanoscale dimension all the physical, chemical and biological properties changes drastically. Nanoscience has wide opportunities in the field of medical science, biotechnology, information technology, environmental science, cosmetics and textile industries and agriculture and allied sectors. Out of the different nanoparticles, Zinc oxide nanoparticles (ZnO NPs) are commonly employed in the fields like biomedicine, electronics, electro technological industries, food industry etc. due to their noble properties. A series of study is being done since last 10 years and able to standardize the protocol for green synthesis of ZnO NPs. These were then characterized by DLS, SEM, TEM, FTIR, NTA and EDX *etc* and found to have hydrodynamic diameter of 47.8 nm, average zeta potential of -22.7 mV, concentration of 2.07X1010 ± 3.54×109 particles/ml, roughly spherical in shape and composition of Zn and O as 85.99 and 14.01% by weight respectively. The characterized ZnO NPs when tested against soil borne and aerial plant pathogens at different dosages, 100 ppm concentration was found best in inhibiting the pathogens like *Sclerotinia sclerotiorim*, *Rhizoctonia solani*, *Sclerotium rolfsii, Bipolaris oryzae, Xanthomonas oryzae* pv. *Oryzae* and *Ralstonia solancearum*. Mode of action of ZnO NPs on the targeted pathogens was found as swelling, deformation, lysis that ultimately leads to death of the of inoculam. Further formation of ROS, reduction of TSS, TSP were also observed in the inoculam upon exposure to ZnO NPs. During the study it was also found to be safe up to 100 ppm with mild toxicity to the mammalian cell. An encapsulated formulation was prepared with ZnO NPs and bioactive compound of biocontrol agents which showed as an effective plant health material for management of the targeted fungal and bacterial diseases as seed treating and foliar application with positive effect on the plant growth and yield attributing parameters of agricultural crops. Besides, increased concentration of major secondary metabolites like phenols and terpenoids, and reduced sugar content were also observed in treated plants.

PPSMA (S1) 02: Fungicide Tolerant Phylloplane Bacteria for the Management of Early Blight Disease of Tomato

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Tomato is an important vegetable crop consumed all over the world. It is highly vulnerable to infection caused by several pathogens and among them; early blight disease incited by *Alternaria solani*is one of the main limiting factors. In order to manage this disease, an attempt was made to develop the management practices involving fungicides and bioagents. In the study, leaf samples exhibiting the characteristic symptoms of early blight disease of tomato were collected from ten different places belonging to five districts of Karnataka. The pathogenic isolates associated with disease were isolated on PDA media. The isolates were coded as A1 to A10. The pathogen was identified based on the cultural and morphological characters. The Koch's postulates were proved for the isolate A1 using variety Durga. The pathogenic isolates were further characterised through amplification and sequencing of ITS region. The sequence analysis of all isolates revealed that isolate A1, A2, A3, A5, A8, A9 and A10 were found to have homology with *Alternaria longipes*, while the isolates A6 and A4 hadhomology with *Alternaria infectoria* and A7 was found to have homology with *Alternaria alternata.* For the management of disease, various fungicides belonging to systemic, contact and combi-product group were screened through invitro. Among the fungicides, Propiconazole 25% EC, Copper oxychloride 50% WP, and Zineb 68% + Hexaconazole 4% WP were found to be effective in arresting the growth of *Alternaria* sp. *in-vitro.* Further, out of twenty-eightphylloplane bacteria screened against *Alternaria* spp. *in-vitro*, BA1 and PS4 were selected based on efficacy and compatibility with potent fungicides. The two effective bacterial isolates namely PS4 and BA1 were identified through amplification and sequencing of the 16S rRNA gene.Based on the homology search, it was observed that isolate BA1 had homology with *Bacillus halotolerans* while the isolate PS4 exhibited homology with *Micrococcus luteus.* In order to understand the survival and multiplication of bioagents PS4 and BA1 on phylloplane of tomato, the seedlings of tomato were sprayed with fungicides *viz.*, Propiconazole 25% EC, Copper oxychloride 50% WP, and Zineb 68% + Hexaconazole 4% WP and bioagents in different combinations. The bacterial population on phylloplane of tomato at different interval was counted using nutrient agar medium. The CFU was assessed using dilutions of 10^{-4} for *Micrococcus* and $10^{-6}$for *Bacillus* sp.at 0, 1, 3, 5, 7, and 10 days of interval. In *Micrococcus* PS4 and *Bacillus* BA, it was observed the population of bacteria was not affected by addition of fungicides on phylloplane. This clearly implied that, the bacteria were compatible with fungicides applied. The effective bacteria and fungicides were further evaluated under field conditions against early blight of tomato. It was observed that, the treatment Zineb 68% + Hexaconazole 4% WP@ 2 g/litre, Propiconazole 25 % EC@1 ml/litre, *Bacillus* BA1 @ 10 g/litre + Propiconazole 25% EC@ 0.5 ml/litre and *Bacillus* BA1@ 10 g/litre + (Zineb 68% + Hexaconazole 4% WP)@1 g/litre were found to be effective against early blight of tomato. Based on the field efficacy and economics, treatment Propiconazole 25% EC@ 1 ml/litre, *Micrococcus* PS4 @ 10 g /litre + Propiconazole 25% EC@ 0.5ml /litre and *Bacillus* BA1 @10 g/litre+Propiconazole 25% EC@ 0.5ml /litre were chosen for residue analysis.Fruits were harvested from these treatments at different intervals and were subjected to residue analysis by Liquid Chromatography-Mass Spectrometer (LC-MS). It was observed that among treatments, BA1 @ 10 g/litre +Propiconazole 25% EC 0.5 ml/litre showed the least residue and highest dissipationon the 10^{th} day, thus indicating safe for consumption.

PPSMA (S1) 03: Chemical Control of Blight (*Alternaria burnsii* Uppal, Patel & Kamat) Disease in Cumin under Field Conditions

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Sustainable cumin cultivation is continuously challenged by diseases that cause quantitative and qualitative losses in yield. Alternaria blight caused by *Alternaria burnsii* Uppal, Patel & Kamat is the most devastating disease in major cumin-growing areas in Gujarat, Rajasthan and part of Madhya Pradesh. It is quite prevalent and destructive as it affects all above-ground plant parts including seed, thus, causing direct yield loss. The main importance of the study was to determine the efficacy of systemic, multi-site contact and broad-spectrum fungicides such as fluxapyroxad (pyrazole-4-carboxamides), pyraclostrobin, azoxystrobin (strobilurin), tebuconazole (triazole) and metiram (dithiocarbamate) used as a ready-mix fungicide (pyrazole-4-carboxamides + strobilurin, strobilurin + triazole and dithiocarbamate + strobilurin) as foliar sprays at three different concentrations to manage cumin blight under field conditions during *Rabi* 2019-20 and 2020-21.Significant differences ($p<0.05$) between the treatments were determined by the use of Duncan's multiple-rangetest. Seed treatment with thiram 75 WS @ 3 g/kg seeds followed by foliar spraying of ready-mix fungicides either metiram 55% + pyraclostrobin 5% WG, 0.180% (30 g/10 litre of water) or fluxapyroxad 25% + pyraclostrobin 25% SC, 0.031% (6 ml/10 litre of water) along with a sticker, 0.1% (10 ml/10 litre of water) first at the initiation of the disease and subsequent two sprays at 15 days interval showed lowest Alternaria blight (7.00, 7.84%) intensity as compared to untreated control (77.50%) and exhibited highest seed yield (570, 556 kg/ha)and 1000-seed weight (5.29, 5.18 g) over untreated control (109 kg/ha and 2.34 g). These treatments also registered the highest 1:4.43 and 1:3.65 ICBR. The use of a combination of fungicides, each with its own mode of action, broadens the disease spectrum, improves activity and protects against resistance development. These treatments dramatically decreased blight disease in cumin crops and broke the chain of pathogen resistance development. This fungicide could be used as part of a disease control programme to reduce disease risk.

PPSMA (S1) 04: Epidemiology and Management of Alternaria Leaf Spot of Sesame

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Alternaria leaf spot (*Alternaria sesami*) is a serious disease of sesame and causes heavylosses in the field. The damage caused by Alternaria leaf spot may be manifested as a direct fall in the yield, because of suppression or distortion of plant growth. There is no definite evidence available regarding the conditions which help the outbreak of sesame leaf spot. Therefore, in present investigation a field trial was conducted during *Kharif,* 2021 and 2022 at Agricultural Research Sub-station Farm (Agriculture University, Jodhpur), Sumerpur, Pali, Rajasthan with susceptible variety RT-351 to find out alternaria leaf spot disease development and progress in relation to meteorological factors and best novel fungicide for management of alternaria leaf spot of sesame. Amidst the Eight factors, the mean temperature and crop age shown significantly positive correlation while, significantly negative correlation was shown by morning relative humidity, afternoon relative humidity, mean relative humidity and rainfall with the alternaria leaf spot of sesame, in *Kharif* season. The field study showed the variable reactivity to different fungicides by alternaria leaf spot of sesame pathogen that Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.1% recorded minimum per cent disease intensity (24.81 & 20.74%) and maximum yield of alternaria leaf spot of sesame at before harvesting, which was at par with Pyraclostrobin 133g/l + Epoxiconazole 50 g/l w/w SE @ 0.1% (27.04 & 21.11%).While Chlorothalonil 75% WP, Tebuconazole 25%WG,Hexaconazole 5% EC, Azoxystrobin 23%SC, Difenconazole 25 EC,Propineb 70% WP and Carbendazim 50% WP were found least effective against alternaria leaf spot of sesame.

PPSMA (S1) 05: Fungicides: A Way to Combat Cumin Blight

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India is a largest consumer of the spices as well as a predominant country in spices production in the world. Hence, it is known as “The land of Spices”. The seed spices *viz*., cumin, fennel, coriander, fenugreek, ajwain, dill seed are important for their demand for domestic consumption and for export earnings also. Gujarat and Rajasthan states have emerged as “Seed Spices Bowl” and together contribute more than 80 % of the total seed spices production in the country. Among the seed spices, cumin (Cuminum cyminum L.) is one of the important crops and it also commonly known as “Zeera”. Cumin crop generally grown in sandy to loam soil and it requires very low inputs *viz*., fertilizers and irrigation. Production and quality of cumin produce is mainly dependent on the three major diseases *viz*., Alternaria blight (*Alternaria burnsii*, Uppal *et al*.), wilt (*Fusarium oxysporum* f.sp. *cumini*, Prasad and Patel) and powdery mildew (*Erysiphe polygoni* DC). Out of these diseases, blight caused by *Alternaria burnsii* is a serious and threatening disease occurs more or less every year in all cumin growing areas, fluctuate the market prices and reduce the quantity as well as quality of cumin. Cold and humid weather coupled with cloudy days favours the occurrence and spread of the blight and that become devastating. Losses due to this disease up to 63.81 per cent or complete failure of crop were recorded. As the disease is air borne and therefore, it becomes difficult to manage the disease only way to manage by application of fungicides. There is no resistance source in cumin against blight that's why newer fungicides were recommend to farmer time to time. Variability of blight pathogen studied and collected fifteen isolates from North Gujarat and good variation among the isolates of *Alternaria burnsii* in relation to cultural, morphological and virulence to cause disease was observed. Various fungicides has been applied and tested against blight disease and mancozeb 0.2 %, Difenoconazole @ 250 ml /ha,Tebuconazole 25WG @ 750 g/ha, Captan 70% + Hexaconazole 5% @ 750 g/ha,Zineb 68% + Hexaconazole 4% WP @ 0.2%, Ergon 50 SC @ 200 g a.i./ha (Kresoxim methyl), Metiram 55% + Pyraclostrobin 5% WG (Cabrio Top 60% WG) @ 900 a.i.g/ha (1500 ml/ha), Nativo (Tebuconazole 50 % + Trifloxystrobin 25% WG) @ 350 g/ha,Sarthak 71%WG @ 1250 g/ha (Kresoxim Methyl 15% + Chlorothalonil 56% WG)andFluxapyroxad 167 g/l + Pyraclostrobin 333 g/l SC 200 g/ha found effective during couple of years and they have good results, respectively.

Smt. Guman Devi Verma Memorial Best Woman Scientist Award Competition

SGDVA (S1) 01: Bacterial Lipopolysaccharide Mediated Induced Systemic Resistance in Pearl Millet against Blast Disease

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Pearl millet [*Pennisetum glaucum* (L.) R. Br.], is the worldwide nutritious staple food for millions of poor people. The crop is often jeopardised by various biotic and abiotic stresses, of which blast or leaf spot disease caused by the hemibiotrophic, ascomycete fungus *Magnaporthe grisea* (Herbert) Barr has recently become a disease of economic concern in our country. Lipopolysaccharide (LPS) elicitor isolated from plant growth promoting rhizobacteria *Pseudomonas fluorescens* UOM_SAR 14 effectively induced systemic and durable resistance against pearl millet blast disease. In comparison to control seedlings, blast susceptible seeds pre-treated with LPS (SLPS) demonstrated rapid and enhanced callose, lignin deposition and H_2O_2 accumulation, which also associated with the development of various increased defense responses. Biochemical analysis of enzymes and quantitative real-time

polymerase chain reaction data suggested that LPS protects pearl millet against blast disease through the stimulation of NO concentrations was shown to be essential for LPS-mediated defense manifestation in pearl millet and had an impact on the other downstream defense responses like enhanced activation of enzymes and pathogen-related (PR) proteins. Temporal expression analysis of defense enzymes and PR-proteins in SLPS seedlings challenged with the blast pathogen revealed that the activity and expression of peroxidase, phenylalanine ammonia lyase, and the PR-proteins (PR-1 and PR-5) were significantly enhanced compared to untreated control. Higher gene expression and protein activities of hydroxyproline-rich glycoproteins (HRGPs) were observed in SLPS seedlings which were similar to that of the resistant check. Collectively, our findings suggest that, in pearl millet-Blast disease interaction, LPS treatment affects defensesignaling which triggers the activities of PAL, POX, PR-1, PR-5, NO, and HRGPs. The time-specific comparison showed activation or repression of specific genes in various pathways could be useful to understand the host-plant resistance and design novel strategies to manage blast disease in pearl millet.

SGDVA (S1) 02: Discovery of Candidate Genes for Disease Resistance and Dissection of Genetic Architecture of Host Tolerance as Revealed Through Genome-Wide Association Studies (GWAS) in Rubber (*Hevea brasiliensis*)

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Hevea brasiliensis, the Para rubber tree is the most important source of natural rubber cultivated in the equatorial regions and mainly in the humid and sub humid tropical climates. Two of the major leaf pathogens of rubber are *Phytophthora* spp. which causes shoot rot, abnormal leaf fall, patch canker, and black stripe diseases and *Corynespora cassiicola*, which causes Corynespora leaf fall disease. Phenotyping for disease resistance to *P. meadii* and *C. cassiicola* was carried out in an F_1 progeny population of 86 individuals derived from an interspecific cross between *H. brasiliensis* and *H. benthamiana* as well as in a natural population of 200 Wickham clones obtained from different countries and wth varying parentage. An integrated linkage map was constructed with the F_1 progeny using 23,978 SNP and SilicoDArT markers. The genetic map spanned 3947.83 cM with an average marker-interval of 0.83 cM. Quantitative trait loci (QTL) markers for both these diseases were identified by merging the genotypic and phenotypic data. Association mapping was performed using the Wickham clones. Association analysis identified single nucleotide polymorphisms (SNPs) significantly associated with resistance against *Phytophthora* and *Corynespora*. Within the proximity to those SNPs, potentially key genes that have previously been reported to associate with plant disease resistance were predicted with high confidence. Many of the annotations were related to innate immune response, host-pathogen relationships, or plant defense (disease resistance protein, heat shock factor protein, aquaporin, transcription factors, zinc finger protein, cinnamoyl-CoA reductase 1, LRR receptor-like serine/ threonine-protein kinase). This study provides new resources for candidate genes for predicting resistance against major foliar diseases in rubber.

SGDVA (S1) 03: Coat Protein and Movement Protein-Based Characterization of Mungbean Yellow Mosaic Virus Infecting Urdbean

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Urdbean varieties *viz*., T9, GU-1, and Pant U-40 cultivated in different villages of Kheda, Vadodara, Panchmahal and Ahmedabad districts were monitored for occurrence of MYMV. Molecular detection was carried out for confirming the presence of the mungbean yellow mosaic virus (MYMV) in T9, GU-1 and Pant U-40 varieties of urdbean. DNA was extracted fromwhole seed, seed coat, cotyledons, as well as embryo of discoloured seeds ofUrd bean varieties. Virus specific primers for coat protein and movement protein of two different strains *viz*., Mungbean Yellow Mosaic India Virus (MYMIV) and mungbean yellow mosaic virus (MYMV) were used to amplify required fragment and PCR reaction was performed followed by the separation of amplicons on agarose gel. Virus specific bands obtained in PCR amplification were eluted and purified for sequencing and the results were analysed using NCBI nucleotide BLAST to find out similarity of newly sequenced sample with previously available virus sequences. The sequencing result of urdbean showed 94-99% similarity with previously available MYMV-Movement protein genome. Whereas, MYMIV-Movement protein showed 95-99% and MYMIV-coat protein showed 97-99% similarity with previously available sequence. However, no band was observed in variety PU-40 which indicated absence of specific virus gene that cause virus infection.

SGDVA (S1) 04: Antinematicidal Activity of Lions Mane and Oyster Mushroom against *Meloidogyne incognita* (root-knot nematode – RKN)

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Lions mane and Oyster (*Pluerotussajor-kaju*) mushroom were grown on respective substrate and fruits of both the mushroom were taken for pure culture isolation. From these isolated pure culture filtrate of Lions mane and Oyster (*Pluerotussajor-kaju*) mushroom were prepared at three different doses *i.e.* 0.5, 1.0 and 1.5% and were taken under study to observe the anti-nematicidal activity on egg hatching inhibition under *in vitro* condition. Hence, overall findings revealed that all tested concentration caused effects on *M. incognita* with different percentage of egg hatching inhibition and juveniles mortality. Moreover, longer the exposure to mushroom extract higher the juvenile mortality was observed. Among the three different

concentrations of two species of mushroom tested, the higher concentration (1.5ml) of Lions mane mushroom culture extract exhibited effective anti-nematicidal activity against *M. incognita*. Both the mushroom culture filtrate was found to have anti-nematicidal activity against egg hatching after 72 hrs. of exposure with different percentages of egg hatching inhibition. The maximum egg hatching inhibition (89.18%) was recorded in Lions mane @ 1.5% as compared to control (20.41%).

SGDVA (S1) 05: Multiplex PCR Based Simultaneous Detection of Viruses in Potato and Their Sustainable Management

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Gujarat is agriculturally very richest state with diverse climatic habitat. It ranks first in productivity within limited acreage and other constraints. The different agro-climatic condition of Gujarat favors the production of various economically important crops. Among them, potato is grown in wider acreage of North Gujarat. Presently, this crop is popularized due to their increasing economic importance in industrial scale and export purpose. However, farmers of North Gujarat are facing the problem emerging plant diseases which are responsible for havoc yield loss. Among them, plant viruses are causing mosaic, leaf roll, rugosity and necrosis in potato which results havoc quantitative and qualitative yield losses due to their complex nature and tuber based perpetuation. Potato growers of North Gujarat usually purchase potato seed tubers from Punjab, and other states. These seed lots acts as reservoir of plant virus and helps them to survive and spread. It makes them very difficult to manage in field. The repeated cultivation of such infected seeds increases the inoculum load at critical level. In India, *Potato aucuba mosaic virus* (PAMV), *Potato leafroll virus* (PLRV), *Potato virus A* (PVA), *Potato virus M* (PVM), *Potato virus S* (PVS), *Potato virus X* (PVX) and *Potato virus Y* (PVY) are known to infect potato crops, severely, However, virus and virus-like diseases in potatoes are progressively becoming severe and destructive in last few years in Gujarat state. Keeping in view of the above it has been felt necessary to establish reliable virus detection programmes supporting the real scenario, optimization of doses of bioefficacy of cow urine, plant extract for insect pest management, hence producing disease-free seed tubers and application of strict seed certification protocols. This ultimately puts thrust on performing multiplex-RT-PCR for simultaneous detection of potato viruses and their effective management using organic inputs.

PR Verma Awards Competition for Ph D Students

PRVA (Ph D) (S1) 01: Characterization of Papaya Ring Spot (PRSV) and Papaya Leaf Curl (PaLCuV) Viruses Infecting Papaya, Epidemiology and Management of PRSV Disease

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The investigation was conducted at the Department of Plant Pathology, C.O.H Bagalkot during 2019-2021. The roving survey carried during 2019 to 2021 in major papaya growing districts of Karnataka revealed that PRSV disease incidence ranged from 50.5-100%. The 107 samples collected from 75 locations during survey were subjected to PCR based detection. Among them, 75 samples were tested positive for PRSV infection and the remaining 32 for PaLCuV (monopartite Begomovirus). Complete genome characterization of a representative PRSV-BGK (Collected from Bagalkot) isolate revealed that this isolate contains 10,341 nt with ten mature polyproteins and is demarcated as a variant. It is given a descriptor as PRSV-[IN: Kar: Bgk: Pap: 21]. Among 32 begomoviral samples 13 representative isolates were subjected for RCA based characterization, out of which 4 were found new distinct species of Begomovirus and based the ICTV species classification, proposed the name for the isolates as PaLCuBKV-[IN:Kar:Bel:Pap:21]; PaLCuBKV-[IN:Kar: Bgk:Pap:21] and PaLCuHV-[IN:Kar:Hav:Pap:21]. Another four were found as new strains and proposed the name as ChiLCV-[IN:Kar:Kal:Pap:21]; PaLCuV-[IN:Kar:Kal:Pap:21]; CYVMV-[IN:Kar:Kal:Pap:21]andPaLCuV-[IN:Kar:Vij: Pap:21]. Five isolates were demarcated as new variants and suggested the name as ChiLCV-[IN:Kar:Bel:Pap:21]; ChiLCV-[IN:Kar:Bel:Pap:21]; ChiLCV-[IN:Kar:Bgk:Pap:21]; ChiLCV-IN:Kar:Bgk:Pap:21] and ChiLCV-[IN:Kar:Kal:Pap:21]. Studies on the different months of planting under field conditions revealed that planting during March is effective for the management of PRSV as it recorded the least disease incidence (5.56 % at 60 DAT and took 270 DAT to reach 100 %) and maximum yield (185.54 t/ha) along with good growth and yield parameters. The effect of inoculation of PRSV at different growth stages of papaya revealed that percent transmission and severity of symptoms on PRSV inoculated papaya plants were drastically greater in early inoculated plants than in plants inoculated at later stages. As the inoculation was delayed there was reduction in diseases incidence and an increase in growth and yield parameters. The studies on the management of PRSV under field conditions for two seasons (2019-20 and 2020-21) using insecticides and bio rationales revealed that T1 (8 sprays of four different insecticide *i.e.* tolfenpyrad 15% EC @1 ml/l, imidacloprid 17.8% SL @ 0.2 ml/l, thiacloprid 21.7 SC @ 1 ml/l and dinotefuran 20% SG @ 0.5g/l alternatively and micronutrients at every 30 days intervals) proved as the best treatment. It recorded the least diseases incidence (1.49% at 210 DAT and took 360 DAT to reach 100%) and maximum yield (178.56 t/ha) along with a high cost-benefit ratio (1: 3.54). Looking into these results, three integrated diseases management modules were designed and evaluated along with recommended POP as a check and found that M1 (12 sprays insecticides *i.e.* tolfenpyrad 15% EC @1 ml/l, imidacloprid 17.8% SL @ 0.2 ml/l, thiacloprid 21.7 SC @ 1 ml/l and dinotefuran 20 % SG @ 0.5g/l alternatively 3 times and micronutrients at 20 days interval) is the best module for managing PRSV (0.44% incidence at 180 DAT and took 330 DAT to reach 100%).

PRVA (Ph D) (S1) 02: Bioprospecting Antifungal Activity of Plant and Microbial Volatilomes against Damping Off and Fusarial Wilt Pathogens in Tomato

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Plant diseases are critical biotic stress that severely affects plant growth and development. The bio-molecules associated with plants and microbes are well known to help in disease management and enhance plant health. Among them, the plant can support reducing biotic stress by inducing defense termed plant-induced defense priming. The mechanisms are by the production of enzymes, metabolites, and volatiles to manage the plant disease directly or by inducing defense and plant growth to protect the plant indirectly.With this background, the present investigation was carried out to evaluate the volatilomes produced by selected plants and microbial sources against the pathogens causing damping off and fusarium wilt diseases in tomato plants. The volatilomes produced by the leaves of *Menthaspicata*, *Cymbopogon citratus*, *Vitex negundo*, *Coleus amboinicus*, *Vetiveria zizanioides*, *Ocimum tuniflorum*, *Azadirachta indica*; mycelia of *Auricularia auriculata, Coprinus cinereus, Ganoderma lucidum, Lentinus edodus, Trichoderma asperellum* and cell cultures of *Bacillus subtilis, Streptomyces rochei* were screened for their antifungal activities against *P. aphanidermatum* and *F. Oxysporum* f.sp. *lycopersici* by sealed plate assay. Among them, the volatilomes produced by the leaves of *M. spicata* and *C. citratus* showed the maximum inhibitory effect of 45.56 and 24.70 percent, respectively on the mycelial growth of *P. aphanidermatum* and 41.89 and 39.67 percent, respectively against *F.oxysporum* f.sp. *lycopersici*. The volatilomes produced by the mycelia of *C. cinereus, G. Lucidum* and *L. edodes* showed the maximum inhibitory effect of 70, 60.37 and 35.78 percent on mycelial growth of F. *oxysporum* f. sp. *lycopersici,* respectively; whereas, *P. aphanidermatum* was not inhibited. The volatilomes produced by the mycelia of *T. asperellum* showed the maximum inhibitory effect of 69.26 percent against *P. aphanidermatum* and 24.78 percent against *F. oxysporum* f.sp. *lycopersici.* In order to identify the nature of VOCs involved in the suppression of pathogens, the volatilomes produced by the leaves of *M. spicata and C.citratus* were subjected HS GC-MSandthevolatilomes by the mycelia of *C. cinereus, G. lucidum, L. edodes* and *T.asperellum* were subjected to GC-MS-ATD. The results revealed the production of carvone by the leaves of *M. spicata*; citronellol and geraniol by *C. citratus*; alfacopaene and 2 undecanone by the mycelia of *C. cinereus*; trichloromethane and pentanoic acid by the mycelia of *G. lucidum*; isopentyl alcohol and limonene by *T. asperellum*with increased peak area percentage and these compounds possessed antifungal properties against *P. Aphanidermatum* and *F. oxysporum*f.sp. *lycopersici.* In addition, the VOCs of carvone, citronellol, geraniol, isopentyl alcohol, limonene and 2 undecanone produced by standard compounds were also tested against the pathogens. Vaporous action of isopentyl alcohol completely suppressed the mycelial growth of *P. aphanidermatum,* while the compounds, carvone and citronellol showed the maximum inhibitory effect of 89.02 and 85.49 per cent, respectively when used at 500 ppm. The compounds, isopentyl alcohol and citronellol completely suppressed the mycelial growth of *F. oxysporum* f.sp. *lycopersici*, while they showed 90.98 per cent inhibition against the mycelial growth of pathogens when exposed to carvone at 500 ppm. Similarly, the volatilomes diffused from the leaf extract of *M. spicata* completely inhibited the mycelial growth of *P. aphanidermatum* and *F. oxysporum* f.sp. *lycopersici.* The leaf extract of *C. citratus* showed the maximum inhibitory effect of 97.84 per cent on the mycelial growth of *P. aphanidermatum* and 92.94 per cent against *F. oxysporum* f.sp. *lycopersici.* The vapourousaction of *M. spicata* extract showed the maximum reduction of spore germination of *P. aphanidermatum* and *F. oxysporum* f.sp. *lycopersici* (cent percent) followed by the volatiles of *C. citratus* extract (86.26 and 85.71 per cent reduction, respectively). The volatilomes produced by the leaves of *M. spicata, C. citrates* and mycelial cultures of *T. asperellum* were immobilized in vermiculite sample bound with castor oil in the ratio of 3:7 (3 g of volatilomes leaf sample in 7 g of vermiculite) as the volatilomes immobilized vermiculite ball formulation. The efficacy of volatilomes immobilized vermiculite balls were tested *in vitro* by olfactory chamber. The results revealed the volatilomes of *M. spicata* immobilized vermiculite balls could completely suppress the mycelial growth of *P. aphanidermatum*, as against 92.35 per cent inhibition of *F. oxysporum* f. sp. *lycopersici.* Studies on defense genes expression revealed that pathogenesis related protein (PR1) (2.69 folds) and jasmonic acid signaling (LOX) (2.65 folds) genes were highly expressed after 48 hon exposure to the volatilomes of *M. spicata* immobilized vermiculite balls against *P. Aphanidermatum* in tomato plants. Similarly, tomato plantsinoculatedwith *F. oxysporum* f.sp. *Lycopersici* also revealed increased expressions of pathogenesis related protein (PR1) gene (2.63 folds) after 72 h and WRKY gene (2.5 folds) after 48 h on exposure to the volatilomes of *M. spicata* immobilized vermiculite balls. However, the defense genes expression was considerably reduced after 72 h of volatilomes of *M. spicata* exposed tomato plants. The result of poly house trail revealed that the volatilomes of *M. spicata* immobilized vermiculite balls could significantly reduce the severity of damping off (with a per cent reduction of 85.71) and fusarial wilt (with a per cent reduction of 95.45) and they showed the highest germination with 97.92 per cent, enhanced plant height of 115.67 cm, higher number of fruits/ plant (26.32), increased fruit weight (49.53 g) and more fruit yield (1485.90 g/ plant) due to the exposure of volatilomes of *M. spicata* in the tomato plants raised beds with relatively abundant control of *P. aphanidermatum* and *F. oxysporum* f.sp. *lycopersici.*

PRVA (Ph D) (S1) 03: Biology and Management of Stem Rot of Indian mustard (*Brassica juncea* L.) Caused by *Sclerotinia sclerotiorum* (Lib.) de Bary

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Indian mustard (*Brassica juncea* L.) is a valuable source of edible oil and a leading player in the Indian economy. Among fungal constraints, Sclerotinia stem rot (SSR) caused by *Sclerotinia sclerotiorum* is most destructive disease of mustard. The present investigation entitled "Biology and Management of Stem Rot of Indian Mustard (*Brassica juncea* L.) Caused by *Sclerotinia sclerotiorum* (Lib.) de Bary" was carried out to study sclerotinia stem rot incidence, yield losses, variability and to develop integrated disease management (IDM) module. During survey of major mustard growing districts, Incidence of sclerotinia stem rot varied from 3.59-18.50 per cent and that resulting in18.80 per cent yield losses. White cottony fungal growth on stem and presence of sclerotia were seen during survey on infected plants. With increasing inoculum level, sclerotinia stem rot incidence and plant mortality increased, whereas sclerotial germination reduced as soil depth increased. Isolates under investigation showed significant variation in morphological characteristic *viz.*, pattern of sclerotia formation, number and size of sclerotia. The number of sclerotia per plate ranged from 13 to 26, with a length of 28.34-35.34 mm and a width of 17-22 mm. All isolates showed different types of growth, including fluffy, sparse, and regular growth. After 24 hours of incubation, Udr and Mwl isolates grew mycelia slowly, whereas Btr and Dig isolates produced mycelia swiftly. In RAPD analysis isolates exhibited overall 73.23 per cent polymorphism and 46-77 per cent Jaccard's similarity coefficient. In dendogram, all isolates separated in to two groups and depicted correlation among isolates grouping and morpho-cultural characters. It was noticed that there is a fragmented relationship between RAPD grouping and geographical origin of isolates. Among *in-vitro* assessed fungicides, de-oiled cakes and antagonistis, Hexaconazole (100ppm), neem cake (40%) and *T. viride* was found best effective in inhibition of mycelial growth of *S. sclerotiorum*. Application of 250gm/m^2 de-oiled neem cake was found effective in suppression of sclerotinia stem rot under field conditions. The module comprising soil application of de-oiled neem cake mixture@250gm/m^2+Seed treatment with Carbendazim @2gm/kg seed + Seed treatment with *T. viride* @10gm/kg seed + Sand mix and foliar application (0.2%) of Carbendazim at 45, 60, and 75 DAS, was best effective with minimum PDI-3.78% and higher PEDC-79.56, grain yield-1616.25 kg/ha and 57.59 per cent increase in yield over control for the management of SSR.

PRVA (Ph D) (S1) 04: Assessment of *Ganoderma lucidum* P Karst for Its Antagonistic Potentiality and Mass Production on Various Substrates for Commercialization

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The current studies deal with survey and collection of fruiting bodies of *Ganoderma* sp., isolation, characterization (cultural and morphological) of different isolates, molecular characterization of selected isolate, growth of isolate on different liquid media, determination of total phenols, total flavonoids and β-glucan from mushroom mycelium and mass production of *Ganoderma lucidum* by using different sawdust and brans. Survey for the collection of naturally growing *Ganoderma* was conducted during the period of June 2021 to September 2021 at the different talukas of Navsari *viz.,* Jalalpore, Gandevi, Vansada and Chikhli. The isolate was identified based on cultural, morphological and molecular characteristics. Further, *G. lucidum* was tested for its adoptability to different medium to find out the natural or selective mediafor its growth and survival. Results of the present study revealed that the maximum dry mycelium weight was recorded in Potato Dextrose Broth (1.30g) which was found to be significantly superior as compared to all other medium tested. Total phenols, total flavonoids and β-glucan content of methanol extract of mycelium was determined by using Folin-Ciocalteu Reagent method, aluminum chloride colorimetric method and yeast and mushroom β-Glucan assay kit protocol, respectively. The result revealed that methanol extract of mycelium showed 45.5 mg/g total phenol, 14.5 mg/g total flavonoids and 34.22% w/w β-Glucan content. Antimicrobial activity of *G. lucidum* were tested against different pathogens by dual culture technique and well diffusion method. In dual culture technique maximum per cent growth inhibition was recorded against *Fusarium moniliforme* that was74.99%. In well diffusion method three different solvents like ethanol, di ethyl ether and chloroform were used with different concentrations 250 and 500 ppm. Maximum zone of inhibition (3.2 cm) was recorded in chloroform extract at 500 ppm against *Aspergillus niger.* For spawn development, five different grains were evaluated for their efficacy as spawning substrate. The best spawn substrate was selected based on the minimum time taken for the spawn run and the nature of growth. Wheat grains took significantly less (9.87 days) time as compared to other grains with white, extensive, thick mycelium colonization and complete growth. Sawdust of different hardwoods were used for the mass production of *G. lucidum*. Pin head formation (days) and dry weight (g/kg) of fruiting body were recorded. In this experiment treatment having Mango sawdust + Rice bran (3:1) performed best as compared to others. This treatment took less time (20.76 days) for pin head production and it produced 16.35 g/kg dry mushroom with 5.84% BE which was superior on all other treatment. Different brans were tested to know the best supplements for the mass production of *G. lucidum.* Mango sawdust supplement with wheat bran showed superior result as compared to others. It took significantly less time (21.50 days) for pin head formation and it produced 15.87 g/kg yield of dry mushroom with 0.33% BE which was highest among all the treatment.

PRVA (Ph D) (S1) 05: *Trichoderma viride*: A Biocontrol Agent for Sustainable Management of Plant Disease in Agroclimatic Zone IIB and IV A

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Multifaceted impact of bio control agents makes them an integral part of agricultural production technology. It is the demand of 21st century to make the farmers more familiar with the use of bio control agents. Such a work is being continued by KVK Sirohi in addressing the major biotic problems of the region with minimum use of chemicals. Farmers field were selected based on occurrence of disease on yearly basis. The field which were severely impacted with disease such as wilt and root rot were given *Trichoderma viride* treatment through soil application as well as seed treatment. Farmers were significantly convinced by the results they have seen on their field. Field data were collected for six seasons. Major disease for which the agent used were: root rot of papaya, castor wilt, fennel wilt and tomato wilt. Among all the agent was found most effective against root rot of papaya.

PRVA (Ph D) (S1) 06: Molecular Characterization of Potato Leaf Roll Virus Infecting Potato and Its Management

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Potato (*Solanum tuberosum* Linn.) is an important vegetable crop cultivated throughout the world. The power of potato is known for sustaining millions of lives by providing nutritious food in times of war and hunger and is also used as a staple food in several countries of the world. In Gujarat, it is mainly cultivated in Banaskantha, Aravalli, Sabarkantha, Gandhinagar, Mehsana, Kheda, Anand, Patan, Vadodara, Mahisagar, Panchmahal and Ahmedabad districts. Among all diseases of potato, early blight disease caused by *Alternaria solani* (Ellis and Martin) Jones and Grout is widely distributed and highly destructive depending upon the variety grown, weather conditions and inoculum load in the soil. This disease can cause an average annual yield loss of approximately 79 per cent of the total production of potato. To overcome such issues, eco-friendly inputs are one of the best, low-cost and ecologically sustainable methods for managing plant diseases. Considering the importance of the disease, the present study on various aspects of the disease was carried out at the Department of Plant Pathology, BA College of Agriculture, Anand Agricultural University, Anand from 2021 to 2022 for developing effective and eco-safe management strategies for the disease. The isolation was made from potato leaves showing characteristic symptoms, revealed the association of *A. solani.* A total of 36 isolates were collected from major potato growing areas of different agro-climatic zones of Gujarat. The isolated fungus satisfied Koch's postulates on potato plants by employing the spore suspension spray inoculation method. The identification of the pathogen was confirmed based on cultural and morphology characters as well as through DNA sequencing. The ITS rDNA region-based sequencing of *A. Solani* proved accurate for species-level identification of the pathogen. The phylogenetic tree was also constructed and compared with other similar worldwide fungal isolates available in the NCBI database. It is evident from the ITS rDNA sequence that pathogenic *Alternaria solani* (GenBank Accession No. MZ557830) is responsible for causing early blight in potato growing regions of Gujarat. The cultural and morphological variability studied on two media *viz*., Potato dextrose agar and Richard's agar revealed the considerable variation among the isolates of *A. solani*. The glaring differences in conidial length, conidial width, beak length, beak width, vertical and horizontal septation of conidia were noticed among the isolates even when the same medium was used for the growth. The molecular study revealed that the cent per cent polymorphism was recorded by the primers OPA-11, OPC-6 and OPE-1 while the lowest polymorphism was observed in the OPA-12 and OPB-9 primers. Cluster A was containing only nine isolates *viz*., Anand-1 (As1), Anand-2 (As2), Boriyavi (As5), Khambhodaj (As6), Bakrol (As3), Vadtal (As10), Lambhvel (As4),Narsanda (As7) and Chaklasi (As8), whereas cluster B containing twenty-seven isolates showed that these isolates are genetically similar. Among all isolates, As16, As17, As18, As19 and As21 showed high genetic variation in between with highest similarity index value of 0.89, while As1 and As34 isolates were found with lowest similarity index value (0.13). The impact of various weather variables on disease progression, as well as their relationship, indicated that evening relative humidity was negatively correlated with per cent disease intensity. The spore load, bright sunshine hour and evaporation were positively correlated and had a substantial effect on early blight during both seasons. Among the twenty-three varieties of potato screened against early blight disease under field conditions during *Rabi* 2020-21 and *Rabi* 2021-22, the final disease reaction revealed one variety *i. e.* Kufri Lima showed a resistant reaction and two varieties (KufriHimalini and KufriNilkanth) showed a moderately resistant reaction. The biochemical analysis of resistant (Kufri Lima), moderately resistant (KufriHimalini and KufriNilkanth), moderately susceptible (Kufri Mohan and KufriChadramukhi), susceptible (KufriPukhraj and KufriKesar) and highly susceptible (KufriLalit) varieties revealed that healthy leaves of resistant, moderately resistant, moderately susceptible, susceptible and highly susceptible varieties showed higher moisture content, while it was lower in diseased leaves. *W.r.t.* phenol content and true protein content, diseased leaves of resistant, moderately resistant, moderately susceptible, susceptible and highly susceptible varieties contained higher phenol content and true protein content as compared to healthy leaves. A higher amount of total soluble sugar and total chlorophyll were recorded in healthy leaves of resistant varieties compared to diseased leaves of highly susceptible varieties. Among the nineteen

medicinal plant extracts evaluated at 5 and 10 per cent concentrations by poisoned food technique under *in-vitro* conditions against *A. Solani* revealed leaf extract of *Azadirachta indica* at 5 and 10 per cent concentrations significantly inhibited the mycelial growth of the pathogen and proved to be the most effective. The antifungal activity of six organic inputs was tested by poisoned food technique under *in-vitro* conditions against *A. Solani* at five different concentrations. *Panchagavya* at the highest concentration (15%) showed cent per cent inhibition of the mycelial growth of the pathogen. Out of nine biological control agents evaluated under *in-vitro* against *A. Solani* by dual culture technique, *Trichoderma harzianum* (AAU isolate) was highly antagonistic to *A. Solani* followed by *T. Viride* (AAU isolate). Seed tuber soaking with *beejamrutha* (5 litre/10 kg tubers) for 30 minutes + two foliar sprays of *jeevamrutha* @ 5 per cent at an interval of 10 days, commencing from the initiation of disease was found most effective and economical for eco-safe management of early blight of potato under field conditions.

PRVA (Ph D) (S1) 07: Molecular Characterization of *Alternaria solani* (Ellis and Martin) Jones and Grout Causing Early Blight of Potato and Its Eco-safe Management

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Potato (*Solanum tuberosum* Linn.) is an important vegetable crop cultivated throughout the world. The power of potato is known for sustaining millions of lives by providing nutritious food in times of war and hunger and is also used as a staple food in several countries of the world. In Gujarat, it is mainly cultivated in Banaskantha, Aravalli, Sabarkantha, Gandhinagar, Mehsana, Kheda, Anand, Patan, Vadodara, Mahisagar, Panchmahal and Ahmedabad districts. Among all diseases of potato, early blight disease caused by *Alternaria solani* (Ellis and Martin) Jones and Grout is widely distributed and highly destructive depending upon the variety grown, weather conditions and inoculum load in the soil. This disease can cause an average annual yield loss of approximately 79 per cent of the total production of potato. To overcome such issues, eco-friendly inputs are one of the best, low-cost and ecologically sustainable methods for managing plant diseases. 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The phylogenetic tree was also constructed and compared with other similar worldwide fungal isolates available in the NCBI database. It is evident from the ITS rDNA sequence that pathogenic *Alternaria solani* (GenBank Accession No. MZ557830) is responsible for causing early blight in potato growing regions of Gujarat. The cultural and morphological variability studied on two media *viz*., Potato dextrose agar and Richard's agar revealed the considerable variation among the isolates of *A. solani*. The glaring differences in conidial length, conidial width, beak length, beak width, vertical and horizontal septation of conidia were noticed among the isolates even when the same medium was used for the growth. The molecular study revealed that the cent per cent polymorphism was recorded by the primers OPA-11, OPC-6 and OPE-1 while the lowest polymorphism was observed in the OPA-12 and OPB-9 primers. 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vitro conditions against *A. Solani* at five different concentrations. *Panchagavya* at the highest concentration (15%) showed cent per cent inhibition of the mycelial growth of the pathogen. Out of nine biological control agents evaluated under *in-vitro* against *A. Solani* by dual culture technique, *Trichoderma harzianum* (AAU isolate) was highly antagonistic to *A. Solani* followed by *T. Viride* (AAU isolate). Seed tuber soaking with *beejamrutha* (5 litre/10 kg tubers) for 30 minutes + two foliar sprays of *jeevamrutha* @ 5 per cent at an interval of 10 days, commencing from the initiation of disease was found most effective and economical for eco-safe management of early blight of potato under field conditions.

PRVA (Ph D) (S1) 08: Assured Potential of Biogenic and Chemically Synthesized Copper Nanoparticles in Curbing Phytopathogens and Management of Disease of Maize

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The struggle of farmers to protect their crops from the pathogen is ceaseless and to prevent the loss, the use of pesticides is inevitable. However, such chemicals have numerous setbacks. The present study reports the synthesis of copper nanoparticles (CuNPs) using the supernatant of *Trichoderma virens* and *Chaetomiumglobosum,* which was further characterized using UV-Vis spectroscopy*,* Transmission Electron Microscopy, and Fourier Transform Infrared spectroscopy. The *in-vitro* evaluation revealed percent inhibition at a low dose of 10 µg/L against two bacteria namely *Enterobacter cloacae* and *Xanthomonaseuvesicatoria.* In addition, Essential oil-grafted CuNPs (EGC) were generated, characterized, and evaluated against the fungal pathogens of maize crops. A substantial inhibition was seen*invitro,* at a low dose of 20 µg/mlagainst *Bipolarismaydis*, *Rhizoctoniasolani* f.sp. *sasakii*, *Fusariumverticillioides, Macrophomina phaseolina,* and *Sclerotium rolfsii.*In two seasons, seed treatment + foliar spray at 250 and 500 mg/L of EGC considerably decreased the percent disease index (PDI) of maydis leaf blight disease caused by *B. maydis*. Enzymatic antioxidants activity *viz., β*-1, 3-glucanase, PAL, POX, PPO and a non-enzymatic antioxidant (total phenolics) content in maize treated with EGC. Expression studies of genes *viz.,* PR1, Chitinase, Catalase, *β*-1, 3-glucanase, POX, PPO, SOD, and APX, were also promoted indicating host defence triggered. Further, phytotoxic studies revealed higher concentrations of 1000 mg/L rendered phytotoxicity and reduced growth and biomass. However, the optimum concentrations of EGC (< 500 mg/L) exhibited improved physiological characteristics such as photosynthetic activity, biomass, germination percentage *etc*. Cu bioaccumulation was notably high and reached toxic levels, mostly in foliar-sprayed maize. Additionally, Cu lowered Mn and Zn's absorption and concentration. Our study proposes that *T. virens*and *C. globosum* are potent candidates for synthesizing CuNPs. Furthermore, CuNPs combined with EO (Clove oil) exhibit remarkable synergistic efficacy against maize fungal pathogens and optimized concentration can be employed as a safe substitute for commercial fungicides.

