Proceedings of the XXXI Annual Review meeting of All India Coordinated Research Project on Biological Control of Crop Pests

Organized
by
ICAR - National Bureau of Agricultural Insect Resources, Bengaluru

(October 20 - 21, 2022)

AICRP on Biological Control of Crop Pests
NATIONAL BUREAU OF AGRICULTURAL INSECT RESOURCES
P. B. No. 2491, H. A. Farm Post, Bengaluru 560024
Karnataka

XXXI ANNUAL REVIEW MEETING OF ALL INDIA CO-ORDINATED RESEARCH PROJECT ON BIOLOGICAL CONTROL OF CROP PESTS

PROCEEDINGS OF THE TECHNICIAL SESSIONS OF THE XXXI ANNUAL REVIEW MEETING OF AICRP-BC (October 20 – 21, 2022)

The ICAR-National Bureau of Agricultural Insect Resources, Bengaluru organized the XXXI Annual Review Meeting of All India Coordinated Research Project on Biological Control of Crop Pests.

Inaugural Session

Dr S N Sushil, Director, ICAR-NBAIR, Bengaluru & Project Coordinator, AICRP on Biological control of Crop Pests welcomed the dignitaries and participants. He briefly presented the highlights of the project for the period 2021-22, which included the development, validation and commercialisation of promising bioagents under the project and area covered through the adoption of biocontrol modules. He also presented the monitoring and management of the recent invasive pests and preparedness to tackle the invasive attacks

Deputy Director General (Crop Science), Dr. Tilak Raj Sharma, ICAR, New Delhi inaugurated the workshop and appreciated the progress made in the project. He emphasized the scope of biological control in the natural farming. He stressed upon the need of concentrating the basic studies on the biological control with special emphasis on rhizosphere biology and the interaction between the rhizosphere and biocontrol agents. He urged to strengthen the public private partnership to test, validate, mass produce and register the potential biocontrol products. He highlighted the importance of generating molecular signatures for the promising bioagents and depositing the same in recognised nodal centres. He also opined a good biocontrol product should have quality, scalability, applicability and traceability. He mentioned that Artificial intelligence (AI) and Internet of Things (IOT) need to be studied and explored to develop innovative ways of application and monitoring of biocontrol agents. More concentration has to be given to develop climate resilient biocontrol agents like temperature tolerant, drought tolerant etc.

Registrar, University of Agricultural Sciences, Bengaluru, Dr Basave Gowda mentioned about the integration of biocontrol in natural farming to avoid the usage of chemicals and insecticides. He also spoke on doubling farmer's income involving quality biocontrol agents.

Dr S C Dubey, Assistant Director General (Plant Protection & Biosafety) shared his knowledge and experiences on registration of microbial biopesticide products. He stressed

upon the need of stringent and scientific proven procedures for survey and surveillance of crop pests and their natural enemies. Standard formulation technologies should be followed by all the centres while developing a product against a crop pest or disease. Basic research on mode of action, competence, virulence and colonization of biocontrol agents should also be focussed along with the field evaluation. He emphasized to develop measures to conserve the natural enemies of crop pests and diseases for better utilization. He also pointed out AICRP on Biological Control should involve other plant protection institutes like ICAR-NCIPM for conducting large scale demonstrations.

Programme Advisory and Monitoring Committee members, Dr. H. C. Sharma, Dr. H. B. Singh and former directors of ICAR-NBAIR Dr. N. K. Krishnakumar, Dr. Abraham Verghese, Dr. Chandish R. Ballal, Dr. N. Bakthavatsalam and senior retired biocontrol workers Dr. T. M. Manjunath, Dr. M. Mani actively participated in the review meeting. Around100 scientists and ten company representatives from different parts of the country participated in the XXXI AICRP on Biological Control Annual Review Meeting. Dr G Sivakumar, Principal Scientist & In charge, AICRP - BC, PC cell proposed the vote of thanks.

Recommendation and Conclusions of Technical sessions:

SESSION I: Panel discussion for collaboration between institutes and AICRPs

Chairman	**:**	**Dr. T.R. Sharma**, DDG (CS)
Co-Chairman	**:**	**Dr. S. C. Dubey,** ADG (PP& BS)
		Dr. S.N. Sushil, Director, ICAR-NBAIR, Bengaluru
Rapporteurs	**:**	**Dr. A. Kandan,** ICAR-NBAIR, Bengaluru
		Dr.Omprakash Navik, ICAR-NBAIR, Bengaluru

Suggestions / Recommendations

- ICAR-NIBSM proposed to collaborate with ICAR-NBAIR for barcoding and identification of Thrips spp., evaluation of nano formulations of insect pheromone and multilocation testing of NIBSM *Bacillus thuringiensis* product.
- ICAR-NBAIM, Mau agreed for microbial charectarization and deposition in its repository.
- ICAR-NCIPM, New Delhi agreed to collaborate with ICAR-NBAIR for large scale field demonstration of macrobials and microbial biopesticides of ICAR-NBAIR.
- Joint surveillance or monitoring of pests, natural enemies and pathogens in collaboration with AINP on Vertebrate Pest Management should be carried out.
- AINP-Acarology will help in mass production of mites and one set of cultures will be deposited in ICAR-NBAIR. AINP-Acarology will also evaluate NBAIR technologies under the field condition for the management of mite pests.

SESSION II: Basic research on biodiversity and natural enemies of insect pests at NBAIR and biological control of plant diseases

Chairman : Dr.Chandish. R. Ballal, Former Director, ICAR-NBAIR, Bengaluru
Co-Chairman : Dr.T.Venkatesan, Head (GR), ICAR-NBAIR, Bengaluru
Rapporteurs : Dr. Deepa Bhagat, Pr. Scientist, ICAR-NBAIR, Bengaluru.
Dr. B. S. Gotyal, Sr. Scientist, ICAR-NBAIR, Bengaluru

Salient findings

- Overall, 80.46% FAW larval mortality by the natural enemy complex was observed in northern India. *Chelonus* nr. *blackburni* (Hymenoptera: Braconidae) was the predominant parasitoid in the study area causing 49.24% larval mortality followed by *Chelonus formosanus* Sonan.
- Tetragnathid spider diversity in the paddy ecosystem from different agro-climatic zones of Tamil Nadu (14 locations) was documented. Collected specimens belonging to two genera, *Tetragnatha* Latreille and *Leucauge* White, and six species *viz*. *Tetragnatha javana*Thorell (10.75%), *T. keyserlingi* Simon (58.78%), *T. mandibulata* Walckenaer, *T. nitens* Audouin (13.26%), *T. vermiformis* Emerton (5.81%) and *Leucauge decorata* Blackwall (0.71%).
- Parasitisation potential of *Trichogramma chilonis* and *Telenomus remus* against fall armyworm, *Spodoptera frugiperda* was studied. In a single release, the percent parasitism of *T. remus* was highest (92%) followed by *T. chilonis* (81%) and *T. pretiosum* (45%). In the simultaneous release of *T. remus* and *T. chilonis* per cent parasitism was 88.9 % and was on par with *T. remus* single release. Among all the duration-dependent treatments of sequential release, *T. chilonis* release post 24-48 hours of *T. remus* release provided the most satisfactory outcome.
- The biocontrol potential of anthocorid predator, *Blaptostethus pallescens* was evaluated against *Scirtothrips dorsalis* and *Thrips palmi* on capsicum grown in polyhouse at Doddabalapura. Weekly release of *B. pallescens* @ 20-30 per square meter (total 4-5 releases) with alternation of biopesticide *Bacillus subtilis* reduced the thrips population by 26.2%.
- The field studies results indicated that granular formulation of *Heterorhabditis indica* and *Steinernema carpocapsae* were on par with respective wettable powder formulations in reducing the populations of fall armyworm (FAW) (58-65%), however granular formulation of *H. bacteriophora* imparted only 24-28% control.
- Field trial data showed that the reduction in *Holotrichia* grub population in sugarcane was significantly higher in field treated with ***Heterorhabditis indica*** at rate of 2.5×10^9 IJ ha^{-1} than *Steinernema carpocapsae* and chlorpyrifos application. Chlorpyrifos application was more efficient in reducing the grub population than both nematode species at the lower application rate (1.25×10^9 IJ

ha-1). These experiments suggest *H. indica* to be a promising biocontrol agent against *Holotrichi*a species in sugarcane.