PRVA (Ph D) (S1) 09: Studies on Blast Disease of Pearl Millet [*Pennisetum glaucum* (L.) R. BR.] Caused by *Pyricularia grisea* and its Management

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Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is an important cereal crop belong to *Poaceae* family. It is the excel crop among all other cereals. Pearl millet suffers from many diseases among them blast is one of the major foliar diseases and it affects fodder quality and production of pearl millet. The disease cause economical losses and has devasting nature of disease to the crop, it was necessary to investigate the different aspects such as host range, resistant source, effect of environmental conditions in relation to disease outbreak in recent years and crop management. The present investigations were carried out at Department of Plant Pathology, C. P. Collage of Agriculture, and Centre for Crop Improvement, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. The infection of blast disease started from lower leaves and then progress upward. Initially the lesion spots appear as minute circular to slightly dark brown specks of pin head size on leaf surface. Later gradually enlarge into spindle shaped spots and become elliptical to irregular. The neck portion initially turns to brown, later dark brown which resulted in breaking at the infected area. The diseased tissue from infected leaves subjected to tissue isolation. The isolated fungal cultures were purified by single spore isolation technique. The pure culture of the *Pyricularia grisea* was maintained on oat meal agar slants. The mycelium of fungus was hyaline, septate, profusely branched, smooth, uninucleate and dark brown in colour. Conidia were pyriform to obclavete, hyaline with narrowed towards the apex with rounded base, mostly three celled with small appendages at the broader base cell. Conidia were grey to light brown in colour. The pathogenicity was proved on plants grown in pot under net house condition by spraying spore suspension of *Pyricularia gresia* with little injury by pin pricking. Among different inoculation techniques, spore suspension spray inoculation with injury found highest disease intensity (70.56%) with maximum lesion size and lowest in spore suspension spray inoculation without injury (44.81%) at 21 DAI. *Pyricularia grisea* can produce highest blast disease intensity 26.30, 31.48 and 52.41 per cent on barley host after seven, fourteen and twenty one days of inoculation, respectively. The next host in order to merit was napier grass. The *P. grisea* was not able to infect sorghum host even twenty one days after inoculation. Highest area under disease progress curve (587.88 unit) was recorded in barley followed by napier grass (526.93 unit). In sorghum not any disease progress was observed *i.e.* 0.00 unit. Evolution of resistant varieties is an ideal, simple and cheapest method for the control of plant disease. Varietal screening was carried out with different forty cultivars among them none of the cultivar showed highly resistant reaction, two cultivars

found resistant reaction, eight cultivars were moderately resistant, eleven cultivars were moderately susceptible, seventeen cultivars were susceptible and two cultivars were reacted highly susceptible against blast disease. The minimum blast disease intensity 63.27 per cent was observed in 4th July which was at par with 11th July sown crop. The maximum disease intensity (72.49%) was recorded in 18th July sown crop. Effect of weather factors on the progress of blast disease was carried out. The first leaf blast intensity was recorded from initiation of disease fifteen days after sowing and gradually increased up to harvesting in all different dates of sowing in both crop season. In correlation study all the weather parameters were showed different effect in relation with disease progress in both *Kharif* season, 2018 and 2019. Hence long term correlation study will be needed with different weather parameters. The minimum 19.22 per cent disease intensity with highest (70.71%) disease reduction was recorded by tricyclazole 45% + hexaconazole 10% WG (0.05%) and AUDPC value (824.58 units) with highest 1857.50 kg/ha grain and 2342.50 kg/ha fodder yield which was at par with Tricyclazole 75% WP (0.05%) recorded 25.29 per cent disease intensity with (62.74%) disease reduction over and AUDPC (828.34) with 1445.81 kg/ha grain yield and 1901.67 kg/ha fodder yield. The maximum disease intensity (67.92%) was recorded in control (without spray) in pooled. The economics of spraying of different fungicides revealed that the highest Incremental Cost: Benefits Ratio (ICBR) was obtained by two spraying of tricyclazole 45% + hexaconazole 10% WG (0.05%) followed by tricyclazole 75% WP (0.05%).

PR Verma Awards Competition for M. Sc. Students

PRVA (M. Sc.) (S1) 01: Detection of Airborne Inocula of Grapevine Mildews Using Spore Trap and LAMP Assay

J. Shajith Basha[1], A. Kamalakannan[1], S. Saraswathy[2], I. Johnson[1], Patil Santosh Ganapati[3]

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Grapevine is cultivated worldwide predominantly for the production of fresh fruits, wines and raisins and has an important role in economy of many countries. The production of grapevine was hindered by many fungal plant pathogens. Among them, powdery mildew and downy mildew caused by *Erysiphe necator* and *Plasmopara viticola* are the most devastating diseases in worldwide resulting in significant loss of yield and quality of grapes. Epidemic development of grapevine mildews is caused by airborne inocula of conidia and sporangia. The detection of airborne inocula will help to face up timely management strategies under field conditions. In this study an impaction and suction spore traps were designed for trapping the airborne inocula of grapevine mildews in Appachipannai grapevine field. The impaction spore trap was capable of sampling 48.3 ± 1.2 L air min^{-1} by spinning of two stainless steel sampling rods at speed of 1.151 m/s. The sampling rods were coated with silicone vacuum grease affixed on rotating arm and the spore trap was installed at a height of 1.5m above ground level. Impaction spore trap was operated continuously by 6V - 4.5Ah rechargeable battery which was charged by a solar panel. The suction spore trap was capable of sampling 1953.86 L air min^{-1} by running DC cooling fan at a speed of 10.07 m/s. The sampling plates coated with silicon vacuum grease inserted in a slit and the spore trap was installed at height of 1.2 m above ground level. Suction Spore trap was operated continuously by 6V - 4.5Ah rechargeable battery which was charged by a solar panel. A total of sixteen air samples from impaction and suction spore trap were collected at weekly intervals from 3rd to 18th standard weeks of 2021 during cropping season. A microscopic observation of air samples through Phase contrast microscope revealed that the presence of hyaline, oval shaped, single celled and thin walled airborne sporangia on 3rd, 4th and 5th standard weeks and hyaline, barrel shaped, single celled and thin walled airborne conidia on 12th and 16th standard weeks. The air samples from different standard weeks further subjected to PCR assay to detect the mildew pathogens. PCR assay confirmed the presence of grapevine downy mildew airborne inoculum on 3rd to 5th and 10th to 12th standard week samples using species specific primers targeting a region between *NADH dehydrogenase subunit 9 (NAD 9)* and *apocytochrome b (COB)* gene. This PCR assay yielded an amplicon size of ~520 bp. Similarly, airborne inoculum of powdery mildew was also detected with PCR assay on 3rd to 6th and 15th to 18th standard week samples using a species-specific primers targeting *cytochrome b* (*Cyt b*) gene with an amplicon size of ~470 bp. Further the air samples were subjected to rapid, highly specific and sensitive Loop mediated isothermal amplification (LAMP) assay to detect the airborne inoculum of *P. viticola* and *E. necator* using six sets of LAMP primers targeting Ces A4 gene and *rDNA* region encoding the *ITS* and *5S ribosomal RNA* gene, respectively. LAMP assay was efficiently detected the airborne inoculum of *P. viticola* in all air samples collected from 3rd to 18th standard weeks. The presence of airborne inoculum of *E. necator* was detected from 3rd to 7th and 10th to 18th standard weeks. The cluster sampling method was conducted to assess the downy and powdery mildew disease incidence during cropping season from 3rd to 18th standard week. For downy mildew, the highest disease incidence was recorded on 10th standard week (13.6%) and lowest disease incidence was recorded on 6th standard week (3.2%). For powdery mildew, the highest disease incidence was recorded on 18th standard week (20.8%) and lowest disease incidence was recorded on 12th standard week (6.4%). The correlation between weather parameters and disease incidence of grapevine mildews was studied using Karl Pearson's coefficient of correlation. For downy mildew, the minimum temperature showed a highly positive correlation and wind speed showed a highly negative correlation. Whereas, for powdery mildew relative humidity showed a highly positive correlation and wind speed showed a highly negative correlation.

PRVA (M Sc) (S1) 02: Facile Biosynthesis of Silver-Silica Nanocomposite for Management of Sheath Blight Disease of Rice

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Sheath blight of rice, is a dominant lethal disease, especially in intensive rice cropping systems and till dateno cultivar has been found to be completely resistant to this disease. Presently, conventional farming methods are substituted with new technologies, that are essential for quality crop production and the application of nanotechnology, especially green technology offers considerable promise in answering these problems. In this study, *Litsea salicifolia* mediated silver (Ag) and silica (SiO_2) nanocomposite (NC) was synthesized. Efficacy test showed, Ag nanoparticle (NP) alone possessed high antimicrobial property and SiO2nanogel (NG) as a good enhancer of defense mechanism in plants. Combing both the nanoparticles, the NC was formed and found to be a potent drug for management of *R. solani*. Characterization of Ag-NP and SiO2-NG was done using UV-vis spectroscopy, dynamic light scattering, zeta potential, SEM, TEM, SAED, EDX and NTA. NC at seven doses when tested for efficacy against the mycelia and sclerotia of *R. solani,* the effect was found to be dose dependant. The highest inhibition against both sclerotia and mycelia was recorded at a concentration of 200 ppm with inhibition of 85.66% and 73.55% respectively. An encapsulated (EN) product of Ag-SiO_2 was developed and when tested for its efficacy and compared with the Ag-SiO_2 NC and a chemical, 100% mycelial growth inhibition of *R. solani* at 200 ppm of encapsulated product was recorded. Further analysis of the NC on rice plants with challenged inoculation of *R. solani* showed reduced per cent disease incidence up to 20% from 80% incidence in untreated control and also enhanced effect of plant growth parameters and biochemical defences in rice.

PRVA (M Sc) (S1) 03: Studies on Variability and Management of *Colletotrichum gossypii* Causing Anthracnose of Cotton through New Generation Fungicides

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Cotton (*Gossypium* spp. L.) of *Malvaceae* family, called “white gold" and “king of fibres” is one of the major fibre crops of global significance. Among the various fungal diseases, anthracnose caused by *Colletotrichum gossypii* is the most important pre- and post-harvest diseases in cotton. Considering the economic damage by this pathogen, a roving survey was conducted during *Kharif*, 2021-22 in different regions of cotton growing areas of Rajasthan. A total of five isolates/ diseased samples of cotton showing lesions on leaves and spots on bolls symptoms were collected. Maximum mean severity of the disease was recorded at Hanumangarh district (42.25%) followed by Sri Ganganagar (RJCG-4) district (38.00%). Among five isolates of *Colletotrichum gossypii,* the isolate RJCG-3 (Hanumangarh) was found to be more virulent. Morphological characters of five different isolates with respect to radial mycelial growth, conidial characters, setae and acervuli were studied on PDA to know the variability among the isolates. Among the five isolates of *Colletotrichum gossypii*, maximum radial mycelial growth of 88.25 and 86.00 mm was recorded in RJCG-3 and RJCG-4 respectively. Acervuli length 215.30 µm and breadth 85.25 µm found to be maximum in RJCG-3. Maximum conidia length *i.e.*, 28.92 µm and breadth 3.91 µm was observed in RJCG-3 and maximum length and breadth of setae (132.92 µm and 5.70 µm) in RJCG-3. In this study, nine new generation fungicides were evaluated against this pathogen. Among these fungicides, Gloit 300 EC (Propiconazole 13.9% + Difenoconazole 13.9% EC) was found to be most effective at all the concentrations (*i.e.*, 0.05%, 0.10%, 0.15% and 0.20%), which inhibited maximum 95.20% mean mycelia growth and 93.66% of mean spore germination. Fungicides found effective were tested in field condition for the management of cotton leaf spot. The results showed that Gloit 300 EC (Propiconazole 13.9% + Difenoconazole 13.9% EC) @ 0.1% were found effective in controlling the leaf spot and boll rot incidence as compared to other treatments.

PRVA (M Sc) (S1) 04: Eco-friendly Management of Stem Rot of Berseem Caused by *Sclerotinia* spp.

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The investigation on the eco-friendly management of stem rot of berseem caused by *Sclerotinia* spp. was undertaken in the Department of Plant Pathology, CSK HPKV, Palampur during 2020-22. The pathogen was isolated from the diseased berseem samples and pathogenicity of the associated pathogen was proved. On the basis of symptoms, the disease was identified as stem rot and on the basis of morpho-cultural and molecular identification the pathogen was identified as *Sclerotinia sclerotiorum*. Temperature was observed as the most important factor in the disease development having significant negative correlation with disease severity. Twenty fungal and one bacterial bioagents isolated from berseem rhizosphere along with five established bioagents from the department were evaluated for their antagonistic activity against *S. Sclerotiorum* in dual culture. Bioagent TRN-10 was found the most effective with 75.20 per cent mycelial inhibition, which was followed by TRN-9 (73.00%), TRN-14 (72.20%), TRN-12 (71.90%), TRD-2 (64.07%) and BN-1 (51.90%). These six bioagents were tested for their effect of volatile and non-volatile compounds in which TRN-10 gave the maximum mycelial inhibition (34.44%) using volatile metabolites with 56.00 per cent inhibition of sclerotial germination. However, bioagent TRN-9 provided maximum mycelial inhibition (50.74%) using non-volatile metabolites with 51.99 per cent inhibition of sclerotial germination. Among the botanicals, extracts of *Eucalyptuscamaldulensis* (aqueous) and *Melia azedarach*

(alcoholic) gave maximum mycelial inhibition *i.e.* 15.93 & 39.26 per cent, respectively at 50 per cent concentration. Panchgavya as an organic input and Brahmastra as a natural product, were found the best with 65.50 & 70.70 per cent mycelial inhibition, respectively at 25 per cent concentration. The five most effective bioagents *i.e.* TRN-9, TRN-10, TRN-12, TRN-14 and TRD-2 were evaluated for their disease management potential in pot culture. TRN-10 was found best which provided maximum disease control when applied as soil (58.33%) and seed treatment (60.00%). Bioagent TRN-9 gave maximum increase in seedling root (34.45%) & shoot length (51.13%) however, TRN-12 provided maximum increase in green fodder yield (50.00%) under *in vivo* conditions. Among the botanicals, extract of *Eupatorium adenophorum* was found the best with 23.48 per cent disease control in pot culture. Panchgavya and Brahmastra as organic and natural product provided 48.74 & 45.09 per cent disease control under *in vivo* conditions, respectively. The integration of eco-friendly components in pot culture showed that T7{*Trichoderma* spp. (TRN-10) + *Eupatorium adenophorum* + panchgavya + ghanjeevamrit} was found most effective for the management of the stem rot disease with 75.00 per cent disease control after 35 days of inoculation.

PRVA (M Sc) (S1) 05: Distribution of *Alternaria* Species in Sunflower, Their Host Range and Management

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Sunflower an important oilseed crop of India is affected by diverse species of *Alternaria* causing leaf blight and with significant yield loss. Isolates of *Alternaria* (23 nos.) from Chitradurga, Chikkaballapur, Chamarajnagar and Bengalore Urban were studied morphologically and groupedto different species,that was re-confirmed by sequence analysis of ITS, Alt 1a,SSU, GAPDH, endoPG, OPA10-2 and species specific genes (AA, AHN1and QPHEL).It revealed the prevalence of species with distribution frequency as *A. alternata* (91.65%), *A. tenuissima* (66.6%) *A. helianthi* (55.33%) and, *A. solani*, *A. burnsii* and *A. Gossypina* had similar frequency (33%). *A. alternata* had highest distribution frequency in Chikkaballapur, Bangalore Urban, Chamarajnagar whereas *A. Tenuissima* and *A. Alternate* in Chitradurga only. *A. helianthi* was second highest in Bangalore Urban.Host range studies revealed that, *A. alternata, A. Tenuissima* and *A. helianthin* are not host specific and can infect other members of Asteraceae family (African marigold, China aster, Safflower and Parthenium). While – *A. burnsii*, *A.solani* and *A. Gossypina* infected sunflower only not other host species. *In-vitro*assays of new fungicide molecules revealed thatFluopyram17.7% + Tebuconazole 17.7% 400 SC at 100, 250, 500, 750, and 1000 ppm completely inhibited the mycelial growth of the pathogen. Under field lowest disease severity (7.36% PDI) and best seed yield (2153 Kg/ha) were obtained in seed treatment with Fluxapyroxad FS @ 1.5g/kg seed followed by foliar spray with Fluopyram 17.7% + Tebuconazole17.7% 400 SC @ 1 ml/L on disease appearance.

PRVA (M Sc) (S1) 06: Epidemiology and Symptomatological Variations of Pestalotiopsis Leaf Spot and Blight Disease of Cashewnut in Western Part of West Bengal

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The major cashew growing states in India are Kerala, Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu, Orissa and Goa. The cashewnut (*Anacardium occidentale* L.) is an important plantation crop in red lateritic zones of West Bengal, which is mostly grown in the districts of Jhargram in West Bengal. Biotic stresses are the major limiting factors in cashew production. Cashew leaf blight incited by *Pestalotiopsis* sp. is one of the most prevalent foliar diseases in the western region of West Bengal and primarily affects older leaves. The changeable weather condition interacting with high density planting in cashew coupled with orchard management system of the area trigger the pathogenic fitness of *Pestalotiopsis* sp. and poses a serious threat of crop production in this region. Cashew is mainly grown on coastal saline belt and western parts of West Bengal and scanty of literatures available on dynamics of different foliage diseases of cashew in West Bengal. Hence, in the present investigation attempts have been made to study the dynamics of Pestalotiopsis leaf blight disease of cashew under red and lateritic regions of West Bengal, morphological and molecular characterization of the pathogen and the effect of weather variables on initiation and spread of the Pestalotiopsis leaf blight disease of cashew. Periodical disease survey data during (Oct- June), 2022 under fixed plot survey at Cashew orchard of Regional Research Sub Station, Jhargram, Bidhan Chandra Krishi Viswavidyalaya indicated that Pestalotiopsis leaf spot and blight is the most important disease during Rabi and Pre kharif season under western part of West Bengal. During this field survey, four different characteristic symptoms (sym 1, sym 2, sym 3 and sym 4 types) of Pestalotiopsis leaf spot and blight was recorded and sym1 and 4 type of symptoms were found to be more dominant throughout the study period. Among the different morphological characters, conidial length, length of median cell and length of apical appendages are found to be the most significant morphological markers utilized for species and strain differentiation of *Pestalotiopsis*. The oat meal agar and potato dextrose agar were found to be the best medium for growth and sporulation of *Pestalotiopsis* sp. infecting leaf blight disease of cashew. The temperature at the range of 22-25 °C was found to be the favourable temperature for mycelia growth of *Pestalotiopsis* sp. causing leaf spot and blight disease of cashew. Maximum and minimum temperature and average RH were found to be the significant weather variables associated with prediction of Pestalotiopsis leaf spot and blight disease risk/no risk period in cashewnut. Maximum temperature of (21-24 °C) and average relative humidity > 80% were found to be highly congenial for rapid progression of Pestalotiopsis leaf spot and blight disease severity in cashewnut under lateritic belts of West Bengal. Binary Logistic Regression model performed better in predicting the disease risk and no-risk condition over the multiple regression model.

PRVA (M Sc) (S1) 07: Interaction of *Fusarium solani* and *Meloidogyne javanica* in Causing Root Rot of Fennel and its Management

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Fennel is one of the important seed spice crops grown in India. Disease complex of *Fusarium solani* and *Meloidogyne javanica* is widely distributed in India. It has been found frequently associated with spices and responsible for severe economic losses. Considering the economic importance of *Fusarium solani* and *Meloidogyne javanica* as disease causing organism of fennel, the present investigation was carried out to find interaction of *Fusarium solani* and *Meloidogyne javanica* in causing root rot of fennel and its Management. Fennel plants depicting root rot symptoms were collected from farmer's field. The fungus, *Fusarium solni* was isolated from infected fennel plants, purified by single spore technique and proved pathogenic. An experiment was conducted on interactive effect of *Fusarium solani* and *Meloidogyne javanica* on root rot incidence in fennel. Among all the treatments, minimum nematode reproduction and maximum plant growth parameters were recorded by inoculating fungus at the time of sowing and nematode after one week. While, maximum disease incidence was recorded by inoculating nematode at the time of sowing and fungus one week after. Among screened 30 varieties/ germplasm of fennel four varieties (RF-101, RF-145, RF-157 and RF-143) showed resistant reaction, 21 showed moderately resistant reaction and five showed susceptible reaction against the pathogens. Among all varieties/germplasm, highest root rot incidence was recorded in RF-125 and UF-33. However, minimum root rot incidence was recorded in RF-101 and RF-205. An experiment was conducted on management of the root rot and root knot disease complex through bio-agents (@ 2.5kg/ha as soil application) and botanicals (@ 10% concentration as seed soaking). Among all the treatments combination of *Trichoderma harzianum* and garlic showed best results followed by *Trichoderma harzianum* + parthenium for increase plant growth parameters and reduce percent root rot incidence as well as nematode reproduction as compared to untreated control. Biochemical studies were also carried out to find the peroxidase, polyphenol oxidase, phenylalanine ammonia lyase and phenol level. Highest peroxidase, polyphenol oxidase, phenylalanine ammonia lyase and phenol activities was observed in *Trichoderma harzianum* and garlic followed *Trichoderma harzianum* + parthenium and parthenium treated fennel roots as compared to untreated control.

PRVA (M Sc) (S1) 08: Detection, Pathogenic Potential and Eco-friendly Management of Seed-borne Mycoflora Associated with Fennel Cultivars

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Fennel (*Foeniculum vulgare* Mill.) is a medicinal plant belonging to the *Umbelliferae* (*Apiaceae*) family. The seeds have a fragrant odour and a pleasant aromatic taste. They are widely used in various food preparations, candies, soups, sauces, pastries, pickles, liquors, bakery items, *etc*. It has antioxidant, antitumor, chemopreventive, cytoprotective, hepatoprotective, hypoglycemic and oestrogenic activities. The fennel crop is affected by many fungal and bacterial pathogens. The poor seed yield, quality and quantity of fennelare due to a number of causes but seed-borne infections are one of the most important factors among them. The most predominant fungal genera encountered on fennel seeds were *Aspergillus* spp., *Penicillium* spp., *Alternaria* spp. and *Fusarium* spp. Therefore, the present investigation was taken up on detection, pathogenic potential and eco-friendly management of seed-borne mycoflora associated with fennel cultivars in respect of seed abnormalities, mycoflora load on seed, molecular identification of dominant mycoflora, seed germinability, seedling length, seedling vigour, seedling discolouration intensity and their eco-friendly management through bio-priming, plant-derived products and organic inputs under *in-vitro* and pot conditions at AAU, Anand. Dry seed inspection of fennel seeds revealed discoloured and deformed seeds mixed with healthy seeds.Cultivar GF 12 recorded significantly the highest healthy seeds while the highest discoloured and deformed seeds were recorded in GF 11. Seven fungal species from five different genera *viz., Alternaria alternata, Macrophomina phaseolina, Fusarium oxysporum, Curvularia lunata, Aspergillus niger, A. flavus* and *A. Fumigates* were detected by agar plate method. Significantly highest seed mycoflora load was observed on the cultivar GF 11while the lowest was observed on seeds of GF 12. Among seven different mycoflora, the incidence of *A. alternata* was found more prevalent and it developed more colonies in all five cultivars. *Curvularia lunata* and *A. fumigatus* had the least per cent incidence thus they developed fewer colonies on seeds. Molecular identification of dominant seed mycoflora of fennel cultivars *i.e., A. alternata* was performed *via* PCR amplification and sequencing of the Internal Transcribed Spacer (ITS) region of fungal DNA (rDNA) with universal primer ITS1 and ITS4. The ITS primers produced an amplicon of 530 bp for *A. alternata.* The sequence of the rDNA region (Accession no. ON613536) was aligned and analysed in the NCBI nucleotide BLAST. It showed 97.94 per cent similarity with already reported *A. Alternate* (MN268767.1, MN268766.1 and MH894277.1) sequences. The seed germination, seedling length and seedling vigour index-I (SVI-I) were drastically reduced by all detected seed mycoflora in all five fennel cultivars. Seeds inoculated with culture filtrate of *M. Phaseolina* showed the lowest germination, seedling length and SVI-I in all cultivars. *Macrophomina phaseolina* showed the highest per cent discolouration intensity in all the cultivars. Seed bio-priming with two fungal and two bacterial bioagents *i.e., Trichoderma viride, T. harzianum, Pseudomonas fluorescens* and *Bacillus subtilis*a nd hydro-priming with three time periods of bio-priming *i.e.,* 3, 6 and 9 hrs. were evaluated for eco-friendly management of seed mycoflora. Among them, *T. Harzianum* and *T. viride* (60%) for 9 hrs. recorded maximum seed germination, seedling length and SVI-I whereas the lowest

seed germination, seedling length and SVI-I were recorded in hydroprimed seeds. *Trichoderma harzianum*and *T. Viride* showed significantly highest inhibition effect against seed mycoflora resulting in the least average mycoflora load. Among the all evaluated phytoextracts, minimum seed mycoflora load was recorded in seeds treated with garlic clove extract, 10%. There was an absence of *C. Lunata* in seeds treated with garlic clove extract, moringa leaf extract and neem oil. The highest seed mycoflora load was observed on seeds treated with onion bulb extract. Organic inputs *viz.,* cow urine, *beejamrutha* and *panchagavya*at 3 and 5 per cent concentrations showed significant inhibitory effect against dominant seed mycoflora *i.e., A. alternata.* Minimum mycelial growth and the highest growth inhibitionwas registered in *panchagavya*, 5% while the lowest inhibitory effect was observed in *beejamrutha*, 3% against *A. alternata*. Seed treatment with eco-friendly inputs significantly increases seed germination and reduces seed rot under pot conditions. Among seed treatments, seeds treated with *T. harzianum* (60%) for 9 hrs. showed the maximum germination and lowest seed rot.

PRVA (M Sc) (S1) 09: Studies on Citrus Canker Incited by *Xanthomonas citri* pv *citri* and its Management

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In India, Citrus is one of the major grown fruit crop after banana and mango which is known for its high nutritive and refreshing value, distinct aroma, delicious taste and also for its medicinal properties. Among all the diseases that attacks citrus crops, citrus canker caused by *Xanthomonas citri* pv. *citri* is one of the most devastating disease and of great economic importance. The initial symptoms appeared on leaves in the form of lesions as dark green and later become thickened brown and corky which become raised and blister-like, growing into white or yellow spongy pustules. Considering the seriousness of the disease, the present investigations entitled "Studies on citrus canker incited by *Xanthomonas citri* pv. *citri* and its management" was carried out with the objectives to study the morphological and biochemical characteristics, *in-vitro* evaluation of different antibiotics, medicinal plant extracts and molecular characterization among isolates of *Xanthomonas citri* pv. *citri.* Bacteria was isolated on Nutrient agar medium from infected leaves and fruits collected from Horticultural farm, College of Horticulture, AAU, Anand which showed yellow, circular and mucoid colony. Purification of bacteria was done by using streak plate method. Pathogenicity test was successfully carried out using pin prick method. Inoculated seedlings produced small water-soaked lesions which later becomes necrotic and corky. The causal agent was confirmed by re-isolation from artificially inoculated seedlings. The pathogen was identified through Indian Type Culture Collection (ITCC), ICAR-Indian Agricultural Research Institute (IARI), New Delhi as well as by marker assisted identification using specific primers XACF and XACR. From the results of identification, the pathogen was identified as a *Xanthomonas citri* pv. *citri*. Different morphological and biochemical test were performed on fifteen isolates collected from various places of Gujarat. The bacterial cells were straight rod shaped, gram-negative and having single polar flagella. All the isolates tested positive for motility test, catalase test, KOH test, starch hydrolysis, Tween 80 hydrolysis, gelatin liquefaction and citrate utilization while negative for gram staining and Kovac's oxidase test. The growth of *X. citri* pv. *citri* were checked against 1, 2, 3 and 4 per cent salt concentration in NA media. All the isolates grew well up to 3 per cent NaCl concentrations butisolates collected from Dhoraji, Kadi, Kheda, Rajkotand Junagadh showed poor growth on 4 per cent salt concentration. *In-vitro* efficacy of different agrochemicals and medicinal plant extracts were assessed using agar well diffusion method. Amongten tested agrochemicals, streptomycin sulphate 90% + tetracycline hydrochloride 10% SP mixed with copper oxychloride 50% WP showed highest zone of inhibition with all three concentration (100, 200 and 300 ppm) 20.28mm, 22.62mm and 26.08mm with per cent inhibition of 22.54, 25.13 and 28.97 followed by streptomycin sulphate 90% + tetracycline hydrochloride 10% SP mixed with bordeaux mixture 1% (mixed) 17.35mm, 20.80mm and 24.26mm with per cent inhibition 19.27, 23.11 and 26.95, respectively. Among medicinal plant extracts, highest zone of inhibition was recorded with treatment Neem 7.91mm and 12.20mm with per cent inhibition of 8.78 and 13.55, followed by Ardusi 6.32mm and 9.31mm with per cent inhibition of 7.02 and 10.34 at 5 and 10 per cent concentration, respectively. The genetic diversity of the isolates was evaluated by using RAPD marker and the result indicating high level of polymorphism. Out of 10 primers used, 8 primers showed 100 per cent polymorphism. The highest similarity index value of 0.88 was found between isolate of Kheralu and Aravalli, while the least similarity index value of 0.22 was found between isolate of Rajkot and Morbi. The average similarity coefficient among isolates was 0.46. A dendrogram was constructed among the isolates according to Jaccard's coefficient. Principle Component Analysis (PCA) results almost coincided with the results of cluster analysis of dendogram.

PRVA (M Sc) (S1) 10: Study of Growth Behaviour, Yield Comparison and Post-harvest Quality Preservation of Oyster Mushroom (*Pleurotus florida*)

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The oyster mushroom, (*Pleurotus* spp.) belongs to Class Basidiomycetes of the Family Agaricaceae. It is popularly known as 'dhingri' in India and grows naturally in the temperate and tropical forests around the world. *Pleurotus* spp. is generally referred as the oyster mushroom because the pileus or cap is shell-like, spatulate and the stipe is eccentric or lateral. *Pleurotus ostreatus* (Jacq.: Fr.) Kummer is one of the best-known species of oyster mushrooms. The oyster

mushroom is preferred over other species of mushroom for commercial cultivation because of it's rapid mycelial growth, high ability for saprophytic colonization and inexpensive cultivation techniques. The research was conducted on a total of three isolates of *Pleurotus florida, viz.*, PL-20-204, PL-20-205 and PL-20-206 collected from Dr. RPCAU, Pusa, Samastipur. The pure culture was sub-cultured on PDA media and stored in a BOD incubator at 25°C. Three different culture medias *viz.,* Potato dextrose agar, Yeast malt agar, and Sabouraud dextrose agar were studied to evaluate the in-vitro mycelial growth pattern of three strains of *Pleurotus florida* species. The best results were obtained with Yeast malt agar media that showed a growth of 60mm in PL-20-204, 52mm in PL-20-205 and 48.25mm in PL-20-206 strain with white dense mycelia and regular margin. PDA also showed good results with a growth of 56mm in PL-20-204,47.27mm in PL-20-205 and 44mm in PL-20-206 strain with white concentric ring like mycelia and irregular coverage. Lowest growth was observed in Sabouraud' dextrose agar media. Out of the three strains, highest mycelia growth was observed in PL-20-204 strain in all the media followed by PL-20-205 strain. Slowest growth was observed in PL-20-206 strain. PL-20-204 strain showed best growth in Yeast malt agar media with a growth of 60 mm along with pure white and thick mycelial coverage. The best performance of PL-20-205 strain was observed in Yeast malt agar media with a growth of 52 mm along with thick mycelia growth whereas PL-20-206 also showed best results in Yeast malt agar media with a growth of 48.25mm. Four different substrates *viz.,* wheat straw, wheat straw + water hyacinth (1:1), maize straw and maize straw + bajra straw (1:1) were used to study growth behaviour and yield potential of all three strains. WS+WH showed best results among all substrates with average weight of 18.03gm in case of PL-20-204,13.25gm in case of PL-20-205 and 19.30gm in case of PL-20-206 and total yield of 900.1 Kg for PL-20-206, 795.1 Kg for PL-20-204 and 731.9 Kg for PL-20-204 in three flushes. Out of three strains, PL-20-206 showed best growth followed by PL-20-204.The post-harvest quality preservation of mushroom was assessed using four essential oils *viz.,* lemongrass oil, citronella oil, mint oil and clove oil. Biochemical analysis of Total phenol content, PAL, PPO and POD was done. Out of the four treatments, *i.e.,* lemongrass oil(T1), citronella oil(T2), mint oil(T3) and clove oil(T4), T3 showed maximum accumulation of phenolic compounds which was 0.250mg/gm and 0.286mg/gm of gallic acid equivalent at 5µL and 10µL respectively. The concentration of PAL was highest (0.038 µM/gm at 5µL concentration and 0.042µM/gm at 10µL concentration) in T3. The lowest value of POD was recorded for T3 (0.105U/gm at 5µL concentration and 0.38U/gm at 10µL concentration). Lowest concentration of PPO was found in T3 which was 0.042U/gm in 5µL treatment and 0.022U/gm in 10µL treatment. It was concluded that concentration of Total phenol and PAL was higher in treated samples and concentration of PPO and POD was higher in untreated plots showing that essential oil fumigation improves the quality of harvested mushroom and increases its shelf life.

PRVA (M Sc) (S1) 11: Efficacy of Multifaceted Microbes against Fusarial Wilt of Chickpea

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A total of 28 endophytic bacteria, isolated from roots with root nodules of chickpea, were characterized for antagonistic potential against, *Fusarium oxysporm* f.sp. *ciceris* (Foc) causal organism of wilt disease, in chickpea. Among them, four most potential endophytes, ENC1, ENC8, ENC10 and ENC22 were further characterized for their plant growth-promoting (PGP) and induce systemic resistance (ISR) against Foc, in chickpea. The sequences of 16 S rDNA gene of the four endophytes were matched with *Bacillus* but different species. In planta, the combinations of all the four potent isolates were able to significantly enhance PGP traits including seed germination (100%), plant height (43-53 cm), number of branches (19-21/plant), early flowering (54 DAS) and yield (19.82 q/ha) as well as least disease incidence (8.06 and 9.33% at 30 and 60 days after sowing) over the un-inoculated control in chickpea genotype Vishal. Further, pathogenesis related (PR) proteins such as phenylalanine ammonia-lyase, polyphenolperoxidase, total phenolics and H2O2 content and chlorophyll and carotene contents were found induced in the roots and leaves of chickpea respectively inoculated with selected endophytes over un-inoculated control. The selected endophytes enhanced the plant growth and also host plant resistance against Foc in chickpea.

PRVA (M Sc) (S1) 12: Studies on Infusion and Translocation of Insecticides in Mungbean Seeds against *Bemisia tabaci* Transmitting *Mungbean* Yellow Mosaic Virus (MYMV)

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Mungbean yellow mosaic virus (MYMV) is one of the major constraints in the cultivation of mungbeanin southern Karnataka. The survey conducted during summer 2022 to assess the incidence of MYMV in Chamarajanagar, Mysore and Mandya districts, revealed that the highest disease incidence was recorded in Hunsur taluk (58.4%) of Mysore district and lowest disease incidence was recorded in Mandya district (40.8%). The efficacy of seed dressed and seed primed methods revealed that, the minimum disease incidence (5.36%) and whitefly population of 1.05 per plant was recorded at 15 DAS in which seed were dressed with Imidacloprid 48 FS (1.25ml/kg) and recorded benefit-cost ratio of 3.04. Similarly, among seed primed treatments, the minimum disease incidence (11.32%) and whitefly population of 1.10 per plant was recorded at 15 DAS in which seeds were treated with

Imidacloprid 48 FS (1.25ml/kg) and recorded benefit-cost ratio of 2.92. The virus associated with the host was detected by PCR using coat protein (CP) specific primers. The PCR amplification yielded ~900 bp and the products were sequenced. The validation on the absorption of potential insecticides by the seed was studied using TLC method which revealed that the metabolites of insecticides in the seed treated plant samples were found below the limits of detection. The undetectable insecticide metabolite did not rule out the possibility of absorption of insecticide during seed dressing and priming methods.

Oral Papers

Technical Session 2: Emerging and Innovative Technologies in Plant Health Management

OP (S2) 01: Management of *Cercospora* leaf spot in okra through organic inputs

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A study on effect of organic inputs against *Cercospora* leaf spot in okra was carried out at two locations *viz.,* College of Agriculture, AAU, Vaso and Jabugam for the two consecutive years 2020 and 2021 during *kharif* season. The experiment was laid out in randomized block design with three replications and ten treatments consisting of T_1: Seed treatment with *Beejamrit*200 ml/ kg seed for 30 minutes. T_2: T_1 + foliar spray of cow urine, T_3: T_1 + foliar spray of cow urine @ 10%, T_4: T_1 + foliar spray of *Panchagavya* @ 5%, T_5:T1 + foliar spray of *Panchagavya* @ 10%, T_6:T1 + foliar spray of liquid *Jeevamrut* @ 5% T_7: T_1 + foliar spray of liquid *Jeevamrut* @ 10%, T_8: T_1 + foliar spray of fermented buttermilk @ 5%. T_9: T_1 + foliar spray of fermented buttermilk @ 10% and T_{10}: Untreated check. The data on the pooled over sprays over years of evaluation organic inputs against *Cercospora* leaf spot disease of okra in the year 2020 and 2021 revealed that, the lowest percent disease intensity (20.37%) and Highest fruit yield (11887 kg/ha) was recorded in treatment T_5 *i.e.* Seed treatment with *Beejamrit* + foliar spray with *Panchagavya* @ 10% and was significantly superior over rest of treatments.

OP (S2) 02: Evaluation of Organic Inputs against Major Foliar Diseases of Turmeric

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A study on effect of organic inputs against *Cercospora* leaf spot in okra was carried out at two locations *viz.,* College of Agriculture, AAU, Vaso and Jabugam for the two consecutive years 2020 and 2021 during *kharif* season. The experiment was laid out in randomized block design with three replications and ten treatments consisting of T_1: Seed treatment with *Beejamrit*200 ml/ kg seed for 30 minutes. T_2: T_1 + foliar spray of cow urine, T_3: T_1 + foliar spray of cow urine @ 10%, T_4: T_1 + foliar spray of *Panchagavya* @ 5%, T_5:T1 + foliar spray of *Panchagavya* @ 10%, T_6:T1 + foliar spray of liquid *Jeevamrut* @ 5% T_7: T_1 + foliar spray of liquid *Jeevamrut* @ 10%, T_8: T_1 + foliar spray of fermented buttermilk @ 5%. T_9: T_1 + foliar spray of fermented buttermilk @ 10% and T_{10}: Untreated check. The data on the pooled over sprays over years of evaluation organic inputs against *Cercospora* leaf spot disease of okra in the year 2020 and 2021 revealed that, the lowest percent disease intensity (20.37%) and highest fruit yield (11887 kg/ha) was recorded in treatment T_5 *i.e.* Seed treatment with *Beejamrit* + foliar spray with *Panchagavya* @ 10% and was significantly superior over rest of treatments.

OP (S2) 03: Bio-efficacy of Botanicals against Aphids on Coriander

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A field experiment was conducted at Entomology farm, Department of Agricultural Entomology, B. A. College of Agriculture, Anand Agricultural University, Anand during 20218-20 to determine the bio-efficacy of different botanicals against aphids infesting coriander bio-efficacy of different botanicals against aphid, *Hyadaphiscoriandri* (Das) infesting coriander [Var. Coriander, Gujarat Coriander 2 (GC 2)] by using Randomized Block Design (RBD) with three replications. Among nine botanicals evaluated in field condition, lowest number of aphids was observed in the plots treated with aqueous bidi tobacco dust extract 2% (9.55 aphids/3 shoot) and it was at par with aqueous ginger rhizome extract 5% (10.72 aphids/3 shoot) which were the most effective among all evaluated botanicals. Treatments garlic bulb water extract 5% (19.75 aphids/3 shoot) and neem oil 1% (21.97 aphids/3 shoot) were found at par and emerged as second-best treatments in managing aphid population. While, the highest aphid population was observed in the plot treated with *Ipomea* leaf extract 10% (35.74 aphids/ 3 shoot) which was at par with lantana leaf extract 10% (35.02 aphids/3 shoot), indranama fruit water extract 5% (34.31 aphids/3 shoot) and kalmegh water extract 10% (33.26 aphids/3 shoot).The population of coccinellids (grubs and adults) and syrphids (larvae)/plant were found non-significant during both the years. Hence, all the botanical treatments found more or less equally safer to this predator. Of tested botanicals, the highest seed yield was recorded from the plot treated with tobacco decoction 2% (1369 kg/ha) and it was at par with ginger rhizome water extract 5% (1335 kg/ha).

OP (S2) 04: Bio-efficacy of Organic Inputs against Aphid in Fennel

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Fennel, *Foeniculum vulgare* (Miller) considered as important spices crop a commonly known as '*Variali'* in Gujarati, where '*Saunf*' in Hindi. Various insect pests of fennel, aphid is an important threat to cause damage by suck the cell sap after formation of umbel which deteriorate the quality as well as quantity of fennel seed. The use of insecticide at this time may reduces the activity of honey bees and natural enemies. Besides its also creating problem of residue as this crop has a great export potential. Hence, overcome these problems as well as promoting of organic farming the experiment on bio-efficacy of organic input against aphid in fennel was carried out at entomology farm, B. A. Collage of Agriculture, Anand Agricultural University, Anand, Gujarat during the two consecutive years *i.e.* 2020-21 and 2021-22. Among the various organic inputs, *Lecanicillium lecanii* 1.15% WP (0.85 aphid index) and *Metarhizium anisopliae* 1.15% WP (0.93 aphid index) were found more effective against aphid in fennel. Neem seed kernel extract 5%, neem oil 0.3% and *Beauveria bassiana* 5% WP were emerged as next best effective group in effectiveness. Treatments cow urine 5% (1.94 aphid index) and neemastra (1.88 aphid index) recorded higher population of aphid than rest of the organic inputs but significantly superior than control. The toxicity of all organic inputs to the coccinellids (grubs and adults) were found non-significant as compared with control. Hence, all the organic inputs were safer to this predator. The treatments *L. lecanii* 1.15% WP (1452 kg/ha) and *M. anisopliae* 1.15% WP (1400 kg/ha) yielded highest seed yield of fennel followed by the treatments of neem seed kernel extract 5% (1199 kg/ha), neem oil 0.3% (1186 kg/ha) and *B. bassiana* 5% (1170 kg/ha).

OP (S2) 05: Efficacy of Different Botanicals against Spotted Pod Borer, *Maruca vitrata* on Pigeonpea

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A field experiment was conducted at Agricultural Research Station, Anand Agricultural University, Derol, Gujarat, India during *kharif*, 2019-20 to investigate the efficacy of different botanicals against spotted pod borer, *Maruca vitrata* on pigeonpea. Ten treatments for *M. vitrata* management were evaluated in a randomised block design with three replications. The botanicals neem seed kernel extract 5 per cent, neem leaf extract 10 per cent, neem oil 0.5 per cent, custard apple leaf extract 10 per cent, custard apple seed extract 5 per cent, garlic extract 5 per cent, tobacco decoction 2 per cent, eucalyptus leaf extract 10 per cent, azadirachtin 0.15 EC 0.0006 per cent were applied at initiation of pest and subsequent two sprays were applied at ten days interval. Among all the different treatments, larval population of *M. vitrata* was found significantly lower in the plot treated with azadirachtin 0.15 EC @ 0.0006 per cent (0.31 larva/plant) and it was at par with neem seed kernel extract 5 per cent (0.44 larva/plant).

OP (S2) 06: Evaluation of Different Organic Inputs against Bacterial Pathogen *Xanthomonas campestris* pv. *campestris* under *in-vitro* Conditions

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An age-old practice of using liquid organic manures is flourishing back in Indian agriculture due to their eco-safeness and inhibitory actions against many phytopathogenic bacteria and fungi. In present study A total of six organic inputs *viz*., *Panchagavya*, *Beejamrutha, Jeevamrutha,* fresh cow urine, Fermented buttermilk and kunabjal were evaluated *in-vitro* at four different concentration (3,5,7,10%) against *Xanthomonas campestris* pv. *campestris* (*Xcc*) causing black rot of cabbage wherein, Kunapjal (10%) totally inhibited the growth of *Xcc* bacteria in agar well plate method. *Panchagavya* and *Jeevamrutha* also gave marked inhibition of *Xcc* using the same method while, *Beejamrutha, Fermented buttermilk* and fresh cow urine were not up to the mark in hindering bacterial growth. Hence, present study can aid in combining usage of organic manures in designing an effective and eco-safe strategy for managing highly seed borne *Xcc* destroying various delicate crucifer crops in nurseries.

OP (S2) 07: Isolation, Pathogenicity and Management of *Colletotrichum musae* Berk. & Curt. Infecting Banana Fruits Using Different Chemical Salts

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Banana (*Musa paradisiaca* L.) is one of the most important crops in tropical and subtropical countries. It suffers with several kinds of infections like fungal, bacterial and viral origin diseases, among them anthracnose caused by *Colletotrichum musae* has become a severe problem in recent years and directly affecting the quality of fruits. A seasonal market survey was conducted during 2018 in major fruit markets of Junagadh (Gujarat) district and maximum disease intensity was found in retail markets of Junagadh city (26.19%) followed by market of Vanthli (25.40%), Keshod (23.82%) and Manavadar (20.09%) during the monsoon. Fruits showed typical symptoms of anthracnose having numerous small to large circular and brown to dark brown spots which at severe stage, collapsed and produced peel blemishes as black or brown big sunken spots infecting inside the banana fruits. Isolation of pathogen was carried out by tissue segmented method from infected portion and identified as *C. musae*. The colony of *C. musae* was loose

with white aerial mycelium, which later became light orange to pink in colour having hyaline, thin walled, oblong, elliptical or cylindrical conidia containing 1-2 oil globules. The pathogenicity test was proved by different inoculation methods *viz*., pin prick injury method, tooth brush injury method and cork borer wounding method. However, maximum per cent infection was more significant in pin prick injury method (75%) than cork borer (70%) and tooth brush (58%) methods showed the typical symptoms as natural infection. To manage this the efficacy of different six non-poisonous chemical salts *viz*., sodium chloride (NaCl), calcium chloride ($CaCl_2$), sodium bicarbonate ($NaHCO_3$), boric acid (H_3BO_3), citric acid ($C_6H_8O_7$) and sodium metabisulphide ($Na_2S_2O_5$) were used at 1, 2, 3 and 4 per cent concentration. Among them minimum disease intensity (10.49%) was found in fruits treated with calcium chloride at 4% followed by treatment with sodium chloride (12.20%) at 4% concentration.

OP (S2) 08: Antinematicidal Activity of Lions Mane and Oyster Mushroom against *Meloidogyne incognita* (root-knot nematode)

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The culture filtrate of Lions mane and Oyster mushroom at three different doses *i.e.,* 0.5, 1.0 and 1.5% were taken under study to observe the nematicidal activity on egg hatching inhibition under *in vitro* condition. Hence, overall findings revealed that all tested concentration caused effects on *M. incognita* with different percentage of egg hatching inhibition and juveniles' mortality. Moreover, longer the exposure to mushroom extract higher the juvenile mortality was observed. Among the three different concentrations of two species of mushroom tested, the higher concentration (1.5ml) of Lions mane mushroom culture extract exhibited effective nematicidal activity against *M. incognita*. Both the mushroom culture filtrate was found to have nematicidal activity against egg hatching after 72 hrs. of exposure with different percentages of egg hatching inhibition. The maximum egg hatching inhibition (89.18%) was recorded in Lions mane @ 1.5% as compared to control (20.41%).