- Field experiment data revealed that the application of aqueous suspension of *Spodoptera frugiperda nucleopolyhedrovirus* through two foliar sprays @ 1.5 x 10^{12} OBs/ ha during 20 and 35 after sowing reduced 68.75% of FAW población.
- Application of *Bacillus subtilis* in soil @ 2.5 kg/ha along with seed treatment @ 10g/kg, seedling root dip @ 2.5 kg/ha and foliar spray @ 20 g/L was found to be the best in reducing the incidence of blast, brown spot, bacterial leaf blight and false smut of rice.
- Application of Pant Bioagent formulation, PBAT-3 (*Trichoderma harzianum* Th14 + *Pseudomonas fluorescens* Psf 173) through seed bio-priming (10 g/kg of seeds), seedling root dip (10 g/L for 30 minutes) and three foliar sprays (10 g/L) on standing crop at 15 days interval was found effective in the management of soil borne diseases in rice, chickpea, pea and tomato.
- NBAIR-PFDWD (*Pseudomonas flourescens*) was the most effective against sheath blight, brown spot and blast with lesser Percent Disease Index (PDI) of 17.58%, 20.72% and 11.43%, respectively.
- Seed treatment with *P. flourescens* (KAU strain) followed by fortnightly soil drenching and foliar spraying with *P. flourescens* was found effective in managing *Fusarium* wilt of cowpea.
- Seed treatment with NBAIR *P. fluorescens* + NBAIR *T. asperellum s*oil drenching & Seed treatment with NBAIR *T. asperellum* + NBAIR *P. fluorescens* soil drenching were found effective in the management of stem rot in sesame with higher yields
- Less incidence of powdery mildew of grape was observed in the plots treated with with *Trichoderma harzianum* @ 5 g/L. and *Ampelomyces quisqualis* @ 5 ml/L.
- Spraying of *Trichoderma reese* @ 20 ml/L (2 $\times 10^6$cfu/ml) twice during June and September was found potent in reducing cocoa pod rot.

Suggestions / Recommendations

- Relevant data should be generated through AICRP trials to register and commercialize *Spodoptera frugiperda* NPV and *Spodoptera mauritia* NPV. *Maruca vitrata* NPV should also be field tested at IIPR Kanpur and data relevant for registration to be generated.
- Predatory mite *Typhlodromus* (*Anthoseius*) *transvaalensis* to control mites and thrips should be tested in all relevant centres on priority with focus on the important target mites / thrips on two selected crops.
- Relevant data may be generated on the association of entomopathogenic fungi with chilli thrips *Thrips parvispinus*y.
- *Beauveria brongiartii* NBAIR strain can be compared with the strain of *B. brongniartii* from YSPUHF, Solan.
- KAU, Thrissur has to present results of bioassay studies on the identified fungal pathogen on cassava mealy bug.
- The centres reporting parasitism by *Encarsia* sp. on coconut RSW should get the species identified.

- Basic research related to understanding the mode of action of a bioagent or the processes or factors leading to the success or failure of a biocontrol agent or biocontrol strategy can be reported by the centres. However, pure basic studies based on laboratory research by students are not to be included in the annual reports.
- While assessing the best performing centre, one award can be for the regular centre and one for the voluntary (contingency) centre based on their performance.

SESSION III: Biological suppression of pests of food and fibre

Chairman : Dr. Subash Chander, Director, ICAR-NCIPM, New Delhi
Co-Chairman : Dr. Sunil Joshi, Head (GCC), ICAR-NBAIR, Bengaluru
Rapporteurs : Dr. M. Mohan, ICAR-NBAIR, Bengaluru
Dr. B. L. Raghunandan, AAU, Anand

Salient findings

- Large-scale demonstrations (100 ha all distrcits of Punjab) on bio-intensive pest management in organic *basmati* rice using *Trichogramma chilonis* and *Trichogramma japoniucm* @ 1,00,000 per ha each (5-6 releases) at farmer's fields resulted in 55-60 and 50 per cent reduction in incidence of leaffolder and yellow stem borer, respectively
- Large scale demonstration (50 ha at Rajabahar and Colaghat, Jorhat) of biocontrol based IPM package in rice on variety 'Ranjit' revealed that maximum yield of 4963.5 kg/ha was recorded in biocontrol based IPM package treated plots, which are significantly higher compared to farmer's practice plot with 4637.5 Kg/ha. The net returns over control in BIPM package were ₹ 56291.90 as compared to ₹ 44967.50 in farmers practice
- Among different entomopathogens, entomopathogenic bacterium *Bacillus thuringiensis* and the fungus *Beauveria bassiana* could be viable alternatives to insecticides for the management of leaf folder in rice.
- Maize fall armyworm incidence was very less in the plots treated with *Trichogramma chilonis* and *Metarhizium anisopliae* Ma 35 (14%) followed by *Trichogramma chilonis* NBAIR Bt 2% (15%) when compared to control (45%).
- The demonstrations on biological control of maize stem borer, C*hilo partellus* using *Trichogramma chilonis* @ 1,00,000 per ha (two releases at 10 and 17 days old crop) conducted at farmer's fields reduced its incidence by 50-55 per cent over control
- Four applications of liquid formulations of *Trichoderma asperellum* NBAIR strain recorded low incidence of maize turcicum leaf blight which was equally effective as chemical fungicide.
- Aplication of talc based formulation of entomopathogenic fungi *Metarhizium anisopliae* Ma 35 against Pink borer, *Sesamia inferens* on Finger Millet @ 10 gml/lit at 30 & 45 days of crop emergence was effective, causing 34 and 63.1 per cent reduction in dead hearts and white earheads, respectively over the untreated control..
- Large-scale demonstrations of proven biocontrol technology using *Trichogramma chilonis* @ 50,000 per ha (10-12 releases at days interval from July to October, 2021 against sugarcane stalk borer, *Chilo auricilius* conducted at farmer's fields in

collaboration with sugar mills resulted in 50-60 per cent reduction in borer incidence over control

- Three sprays of endophytic entomopathogenic strains NBAIR-Ma35, NBAIR Bb23 (5g/lt) were found effective in the management of sugarcane early shoot borer with 8.9 and 10.3% dead heart compared to chlorantraniliprole sprays (6.9% dead heart)
- Wettable powder formulation of entomopathogenic nematode *Heterorhabditis indica* NBAIR @ 22.50 kg/ha was found superior in controlling sugarcane white grubs and recorded 3.11 per cent mean clump mortality as compared to control (11.31%)
- Six releases of *Trichogramma chilonis* @ 50,000 parasitoids/ha at weekly interval starting from 40 days after emergence of shoots found significantly superior to untreated control in reducing early shoot borer infestation from 18.67 to 6.95 % dead hearts while the chemical, Chloropyrifos reduced the early shoot borer infestation from 17.16 to 8.54 %. The net benefit of ₹ 9874/ha was received by considering the additional cost of Chlorpyrifos of ₹ 750/ha.
- Application of *Lecanicillium lecanii* NBAIR Vl 8 @ 5g/L and botanicals against sucking pests of cotton, was found to be more effective than the other treatments against leafhoppers (69.76 - 70.83 % reduction) and aphids (91.80% reduction).
- *Beauveria bassiana* NBAIR *Bb* 35 was found effective against cotton leafhoppers (58.60% reduction) and Thrips (61.39% reduction).
- Three year evaluation of Bio-intensive pest management practices for the management of pink bollworm revealed that BIPM practices recorded lesser rosette flowers (1.22-7.87%), lesser green boll damage (9.20 - 14.23%) and higher yield (18.90-26.60 q/ha) compared to the control plots (2.87 - 43.67%, 12.80 - 24.66% and 15.98-11,25 q/ha respectively, but was inferior to the insecticide treatment (0.81-6.80%, 7.10 - 9.67% and 22.15 - 31.72 q/ha) respectively.
- Application of neem oil (0.5%) and entomofungal patohogen, *Isaria fumosorosea* (5g /litre) was found effective in the bio-suppression of RSW during high infestation period. However, conservation biological control using the aphelinid parasitoid, *Encarsia guadeloupae*, neuropteran predator, *Apertochrysa* sp. and sooty mould scavenger beetle, *Leiochrinus nilgirianus* subdued the invasive potential of RSW after four-month period.
- Augmentative release of the larval parasitoids, *Goniozus nephantidis* (20 /palm) and *Bracon brevicornis* (30/palm) reduced the incidence of black headed caterpillar from 39% to about 1% in a period of two years at Kasaragod.
- Area-wide innundative release of the green muscardine fungus, *Metarhizium majus* @ 5 $x10^{11}$ spores/m^3 on to the breeding sites (wooden logs & cow dung pits) reduced the coconut rhinoceros beetle incidence and spear leaf damage of coconut.

Suggestions / Recommendations

- Along with trade names of commercial formulations of microbials, scientific names should be mentioned.
- Availability of Trichocards at all the AICRP-BC centres and their stakeholders should be ensured for large scale demonstrations and distribution to farmers.