OP (S2) 09: Influence of Metham Sodium and Metal Ions on Rhizobacterial Siderophore Production

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The influence of herbicide metham sodium and metal ions Fe, Co, Mn and Zn on the growth, fluorescence and siderophore production were examined in six confirmed fluorescent *Pseudomonas* isolates, obtained from chilli (CHRB2), cotton (CORB1), groundnut (GNRB1, GNRB2 and GNRB3) and soybean (SBRB2) in succinate medium. The herbicide prevented the growth in all the six rhizobacterial tested. Cobalt reduced siderophore production while Fe repressed it. But Mn and Zn had promoted the siderophore production. The data indicate that none of the six organisms could make any growth in presence of metham sodium, which they did in presence of the metal ions, though the growth was different compared to the controls. In the presence of FeCl3, the growth was similar to control, but there was no fluorescence and there was a total loss of siderophore production. Cobalt reduced the siderophore production of all the six isolates, which was proportional to the concentration. A different effect was noted with manganese and zinc, which increased the absorbance of siderophore peak indicating a higher production. Zinc was more effective than manganese for all isolates and at both concentrations. It is worth mentioning that zinc is added in Philson and Llinas medium used for siderophore production.

OP (S2) 10: Molecular Phylogenetic Diversity and Identification of Signature sequences for Pathogenic Species within *Fusarium solani* Species Complex

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Fusarium solani species complex (FSSC) has been reported globally as plant pathogens in a variety of agriculturally important crops. Therefore, an objective of the present study was to identify the strains of FSSC recovered from soil and plants in India, their morphological descriptions, and the development of species-specific markers for the most commonly occurring species. A total of 85 isolates belonging to the FSSC were examined and molecularly analyzed using TEF1, ITS, RPB2, LSU, calmodulin, mtSSU, and the intergenic spacer of rDNA gene sequences. Based on the phylogeny of combined TEF1, ITS, RPB2 and LSU gene sequences, a total of eleven FSSC species were identified, which are represented as predominantly, *F. falciforme* (54.11%), followed by *F. solanisensustricto* (9.41%), *F. striatum* (9.41%), *F. keratoplasticum* (5.88%), *F. vanettenii* (5.88%), *F. metavorans* (4.70%), *F. petroliphilum* (2.35%), *F. breve* (2.35%), *F. cyanescens* (2.35%), *F. solani* f. sp. *mori* (1.17%) and *F. solani* f. sp. *radicicola* (1.17%). In order to define the FSSC species, all taxonomic keys were evaluated for all 85 isolates, and the key differentiating features among the eleven FSSC species were identified as colony morphology on MEA, the shape of macro- and microconidia, the size of microconidia, and the septation of macroconidia. Further, the pathogenicity was we investigated for all 85 strains by the pot culture experiment on tomato plants and observed that all species *except F. solani* f.sp. *radicicola are capable of causing* root rot and wilt disease on tomato plants. Three species-specific primers, FU_FAL3/FU_FAL2, FU_MET1/FU_ MET2, and FU_STR1/FU_STR2, were designed *in vitro* for the detection of most prevalent species of FSSC *i.e. F. falciforme, F. metavorans and F. striatum, respectively, and validated against the eleven identified members of FSSC*. This is the first report of species-specific markers in *Fusarium solani* that can be detected specifically among the different members of the FSSC.

OP (S2) 11: Computational and *in silico* Docking Insight into Succinate Dehydrogenase Inhibitors Belonging to FRAC code 7

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Succinate Dehydrogenase Inhibitors (SDHIs) are one of the fastest growing classes of novel fungicides owing to its unique structure and broad fungicidal spectrum. These inhibit mitochondrial respiratory complex II or Succinate ubiquinone oxidoreductase (SQR), a catalyst in tricarboxylic acid cycle, and ultimately kill pathogenic fungi. Despite being a novel target site, there detailed interaction is still unclear. With the aim to uncover binding conformation of SDHIs, molecular docking, ligand−receptor interaction, and correlation between Autodock4.2 and PyRx binding affinity scores were performed. The *in silico* docking binding affinity scores of 24 FRAC code 7 fungicides with SQR of porcine (PDB ID: 1ZOY), *E. coli* (2WDQ) and avian (2WQY) proteins ranged from a maximum of – 9.6 kcal/ mol (fluxapyroxad with 2WQY) to – 5.9 kcal/ mol (fenfuram with 1ZOY) with the highest overall score of − 8.62 kcal/ mol (pyridine-carboxamide fungicide: pyraziflumid and pyrazole-4-carboxamides fungicide: benzovindiflupyr) with carboxin as positive control. A highly significant correlation was observed between Autodock4.2 and PyRx binding affinities (r=0.98, 0.57 and 0.72 for 1ZOY, 2WDQ and 2WQY, respectively) defining the reliability. In detailed visualization, docking positions indicated that a pyrazine ring as an acid moiety would be a good starting point to design newer SDHIs. These findings provide valuable insights into the effectivity of SDHIs which can be utilized to design more potent inhibitors of SQR of pathogenic fungi.

OP (S2) 12: Testing of Fluopyram 250 g/l + Trifloxystrobin 250 g/l SC against Sigatoka Leaf Spot and Post-Harvest Diseases of Banana

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Banana (*Musa* sp.) is the second most important fruit crop in India next to mango. Banana is a rich source of carbohydrate and vitamins, particularly vitamin B. It is also a good source of potassium, phosphorus, calcium and magnesium. The fruit is easy to digest, free from fat and cholesterol. Banana powder is used as the first baby food. It helps in reducing risk of heart diseases when used regularly and is recommended for patients suffering from high blood pressure, arthritis, ulcers, gastroenteritis and kidney disorders. Major diseases reported in banana plantation *viz.*, Panama wilt, Moko disease, Sigatoka leaf spot, bunchy top, Post-harvest diseases etc. Among all, Sigatoka leaf spot has the potential to cause major yield losses. They have developed a new formulation containing a combination of two products Fluopyram 250 g/l and Trifloxystrobin 250 g/l SC. The experiment was carried out to test the effect of Luna Sensation along with the recommended fungicides against the Sigatoka leaf spot and post-harvest diseases of bananas in the year 2020-21 and 2021-22. Testing of different concentrations of Fluopyram 250 g/L + Trifloxystrobin 250 g/L SC @6ml/10lit, @ 20ml/10lit, Fluopyram 400SC @16ml/10 lit, Trifloxystrobin 50WP @5g/10 lit, mancozeb 75 WP @40g/10lit and copper oxychloride An experiment was conducted with RBD design, nine treatments and four replications. The minimum disease intensity of Sigatoka leaf spot, and minimum disease index of post-harvest disease was recorded in two sprays of Fluopyram 250 g/l and Trifloxystrobin 250 g/l SC@ 20ml/10 lit water followed by Fluopyram 250 g/l and Trifloxystrobin 250 g/l SC@10ml/10 lit and Trifloxystrobin 50WP @5g/10 lit.

Technical Session 3: Seed Health in Food Security

OP (S3) 01: Development of Eco-Friendly Low-Cost Input/ Indigenous Technology for the Production of Disease-Free Chickpea and Groundnut Seeds

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Seeds represent a particularly efficient vehicle to disperse seed-borne pathogens. A seed-borne pathogen growing externally, internally or associated with the seed as a contaminant might cause; seed abortion, rot, necrosis, reduction or elimination of its germination capacity. As a result, seedling damage causes the development of plant disease at later stages of its growth. Healthy, pathogen-free seeds are the basic requirement for growing a disease-free crop. It is necessary to develop an effective, eco-friendly, economical and easy method for control of seed-borne pathogens that is socially acceptable among the farmers. Considering the facts, the experiment has been conducted to sustain the quality and viability of chickpea and groundnut seeds by reducing seed-borne infections and to assess the *in-vitro* efficacy of bioagents and natural farming inputs against the growth of the seed-borne pathogens *viz*., *Fusarium oxysporum* f.sp. *ciceri, Rhizoctonia solani* and *Rhizoctonia bataticola* of chickpea (variety: GG 2) and *Sclerotium rolfsii, Aspergillus flavus* and *A. niger* of groundnut (variety: GG 20) following the dual culture and poisoned food techniques. The treatment comprises bioagents *viz.*, *Trichoderma asperellum* and *Pseudomonas fluorescens* were evaluated following dual culture technique while natural farming inputs *viz*., *Beejamrit, Jeevamrit* and *Kunab Jal* were evaluated at 2 and 5% concentrations along with a chemical check carboxin 37.5% + thiram 37.5% WS following poisoned food technique. *Jeevamrit* @ 5% was found significantly effective against the growth of *Fusarium oxysporum* f.sp. *ciceri* while Kunab Jal @ 5% was found effective against *Rhizoctonia*

solani and *Rhizoctonia bataticola* of chickpea. In the case of groundnut, Kunab Jal @ 5% was found significantly effective against the growth *S. rolfsii,* while *Beejamrit* @ 5% and Kunab Jal @ 5% were found effective against the growth of *A. flavus* and *A. niger* of groundnut.

OP (S3) 02: Studies on Rate of Degeneration of Potato Varieties Due To Virus Incidence

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The degeneration of potato is either due to physiological causes or due to infection of viruses. Physiological degeneration can be managed through proper crop management, but degeneration due to viruses can hardly overcome. The rate of degeneration of seed potato tubers varies according to variety, place and cropping season. The viruses are transmitted through infected tubers from one generation to next generation and sucking pests such as aphid, whiteflies and thrips during crop period. The seed potato infected with viral diseases degenerated in the following successive generation therefore the present study was conducted to evaluate the most popular potato varieties Gujarat *i.e.* K. Badshah and K. Pukhraj against viruses and their subsequent degenerative effects on yield with comparison to fresh breeder seed. The three different treatments *viz.*, T_1: Fresh breeder seed every year, T_2: Previous seed produce using seed plot techniques and cold store the produce, T_3: Previous seed produce without seed plot techniques and cold store the produce was evaluated. The studies were conducted for four consecutive years. The result revealed that the incidence of viral diseases (mild mosaic, severe mosaic and PLRV) increasing slowly up to three consecutive years then after the incidence increasing fast in the seed which produce through seed plot techniques as compared to seed produced from breeder seed so the potato seed growers can produce own seed from breeder seed up to three consecutive years by using seed plot technique under North Gujarat condition.

OP (S3) 03: Evaluation of Novel Fungicides for Effective Management of Seed and Seedling-Associated Pathogens of Rice and Groundnut

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Seed is a source of origin and beginning of anything and about 90 per cent of all the food crops grown on the earth are propagated by seed. Seed treatment is the safest and cheapest way to control seed-borne fungal diseases and to prevent the bio-deterioration of grains. Considering the facts, experiments have been conducted to evaluate the effect of seed dressing fungicides on seed and seedling-associated pathogens of rice (GR 11) and groundnut (GG 20) following standard blotter and paper towel methods during 2021 and 2022. During the first year, a total of 14 (rice) and 13 (groundnut) novel fungicides were evaluated at X and 2X doses. Seed treatment with propiconazole 13.9% + difenoconazole 13.9% EC @ 0.5 ml/kg seeds under X dose and seed treatment with azoxystrobin 16.7% + tricyclazole 33.3% SC @ 0.75 ml/kg seeds under 2X dose found significantly effective as seed dresser to manage seed mycoflora of paddy along with the minimum seed infection and highest seedling vigour index. While in the case of groundnut, seed treatment with trifloxystrobin 25% + tebuconazole 50% WG @ 0.25 g/kg seeds or 0.5 g/kg seeds was found significantly effective as a seed dresser to manage seed mycoflora of groundnut along with the minimum seed infection and highest seedling vigour index. The fungicides found effective during the first year were re-evaluated at the lowest dose during the second year and found that seed treatment with trifloxystrobin 25% + tebuconazole 50% WG @ 0.5 ml/kg seeds was significantly effective as a seed dresser to manage seed mycoflora of rice along with the minimum seed infection and highest seedling vigour index. In the case of groundnut. Seed treatment with penflufen 13.28% + trifloxystrobin 13.2% FS @ 1 ml/kg seeds was found significantly effective as a seed dresser to manage seed mycoflora of groundnut along with the minimum seed infection and highest seedling vigour index.

OP (S3) 04: Effect of Seed bio-priming on Seed Health of Fennel under *in-vitro* Conditions

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The seed is the embryonic stage of the plant life cycle and a source of development or growth. Seed germination and growth of seedlings are greatly influenced by seed-borne fungi which are known to produce some toxic metabolites. Delayed and erratic germination of fennel seeds is one of the reasons of low yield. The present investigation was conducted to assess the effect of seed biopriming with *Trichoderma viride, T. harzianum, Pseudomonas fluorescens* and *Bacillus subtilis*on seed gemination, seedling length, SVI-I and seed mycoflora of fennel. The highest germination per cent was recorded in seeds bio-primed with *T. harzianum* (93.61%) while the lowest germination per cent was recorded in hydro-primed seeds (74.28%). The longest seedling length was recorded in seeds bio-primed with *T. harzianum* for 9 hrs. (18.65 cm) which was statically at par with *T. viride* for 9 hrs. (18.35 cm). Among all the bioagents, *T. Harzianum* showed the highest SVI-I (1555.25) and the lowest SVI-I was recorded in hydro-primed seeds (709.15). All the treatments showed pronounced inhibitory effects against seed mycoflora except hydropriming of seeds which shows a negative effect on seed mycoflora. Significantly lowest mycoflora load was found on seeds bio-primed with *T. Harzianum* (8.44%) followed by *T. viride* (9.34%). Overall, the seeds bio-primed with *T. Harzianum* proved significantly effective for seed germination, seedling length, SVI-I and seed mycoflora.

OP (S3) 05: Effect of Seed Mycoflora on Seed Health of Black Gram Genotypes/Cultivars

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Black gram seeds carry a variety of mycoflora on the outside, inside or both, which contributes significantly to quantitative and qualitative losses. Pre- and post-emergence mortality, seed rot, root rot, leaf blight, anthracnose, charcoal rot, wilt and other symptoms caused by seed-borne mycoflora reduced the quality and quantity of black gram seeds and rendered them unfit for consumption. Contaminated seeds do not germinate, and seedlings and plants grown in the field from infected seeds may survive the early infection, but they are frequently infected later in the crop's life cycle. Present investigation was envisaged to study the effect of seed mycoflora on seed health with respect to seed germination, seedling length, seedling vigour and seedling discoloration intensity of five black gram genotypes/cultivars *viz.,* T 9, GAU 4, VUG-45, VUG-54 and VUG-96. The highest reduction in seed germination was found in seeds treated with culture filtrate of *A. flavus* (46.53%) while the lowest germination was recorded in seeds treated with culture filtrate of *F. oxysporum* (75.35%). *Macrophomina phaseolina* showed maximum detrimental effect thereby recorded minimum seedling length (8.09 cm) while *A. Terreus* showed minimum detrimental effect in seedling length (11.22 cm). Among all the mycoflora, *A. flavus* had the most detrimental effect, resulting in the lowest SVI-I (447.47) and *A. niger* had the least detrimental effect, resulting in the highest SVI-I (785.85). *Macrophomina phaseolina* had the highest discoloration intensity (45.26%) among all the tested fungi. Whereas *A. niger* had the lowest discoloration intensity (29.82%). Overall, *Macrophomina phaseolina* showed maximum detrimental effect on the seeds of black gram genotypes/cultivars. Among all the genotypes/cultivars, lowest detrimental effect of mycoflora was observed in the seeds of cultivar GAU 4 while highest detrimental effect was observed in the seeds of cultivar T 9.

OP (S3) 06: Molecular Characterization and Development of High Throughput Diagnostics for the Detection of Bakanae Pathogen *Fusarium fujikuroi* Infecting Rice Seeds

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Bakanae disease or foolish seedling disease of rice caused by *Fusarium fujikuroi*is one of the emerging diseases of basmati rice in India. The disease mainly affects basmati varieties of rice and more prevalent in Haryana, Punjab, Jammu and Kashmir, Himachal Pradesh and Uttar Pradesh. *Fusarium fujikuroi* isolates collected from different rice growing states of India such as Punjab, Haryana, Uttar Pradesh, Uttarakhand, Rajasthan and Delhi were characterized using rice genotypes differing for their resistance. A total of 15 pathotype groups were identified based on the responses of the rice genotypes to the *Fusarium fujikuroi* isolates. The pathotype group 1 consists of 19 isolates that showed susceptible reactions in all rice genotypes except C101A51, followed by pathotype 2 and pathotype 3, which include 13 and 9 isolates, respectively. The pathotype group 1 is more prevalent as compared to other groups. The isolates in pathotype group 8 showed a susceptible reaction in all rice genotypes except C101A51. Further, the isolates representing different pathotypes were selected for gene expression and Multi Locus Sequence Analysis (MLSA). A positive correlation could be established between six pathotype groups and the expression profile of virulence-related genes such as acetylxylan (*FFAC*), exopolygalacturanase (*FFEX*), and pisatindemethylase (*FFPD*). Total six genes Translation elongation factor 1α (Tef1ά), RNA Polymerase II (RPB2), Histone H_3 (HIS3) β-tubulin (TUB2), (28S-18S rRNA Intergenic spacer (IGS) and Calmodulin (CL) were selected for MLSA. Single Nucleotide Polymorphism (SNPs) was observed in these pathotypes. Housekeeping genes such as *Tef1α, CL, HIS3* shown 3 SNPs, *TUB2, rRNA IGS* have 2 SNPs and *RPB2* shown 1 SNP. Total 14 SNPs were identified across six housekeeping genes in *Fusarium fujikuroi* isolates. The unique secondary metabolite gene cluster present in *Fusarium fujikuroi* has been utilized to amplify and develop the specific point of care diagnostic protocol for bakanae disease through PCR, real time PCR, LAMP and recombinase polymerase amplification (RPA). The target gene was amplified only in *Fusarium fujikuroi* and did not amplify in other spp. of *Fusarium*. The diagnostics developed will be helpful for the seed testing and genotypes evaluation for the resistance.

Technical Session 4: Millets: Pest & Diseases and Their Management

OP (S4) 01: Scenario of Viral Disease Incidence in Sorghum across the Seasons in Solapur, Maharashtra

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Sorghum [*Sorghum bicolor* (L.) Moench.] is nutritionally rich, climate resilient millet crop cultivated for both food and fodder purpose. However, like other crops sorghum also encounters numerous fungal, bacterial, and viral pathogens. Among the pathogens viral diseases are least studied even though they play a significant role in reducing the yield and quality of the produce (grains and fodder). There are three groups of viruses *viz.*, *Potyvirus, Tenuivirus* and *Mastrevirus* that are reported to infect sorghum in India. Viral infection in sorghum causes a range of symptoms like mosaic, mottling, yellowing, chlorotic streaks or stripes, reddening of leaves, necrotic spots, dwarfing/stunting and even delayed flowering. In some cases, sterility and poor exertion of panicle was also recorded. These diseases lead to reduction in grain and fodder yield and also

affects the protein, total soluble solid, digestibility in forage sorghum and sugar yield in sweet sorghum. Looking into the gravity of the viral diseases and to have a present scenario of viral diseases, a survey was conducted across the seasons in Solapur from 2021 to 2023 in farmers filed and in experimental plots at Solapur. In Rabi 2021-22 it was observed that, the incidence of viral diseases like red stripe, maize stripe and mosaic ranged from 1-6%, 2-4% and 1.5-4% respectively. Summer 2022 recorded red stripe and maize stripe in the range of 2-6 and 2-3% respectively, while in Kharif 2022 these diseases were in the range of 3-6 and 1-3%. But, during Rabi 2022-23 an increased incidence of red stripe was recorded ranging from 10-18% while maize stripe and mosaic remained at 1-2 and 0.5-1% respectively. It was also observed that during rabi 2022-23, the breeding lines of different genetic background recorded a higher incidence of red stripe ranging from 10-20% in comparison to released varieties with 1-4% incidence. Overall, red stripe looks to dominate over maize stripe and mosaic with higher percent disease incidence. The red stripe disease induces necrotic leaf, leading to a significant economic loss in terms of fodder and grain yield due to reduced photosynthetic area. The survey revealed the existence of viral diseases that can lead to an economic impact in future. Looking into the impact that the viral diseases can cause, there is a need to initiate studies on epidemiological aspects and also developing advanced diagnostic tools for their application in devising management strategies through resistance breeding programme.

OP (S4) 02: Management of Pearl Millet Downy Mildew (*Sclerospora graminicola*) by Using Organic Compounds

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Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is an important cereal and forage crop of arid and subtropical regions of the Indian subcontinent as well as several African regions. Downy mildew (DM) or 'green ear' disease caused by *Sclerospora graminicola* (Sacc.) Schroet. occurs most destructively in Asia and Africa. The first epidemic of downy mildew occurred in 1971 on the first popular pearl millet hybrid, HB 3, resulting in severe grain loss of about 4.6 million metric tonnes. Eco friendly management components were evaluated at Main Pearl Millet Research Station, JAU, Jamnagar (Gujarat) during *kharif* 2021 and *kharif* 2022 for minimize downy mildew disease incidence. Total five seed treatments [(*Trichoderma harzianum (JAU* @ 8g/kg), PSB formulation (PSB 8 g/kg), neem oil (3%) and metalaxyl (6 g/kg)] including check were tested. Minimum percent downy mildew incidence recorded in standard check metalaxyl (11.79%) which was at par with *T. harzianum* (12.58%) and PSB formulation (13.12%). Same trends observed in grain yield, maximum grain yield found in standard check metalaxyl (2051 kg/ha) which was at par with *T. harzianum* (1966 kg/ha) and PSB formulation (1941 kg/ha). While maximum fodder yield recorded in metalaxyl (39.02 q/ha) which was at par with *T. harzianum* (38.75 q/ha), PSB formulation (35.84 q/ha) and neem oil (34.64 q/ha).

OP (S4) 03: Biological Control of Finger Millet Foot Rot

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Finger millet [*Elusine coracana* (L.) Gaertn] is one of the important millet crops of India. In Gujarat, finger millet is the staple food of the tribal people of the Dang district of south Gujarat and is grown as rain fed crop in *kharif* season on least fertile hilly soils. Finger millet is a rich source of protein, dietary fiber, minerals and amino acids. This crop is grown on an average area of about 12128 ha per year in the Dang district of Gujarat. In *kharif* season due to continuous, heavy rainfall, high humidity and warm temperature, the crop is heavily infested by a soil borne foot rot disease incidence (up to 47%) and found to be a major constraint in the production of finger millet, resulting in direct crop losses mainly in The Dang district of south Gujarat. Since recent past The Dang district of south Gujarat was declared as organic district and thus, a field experiment on biological management of finger millet foot rot was formulated and conducted for three years. Two bio agents *viz*., *T. viride*1.5% WP (2 x 10^6 cfu/g) (IIHR strain) and *P. fluorescence* 1.5% liquid form (1 x 10^8 cfu / ml) (NAU strain) were used as seed treatment and soil application. Among all the treatments, maximum disease control and grain production was reported in the seed treatment of *P. fluorescence* @ 10 ml / kg of seeds + two soil applications of *P. fluorescence* @ 2.5 l /ha in 250 kg FYM at transplanting and at 50% flowering with the minimum foot rot incidence of (9.63%) and highest grain (3415 kg/ ha) and fodder yield (7091 kg/ ha) which was found at par with the seed treatment of *T. viride* @ 10g/kg of seeds + two soil applications of *T. viride* @ 2.5 kg /ha in 250 kg FYM at transplanting and at 50% flowering with the foot rot incidence of (12.59 %) and highest grain (3226 kg/ha) and fodder yield (6173 kg/ ha) followed by all the other treatment and control with positive effect on average plant height (cm), average numbers of productive tillers per plant, average numbers of fingers, average finger length and bio agent cfu /gm soil at harvest with high cost benefit ratio.

OP (S4) 04: Biological Control of Finger Millet (*Elusine coracana* L.) Leaf Blast Incited By *Magnaporthe grisea* (Cke) Sacc.

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Finger millet (*Elusine coracana* L.) locally known as *Nagli* or *Ragi* is rich source of sulphur containing amino acids. It ranks third in importance of area and production after sorghum and pearl millet. In India, finger millet is cultivated in about 1.74

Mha with 2.01 MT productions during *Kharif*-2020. Finger millet is heavily infested by blast caused by *Magnaporthe grisea* (Anamorph: *Pyricularia grisea*) and is a major constraint to the production of finger millet, resulting in direct crop losses. As tribal man is using negligible chemicals, biological control will be certainly a mainstay in commercial agriculture. An experiment was conducted in field condition from 2009-10 to 2011-12 at Hill Millet Research Station, Waghai to evaluate the efficacy of native strains of *Pseudomonas* spp. isolated from the rice, finger millet, castor, banana, farm pond and river soil/rhizosphere against finger millet blast. Bio-efficacy of the seven native strains of *Pseudomonas* spp. was compared along with local commercially available biopesticides and Hinosan. Three times spraying of *P. fluorescens* Rambhas Strain @ 0.6% (2×109 cfu/ml) at 15 days interval, starting after 21 days of transplanting was found significantly effective for economical management of the leaf blast of Finger millet. The significantly lowest disease intensity (PDI) was recorded in Hinosan (12.22%) which was statistically at par with PfRS (14.33%) and PaWS (16.33%).

OP (S4) 05: Disease-free Grain Production of Pearl Millet

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Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is one of the important cereal crops grown in semi-arid and arid tropics of Asia and Africa. The Government of India proposed to the United Nations for declaring 2023 as the International Year of Millets (IYoM-2023). Millet is referred as **"*shri anna*"** or the best of all grains. India is one of the leading producers of millets in the world with an estimated share of around 41 per cent in the global production. India's top five millet producing states are Rajasthan, Maharashtra, Karnataka, Gujarat and Madhya Pradesh. Millets can grow on arid lands with minimal inputs and are resilient to changes in climate. The most damaging pests of pearl millet are fungi, bacteria, viruses, insects, and weeds. Around 111 diseases caused by different biotic factors have been reported on pearl millet in India and Africa, among these, five fungal diseases *viz.,* downy mildew, smut, ergot, rust, and blast as they adversely affect the grain yield and quality. Diseases are always observed when favourable environmental conditions, susceptible hosts and virulence pathogens coincide. Disease triangle play an important role in plant disease development and also for plant disease management too. All diseases of pearl millet are observed during *kharif* season, due to favourable environmental conditions *viz.*, continuous rain, high humidity and cloudy weather factors favourable to fungi diseases of pearl millet. If an irrigation facility is available, farmers grow pearl millet during the *semi-rabi* or *rabi* or summer season, obtain disease-free grain, maximum yield with the best quality of grain, due to unfavourable weather conditions for all diseases of pearl millet.

Technical Session 5: Biotechnological Approaches for Plant Health Management

OP (S5) 01: Survey, Transmission Electron Microscopy (TEM) and Molecular Detection of *Potato virus* Y (PVY) by Using Gene Specific Primers of PVY

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Among the viral diseases of potato, Potato mosaic disease caused by Potato virus Y (PVY) is widely distributed. In view of the importance of potato mosaic disease, survey, transmission of the virus, detection through RT-PCR and sequencing of viral coat protein (CP) gene were carried out during current study. During the survey it was recorded that maximum disease incidence (40-50%) of potato mosaic disease was recorded in village Shahpur (kathlal), (District Banaskatha). There was no incidence of potato mosaic disease in village Harjipur and village Bibipura kampa (Taluka Bayad). Flexuous particles of the PVY were observed through Transmission Electron Microscopy (TEM). To confirm the presence of PVY in the infected plants, total RNA was isolated from both infected as well as non-infected leaf samples. Isolated RNA samples were subjected to cDNA synthesis. Synthesized cDNA was subjected to PCR (Polymerase Chain Reaction) using the PVY CP gene and other gene specific primers for the confirmation of viral infection. Both the primers amplified 166 bp fragment of PVY gene and other primer pair amplified 801 bp fragment of PVY coat protein gene. These showed specific amplicon size of PVY-specific primers which suggested presence of virus.

OP (S5) 02: Cloning of Supressor of Gene Silencing 3 and RNA Dependent RNA Polymerase1 Genes from Resistant and Susceptible Cultivars of Soybean

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Yellow mosaic disease is a major constraint in soybean cultivation. In order to understand the genetics of resistance, composite interval mapping revealed two major quantitative trait loci (QTLs), located on chromosome 6 and 2. Annotation of these QTLs on soybean genome suggests presence of two candidate genes, namely RDR1 and SGS3 with these QTL corresponding DNA sequence. Function of these genes governing the resistance has not been carried out. Our main Objective was Cloning of SGS3 and RDR1 genes from resistant (SL-1024) and susceptible (JS 335) cultivar of soybean against yellow mosaic disease. To full fill this objective Seeds were sown in the pot and maintained in growth chamber, samples were collected for RNA extraction, and total RNA was obtained using the Trizol technique. cDNA was prepared using the RevertaidTM first strand cDNA synthesis kit following the manufacturer's instructions. Primer designed

for reverse transcriptase PCR (RT-PCR). Amplification of gene has done and directional cloning was done using pUC18 vector. The amplicon size of the cDNAs of SGS3 and RDR1 genes irrespective of their plant type (resistant/susceptible) was found to be 1.9 kb and 3.3 kb, respectively. Both the amplified products from both the cultivars have been cloned using directional cloning method in pUC18 vector and clones are confirmed through restriction digestion and sequencing. Cloning of these two genes will help us to do further functional analysis of these genes and find out the function of these genes in silencing pathway involved in disease resistance mechanism.

OP (S5) 03: Identification of Disease-free/resistant Khasi Mandarin Mother Stock, and Use of Ab-initio Modelling and Docking Evaluation of Geographically Derived ORF1a Gene of *Citrus tristeza virus* with Flavonoids and Chemical Compounds

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The *Citrus tristeza virus* (CTV) has decimated many citrus trees throughout the globe. The genome of this phloem-limited virus is 19.3 kb in size and comprises 12 open reading frames (ORFs) encoding 19 predicted proteins. The brown citrus aphid (*Toxoptera citricida*) is the primary vector for this disease. Because of the devastating effects of the CTV, the Khasi mandarin (KM) (*Citrus reticulata*) has become the most economically and frequently farmed citrus fruit in Northeast (NE) India. Control strategies rely heavily on the availability of CTV-free and immune-grafted KM planting materials. Consequently, research has been conducted to find KM mother plants that are both disease-free and immune in order to use them as scion sources. Seven different orchards in Assam were surveyed, and twig samples from the healthiest, highest-quality fruit trees were taken for KM analysis. Ten of the plant's twigs, all of which were vigorous and disease-free, were taken, grafted onto the rough lemon rootstock, and placed in a nursery. Direct antigencoated enzyme-linked immunosorbent assay (DAC-ELISA) with CTV-specific antibodies and polymerase chain reaction (PCR) with specific primers targeting coat protein and the 5' ORF1a were used to identify CTV infection. Most of the samples were positive for CTV infection with a high viral titer in ELISA. PCR verified the positive ELISA samples. One of the KM trees proved negative for CTV, while the other nine plants tested positive for the virus. To investigate the diversity, a phylogenetic tree was built using the orf1a and coat proteins. From a total of 9, Boko KM-1 belonged to the same clade as Mnp1 (a moderate virus according to in silico research). The host range of Boko KM-1 has been investigated by grafting it onto several hosts such as rough lemon, sweet orange, and sour orange. To combat the dwindling KM population in Northeast India, these plants will serve as immune mother plants from which grafted plating materials would be created. When it comes to structural molecular biology and AI-assisted drug design, molecular docking is an indispensable resource. Predicting the primary binding mode(s) of a ligand with a protein having a known three-dimensional structure is the purpose of ligand-protein docking. Diosmin and Hesperidin, two of the 12 flavonoids and chemical compounds used here, showed the greatest affinity for the ORF1a of CTV when tested with PyRx. In a preliminary drug-likeness and bioavailability study, these ligand compounds were found to be safe for human consumption of economically valuable crop by products. Since these flavonoids are produced naturally by the plant, they pose no threat to the hosts.

OP (S5) 04: *In silico* Prediction of Signatures in 3' UTR of *Tobamoviruses* for Replication

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A tobamovirus genome is very complex containing several *cis*-acting elements that perform various functions related to efficient replication, translation, and genome encapsidation. These functional *cis*-acting elements present in the form of either simple sequences or highly ordered secondary and tertiary structures like hairpin loops, knots, and pseudoknots, etc., along with long-distance kissing hairpins/loops/stem-loops that act as the vital signals for initiation of replication and subsequent genomic-strand synthesis. Besides these, the promoters and terminators for the expression of genomic, subgenomic structures, viral packaging signal for the direct encapsidation of virus genome into virions; and polyadenylation signal in the viral genome are also very crucial to complete the infection cycle. But, unfortunately, the very least information is available regarding cis-elements necessary for replication in tobamoviruses. So far, the highly structured 5' and 3′ untranslated region (UTR) was identified as indispensable elements for TMV genome replication and translation. This terminal 3′ end acts as the initiation site for the minus-strand (RNA) synthesis, which, later on, acts as the template for the synthesis of plus-strand genomic RNA with 5' UTR as the initiation site. Both these regions are reported to interact with the viral replicase enzyme through RNA dependent RNA Polymerase (RDRP), but not have been mapped properly. Therefore, many questions and confusions on the replicase-3'UTR interaction still remain unsolved. To address this issue, the RNA structurome of Cucumber green mottle mosaic virus was elucidated, computationally and the transcriptional and translational regulatory elements located in 3' UTRs were predicted. Now, their interactions with the helicase and RDRP domains of the replicase enzyme were mapped, to comprehend how the replicase binds to the UTRs during the replication process. This information will be reflected for a better understanding of the replication strategy of the tobamovirus genome.

OP (S5) 05: Development of Reverse Transcription Polymerase Chain Reaction Based Assay for Sensitive and Specific Detection of *Cucumber Mosaic Virus* from Banana Crop

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Banana belongs to the genus Musa, is one of the most consumed fruits around the world. India is one of the leading producers of the world's dearest fruit and accounts for approximately 26.7% of the world's produce. However, banana plantations have been suffering from several viral infections including Banana Bunchy Top Virus (BBTV), Banana Streak Virus (BSV), and Cucumber Mosaic Virus (CMV). Among these, Cucumber Mosaic Virus presents a peculiar case of destroying millions of banana plant globally. CMV is identified to infect a widespread host range of more than 1200 species in over 100 plant families, including Banana. CMV is member of the genus Cucumovirus and consists of three positive sense single-stranded genomic RNAs (RNA1, 2, and 3) that expresses five proteins. Present study aims to develop an efficient diagnostic protocol for the sensitive and specific detection of CMV in bananas leaves samples through polymerase chain reaction. For this, a novel coat protein gene-based primer from the most conserved regions of the Indian strains of CMV was designed using several bioinformatics tools and guidelines. The developed primer AWCMV-F/ AWCMV-R shows prominent PCR band of approximately 402 nucleotides in agarose gel electrophoresis. After sequencing of representative sample, BLAST analysis shows 97-100% sequence similarity with previous isolates with 100% query coverage. A sequence similarity & characterization studies revealed that CMV successfully detect from the banana leaves. Our results suggest that, novel primer is more sensitive, specific and efficient in detection of CMV. This developed RT-PCR based assay will be used for the Virus indexing and certification in clonal crops and mother plant. Further, developed RT-PCR based assay useful for the management of mosaic disease in Banana and prevent the subsecutative spread of the CMV in Banana Crop.

Technical Session 6: Endophytes and Biological Agents in Plant Protection

OP (S6) 01: Bio-efficacy of Different Mycoinsecticides for the Management of Leaf Eating Caterpillar, *Spodoptera litura* (F.) in Tobacco Nursery

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Bidi tobacco, *Nicotiana tabacum* L. is major crop of middle Gujarat agroclimatic zone. Tobacco leaf eating caterpillar, *Spodoptera litura* (F) is a regular and polyphagous pest of nursery and transplanted crop. The grown-up larvae feed voraciously on leaves and defoliate them, so the seedlings become unfit for transplanting. Under favorable conditions, the extent of loss may be about 80% and entire nursery can be wiped out. Biopesticides offer several advantages over the chemical pesticides *viz.* safety, targeted activity to the desired pests, effective in lower quantities thereby offering lower exposure and quick decomposition to leave no residues and allowing field re-entry immediately after application as part of IPM programs. The experiment on evaluation of entomopathogenic fungi and its formulations for bio-efficacy against *Spodoptera litura* (F.) infesting bidi tobacco under nursery conditions was carried out at Bidi Tobacco Research Station, Anand Agricultural University, Anand, Gujarat. In this experiment, total three different mycoinsecticides with their wettable powder and oil formulation along with two control treatments (with water and without water spray) were evaluated. Based on the observations on germination per cent, damaged seedlings and healthy seedlings, the treatment of spraying of *Metarhizium anisopliae* 1% WP (2 × 108 CFU) 5 gm/lit water or oil formulation of *Metarhizium anisopliae* 1% (2 × 108 CFU) 5 ml/lit water found effective against leaf eating caterpillar, *Spodoptera litura* (Fab.) first at initiation of the pest and subsequent at 10 days interval in bidi tobacco nursery.

OP (S6) 02: Integration of Entomopathogenic Fungi *Metarhizium anisopliae* with Insecticides for the Eco-friendly Management of Hopper, *Idioscopus nitidulus* Walker in Mango Ecosystem

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One of the most severe and endemic species of mango leafhopper in India is *Idioscopus nitidulus*. The nymphs and adults of *I. nitidulus* found sucking sap from young shoots, fragile leaves, and inflorescences, causing a 20-100% loss of inflorescence. The ability of entomopathogenic fungi *Metarhizium anisopliae* to manage a variety of arthropod pests is very promising. However, fungal biological control agents and selective insecticides may act synergistically, allowing lower pesticide doses, preserving natural enemies and reducing the risk of resistance development. Out of ten insecticides evaluated for their compatibility with *M. anisopliae*, flonicamid 50 WG recorded the highest vegetative growth (33.49 mm) of *M. anisopliae* followed by buprofezin 25 SC (30.25 mm) and thiamethoxam 25 WG (27.38 mm). However, the media treated with tolfenpyrad 15 EC showed the least vegetative growth (11.61 mm). With respect to the compatibility study, flonicamid 50 WG, buprofezin 25 SC, imidacloprid 17.8 SL, spinosad 45 SC and thiamethoxam 25 WG were classified as compatible insecticides, while the insecticides lambda cyhalothrin 5 EC, tolfenpyrad 15 EC and afidopyropen 5 DC found very toxic to *M. anisopliae.* The study pertaining to effectiveness of various combinations of chemical insecticides with *M. anisopliae* under laboratory conditions, *M. anisopliae* 1% WP + flonicamid 50 WG found effective with 98.98% mortality of mango hopper followed by *M. anisopliae* 1% WP + buprofezin 25 SC (97.91%), *M. anisopliae* 1% WP + thiamethoxam 25 WG (90.19%), *M. anisopliae* 1% WP + tolfenpyrad 15 EC (90.13%) and *M. anisopliae* 1% WP + imidacloprid 17.8 SL (88.21%). Similarly, under field conditions the treatments *M. anisopliae* +

flonicamid 50 WG and *M. anisopliae* 1% WP + buprofezin 25 SC registered as most effective in comparison to sole application of *M. anisopliae* 1% WP against *I. nitidulus* infesting mango.

OP (S6) 03: Eco-friendly Management of Collar Rot *Aspergilus niger* Van Teighem and Stem Rot *Sclerotium rolfsii* Sacc. in Groundnut (*Arachis hypogaea* L.)

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Groundnut as an important oilseed crop grown extensively in various part of the country. Collar rot (*Aspergilus niger* Van Teighem) and stem rot (*Sclerotium rolfsii* Sacc.) are the major diseases affecting the groundnut cultivation across the India and worldwide. The main aim of this study was to find out the effective eco-friendly management for these diseases in groundnut. Total eight treatments included with six treatments combinations of three microbial bio-agents; bijamrut and jivamrut with untreated control were tested. The treatments were applied as seed treatment alone and in combination of seed treatment and soil application. The bio-agents tested were *Trichoderma viride, Trichoderma harzianum* and *Pseudomonas fluorescence.* Maximum groundnut seed germination(70.96%), maximum numbers(107.45) and dry weight of root nodules (0.151g) at 45 days after seed germination, minimum per cent disease incidence of collar rot (10.56) and stem rot (4.86) and maximum grain yield (2084.73kg/ha) were recorded with groundnut seeds treated with talc based formulation of *Trichoderma viride* 1.15% WP *(*2x10^{6}cfu/g) @ 10 g/kg seeds plus soil application of *Trichoderma viride* 1.15% WP *(*2x10^{6}cfu/g) @ 2 kg in 500kg FYM/ha enriched 15 days before sowing, which was at par with groundnut seeds treated with talc based formulation of *Trichoderma harzianum* 1.15% WP *(*2x10^{6}cfu/g) @ 10 g/kg seeds plus soil application of *Trichoderma harzianum*1.15% WP *(*2x10^{6}cfu/g) @ 2 kg in 500kgFYM/ha enriched 15 days before sowing with groundnut seed germination (70.16%), maximum numbers (105.17) and dry weight of root nodules (0.136g) at 45 days after seed germination, minimum per cent disease incidence of collar rot (10.90) and stem rot (5.99) and maximum grain yield (1778.60kg/ha).

OP (S6) 04: Effectiveness of *Trichoderma harzianum* and *Pseudomonas fluorescens* against Early Blight Disease of Tomato

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One of the most popular vegetables and second important vegetable next to potato grown worldwide is tomato (*Lycopersicon esculentum* Mill.). Among the various fungal diseases, *Alternaria* leaf blight caused by *Alternaria solani* is detrimental in tomato cultivation and it is a soil inhabiting air-borne pathogen, occurs globally. An experiment was conducted to assess the efficacy of antagonistic microbes *viz*., *Trichoderma harzianum* (AAUBC-Th1) and *Pseudomonas fluorescens* (NBAIR PfDWD) against early blight disease of tomato. The treatment comprising *Trichoderma harzianum* and *Pseudomonas fluorescens* (Soil application + Seedling root dip treatment + Foliar spray) was proved effective in reducing the early blight disease intensity (5.97%). However, the treatment comprising *Pseudomonas fluorescens* (Soil application + Seedling root dip treatment + Foliar spray) was also found equally effective in reducing the early blight disease intensity (7.95%). The untreated control treatment witnessed the highest disease intensity of 28.41%. Similarly, the data on ancillary observations of growth parameters revealed the significant influence of bioformulations evaluated. The antagonistic microbes *viz*., *Trichoderma harzianum* and *Pseudomonas fluorescens* were found to be promising due to increased plant height and number of branches per plant in comparison to untreated control treatment. The treatments, which were proved promising against early blight, documented the highest fruit yield. The treatment comprising *Trichoderma harzianum* and *Pseudomonas fluorescens* recorded the highest fruit yield (29.25 t/ha) and it was found statistically equivalent with the fruit yield recorded in sole application of *Pseudomonas fluorescens* (28.08 t/ha). Hence, soil application, seedling root dip and foliar sprays of either *Trichoderma harzianum* (AAUBC-Th1) + *Pseudomonas fluorescens* (NBAIR PfDWD) or *Pseudomonas fluorescens* (NBAIR PfDWD) is an effective and eco-friendly strategy for the management of early blight disease of tomato.

OP (S6) 05: Eco-friendly Management of Pigeon pea Wilt

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Pigeon pea (*Cajanus cajan* (L.) Millsp.) is one of the major pulse crops of tropics and sub tropics of India. Pigeon pea is known to be affected by more than hundred pathogens but main constraints in boosting the yield of the crop is wilt disease. The wilt pathogen is primarily a soil inhabitant, hence controlling the disease 00 is very difficult as no effective chemicals are available at present. An experiment was conducted during 2012-2015 at NARP, Navsari Agricultural University, Bharuch to find out effective biological control method for management of pigeon pea wilt. The *Trichoderma viride*, *T. harzianum* and *Pseudomonas fluorescens* biocontrol agents were used for evaluation and found that all the treatments were significantly superior over control during individual years as well as in pooled to manage an incidence of wilt disease of pigeon pea. The pooled data of wilt incidence at harvest showed that, the lowest incidence of wilt per cent was recorded in the treatment of seed treated with *Trichoderma viride* @10g/kg seed + soil application of *T. viride* @ 2.5kg in

500kg FYM/ha in furrow at time of sowing (20.28%) followed by treatment seed treated with *Trichoderma harzianum* @10g/kg seed + soil application of *T. harzianum* @ 2.5kg in 500 kg FYM/ha in furrow at time of sowing (27.23%). Amongst the treatments, highest wilt incidence was recorded in treatment Seed treated with *T. viride* @10g/kg seed (36.52%).

OP (S6) 06: Plant Growth Promotion and Stress Tolerance Ability of Endophytes Isolated From Cotton and Pigeon Pea

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An experiment was conducted in Department of Plant Pathology, College of Agriculture, Bharuch to isolate and evaluate efficacy of cotton and pigeon pea endophytes regarding Plant Growth Promoting (PGP) and abiotic stress tolerance evaluation. The cotton and pigeon pea root as well as shoot samples were subjected to isolation of endophytes by standard method. The five bacterial isolates were isolated and identified by BIOLOG instrument from Department of Plant Pathology, NMCA, Navsari. Two cotton endophytic bacterial isolates were identified as *Bacillus subtilis* and *B. amyloliquefaciens* while *Bacillus safensis* and *B. Qingdaonensis* (2) from pigeon pea. These endophytes were subjected for physiological and biochemical characterization, the salinity tolerance (2 % to 14% NaCl) also tested. Among four endophytes *Bacillus safensis* and *B. qingdaonensis* showed tolerance to all level *i.e.* 2to 14 per cent and observed growth upto 14 per cent NaCl while *B. Amyloliquefaciens* recorded growth at different concentration except 14 per cent. The *B. subtilis* showed tolerance only upto 10 per cent NaCl. An *in vitro* and pot experiment were conducted to test PGP activity of endophytes in comparison with NAU isolates (*Bacillus subtilis & Pseudomonas fluorescens*) and found that endophytic bacterial isolates were not effective as compare to NAU isolates. The similar results were repeated in pot condition also.

OP (S6) 07: Eco-friendly Management of Groundnut Root Rot Incited by *Macrophomina phaseolina* (Tassi) Goid with Biocontrol Agents

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Groundnut (*Arachis hypogaea* L.) is an important leguminous oilseed crop of India. The root rot disease of groundnut caused by *Macrophomina phaseolina* cause significant yield losses and become major hurdle in production. The control of disease by using chemical is not feasible and economic viable, as it is soil born pathogen. Nine different biocontrol agents were tested for their antagonistic activity against *M. Phaseolina* under *in vitro* study by dual culture method. Out of nine antagonistic agents evaluated, *Trichoderma viride*, *T. Harzianum* and *Pseudomonas fluorescens* showed strongest antagonistic activity against *M. phaseolina*, which were further assessed alone and in combination under field condition during *Kharif* 2016-17, 2017-18 and 2018-19. Soil application of biocontrol agent along with FYM at the time of sowing checked the incidence of root rot in the range of 22.40-55.11 per cent and increased the pod and haulm yield of groundnut in a range of 26.12-41.25 and 23.71-36.08 per cent, respectively. The minimum disease incidence (23.61%), maximum pod and haulm yield (1796 kg/ha and 3934 kg/ha) and highest ICBR (1:32.25)was recorded in the treatment of soil application of *T. harzianum* (1.5 kg/ha) +*T. viride* (1.5 kg/ha) along with FYM @ 500 kg/ha which was found statistically at par with the treatment of soil application of *T. viride* (1.5 kg/ha) + *P. fluorescens* (1.5 kg/ha) along with FYM @ 500 kg/ha with 25.36 per cent disease incidence, 1756 kg/ha pod yield, 3813 kg/ha haulm yield and 1:30.36 ICBR. The soil application of *T. harzianum* (1.5 kg/ha) + *P. Fluorescens* (1.5 kg/ha) along with FYM @ 500 kg/ha remained next best treatment with 27.21 per cent disease incidence, 1660 kg/ha pod and 3723 kg/ha haulm yield, respectively.