- Results of common experiments of different centres can be pooled and presented for comparative analysis of treatment's efficacy.
- PPP mode may be explored to ensure the timely availability of quality bio-agents/bio-pesticides to attain sustainable pest and disease management.

SESSION IV: Biological suppression of pests of oil seeds and pulses

Chairman : Dr. H. C. Sharma, Former Vice Chancellor, YSPUHF, Nauni, HP & Chairman, RAC, ICAR NBAIR, Bengaluru
Co-Chairman : Dr. A. N. Shylesha, Head (GCU), ICAR-NBAIR, Bengaluru
Rapporteurs : Dr. K. Selvaraj, ICAR-NBAIR, Bengaluru
Dr. Shyamal Sahoo, UBKV, Pundibari

Salient findings

- Chitin enriched oil formulation of entomofungal pathogen *Lecanicillium saksenae* (10^7 spores mL^{-1}) @ 10 ml/L was found effective in managing pod bugs in cowpea with a mean population of 0.5 bugs per plant as compared to control (8 bugs/plant)
- Large scale demonstration of HearNPV in chickpea showed that three applications of HearNPV was found effective in reducing the pod borer damage and increasing 20 % more yield.
- Large scale demonstration (15 ha) of two applications of *Metarhizium rileyi* at vegetative and reproductive stages against soybean defoliators showed that there was drastic reduction of defoliators and 10 percent increase in yield over farmers practice.
- Application of *Metarhizium rileyi* (KK-Nr-1) @ 1×10^8 spores/ml (5g/L) reduced the groundnut leafminer damage to the tune of 69.57 per cent and it was at par with *M. rileyi*@ 1×10^8 @ 5 gm/l (UAS- Dharwad) with 68.64 per cent reduction. The highest per cent reduction of groundnut defoliator was noticed in *M. Rileyi* (KK-Nr-1) @ 1×10^8 spores/ml (5g/L) (67.45 %) followed by *M. rileyi* @ 1×10^8 @ 5 gm/l (UAS-Dharwad) 63.75 %).
- Among the bio-pesticides, Azadirachtin 3000 ppm @ 2.5 ml/lit treated plots showed the lowest number of mustard aphids per shoot (7.70 Nos.) followed by *Beauveria bassiana* (11.83 Nos.).
- Population of mustard aphid in BIPM module was 4.40 Nos./plant while in farmers' practice it was 17.30 Nos./plant. In farmers practice, the yield (6.80 q/ha) was significantly lower than that of BIPM module (10.40 q/ha).

Suggestions / Recommendations

- Role of entomopathogenic fungi as endophytes should be assessed against sucking pests.
- Mass production of parasitoids may be standardized for managing pod bugs in pulses.
- Experiments on other economically important oilseed crops may also be taken up and incorporated in technical program.
- Population of natural enemies should be recorded in all the treatments including control.
- Package of practices recommendations with label claim insecticides should be taken as standard control while evaluationg bioagents against crop pests.

- Experiments should be planned in such a way to the input costs and enhance the crop yield.

SESSION V: Biological suppression of pests of fruits, vegetables and polyhouse crops

Chairman : Dr. H. B. Singh, Head (Rtd), Department of Mycology & Plant Pathology, Institute of Agricultural Sciences, BHU, Varanasi
Co-Chairman : Dr. Murali Baskaran, Principal Scientist, ICAR- NIBSM, Raipur
Rapporteurs : Dr. P. S. Shera, PAU, Ludhiana
Dr. M. Sampath Kumar, ICAR-NBAIR, Bengaluru