OP (S6) 08: Effect of Liquid Bioformulation *Trichoderma harzianum* (Um-Tricho) for the Organic Management of Major Foliar Diseases of Maize

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The crop Maize is affected by a number of biotic factors during its cultivation that leads to significant yield loss. An experiment was conducted consecutively for two seasons with an aim to formulate an organic package of the crop. Um-Tricho a liquid bioformulation prepared with the native isolates of Meghalaya was tested as seed treating agent, soil application and foliar spray in eight different treatment combinations *viz*., T_1: control, T_2: seed treatment with *T. harzianum* (Th), T_3: Soil application of Th enriched vermicompost, T_4: foliar spray of Th, T_5: T_2+T_3, T_6: T_3+T_4, T_7: T_2+ T_3+ T_4, T_8: Chemical. Besides, recommended cultural practices were followed to avoid insect pest infestations. Combined application of Um-Tricho as seed treatment, soil application and foliar spray was found best in significant reduction of disease incidence *viz*., *Exserohilum* leaf blight and banded leaf and sheath blight with enhancement of plat growth parameters. Different biochemical tests were carried out to observe the response of host plant to the treatments and observed increase of major secondary metabolites in the T_7. This was followed by T_8 without any significant difference. We also observed a positive effect on percentage of total organic carbon and total microbial populations as compared to the control. The findings of the experiments may be useful as an effective way of tackling the targeted diseases of maize.

OP (S6) 09: Evaluation of PGP Traits and *in-vitro* Antagonism of Endophytic *Chaetomium* sp. against Soil Borne Fungal Pathogens of Chickpea

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Endophytic *Chaetomium* sp. isolated from healthy leaves of black tulsi (*Ocimum basilicum*) was studied for its plant growth promoting traits and antagonism against soil borne fungal pathogens of chickpea through dual culture. The fungus gave a positive reaction for production of IAA, ammonia, cellulase and laccase under *in-vitro* conditions whereas phosphorous solubilisation and laccase production was not found. In the dual culture assay, *Chaetomium* sp. was tested against three soil borne fungal pathogens of chickpea, *viz.*, *Macrophomina phaseolina*, *Fusarium solani* and *Sclerotium rolfsii* in which the endophyte showed maximum growth inhibition against *Fusarium solani*. Through this study, it can be concluded that endophytic *Chaetomium* sp. has a role in both plant growth promotion as well as disease management and can be used as a potential biocontrol agent in future.

OP (S6) 10: Evaluation of Bio-efficacy of Indigenous *Trichoderma* Isolates against *Fusarium oxysporum* f. sp. *ciceri in-vitro*

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Management of chickpea wilt by chemical fungicides can be spectacular but this is relatively short-term measure. So, in the present study, inhibitory effects of twenty *Trichoderma* isolates were investigated by dual culture assay under *in-vitro* conditions against *Fusarium oxysporum* f.sp. *ciceri* causing wilt of chickpea. *Trichoderma* isolates were isolated from rhizospheric soil of different pulse crops grown in middle Gujarat. Results showed that all the tested *Trichoderma* isolates significantly reduced the growth of *Fusarium oxysporum* f.sp. *ciceri*. Maximum per cent inhibition (86.4%) was recorded with isolate T3 whereas minimum inhibition per cent was recorded in T11 (66.43%).

OP (S6) 11: Evaluation of Different Biocontrol Agents against Collar Rot (*Sclerotium rolsii* Sacc.) of Chickpea under Pot Condition

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Chickpea (*Cicer arietinum* L.) family *Fabaceae* is one of the most important leguminous crops grown all around the world. In India, chickpea contributes about 30% of total pulse acreage and about 40% of total pulse production of the nation. The crop was found to suffer from collar rot disease caused by *Sclerotium rolfsii* Sacc. in severe form in many regions of Gujarat where groundnut chickpea cropping sequence present. So, for its management with different biocontrol agents evaluated under pot condition, among them antagonists found best in inhibition in dual culture experiment were selected for pot culture experiment. The experiment was conducted with seed treatment of *Trichoderma* spp. isolate 3 found most effective with incidence 22.79 per cent. *Pseudomonus fluorescence* observed as second most effective bioagent in reducing disease incidence with 61.76 per cent followed by *Bacillus subtilis* with 74.85 per cent disease incidence. Similarly, organic amendments *viz*., farm yard manure, neem cake, poultry manure and vermicompost enriched with effective bioagents were evaluated in pot culture experiment and found that all were effective in reducing per cent disease incidence. Among them farm yard manure enriched with *Trichoderma* spp. isolate 3 showed maximum reduction of diseases incidence of 5.09%, 8.08%, 8.91% and 31.54%, respectively.

OP (S6) 12: Efficacy of Bioagents against *Pythium aphanidermatum* under *in-vitro*

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Damping-off is the most serious disease of tobacco in nursery conditions caused by *Pythium aphanidermatum.* Looking at the significance of the disease and economic importance of the crop in Gujarat, the effects of six bio-agent *viz*., *Trichoderma viride*, *T. harzianum*, *T. virens*, *T. asperellum*, *Bacillus subtilis* and *Pseudomonas fluorescens* were evaluated by dual culture methods for their antagonistic activity against *P. aphanidermatum*. *Bacillus subtilis* was highly antagonistic to *P. aphanidermatum* followed by *T. harzianum.*

OP (S6) 13: Exploring Potential of *Trichoderma viride* Enriched Vermicompost in Suppression of Early Blight and Black Scurf in Potato under South Eastern Rajasthan Conditions

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A field experiment was conducted to assess the effect of *Trichoderma viride* as seed treatment, foliar spray and enriched vermicompost in suppression of early blight and black scurf in potato variety of K. Bahar at Agricultural Research Station, Kota during the year rabi 2021-22 and 2022-23. Early Blight of potato (*Alternaria solani* (Ell. and Mart.) Jones and Grout is one of the most serious diseases of potato. Black scurf caused by *Rhizoctonia solani* Kuhn is of worldwide occurrence. It deteriorates the quality of potato tubers and presence of sclerotia on tubers help in introducing the disease in a disease-free field. *Trichoderma* comes in the category of the most useful bioagents in agriculture. The study revealed that

application of *Trichoderma viride* @ 8 g/kg tuber, *T. viride* spore suspension (2x106 cfu) @ 8 ml/lit/20kg potato tuber than dry in shade 30 minutes at the time of planting and *T. viride* enriched with vermicompost (1kg: 100 vermicompost) as broad cast at time of planting showed maximum growth of potato plants, minimum disease incidence of early blight and black scurf, highest total tuber and marketable yield over untreated control. Comparatively, recommended fungicide Mancozeb 75WP @ 0.25% also provided good disease control but the tuber yield per plot was inferior to *T. viride* treatments. The soil microbial population was carried out in laboratory conditions through serial dilution methods and revealed that minimum plant pathogens colony was recorded in using *T. viride* treatments and maximum in untreated control. Disease suppression ensues by interactions between the plant-pathogens and the microbial community. Trichoderma has the capacity to protect plants and harbour microbial populations in different conditions of soil. They release anti-fungal compounds and secondary metabolites which are biologically active and have the power to degrade the pathogen cell wall.

OP (S6) 14: Field Evaluation of Potential Bioagent and Estimation of Biochemical Parameters against Okra Root Rot (*Macrophomina phaseolina* (Tassi) Goid.)

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Okra [*Abelmoschus esculentus* (L.) Moench] is the only vegetable crop of significance in the *Malvaceae* family and is very popular in the Indo-Pak subcontinent. In India, it ranks first in its consumption. The crop was found to suffer from stem and root rot disease in severe form in many regions of Gujarat state during *Kharif*, 2021. So for its management different biocontrol agents evaluated under field condition, recorded minimum disease incidence 17.88 per cent was recorded in *T. viride* @ 2.5 kg/ha + *P. fluorescens* @ 2.5 kg/ha+ 300 kg FYM which was found at par with *T. Harzianum* @ 2.5 kg/ha+ *P. Fluorescens* @ 2.5 kg/ha + 300 kg FYM with 22.07 per cent disease incidence and the highest yield (100.99 q/ha) was obtained in *T. viride* @ 2.5 kg/ha + *P. fluorescens* @ 2.5 kg/ha + 300 kg FYM, which was statically at par with *T. Harzianum* @ 2.5 kg/ha+ *P. fluorescens* @ 2.5kg/ha + 300 kg FYM (94.65 q/ha). While, highest sugar, phenol and protein content were recorded in *T. viride* @ 2.5 kg/ha + *P. fluorescens* @ 2.5 kg/ha+ 300 kg FYM.

OP (S6) 15: Isolation and Identification of Promising Endophytes from Tomato Plants

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Plant colonization by endophytes is known to influence insect pests and phytopathogens. A study was conducted to isolate and identify promising endophytic microbes from tomato plants grown in the Anand district of Gujarat state. The study was conducted during the year 2021-22 & 2022-23. The branches of tomato plants were collected at three different stages of plant growth *i.e.* (1) vegetative stage (2) flowering stage and (3) fruit development stage. Forty-two endophytic fungal and 84 endophytic bacterial isolates were isolated from the tomato plants. The fruit development stage recorded a higher number of endophytic fungi and bacteria as compared to vegetative growth stage and flowering state. Among the fungal endophytes, *Fusarium* sp. (AAUBC EF-1), *Acrophialophora* sp. (AAUBC EA-1) and *Talaromyces* sp. (AAUBC ET-1) were found to be promising as entomopathogenic as their culture filtrate wastoxic to *Corcyra cephalonica* larvae.Among bacterial endophytes, *Bacillus subtilis* (AAUBC-EBS1, AAUBC-EBS2), *B. velezensis* (AAUBC-EBV1, AAUBC-EBV2) were found to possess antimicrobial potential against phytopathogens *viz*., *F. oxysporum* f. sp. *lycopersici* and *Macrophomina phaseolina.* Promising fungal endophytes were identified with molecular technique through sequencing of β-tubulin gene, whereas promising bacterial endophytes were identified through the sequencing of 16SrRNA gene.

OP (S6) 16: Eco-friendly Management of Thrips, *Scirtothrips dorsalis* on Pomegranate

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Pomegranate, *Punica granatum* L. is an ancient and important familiar fruit crop of tropical and subtropical regions. Among various biotic stress, thrips, *Scirtothrips dorsalis* has attained alarming status leading to severe quantitative and qualitative fruit losses. Field experiments was planned with five non chemicals treatments *viz.,* Azadirachtin1500 ppm @ 40ml/10 L, *Lecanicillium lecanii* 1.15WP (1 x 109cfu/G) @ 50 G/10 L, NSKE 5% @ 500 G/10 L, *Beauveria bassiana 1.15WP (*1 x 109cfu/G) @ 50 G/10 L (two sprays of each at 10 days interval), Azadirachtin1500 ppm@ 40ml/10 L followed by *L. lecanii* 1.15WP (1 x 109cfu/G) @ 50 G/10 L for two spray at 10 days interval and untreated control. Result revealed that the lowest thrips population (3.93 thrips/twig) and highest yield (2413.54 kg/ha) was found with the Azadirachtin 1500 ppm @ 40ml/10 L.

OP (S6) 17: Study the Effect of Endophytes on Rice Seed Germination and Management of Blast of Rice

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Rice (*Oryza sativa* L.) is second most important food crops of the world after wheat. In India, it is grown in 43.50 million hectares in diverse ecological conditions with an annual production of 104.40 million tonnes and productivity of 2400

kg ha^{-1}. Gujarat state ranks 15th and 9th in terms of rice production and productivity respectively in India. In the present study, isolated fungal and bacterial endophytes *Trichoderma viride, Aspergillus niger, Aspergillus flavus, Curvularia lunata, Pseudomonas fluorescens, Pseudomonas aeruginosa, Pseudomonas stuzeri, Bacillus subtilis, Bacillus pumilus, Bacillus marisflavi* and fungal pathogen confirmed the association of Pyricularia oryzae Cav. with blast. Among the endophytes, four endophytes *viz.*, *P. fluorescens*, *B. subtilis*, *T. viride*, *A. niger* were evaluated under the pot condition by different application method against *Pyricularia oryzae*. The minimum percent blast disease severity and highest per cent disease control was recorded in seed treatment with four endophytes.

Technical Session 7: Nanotechnology for Plant Health Management

OP (S7) 01: Thymol Nano emulsion: an Efficient Antimicrobial Agent for Control of Contaminants Encountered during Tissue Culture

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Decontamination of explants is the first pre-requisite for successful development of *in vitro* plant tissue culture process which includes regeneration protocol, mass multiplication of plants etc. Over the decades, mercuric chloride ($HgCl_2$) is used as a sterilizing agent to overcome *in vitro* contaminants. However, with recent threat to ecosystem due to heavy metal accumulation in soil and water bodies, there is a need to reduce the dependency on $HgCl_2$ and exploit new molecules which are environment and human safe. In the present investigation, nano thymol is efficiently synthesized using analytical grade thymol crystals and tween 20 as a surfactant using probe sonicator. Ten minutes of sonication delivered a long-term stable thymol nano emulsion which was characterized by dynamic light scattering (DLS) and fourier transform infra-red (FTIR) spectroscopy. Effect of pH and dilution on size (nm), zeta potential (mV) and poly dispersity index were also studied to examine the changes in physical properties of synthesized nanothymol. The size of nanothymol at the end of forty-five days of incubation was 15.43 nm with PDI value of 0.3 and zeta potential of -19.8 mV which suggest that the nanothymol is stable and can be used for *in vitro* studies**.** Bacterial and fungal contaminants normally encountered during tobacco, date palm and rose tissue culture were isolated and characterized as gram positive or negative and at genus level. The nano emulsion (0.01–0.06%, v/v) showed substantial mycelial growth inhibition of various fungal isolates and nanothymol dilutions (50:50 and 25:75 nanothymol: water) also exhibited growth inhibition of various bacterial isolates under *in vitro* conditions. Depending upon the explant differentiation, different concentration and duration of nanothymol exposure can be effectively utilized for developing axenic cultures tobacco and date palm leaves and rose nodes.

OP (S7) 02: Synthesis, Characterization and Evaluation of Efficacy of Biologically Synthesized Silver Nanoparticle against *Alternaria solani*

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In the current study, *Trichoderma harzianum* culture filtrate was employed as a capping and reducing agent for the fast, easy, cost effective, and eco-friendly synthesis of silver nanoparticles. On the synthesis of silver nanoparticles, the impact of various ratios (AgNO3: Culture filtrate), pH, and incubation times was also investigated. The UV-Vis spectra of synthesized silver nanoparticles revealed a distinct surface plasm on resonance peak at 420 nm. Spherical-shaped and monodispersed nanoparticles were observed using scanning electron microscopy. The peak in the silver region seen by energy dispersive X-ray spectroscopy provided evidence for the presence of elemental silver. Crystalline nature of silver nanoparticles confirmed by X-ray diffraction. Fourier trans-infrared was used to examine the functional groups present in culture filtrate. The average size was determined using dynamic light scattering, which also indicated that it had been steady for four months. The surface morphology was verified using atomic force microscopy.We also examined the antifungal effectiveness of biosynthesized AgNPs against *Alternaria solani*, and the results showed a pronounced inhibitory effect on mycelial growth and spore germination. Also, the microscopic analysis showed that mycelia treated with AgNPs had defects and collapsed. In addition to this, AgNPs was examined against *Alternaria solani* in field condition. According to the field testing, AgNPs were demonstrated to be able to manage the early blight disease. The maximum percentage of inhibition of early blight disease by nanoparticles was observed at 40ppm (60.27%) followed by 20 ppm (58.68%) whereas in the case of fungicide mancozeb (1000ppm) inhibition was recorded 61.54%.

OP (S7) 03: Nanotechnology and Chemical Approaches for Effective Management of Banded Leaf and Sheath Blight in Maize

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The aim of this work was to evaluate efficacy of nano formulation and fungicides against Banded Leaf and Sheath Blight in maize to identify the effective management tools. For this purpose, two field and lab experiments were conducted during 2020 and 2021. Nanoformulation were used as 2,12.5,25 and 50% v/v as T-1,T-2,T-3 and T-4.The foliar spray was applied before 10 days of inoculation of pathogen. The data revealed that maximum PDI (75.8%) was observed in control plants, followed by 68.7% PDI in 2% nano formulation. The minimum PDI (5.68%) with PEDC (25.57%) were recorded in 50% nano formulation treatment. A significant reduction in the severity of the symptoms of *Rhizoctonia solani* was found after the use of Azoxystrobin +

tabuconazole (100% reduction in mycelial growth) and Azoxystrobin (100% reduction), control of BLSB of maize In vitro at 250, 500 and 750 PPM, whereas minimum mycelial growth inhibition recorded 68.89 per cent in Fluxopyroxad + pyraclostrobin followed by Sedexane with 67.50 per cent respectively. Under artificially inoculated conditions in field in both tested seasons kharif 2020 and 2021, Azoxystrobin + tabuconazole and Azoxystrobin were provided best efficacy by minimum PDI and disease rating with maximum grain yield. However, this positive effect was still evident variations ineffectiveness of fungicides were observed during the same treatment in repeated trials.

OP (S7) 04: Chitosan and Chitosan-based Nanoparticles for Eco-friendly Plant Health Management

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Diverse plant species are adversely affected by phytopathogens on a large scale, which results in severe economic losses. The conventional approaches to plant disease control are no longer efficient and secure, especially in light of the occurrence of severe climatic changes. At present, nanotechnology is an interdisciplinary approach offering novel management options against different biotic stresses threatening agricultural production. At this juncture, a combination of nanotechnology with a few naturally occurring and biologically significant components delivers high target efficacy along with distinctive modes of action with low environmental toxicity. Among the biologically active products, the biopolymer, chitosan has attracted more attention because of its unique characteristics and biological activities. Chitosan are naturally occurring compounds that have potential in agriculture with regard to controlling plant diseases. A broad-spectrum fungicidal activity of chitosan has been reported against many pathogenic fungi, for example, *Botrytis cinerea*, *Alternaria alternata*, *Colletotrichum gloeosporioides, Sclerotium rolfsii, Pythium aphanidermatum* and *Rhizopus stolonifer* and several pathogenic bacteria including *Xanthomonas*, *Pseudomonas syringae*, *Agrobacterium tumefaciens* and *Erwinia carotovora*. Nanotechnology-derived products of chitosan either single or in combination with other pesticidal compounds showed a great promise against both phytopathogenic fungi and phytophagous insect pests. The two-way action (direct management and elicitation of immune response in the host) of these nano-chitosan compounds also offers a novel mechanism to tackle the disease and pest problems in agriculture.

OP (S7) 05: Role of Nanotechnology in Management of Stored Grain Pests of Cereals and Pulses

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A "pest of stored food grains" can be referring to any organism that infests and damages stored food resulting in qualitative and quantitative losses. Grain crops that are most widely grown worldwide include cereals (rice, wheat, maize, millets, etc.); pulses (mung, beans, chickpea, cowpea, black gram, green gram, etc.) and oilseeds (soybean, sunflower, linseed, groundnut, etc.). These crops form a crucial component of our diet as they are rich in proteins, carbohydrates, fats, vitamins, minerals and oils. Due to the presence of these nutrient elements, the grains of these crops are prone to infestation by insect pests during storage. With the advent of nanotechnology, it has been now possible to enhance the efficiencies of traditionally used agricultural inputs and supplements in a more sophisticated, reliable and easily accessible way for improving food productivity and nutritional security. Using nanotechnology, we can transfer our desired material to the insect-pests effectively in the form of several formulations, *viz.,* nanoemulsions, nanosuspensions, nanoparticles, nanogel, nanocapsules and solid-based nanopesticides. It provides selective, targeted and long-term controlled release of formulation of nanopesticides which is ecologically more viable. Nanopesticides have the ability to control the pest menace in stored food commodities and subsequently enhance the food security to growing populations. Nanopesticides can therefore provide green and efficient alternatives for the management of insect pests of field and storage.

OP (S7) 06: Nanocomposites: A Green Alternative for Safe Food Storage

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Nanocomposites (NCs) are the combinations of polymers which can be one of the best alternatives for safe material for storage of food. This active packaging material having antimicrobial, antioxidant and other beneficial effects like maintaining aroma, flavour and ascorbic acid content intake in the stored food product. Different nanoparticles (NPs) such as nano clays, nanocellulose or metal ions like Zn, Cu, Ag can be used for preparation of NCs due to their wide range of mechanism including adhering to the targeted cell membrane, electrostatic attraction, shrinkage and detachment of cell membrane followed by cell rupture, NPs may penetrate to the cell membrane, binds to the cellular organelle like DNA,

RNA, protein or lipid hampering their normal pathway and ultimately results in microbial cell death. NPs also destroy the lipid bilayer membrane of the cell wall by interacting with sulphur group causing irreversible damage to the cell wall and increase membrane permeability resulting loses of ions. Moreover, increased level of ROS and other free radicle results in dysfunction of mitochondria and endoplasmic reticulum. Due to these properties NCs can be designated as next generation antibiotic. Out of all the nanomaterials, Ag ions are most widely used as antimicrobial agent due to release of Ag+ ions, resulting cell membrane or cell wall damage, disruption of electron transport and signal transduction pathway, and damage to cellular DNA and proteins due to the generation of ROS. ZnO NPs are also in close proximity in human health due to its application in cosmetics, pharmaceutical products etc. which open the door for using in food packaging material also. Due to extensive use of TiO_2 NPs in sunscreen lotion, toothpaste, coatings etc for its high refractive index and whitening property, nontoxic after ingestion and result in photo-catalytic disinfection, provide a scope for using it also as antimicrobial food packaging material for more shelf life.

Technical Session 8: Pest Risk Analysis, Disease Forecasting and Decision Support Systems, Plant Clinics

OP (S8) 01: Epidemiology of Powdery Mildew Disease in Ber

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Ber, *Zizyphus mauritina* Lamarcke is severely damaged by powdery mildew (*Oidium erysiphoides* f.sp. *ziziphi* Yen and Wang) which resulted in heavy loss in fruit yield. The fungus produces white powdery mass of spores on arial part of the plant resulting pre-mature drop of flower buds and fruits (Rawal 1996). To find out the relation between powdery mildew disease with different abiotic factors the long-term experiment was conducted for three decades at Agroforestry Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat. Temperature (maximum and minimum), evening relative humidity and evaporation rate shown a significant negative correlation whereas bright sun shine hours exhibited significant positive correlation with powdery mildew disease severity in ber under arid region of North Gujarat.

OP (S8) 02: Epidemiology of Leaf and Fruit Spot Diseases of Pomegranate

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Pomegranate, *Punica granatum* L is an important arid and semi-arid fruit crop cultivated in the states of Arunachal Pradesh, Gujarat, Himachal Pradesh, Karnataka, Maharashtra, Nagaland and Rajasthan in India. The crop is adversely affected by various foliar (leaf spots), fruit (spots and rots) and soil borne (wilt) diseases. Leaf and fruit spot (*Colletrotrichum gleosporioides* L.) disease resulted in heavy loss in fruit yield and its quality. To find out the correlation of different weather parameters with leaf and fruit spot diseases in pomegranate, this experiment was conducted at Agroforestry Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat during 1989-90 to 2020-21. Minimum temperature, relative humidity (morning and evening), rainfall (mm) and wind velocity (km/h) have shown a significant negative correlation with leaf and fruit spot diseases in pomegranate, whereas maximum temperature, bright sun shine hours and evaporation rate (%) established significant positive correlation with disease intensity under arid and semi-arid region of North Gujarat.

OP (S2) 03: Witches' Broom and Little leaf – Symptom Morphology Associated with Phytoplasma in *Dendrocalamus stocksii* (Munro.) and *Dendrocalamus strictus* (Roxb.) Nees

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The abnormal physiological or biochemical process that inhibits the normal activities of the plant reveals pathological conditions and unveils characteristic symptoms. Witches' broom and little leaf symptoms are prevalent in Bamboo in parts of Karnataka. Witches' broom and little leaf symptoms in Bamboo are by and large characterized by increased shoot branching, *i.e.*, the proliferation of shoots. Critically, the morphology of the symptom expression varies, as the name conveys. The proliferating small-sized shoots emerging from the nodal region are in clusters, profusely growing vertically with a narrow base at the intersection point of the node, thereby giving a cone-shaped appearance, which was circumstantially named as witches broom' in *D. stocksii* (Munro.). On the other hand the symptom morphology in *D. strictus* (Roxb.) Nees, is characterized by prolific small sized shoots emerging from the nodal region, where the shoots spread on either/all sides, thereby giving a doom/sphere shape appearance. Therefore, evidentially the symptom morphology should have been "sphere balls of *D. strictus* (Roxb.) Nees", despite little leaf/small-sized shoots. Symptom morphology is ignored in the diagnosis of plants, especially woody plants associated with multiple groups of Phytoplasma, eventually influencing in accurate diagnosis.

OP (S8) 04: Prevalence of *Alternaria alternata* with *Alternaria brassicicola* and *Alternaria brassicae* Causing Leaf Spot on Rapeseed-Mustard

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In this study, the occurrence and prevalence of Alternaria species causing leaf spots in oil seed brassica in Bundelkhand region of India was accessed. Block wise survey of five districts of Bundelkhand region of Uttar Pradesh and Madhya Pradesh was conducted during rabi 2019-20 and 2020-21. From each district including Research farm, RLBCAU, Jhansi randomly 50 leaf samples showing at least ten lesions were collected. The lesions formed in most of the leaf samples were appear as irregular brown spots which later on turn into dark brown blighted areas with concentric rings. Isolations were made on PDA. Species identification was performed on the basis of conidial morphology compared with literature data and molecular characterization. Among the three Alternaria species found, *A. brassicae* and *A. brassicicola* were isolated from the samples collected from 2 places while *A. alternata* was isolated from all samples. Overall, *A. alternata* was more prevalent than *A. brassicae* and *A. brassicicola*. Predominance of *A. alternata* with mean prevalence was 91.0%. On the other hand, mean prevalence *A. brassicae* and *A. brassicicola* was 35.1% and 49.8% respectively. The frequency of co-occurrence of all three Alternaria species on oilseed brassica was low. The results of this study reinforce the prevalence of *Alternaria alternata* within species of Alternaria in Bundelkhand region due to low humidity and relatively high temperature during rabi season as compared to other states of India. This information is critical to developing strategies for managing Alternaria leaf spots in oilseed brassica in this region. A review of literature revealed that this fungus has not been reported so far solely as a disease-causing pathogen on oilseed brassica and is a new report from India.

OP (S8) 05: Effect of Weather Parameters on the Progression and Development of Early Blight Incited by *Alternaria solani* (Ellis and Martin) Jones and Grout in Potato

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A study was conducted to find out the influence of weather factors, temperature, relative humidity, bright sunshine hour, rainfall, evaporation and wind speed and spore load on the incidence of *Alternaria solani* (Ellis and Martin) Jones and Grout induced early blight of potato (*Solanum tuberosum* L.) during 2019 to 2022. Eight weather factors taken from the agrometeorological observatory located at Anand Agricultural University, Anand, Gujarat and were subjected to correlation analysis. The relationship between early blight and concerned weather parameters during *Rabi* 2020-21 revealed a highly significant positive correlation with evaporation (0.87) and maximum temperature (0.84) at the 0.01 level. PDI was significantly positively correlated with spore load (0.71) and bright sunshine hour (0.64) at the 0.05 level. Whereas PDI was negatively correlated with evening humidity (-0.78) at a 0.01 level. During the year *Rabi* 2021-22, a substantial negative correlation with evening humidity at the 0.05 level. PDI was positively correlated with spore load (0.79), bright sunshine (0.73) and evaporation (0.68).

OP (S8) 06: Influence of Weather Parameters on Potato Leafroll Disease Development

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Among the viral diseases of potato, *Potato leafroll virus* (PLRV) is widespread and highly destructive in nature. Due to increasing incidence of leafroll disease according to changing weather, this study was undertaken to know the influence of weather parameters on potato leafroll disease progression and its aphid vector. Disease appearance was observed in 51st Standard Meteorological Week (SMW) in both years. Maximum increase in percent disease incidence (PDI) 15 per cent was observed during 3rd SMW in 2020-21 and 17.50 per cent in 2nd SMW during 2021-22. At this same 3rd week aphid population was also high 8.92 in 2020-21 and 9.22 in 2021-22. Highly significant correlation observed with aphid population during both the years which suggest major role of vector in disease development. Maximum temperature also showed positive highly significant correlation during first year. Bright sunshine hours and evaporation also exhibited positive significant correlation during both the years whereas evening relative humidity showed negative significant correlation during both years.

OP (S8) 07: Pathogenic Variability in *Sclerotium rolfsii* Sacc. Causing Stem Rot of Groundnut

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Groundnut (*Arachis hypogaea* L.) is an important leguminous edible oilseed crop that is mainly cultivated during the *Kharif* season in the Saurashtra region of Gujarat state. The economic production of this crop is severely affected by stem and pod rot disease caused by *Sclerotium rolfsii* Sacc. which affects approximately 50 to 60 percent of the groundnut area in Saurashtra. Effective management practices against *S. rolfsii* are challenging to achieve due to the wide host range of *S. rolfsii* as well as the long survival period of its sclerotia in the soil for many years. Hence the present study was taken up to assess the occurrence of stem rot in major groundnut-growing areas of the Saurashtra region of Gujarat. The results of the survey revealed that stem rot incidence ranged from 7.9 per cent to 16.4 per cent across the 50 surveyed locations/fields in five districts of Saurashtra. The Junagadh district had the highest incidence with a mean stem and pod rot incidence of 16.4 per cent, whereas the Porbandar district had the lowest mean disease incidence of 7.9 percent. All 50 isolates were subjected to a pathogenicity study by soil inoculation method under sick pot conditions. These isolates exhibited pathogenicity with disease incidence rates ranging from 33.33 per cent (RJK-9) to 80.95 per cent (JMN-2) and produced symptoms similar to infection observed under natural field conditions. All 50 isolates preferred Potato Dextrose Agar medium for superior growth as compared to other media and produced dull white to shiny white colour colonies with various growth patterns ranging from dispersed to aggregated growth. The glaring difference in their appearance is either

loose or dense cottony with mycelium being compact, suppressed or fluffy was also noticed among the isolates. In terms of colorations, thirty isolates produced brown colour sclerotia. However, twelve isolates produced sclerotia of dark brown colour and only eight isolates generated light brown sclerotia. All the isolates produced sclerotia in the range from 32 to 525 numbers per plate with either smooth or coarse surfaces or significantly varied in sizes ranging from 0.61 to 1.8 mm with a spherical morphology being the most common. The production pattern of sclerotia in the plate varied significantly from the peripheral region, and center region to a scattered pattern.

OP (S8) 08: Deciphering the Symptomatological and Etiological Complexity for Root Rot and Wilt Complex in Date Palm

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Date palm trees, under the North Gujarat condition are subjected to infection with root rot-wilt complex. The disease is severely spreading in date palm growing areas of Kutch, and the etiology is still unknown. To study the symptomatology of disease and to identify the associated pathogens with this disease, regular survey was carried out. This disease is characterised by yellowing, wilting, drying and gradual declining of date palm trees and off-shots. The disease usually starts after 1-2 years of planting. Initially plants become yellow and gradually dried. On close observation, the visual symptoms were pointed to start from mid rid, resulting brown to black strips that gradually extended up to the leaf lets. The roots of infected plants become rotten, and density of feeder root reduces. This symptomatological study clearly indicates the primary colonization of pathogens on root and their further systemic movement in to the upper plant parts. To decipher the aetiology, root samples of infected date palm plants were collected from different places of Kutch region, *viz*., Anjar, Bhachau, Bhuj, Dhanati, Mandvi and Mundra. From infected root samples, different species of *Fusarium* were isolated. According to pathogenicity test, some species of *Fusarium* is supposed to be predominantly involve to cause this disease and their cultural and morphological variation was also indicate etiological complexity of this disease. The identity of the cultures was confirmed further by molecular analysis.

OP (S8) 09: Effect of Mosaic and Mottle Disease on Yield and Seed Quality Parameters of Soybean

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Soybean, widely known as "Queen of pulses", is one of the major oilseeds crops rich in high quality protein, oil content, vitamins and minerals. It is mainly grown under rain-fed conditions and the crop faces various biotic stresses including viral diseases that impacts crop growth, production and productivity. The major viral disease responsible for huge loss was reported to be mosaic and mottle disease caused by multiple viruses. Hence, the present study was conducted with 34 soybean cultivars to identify the major viruses associated with mosaic and mottle disease and its impact on yield and seed quality parameters under field conditions. These cultivars grown at Indian Agricultural Research Institute (IARI), New Delhi experimental field were found to be severely affected by mosaic and mottle disease with symptoms of mosaic, mottling, stunting and blistering with leaf deformation. The leaf samples tested through DAC-ELISA revealed the presence of viruses namely Bean pod mottle virus (BPMV) in 10 cultivars, Cowpea mild mottle virus (CPMMV) in 2 cultivars, Mungbean yellow mosaic India virus (MYMIV) in six cultivars, Soybean mosaic virus (SMV) in 14 cultivars and Soybean yellow mottle mosaic virus (SYMMV) in 33 cultivars with higher absorbance values at 405 nm. Multiple viral infection was observed in cultivars JS-335, JS-2029, JS-2069, JS-2094, JS-2098 and MACS-1188 with major viral combination of BPMV+CPMMV+SMV+SYMMV, BPMV+SMV+SYMMV, MYMIV+SMV and SMV+SYMMV respectively. MYMIV, SMV and SYMMV infection in soybean cultivars JS-2029, DSB-34, JS-335, Monetta and MACS-57 was confirmed through PCR and RT-PCR with the amplification of 900bp, 800bp and 1065bp fragments respectively. The mosaic and mottle disease showed significant influence on growth, yield and seed quality parameters like plant height, number of pods per plant, number of seed per plant, 100 seed weight, seedling length, seedling fresh weight, seedling vigour index I and II and electrical conductivity in twelve soybean cultivars JS-335, JS-2029, JS-2034, JS-2094, JS-20116, MACS-58, MACS-124, MACS-450, MACS 1188, MACS 1281, Monetta and DSB-28. Seed mycofloral studies revealed the presence of fungi *Alternaria* and *Cercospora* mycelium and conidial spores on the seed surface. The present study ruled out the etiology of mosaic and mottle disease caused by multiple viruses under Delhi conditions. The present study findings have implications for designing management strategies of these viruses that affect the soybean production.

Technical Session 9: Molecular Plant Pathology and Plant Disease Resistance

OP (S9) 01: Identification of Anti-fungal Protein Released during *Fusarium oxysporum* Infection in Castor (*Ricinus communis*)

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Castor is industrially important oil seed crop severely affected by *Fusarium oxysporum* f.sp. *ricini* which causes heavy economic losses among the castor growing states. Development of Fusarium wilt resistant varieties in castor is challenging because the genes identified for resistance is

recessive in nature. Unlike transcriptomics and genomics, proteomics is a method of choice for quick identification of novel proteins expressed during biological events. Therefore, comparative proteomic approach was employed for identification of proteins released in resistant genotype during Fusarium infection. Protein was extracted from inoculated 48-1 (resistant) and JI-35 (susceptible) genotype and subjected to 2D-gel electrophoresis coupled with RPLC-MS/MS. This analysis resulted in 18 unique peptides in resistant and 8 unique peptides in susceptible genotype were identified through MASCOT database. The real time expression study showed that 5 genes namely *CCR 1, Germin like protein 5-1, RPP8, Laccase 4* and *Chitinase like 6* was found highly up-regulated during *Fusarium oxysporum* infection. Furthermore, end point PCR analysis of c-DNA showed amplification of 3 genes namely *Chitinase 6 like, RPP8* and *β-glucanase* exclusively in resistant genotype which gave precise idea of involvement of these genes in providing resistance in castor. Whereas, up-regulation of *CCR-1* and *Laccase 4* involved in lignin biosynthesis provides mechanical strength and may help to prevent the entry of fungal mycelia and protein *Germin like 5-1* helps to neutralized ROS by SOD activity. This is the first report of proteomics for identification of antifungal protein in castor. These genes can be further utilized for castor improvement program and also for development of transgenic in different crops for fungal wilt disease.

OP (S9) 02: Biochemical Basis of Resistance in Chickpea (*Cicer arietinum* L.) against Wilt and Root Rot Complex

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The wilt and root rot complex of chickpea is considered the most important, devastating and challenging disease that becomes major limiting factor in successful cultivation of chickpea crop in Saurashtra region of Gujarat state. The management of chickpea wilt and root rot complex is quite difficult to achieve, as pathogens are soil borne in nature. One hundred five varieties/germplasm screened against the wilt and root rot complex disease of chickpea. The two years screening data revealed that, none of the varieties/germplasm showed immune response against the wilt and root rot complex disease, whereas nine varieties/germplasm *viz.*, WR-315 (6.26%), Phule G-08108 (6.33%), AKG-1303 (7.49%), JG 315 (7.89%), GJG 1713 (9.17%), GJG 2002 (9.44%), GJG 2015 (9.49%), GJG 1820 (9.69%), PUSA-256 (9.88%) were found as resistant, thirty seven were moderately resistant, thirty six were moderately susceptible, seventeen were susceptible and six were highly susceptible. The biochemical alteration in infected roots as compared to healthy roots revealed that sugar and protein content were maximum in healthy root of chickpea, while phenol content was maximum in infected root. The minimum decreased in protein (32.48%) and sugar (24.48%) content and maximum increase in phenol content (30.69%) was recorded in resistant germplasm (WR 315).

OP (S4) 03: Evaluation of Sugarcane Varieties/ Genotypes for Resistance against Red Rot Pathogen

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Twenty-two promising genotype of sugarcane (*Saccharum* spp. complex) were screened artificially for their reaction to red rot disease at Main Sugarcane Research Station, Navsari Agriculture University, Gujarat, India using plug and cotton swab method of inoculation for red rot. Among all entries none was found resistant reaction, while twelve entries *i.e.* Co 13003, Co 13004, CoN 13072, CoSnk 13101, MS 13081, Co 13006, Co 13008, Co 13009, Co 13013, Co 13018, CoN 13073, and CoSnk 13013 were showed moderately resistant reaction against red rot Whereas check varieties Co 94008, CoSnk 05103 and Co 99004 exhibited moderately resistant reaction in plug method. In cotton swab method all variety exhibited resistant reaction to red rot. In plug method and in cotton swab method check variety CoC 671 exhibited susceptible reaction. Rest of entries including check displayed moderately susceptible reaction to red rot in plug and cotton swab method.

OP (S9) 04: Screening for Resistance Material against Powdery mildew (*Oidium erysiphoides* f.sp. *ziziphi*) Disease of Ber

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Ber (*Ziziphus mauritiana* Lamk.) is Ber (*Zizyphus mauritina* Lamarcke) is an important arid and semi-arid fruit crop indigenous to an area joined from India to China. In Gujarat, ber is being cultivated on an area of about 11,190 hectares with production of 1, 13, 901 metric tonnes and productivity of 9.40 metric tons (Anon. 2019). Powdery mildew incited by *Oidium erysiphoides* f.sp. *ziziphi,* Yan and Wang are the most important biotic stress which causes maximum reduction in yield and quality of ber fruits. Developing a varietal resistance to disease provides an early, cheaper, stable and sustainable remedy for management of the disease. In the present investigation, 65 cultivars/germplasms were tested for resistant against *Oidium erysiphoides* f.sp. *ziziphi.* Among them the variety Apple beris found highly resistant; Mehrun and Sukavani found moderately resistant; Mundia mehra, Kaithly, Sukavani, Vikas, Darakhi-1, Banarasi Pavandi, Seo and Manuki found susceptible and rest of the cultivars/germplasms found highly susceptible with powdery mildew disease in ber.

OP (S9) 05: Identification of New Sources of Resistant Entries against Black Rust of Wheat

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Disease is one of the major factors which restrict the increment in wheat production. Among several diseases of wheat, black rust pathogen is more devastating as they evolve continuously

through mutation and their wind-borne uredospore are spread over long distances, which has resulted in failure of resistance and led to severe losses in global wheat production. However, for the management of black rust, the most useful and economically effective measure is the utilization of resistant cultivars. The development of new cultivars with improved genetic resistance has a great impact in reducing production costs and risks of environmental pollution due to heavy use of fungicide against wheat rust. For the successful implementation of resistant sources against black rust, effective field screening of wheat lines is an important task. Therefore, screening of forty entries of wheat were conducted during 2018-2019, 2019-2020 and 2020-2021 *Rabi* season at Pathological block, Vijapur. For effective screening under field condition, an artificially created epiphytotic condition was also created during all the experimental seasons by injecting the inoculum suspension of black rust in the susceptible varieties. It was found that four entries were found to be immune with no infection at all. Six entries were found with susceptible response of severity score ranged from 10 to 100 percent. While thirty entries were found to be resistant against black rust of wheat. Moreover, these thirty entries showing resistant in field condition were also confirmed by their low values of AUDPC ranged from 3.73 to 81.90. Thus, these identified promising resistant entries could be a valuable source of wheat while combating black rust in wheat cultivation.

OP (S9) 06: Screening of Rice Genotypes against Major Insect-Pests and Diseases

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Rice is affected by number of insect-pests and diseases during its different growth stages. The use of resistant varieties is an economical and eco-friendly management practices. Hence, the present screening programme was intended for multiple insect-pests and diseases resistance under both artificial inoculation and natural conditions during *kharif,* 2021 and 2022 at MRRS, AAU, Nawagam, Gujarat. Total of 48 rice genotypes including checks were screened for major insect-pests *viz*., stem borer (SB), leaf folder (LF), white backed plant hopper (WBPH) and major disease like bacterial leaf blight (BLB), leaf blast (LB), sheath rot (ShR) and grain discoloration (GD) by following standard evaluation system (SES, 2014). The screening results showed that two genotypes NWGR-16033 and NWGR-16035 were found resistant against LF (1 score), while moderately resistant against WBPH and LB with score3 and 4, respectively. Whereas, NWGR-18003 genotype was found resistant to LF (1 score) and moderately resistant against WBPH, BLB, ShR and GD with score 3. The genotype NWGR-18087 also showed resistant against LF (1 score) and moderately resistance against WBPH (1-3 score), BLBand GD with score 3. However, NWGR-18121 genotype showed resistance reaction against LF with 1 score, whereas this genotype found moderately resistant against WBPH and GD with 3 score and NWGR-18201 genotype found resistance with 1 score against LF and moderately resistant against WBPH and ShR (3 score). NWGR-17034 genotype found resistance to LF (1 score) and moderately resistant against WBPH (3 score), LB (3-4 score) and ShR (3 score). Based on the screening results, conclude that those genotypes showed resistant to moderately resistance against multiple major insect-pests and diseases, can be used as donor parent for rice varietal developmental programme.

OP (S9) 07: Identification of Resistant Sources to Yellow Mosaic Virus Disease in Blackgram (*Vigna mungo* (L.) Hepper)

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Yellow mosaic virus (YMV) disease is one of the most detrimental yield limiting factor for blackgram cultivation. Identification of stable resistant source through field evaluation is considered as the most economical and eco-friendly option to manage disease. To identify stable resistant source, an experiment was conducted at Farm of Department of Genetics and Plant Breeding, BACA, AAU, Anand for two consecutive seasons *i.e*. summer 2021 to *kharif* 2021-22. A set of 144 blackgram genotypes were evaluated for responses to YMV disease under natural infection using infector row method. Genotypes were evaluated based on percent disease incidence (PI) and percent disease index (PDI). The genotypes were scored using on 0 to 5 rating scale at two stages (30 and 60 DAS). Based on PDI values genotypes were classified into different disease reaction categories. Results indicated differential response of genotypes with respect to disease. Based on disease score of individual plants, genotypes were categorized into highly resistant, resistant, moderately resistant, moderately susceptible, susceptible and highly susceptible. Analysis of variance clearly revealed significant differences among the genotypes at both different stages in both seasons. Based on mean performance of genotypes, five genotypes *viz.*, NUK 15-01, NUK 17-05, VUG 100, VUG 108, and VUG 146 were identified as highly resistant. The genotypes clustered under resistant category would be employed as donors to develop YMV resistant high yielding varieties.

OP (S9) 08: Molecular Cloning and *in-silico* Characterization of Pelota Gene in *Solanum lycopersicum*

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Tomato leaf curl disease is caused by a number of begomoviruses with Tomato yellow leaf curl virus (TYLCV) being the most dominant one to tackle this Recently various

resistance loci have been identified in tomato which have shown promising resistance to TYLCV. Amongst them only few are well characterized. However, functional characterization of Ty-5 loci which codes for pelo protein (ty-5) is not yet done. With respect to this, we have isolated ty-5 gene from susceptible variety (Pusa ruby) for functional characterization. All the available sequences of pelota were analysed through MEGA software, we were able to identify a single SNP change in 1st exon of *Pelota* gene T-to-G at 47th positions, resulting in a Valine-to-Glycine substitution While this mutation is not found in wild relatives of tomato, *in-silico* protein interaction studies through PHYRE 2.0 and string we found 3 ERF like domains which were interacting with 7 different host proteins like Guanine nucleotide-binding protein subunit beta-2-like 1 protein, 40S ribosomal protein S17 which were found to be associated with susceptibility of other tomato infecting viruses. For siRNA studies we found Domain one is suitable, thus we have amplified pelota gene from susceptible variety and cloned in DEntry TOPO vector and sequenced found same mutation in our sequence too. These findings are essential for further functional characterization of pelota gene and its involvement in imparting resistance against tomato infecting begomoviruses.

OP (S9) 09: Breeding for and Identification of Source with Multiple Disease Resistance in Urdbean (*Vigna mungo* L.)

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Urdbean (*Vigna mungo* L.), is a major grain legume and a rich-sources of protein and minerals especially for vegetarian population of India. The crop is inflicted by various diseases out of which mungbean Yellow mosaic virus (MYMV), Anthracnose (Ant,), Cercospora leaf spot (CLS) and powdery mildew (PM) cause huge losses. The diseases can be effectively managed by cultivation varieties with multiple resistance to various diseases which require identification of donors with multiple resistance to the prevailing diseases. Extensive breeding program has been undertaken at CSKHPKV, Palampur to develop urdbean varieties and pre-breeding material with multiple resistance to prevailing diseases. In the present studies, more than 300 promising genotypes and pre-breeding material of urdbean were evaluated against Anthracnose (*Colletotrichum truncatum*), Cercospora leaf spot (*Cercospora* spp.), mungbean yellow mosaic virus (MYMV) at Palampur and MYMV (Akrot). It was observed that 49, 13, 32 and 94 genotypes were resistant to PM, anth., CLS and MYMV, respectively. None of the genotypes were free from Anth, and CLS, Genotypes Mash 1-1, NBU 785 and OBG 32 were resistant/moderately resistant (DR≤5) to PM, anth., CLS and MYMV. Five genotypes *i.e.* DKU 131, NGU 14, 15, PK HPU 157, 557 and TU 94-2 were resistant to Anth. CLS and MYMV whereas, genotypes DKU 113, 123, 142, 15-7, HPBU 18, NGU13 and COBG953 were resistant to CLS, PM and MYMV and 10 genotypes were resistant/moderately resistant to Ant., CLS and PM. MYMV resistant genotypes will be registered with NBPGR and promising genotypes DKU 87, 90, 98 and 116 are being evaluated at farmers' fields. The genotypes with multiple resistance may prove useful donors to develop resistant varieties. The genotypes with moderately resistant genotypes may be deployed in disease prone areas after agronomic evaluation.

OP (S9) 10: Screening of Germplasm against Major Pests of Ber in Field under North Gujarat Condition

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Ber, *Zizyphus maruritiana* is cultivated under arid zone in large scale. The estimate area in India under plantations of improved varieties is about 70,000 ha. Ten insect species belonging to four different orders were found feeding in ber (Praveen *et.al.,* 1998). Among them, bark eating caterpillar, fruit borer and fruit fly are the important one. North Gujarat region of the state falls under semi-arid to arid condition where, ber is an important fruit crop for marginal farmers. Infestation of pests starts with the initiation of fruit setting. Screening of sixty-five entries of ber against major pests were carried out during 1995-96 to 2020-21 under Arid Fruit Research Scheme at Agroforestry Research Station, S.D. Agricultural University, Sardarkrushinagar. The observations on newly formed holes by bark eating caterpillar were recorded twice in a season. To observe the damage of fruit fly and fruit borer, 100 fruits were taken randomly from each tree and cut open and examined to confirm the damage. Out of sixty-five varieties/germplasm of ber against major pests of ber, fifty varieties/germplasm were reported less than 3 holes per trunk by bark eating cater pillar infestation. Among them, minimum holes were recorded in germplasm Selection-6 (0.32 per trunk) whereas, maximum found in variety Mundia Mahera (8.80 holes per trunk). Eighteen varieties/germplasm recorded less than 10 per cent fruit fly infestation. Maximum (28.91%) fruit fly infestation was recorded in germplasm Selection-11 (8.80 per trunk) and minimum observed in variety Sukavani (0.29%). Twenty-eight varieties/germplasms were recorded less than 10 per cent fruit borer infestation. Maximum fruit borer infestation was recorded in germplasm Selection-9 (25.49%) and minimum observed in variety Sukavani (0.38%).

OP (S9) 11: Screening of Castor Germplasm for Wilt Reaction and Morphomolecular Characterization of Genotypes

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The objective of investigation was identification of wilt resistance genotypes followed by characterization of genotypes for yield related traits and inter-genotype genetic diversity. The 50 genotypes artificially screened for wilt disease in pot and genotypes were also evaluated in Randomized Block Design with three replications for yield parameters. Wilt incidence among 50 genotypes ranged from 0 to 100 per cent. Data revealed that 28 and 8 genotypes were found highly resistant and resistant in wilt screening. Genotypes JI-402, RG-1673 and RG-1954 were found superior as higher seed yield, capsules on primary raceme, bold seed, oil content and resistant to wilt disease. In respect to seed yield and wilt resistance, genotypes JI-403 and RG-1673 were elite genotypes based on *per se* performance. RG-3467 recorded higher test weight, oil content and moderately resistance to wilt. The high values of GCV, PCV and heritability for capsules on primary raceme, seed yield, total and effective length of primary raceme, effective raceme, plant height and test weight suggesting additive gene action offering better scope for selection. Seed yield per plant was strongly and positively associated with capsules on primary raceme, days to maturity, plant height and oil content at both levels, whereas path analysis revealed total length of primary racemes, capsules per plant, nodes per plant, oil content, effective raceme per plant, days to maturity, test weight and plant height up to primary raceme had direct and positive effect on seed yield therefore, major focus on these characters during selection of genotypes. Accessions were grouped into six clusters *i.e.* I, II, III, IV, V and VI contained thirty, eight, six, four, one and one genotypes, respectively. Genotypes were grouped in three cluster *i.e.* cluster A, B and C with 25,15 and 10 genotypes, respectively using SSR molecular markers. RG-3467 from cluster VI for moderately wilt resistance, plant height, total length of primary raceme, seed yield, test weight and oil content, RG-1673, JI- 403 and RG-1941 from cluster IV for days to maturity, capsules on primary raceme, effective length of primary raceme and wilt resistance used for intercrossing to generate desired breeding material having a wilt resistance. Both morphological and SSR data demonstrated to be effective tools for discerning inter-genotypes diversity and categorizing high-yielding and disease-tolerant castor genotypes.

OP (S9) 12: Screening of Wild Relatives and Cultivated Species of *brassica* for Aphid Resistance

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Rapeseed and mustard are the third most important oilseed crop after soybean and oil palm in world agriculture. Among the various *Brassica* oilseeds, Indian mustard *Brassica juncea* (L.) is the predominant cultivated species in India with good yield potential. Rapeseed-mustard crops are vulnerable to many insect-pest attacks. More than three dozen insect pests are reported to infest these crops in India. Among these, Mustard aphid, *Lipaphis erysimi* (Kalt.), is a most serious and destructive pest. To identify the resistance source for aphid resistant, a study was undertaken using 13 different cultivated and wild species of *Brassica* and *Diplotaxis* along with *Bassica rapa* as an infector line with three dates of sowing. The aphid infestation index (AII) was calculated at two different growth stages, *i.e*. FIS (Flower Initiation stage) and FBS (Full Bloom Stage). The results revealed that wild species *Brassica fruticulosa* (0.8 aphid infestation index) had been found highly resistant and *Brassica tournifortti* (2.0 aphid infestation index) had been found resistant, therefore, it is advisable to include both the species in breeding programme to introgress the genes for aphid (*Lipaphis erysimi*) resistance. All the cultivated varieties of *Brassica juncea* had been found susceptible to aphid.

OP (S9) 13: Study of Root Knot Nematode (*Meloidogyne incognita*) Resistance in Different Species of Tomato

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Tomato is one of the major vegetable crops cultivated in middle Gujarat as well as other parts of the state and country. Root knot nematode is major pest of this crop found in field and also in protected cultivation, leading to yield loss or no harvest. Therefore, to identify the species of tomato having resistance against root knot nematode (*Meloidogyne incognita*) a study was conducted at nematode sick plots of Department of Nematology, BA College of Agriculture, AAU, Anand. Thirteen different accessions/varieties including resistant (SL-120) and susceptible (GAT-5) checks from nine different species of tomato *viz., Solanum habrochaites, Solanum arcanum, Solanum pimpinellifolium, Solanum peruvianum, Solanum cheesmani, Solanum chilense, Solanum hirsutum, Solanum chmielewskii* and *Solanum lycopersicum* were subjected for screening. Observation on root gall formation at 45 days after transplanting in nematode sick plot was made on a scale 0 to 5 (Taylor and Sasser, 1978). All 13 accessions showed varying degree of response. Out of nine different species used in this study, none of them recorded on scale 0, two species *S. arcanum* and *S. peruvianum* besides resistant check found resistant with scale 1; similarly, two species *S. cheesmani* and *S. chilense* along with susceptible check observed with the highest no. of gall formation. While *S. pimpinellifolium* and *S. hirsutum* recorded with scale 3 exhibiting moderate resistant reaction against *M. incognita,* while rest species were found susceptible. The resistant species namely, *S. arcanum* and *S. peruvianum* can further be utilised to breed resistant varieties or can be used as parent in developing RKN resistant hybrids in tomato. Future proteomic studies may yield fruitful result by identifying the protein conferring resistance against RKN that may open avenues of making plant resistant using unconventional methods.

OP (S9) 14: Screening of Okra Genotypes for Shoot and Fruit Borer, Yellow Vein Mosaic Virus Disease and Enation Leaf Curl Virus Disease Over Environments

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Okra also known as lady's finger, one of the versatile vegetables of tropical and subtropical climates, is prized for its flavourful and soft pods. Its productivity is low across the Indian subcontinent for a variety of reasons, including use of subpar OPVs and the absence of varieties or hybrids that are more resistant to pests and diseases. Among several biotic stresses, OSFB (*Earias* sp.) causes 71% damage, YVMV causes 50% - 94% yield loss and ELCV causes 80% - 90% yield loss. A study was conducted with six lines and four testers mated in Line x Tester mating design producing 24 hybrids. For this investigation, a complete collection of 35 genotypes was employed, including 24 hybrids, 10 parents, and one standard check (Syngenta-based okra hybrid, OH 102) and was repeatedly assessed during the two cropping seasons of summer, monsoon, with timely and late sowing periods laid out in a randomized complete block design with three replications at Navsari Agricultural University, Navsari in 2019. None of the hybrid gave immune/resistant reaction for OSFB, YVMV and ELCV in all the environments. Parents and hybrids which showed moderately resistant or tolerance reaction can be used in further breeding programmes to develop varieties/hybrids resistant or tolerant to YVMV, ELCV and OSFB along with good agronomic traits.

OP (S9) 15: Wilt Screening and Molecular Marker-Based Diversity of Castor Germplasms

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Castor (*Ricinus communis* L., 2n = 2x = 20) is a tropical non-edible oil yielding plant of high commercial importance. It belongs to the *Euphorbiaceae* family and has a wide range of distribution in both tropical and subtropical regions. Castor production is seriously affected by several pests and diseases of which wilt caused by *Fusarium oxysporum* f.sp. *ricini* is the most destructing soil-borne disease. Ninety genotypes were screened for reaction to *Fusarium oxysporium* f.sp. *ricini* using pot culture at Regional Research Station, Anand Agricultural University. The experiment was set-up in completely randomized design (CRD) with each genotype replicated twice. SSR marker-based analysis were carried out with extracted DNA from leaves and primers available from different literature. Based on per cent wilt disease incidence, the genotypes were grouped into different disease reaction. Among them, 26 genotypes were found highly susceptible (HS), 13 genotypes were susceptible (S), five genotypes were moderately susceptible (MS), seven genotypes were moderately resistant (MR), seven genotypes were resistant (R) and 32 genotypes were highly resistant (HR). Genotypes of moderate resistance, resistance and highly resistance category can be potential source for developing new wilt resistant hybrids. According to Nei's genetic distance, 90 castor genotypes were grouped into three main clusters A, B and C with 26, 46 and 18 genotypes, respectively. Maximum number of accessions were grouped in sub sub-cluster B11 belonging to Gujarat region, indicate high genetic similarity among genotypes of this group. But there is no any correlation between wilt resistance and molecular marker.

OP (S9) 16: Somatic Hybridization in Okra

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Protoplast isolation and culture are extremely difficult in recalcitrant crop like okra due to high mucilage content. Hence, procedure was required to be standardized for protoplast isolation. Protoplasts isolation was carried out from both *in vitro* and *ex vitro* leaf materials through an enzymatic method from cultivated okra (*Abelmoschus esculentus* L.) and its wild species (*A. moschatus* subsps. *tuberosus*). Plasmolysed pre-treatment was utilized for easy isolation of protoplasts. Protoplasts were purified using CPW 13M solution followed by centrifugation. Protoplast viability, yield, diameter and residual cell wall were determined by fluorescent dyes such as fluorescein diacetate (FDA), rhodamine, propidium iodide, 4', 6 - diamidino -2 phenylindole (DAPI) and calcoflour white under fluorescence and UV microimaging. The viable protoplasts obtained were further utilized in protoplast fusion, culture and regeneration of inter-specific microcalli. Plating density, growth regulator concentration and the use of antioxidants were all demonstrated to have a significant effect on the protoplast plating efficiency. Protoplasts labeled with a fluorescent marker were subjected to chemical fusion. Using micromanipulator, heterokaryons formed during chemical fusion, were recovered. Such heterokaryons, when cultured underwent division and formed microcalli which subsequently developed into calli with green shoot bud point. The hybrid nature of such calli was confirmed by morphological and molecular characterizations.

OP (S9) 17: Convenient Disease Rating Scale for the Resistant Screening against *Begomoviruses* Causing Yellow Mosaic Disease in Different Crops

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The utmost care is required for the measurement of disease in resistance screening as a minor error may lead to the inappropriate selection and collapse of the entire breeding program. Resistance screening aims to select the highly resistant or resistant germplasm. For this, we should pay more attention to the germplasm showing no disease symptoms or very mild symptoms. Severely symptomatic plants efficiently represent crop loss; therefore, they cannot be ignored in the disease appraisal. However, it does not have any significance in the resistance screening. Accordingly, modifying a disease rating scale by focusing more on plants with mild symptoms can enhance precision. The proposed disease rating scale has been prepared on this principle. Proposed rating scale, a score of 0 indicates no visible symptoms, 1 indicates small yellow specks covering 0.1 to 5%, 2 indicates the yellow mottling of leaves covering 6 to 10%, 3 indicates yellow mottling of leaves covering 11 to 30%, and 4 indicates yellow mottling and discoloration of 31 to 100% leaf area of the plant. The scale uses absolute values as it is estimated by the observer based on visual observation. However, the categorization of the disease reaction of various genotypes is based on PDIx which is a calculated value; it has been represented as more than an absolute value. The line having a disease rating of 0 is considered disease free, >0 to 13 to 26 to 50 to 100 is highly susceptible.

OP (S9) 18: Comparative Expression Analysis of Defense-Related Enzymes and Antibiotic Genes in *Bacillus* spp. treated *Oryzae sativa* upon challenge inoculation with *Sarocladium oryzae*

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Bacillus species have been identified as effective bioagents and plant growth boosters in rice. The purpose of this study was to assess the efficacy of *Bacillus* spp. in controlling sheath rot disease caused by *Sarocladium oryzae* and promoting rice plant growth. We investigated the antagonistic and growth-promoting potential of eighty-four *Bacillus* spp. against *Sarocladium oryzae in vitro*. Ten efficient strains were selected and identified at the molecular level based on their antagonism and growth promotion. PCR study revealed that the presence of lipopetides genes that produce bacilysin, bacillomycin, iturin, surfactin, subtilin, subtilosin and fengycin in the potential strains. Among the strains RBS-57 had the highest mycelial growth inhibition (74.44 per cent) of the pathogen and also had the most number of antibiotic genes (6). We further tested the efficacy of talc and liquid formulations of *Bacillus* strains BS-5, RBS-57, and RBS-3 against sheath rot disease. Under glasshouse conditions results indicated that, combined application of seed treatment + seedling dip + foliar spray of RBS-57 liquid formulation showed a considerable reduction in the intensity of sheath rot disease, followed by BS-5, RBS-3. Similarly RBS-57 significantly increased the plant growth attributes and yield compared with other treatments. *B. cereus* (RBS-57) treatment induced defense enzymatic activities such as PO, PPO, PAL, CAT, SOD and reactive oxygen species such as H_2O_2 and O2- in the treated rice sheath. Real time expression analysis was performed to validate the fold changes occurred in defense enzymes and reactive oxygen species. RBS-57 liquid formulation was found to be effective when applied as a combination of seed treatment @ 10 ml/l + seedling dip @ 10ml/l + Foliar spray @ 10ml/l in reducing disease incidence. This treatment also recorded higher defense enzyme activities, maximum plant growth promotion and higher yield. This study has the potential to be used for the management of sheath rot disease in an eco-friendly and sustainable manner.

Technical Session 10: Multidisciplinary Approaches for Plant Health Management

OP (S10) 01: Effect of Planting Periods on Root-Knot Nematodes Infecting Tomato

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The effect of eight selected planting periods (*i.e.*, T_1- firstweek of September; T_2- third week of September (Control); T_3- first week of October; T_4- third week of October; T_5- first week of November; T_6- third week of November; T_7- first week of December; T_8- third week of December) on the root-knot index (RKI: 0-5) and fruit yield of tomato *var*. GAT-3 was evaluated. Data were pooled at the end of four years (2016-17 to 2019-20) of experimentation. In the case of the root-knot index (RKI), the four years of pooled data were recorded the minimum RKI of 1.72 in the third week of November (T_6), followed by 1.90 in the first week of December (T_7) and 2.01 in the first week of November (T_5), as compared with other treatments. The RKI in T_6, T_7, T_8 and T_5 were at par with each other and also did not differ significantly. Whereas the data based on fruit yield was observed a maximum 40199.5 kg/ha yield in the first week of November (T_5), followed by 31540.2 and 30720.2 kg/ha in the first week of September (T_1) and in the third week of October (T_4), respectively. The first week of November (T_5) planting period consistently gave maximum yield in all four years of the experimentation compared with other treatments. Whereas the third week of November (T_6), the first week of December (T_7), the first week of November (T_5) & third week of December (T_7) were found best in minimum RKI as compared with other treatments. The treatment T_5 (first week of November) proved effective in producing maximum yield and minimum RKI.

OP (S10) 02: Management of Aphid in Coriander through Insecticidal Seed Treatments and Foliar Application of Bio Pesticides

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Coriander (*Coriandrum sativum* Linnaeus) commonly known

as 'Dhania' is a very important seed spice which is used both as green vegetables as well as spice and medicine. Rajasthan and Gujarat states have emerged as "Seed Spices Bowl'. The sucking insect pests are the limiting factors for higher production as well as good quality seeds. Among the various insect pests, coriander aphids have been reported as a regular and key pest of coriander. Among them, three aphid species *i.e*. *Hyadaphis coriandri*, *Myzus persicae* and *Aphis craccivora* (Hemiptera: Aphididae) have been reported as a major pest on the crop. For the sustainable management of aphids without causing any adverse effect on crop, natural enemies, pollinators and environment study carried out with seed treatments of two insecticides and foliar application of three bio pesticides for the two successive years 2019-20 & 2020-21. Among the seed treatments and foliar application of bio pesticides, imidacloprid 600 FS and *Lecanicillium lecanii*1.15% WP were found most effective against aphids. Results revealed that the among different interaction effect of seed treatments and foliar application of bio pesticides, interaction effect seed treatment with imidacloprid 48% FS and foliar application of *Lecanicillium lecanii* 1.15% WP found most effective than the other interaction effect and recodedminimum population of aphids (10.06 aphids /3) with highest seed yield (1460 kg/ha). There was no adverse effect of evaluated treatments on population of coccinellids and syrphids.

OP (S10) 03: Evaluation of New Chemical Molecules against *Meloidogyne* spp. Infecting Cucumber in Polyhouse

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Protected cultivation is an emerging technology for raising vegetable and ornamental crops. Due to controlled environmental condition and continuous growing of crops, the root-knot nematodes (*Meloidogyne* spp.) has emerged as a major problem causing enormous yield loss. Root-knot disease caused by *Meloidogyne* spp. is a well-known disease of most of the cucurbits and causing immense crop losses. In the present study, three exclusive nematicides *i.e. fluopyram, fluensulfone and fluazaindolozine* were applied manually by ring method at lower and higher dose. T_1: Fluopyram 400 SC @ 500 g a.i./ha one DAT (200 ml/plant) manually, T_2: Fluopyram 400 SC @ 250 g a.i./ha one DAT, again 25 DAT (200 ml/plant) manually, T_3: Fluensulfone @ 3 g /plant one DAT by ring method manually, T_4: Fluensulfone @ 1.5 g/plant one DAT, again 25 DAT by ring method manually, T_5: Fluazaindolizine 500 SC @ 0.025% (10 ml/ 20 lit. of water) one DBT (200 ml/plant hole) manually, T_6: Fluazaindolizine 500 SC @ 0.0125% (5 ml/ 20 lit. of water) one DBT (200 ml/plant hole), again 25 DAT (200 ml/plant) manually along with T_7: Carbofuran @ 2 kg a.i./ha at transplanting and T_8: Untreated check were tested in Randomized Block design with four replications to combat and manage the disease complex of cucumber caused by *Meloidogyne* spp. for three consecutive years (2018, 2019 and 2020) at Polyhouse, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat. The pooled data revealed that among the treatments, application of fluazaindolizine 500 SC @ 0.025% (10 ml/20 lit. of water) manually at one day before transplanting proved effective to manage root-knot nematodes, *Meloidogyne* spp. and thereby increased cucumber fruit yield.

OP (S10) 04: Management of Powdery Mildew in Okra through Fungicides

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A study on field evaluation of fungicides for the management of powdery mildew in okra was carried out at College of Agriculture, AAU, Jabugam for three consecutive years 2020, 2021 & 2022 during *kharif* season. The experiment was laid out in randomized block design with three replications and eight treatments consisting of T_1: Azoxystrobin 18.2% + Difenoconazole 11.4% SC@0.022, T_2: Azoxystrobin 18.2% + Difenoconazole 11.4% SC@0.03, T_3: Azoxystrobin 18.2% + Difenoconazole 11.4% SC@0.0375, T_4 :Tebuconazole 50% + Trifloxystrobin 25% WG@0.056, T_5:Tebuconazole 50% + Trifloxystrobin 25% WG@0.075, T_6:Tebuconazole 50% + Trifloxystrobin 25% WG@0.093 T_7: Wettable Sulphur 80% WP@0.3 (Check) and T_8: Control (Untreated). First spray of fungicides was given at the initiation of the disease and second spray was given at 15 days after first spray. The data on per cent disease intensity pooled over years revealed that all treatments showed lower disease intensity as compared to control (26.61%). Among all the treatments, treatment number – 6 *i.e.* Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.093 recorded lowest disease intensity (9.80%) with highest fruit yield (111 q/ha). From the above result it was concluded that among different treatments evaluated, foliar spray with Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.093 was more effective for the management of powdery mildew in okra.

OP (S10) 05: Evaluation of Different Modules for Effective Management of Banded Leaf and Sheath Blight (*Rhizoctonia solani*) of Maize

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The present investigation was carried out to evaluation of different modules for effective management of banded leaf and sheath blight (*Rhizoctonia solani*) of maize. The experiment was conducted at Main Maize Research Station, AAU, Godhra, during *kharif* 2019, 2020 and 2021 in large plot sampling technique with four modules and four repetitions toevaluate the different modules for effective and eco-friendly management of banded leaf and sheath blight disease of maize. Effect of different module was evaluated by recording observations on disease index (1-9), plant height, final plant stand/net plot, no. of cobs/plot, grain yield kg/ha. The significantly application ofIDM module (Seed treatment with T. viride @ 10g/kg seed

and Thiram 75 WS @ 3g/kg seed; Soil application of T. viride @ 10g/100g FYM/m2; One foliar application of Azadirachtin 1500 ppm @ 4ml/litof water @ 35 DAS; and One foliar application Azoxystrobin 18.2% + Difenoconazole 11.4% (29.6 SC) @ 1 ml/litre of water @ 50 DAS) was found best in checking banded leaf and sheath blight (BLSB) disease severity (11.80%) resulted in the highest grain (5034 kg/ha) and fodder yield (5551 kg/ha) over unprotected inorganic check.

OP (S10) 06: Residues and persistence of zineb 75 WP in chilli

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To study the residues and persistence of zineb 75 WP in chilli, a field experiment was conducted during *rabi* 2020-21 at Main Vegetable Research Station, AAU, Anand with three replications. Three applications of zineb 75 WP were applied, first at fruiting stage followed by two sprays at 7-day interval @ 1500, 1875 and 3000 g a.i. /ha. From each replicate, representative samples of chilli fruits were collected at 0 (1-h), 1, 3, 5, 7, 10 and 21 after the last spray. The red chilli and soil samples were collected at harvest *i.e.* 69 days after last application. The samples were immediately processed for residue analysis following QuEChERS multiresidue method and quantitative estimation was performed by GC-MS.The result revealed that the initial residues of zineb were 3.90, 4.84 and 9.71 mg CS_2 /kg at 1500, 1875 and 3000 g a.i./ha, respectively. The residues of zineb degraded gradually and reached 0.12, 0.16 and 0.17 mg CS_2 /kg at 1500, 1875 and 3000 g a.i./ha, respectively on the 10th day. From the 21st day, the residues were below the determination limit of 0.05 mg CS_2 /kg for all the three dosages. Three foliar applications of zineb 75 WP in chilli, at 7-day interval @ 1500 g a.i./ha at fruiting stage resulted in residue of zineb below its MRL of 1.0 mg CS2 /kg, if harvested on 7 days after last application. Therefore, minimum 7-day PHI is recommended for zineb 75 WP for green chilli. Red chilli (dry) having residues of zineb 75 WP at below determination level when harvested on 69 days after the last application. Therefore, minimum 69 days PHI is recommended for zineb 75 WP in red chilli.

OP (S10) 07: Impact of Different Insecticidal Treatments on Larval Population of Lady Bird Beetles in Soybean

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An investigation was carried out to evaluate the impact of different insecticidal treatments on larval population of lady bird beetles in soybean at Department of Entomology, College of Agriculture, Anand Agricultural University, Jabugam. A total of nine insecticides *viz;* indoxacarb (0.079%), flubendiamide (0.0145%), chlorantraniliprole (0.006%), chlorfenapyr (0.01%), novaluron(0.01%), emamectin benzoate (0.0025%), beta-cyfluthrin (0.0125%) and quinalphos (0.025%) were evaluated. Based on overall mean values, it was found that the plots treated with beta-cyfluthrin and quinalphos exhibited significantly higher levels of toxic than the rest of the insecticides. Indoxacarb, emamectin benzoate and novaluron proved moderately toxic to the predator. While, chlorantraniliprole and flubendiamide proved safer insecticides to the larval population of lady bird beetle.

OP (S10) 08: Effect of Transplanting Date of Rice and Nitrogen Levels on Incidence of Pests and Diseases

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A field experiment was conducted on rice variety GR-11 at College of Agriculture, AAU, Vaso during *Kharif* season of three consecutive years from 2017 to 2019. Thirty days old seedlings of rice were selected for transplanting for determine the effect of date of transplanting and nitrogen levels on incidence of pests and diseases in riceby using Split plot design with three replications. Results revealed that rice seedlings transplanted on 2nd and 4th week of July with application of nitrogen at 80 kg N/ ha and 100 kg N/ ha recorded minimum sheath rot and bacterial blight disease intensity as well as insect pests (leaf hopper, leaf folder and rice stem borer) incidence as compared to rice seedlings transplanted during 2nd week of August and application of nitrogenous fertilizer at 120 kg/ ha. The maximum grain and straw yield were obtained higher in 2nd and 4th week transplanted rice seedling as well as plots fertilized with 100 kg N/ ha and 80 kg N/ ha. Interaction effect between date of transplanting and nitrogen levels on sheath rot and bacterial blight disease intensity, insectpests incidence as well as yield of grain and straw were non-significant.

OP (S10) 09: Efficacy of Different Fungicides against Leaf Blast of Rice

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Rice (*Oryza sativa* L.) is the staple food for more than 60% of the world's population. In India, rice occupies an area of 43.66 m ha with the production of118.87 million tonnes and

productivity of 2722 kg per ha. The production and productivity of rice is affected by several diseases like blast, sheath rot, false smut and bacterial leaf blight. Among these the blast caused by *Pyricularia oryzae* is one of the most devastative and destructive diseases of rice worldwide, causing yield losses to the extent of 70-80% in various rice ecosystems. The disease is causing substantial yield losses during both *kharif* and summer rice in Gujarat state. Seven fungicides were evaluated against the disease in the field during *kharif*, 2020, 2021 and 2022 under AICRIP trial. The pooled results showed that all the treatments were minimized the per cent disease severity of leaf blast (21.78–34.33) as compared to control where it was 44.59 per cent. The minimum per cent disease severity (21.78) of leaf blast was recorded in isoprothiolane 40% EC at 1.5 ml/ L followed by thifluzamide 24% SC at 0.8 g/L, where it was 24.26 per cent. The maximum grain yield (6730 kg/ha) was recorded in isoprothiolane 40% EC at 1.5 ml/L followed by thifluzamide 24% SC at 0.8g /L, where it was 6518 kg per ha. The maximum straw yield (8570 kg/ha) was recorded in thifluzamide 24% SC at 0.8g /L followed by isoprothiolane 40% EC at 1.5 ml/L, where it was 8480 kg per ha. Where as in untreated control the grain and straw yield was 4389 and 6901 kg per ha, respectively.Therefore, it is concluded that isoprothiolane 40% EC at 1.5 ml/L or thifluzamide 24% SC at 0.8g /L can be used for the management of blast disease.

OP (S10) 10: Efficacy of Ready-mix Fungicides for the Management of Damping-off Disease in Bidi Tobacco Nursery

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Damping-off caused by *Pythium aphanidermatum* is a serious threat in successful rising of bidi tobacco nursery. Bordeaux mixture and metalaxyl 8% + mancozeb 64% WP are found effective and economical for management of damping-off in the nursery. Now a days, new ready-mix fungicides are available to control phycomycetes. The purpose of the present study was to know the efficacy of the ready-mix fungicides against damping-off disease in bidi tobacco nursery. The experiment was taken up for two years (2020-21 to 2021-22) at Bidi Tobacco Research Station, Anand Agricultural University, Anand in randomized block design with twelve treatments *viz.*, cymoxanil 8% + mancozeb 64% WP and metiram 55% + pyraclostrobin 5% WG fungicides having three different doses of 25% higher and lower than the CIB recommended dose, dimethomorph 50% WP, metalaxyl 8%+ mancozeb 64% WP and Bordeaux mixture along with control. The results revealed that significantly minimum damped-off seedlings were registered in all three concentration of metiram 55% + pyraclostrobin 5% WG and it was at par with metalaxyl 8% + mancozeb 64% WP. The maximum transplantable seedlings were recorded in treatment of metalaxyl 8%+ mancozeb 64% WP (434/m^2) as treated check and it was at par with metiram 55% + pyraclostrobin 5% WG (0.131%) (418/m^2) and metiram 55% + pyraclostrobin 5% WG (0.105%) (379/m^2). More or less similar trend was observed in total transplantable seedlings.

OP (S10) 11: Management of Powdery Mildew Disease in Ber (*Zizyphus mauritina* Lamarcke.)

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Ber, *Ziziphus mauritiana* Lamk. is an important arid and semi-arid fruit crop indigenous to an area under India to China. In Gujarat, ber is cultivated on an area of 11.90 hectares with production of 1,13,901 metric tonnes and productivity of 9.40 metric tons (Anon. 2019). Powdery mildew caused by *Oidium erysiphoides* f.sp. *ziziphi,* Yan and Wang are the most divesting biotic stress which resulted in heavy loss in yield and quality of the fruits. An experiment was conducted at Agroforestry Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat during the year 2016-17 to 2020-21. First spray of fungicides was applied at the initiation of the disease and subsequent two sprays were applied at fifteen days interval. Eight fungicides *viz.* Potassium bicarbonate @0.5%, Difenconazole 25% EC@0.05%, Myclobutanil 10%WP@0.04%, Penconazole 10% EC@0.05%, Hexaconazole 5% EC@0.1%,Flusilazole 40% EC@0.01%, Dinocap 48 EC@0.1% & 0.05% and Wettable Sulphur 80% WP @0.2% were evaluated against powdery mildew disease. The trees treated with myclobutanil 10% WP @ 0.04% revealed minimum powdery mildew incidence (9.09% PDI) with highest fruit yield (8613kg/ha.) and also remained at par with dinocap 48 EC @ 0.1% which recorded with 10.58% PDI and 8457 kg/ha. fruit yield.

OP (S10) 12: Management of Fig Rust (*Cerotelioum fici* (Cast))

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Fig, *Ficus carica* is sub-tropical fruit crop. Being a deliciousfruit, it is damaged during handling and transportation. The tree is medium to large sized with erect, woody and branched stem. Leaves are stipulated with three to five lobed. The fig rust incited by *Cerotelioum fici (Cast)* causes severe damage on leaves and fruits. Initially small round rusty spots on lower surface of the leaves. During heavy rains, in heavy incidence the entire leaf becomes reddish brown defoliates the tree with fruits drop off. Which drastically reduced the fruit yield. To overcome this biotic stress present investigation carried out at Agroforestry Research Station, Sardarkrushinagar Dantiwada AgriculturalUniversity, Sardarkrushinagar, Gujarat during the year 2016-17 to 2020-21. Eight fungicides *viz.*Mancozeb 75 WP (0.25%); Chlorothanonil 75 WP (0.25%); Carbendazim 50% WP (0.1%); Hexaconazole 5 EC (0.1%); Propiconazole 25EC (0.1%); Tebuconazole 25.9EC (0.1%); Trifloxystrobin 25% + Tebuconazole 50% (0.05%) and Carbendazim 50% WP (0.1%) + Chlorothalonil (0.20%) were evaluated against fig rust. The

result revealed that all fungicides significantly reduced the disease incidence over control. Significantly minimum disease incidence (9.09 % PDI); highest number of fig fruits per plant(182.25) and fruit yield (3086.42 kg/ha) were recorded in treatment Trifloxystrobin 25% + Tebuconazole 50%, which also remained at par with treatment Carbendazim 50% WP (0.1%) with 11.4 % PDI; 174 number of fruits per plant and 2995 kg/ha. fruit yield.

OP (S10) 13: Evaluation of Newer Insecticides against Thrips in Castor

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Castor is considered as one of the most remunerative crop in the world rich in seed oil content. Being a drought resistant crop, finds favourable conditions for cultivation in north Gujarat and south Rajasthan. Our country is the largest seed producer of castor in the world. Castor is damaged by an array of insect pests *viz., Achaea janata*, *Spodoptera litura*, *Conogethes punctiferalis* as foliage feeder and *Empoasca flavescens*, *Retithrips syriacus* and *Trialeurodes ricini* as sap suckers. Besides, several hairy caterpillars and castor slug caterpillar have also assumed sporadic and regional importance. Thrips, *Retithrips syriacus* a tiny pinkish nymph and black adult with fringed wings, feed on leaf surfaces, resulting in crinkling of the terminal leaves with a silvery appearance. Severe infestation causes poor growth of plants, withering of emerging spikes, poor capsule setting and drying of the newly formed capsules which ultimately results in poor yield. To get rid of this biotic stress, an experiment was planned and maintained for four seasons on castor variety, SKP 84. Castor crop was twicely sprayed with different treatments starting from appearance of pest in tender spike at 15-day interval. The observation thrips population were recorded on number of thrips/ tender spile/ plant from 10 randomly selected tender spike before and three, seven and fourteen days after each spray. Out of three newer chemicals (Acetamiprid 20 SP, Clothianidin 50 WDG, Flonicamid 50 WG) evaluated at different three doses, Flonicamid 50 WG @ 0.019% (3.8 g/ 10 L water) recorded minimum thrips *i.e.* 36.45 thrips/ tender spike compared to untreated crop (56.32 thrips/ tender spike).

OP (S10) 14: Management of Stem and Pod Rot of Groundnut

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Groundnut is an economically important oilseed crop in Gujarat. Cultivation of groundnut was nearly 20 lakh hectares every year. Groundnut increases soil fertility through symbiotic nitrogen fixation. This crop is suffering many diseases *viz*., stem rot, collar rot, leaf spots, rust and bud necrosis. Among them, stem rot is an important disease that causes a huge loss up to 8o per cent. Stem rot is caused by *Sclerotium rolfsii* Sacco. This fungus has a wide host range and survives through sclerotia for many years. Management of stem rot, and field tails was conducted during *kharif* seasons with combinations of different treatments *viz.,* seed treatment with Carboxin 37.50% + thiram 37.50% (vitavax power 75WP) @ 3gm/kg seed, soil solarization, summer irrigation, application of pre- emergence weedicide, Fluchloraline/ pendimethline as per recommend dose, furrow application of *Trichoderma harzianum* @2.5kg/ha mixed with 300kg FYM at the time of sowing, three spraying of mancozeb 75 WP (0.20%) and hexaconazole 5EC (0.005%) at 35, 55 and 75 days after sowing. Minimum disease incidence and maximum pod yield of groundnut were obtained in the treatment of spraying of pre-emergence weedicide, seed treatment with vitavax power @3gm/kg seed + application of *T. harzianum* @ 2.5kg/300kg fym + three spraying of hexaconazole 5 EC (0.005%) or mancozeb 75 WP (020%) at 35, 55 and 75 DAS.

OP (S10) 15: Efficacy of Eco-safe Products against Potato Early Blight Caused by *Alternaria solani* (Ellis and Martin) Jones and Grout

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Potato is an important vegetable crop and can be used for table consumption. In India, Gujarat has major growing areas. Among major diseases, early blight is one of the most common and widespread diseases of potatoes caused by *Alternaria solani* can cause an average annual yield loss of 79 percent of the total production. When *Alternaria* attacks the host leaf, morphologically it produces a series of concentric rings around the initial site of the attack. This gives a "target spot" effect. Considering the severity of disease, different organic inputs, medicinal plant extracts, bio agents were tested against the pathogen under *in vitro* conditions. Among the nineteen medicinal plant extracts evaluated at (5, 10) per cent concentrations, Neem significantly inhibited the test pathogen. Among six organic inputs were tested at five different concentrations. *Panchagavya* at the highest concentration (15%) showed cent per cent inhibition of the test pathogen. Out of nine biological control agents evaluated by dual culture technique, *Trichoderma harzianum* was highly antagonistic to *A. solani.* Seed tuber soaking with *Beejamrutha* + two foliar sprays of *Jeevamrutha* @ 5 per cent at an interval of 10 days, commencing from the initiation of disease was found most effective for eco-safe management of potato early blight under field conditions.

OP (S10) 16: Management of Potato Leafroll Virus and Its Vector Through Insecticides and Phytoextracts

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Among the viral diseases of potato, *Potato leafroll virus* (PLRV) is widely distributed and highly destructive in nature. In view of the severity of potato leafroll disease, field

experiment was conducted for two years to manage potato leafroll disease and its vector in potato using different insecticides and phytoextracts. Two sprays were employed at 10-days interval starting from the disease initiation. The pooled data for vector control and disease incidence followed the same manner and recorded the lowest aphid population and disease incidence in thiamethoxam 25 WG, 0.1 per cent followed by acetamiprid 20 SP, 0.2 per cent. Plants of various treatments in the management trial were confirmed for the presence of PLRV by employing DAS-ELISA using PLRV specific polyclonal antiserum. The OD values ranged from 0.9675 to 3.2569 in the positive samples which was three times higher than the 0.2356 and 0.2145 OD of negative control and healthy sample, respectively. Treatments thiamethoxam 25 WG, 0.1 per cent (268 q/ha) and acetamiprid 20 SP, 0.2 per cent (267 q/ha) recorded the highest potato tuber yield which was statistically *at par*. Treatments bougainvillea leaf extract, 10% and parthenium leaf extract, 10% recorded lowest yield and were statistically *at par* with control (128 qt/ha).

OP (S10) 17: Evaluation of Bio-efficacy and Phytotoxicity of Isotianil 7% + Fosetyl Al 70% WG (TIVIANT) in Pomegranate against Bacterial Blight Disease

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Pomegranate is an important fruit crop of India, grown mostly in the western part including Maharashtra, Karnataka, Gujarat and Rajasthan. India occupies top position among pomegranate growing countries in the world, producing 50% of the total world production. The field trial was conducted at Horticultural Instructional Farm, C. P. College of Agriculture, Sardarkrushinagar during the kharif 2021-22 and 2022-23, respectively on bhaghwa variety. Seven treatments including untreated control were evaluated and each treatment was replicated four times. The disease severity (%) on leaves and fruits were recorded at before and at 5 and 10 days after eachspray. Disease assessment for bacterial leaf & fruit blight were done using standard rating scale considering 5 branches per tree, randomly. Finally, Percent Disease Intensity/ Index were calculated based on 0-9 rating scale. Phyto-toxicity observations were also been taken at 1, 3, 5, 7, and 10 days after first spray based on 0-10 Phytotoxicity rating scale. Isotianil 7% + Fosetyl Al 70% WG (TIVIANT) @ 200 gm/ha recorded significantly lowest disease intensity at 5 as well as 10 days after first and second application, respectively and Isotianil 7% + Fosetyl Al 70% WG (TIVIANT) @ 150 gm/ha which was found at par with Isotianil 7% + Fosetyl Al 70% WG (TIVIANT) @ 100 gm/ha during the two consecutive studied season. The yield data showed the same above trend. The phytotoxicity study revealed that none of the treatments exhibited any of the Phytotoxicity symptoms.

OP (S10) 18: Evaluation of Fungicides for the Management of Pearl Millet [*Pennisetum glaucum* (L.)] Blast Caused by *Pyricularia grisea* under Field Conditions

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Blast disease caused by *Pyricularia grisea* is a major problem and a serious threat to pearl millet productivity. Most of the hybrids being grown in India are susceptible to blast, as not much effort has been made to breed for blast resistance in pearl millet. In the absence of host plant resistance, the disease can be effectively managed with chemical fungicides. Therefore, seven fungicides (Tricyclazole 75% WP, Edifenphos 50% EC, Carbendazim 50% WP, Tricyclazole 18% + Mancozeb 62% WP, Tricyclazole 45% + Hexaconazole 10% WG, Propiconazole 10.7% + Tricyclazole 34.2% SE, Carbendazim 12% + Mancozeb 63% WP) were tested for their efficacy to manage blast disease on a blast susceptible pearl millet line (ICMB 9544). Results of this study clearly demonstrated that the disease can be effectively managed with two sprays of Tricyclazole + Hexaconazole @ 0.05% recorded lowest PDI (19.22%) and AUDPC value (824.58 units) while highest grain and fodder yields of 1857.50 kg/ha and maximum disease intensity of 67.92% recorded in the control (without spray).

OP (S10) 19: Residue Status of Mancozeb 75% WP in Paddy

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A field experiment was conducted to evaluate the dissipation kinetics and residue status of mancozeb in paddy. Two foliar applications of mancozeb 75% WP was given at 15-day interval at panicle stage in paddy @ standard (1500 g a.i. ha^{-1}) and double (3000 g a.i. ha^{-1}) doses. The estimation of mancozeb residues was done as carbon disulfide (CS_2). One hour after the last foliar application, the initial residue was 5.25 and 15.99 mg CS_2 kg^{-1} in paddy plant foliage at standard and double doses, respectively. The residues of mancozeb there after declined gradually up to 3 days and drastically declined on 5th day and reached below the limit of quantification (0.05 mg CS_2 kg^{-1}) on 15th day in standard and double doses, respectively. The dissipation pattern of mancozeb followed bi-phasic mode, in which half-life values for standard dose were 7.7 days for phase-I (0-3 days) and 2.1 days for phase-II (5-10 days); while in double dose, they were 6.2 days for phase-I (0-3 days) and 1.9 days for phase-II (5-10 days). Residues of mancozeb in grain, husk, straw and soil samples collected at harvest (56

days after last application), were below the limit of quantification at both the doses. Based on the data minimum 56 days could be considered as a waiting period for mancozeb 75 WP in paddy.

OP (S10) 20: Analytically Determination of Antibiotic Streptomycin with Bacterial Disease Infected Leaf of *Spathiphyllum wallisii*

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Remediation and to control of bacterial diseases of ornamental plants antibiotics used. Spray of Streptomycin antibiotics on plants effective in leaf disease control on entire plant growing, new leaf observation evaluate by using analytical analysis extent of antibiotic dosages on plant leaf determined by analysing 1g/lL of Streptomycin solution experiments carried out had potential in control of bacterial disease on leaf parts. Resistance of plant pathogens the role of use of antibiotic and its physico- chemical experiments & analytically determination of nutritive value of plant sample evaluated.

OP (S10) 21: Management of Die Back of Mango Caused by *Lasiodiplodia theobromae* (Griff. & Maubl.)

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A field experiment was conducted at Talala block in *kharif*-2020-21 and 2021-22 to study the effect of different fungicides against die-back of Mango *cv.* Kesar. The results revealed that the spraying of azoxystrobin 18.2 + difenoconazole 11.4 SC, 0.037% or azoxystrobin 18.2 + difenoconazole 11.4 SC, 0.030% or tebuconazole 50 + trifloxystrobin 25 WG, 0.094% were found effective in managing the die back disease of mango caused by *Lasiodiplodia theobromae*. Two years pooled data (*Kharif*:2020-21 & 2021-22) indicated that minimum disease intensity (24.13%) was found in the treatment of azoxystrobin 18.2 + difenoconazole 11.4 SC (0.037%) which was at par with azoxystrobin 18.2+ difenoconazole 11.4 SC (0.030%) and tebuconazole 50 + trifloxystrobin 25 WG (0.094%) with 26.50% and 28.50% disease intensity, respectively. The maximum disease intensity (45.00%) was recorded in control. Two years pooled data (*Kharif*:2020-21 & 2021-22) revealed that the highest fruit yield (5375 kg/ha) was recorded in treatment of azoxystrobin 18.2 + difenoconazole 11.4 SC (0.037%) and it was remained statistically at par with azoxystrobin 18.2 + difenoconazole 11.4 SC (0.030%) and tebuconazole 50 + trifloxystrobin 25 WG (0.094%) with 5294 and 5031 (kg/ha) fruit yield, respectively. The minimum fruit yield was recorded in control (3594 kg/ha).

OP (S10) 22: Evaluation of Fungicides for the Management of Early and Late Leaf Spot Diseases of Groundnut (*Arachis hypogaea* L.) under South Saurashtra Condition

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A field experiment was conducted to study the field efficacy of different ready-mixed formulation of fungicides against early [*Cercospora arachidicola* (Hori)] and late leaf spot [*Cercosporidium personatum* (Berk. & Curt.)] diseases of *Kharif* groundnut cv.GJG-22 under south Saurashtra condition at Research Farm of the Department of Plant Pathology, Junagadh Agricultural University, Junagadh during four consecutive year of 2017-18 to 2020-21. Considering the economics, the pooled results over four years revealed that spraying the crop with pyraclostrobin 12.5 + epoxiconazole 4.7 SE at 0.025 per cent concentration or carbendazim 12 + mancozeb 63 WP at 0.15 per cent concentration at initiation of disease and subsequent two spray at 20 days interval found equally effective for managing the early and late leaf spot diseases of groundnut with corresponding per cent disease intensity of (36.47 and 40.12) as compared with control (79.35%) at ten days after last spray. The pooled over four years result indicated similar trend with the highest pod yield of 1674 kg/ha in pyraclostrobin 12.5 + epoxiconazole 4.7 SE at 0.025 per cent concentration followed by carbendazim 12 + mancozeb 63 WP at 0.15 per cent concentration with 1551 kg/ha as compared to control (893 kg/ha). Whereas, the treatment pyraclostrobin 12.5 + epoxiconazole 4.7 SE remained significantly superior over rest of the treatments with 3087 kg/ha of haulm yield as compared with 1627 kg/ha in control in pooled over four years.