Salient findings

- Tomato fruit borers damage was very low (13.83 %) in the plots where tomato was intercropped with cowpea and marigold as border crop which was statistically at par with the treatment where tomato was intercropped with chickpea and bordered with mustard (14.65 %).
- Installation of yellow sticky traps @ 4 per 250m^2 and two releases of *Chrysoperla zastrowi sillemi* @ 4 larvae / plant were significantly better in reducing the population of aphids and whiteflies under net house conditions in tomato.
- Among the different biopesticides, *L. lecanii* V1-8 @ 5 ml/L was the best treatment in reducing the mean population of aphid, *B. brassicae* (3.24/plant) and *P. xyllostella* (3.07/plant) followed by *B. bassiana* Bb-45 *i.e.,* aphid (3.68/plant) and DBM (3.67/plant), respectively in cabbage.
- *Beauveria bassiana* (CISH strain) and *Beauveria bassiana* (NBAIR strain) @ 1x10^8 spores/g @ 5 g/L were found very effective in reducing the mango thrips.
- Large scale demonstration of bio- intensive module found very effective in reducing the mango hopper population at Anand.
- Among the entomopathogenic fungi tested against citrus thrips and mites, *Lecanicilium lecanii* NBAIR Vl 8 @ 5g/L was found very effective.
- Entomopathogens, *Lecanicilium lecanii* NBAIR –VI-22 and *Metarhizium anisopliae* NBAIR-Ma - 4 @ 5g/L was found effective against guava and aonla mealybugs respectively.
- BIPM practices involving, ploughing in orchard during March-April, clean cultivation, regular collection and destruction of fallen infested fruits during May-June and releases of *Trichogramma embryophagum* @ 4000 parasitized eggs per tree, six times at 7-10 days interval were significantly better in reducing the damage by litchi fruit borer as compared to farmer's practice.
- Three weekly sprays of combination of Azadirachtin 1500 ppm and *Lecanicilium lecanii* NBAIR strain @ 5.0 ml/ lit. reduced green apple aphid by 73. 28 % and reduced the apple mites by 44.66 %.
- Three sprays of Azadirachtin 10000 ppm @ 2.0 ml/ L followed by spraying of *Metarhizium anisopliae* NBAIR Ma4 (5g/L) and *Lecanicilium lecanii* NBAIR Vl8 (5g/L) resulted in 85.0% reduction of apple woolly aphid.

- *Heterorhabditis bacteriophora* (5000IJs/gallery) was found the most effective bioagent and resulting in 67 per cent mortality of apple leopard moth, *Zeuzera multistrigata*
- Two weekly releases of anthocorid bug, *Blaptostethus pallescens* @ 400 bugs/ plant revealed 25.27 and 35.91% reduction in European red mite and two spotted spider mite on apple respectively over untreated control
- Larval parasitoid, *Bracon hebetor* parasitization on mango leaf webber (*Orthaga euadrusalis*) under filed conditions was recorded up to 62.5%.
- Spraying biopesticide *Metarhizium anisopliae* NBAIR Ma4 @5 g/L at three sprays at 7 days interval reduced the manago thrips to 49.4%.
- Application of *Purpureocillium lilacinum* CISH strain and *Bacillus* spp CISH strain along with with vermicompost reduced the wilt and root knot nematode incidence in guava plants with low root not index of 1.88 compared to the control root not index of 3.19.
- *Metarhizium anispliae* (NBAIR-Ma-4), *Beauveria bassiana* (NBAIR-Bb-5a) and Azadirachtin 10000 ppm effectively reduced guava and aonla mealybug populations.

Suggestions / Recommendations

- When neem has to be integrated as component of BIPM, neem oil should be used for sucking pests while other neem formulations should be used for chewing pests.
- PC cell to provide a datasheet for recording observations of experiments to be followed by all the centres uniformly.
- In the evaluation trials of microbial agents, neem products to be used as control in addition to chemical insecticides.
- Public private partnership model should be explored for production of most potent local isolates of biopesticides by the centres.
- Data generated in AICRP trials should be compiled across the centres for publications in high impact factor journals.

SESSION VI: Formulation of technical programme for 2022-25

Chairman : Dr. S. C. Dubey, ADG (PP&BS), ICAR, New Delhi
Co-Chairman : Dr. S. N. Sushil, Director, ICAR-NBAIR, Bengaluru
Rapporteurs : Dr. Jagadeesh Patil Sr. Scientist, ICAR-NBAIR, Bengaluru
Dr. B. S. Gotyal Sr. Scientist, ICAR-NBAIR, Bengaluru

Suggestions / Recommendations

- Wherever possible, additional centres and bio-agent strains should be included in the experiment.
- Recommended package of practice of the respective universities should be included in the experiment.
- Isolation distance of 100m should be maintained wherever *Trichogramma* experiments are being conducted.
- Combined experiments for both disease and insect pests should be formulated.