OP (S10) 23: Determination of Fluoxapiprolin + Fluopicolide Residue and Its Dissipation Kinetics in/on Tomato by Liquid Chromatographic Technique

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Fluoxapiprolin and fluopicolide are used to control the downy mildew in grapes, and they are not yet registered with an Indian regulator. Therefore, to generate the data on the residue of these fungicides in/on tomato, in house simple and sensitive LC-MS/MS analytical method was developed and validated for the determination of residues of fluoxapiprolin + fluopicolide from tomato fruits and a field experiment was conductedto study their dissipation kinetics in tomato fruits.Three foliar applications of combination product fluoxapiprolin 30 g L^{-1} + fluopicolide 200 gL^{-1} SC were done at the standard dose (18.75 + 125g a.i. ha^{-1}) and 1.25X of standard dose (23.46 + 156.4g a.i. ha^{-1}) at 7-day interval starting from

the fruit development stage. The validation results revealed that the limit of detection and limit of quantification of the method were 0.005 and 0.01 µg g^{-1}, respectively, while the mean recoveries of fluoxapiprolin and fluopicolide and their metabolites from tomato fruit matrices were 92.02-114.30% and 87.26-105.42%, respectively.The result of the field study shows that the initial deposits of fluoxapiprolin were 0.056 and 0.064 µg g^{-1} at both the tested doses, while its metabolites were also found below the determination level (BDL) throughout the study. Whereas the initial residues of fluopicolide were 0.380 and 0.438 µg g^{-1} at boththe tested doses. While the residues of fluoxapiprolin werefound BDL at 21 days after application and the residues of fluopicolide were 0.023 and 0.036 µg g^{-1}at 28 days after an application for both doses.The results show that the residue of metabolites of fluopicolide was BDL in both doses. The dissipation of fluoxapiprolin and fluopicolide at standard dose followed the first-order kinetics with respective half-lives of 7.167 and 8.853 d.

OP (S10) 24: Influence of Intercropping on Incidence and Severity of Pest Damage in Okra

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A field experiment was conducted at Main Vegetable Research Station, Anand Agricultural University, Anand during summer, 2021 to determine the effect of intercropping on insect pests infesting okra. Crops such as cluster bean (cv. Pusa navbahar), cowpea (cv. Anand Vegetable Cowpea-1), greengram (cv. Gujarat Anand Mungbean-5) and urdbean (cv. T9) were intercropped with the main crop okra (cv. Gujarat Anand Okra-5) in the row ratio of 1:1. In the control treatment, the sole okra crop was grown. During the experiment period, leafhoppers (*Amrasca biguttula biguttula* Ishida), aphids (*Aphis gossypii* Glover), whiteflies (*Bemisia tabaci*), mites (*Tetranychus urticae*), shoot and fruit borer (*Earias vittella)* and fruit borer (*Helicoverpa armigera*) were recorded. The observations pertaining to effect of integration of different crops with okra revealed that the significantly lowest population of leafhoppers (2.96/3 leaves), aphids (1.16/3 leaves), whiteflies (1.37/3 leaves) and mites (4.06/cm2 leaf area) was witnessed in the treatment comprising cluster bean as an intercrop. Similarly, the damage due to shoot and fruit borer *E. vittella* (7.04% shoot damage, 5.21% fruit damage) and fruit borer *H. armigera* (8.11% fruit damage) was recorded significantly lowest in okra intercropped with cluster bean. The treatment comprising okra as a sole crop recorded the highest pest population, shoot, and fruit damage. When compared to a sole crop, the ecological engineering of the okra ecosystem with different intercrops showed the highest population of natural enemies coccinellids and spiders. Similarly, the highest ICBR (1:2.44) was obtained in the treatment of okra intercropped with cluster bean.

OP (S10) 25: Dissipation Kinetics of Fluopyram in Different Textured Soils of Gujarat

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The dissipation study of agrochemical is often carried out to answer the most basic question: How does an agrochemical dissipate in the soils or the environment? In the present study, dissipation dynamics of fluopyram was assessed in two separate studies (i) in vitro dissipation of technical grade fluopyram at 5 mg/kg concentration, and (ii) bare field dissipation of fluopyram 34.48% SC formulation at three application rates, 0.5, 1.0 and 2.0 kg a.i./ha. Briefly, fluopyram was found to be persistent in all of the soil tested, with the dissipation of ~27-33% of initial amounts after 120 days of incubation. The dissipation kinetics of fluopyram in all examined soils was biphasic, and best described by the combined first + first-order and double first-order in parallel (DFOP) kinetic models, with half-lives ranging from 363 to 676 days. The same bi-phasic kinetic equations best describe the dissipation results of fluopyram 34.48% SC in sandy loam soil under field aerobic conditions. However, the fluopyram was dissipated reasonably at a faster rate and in greater amounts under field conditions, with the DFOP model half-lives of 54, 130, and 252 days respectively for 0.5, 1.0 and 2.0 kg a.i./ha application rate. Importantly, the results of the in vitro and field dissipation studies presented in this work would be useful for better predicting fluopyram's environmental fate, as well as would provide useful reference data for risk and safety assessments associated with the use of plant protection products containing fluopyram as an active ingredient.

OP (S10) 26: Quantification of Fosetyl Aluminum and Phosphonic Acid Residue and Its Dissipation Kinetics in/on Banana

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Banana (*Musa* sp.) is the second most important fruit crop in India next to mango. Banana is a very popular fruit due to its low price and high nutritive value. Currently, India is the largest producer of banana in the world. Fosetyl aluminium are used to control the downy mildew in grapes and azukhal disease and damping of in cardamom. They are not yet registered with an Indian regulator. Therefore, to generate the data on the residue of these fungicide in/on banana, in house simple and sensitive LC-MS/MS analytical method was developed and validated for the determination of residues of fosetyl aluminium and its metabolite of phosphonic acid from banana fruits. The present experiment was carried out at Horticultural Farm, Anand Agricultural University, Anand during 2018-19 and 2019-20. To study their dissipation kinetics in banana with two treatments, includes five applications of fosetyl aluminium as soil drenching at standard and double

dose *i.e.*, 1.2 and 2.4 g/L water/plant at two months after planting of banana. Suitability of the extraction method for fosetyl aluminium in banana was worked out following recovery study at the limit of quantitation (LOQ) and 10 X LOQ *i.e.*, 0.05 and 0.5 mg/kg for in five replications. Recoveries of fosetyl aluminium were found in the acceptable range (70-120%) showing suitability of the extraction method. The result of the field study shows that the residues of fosetyl aluminium and its metabolites phosphonic acid below the limit of quantification (<0.05 mg/kg) in banana fruits at both standard and double dose in both seasons, respectively. Residues of fosetyl aluminium and phosphonic acid in mature banana, pulp (collected from mature banana) and soil samples collected from either dose at (228 and 184 days) after last application did not reveal residues above the limit of quantification during both seasons. This fungicide is not registered to use in banana in India, so to generate the information on persistence and residues of fosetyl aluminium 80 WP in banana fruits and soil, the information generated would help in fixing up MRL and PHI for label claim.

OP (S10) 27: Effect of Sowing Dates on Incidence of *Mungbean Yellow Mosaic India Virus* in Mungbean

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Yellow mosaic disease, a most important destructive disease of mungbean production caused by *Mungbean yellow mosaic India virus* (MYMIV) under North Indian conditions. However, management of this deadly disease is still becoming the biggest challenge due to breaking of resistance under changing climatic conditions. Hence, a field experiment was conducted at IARI, New Delhi, India during *Kharif* 2021 and *Spring-Summer* 2022 in order to understand the sowing date influence on incidence of MYMIV in mungbean resistant (Pusa 1371) and susceptible (Pusa 9531) cultivars. The results revealed the higher disease incidence percentage (PDI) in the first sowing (15-20th July) of *Kharif* and third sowing (5-10th April) of *Spring-Summer* season. The mean PDI ranged from 25-41% and 11.80-13.54% for resistant and 23.13-49.84% and 14.40-21.45% in susceptible cultivar during *Kharif* and *Spring-Summer* season respectively. The detection of MYMIV through DAC-ELISA at 405nm showed the absorbance values of 0.40 to 0.60 in susceptible and <0.45 in resistant cultivar during the *Kharif* and 0.40 to 0.45 in *Spring-Summer*. The PCR analysis with MYMIV and MYMV specific primers indicated the presence of only MYMIV and absence of MYMV in the present studied mungbean cultivars. The PCR analysis with DNA-B specific primers resulted in the amplification of 850bp from both susceptible and resistant cultivars during the first sowing of *Kharif* whereas amplification was observed only in susceptible cultivar with second and third sowings of *Kharif* and all the three sowings of *Spring-Summer* season. The experiment results revealed that the most suitable date of sowing for mungbean will be before 30th March during Spring-Summer and after third week of July (30th July to 10th August) during the *Kharif* season under Delhi conditions.

OP (S10) 28: Evaluation of Fungicides against the Sheath Rot of Rice

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Rice (*Oryza sativa* L.) is major staple food crop grown in 112 countries of the world. The total area of the world under harvested rice is 167.24 million hectares producing 500 million tons of grains. Rice is the staple food crop for people of south, south-east and eastern Asia where 90 per cent of the world's rice is produced and consumed. Considering the importance of disease, a field experiment with different newer as well as combination of a fungicides available in the market was laid out to test their efficacy against sheath rot disease of rice. It suffers from *Sarocladium oryzae* fungal disease-causing heavy losses at maturity stage of rice. Field experiment was laid out with different combinations fungicides against rice sheath rot disease under field conditions with eight fungicides at various concentrations were screened against the disease. Among them, azoxystrobin 11 + tebuconazole 18.3 (29.3 SC) 0.045 per cent (15 ml/10 l.) or azoxystrobin 18.2 + difenoconazole 11.4 (29.6 SC), 0.030 per cent (10 ml/10 l.) for effective control of sheath rot and recorded significantly higher grain yield. The first spray should be given at appearance of the disease and second spray at booting stage.

Technical Session 2: Emerging and Innovative Technologies in Plant Health Management

PP (S2) 01: Vesicular Arbuscular Mycorrhizae – A Plant Protection Tool

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Vesicular Arbuscular Mycorrhizae are indigenous soil fungi that are found symbiotically associated with common plant root system. They promote growth of the root system by protecting the plant from pathogen attack and acting directly or indirectly as biocontrol agents and offering plant resistance. These groups of rhizospheric fungi also benefitted from various biosynthetic substances produced by the root of the plant (root exudates). Among all the organisms, the mycorrhizal fungi are the common and the most important beneficial groups of fungi with having a target specific inhibitory or antagonistic reaction on various soil-borne phytopathogens. By means of changing both the anatomical and morphological structures of plant roots, mycorrhizal fungi improve both the chemical and physical properties on the root-zone environment, hence activating various defensive and disease resistance systems in

the plant. Furthermore, they have the abilities to minimize the damage infringed by bacteria, fungi, nematode, as well as other phytopathogens of crops such as tomato, maize, cucumber, banana, potato and other crop plants. Mycorrhizal fungi played some significant roles in regulating plant growth and development by increasing levels of zeatin, GA and IAA growth hormones in numbers of crop plants. Arbuscular mycorrhizae has been used as a biological control agent in the reduction of incidence and severity of bacteria such as *Pseudomonas syringae*, *Erwinia carotovora* and fungi such as *Fusarium* spp., *Pythium* sp., *Verticillium* sp., *Sclerotinia* sp., *Phytophthora* sp., *Macrophomina* sp., and nematodes such as *Radophulus* sp. in majority of important crops. *Acaulospora longula*. *Glomus microcarpum, Glomus claroideum, Glomus fasciculatum, Glomus mosseae* and *Acaulospora scrobiculata* are most common mycorhizal fungi those can be used to combat numbers of soil borne diseases in the crops. Thus, Vesicular Arbuscular Mycorrhizae is a successful plant protection tool in plant disease management.

PP (S2) 02: Eco-friendly Management of Early Blight of Tomato Using Plant Extracts

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Tomato (*Solanum lycopersicum* L.) is one of the most popular vegetable crops cultivated worldwide for its edible fruits. Tomato can be affected by many diseases during growing season and is vulnerable for biotic and abiotic stresses. The leaf extracts of nine plants *viz., Azadirachta indica, Ocimum sanctum, Pongamia pinnata, Jatropha curcas, Acacia nilotica, Polyanthia longiifolia, Bougainvillea* sp*., Lawsonia inermis, Eucalyptus globulus* were tested on mycelial growth of *Alternaria solani* at ten, fifteen, twenty and thirty percent concentrations. The phytoextracts significantly inhibited growth of *A. solani*. Highest percent inhibition (74.67%) was recorded in *Azadirachta indica* at thirty percent concentration followed by *Pongamia ponnata* (65.64%), *Ocimum sanctum* (57.74%), *Eucalyptus globulus* (56.53%) and *Jatropha curcas* (54.64%) and lowest percent inhibition (50.45%) was recorded in *Lawsonia inermeris* after 120 hrs of inoculation. Mainly the growth of *Alternaria solani* was inhibited by neem leaves.

PP (S2) 03: Detection of Antifungal Efficacy of Plant-derived Products against Seed Mycoflora of Fennel under *in-vitro* conditions

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Fennel (*Foeniculum vulgare* Mill.) is a medicinal plant belonging to the *Umbelliferae* (*Apiaceae*) family, known and used by humans since antiquity, due to its flavour. Fennel crop suffered from heavy yield losses caused by seed-borne pathogens. Pathogens that infect seeds pose a serious hazard to crop establishment and productivity. Field fungus associated with seeds causes deterioration of seed quality, affects viability and reduces germination. An attempt was made to identify the most appropriate plant extract capable of protecting fennel plants against several seed-borne fungal infections. Five plant-derived products *viz.,* neem (*Azadirachta indica*) leaf extract (10%), onion (*Allium cepa*) bulb extract (10%), garlic (*Allium sativum*) clove extract (10%), moringa (*Moringa oleifera*) leaf extract (10%) and neem oil (0.3%) were evaluated for the management of seed-borne mycoflora of fennel. Among them, the minimum seed mycoflora load was recorded in seeds treated with garlic clove extract (13.92%) which was followed by moringa leaf extract (30.46%). Whereas the highest seed mycoflora load was observed on seeds treated with onion bulb extract (72.21%) followed by neem leaf extract (60.68%) as compared to control (97.24%).

PP (S2) 04: Evaluation of *Yellow Mosaic Virus* of Blackgram using Field Based Hyperspectral Observations

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The difference in spectral reflectance between healthy and diseased blackgram genotypes infected with yellow mosaic virus was investigated. The hyperspectral data was collected from two highly resistant (NUK17-05 and VUG 146) and two highly susceptible genotypes (VUG 41 and VUG 49) during two consecutive seasons *i.e.* summer 2021 and semi-rabi 2021. Over two successive developmental stages, reflectance was measured from seven samples from each genotype using SVC HR-512i field spectroradiometer over the spectral range of 336-1076 nm and average was calculated. Using reflectance data, the reflectance curve was plotted. The notable differences in healthy and diseased blackgram genotypes were noticed in both visible and NIR region during both seasons. Again, using reflectance values, vegetation indices, such as NDVI, RVI, GI, PRI, MCARI, RVSI and RENDVI were calculated. The differences between the vegetation indices were found highly significant to differentiate resistant and susceptible genotypes. One-way ANOVA and Tukey's HSD post hoc analysis was performed to choose the spectral zone that could be used to differentiate highly resistant and highly susceptible genotypes. The present work uses Linear Discriminant Analysis (LDA) and Principal Component Analysis (PCA) to improve the classification of genotypes according to their severity level, while only relying on the information carried out by the already used spectral features. Results suggested that, it is possible to distinctively differentiate the different YMV disease classes using various spectral vegetation indices in combination, and also encourages the involvement and/development of a cost-effective optical device for recognizing diseases, such as yellow mosaic virus, in early stages for effective disease management.

PP (S2) 05: Assessment of *Okra Yellow Vein Mosaic Virus* using Ground Based Hyperspectral Remote Sensing

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Okra (*Abelmoschus esculentus* L. Monech) is one of the important vegetables of the family *Malvaceae* and also economically important in tropical and sub-tropical parts of the world. The *Okra yellow vein mosaic virus* (OYVMV) appears to attack okra plants in any stage of development, spreads quickly in the field and has a negative impact on the growth and yield contributing features due to significant changes in cellular components of the infected plants. The most vulnerable stage is between 35 and 50 days. It has been evident that, the remote sensing technology has played an important role in disease assessment through various modes. Ground based hyperspectral remote sensing having the capability of differentiating spectral reflectance of disease severity, has been used to identify the OYVMV initiation in the crop cycle using spectral signatures collected at various stages of the crop. Disease severity was categorized in 4 scales and its spectral difference was observed to discriminate. At various growth stages, 10 samples were evaluated for the disease identification using spectral range of 400-100 nm. Various vegetation indices like NDVI, RVI, GI, PRI, MCARI, RVSI and RENDVI sensitive to the plant stress have also been evaluated. The K means Principal Component Analysis (PCA) has been performed for the classification and identifying the important feature contributing to identification of the disease. The spectral band and indices have been identified to have influence of the disease. The results show the potential of hyperspectral data for the disease identification using effective spectral band and spectral indices due to the narrow bandwidth of the hyperspectral data.

PP (S2) 06: Effect of Calcium Salts on Fusarium Wilt Disease of Castor

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High calcium nutrition leads to the reduction of the severity of bacterial wilt of tomato and *Fusarium* wilt in Flax. The Ca^{2+} is as important signalling molecule playing role as an intracellular secondary messenger in plants under various abiotic stresses, but few studies have explored that ca^{2+} is also an important signalling molecule under biotic stress. Reduced potato late blight severity was observed when seed tuber treated with calcium chloride followed by foliar application. In present study, Effect of three calcium salts *viz*., calcium carbonate, calcium chloride and calcium hydroxide as nutrition and inducer on *Fusarium* wilt disease of castor was studied in greenhouse. Calcium salts were mixed @ 0.0, 0.5, 1.0, 1.5 and 2.0% (w/w) with sterilised soil. Effect of calcium salts as nutrition was tested in two sets. In set-I, inoculum (colonised sand maize meal medium) was mixed @ 5% (w/w) thoroughly with sterilized soil. While in set-II, conidial suspension (1×106 conidia/ml) was poured near the roots zone of 10 days old seedlings. A non-inoculated healthy treatment was also maintained. Application of calcium salts significantly delayed the germination of castor seedlings. Daley in germination was observed with increase in concentration. Decrease in germination (%) was observed with increase in concentration. Effect of calcium salts on wilt incidence (%) was non-significant in both sets. Effect of concentration and their interaction with calcium salts was significant on wilt incidence in both sets. Reduction in wilt incidence (%) to some extent was observed with increase in concentration. The effect of calcium salts as resistance inducer was assessed with foliar application at different concentrations (0, 50, 100, 250 and 500 ppm) at 15 days after sowing. Effect of calcium salts and their interaction with different concentrations on wilt incidence (%) was non- significant. Toxic effect of calcium chloride at 250 ppm and 500 ppm concentration was observed as irregular necrotic area on leaves after 3-5 days of application.

PP (S2) 07: Development of *in-vitro* Inoculation Methods for Assessing Pathogenicity of *Macrophomina phaseolina* in Clusterbean

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Clusterbean is one of the oldest domesticated crops, mainly grown under rainfed conditions of arid and semi-arid regions of tropical India during *Kharif* and *Zaid* seasons. It is affected by the number of phytopathogenic fungal and bacterial diseases *viz*., bacterial blight, Alternaria leaf spot, root rot, powdery mildew, etc. Of them, dry root rot of clusterbean caused by *Macrophomina phaseolina* is a serious problem in cluster bean cultivation resulting upto 21-60% losses at pre-and post-emergence stages. The root rot pathogen can attack a wide range of hosts which makes it highly destructive among other plant pathogens in the tropics and sub-tropics. The development of this disease is favoured by high temperature (30-35°C), and moisture stress. Due to these specified epidemiological factors, it is very difficult to prove pathogenicity in the field as well as in pot conditions. Therefore, the urgency of *in vitro* inoculation techniques has felt to assure the pathogenicity of *Macrophomina phaseolina.* For that, two *in vitro* methods, *viz*., blotter paper towel method and *in vitro* agar method were developed for the pathogenicity testing of a native isolate on clusterbean susceptible genotype (RGC-1066). In the blotter paper towel method, seeds were directly placed on freshly grown sorghum grain-based fungus culture; whereas, *in vitro* agar methods, 5 days old germinating seedlings were inoculated with fungal culture. Among these

two methods, blotter paper towel method was found a rapid method for proving the pathogenicity of *Macrophomina phaseolina* as all the inoculated seedlings died within 10 days of inoculation. This method is best and can easily be practicable *in vitro*; thus, expected to be suitable for rapid and robust screening of clusterbean germplasms.

PP (S2) 08: Elucidation of the Biocontrol Potentiality of *Pleurotus* spp. against Free-living and Root-knot Nematode *in-vitro* and *in-vivo*

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This study aimed to reveal the biocontrol potentiality of *Pleurotus* fungi against root knot nematode in tomato and also the plant growth promotion ability of *Pleurotus* fungi *viz*, *P. ostreatus, P. sajor-caju, P. djamor, P. pulmonarius* and *P. columbinus* at different time intervals, *i.e.*, 6, 12, 18, and 24 hrs after inoculation of nematode under *in vitro* condition, and best performing three species of *Pleurotus* were further used in pot study. Under *in vitro* condition, all five species of *Pleurotus* were able to produce tiny appendages on the vegetative hyphae, which secreted droplets of a potent toxin in various amounts. It degrades and immobilized the juveniles of free-living as well as root knot nematodes. Of them, *P. ostreatus* showed the maximum number of killed RKN juveniles (18.63 out of 25) after 24 hrs with more number of producing toxins (35.84 number/1microscopic view) which was followed by *P. sajor-caju, P. pulmonarius, P. djamor*, and lowest parasitization was observed in *P. columbines* (4.58 juveniles) with toxin production (14.25 number/1 microscopic view) after 24 hrs. *In vitro* result revealed that *P. ostreatus* followed by *P. sajor-caju* and *P. pulmonarius* have the best predatory ability. Hence, these isolates were selected for pot study. Application of mushroom spent of *P. ostreatus* in sterilized soil along with farm yard manure showed significantly increased length of shoot and root (55.32 cm, 12.89 cm) respectively, and weight of shoot (39.22 g) in the tomato plant. However, root length (12.98 cm) show more in nematode infected soil with FYM and spent of *P. ostratus* which was followed by *P. sajor-caju*.

PP (S2) 09: Evaluation of Different Phytoextracts against *Colletotrichum* spp. *in-vitro*

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Indian bean (*Lablab purpureus* L.) is one of the pulse crops grown extensively in Gujarat. The occurrence of anthracnose disease in Indian bean was observed in serious proportion in Gujarat. Considering the seriousness of the problem, the investigations were carried out to develop suitable management strategies on Biological management, Botanical management and chemical management. In this *in-vitro* study, fifteen different phytoextracts were evaluated against the associated pathogen *Colletotrichum gloeosporioides* using the poisoned food technique. The phytoextracts were obtained from leaves of Datura, leaves of Neem, leaves of Tulsi, cloves of Garlic, leaves of Nafattia, leaves of Acalypha, rhizome of Turmeric, leaves of Kadvi mehandi, leaves of Gando baval, leaves of Nilgiri, leaves of Desi baval, rhizome of Ginger, leaves of Karanj, leaves of Amli, leaves of Kuvadio and a control treatment. The percent growth inhibition was calculated by measuring the average mycelial growth in control and treatment plates. Among all the treatments, the extract of garlic (*Allium sativum* L.) was proved superior in inhibiting mycelial growth followed by Gando baval (*Prosopis juliflora* L.), Tulsi (*Ocimum sanctum* L.) and Kadvi mehandi (*Lowsonia inermis*).

PP (S2) 10: *In-vitro* Evaluation of Plant Extracts against *Alternaria* spp. Infecting Cluster Bean

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Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] is an important arid legume crop. It is commonly called as Guar. Cluster bean is grown for different purposes *viz*., vegetable (pods), green fodder, green manure, straw, guar gum, seed production, cattle fodder and increase soil fertility. Effective management leaf spot (*Alternaria* spp.) by use of plant extracts investigated in *in vitro*. The extract of five plants part were evaluated against leaf spot pathogen by poisoned food technique. Among these, the extract of garlic (10%) and neem (10%) were found most effective 61.08 percent and 62.44 per cent respectively, in inhibiting the mycelial growth of *Alternaria* spp.

PP (S2) 11: Eco-friendly Tactics to Manage Mango Anthracnose

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Mango is most popular Asian fruit and commonly called as "King" of all fruits. In the post-harvest condition, mango is susceptible to many fungal diseases like anthracnose, rhizopus rot, stem end rot *etc*. The first investigation was carried out to determine the effect of pre harvest KCl treatment on anthracnose disease development. Different concentration of KCl (g l^{-1}) were sprayed on mango fruit when they were at egg size, followed by bagging and harvested after three months of treatments. Among the evaluated treatments, lowest per cent disease incidence was found in 2.5 g l^{-1} KCl (10.00% PDI) treatment followed by 2.0 g l^{-1} (20.00% PDI) and 1.5 g l^{-1} (20.00% PDI). While, highest incidence was found in control II (without water) (40.00% PDI) treatment. Therefore, fruit treated with 2.5 g l^{-1} KCl are most effective and 0.5 g l^{-1} KCl was less effective treatment against anthracnose, which reduced disease incidence up to 75 per cent and 33.70 per cent than the rest of the treatments. Use of adequate amount of

potassium developed resistance against many pathogens and provide good quality fruits. The second investigation was carried out to know the effect of different botanicals on suppression of post-harvest anthracnose disease and its effect on shelf life of mango cv. Kesar. Among the evaluated different treatments, fruits covered with neem leaves showed lowest disease incidence (30.00%) which was at par with lantana leaves (33.33%) followed by marigold leaves (40.00%) as compared to control (80.00%). The shelf life was significantly found higher (13.33 days) in fruit covered with neem leaves followed by lantana leaves (12.00 days) as compared to control (7.00 days). The experiment exhibits the results with scientific reasoning of aroma and volatile compound of different leaf form a thin film around the fruit that work as anti-repellent, antifungal and it prevent the entry of pathogen. Thus, KCl and botanicals might be a substantial alternative of chemical for managing post-harvest diseases and eco-friendly, cost-effective, as well as safe to consumers and the environment.

PP (S2) 12: Evaluation of Different Organic Inputs for the Management of Sclerotium Rot in Groundnut (*Arachis hypogea* L.)

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Groundnut (*Arachis hypogaea* L.) is an important oil seed crop in India. Several factors are responsible for low productivity among which diseases such as leaf spot, collar rot, stem rot, bud necrosis, etc., are very important. Stem rot is a major soil-borne disease of groundnut causing serious pod loss at harvest resulting great economic losses in groundnut (Kumar *et al*., 2013). For its management, pesticides application is a routine practice among farming community but pesticides may affect groundwater by a process known as leeching. Not only pesticides dangerous to the environment, but they are also hazardous to a person's health. Indigenous agricultural 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 farming system. To manage the sclerotium rot in groundnut, various eleven treatment combinations were evaluated during 2021-22 and 2022-23. Treatment of (Seed soaking with *Beejamrutha* @ 300 ml per kg seeds + seed treatment with *Trichoderma harzianum* 1 WP (1 X 108cfu/g) @ 10g/kg seeds + soil application of vermicompost (dose: 1 ton/ha) enriched with *T. harzianum* 1 WP (1 X 108cfu/g) (10 g *T. harzianum* per kg vermicompost)} gave minimum sclerotium rot incidence 2.78 and 5.36 per cent, respectively which was found at par with the treatment of {(Seed soaking with *Beejamrutha* @ 300 ml per kg seeds + seed treatment with *T. harzianum* 1 WP (1 X 108cfu/g) @ 10g/kg seeds + soil application of vermicompost (dose: 1 ton/ha) enriched with *Pseudomonas fluorescens* 1.75 WP (2 X 106cfu/ml) (10 ml *P. fluorescens* per kg vermicompost)} 3.43 and 6.65 as compared to control 27.78 and 39.29 per cent, respectively.

Technical Session 3: Seed Health in Food Security

PP (S3) 01: Seed Biopriming -A Boon of Organic Farming and Seed Industry

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There are many seed priming methods *viz*., hydro priming, osmo priming, solid matrix priming, hormo-priming, chemo-priming, nutri-priming and biopriming being useful for enhancing the seed germination, seedling vigour and to overcome abiotic stress. Moreover, to these advantages, of all priming methods only biopriming method gives an extra advantage of biotic stress management and thus gains special attention. Bio-priming is an innovative skill of seed treatment that assimilates biological (inoculation of seed with beneficial organism to protect seed) and physiological facets (seed hydration) of disease control. Biopriming of seeds denotes standard tactic for introduction of disease resistance via bio control agents. The seed biopriming is a recently adapted method of seed priming. Seed priming is a pre-sowing treatment which leads to a physiological state that allows seed to germinate more proficiently. The preponderance of seed treatments is based on seed imbibition allowing the seeds to go through the first reversible stage of germination but do not allow radical protrusion through the seed coat. Seeds keeping their desiccation tolerance are then dehydrated and can be stored until final sowing, Solubilisation or mobilization of soil macro and micronutrients, siderophore production, induction of plant growth promoting activities, induction of useful biochemicals, phytoalexin and defense-related enzymes and induced systemic resistance are the mechanisms involved in seed biopriming. Range of fungal or bacterial bio agents *viz.*, *Azotobacter*, *Rhizobium*, *Arthrobacter*, *Agrobacterium*, *Azospirillum*, *Enterobacter*, *Streptomyces*, *Bacillus*, *Burkholderia*, *Klebsiella*, PSB, *Pseudomonas fluorescence*, *Trichoderma viride*, *Trichoderma harzianum* and Vesicular Arbuscular Mycorrhiza, whether they are biofertilizer or biopesticide, may be useful as biopriming agents. Seed biopriming is useful in almost all the crops over the globe and is an eco-friendly substitute to chemical fungicides and thus seed biopriming will be a boon of organic farming and seed industry in near future.

PP (S3) 02: A Rapid Detection Procedure for Latent Infection of *Xanthomonas campestris* pv. *campestris* from Cabbage Seed

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The seed lot of commercial variety (cv. Golden acre) of cabbage were tested for presence of latent infection of *Xanthomonas campestris* pv. *campestris*. A standard liquid

plating assay and seed plating were performed *in-vitro* as recommended by ISTA, 2007. After 24to48hrs of incubation, presence of *Xcc* were detected in both the assays. An oozing was detected in seed plating. Whereas highly purified colonies were observed in the standard liquid plating assay with use of selective mCS20ABN agar medium. Further the colonies were purified on Nutrient Agar plates and bacteria gave Gram negative reaction producing pink colour. Additionally, the results of Gram staining were confirmed by catalase test, Potassium hydroxide (KOH) solubility test with positive reaction. Thus, this study can further aid in a rapid and early detection of internally seed borne *Xcc* for routine seed health testing of various crucifer seed lots.

PP (S3) 03: Coriander Seed Health Status Influenced by Fungal Metabolites of *Alternaria alternata*

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In India, spices are considered of the highest quality in the world and is known as the "Home of Spices". Coriander (*Coriandrum sativum* L.) is one of the important spices crop. The coriander plant suffers from several diseases caused by fungi and other microorganisms. Out of these diseases, alternaria blight of coriander (*Alternaria alternata*) is emerging as a major and widespread problem in India. Coriander leaf blight caused by *A. alternata* is one of Gujarat state's most important foliar disease-causing heavy losses. The present study included the effect of fungal metabolites of *A. alternata* on seed germination and the seedling vigour index of coriander. Fungal metabolites of *A. alternata* were prepared on potato dextrose broth medium to test the effect of various ages and concentrations on seed germination and seedling growth (radicle and plumule length) and vigour index on a variety of coriander GC-3. There is a clear positive relationship between the toxicity of fungal metabolites increasing with age and concentration. Fifty days old fungal metabolites were highly toxic and caused a maximum reduction of seed germination, seedling growth (radicle and plumule length) and vigour index over control in both 7 days and 14 days after seed germination, respectively. While the highest reduction of germination per cent, seedling growth (radicle and plumule length) and vigour index at 100 per cent fungal metabolites concentration over control. The evaluation of the coriander seed's germination and seedling vigour index is helpful in evaluating the seed's health status and is helpful to the scientific community in identifying strategies for improving these indices.

PP (S3) 04: Effect of Seed Biopriming on Wilt Complex of Chickpea

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A seed is the preferred technique for agriculture scientists to disseminate any technology as it is an easy means of adaptation. Seed biopriming is an advanced technique of seed treatment that involves the application of beneficial microorganisms on the seed surface. Besides disease control, biopriming has reported a positive impact on the germination and producing vigorous plant root system, which is key for better production. For the present experiment, different *Trichoderma* spp. were evaluated to study the effect of seed biopriming against wilt complex of chickpea during *rabi* 2018-19 and 2019-20 *in vitro* and *in vivo* conditions. Based on two years of experiment seed biopriming for 10 hrs. with the suspension of talc-based formulation ($2x10^8$ CFU/g) of *T. asperellum* or *T. viride* @ 50 g in 250 ml of water/kg of seed recorded lowest seedling mortality and highest growth-promoting activities of plant in pot condition and disease was effectively and economically managed under field conditions by seed biopriming for 10 hrs. with the suspension of talc-based formulation (2×10^8 CFU/g) of *T. viride* @ 50 g in 250 ml of water/kg of seed followed by soil application of *T. viride* enriched FYM (10 g/kg FYM) @ 100 g/m^2 of soil as it recorded least disease incidence (14.72%) with highest germination (93.84%) and grain yield (1775 kg/ha).

PP (S3) 05: Seed Coating with Sodium Alumino Silicate Margosa Nanocomposite – A Proficient Technique to Reduce Fusarium Toxins Inciting Grain Discoloration of Rice During Storage

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Various toxigenic fungi belonging to *Fusarium fujikuroi* species complex (*FFSC*) can contaminate rice seeds prior to or during storage. Their infestation causes wastage of about 4.6–6% of cereal grains during storage. Due to the negative impacts of toxicgenic fungi on seed health and quality metrics, it significantly reduces the market value of rice seeds. Apart from nutrient losses to the rice seeds, fumonisins B1, fusaric acid and gibberellic acid production by *FFSC* complex interacts with physiological variables influencing the integrity of seeds. Chemical seed treatments cannot be used during storage due to their detrimental effects on seed germination and viability. Sodium alumino silicates (SAS) are used as food preservatives due to their antimicrobial properties against toxigenic pathogens. Margosa leaves has been well known for their antifungal characteristics against various phytopathogenic fungi. The paper presents the efficacy of SAS-Margosa nanocomposite against toxigenic *FFSC* complex including *F. fujikuroi, F. verticillioides,* and *F. proliferatum* during storage in rice seeds with augemented antitoxin and seed invigorating potentials. The synthesized nanocomposite was chemically and morphologically characterized using XRD, FTIR, TEM, and EDS analysis. The antifungal potential of synthesized nanocomposite was examined using poison food technique.

The toxin quantification of *FFSC* complex inoculated seeds treated with nSAS-Margosa was carried out at monthly intervals upto a period of six months in storage along with control on two rice varieties *viz.*, PR114 and Pusa Basmati 1121. The study showed that treated seeds of PR114 and Pusa Basmati 1121 showed significanlty higher seed germination (87.63 & 83.57%) and minimum seed rot (5.70 & 5.24%) after 6 months of storage as compare to control. Also there was significant decrease in toxin levels after six months as compare to control in both the varieties. The nSAS-Margosa composite proved effective against toxigenic *FFSC* complex during rice seed storage without compromising the seed quality parameters.

PP (S3) 06: Effect of Seed Mycoflora on the Seed Viability and Quality Deterioration of Chickpea

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Seeds are the source of life; healthy and quality seeds are prerequisite for enhancing the production of any crop including chickpea. Seeds can harbor a wide range of mycoflora, bacteria, viruses, and other agents that initiate diseases in the field, reduce germination, contaminate the soil, and introduce into new areas which were previously disease free. To avoid such problems, seed health must be tested before their sowing. It is imperative to have proper knowledge about seed borne pathogens in chickpea; so that their accurate identification can be done and significant impact on seed health can be assessed. A study was conducted to decipher the effect of seed mycoflora on the seed health of chickpea. For that, seed samples were collected from Pulse Research Station, SDAU, Sardarkrushinagar, Pulse Research Station, JAU, Junagadh and also from local farmer's fields. Six different fungal pathogens, *viz*., *Aspergillus niger, A. flavus, Fusarium oxysporum*, *Macrophomina phaseolina, Penicillium* spp., *Rhizopus stolonifer* were isolated from the collected chickpea seeds using standard agar and blotter paper methods and identified on the basis of morphological and cultural characters. Interestingly, the maximum incidence of seed mycoflora was detected from farmer's field (29%) in comparison to Pulses Research Station, SDAU, Sardarkrushinagar (20%) and Pulses Research Station, SDAU, Sardarkrushinagar (21%). These fungi have significant adverse effects on the seed health of chickpea, as they reduce the seed viability and deteriorate the seed quality under inoculated conditions. Minimum (11.11%) and maximum (44.44%) seed germination was observed in seeds inoculated with *Aspergillus niger* and *Penicillium* spp. respectively. Similarly, the highest degradation of carbohydrates was recorded in seeds inoculated with *Aspergillus niger* whereas minimum degradation was done by *Penicillium* spp. Likewise, the maximum and minimum degradation of protein was done by *Fusarium oxysporum* and *Penicillium* spp., respectively. It indicates the adverse effect of seed mycoflora on seed health and seed viability. The necessity for carbohydrates in the seed germination of chickpeas can also be hypothesized.

PP (S3) 07: Detection of *Alternaria burnsii* in Cumin Seeds

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Cumin (*Cuminum cyminum* L.) an important seed spice crop is largely grown in the states of Rajasthan and Gujarat. In Gujarat the major cumin growing areas are Arnej, Jagudan, Patan, Radhanpur, Sanand, Mandal, Dhandhuka, Rapar, Tharad and Unjha. Detection of conidia of *A. burnsii* from cumin seeds by seed washing method was found in A_9 isolate (9.10×10^4 ml) has the maximum sporulation. Whereas in blotter paper method, *Alternaria burnsii* has found the highest per cent seed infection (19.25%). While in case of agar plate method, the maximum per cent infected seeds were found in A_9 isolate (73.33%).

PP (S3) 08: Impact of PGPR on Finger Millet (*Elusine coracana* L.) Seed Vigour, Growth and Colonization

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Finger millet (*Elusine coracana* L.) locally known as *Nagli* or *Ragi* is rich source of sulphur containing amino acids. It ranks third in importance of area and production after sorghum and pearl millet. In India, finger millet is cultivated in about 1.74 Mha with 2.01 MT productions during *Kharif*-2020. The Dang district of south Gujarat known for organic farming and considered as organic hub for finger millet farming. The rhizosphere harbours a large and diverse community of prokaryotic and eukaryotic microbes that interact and compete with each other and with the plant root. Plant Growth promoting bacteria (PGPR) are indigenous to soil and the plant rhizosphere and play a major role in the biocontrol of plant pathogens and plant growth as a biofertilizer. The native strains of *Pseudomonas* spp. isolated from cropping pattern of Waghai region were tested as a PGPR on Finger millet seeds. All the doses of seed treatments (ST) with PfRS proved significantly superior over the control. Among these, seed treatment @ 6g/kg seed was significantly superior over the rest giving maximum germination (79.78%), shoot (7.94cm) and root (2.59cm) length, shoot (4.22mg) and root (1.72mg) weight and vigor index (838.97). PfRS colonization was the maximum with the seed treatment of PaRS @ 6g/kg in shoot (6.72×104 cfu/g) and root (4.83×104cfu/g).

PP (S3) 09: Management of Seed Mycoflora of Bottle Gourd by *in-vitro* and Pot Condition

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Seed treatment with seven fungicides were evaluated *in vitro* to reveal their effect on seed germination, shoot length and root length of bottle gourd var. ABG-1. Among all these treatments, seeds treated with captan75WP@0.2 per cent gave significantly maximum germination (70.00%), shoot length (10.87cm) and seedling vigour index (1495.39) followed by fosetyl Al 80 WP (64.00%). Whereas dithane M 75WP, carbendazim 50WP, propiconazole 25EC, carbendazim 12 + mancozeb 63WP and carboxin 37.5 + thiram 37.5WP were recorded 59.00, 56.00, 48.00, 41.00 and 40.00 percent seed germination, respectively. In pot condition, all the seven fungicides tested as a seed dresser among them seeds treated with captan 75WP @ 0.2 per cent gave significantly maximum germination (85.00%) which was statistically at par with fosetyl al 80WP @ 0.2 per cent and propiconazole 25EC @ 0.1 per cent gave maximum seed germination (84.00% and 52.00%), respectively with higher shoot and root length as well as seedling vigour index (SVI).

PP (S3) 10: Seed Health in Food Security

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Crop diseases and their relationship with climate change are major concerns for global food security. In India, extreme temperatures and rainfall have led to a decline in seed quality and size, which is a significant threat to crop production and food security. Climate change can disrupt the interaction between plants and pathogens, affecting pathogen life cycles, host resistance, disease epidemiology, and the development of new pathogen strains, among other factors, which can increase the frequency and severity of crop disease outbreaks. According to the Food and Agriculture Organization (FAO), plant pests and diseases are responsible for the loss of up to 40% of global food crops each year. To address the challenges to global food security highlighted in the paragraph, promoting and prioritizing the cultivation of diverse crops, especially those that are well-adapted to local environmental conditions, may be a viable alternative. Improved and climateresilient seed varieties that are resistant to disease are also seen as a solution to this problem. However, convincing farmers to adopt these new seeds remains a challenge. It is crucial for India to maintain its agricultural productivity by addressing the issue of seed quality. The frequency of plant disease outbreaks is increasing worldwide, posing a significant risk to food security. Moreover, the ongoing global human pandemic is further eopardizing the health and well-being of millions around the world. Ensuring a reliable and nourishing food source becomes imperative to lift people out of poverty and enhance health outcomes.

Technical Session 4: Millets: Pest and Diseases and Their Management

PP (S4) 01: Integrated Crop Disease Management of Minor Millets in Arid Rajasthan

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Millets are coarse cereals from the Poaceae family that have been cultivated since the dawn of civilization. The most important cultivated species of small millets are finger millet, Foxtail millet, proso millet, barnyard millet, kodo millet, and little millet. Minor millets contain micronutrients such as Mg, Ca, Mn, Fe, K, Zn, tryptophan, phosphorous, fibre, and B vitamins. Small or minor millets are considered neglected crops due to their low yield potential in comparison to major millets (sorghum and pearl millet) and fine cereals (rice, wheat, and maize). Small millets are the traditional crops that are better suited to less fertile soils. There are several methods for controlling disease of minor millets, including cultural, chemical, and the use of resistant varieties. The usefulness of any method is determined by the farmers' economic and social circumstances. The use of resistant varieties is the most basic and cost-effective control method, and it can be combined with cultural and chemical control methods. Careful agronomic practises can help reduce their occurrence. Seed treatment, plant spacing, and regulating the amount of nitrogenous fertiliser applied to the crop are all important preventative measures. One farmer-inspired indigenous practise of using raw cow milk as seed treatment has been experimentally validated in farmers' fields and at C. R. Farm of the Central Arid Zone Research Institute, Jodhpur, by integrating with *Trichoderma spp*. (the farmer-friendly fungus and biocontrol agent). Smut disease appears on common millet earheads and can be controlled by treating the seed with copper fungicide.

PP (S4) 02: Efficacy of Plant Powders as Seed Protectant against *Corcyra cephalonica* (Stainton) in Stored Bajra

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An experiment was conducted to investigate different nine plant powders *viz.,* guava leaf powder, mint leaf powder, custard apple leaf powder, moringa leaf powder, curry leaf powder, tulsi leaf powder, orange peel powder, neem leaf powder and neem seed kernel powder as seed protectant. The result showed that mixing of neem seed kernel powder and neem leaf powder @ 2.5 g/100 g bajra seeds were found the most effective against *C. cephalonica* as it achieved 94.52, 93.41 per cent oviposition deterrence, 70.67, 67.01 per cent reduction of adult emergence, 6.84, 7.01 days male longevity, 7.19, 7.04 days female longevity, 57.33, 60.00 per cent viable eggs, respectively after 65 days of seed treatment. None of these plant powders tested at different doses, hampered the germination of bajra during the storage of 65 days in year 2021-22.

PP (S4) 03: Molecular Detection and Characterization of *Magnaporthe grisea*, the Causative Agent of Blast Disease in Pearl Millet

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Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is one of the most widely grown millets after rice, wheat, and sorghum and it's a significant crop in both India and Africa. It is also widely grown in arid and semi-arid regions. The majority of the world's millets are produced in India. The production of Pearl Millet in India represents 40.51% of the total millet production in the globe in 2020. *Magnaporthe grisea*, a blast disease pathogen that infects ancient millet crops such as pearl millet, was collected from different parts of India and was isolated by single spore isolation technique. The fungal spores and blemishes on the infected leaves were initially identified using morphological and microscopic investigations. The identification was confirmed by polymerase chain reaction (PCR)-based method to detect *M. grisea* in infected tissue and pure fungal culture. The commercially available kit is used for isolation and amplification of plant DNA from leaf tissue. The Universal primer ITS1 and ITS4 primers for the internal transcribed spacer (ITS) amplification and *M. grisea* specific Pot2 transposon were amplified PCR product (687 bp) amplified from DNA of *M.grisea.*

PP (S4) 04: Efficacy of Inert Materials as Seed Protectant against *Corcyra cephalonica* (Stainton) in Stored Bajra

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An experiment was conducted to investigate differentfiveinert materials *viz.,* rice straw ash, cowdung powder, soil under the banyan tree, sand and saw dust as seed protectant. The result showed that mixing of rice straw ash @ 2.5 and 5 g/100 g bajra seeds were found the most effective against *C. cephalonica* as it achieved 91.21, 92.09 per cent oviposition deterrence, 90.33, 92.19 per cent reduction of adult emergence, 6.87, 6.83 days male longevity, 7.03, 6.87 days female longevity, adults fecundity 27.09, 26.71 eggs per female, 47.33, 44.67 per cent viable eggs, respectively after 65 days of seed treatment. None of these inert materials tested at different doses, hampered the germination of bajra during the storage of 65 days in year 2022-23.

PP (S4) 05: Effect of *Pseudomonas* on Finger millet (*Elusine coracana* L.) Blast Incidence and Growth

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Finger millet (*Elusine coracana* L.) locally known as *Nagli*or *Ragi* is rich source of sulphur containing amino acids. It ranks third in importance of area and production after sorghum and pearl millet. In India, finger millet is cultivated in about 1.74 Mha with 2.01 MT productions during *Kharif*-2020. Finger millet is heavily infested by blast caused by *Magnaporthe grisea* (Anamorph: *Pyricularia grisea*) and is a major constraint to the production of finger millet, resulting in direct crop losses. *Pseudomonas* is an important component of the rhizosphere and certain isolates can enhance plant health. *P. fluorescens P. putida* or *P. aeruginosa* strains are known to be beneficial to plants. Some strains have been recognized for a long time as biocontrol agents. The *Pseudomonas* culture suspension were applied @ 2, 4 and 6g/kg and tested under pot condition in Department of Plant Pathology, N. M. College of Agriculture, NAU, Navsari. The significantly higher plant height was recorded in ST @ 6g/kg after 15 to 60 of after transplanting (52.07 to 72.36cm), cent percent germination and more number of leaves (8.68 to 20.27). The minimum (10.20%) blast incidence was recorded in ST @ 6g/kg followed by ST @ 4g/kg (14.60%) in finger millet under pot condition.

PP (S4) 06: A Note on Pearl Millets Diseases and Their Integrated Management

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Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is one of the common millets grown as a nutrient-rich food source for human and as a fodder crop for livestock. India is the largest producer of pearl millet in Asia, both in terms of area and production. The important pearl millet growing states in the country are Rajasthan, Gujarat, Maharashtra, Uttar Pradesh, Tamil Nadu, Karnataka, and Madhya Pradesh. It is being grown in Madhya Pradesh as sole crop for grain and fodder purposes. In India, it is cultivated over an area of 79.52 lakh ha., with the production of 87.96 lakh tones and the productivity is 1106 kg/ha. Madhya Pradesh occupies 1.87 lakh ha with an annual production 30.1 lakh tones and productivity of 1698 kg/ha. Demand for pearl millet is expected to exceed the projected increase because of the lower productivity of the crop in India. Green ear disease/ downy mildew, ergot, rust, leaf blast and smut are the major pearl millet diseases in India which are major factors responsible for lower production of pearl millet. Among these diseases, ergot and green ear are more damaging because of direct effect on grain yields and forage quality. However, the diseases like leaf blast, rust and smut also need immediate attention so that they can be managed properly and economic yield of the crop can be harnessed. Therefore etiology, epidemiology and management practices of important diseases of pearl millet such as smut, rust, leaf spot, bacterial and viral disease have been discussed with a purpose to disseminate the knowledge for proper understanding of all aspects of diseases and proper management of the diseases.

Technical Session 5: Biotechnological Approaches for Plant Health Management

PP (S5) 01: It's Based Characterization of *Curvularia lunata*ca using Curvularia Leaf Spot Disease of Maize

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Maize (*Zea mays* L.) is the world's leading crop and is widely cultivated as cereal grain that was domesticated in Central America. It is one of the most versatile emerging crops having wider adaptability. Globally, maize is known as queen of cereals because of its highest genetic yield potential. In Gujarat, major maize-growing areas are Panchamahal, Arrvali, Dahod, Sabarkantha, Banaskantha and part of Vadodara and Kheda districts, Among the all diseases of maize, curvularia leaf spot disease caused by *Curvularia lunata* is a new emerging disease which is widely distributed and highly destructive in maize growing region. The molecular identification of fungal isolate [Anand (Mp13)] was performed via PCR amplification and sequencing the ITS region of fungal DNA (rDNA) with universal primer pairs of ITS1 and ITS4. The amplification was recorded at 540 bp. The ITS rDNA region-based sequencing of *C. lunata* proved accurate for species-level identification of the pathogen. The phylogenetic trees were also constructed and compared with other similar worldwide fungal isolates available in the NCBI database. It is evident from the ITS rDNA sequence that *C. lunata* (GeneBank Accession No. MZ436987.1) is responsible for causing leaf spot in maize growing regions of Gujarat. A high level of genetic variability among the fifteen isolates of *C. lunata* collected from different regions of Gujarat was observed while screening different RAPDprimers. The highest polymorphism (100%) was recorded by the primer OPA-3, OPA-18 and OPB-5. The lowest polymorphism was observed in the primer OPB-9 (55.88%) and OPE-3 (65.90%). The maximum 7 alleles were generated by OPA 12. The lowest numbers of alleles were generated by primer OPB-9 (4 alleles). This result showed the ability of RAPD to discriminate among isolates and suggested their application for species identification.

PP (S5) 02: Novel Antifungal Peptides Harnessing the Dark Genome

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For plant disease specifically fungal disease which causes major loss in crop fields, we need antifungal peptides in agriculture which has low toxicity and minimized negative effects on the environment. Agricultural applications of antifungal peptides are promising since they can be derived from natural compounds and have improved properties such as specificity, biodegradability activity, and toxicity. They are short sequence peptides with fewer than fifty residues reporting in living organisms which are believed to be first-lineof defence in plants.From a functional standpoint, three types of DNA sequences exist: One that encodes proteins, second that encodes RNA, andthird that does not express at all. Our work is finding a purpose to this large repertoire of the non-expressing genome that we call the "Dark Matter" of genome.Could one build a novel inventory of functional molecules from naturally non-expressing regions *e.g.*, intergenic sequences, reverse DNA sequences and antisense DNA strands? Making a new antifungalpeptide molecule from the dark genome then high throughput screening system and data processing with the design of experiments methodology to obtain QSAR equation models and optimized compound. The plant pathogen model system will be evaluated once the best peptide is selected with low cytotoxicity and moderate stability to protease digestion. The peptides will be tested for acute toxicity in higher organisms if they are suitable. If peptides are very small, massive production can be achieved by chemoenzymatic techniques, but in the case of larger molecules biotechnological methods can be used by genetically modified microorganisms.

PP (S5) 03: Cultural, Morphological, Pathogenic and Molecular Variability of *Alternaria burnsii* Causing Cumin Blight

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Cumin (*Cuminum cyminum* L.) an important seed spice crop is largely grown in the states of Rajasthan and Gujarat. In Gujarat the major cumin growing areas are Arnej, Jagudan, Patan, Radhanpur, Sanand, Mandal, Dhandhuka, Rapar, Tharad and Unjha. Ten isolates of *Alternaria burnsii* isolated from different cumin growing regions differed in their cultural and morphological characters. Among ten isolates studied, only four isolates *i.e.* A2, A4, A5 and A9 showed excellent sporulation with a colony diameter of 80.15, 72.30, 78.90 and 67.25 mm respectively. The pathogenic nature of ten isolates of *Alternaria burnsii* on two varieties of cumin was tested and found to differ in pathogenic behavior. All the species collected from the different area of the Gujarat were *Alternaria burnsii* as per the NCBI BLAST results. The search results showed identical or closely related strains sequences which are related to our sequence.

Technical Session 6: Endophytes and Biological Agents in Plant Protection

PP (S6) 01: Management of Root-knot Nematodes, *Meloidogyne* spp. in Tuberose using Bio-agents under Pot Conditions

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Plant parasitic nematodes are widely distributed and cause significant yield losses in a wide range of crops. Among the different plant parasitic nematodes, root-knot nematodes, *Meloidogyne* spp. has been reported as one of the important limiting factors affecting commercial cultivation of tuberose, reducing flower yield up to 10 per cent. Nematode management through use of various chemicals is yet to be explored among the farming community. Therefore, attention has now been directed towards use of biopesticides, *Purpureocillium lilacium, Pseudomonas fluorescens, Trichoderma viride and Pochonia chlamydosporium* as a good potential biocontrol agent to manage root-knot nematodes, *Meloidogyne* spp. In order to assay the effect of different bio-agents for management of *Meloidogyne* spp. in tuberose, seven different bio-agents *viz.*, *Pseudomonas putida* 0.5% WP, *Pseudomonas fluorescens* 0.5% WP, *Bacillus amyloliquefaciens* 1.5% AS, *Bacillus pumilus* 1.5% AS, *Bacillus subtilis* 1.5% AS, *Bacillus megaterium* 1.5% AS, *Purpureocillium lilacinum* 1% WP each @ 0.1% (w/w) enriched with FYM @ 10% w/w along with untreated check were tested in pots during the year 2021 at the Department of Nematology, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat to combat and manage the root-knot disease of tuberose caused by *Meloidogyne* spp. The overall results revealed that among the different bio-agents, *Pseudomonas fluorescens* 0.5% WP (2×10^8 cfu/g) @ 0.1% enriched with FYM found to be promising in improving the plant growth characters and thereby reducing root-knot index and final soil nematode population in tuberose.

PP (S6) 02: Endophyte-New Bioagent for Plant Disease Management

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Biological control is one of the most effective method for plant disease and pest management. The different fungal, bacterial and yeast are used as a bioagent for management practices. The viability of bioagent, availability in market, its efficacy and cost are major threat for effective commercialization of bioagent. Hence, there is need to search an alternative for that. Recently, many researchers focused on exploitation of endophytes for beneficial of human health and agriculture. Endophytes are symptomless, opportunistic pathogen residing in different parts of plants (seed, leaves, stem, root, flower, bark, shoot and meristem). Almost 1-2 per cent terrestrial plants are associated with endophytes. It not only acts as a biocontrol agent but helps in plant growth promotion, bioremediations, phytoremediations and aquatic weed decomposer. They also help to tolerate various biotic and abiotic stresses for better growth and yield. The environmental and host parameters are responsible for alteration of beneficial microbes to pathogen in case of endophytes. This is very complex process and need to understand mechanism. Host-endophyte interaction depend upon biotic/abiotic factor, genotype of host, other interacting microorganism, growing season, tissue type, physiochemical properties of soil and host specificity. The ecology of endophytes is mysterious and scope to study it. The mutual, beneficial and harmful nature of endophytes varied as per host ecology. The balance antagonism is key characteristic of endophytes. The vertical and horizontal transfer of endophytes is most distinguished quality as an effective bioagent.

PP (S6) 03: *In-vitro* Efficacy of *Trichoderma asperellum* against Collar Rot of Brinjal Caused by *Sclerotium rolfsii*

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Brinjal (*Solanum melongena* L.) is a small, short lived perennial herb belongs to the family Solanaceae. It is an important summer vegetable crop grown throughout the world. Brinjal crops are susceptible to various diseases caused by biotic and abiotic factors. Among these Collar rot caused by the fungus *Sclerotium rolfsii* causes 30-40% yield loss. In the present investigation an attempt has been made to study the *in vitro* efficacy of *Trichoderma asperellum* against *Sclerotium rolfsii*. The antagonistic effect of *Trichoderma asperellum* were observed by the Dual culture technique and Poison food technique under the *in vitro* conditions. In Dual culture technique the effective antagonists were selected based on the inhibition to the growth of the pathogen. In Poison food technique to determine the antagonistic activities of antibacterial metabolites present in *Trichoderma asperellum* culture filtrate in different concentration level like as 10%, 20%, 30%.

PP (S6) 04: Qualitative Assay of IAA Production by Fungal Endophytes under *in-vitro* Conditions

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Endophytic fungi were isolated from five medicinal plants, *viz.,* nagol (*Vitex negundo*), black tulsi (*Ocimum basilicum*), brahmi (*Bacopa monnieri*), ceylon leadwort (*Plumbago zeylanica*) and thumbai (*Leucas aspera*). A total of 27 isolates from 18 different species were collected and identified morphologically which were tested for the production of IAA production using salkowski's reagent. Out of all the isolates, V-1 from nagol, B.T.-8 from black tulsi and C.L.-13 from ceylon leadwort gave a positive reaction for IAA production. This study indicates a possible role of fungal endophytes in plant growth promotion and their potential use for hormone production on industrial scale.

PP (S6) 05: Exploration of Rhizospheric Antagonistic Bacteria against *Macrophomina phaseolina* (Tassi) Goid. Causing Black Gram Root Rot under *in-vitro* conditions

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Black gram is an important pulse crop occupying a unique position in the Indian agriculture and is a major source of protein (24%). *Macrophomina phaseolina*, causing root rot disease in black gram is a potential threat under Indian condition. Soil borne nature and complex survival capacity of sclerotia sometime leads to unreliable, difficult and uneconomical chemical control, making disease management challenging. As a result, biocontrol agents offer an eco-friendly alternative to chemicals in the management of soil-borne diseases. Among the wide range of beneficial microorganisms, antagonistic rhizobacteria play a vital role in the management of plant diseases. The present study aimed at isolating bacteria from rhizospheric area of higher trees and evaluate their antagonistic activity against *M. phaseolina* by dual- culture technique. Total of twelve bacterial isolates having different morphological characters were isolated and tested *in-vitro* against *M. phaseolina*. Among them, five bacterial isolates showing strong inhibition (60% to 80 %) against *M. phaseolina*. Among five, three isolates from Anand, one is from Navsari and one is from Junagadh, Gujarat. These isolates have the potential to be used as biocontrol agents against *M. phaseolina*. These potential isolates were further examined for their morphological and biochemical characteristic. Among five one is positive for HCN production, four were positive for lipase enzyme activity and three were positive for protease enzyme activity. Molecular identification of the bacteria as *Bacillus lichieniformis*, *B. pumilus*, *Pseudomonas aeruginosa*, *P. fluorescence* and *Stenotrophomonas chelatiphaga* using 16S rDNA sequencing. In view of these, the apparent bacterial biocontrol agents could provide a mean for reducing the disease incidence in addition to limiting the use of fungicides. Such biocontrol approach should be employed as a part of integrated disease management system.

PP (S6) 06: *In vitro* Bio-efficacy of Bio-control Agents against *Fusarium falciforme* Causing Wilt of Chilli (*Capsicum annum* L.)

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Chilli (*Capsicum annum* L.) is one of the most widely cultivated solanaceous vegetable crops in the world. Chillies are rich sources of vitamin A, vitamin C, vitamin E, folic acid, calcium, potassium and antioxidants. The chilli is adversely affected by several abiotic and biotic factors including insects, pests, and diseases. The most devastating are fungal infections, which reduce yields by a significant amount each year. Fusarium wilt, caused by *Fusarium oxysporum*, is one of the diseases that has become a severe problem in the last decade. Now *Fusarium falciforme* causes wilt of chilli this was reported from isolated chilli wilt samples and proved pathogenicity too. Looking at the seriousness of the disease, the present research was undertaken to find out suitable effective bio-control agents to minimize crop losses. Four different bio-control agents were evaluated *in vitro* by dual culture method against *Fusarium falciforme* which inhibited the growth by 49.92 to 78.89 per cent. Among them, *Trichoderma* isolates *T. viride* followed by *T. harzianum* showed the highest growth inhibition against *Fusarium falciforme* by 78.89 and 74.83 per cent, respectively. Whereas, *Bacillus subtilis* (49.92%) and *Pseudomonas fluorescens* (37.47%) were found less effective as compared to *T. viride* and *T. harzianum* against *Fusarium falciforme.*

PP (S6) 07: Evaluation of Antagonistic Effect of Biocontrol Agents against Mango Dieback Incited by *Lasiodiplodia theobromae* (Pat.) Griffon & Maubl *in-vitro*

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Mango (*Mangifera indica* L.) is one of the most important tropical fruit crop, belongs to family *Anacardiaceae*. It is known as "King of fruit" because of its delicious taste and pleasant aroma in addition to its high content of different valuable nutritional compounds. Mango is infected by number of diseases at all stages of its development, among them dieback caused by *Lasiodiplodia theobromae* (Pat.) Griffon & Maubl. is considered to be the most destructive disease, leading to significant yield loss and low fruit quality of mango due to slowly wilting of tree. The present investigation was carried out to evaluate the inhibitory activity of different bio-control agents (BCA) against *L. theobromae*. Different bioagents *viz., Trichoderma viride* NAU isolate, *T. harzianum*, NAU isolate, *Pseudomonas fluorescens* NAU isolate*, Bacillus subtilis* NAU isolate and Rhizospheric actinobacteria were tested by dual culture technique. Among them, highest per cent growth inhibition was found in *T. viride* followed by *T. harzianum* and Rhizospheric actinobacteria. *P. fluorescens* was found least effective against pathogen. The results indicated that among all the BCA, *T. viride* was most effective against *L. Theobromae.* Hence, it can be explored further for management of mango dieback.

PP (S6) 08: *In-vitro* Determination of Antagonistic effect of different Bioagents against *Fusarium moniliforme* Causal Agent of Mango Malformation

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Mango (*Mangifera indica* L.) acclaimed as "King of Fruits" in Indian subcontinent belongs to the genus *Mangifera* and family *Anacardiaceae* originated in the Indo-Burma in sixteenth century. It occupies the most important place amongst the fruit grown worldwide, particularly in India. The productivity of mango marred by the prevalence of malformation malady which is one of the most destructive diseases in nature and causes economic losses of 5 to 60%. Mango malformation is incidentally the most researched problem still a practical solution to it is so far from the site. So, the present investigation was carried out to determine the antagonistic effect of different bioagents against *Fusarium moniliforme.* Five different bioagents *viz., Trichoderma harzianum, T. viride, T. virens, Pseudomonas fluorescens* and *Bacillus subtilis* (NAU isolates) were evaluated *in vitro* by dual culture method. Among them, *T. harzianum* followed by *T. viride* and *T. virens* showed the most promising results compared to *Pseudomonas fluorescens* and *Bacillus subtilis*. It is therefore, concluded that the antagonistic potentials of *T. harzianum* could be used as a biological control agent for mango malformation caused by *F. moniliforme.*

PP (S6) 09: Management of Dry Root Rot of Blackgram Caused by *Macrophomina phaseolina* (Tassi) Goid. using Bio agents

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Dry root rot caused by *Macrophomina phaseolina* (Tassi.) Goid. is vastly destructive in many crops including pulses. The present study was carried out to manage the dry root rot disease using fungal and bacterial bioagents *i.e. Trichoderma harzianum, Trichoderma viride, Bacillus subtilis* and *Pseudomonas fluorescens* under artificial inoculation *of Macrophomina phaseolina.* Result revealed that maximum percent germination was recorded with all using bioagents with seed treatment. Minimum percent disease incidence (10.0) was recorded with seed treatment of *Trichoderma viride* @ 8 gm/kg seed which was at par with *Trichoderma harzianum* (12.5) and *Pseudomonas fluorescens* (15.0). Significantly highest root length was observed with using seed treatment of bioagents compared to control. However maximum shoot length (20.2 cm) was recorded in seed treatment of *Pseudomonas fluorescens* @ 8 ml/ kg seed which was at par with *Trichoderma harzianum* @ 8 gm/ kg (19.1 cm). Highest Seedling vigour index (2317.7) was recorded in *Pseudomonas fluorescens* @ 8 ml/ kg which was at par with *Trichoderma viride* @ 8 gm/kg (2167.2) and *Trichoderma harzianum* @ 8 gm/ kg (2096.2).

PP (S6) 10: Efficacy of Microbial Antagonistic against Collar Rot and Plant Growth Promoting Activity in Chickpea

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Chickpea (*Cicer arietinum* L.) is an important legume food and excellent source of vegetable protein. Chickpea crops can be attacked by several diseases. Collar rot of chickpea caused by *Sclerotium rolfsii* is an important soil borne and fast spreading fungal pathogen in areas with high soil moisture and warm temperature, which causes considerable damage to the plant stand. An experiment was carried out during *Rabi* 2022-23 under artificial inoculation *of Sclerotium rolfsii* in pot condition and seed treatment through various fungal and bacterial bioagents. Efficacy of *Trichoderma harzianum, Trichoderma viride, Bacillus subtilis* and *Pseudomonas fluorescens* were evaluated against collar rot of chickpea and result revealed that maximum percent germination was recorded with all respective bioagents. Minimum percent disease incidence (12.5) was recorded with seed treatment of *Trichoderma viride* @ 10 gm/kg seed which was at par with *Pseudomonas fluorescens* (15.0), *Bacillus subtilis* (18.7) and *Trichoderma harzianum* (20) over control (46.2) under artificial inoculation in pot conditions. Maximum root length (8.5 cm) was observed with seed treatment of *Trichoderma harzianum* @ 10 gm/ kg whereas maximum shoot length (21.1cm) was recorded in seed treatment of *Pseudomonas fluorescens* @ 10 ml/ kg. Highest Seedling vigour index (2414.0) was recorded in *Pseudomonas fluorescens* @ 10 ml/ kg which was at par with *Trichoderma viride* @ 10 gm/ kg (2276.7) and *Trichoderma harzianum* @ 10 gm/ kg (2222.2).

PP (S6) 11: Evaluation of Different Bio-Agents against Fusarium Wilt of Bottle Gourd

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Among cucurbitaceous vegetable crops, bottle gourd is one of the most important crops. The name 'bottle gourd' is especially appropriate because its fruits having the shape of the bottle. Bottle gourd is a warm season crop and grows well in a warm humid climate and is very susceptible to frost. The production of bottle gourd is affected by a large number of diseases caused by fungi, bacteria and viruses. Among fungal diseases, wilt of bottle gourd caused by *Fusarium oxysporum* f.sp. *lagenariae*, is an economically important disease especially under protected cultivation as is responsible for heavy fruit yield losses. Six different bio-agents evaluated against Fusarium wilt of bottle gourd. The isolates of *Trichoderma* spp. are well documented as an effective bio-control agent in managing many soil-borne pathogens. *In vitro* efficacy study of various isolates of bio-agents indicated that the local isolate *Trichoderma viride* (Sardarkrushinagar) was the most effective against *F. oxysporum* and it was followed by *T. harzianum* (Junagadh), *T. viride* (Junagadh), *T. viride* (Navsari), *B. subtilis* (Sardarkrushinagar) and *P. fluorescens* (Sardarkrushinagar).

PP (S6) 12: Use of Bio-control agents to Manage Root Rot of Cowpea

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Cowpea [*Vigna unguiculata* (L.) Walp.] is one of the important vegetables and pulse crops of India. Cowpea plant is an excellent source of cattle fodder. It has also an ability to fix atmospheric nitrogen in the soil. Root rot disease of cowpea has become a major constraint in recent years for successful and profitable cultivation of cowpea in Gujarat. Considering the serious threat to cowpea cultivation, the investigation was carried out on studies the role of various bio- agents in management of root rot of cowpea caused by *Macrophomina phaseolina*. Seven known antagonists were tested *in vitro* for their antagonism to *M. phaseolina* by dual culture method. In this method, *T. harzianum* (Sardarkrushinagar) and *T. viride* (Sardarkrushinagar) were appeared as strong and potent antagonists of *M. phaseolina*.

PP (S6) 13: Evaluation of Bio-control Agents against *Sclerotium rolfsii* Causing Stem and Pod Rot of Groundnut under *in-vitro* Conditions

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Stem and pod rot disease is a potential threat to groundnut production grown under irrigated conditions. Fungus soil borne pathogen. For the soil-borne pathogens, use of fungicides is not practical due to exorbitant cost and environmental hazards involved. Hence, integrated management of the disease using bio-control agents and chemicals is the best alternative. The present investigation was conducted to evaluate antagonistic potential of five bio-control agents *viz*., *Trichoderma viride, T. harzianum*, *T. asperellum, Pseudomonas fluorescens* and *Bacillus subtilis* were evaluated against *Sclerotium rolfsii* causing stem and pod rot of groundnut. *Trichoderma harzianum* was found most outstanding and effective against the test pathogen. The minimum mycelial growth of *S. rolfsii* was recorded in a dual culture against *T. harzianum* with maximum growth inhibition (72.30%) followed by *T. viride* (51.10%) and *T. asperellum* (42.77%) respectively. *Trichoderma harzianum* formed a translucent inhibition of 0.1 cm at the interaction site but eventually overgrow the test pathogen and completely inhibited sclerotia formation.

PP (S6) 14: Plant Growth Promoting Endophytic Bacteria from Castor Plant [*Ricinus communis* (L.)]

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In present research thirty bacterial colonies of endophytic bacteria from different plant parts were isolated by pure culture technique and best fifteen plant growth promoting endophytes were selected based on *in vitro* seed germination for further studies. All the fifteen isolates were named Erc1 to Erc15. The isolates varied in morphological characteristics. Eight isolates appeared monobacilli and seven were diplobacilli whereas nine were Gram positive and six were gram negative. The isolates were studied for their plant growth promoting activities for plants as ammonia production, Indole acitic acid production, phosphate solubilization, nitrogen fixation, HCN production and antagonistic activity against wilt causing fungus *Fusarium oxysporum* f.sp. *ricini* in castor plant. Among all the isolates, the isolate Erc7 shows best result in all the parameters. All the isolates were also studied in pot trial for plant growth promotion activities by seed inoculation for wheat in season of *Rubi* 2021-22. The isolate Erc7 showed maximum shoot and root length (47.65 cm, 10.50 cm), shoot fresh and dry weight (824.90mg, 308.83mg), root fresh and dry weight (122.37mg, 36.20mg), spike length (09.76cm) and number of seeds in central tiller per plant (15.33). The DNA of all the bacteria were isolated and PCR amplification of *16S rRNA* genes of all the isolates were done. The best PGPR isolate Erc7 was gene sequenced for *16S rRNA* gene. Upon BlastN, the sequence was submitted to the NCBI GenBank (Accession number ON514555). It showed maximum similarity to *Bacillus cereus*. In microscopic examination the isolates Erc7 showed diplobacilli and presence of endospores which is a typical characteristic of *Bacillus cereus*.

PP (S6) 15: Biodiversity of Biocontrol Agents from Agro-Ecological Zones of Gujarat

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Biocontrol constitutes the control of the growth of an insect or pest by using a biological agent or living organism. In the year 2022-23, general surveys were carried out under the project 'Insect Pest Management through Biocontrol Agents' in Gujarat for documenting biocontrol agents. The diverse parasitoids and predators were recorded. Among predators, eleven different species of ladybird beetles were collected and identified. *Novius fumidus* Mulsant found as potential coccinellid predator of Egyptian cottony cushion scale (*Iceryaa egyptiaca* Douglas) in *Casuarina equisetifolia* and it was the first report in India. During the survey, six different types of parasitoids were collected. Aphelinid parasitoid, *Encarsia* sp. was found to have colonized the highly polyphagous invasive rugose spiralling whitefly and naturally suppressing the pest in coconut orchard. A new record of larval parasitoid *Bracon* sp. (Hymenoptera: Braconidae) parasitizing brinjal shoot and fruit borer *Leucinodes orbonalis* and egg larval parasitoid *Chelonus* sp. (Hymenoptera: Braconidae), which has a potential for biological control of fall armyworm, *Spodoptera frugiperda*.

PP (S6) 16: *Metarhizium anisopliae* in Crop Pest Management

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Yield losses caused by insect pests are severe and farmers are using chemical pesticides for their management. Chemical pesticides are hazardous for environment, soil and human health and also killing the natural enemies. Group of fungi that kill an insect by infecting its host is known as entomopathogenic fungi. Bio-control method using entomopathogenic fungi is eco-friendly way to manage pest population. Among entomopathogenic fungi**,** *Metarhizium anisopliae* is most exploited entomopathogenic fungus in biocontrol practices which infects over 200 insect species and causes a disease known as green muscardine disease hence, it is known as green muscardine fungus. It is found effective against many insect pests which includes mainly white grub, potato cut worm, termite, aphids, rhinoceros beetle, brown plant hopper, rice leaf folder, sugarcane pyrilla etc and being used as a bio-insecticide to control a number of important insect pests. Due to the regulations of organic farming, very few options are available for insect pest management. Pest management in organic farming is achieved by using appropriate cropping techniques, natural enemies, bio-pesticides and organic pesticides. *Metarhizium anisopliae* is suitable for pest management under organic farming. Now day, a total 970 biopesticides have been registered through the CIBRC. Among them, 250 myco-insecticides, 150 bacterial insecticides, 39 myco-nematicides and 60 nucleo-polyhedron virus (NPV) products are registered. There are few challenges which includes that unavailability of quality *M. anisopliae* based bio-pesticides in market. Generally, farmers are using of biopesticides when pest population is noticeable however prophylactic application exhibited better results. Further, testing and confirmation study under organic farming on efficacy of *M. anisopliae* based bio-pesticides is required. Easy and economical on-farm production of *M. anisopliae* based bio-pesticides production technology need to be develop and transfer to farming community. There is an evitable need of frontline demonstrations on *M. anisopliae* based bio-pesticides.

PP (S6) 17: Entomopathogens for Insect Pest Management in Organic Farming

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Organic agriculture is a holistic production system that sustains the health of soils, ecosystems and consumer. Due to the regulations of organic farming, very few options remain to manage pests and diseases. Pest management in organic farming is achieved by using appropriate cropping techniques, biological control and organic pesticides (mainly obtained from plant or animal). Entomopathogens are microorganisms that cause severe diseases to arthropods (insects, mites, and ticks). Microbial insecticides are living agents like fungi, virus, bacteria, nematode and protozoa use for preventing, destroying or repelling or mitigating different crop pest. In India, commercial level production of microbial pesticides has gained momentum in the recent years. Now day, a total 970 bio-pesticides have been registered through the CIBRC. Among them, 250 myco-insecticides, 150 bacterial insecticides, 39 myco-nematicides and 60 nucleo-polyhedron virus (NPV) products are registered. In addition, 9 products based on 4 species of entomopathogenic nematodes (EPN) are being sold which are exempted from CIBRC registration. There are few challenges which includes that being living entity, the efficacy of entomopathogens is depends on prevailing environmental conditions; lack of suitable storage facilities with input dealers; The use of entomopathogens when pest population is noticeable however prophylactic application exhibited better results; Limited study on entomopathogen application in organic cultivation. Entomopathogen provides significant and selective insect pest management. Pesticides based on entomopathogen have been proven to be highly effective, species specific and eco-friendly, leading to their adoption in pest management strategies. However, further testing and confirmation study on entomopathogen under organic farming are required. High quality entomopathogen formulation production system needs to be developed. Further exploration of new entomopathogens (or virulent isolates /strains) is required. Easy and economical on-farm production of entomopathogens technology need to transfer to farming community. There is an evitable need of frontline demonstrations on potential entomopathogens based bio-pesticides.

PP (S6) 18: Efficacy of Different Biopesticides against Fall Armyworm, *Spodoptera frugiperda* in Maize

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Investigations on efficacy of biopesticides against fall armyworm, *S. frugiperda* in maize were carried out under field conditions at S. D. Agricultural University, Sardarkrushinagar during *Kharif*, 2020. Among seven biopesticides evaluated, maximum reduction in larval population as well as per cent damaged plant was recorded in treatment of *Beauveria bassiana* 1.15 WP (1×108 cfu/g) @ 0.005 which was at par with azadirachtin 10000 ppm @ 0.002 per cent. Next effective treatment was neem seed kernel extract @ 5 per cent and it was at par with *Bacillus thuringiensis* 0.5 WP (2×108 spores/g) @ 0.001 per cent and azadirachtin 1500 ppm @ 0.0006 per cent. Highest yield was obtained from the plots treated with *Beauveria bassiana* 1.15 WP (1×108 cfu/g) @ 0.005 (27.80 q/ha) followed by azadirachtin 10000 ppm @ 0.002 per cent (27.38 q/ha). Looking to the PCBR, the highest PCBR was obtained in the treatments of plots treated with *Beauveria bassiana* 1.15 WP (1×108 cfu/g) @ 0.005 per cent (1:7.56) followed by, neem seed kernel extract @ 5 per cent (1:6.51).

PP (S6) 19: Evaluation of Inhibitory Effect of Biocontrol Agents against *Alternaria alternata* Causing Alternaria Leaf Spot of Ashwagandha Under *in-vitro* Conditions

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Ashwagandha (*Withania somnifera)* is an important herb in Ayurveda. The roots of the plant are reputed to promote health and longevity. However, ashwagandha is invaded by many plant pathogens. Among them, Alternaria leaf spot caused by *Alternaria alternata* is one of the important foliar diseases. Continuous usage of chemical methods leads to environmental, soil and water pollution. Whereas biological control of diseases is long-lasting, inexpensive, eco-friendly and harmless to target organisms. In this context, it is aimed to evaluate five bioagents namely (*Trichoderma viride, T. harzianum, T. asperellum, Pseudomonas fluorescens* and *Bacillus subtilis*) against *A. alternata* by dual culture method. The result showed that *T. harzianum* showed maximum percentage inhibition of mycelial growth (62.97%) followed by *T. viride* (59.58%).

PP (S6) 20: *In-vitro* Efficacy of Eco-Friendly Management of Stem and Pod Rot Disease of Groundnut Caused by *Sclerotium rolfsii* Sacc.

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Groundnut or Peanut (*Arachis hypogaea* L., *Fabaceae*) is a vital oilseed crop predominantly grown in Tamil Nadu, India. Groundnut cultivation is adversely affected by a wide range of pests and diseases. *Sclerotium rolfsii*, the causal agent of stem and pod rot of groundnut is a serious soil-borne disease, that can cause yield losses up to 80%. The diseased plant stem and pod show white mycelium and brown-coloured sclerotial bodies and then lead to wilting the whole plant. The diseased samples were collected from ten villages in the Cuddalore district, the highest disease incidence was recorded in Kurinjipadi (27.33%). The isolated cultures were observed at cultural, morphological, microscopic, and molecular levels. In the present study, we have isolated and characterized the three antifungal antagonistic bio-agents like *Trichoderma asperellum, Trichoderma hamatum,* and *Trichoderma harzianum* against *S. rolfsii* on groundnut. The *Trichoderma* spp. were tested in-vitro condition and studied on dual culture test. The fungal antagonist *T. asperellum* exhibits maximum percent growth inhibition over the control (31.48) against *S. rolfsii*, followed by *T. harzianum* and *T. hamatum* showing percent growth inhibition over control (42.22 and 56.30) respectively when compared with control. Seed treatment with the talc-based combination of *T. asperellum* + *T. harzianum* + *T. hamatum* at 3g/kg of seeds shows maximum seed germination percentage and vigour index of groundnut in the roll towel test. The results obtained in the study depict that the combination of three *Trichoderma* species not only suppressed *S. rolfsii* disease incidence, but also enhanced the growth parameters of groundnut, indicating their biocontrol potential and plant growthpromoting features.

PP (S6) 21: Wilt and Root Rot Management in Cumin

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Cumin is mainly grown in India and several other countries. It is an important crop of Gujarat, Rajasthan and some adjoining states. The crop suffers from wilt (*Fusarium oxysporum* f. sp. *cumini*), blight (*Alternaria burnsii*), and powdery mildew (*Erysiphe polygoni*). During recent years, root rot has been reported in many pockets of Gujarat. The root rot in cumin was already reported in Rajasthan, which is caused by six different species of *Fusarium viz.*, *F. oxysporum, F. solani, F. monileforme, F. dimerum, F. equiseti and F. lateritium*. In China, the root rot has been reported due to *F. oxysporum, F. solani, Rhizoctonia* sp. and an unidentified *Deuteromycetes* fungus. Hence, an experiment was planned to find out an effective control measures of wilt and root rot in cumin. A field experiment was conducted in a randomized block design with three replications during r*abi* 2017-18 to 2020-21 at Seed Spices Research Station, S. D. Agril. University, Jagudan (Gujarat) on the management of wilt and root-rot in cumin through soil application of biopesticides/soil drenching of fungicides. Cumin cv. Gujarat Cumin 4 (GC4) was sown in the month of November at a distance of 30 cm row spacing by using 12 kg seed rate. Different seven soil application of bio-pesticides/ soil drenching of fungicides schedules with their prefixed concentrations were compared with untreated control. Blanket application of seed treatment using carboxin + thiram @ 2 g /kg seed in all treatments were made except untreated control. Observations on wilt and root-rot were recorded from three rows of 1m length from each plot and percentage was calculated. Among different treatments, application of *Trichoderma viride* @ 2.5 kg/ha and Pseudomonas *florescence* 108cfu @ 2.5 kg/ha with 1 ton FYM/ha or *Trichoderma harzianum* @ 2.5 kg/ha and *Pseudomonas florescence* 108cfu @ 2.5 kg/ha with 1 ton FYM/ha at the time of sowing was found effective for economical management of wilt and root rot in cumin.

Technical Session 7: Nanotechnology for Plant Health Management

PP (S7) 01: Modern prospects of nanotechnology in Plant Pathology

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The most important applications of nanoparticle types and the common practices for control of plant diseases are described.

The chapter will not include a description of all diseases that occur globally or a comprehensive report on the selected diseases and nanoparticles. We have tried to contain information on the impact of the disease and the role of nanotechnology to face these challenges as modern technology in plant control and also report a short, historical background for some nanoparticle types. We have attempted to include the newest literature and scientific research related to each nanoparticle type. We will focus on the synthesis of NPs of some compounds and their influence on plant diseases. The chapter consisted of four sections. The first section will elucidate the meaning of nanotechnology and scientific progression. Section 15.2 covers major information about plant diseases as challenges in agriculture development. The third section will include important techniques that are used to detect and manipulate causal agents of plant diseases and the use of nanoparticle in disease control. The last part addresses a common nanoparticle that is used as control agent for some plant pathogens.

PP (S7) 02: Green Synthesis of Silver and Iron Nanoparticles and Exploring Its Antagonistic Potential against *Xanthomonas citri*

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Nanotechnology plays pivotal role in advancement of agriculture. Green synthesis of nanoaparticles using microorganisms is gaining momentum in current era. In present study, microalgae mediated synthesis of silver (AgNPs) and iron nanoparticles (FeNPs) was attempted using *Coelastrell athermophila* (A) and *Chlorella sorokiniana* (I). Various combinations *i.e.*, reducing agent (2.5% and 5.0% algae extract), exposure durations (20, 40, 60 and 80 min) with 1 mM $AgNO_3$ and $FeCl_3$ were assessed for synthesis of stabilized AgNPs and FeNPs. Algae extract served as reducing, capping agent and catalyst for synthesis process. Biologically synthesized AgNPs and FeNPs were characterized through UV–visible spectroscopy, dynamic light scattering for size, polydispersity index. Results revealed that, as the concentration of algal extract increased size of AgNPs and FeNPs reduced and more stabilized nanoparticles got synthesized. Green synthesized AgNPs and FeNPs were further tested for antibacterial activity against bacterial pathogen of citrus *Xanthomonas citri* under *in vitro* condition. Maximum inhibition zone of *X. citri* (22.0 mm) was observed with AgNPs synthesized using 5% extracts of *C. sorokiniana* AAU BR I with incubation period of 60 min, where as FeNPs synthesized using 5% extract of *C. sorokiniana* AAU BR I with incubation for 20 min gave maximum inhibition. Overall, results provide base for exploring an attractive option to utilize microalgae for green synthesis of AgNPs and FeNPs which can be utilized for control of phytopathogens.

PP (S7) 03: Evaluation of Antifungal Potential of ZSB-ZnO Nanoparticles Combination against Phytopathogenic Fungi and Their Plant Growth Promotion Effect on Chili

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The investigation was aimed to study biocontrol potential and plant growth promotion efficacy of native zinc solubilizing bacteria along with ZnO nanoparticles. Total 4 potent native ZSB isolates M 16, F 2**,** PN 3 and ZSB 2 out of 18 native zinc solubilizing bacterial isolates were screened for their zinc solubilization efficiency in presence of 5% ZnO. The selected isolates were further screened to test their tolerance limit for ZnO nanoparticles and isolates PN 3 and ZSB 2 found to tolerate 250 ppm of ZnO nanoparticle concentration. Selected ZSB isolates PN 3 and ZSB 2 along with ZnO nanoparticles 250 ppm were screened for growth inhibition of three plant pathogenic fungi *Fusarium oxysporum, Curvularia lunata*, and *Macrophomina phaseolina* and recorded with fungal growth inhibition ranging from 10 to 80%. Combine biocontrol activity of isolate PN 3 and ZSB 2 along with 250 ppm ZnO NPs recorded with 13 to 83% growth inhibition of *F. oxysporum, C. lunata* and *M. phaseolina*. The combined application of native ZSB-ZnO nanoparticle formulation found to promote growth of chili plants by 20-30 % in comparison to uninoculated control in presence of plant pathogenic fungi. Overall results indicated that the combine application of native ZSB isolates along with ZnO nanoparticles 250 ppm effectively improve chilli plant growth parameters through various mechanisms and with use of the combine inoculation use of harmful chemical inputs can be curtailed for sustainable agriculture.

Technical Session 8: Pest Risk Analysis, Disease Forecasting and Decision Support Systems, Plant Clinics

PP (S8) 01: Devastating Disease of Paan Methi (*Foenum corniculata*): Root rot (*Rhizoctonia solani)*

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It is one of the important spice crops which are prevalently grown in the Nagaur district and some part of Jodhpur district in Rajasthan state. The dried leaves and flowers are also used for flavouring vegetable curries. Nagauri (Paan) methi is being grown by more than 3000 farmers in the 4100 hectares area. Root rot of Paan methi/Kasuri methi (*Foenum corniculata*), incited by the fungus *Rhizoctonia solani* has become a vital constraint to the growers of paan methi in Rajasthan. It is caused up to 27.65 percent crop loss in Paan methi growing districts in Rajasthan. This disease mainly occurs due to monocropping cultivation in fields. Most of the Paan methi growing farmer grow same host crop for Root rot (*Rhizoctonia*

solani) because of this inoculum density increase every year and also increase disease incidence. *R*oot rot also known as collar rot and damping-off. The main symptom of this disease is damping off. The freshly emerged seedlings fall over and die and most of the seedlings may die at pre- or post-emergence in severely infected areas. They may also develop foot rot and brownish cankers on the root and stem near the ground level. The roots of infected plants are poorly developed; finer roots are either not formed or rotted. Plants show stunted growth and can easily be pulled out. Heavy losses are incurred due to root rot. Being mainly a soil-inhabitant pathogen, many environmental and soil factors are responsible for the development of disease. Study is needed to improve the identification and characterisation of variability within its epidemiological and pathological niches. The present article discusses current status of the disease in the context of climate change and possible management options to alleviate the problem.

PP (S8) 02: Standardized Pathogenicity of Root and Stem Rot of Cucumber

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The studies were aimed; Standardized Pathogenicity of *Fusarium oxysporum* f.sp. *radicis-cucumerinum.* The present study was undertaken in cucumber root and stem rot disease caused by *Fusarium oxysporum* f.sp. *radicis-cucumerinum* leading to rotting of roots, lower stems, crowns and rotting of seeds and seedlings. The pure culture of pathogen was obtained by hyphal tip method. On the basis of morphological and cultural studies, the pathogen was identified as *F. oxysporum* f.sp. *radicis-cucumerinum* and further its pathogencity was confirmed. Pathogenicity test of the culture of *Fusarium oxysporum* f.sp. *radicis-cucumerinum* was confirmed on young plants of susceptible variety (S-82) of cucumber in the pot condition. The same symptoms were initiated after 10-12 days of inoculation as rotting and yellowing, sunken stems and wilting. Re-isolation of the pathogen was made on PDA plates and identified it on the basis of culture characteristics of the parent culture.

PP (S8) 03: Effect of Weather Parameters on the Development of Banded Leaf and Sheath Blight Disease in Maize

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Maize (*Zea mays* L.) is the most important cereal crop belonging to the grassy family *Poaceae* (*Gramineae*). Maize has attained great importance because of its increased demand from many sectors like feed, food sweeteners, ethanol production, cosmetics, alcoholic beverages and pharmaceuticals. The study of environmental factors in the development of any diseases may provide a base to forecast the disease which can assist the growers for timely management of the disease. Keeping this in view, a study was undertaken to examine the influence of meteorological factors on the intensity of the banded leaf and sheath blight disease in maize. The impact of various weather variables on disease progression, and their relationship, indicated that maximum temperature, minimum temperature, morning relative humidity, rainfall and wind speed were negatively correlated with per cent disease intensity. The evening relative humidity, bright sunshine hours and evaporation were positively correlated and substantially affected banded leaf and sheath blight disease in maize during *Kharif*, 2021.

PP (S8) 04: First Report of Soft Rot of Dragon Fruit Caused by *Gilbertella persicaria* in India

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Pitahaya is well known as dragon fruit. In Gujarat, it is also known as *Kamalam*. Its cultivation is increasing day by day in Gujarat as well as in India. A new disease was observed in orchards of Kutch district of Gujarat. Symptoms on fruits were reported as water-soaked and light brown lesions, extending to the whole fruit and covered with mycelia, sporangiophores and sporangia. When grown on PDA, the fungus initially produced a white colony, which covered the entire Petri dish within 3 days, and became darker with age. sporangiophores are hyaline, becoming pale brown with age, simple, sometimes branched, erect, curved below the sporangium. Sporangia are spherical, initially white-yellowish, turning light to dark brown or black when mature wall persistent, covered with spines, separating at maturity into two equal halves, columellae are ovoid to globose, with a distinct basal collar. Based on the above-mentioned characteristics, the fungus was identified as a member of the genus *Gilbertellapersicaria*. For proving the pathogenicity, healthy red flesh dragon fruits were inoculated by the fungal spore mass from growth on PDA with a sterile needle, which was then used to puncture the fruits and they were kept in a moist plastic chamber. All inoculated fruits developed rot within three days after inoculation whereas no symptoms were observed on the Uninoculated fruits. The experiment was repeated twice with similar results. The fungi were consistently re-isolated from the diseased fruits for fulfilling Koch´s postulates.

PP (S8) 05: Epidemiological Studies of Little Leaf Disease of Brinjal (*Solanum melongena* L.)

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Brinjal (Kingdome: Plantae, Order: Solanales, Family: Solanaceae, Genus: *Solanum*, Species: *melongena*) originated from South East Asia. Brinjal has emerged as second most vegetable crop in India after potato, along with tomato and onion. India is the second largest producer of brinjal after

China. Major factor that limits brinjal productivity includes biotic and abiotic stresses. Out of many diseases of which little leaf disease caused by phytoplasma is one of the most important factors causing considerable economic losses. For the study of epidemiology of little leaf disease of brinjal the experiment was conducted at experimental farm of Department of Plant Pathology, B. A. College of Agriculture, Anand Agricultural University, Anand during the *kharif* 2015-16. Leafhoppers (Kingdom: Animalia, Phylum: Arthropoda, Class: Insecta, Order: Hemiptera, Family: Cicadellidae, Genus: *Emposca*, Species: *E. devastans*) population were appear from 1st week of September (35th standard week), then increased and reached to the peak (8.00 per leaf) during 1st week of December (49th standard week), the population then in declined till to the maturity of crop. Bright sunshine hours were found positive correlated while rainfall, wind speed, maximum and minimum temperature, morning and evening relative humidity and morning and evening vapour pressure were negative correlated with leaf hoppers population and disease incidence, respectively. Positive correlation was observed between leaf hopper population and disease incidence, vice versa.

PP (S8) 06: Survey and Disease Incidence of Bhendi Powdery Mildew Disease Incited by *Erysiphe cichoracearum* DC in Chidambaram and Bhuvanagiri Taluk of Cuddalore District of Tamil Nadu

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Bhendi (*Abelmoschus esculentus* (L.) Moench.) belonging to the family *Malvaceae* and its popularly known as Bhendi or Ladies finger is one of the most delicious and important vegetable crops grown throughout the country. India ranks first in global production of okra contributing 70 per cent of world production. Though, the production of bhendi is limited due to different stresses incited by Biotics, meso-biotic and abiotic factors. Under the biotic agents, the major fungal diseases are Fusarium wilt and powdery mildew. Powdery mildew is most destructive and explosive disease in most of the vegetable crops. Powdery mildew disease of bhendi caused by *Erysiphe cichoracearum* D.C. is prevalent throughout the bhendi growing areas of Tamil Nadu. A study on survey was conducted to identify the Powdery mildew disease incidence of Bhendi in Allur, Ayipettai, Odakkanallur, Parathur chavadi and Sivapuri villages in Chidambaram taluk and in Azhichikudi and Manjakollai villages in Bhuvanagiri taluka. The Percent disease incidence (PDI) due to Powdery mildew disease was recorded with a range of 45-92% under field condition.

PP (S8) 07: Surveillance of Important Potato Diseases in the Region (Pest Capture Plots)

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The field experiment was conducted on Surveillance of important potato diseases in the region (pest capture plots) using four varieties *viz.*, K. Ashoka, K. Surya, K. Khyati and K. Pukhraj under sprayed and unsprayed condition at All India Coordinated Research Project on Potato at Zonal Agricultural Research station, Chhindwara, Madhya Pradesh in the year 2020-2021. Results revealed that there was no incidence of late blights disease in all tested varieties under both the conditions, whereas minimum percent incidence of early blight (16.56%), Phoma (2.57%), mild mosaic (2.2%) and leaf roll (1.9%) was recorded in variety K. Surya followed by K. Khyati with early blight (18.43%), Phoma (3.53%), Severe mosaic (2.5%) mild mosaic (2.2%) and leaf roll (2.7%). However, highest incidence of early blight (22.67%) was recorded in variety K. Ashoka among all tested varieties.

PP (S8) 08: Effect of Dates of Sowing on Epidemiology of Cumin Blight Caused by *Alternaria burnsii*

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Cumin (*Cuminum cyminum* L.) an important seed spice crop is largely grown in the states of Rajasthan and Gujarat. In Gujarat the major cumin growing areas are Arnej, Jagudan, Patan, Radhanpur, Sanand, Mandal, Dhandhuka, Rapar, Tharad and Unjha. The mean disease intensity was observed in the ranged of 1.92 to 49.92 per cent in four dates of sowing *i.e.* 15th November, 22nd November, 29th November, and 5th December. Maximum and minimum temperature were found negatively correlated with the blight intensity in different date of sowing whereas, relative humidity was found significantly positively correlated with blight intensity in different dates of sowing during both the years exhibiting positive correlation with disease progression.The seed yield data indicated that seed yield was lowest (707.69 kg/ha) in case of 29th November sown crop followed by 5th December sown crop (744.73 kg/ha) However, 15th November sown crop recorded maximum (863.86 kg/ha) seed yield.

PP (S8) 09: Disease Forecasting

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Forecasting of plant diseases means prediction of the disease with its probable intensity. According to intensity of disease timely application of chemicals can done. It involves well organized AI system work with sensors. Now a days various advanced chemical are available in the market for disease control. But they require specific time and precise concentration. Almost farmers use this chemical according to recommendation of local export. This increases the cost and also chance of residual effect. The prime objective of disease

forecasting is about providing prior information of disease development to farmer in order to reduce the cost and chemical residue. The forecasting system includes AI, IOT, Remote Sensing techniques. According to particular pathogen sensors can predict the infection, rate of disease development. Presently, models like FAST, EPICORN, TOMCAST, MELCAST are available. Likewise by using typical sensor model for forecasting can be prepared. The most valuable application of forecasting model is prediction of dreadful disease in advance by which farmer get enough time go for protective measures. This models also used to estimate the yield and crop losses.

PP (S8) 10: Disease Forecasting: According to Climate Change

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The management of plant diseases involves the use of forecasting systems to predict the occurrence and severity of plant diseases. This forecasting system predicts the occurrence of plant disease in a specific area ahead of time, allowing for appropriate control measures to be taken in advance to prevent losses.The Indian agricultural sector is being negatively impacted by climate change, with rising temperatures and unpredictable rainfall patterns observed over the past three decades. This has led to fluctuations in crop production from year to year and has created conditions favourable for the development of new plant pathogens and the emergence of resistance to biotic and abiotic factors. As climate change continues to impact agriculture, there is an increasing need for reliable forecasting systems. In India, the development of such systems is essential, not only to help growers prevent crop losses but also to provide intellectually stimulating insights into the management of diseases affecting important crops such as vegetables, food crops, and fruits.

Technical Session 9: Molecular Plant Pathology and Plant Disease Resistance

PP (S9) 01: The Role of the Physio-Morphic Characters in Resistance to Powdery Mildew of Okra

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To investigate physio-morphic characters in resistant and susceptible cultivars of okra. 12 okra varieties were screened for powdery mildew resistance in field condition for two year. Among 12 different varieties Sonakshi and Taj-042 showed moderately susceptible reaction. While, the varieties *viz*., R.K.-523, Okra-OH-102, Siri-19, Arka Anamika, Venus, GO-2 and Rani exhibited susceptible, whereas Gitanjali, GAO-5 and Pusa Sawani categorized highly susceptible reaction against powdery mildew of okra. None of the variety was found resistant during both the years. Among the physio-morphic characters of different varieties hair-length on midrib of middle and lower leaves, lamina of upper & lower leaves, hair density on the midrib of upper and lower leaves, veins of lower leaves and lamina of upper and middle leaves exhibited significantly negative correlation with the per cent disease intensity on okra. Similarly, stomatal area of upper, middle and lower leaf and leaf lamina thickness of lower leaves were also found significantly negative correlation with disease intensity. While, stomatal density on upper, middle and lower leaf and stomatal index of upper, middle and lower leaf showed significantly positive correlation with the disease intensity.

PP (S9) 02: Morphological, Biochemical and Molecular Characterization of *Xanthomonas citri* pv. *citri* Isolated from Different Regions of Gujarat

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Different morphological and biochemical test were performed on fifteen isolates collected from various places of Gujarat. The bacterial cells were straight rod shaped, gramnegative and having single polar flagella. All the isolates found positive for motility test, catalase test, KOH test, starch hydrolysis, Tween 80 hydrolysis, gelatin liquefaction and citrate utilization while negative for gram staining and Kovac's oxidase test. The growth of *X. citri* pv. *citri* were checked against 1, 2, 3 and 4 per cent salt concentration in Nutrient agar medium. All the isolates grew well up to 3 per cent NaCl concentrations but isolates collected from Dhoraji, Kadi, Kheda, Rajkot and Junagadh showed poor growth on 4 per cent salt concentration. The genetic diversity of the isolates was evaluated by using RAPD marker and the result indicating high level of polymorphism. Out of 10 primers used, 8 primers showed 100 per cent polymorphism. The highest similarity index value of 0.88 was found between isolate of Kheralu and Aravalli, while the least similarity index value of 0.22 was found between isolate of Rajkot and Morbi. The average similarity coefficient among isolates was 0.46.

PP (S9) 03: Screening of Potential Parents for *Chilli Leaf Curl Virus* Resistance for Developing GMS Based Hybrids in Chilli

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Chilli (*Capsicum annuum* L.) belongs to the family *Solanaceae* and is an important spice cum vegetable crop commonly used in Indian dietary. It is grown throughout the year as a cash crop and used in green and red ripe dried stage for its pungency, colour and culinary properties. So far 65 viruses have been reported, including Begomoviruses causing chilli leaf curl virus disease infecting chilli throughout the world out of the many other diseases affecting the crop loss. Chilli leaf curl complex disease is one of the major limiting factors in chilli production & the reasons behind this complex disease are whitefly (*Bemisia tabaci*) transmitted begomoviruses, thrips & mites lately black thrips whose infestation has caused havoc in chilli production, causing significant reductions in yield and quality of chilli. The investigation aims to gather baseline information on chilli leaf curl virus (ChiLCV) resistance genotypes for production of hybrids based on genetic male sterility (GMS) which can give good seed yield during hybrid seed production and provide durable disease management through host plant resistance. The genotypes evaluated have genetic male sterile lines (female line) which form the basis of hybrids that will be produced and need to be superior in every aspect including ChiLCV resistance. Evaluation of seventeen genotypes of chilli out of which namely, ACGMS-1, ACGMS-2, ACGMS-3, ACGMS-4 are genetic male sterile females, Ujjwala, G-4, ACS-18-03, GVC-101, ACS-20-20, Punjab Gucchedar, IPS-41, Old GP-47, SB-44, New GP-18, Old GP-21, Anand Tej (Resistant check) and Pusa Jwala (Susceptible check) was done for yield attributes and ChiLCV tolerance at Main Vegetable Research Station during *kharif-rabi* 2022-2023. Among the seventeen genotypes, ACGMS-1 showed significantly lowest incidence of ChiLCV (5.980%) and registered fruit yield/plant (745.08 g) which was not the highest but is promising as a female parent. Anand Tej showed the highest fruit yield/plant (789.65 g) and ChiLCV incidence (10.78%). The ChiLCV incidence ranged between 5.98%-88.26%. The two checks namely Anand Tej and Pusa Jwala registered a ChiLCV incidence of 10.78% and 88.26% respectively. Based on the overall performance of all the genotypes screened ACGMS-1 was found to be the most superior followed by ACGMS-4 in female lines, Punjab Gucchedar and Anand Tej gave higher fruit yield and lower incidence so they could give promising hybrids when used as male parent for the Middle Gujarat Agro-Climatic Zone-III where the experiment was conducted.

PP (S9) 04: Evaluation of Biochemical Parameters of Healthy and Diseased Leaves Infected By *Alternaria alternate*

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Biochemical analysis of healthy and infected leaves of chilli plants infected with *Alternaria alternata* from 3rd, 5th, 7th, 9th and 11th days along with control were performed to investigate the role of biochemical parameters in plant defense. The total soluble sugar content 0.91, 0.89, 0.85, 0.81 and 0.78 mg/g fresh weight was recorded at 3rd, 5th, 7th, 9th and 11th days after inoculated infected leaves, respectively. The total phenol content 0.187, 0.297, 0.422, 0.233 and 0.172 mg/g fresh weight was recorded at 3rd, 5th, 7th, 9th and 11th days after inoculated infected leaves, respectively. The total protein content was observed in inoculated leaves 0.679, 0.688, 0.695, 0.660 and 0.657 mg/g fresh weight at 3rd, 5th, 7th, 9th and 11th days, respectively. This study shows the potential role of biochemical parameters activation of plant defense and plant disease management.

PP (S9) 05: Screening of Wild *Nicotiana* spp. and Varieties of Tobacco and Evaluation of Biochemical Characters against Damping-Off Disease

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Damping-off is the most serious disease of tobacco in nursery conditions caused by *Pythium aphanidermatum.* Looking at the significance of the disease and economic importance of the crop in Gujarat, the experiment was conducted during *Kharif* 2021 in sick pot condition. Sixteen wild *Nicotiana* spp. and twelve varieties of tobacco were screened in the pot against *P. aphanidermatum.* The final disease reaction revealed that significantly minimum damped-off seedlings and per cent disease incidence was observed in ABT 10. The biochemical analysis of the selected moderately resistant varieties (GT 5 and ABT 10), moderately susceptible (GT 9) and susceptible varieties (GT 7) were carried out. Significantly the maximum phenol and soluble sugars content were recorded from leaf and root of GT 5 the lowest data was recorded for GT 7.

PP (S9) 06: Screening of Cucumber (*Cucumis sativus* L.) Genotypes against Powdery Mildew (*Erysiphae cichoracearum*) Under Protected Conditions

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Powdery mildew, caused by *Erysiphae cichoracearum* is very important foliar disease of cucumber among major cucurbits which results in huge economic loss. Disease initiates in early growth phase of the plant and continues to produce white mycelial growth on aerial plant parts up to the harvest. Resistant varieties are an important cultural disease management practice to include in a disease management. In the present study, total seven genotypes namely Pant Khira-1 (GBPUA&T Pantnagar), Khira-75 (Dr YSPUHF Solan), Punjab Naveen (PAU Ludhiana), Pusa Barkha (IARI, New Delhi) and three local germplasm *viz.,* LC-1, LC-2 and LC-3 collected from Danoghat and Nalagarh (district Solan) and Naina Devi (district Bilaspur) respectively, were evaluated under protected conditions for disease reaction against powdery mildew at Experimental Farm, College of Horticulture and Forestry, (Dr YSPUHF) Neri, Hamirpur. The

data on disease incidence and severity of powdery mildew were recorded. The disease severity varied among different stages of the crop. Maximum disease severity was recorded in LC-1 (52.96%), while minimum disease severity was recorded in Punjab Naveen collected from PAU Ludhiana (13.33%). Maximum disease incidence was recorded in Local Cultivar collected from Nalagarh district Solan (96.67%) while, on the other hand minimum disease incidence was recorded in Punjab Naveen collected from PAU Ludhiana (60.00%). Variety Punjab Naveen is moderately resistant whereas Pant Khira-1, Khira-75, LC-2, LC-3 and Pusa Barkha were susceptible. From present investigation it is concluded that Punjab Naveen could be the promising parent for utilization in further breeding programs.

PP (S9) 07: Variability Analysis of *Xathomonas citri* subsp. *citri* Causing Bacterial Canker of Citrus

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Bacterial canker of citrus caused by *Xanthomonas citri* subsp. *citri* is the major concern in the growth of citrus industry worldwide. The present study was conducted to evaluate variability among different isolates of the pathogen isolated from different hosts and locations in Himachal Pradesh. Twenty isolates of the pathogen were collected and characterized on morphological, pathological and molecular basis. The colony colour varied from light to dark yellow among the isolates. The pathogenicity variability was evaluated on detached leaves of *Citrus sinensis* which revealed variation in incubation period (2.2 - 4.4 days), percent disease index (40-90%) as well as time for the development of complete symptom (19.6 - 24 days) in the isolates collected. Molecular variability among isolates was carried out by using RAPD and ISSR markers. By analysing the data matrix obtained from 20 RAPD and 14 ISSR primers through NTSYS, all the isolates grouped into four and three clusters, respectively. Combined data of both markers grouped all isolates into two clusters with SM similarity coefficient ranging from 0.64 to 0.85. The data showed the existence of high genetic variability among the isolates of *X. citri* subsp. *citri*.

PP (S9) 08: *Enation leaf curl virus*: Emerging Menace in Okra Production of India

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Okra, *Abelmoschus esculentus* (L.), is an important vegetable crop extensively grown in tropical and subtropical regions of the world. Production of okra is hovered by viral diseases. Enation leaf curl virus (ELCV) disease is getting imminent in major okra-growing regions of the tropics, causing a substantial loss in marketable yield which is transmitted by the sweet potato whitefly, *Bemisia tabaci*. An experiment conducted at MVRS, AAU, Anand in 2022-23, in which 50 germplasm of okra screened over three successive seasons using different statistical designs for a more precise result, observed numerous genotypes of okra were infected with ELCV disease and were evaluated for tolerance at periodic intervals under field conditions. Infection of the disease started at 35 days after sowing (DAS) and was found to have a maximum of 80 DAS. Based on percent disease index (PDI) values, genotypes were categorized as highly tolerant (AOL-20-03 and ANAND KOMAL), moderately tolerant (AOL-16-23, GO-2, GO-6, PHULE VIMUKTA, KRISHI KRANTI, and VARSHA UPHAR), moderately susceptible (PUSA SAVANI, AOL-18-12, and AOL-18-08) and highly susceptible (AOL-15-19, AOL-18-06, and AOL-18-11).

PP (S9) 09: Survey and Screening of Cumin Varieties against Root Rot Disease Under North Gujarat condition

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Cumin (*Cuminum cyminum* L.), locally known as "Jeera" is an important and extensively cultivated spices crop. Diseases are the major constrain in economic crop production as they inflict heavy losses. Cumin is attacked by many diseases during seed germination to seed production and maturity. Hence survey conducted during the year 2018-19 to know the root rot disease incidence and it was found more severe proportion on popular varieties of cumin like GC-4, GC-2 and local in three districts of northern Gujarat *viz*. Banaskantha, Patan and Mehsana. The lowest mean per cent disease incidence was observed in Mehsana (14.66%), while the highest mean per cent disease incidence was observed in the Patan district (35.55%). Twenty genotypes screened against root rot of cumin one genotype, JC-18-07 was found moderately resistant reaction against root rot of cumin. Seven genotypes found moderately susceptible while, eight genotypes showed susceptible reaction. Only four genotypes, JC-16-06, JC-16-07, JC-18-03 and JC-18-11 where showed highly susceptible reaction against root rot of cumin caused by *Macrophomina phaseolina.*

PP (S9) 10: Screening of Potential Parents for *Chilli Leaf Curl Virus* Resistance for developing CGMS Based Hybrids in Chilli

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Chilli pepper or hot pepper (*Capsicum annuum* L.,) is an important spice and vegetable crop of family Solanaceae. India is the secondary centre of diversity for chilli, especially of *C. annuum*, the most important cultivated species. *C. annuum*

having pungent and non-pungent fruits is the most widely cultivated species in India, among the five cultivated species of the genus Capsicum. The cultivation of *C. frutescens*, *C. chinense* and *C. baccatum* is confined to homestead gardening indifferent regions. Chilli is susceptible to various pathogens including viruses, which can cause heavy production losses. So far 65 viruses have been reported, including Begomoviruses causing chilli leaf curl virus disease infecting chilli throughout the world. ChiLCV is the most destructive virus in terms of incidence and yield loss. In severe cases, 100 per cent losses of marketable fruit have been reported. The investigation seeks to collect data on ChiLCV resistant genotypes including cytoplasmic male sterile lines for hybrid production via CGMS that can result in high seed yield and offer long-term disease control through host plant resistance. The evaluated genotypes, serving as the female line for hybrid production, must be superior, including resistance to ChiLCVD. Fourteen genotypes of chilli were evaluated of which, ACCMS-1, ACCMS-2, ACCMS-3, ACCMS-4, CCA-4759 are cytoplasmic male sterile females, ACS-18-03, GVC-101, Punjab Gucchedar, IPS-41, Old GP-47, SB-44, New GP-18, Old GP-21, and G-4 was done for yield attributes and ChiLCV tolerance at Main Vegetable Research Station during *kharif-rabi* 2022-2023. Among the fourteen genotypes, ACCMS-1 and ACCMS-3 showed significantly lower incidence of ChiLCV (4.939%, 5.449% resp.) and registered fruit yield/plant (756.55 g, 733.46 g resp.). Punjab Gucchedar showed the highest fruit yield/plant (793.16 g) and ChiLCV incidence (7.57%). ChiLCV incidence varied from 4.939% to 72.74%. Among the screened genotypes, ACCMS-1 and ACCMS-3 were the top-performing female lines, while Punjab Gucchedar and G-4 produced higher fruit yield with lower incidence, making them potential male parents for creating promising CGMS hybrids if found to restore 100% fertility in female lines.

PP (S9) 11: Screening of Cumin Germplasms for Resistance to Blight under Natural Field Conditions

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Cumin (*Cuminum cyminum* L.) an important seed spice crop is largely grown in the states of Rajasthan and Gujarat. In Gujarat the major cumin growing areas are Arnej, Jagudan, Patan, Radhanpur, Sanand, Mandal, Dhandhuka, Rapar, Tharad and Unjha. Twenty cumin genotypes/varieties were screened against cumin blight in field. Based on disease reaction, cumin genotypes/varieties were grouped into six categories. On the basis of two years observations, it was recorded that none was found free from infection of disease. Only one germplasm JC–91-262 was assessed as moderately resistant.

Technical Session 10: Multidisciplinary Approaches for Plant Health Management

PP (S10) 01: Efficacy of Different Fungicides on Intensity of Cumin Blight

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Cumin (*Cuminum cyminum* L.) an important seed spice crop is largely grown in the states of Rajasthan and Gujarat. In Gujarat the major cumin growing areas are Arnej, Jagudan, Patan, Radhanpur, Sanand, Mandal, Dhandhuka, Rapar, Tharad and Unjha. Studies on the relative efficacy of fungicides *in vitro* against cumin blight. Tebuconazole 50% + trifloxystrobin was found most effective to inhibit mycelial growth (100.0%) followed by propiconazole (100.0%) at 0.02% concentration and 96.67 and 92.59 at 0.1 and 0.05% concentration, respectively. Among the seven fungicides tested *in vivo* all the fungicides were found to be significantly superior over check in controlling the disease in both the years 2016 and 2018. The minimum percent disease intensity was recorded with propiconazole (27.0%) followed by tebuconazole 50% + trifloxystrobin (28.10%) against control (66.70%).

PP (S10) 02: *In-vitro* Efficacy of Fungicides, Bioagents and Botanicals against Phomopsis Blight and Fruit Rot in Brinjal Incited by *Phomopsis vexans*

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Brinjal or eggplant (*Solanum melongena* L.) is a principal solanaceous crop of the subtropics and tropics. Due to its taste and year-round availability, it is one of the widely consumed vegetable in the country and regarded as a cash crop in the tribal dominated area of many states. The crop is susceptible to various biotic and abiotic stresses at different stages of growth and development. Among them the most significant being Phomopsis blight and fruit rot disease. The fungus associated with Phomopsis blight and fruit rot was isolated on potato dextrose agar medium and after proving of Koch's postulates the pathogenic fungus was identified as *Phomopsis vexans.* All fungicides and phytoextracts inhibited the growth of pathogen up to some extent. Best results were obtained by carbendazim 50% WP and carbendazim 12% + mancozeb 63% WP which completely inhibited growth of pathogen. Followed by hexaconazole 5% EC (88.88%), mancozeb 80% WP (80.74), thiophenate methyl 70%WP (80.04%) and chlorothalonil 75%WP (79.04%), the least inhibition (64.15%) was recorded in sulphur 75% WP. Among the phytoextracts tested, soapnut extract showed the best results (100%) followed by garlic bulb extract (71.56%). Least (17.48%) inhibition was observed in tobacco leaf extract. Among the biocontrol agents used

Trichoderma harzianum showed the maximum (74.44%) inhibition of pathogen, followed by *Trichoderma viride* (66.33%), *Psudomonas fluorescens* (60.58%) and least (56.67%) was observed in *Aspergillus niger*.

PP (S10) 03: Efficacy of Pesticides against Lepidopteran Pests of Aonla in North Gujarat Condition

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The efficacy of pesticides was evaluated in 2021 at the Horticultural instructional farm, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat against leaf rolling caterpillar (*Gracillariaacidula*) and gall forming black caterpillar (*Betousastylophora*) of aonla. The field experiment was conducted in Completely Randomized Design (CRD) with three repetitions on aonla variety NA 7 with six treatments including control. Chlorantraniliprole 18.5 SC 0.005% was the most effective treatment among the chemical pesticides because it recorded the lowest lepidopteran pests, including the gall-forming black caterpillar (2.21 galls/25 twigs) and the leaf-rolling caterpillar (2.77% leaflet damage). This led to the highest fruit yield (83.69 q/ha).

PP (S10) 04: Bio-efficacy of Insecticides against Tobacco Leaf Eating Caterpillar Infesting Groundnut

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Investigations onbio-efficacy of insecticides against tobacco leaf eating caterpillar *Spodopteralitura* (F.) infesting groundnut were carried out under field conditions at Anand Agricultural University, Anand during Kharif, 2021. Among eight insecticides evaluated, maximum reduction in larval population as well as per cent damaged plant was recorded in treatment of emamectin benzoate 5 SG (0.0025%) followed by chlorantraniliprole 18.5 SC (0.006%) and chlorpyriphos 20 EC (0.04%). However, the treatments of flubendiamide 48 SC (0.015%), spinosad 45 SC (0.014%), spinetoram 11.7 SC (0.0117%) and lambda cyhalothrin 5 EC (0.005%) found moderately effective against *S. litura*. Highest yield was obtained from the plots treated with emamectin benzoate 5 SG (3179 kg/ha pod and 4768 kg/ha haulm) followed by chlorantraniliprole 18.5 SC (3116 kg/ha pod and 4674 kg/ha haulm) and chlorpyriphos 20 EC (3099 kg/ha pod and 4649 kg/ha haulm). Looking to the ICBR, the highest (1:25.03) return obtained in the treatment of chlorpyriphos 20 EC followed by emamectin benzoate 5 SG (1:14.02), lambda cyhalothrin 5 EC (1:12.58) and chlorantraniliprole 18.5 SC (1:10.36). On the basis of ranking, the treatments of emamectin benzoate 5 SG, chlorpyriphos 20 EC and chlorantraniliprole 18.5 SC were found effective as well as economic against *S. Litura* infesting groundnut and also found superior in increasing yield over control to other treatments.

PP (S10) 05: Economically Management of Thrips by Insecticides in Chilli under Field Condition

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The bio-efficacy of six insecticidal sprays against thrips, *Scirtothrips dorsalis* Hood in chilli was evaluated in a field experiment conducted at Main Vegetable Research Station, Anand Agricultural University (AAU), Anand, Gujarat, India during *Kharif* 2021. The result revealed that in six tested insecticides, the maximum reduction in thrips population and increasing yield over control was found in the treatment of fipronil 80 WG followed by spinetoram 11.7 SC, cyantraniliprole 10.26 OD and thiamethoxam 25 WG with chilli yield of 118.39, 110.58, 105.72 and 87.72 q/ha, respectively. Looking at the ICBR, the highest (1:28.29) return was obtained with the treatment of fipronil 80 WG followed by thiamethoxam 25 WG (1:19.40) and lambda-cyhalothrin 5 EC (1:17.55). Based on ranking, the treatment of fipronil 80 WG was found significantly effective as well as economic against thrips infesting chilli.

PP (S10) 06: Comparative Efficacy of Different Chemical Fungicides against *Sclerotium rolfsii* (Sacc.) Causing Collar Rot of Chickpea (*Cicer arietinum* L.)

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Present investigation was undertaken for efficacy of fungicides like *i.e.*, carboxin 37.5% + thiram 37.5% WS (vitavax), pyraclostrobin 100 g/L CS, propiconazole 25% EC, hexaconazole 5% EC, thiophanate methyl 70% WP, carbendazim 50% WP, mancozeb 75% WP, chlorothalonil 75% WP and captan 70% + hexaconazole 5% WP were evaluated *invitro* at three concentrations *viz.*, 100, 125 and 200 ppm concentration against *S. rolfsii* on PDA by poisoned food technique. The result revealed that increase in concentration of

the fungicides caused increased inhibition of mycelial growth of pathogen. Among these, carboxin 37.5% + thiram 37.5% WS (vitavax) was completely inhibited mycelial growth of pathogen at 100 ppm, 125 ppm & 200 ppm. Followed by hexaconazole 5% EC in mycelia growth inhibition of 95.44, 97.22 and 100% at 100, 125 and 200 ppm, respectively. At 200 ppm both hexaconazole 5% EC and carboxin 37.5% + thiram 37.5% WS (vitavax) is statistically at par in growth inhibition. While, mancozeb 75% WP was found least effective at all concentrations against *S. rolfsii*. Most effective *in-vitro* evaluate fungicides tested for their efficacy against disease under pot experiment along with treatment application methods *viz.,* pre-emergence drenching, seed treatment and integration of both seed treatment & post emergence seedling drenching at 7 days after germination (7 DAG) against collar rot disease of chickpea in pot experiment. All the treatments proved significantly superior when compared with inoculated control. Maximum percent reduction in PESR (100.00%) was recorded in vitavax power applied through seed treatment followed by hexaconazole recorded (90.91%) reduction in PESR. Maximum percent reduction in PESM (62.50%) was recorded in hexaconazole applied through integration of seed treatment & post emergence seedling drenching at 7DAG. Which, was followed by vitavax power observed (50.00%) reduction in PESM. Seed treatment alone reduced PESR while, integration of seed treatment & post emergence seedling drenching at 7DAG also reduced PESM. Among treated pots highest grain yield recorded (45.90 g/pot) in hexaconazole applied through integration of integration of seed treatment & post emergence seedling drenching at 7DAG followed by vitavax power (43.33 g/pot).

PP (S10) 07: Efficacy of Various Fungicides on Growth and Biochemical Parameters of Banana Fruits Infected with *Colletotrichum musae* Berk. & Curt.

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Banana is one of the important fruit crops and economically profitable crop of India having high export potential. Cultivated banana is susceptible to many diseases, among them *Colletotrichum musae* has been the most notorious fungal pathogen causing anthracnose or crown and tip rot of banana. The anthracnose symptoms appeared as peel blemishes, black or brown, sunken spots on banana fruits. The spots bear masses conidia and salmon coloured acervuli some times. Twenty different fungicides *viz*., non-systemic (chlorothalonil, mancozeb, copper oxychloride, copper hydroxide, captan, wettable sulphur at 500, 1000, 1500 & 2000 ppm), systemic (carbendazim, benomyl, fosetyl-Al, metalaxyl, propiconazole, thiophanate methyl, picoxystrobin at 50, 100, 250 & 500 ppm) and readymix (carbendazim + mancozeb, carbendazim + thiram, metalaxyl + mancozeb, captan + hexaconazole, azoxystrobin + tebuconazole, zineb + hexaconazole, tebuconazole + trifloxystrobin at 100, 250, 500 & 1000 ppm) were tested for their effect on mycelium growth of *C.musae*using poisoned food technique at four concentrations. Among them, in case of non-systemic fungicides, cent per cent mean growth inhibition of test fungus was observed in mancozeb 75% WP at 2000 ppm. Among the systemic fungicides carbendazim 50% WP gave cent per cent inhibition of test pathogen. However, the mixture of carbendazim 12% + mancozeb 63% WP was also gave cent per cent mean growth inhibition of *C. musae*. Fruit dip treatment with carbendazim 12% + mancozeb 63% WP tested at 0.05% concentration gave minimum disease intensity (11.54%) and those fruitsalso showed highest total sugar (46.11 mg/g) and total phenol (8.85 mg/g) content nearer to healthy banana fruits *i.e.*, 48.50 mg/g and 9.34 mg/g, respectively as compared to infected banana fruits.

PP (S10) 08: Viral Diseases Caused by *Secoviridae* and Their Management

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Among several plant pathogens, viruses have their own significance due to the impracticality of direct control measures. Among the two groups of DNA and RNA viruses, the secoviridae family belongs to +ve ss RNA virus group and reported to cause heavy yield and economic losses in number of crops. The family secoviridae is further classified into comovirinae and an unassigned subfamily. Comovirus, fabavirus and nepovirus are the genus of comovirinae while sadwavirus, sequivirus, torradovirus, cheravirus and waikavirus are the genera belong to unassigned subfamily of secoviridae. Major crops *viz*., cowpea, rice, tobacco, tomato, bean, grapevine, maize, soybean, strawberry *etc.* are found to be infected by different plant pathogenic genera of secoviridae throughout the world and India. Disease incidence and yield losses reported due to the viruses belong to secoviridae are 35-94 per cent in soybean and 5-80 per cent in cowpwea by cowpea severe mosaic virus. The distribution of viral diseases caused by secoviridae was reported from all the continent and sub continents in majority of the crops over the globe and was reported to be transmitted by various means *viz*., mechanical, aphid, nematode, beetle, mite leaf hopper and thrips. Although the viral diseases did not have direct management strategy, some of the management strategies *viz.* control of vector population, change in cropping system, use of proper fertilizers, use of resistant rootstock with hardwood cuttings, use of onion extract, cow milk, salicylic acid, use of biotechnological tools, antiviral medicines and chemical pesticides were found helpful in managing viral diseases caused by secoviridae family.

PP (S10) 09: Effect of Different Insecticides against Spotted Pod Borer, *Maruca vitrata* and Its Residual Status Infesting Vegetable Cowpea

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A field experiment was conducted at Anand Agricultural University, Anand during *Kharif*, 2021 to assess the bio-efficacy and residue of various insecticides against spotted pod borer, *Maruca vitrata* infesting cowpea. Of the nine evaluated insecticides chlorantraniliprole 18.5% SC, emamectin benzoate 5% SG were found the most effective in reducing the incidence of *M. vitrata*. However, spinetoram 11.7% SC and spinosad 45% SC were found mediocre in their effectiveness. Maximum (76.33 q/ha) green cowpea pod yield was recorded from the plot treated with chlorantraniliprole which was at par with emamectin benzoate (75.50 q/ha). The highest ICBR returns were obtained in the treatment of emamectin benzoate (1: 11.48) followed by chlorantraniliprole (1: 8.67). Residue of chlorantraniliprole 18.5 SC was detected for up to 5 days in cowpea green pods and halflife was 5.02 days. Whereas, emamectin benzoate 5 SG was below determination level (BDL) after next days of last spray. Based on the residual status, green cowpea pod harvest after 5 days of last spray of chlorantraniliprole 18.5 SC and for emamectin benzoate was 1 day.

PP (S10) 10: Studies on Variability and Management of *Colletotrichum gossypii* Causing Anthracnose of Cotton through New Generation Fungicides

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Cotton (*Gossypium* spp. L.) of *Malvaceae* family, called "white gold" and "king of fibres" is one of the major fibre crop of global significance. Among the various fungal diseases, anthracnose caused by *Colletotrichum gossypii* is the most important pre and post-harvest diseases in cotton. Considering the economic damage by this pathogen, a roving survey was conducted during *Kharif*, 2021-22 in different regions of cotton growing areas of Rajasthan. A total of five isolates/ diseased samples of cotton showing lesions on leaves and spots on bolls symptoms were collected. Maximum mean severity of the disease was recorded at Hanumangarh district (42.25%) followed by Sri Ganganagar (RJCG-4) district (38.00%). Among five isolates of *Colletotrichum gossypii,* the isolate RJCG-3 (Hanumangarh) was found to be more virulent. Morphological characters of five different isolates with respect to radial mycelial growth, conidial characters, setae and acervuli were studied on PDA to know the variability among the isolates. Among the five isolates of *Colletotrichum gossypii*, maximum radial mycelial growth of 88.25 and 86.00 mm was recorded in RJCG-3 and RJCG-4 respectively. Acervuli length 215.30 µm and breadth 85.25 µm found to be maximum in RJCG-3. Maximum conidia length *i.e*., 28.92 µm and breadth 3.91 µm was observed in RJCG-3 and maximum length and breadth of setae (132.92 µm and 5.70 µm) in RJCG-3. In this study, nine new generation fungicides were evaluated against this pathogen. Among these fungicides, Gloit 300 EC (Propiconazole 13.9% + Difenoconazole 13.9% EC) was found to be most effective at all the concentrations (*i.e.*, 0.05%, 0.10%, 0.15% and 0.20%), which inhibited maximum 95.20% mean mycelial growth and 93.66% of mean spore germination. Fungicides found effective were tested in field condition for the management of cotton leaf spot. The results showed that Gloit 300 EC (Propiconazole 13.9% + Difenoconazole 13.9% EC) @ 0.1% were found effective in controlling the leaf spot and boll rot incidence as compared to other treatments.

PP (S10) 11: Integrated Management of Sheath Blight (*Rhizoctonia solani* Kuhn) of Rice

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Rice is an important food grain and is a staple food for majority of the world's population. To meet increasing global demand and consumption, rice productivity must be enhanced. Sheath blight is a major soil borne disease causing economic losses to rice cultivation. Various management options and their efficacy for Sheath blight control by Fungicides, antagonists, micronutrients and systemic acquired resistance inducer used to check disease intensity of sheath blight on rice. The results indicated that the disease severity ranged from 17.33 to 41.74 per cent during *Kharif* 2021. Among the tested treatments, two sprays of fungicide, azoxystrobin 18.2 per cent + difenoconazole 11.4 per cent (29.6 SC) at 0.03 per cent was found to be most effective in management of sheath blight disease as compared to the rest of the treatments and recorded minimum per cent disease intensity (17.33%), highest grain yield (6227 kg/ha), straw yield (7685 kg/ha) and test grain weight (26.05g) of rice. This was followed by, trifloxystrobin 25 + tebuconazole 50 (75 WG), propiconazole 25 EC, *Trichoderma viride*, *Pseudomonas fluorescens*, zinc sulphate, ferrous sulphate and salicylic acid.

PP (S10) 12: Efficacy of Pesticides against Aphid, *Aphis craccivora* Koch and Its Effect on Natural enemies in cowpea

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Investigation on "Population dynamics, varietal screening and management of aphid, *Aphis craccivora* Koch in cowpea*, Vigna unguiculata* (L.) Walp." was carried out at Agronomy Instructional Farm, SD Agricultural University,

Sardarkrushinagar during *kharif*, 2020. The investigation of among the different pesticides evaluated, flonicamid 50 WG @ 0.015 per cent, thiamethoxam 25 WG @ 0.010 per cent and chlorfenapyr 10 SC @ 0.015 per cent were found most effective against aphid, *Aphis craccivora* population. Among the effect of different pesticides against ladybird beetle (adult and grub) and syrphid fly (maggot), imidacloprid 17.8 SL @ 0.007 per cent, acetamiprid 20 SP @ 0.006 per cent, flonicamid 50 WG @ 0.015 per cent, thiamethoxam 25 WG @ 0.010 per cent, chlorfenapyr 10 SC @ 0.015 per cent and azadirachtin 10000 ppm @ 0.003 per cent were relatively less safe to ladybird beetle and syrphid fly population. While, *Lecanicillium lecanii* (2×109 cfu/g) 1.15 WP @ 0.004 per cent and *Lantana camera* leaf extract @ 10 per cent has showed relatively safer as compared with the other pesticides on the basis of natural enemies.

PP (S10) 13: *In-vitro* Evaluation of Antibiotics and Bactericides against *Xanthomonas axonopodis* pv. *citri* Causing Bacterial Canker Disease of Acid Lime (*Citrus aurantifolia*)

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Diseases are the major constrains for citrus production which impede the fruit yield and quality. Citrus suffers from a number of diseases caused by fungi, bacteria, viruses and viroids. Among these diseases, canker caused by *Xanthomonas axonopodis* pv. *citri,* foot rot or gummosis caused by *Phytophthora* spp., twig blight caused by *Diplodia natalensis* and *Fusarium* spp. Three antibiotics and three bactericides *viz*., Streptocycline, Kasugamycin 5% + Copper oxychloride 45% WP, Kasugamycin, Bacterimycin, Copper oxychloride 50% WP, Copper hydroxide 53.8% W/W were evaluated for their effectiveness in controlling the growth of *Xanthomonas axonopodis* pv. *citri* at the Department of Plant Pathology, College of Agriculture, Ummendganj-Kota, (Agricultural University, Kota) Rajasthan. Inhibition was highest in case of copper oxychloride 50% WP (34.20 mm) followed by bronopol 27% (28.90 mm) and streptocycline 90% W/W (12.48 mm) at 500 ppm concentration and no inhibition zone was found in kasugamycin. All the antibiotics/bactericides inhibited the bacterial growth at higher concentration.

PP (S10) 14: Powdery Mildew of Cucumber and Its Management

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The cucumber (*Cucumis sativus* L.) is a widely-cultivated creeping vine plant in the family Cucurbitaceae that bears cylindrical to spherical fruits, which are used as culinary vegetables. In India cucumber cultivated in 117 ha area with production of 1652 M.T. during the year 2020-21. Powdery mildew mainly caused by the fungus *Podosphaera xanthii*, infects all cucurbits, including muskmelons, squash, cucumbers, gourds, watermelons and pumpkins. Impacts of powdery mildew on crop production include reduced photosynthesis, impaired growth, premature senescence, and yield loss. Powdery mildew infections favour humid conditions with temperatures around 68-81° F. In warm, dry conditions, new spores form and easily spread the disease. Powdery mildew spots on upper leaf surfaces, and on petioles and stems. Look for the fungus on the shaded older leaves. Infection on the underside is often not clear because of the lighter color of the leaf symptoms first appear mid to late summer in Minnesota. The older leaves are more susceptible and powdery mildew will infect them first. The pathogens are obligate parasites and cannot survive in the absence of living hosts. Different scientist reported those following fungicides found effective against powdery mildew: 1. Tebuconazole 25.9 EC @ 125g a.i./ha, 2. Azoxystrobin 25 EC @ 125g a.i./ha, 3. Mancozeb 75 WP@ 1.5 kg/ha, 4. Propiconazole 25 EC @ 0.025 per cent, 5. Wettable sulphur 80WP @ 0.25 per cent, and 6. Difenconazole 25EC @ 0.05 per cent

PP (S10) 15: Integrated Management of the Cowpea Rust Caused by *Uromyces phaseoli* var. *vignae* (Barcl.) Arth.

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Cowpea rust [*Uromyces phaseoli* var. *vignae* (Barcl.) Arth.] is cosmopolitan and occurs practically everywhere the crop is grown**.** Severe rust infection results in premature defoliation leading to reduced seed size resulting in severe yield loss. Field experiment was undertaken during *kharif* 2020 and 2021 in a Randomised Block Design (RBD) with three replications at Main Agricultural Research Station, Dharwad for integrated management of cowpea rust with eight spray schedule treatments that were developed based on the effectiveness under *in vitro* condition. Hexaconazole @ 0.1%, nimbecidine @ 0.5%, consortium of *Trichoderma harzianum* @ 5g/l + *Pseudomonas fluorescens* @ 5g/l and panchagavya @ 10% found as best in inhibition uredospore germination under *in vitro* and were tested under field conditions alone and their combinations. Among the eight integrated spray schedules evaluated, hexaconazole @ 0.1% – hexaconazole @ 0.1% was significantly superior spray schedule which recorded least per cent disease index (15.18 PDI) with highest grain yield (12.86 q ha^{-1}) and 100 grain weight (10.42 g) with the maximum B:C ratio of 2.29 followed by hexaconazole @ 0.1% - *T. harzianum* @ 5g/l +*P. fluorescens* @ 5g/l (48.60 PDI) (11.71 q ha^{-1}) (9.21 g) (2.04 B:C ratio) and hexaconazole @ 0.1% - nimbecidine @ 0.5% (57.96 PDI) (11.31 q ha^{-1}) (9.02 g) (1.94 B:C ratio) and highest per cent disease index (100 PDI), lowest grain yield (6.94 q $ha.^{-1}$), 100 grain weight (6.45 g) and B:C ratio (1.27) was recorded in unsprayed control.

PP (S10) 16: Eco-friendly Management for Major Insect Pests of Soybean (*Glycine max*)

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The present investigation was carried out to develop eco-friendly management strategies for major insect pests of soybean at Tribal Research cum Training Centre, Anand Agricultural University, Devgadh Baria, Dist. Dahod, Gujarat during *kharif,* 2019 to *kharif,* 2021. The experiment was conducted by using large plot sampling technique with three modules and six repetitions. The effects of different module were evaluated by recording observations on all the pests infesting soybean and their damage periodically. Among the three modules evaluated, IPM module (Seed treatment with imidacloprid 600 FS, 9.0 ml/kg seeds; Spraying of chlorantraniliprole 18.5 SC @ 0.006%, 3 ml/ 10 litre of water at 40 DAS and Spraying of neem oil 40 ml/ 10 litre of water at 60 DAS) found effective against sucking pests (Jassid and Whitefly) and girdle beetle resulted in higher seed yield of soybean (2123 kg/ha).

PP (S10) 17: Comparison for Health Promoting Phytochemicals Present in Ingredients of Panchkutta

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The five fruits of panchkutta-*Capparis decidua* (Ker), *Prosopis cineraria* (Sangri, *Mangifera indica* (Amchur), *Cordia dichotoma* (Gunda), and *Acacia senegal* (Kumati) - have medicinal properties in western Rajasthan. These fruits are traditionally used in dried conditions. These are known for their analgesic, anti-inflammatory, hepatoprotective, diuretic, and anthelmintic activities. The pulp from these fruits was extracted using organic solvents in Soxhlet, and the preliminary phytochemical investigations were done with standard HPLC methods. Steroids were separated using reversed-phase HPLC with a Zorbax ODS column and 4% isopropanol mixed with acetonitrile. The temperature and flow rate were optimized at 20°C and 0.9cc/min. Steroids were identified based on their Rf values calculated from the chromatogram, which was divided into representative regions for specific steroid classes. The dried food made from the five ingredients mentioned above was found to contain several important compounds. Campestral was present in the fruits of *Capparis decidua* (Ker), while *Cordia dichotoma* (Gunda) contained Oleanolic acid, Urosylic acid, Teraxerol, and Betulenic acid. *Acacia senegal* (Kumati) and *Mangifera indica* (Amchur) were found to be good sources of cholesterol, and 3Beta-acetoxy-5-cholestene, which can increase serotonin production, was also identified. Oleanolic acid inhibits gluconeogenesis and promotes glucose utilization, while Urosylic acid increases insulin signaling and reduces cardiac damage. Campestral competes with cholesterol for absorption in the body, and betulenic acid and taraxasterol have antiviral and anti-arthritic effects. The presence of important medical compounds in these dried food plants used by villagers suggests further investigation, including compound extraction and clinical trials. This could raise awareness for their conservation and promote ethno-medico-botany knowledge.

PP (S10) 18: Management of Pest and Diseases in Cumin

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Cumin (*Cuminum cyminum*) is grown in India on large scale besides several other countries. It is an important crop of Rajasthan and Gujarat and some adjoining states. The cumin crop is subjected to many pathogens causing diseases which drastically reduce the seed yield. In cumin-growing districts of Rajasthan and Gujarat, incidence of wilt (*Fusarium oxysporum f.*sp. *cumini*), blight (*Aternaria burnsii*), and powdery mildew (*Erysiphe polygoni*) are in moderate to severe form occurs regularly. It is also ravaged by number of insect pests in the field as well as storage conditions. Among them, cumin aphid, *Myzus persicae* is a key pest in cumin growing areas of the state. It causes serious damage at flowering stage of the crop by sucking the cell sap, as a result yellowing and curling of the leaves is exhibited at the initial stage, later the plants showed stunted growth and the inflorescence set few and shriveled seeds. In case of severe attack, seed yield of cumin is reduced drastically. Under favorable environmental conditions the disease pest is still causing severe yield losses as well as posed pesticides residue problem in cumin. With these views, the present field experiment on the "Integrated pest and disease management in cumin" was planned to manage the pest and disease effectively and economically with low pesticide residues in cumin. A field experiment was conducted in a randomized block design with three replications during *rabi* 2018-19, 2019-20 and 2020-21 at Seed Spices Research Station, Jagudan, Gujarat. Among different treatments, three foliar sprays of kresoxym methyl 44.3 SC @ 0.044% (first spray at the initiation of disease and subsequent sprays at an interval of 15 days after first spray) and two foliar sprays of thiamethoxam 25WG @ 0.0084% (first spray at initiation of aphid and the second spray after 10 days of the first spray) were found effective for getting higher yield and net realization with lower Alternaria blight, powdery mildew and sucking pests.

PP (S10) 19: Screening for *Mungbean yellow mosaic virus* Resistance in Mungbean Genotypes

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Mungbean [*Vigna radiata* (L.) Wilczek], also known as green gram or moong, is a leguminous plant species belonging to the

Fabaceae family. Mungbean is considered a hardy pulse crop and grows well in a hot and dry climate and its cultivation improves soil fertility by adding about 30-40 kg N/ha after the harvest of the crop. The experimental material grown in augmented block design which consisted of 96 genotypes of mungbean and 4 checks namely GM-4, GM-6, GM-7 and 40C. Checks were replicated in each block. These derived genotypes were obtained from the four crosses *viz.,* Meha × GM-4, Meha × Pusa Vishal, Meha × GJM-1006, Meha × GJM-1008. Among all diseases, Mungbean Yellow Mosaic Virus (MYMV) is one of the most common and destructive viral disease in mungbean. Initially the symptoms appear on young leaves as mild yellow scattered spots gradually the spots keep on increasing in size and some of the apical leaf turns completely yellow. Pods of the infected plants also get infected in severe conditions which bear small and shrivelled seeds. MYMV indcidence percentage was recoreded and genotypes were categorized based on MYMV incidence out of these NMS-21-1, NM-21-4, NMS-21-53 and NMS-21-94 genotypes were found highly resistant to MYMV and showed no symptoms of disease. In the present investigation, based on per se performance, NMS-21-48 and NMS-21-82 were found promising genotypes as they recorded higher grain yield per plant and they show resistant reaction to MYMV disease incidence.