SESSION VII: Institute and industry interactions

Chairman : Dr. T.M. Manjunath, Director (Rtd.), Mansanto Pvt Ltd, Bengaluru
Co-Chairman : Dr. M. Nagesh, Principal Scientist, ICAR- NBAIR, Bengaluru
Rapporteurs : Dr. R. S. Ramya, Scientist, ICAR-NBAIR, Bengaluru
Dr. Jaydeep Halder, Sr. Scientist ICAR- IIVR, Varanasi

Suggestions / Recommendations

- Industries can get the products tested through AICRP Biocontrol Network at different locations on payment basis.
- Industries should support institutes for developing products with more shelf life.
- Institutes should concentrate in developing liquid based and nano based formulations.
- Commercial scaling should be intensified and establishment of start-ups, especially by women entrepreneurs should be encouraged.
- Reforms are needed in India for dispensing away the need of toxicological data for biopesticides like *Metarhizium anisopliae*, *Beauveria bassiana*, Bt, NPVs etc.

SESSION VIII : Valedictory and Plenary

Chairman : Dr. T. R. Sharma, Deputy Director General (CS), ICAR, New Delhi
Co-Chairmen : Dr. S. C. Dubey, ADG (PP&BS), ICAR, New Delhi
Dr.S.N.Sushil, Director, ICAR - NBAIR, Bengaluru
Rapporteurs : Dr. Richa Varshney, ICAR- NBAIR, Bengaluru
Dr. K.T. Shivakumara, NBAIR, Bengaluru

Suggestions / Recommendations

- Bioagent formulations used in the experiments are not uniform. NBAIR should produce uniform formulations and distribute them to all AICRP centers.
- Scientist-industry partnership need to be strengthened to ensure availability of biocontrol agents.
- Uniformity should be followed in experimentation methodology and recording observations in all the experiments.
- Strong collaborations with university should be developed for solving mite problems.
- Quality, scalability, traceability, applicability is very important for biocontrol agents.
- One day should be spent in the annual review meeting exclusively for discussing and finalizing of technical programme.
- Private companies should be invited by NBAIR to showcase the technologies and to bridge the gap between Institute and Private companies.
- All AICRP research data should be collated, analysed and published in peer-reviewed journals.

Overall Recommendations

1. All the plant protection institute directors and AINPs project coordinators should be invited for meeting at ICAR-NBAIR, Bengaluru to form collaborative research project proposals and outcome of these research proposals may be presented in the next annual AICRP-BC meeting.
2. Combined experiments for both disease and insect pests should be formulated.
3. PC should take initiative in identifying ICAR - NBAIR as one of the referral lab for testing the quality of bio - pesticides.
4. Molecular signatures have to be generated for the promising microbial bioagents and same bioagents have to be deposited in recognised nodal centres.
5. Focus has to be given to develop climate resilient biocontrol agents like temperature tolerant, drought tolerant etc.
6. Standard formulation technologies should be followed by all the centres while developing a product against a crop pest or disease.
7. AICRP on Biological Control should involve other plant protection institutes like ICAR-NCIPM for conducting large scale demonstrations.
8. PC cell should provide data sheet for recording observations of the experiments for uniformity.
9. It was decided that all the participating centres should be grouped into two categories 1. Regular and 2. Voluntary. All voluntary centres should be funded with minimum contingency to address minimum requirements of conducting the experiments.
10. Industries should be encouraged to test their products and generate bioefficacy data through AICRP Biocontrol network on payment basis.

Formulation of technical programme 2022 - 2025

New experiments

CROP WISE PROGRAMME

1. MAIZE

1.1. Evaluation of native isolates of entomopathogens (ANGRAU & UAS (R) against maize Fall armyworm (RARS Anakapalle, UAS Raichur, COA, Tripura)

Objective		To evaluate the native isolates of entomopathogens against maize FAW
Crop	:	Maize
Variety		Location specific recommended variety
Treatments		3
Replications		7
Plot size /Replication		40 m^2
Treatments	:	T1: *Bacillus thuringiensis* RARS TPT-C33 1% @ 10ml/L T2: *Bacillus thuringiensis* NBAIR Bt 25 @10ml/L T3: POP recommendation (Spraying Azadirachtin 1500 ppm @ 2 ml/L at 15 days after sowing + Chlorantraniliprole 18.5 SC@ 0.4 ml/L at 25 days after sowing + Emamectin benzoate 5SG@ 0.4gm/L at 35 days after sowing T4: Untreated control Three sprays :20, 35 and 50 days after sowing
Observations	:	Number of larvae per plot Number of damaged plants per plot Number of dead larvae due to Bt per plot 20 plants will be randomly selected for FAW incidence and larval mortality

1.2. Large scale demonstration of bioefficacy of multiple insecticide tolerant *Trichogrammachilonis*NBAIR MITS for the management of fall armyworm in maize (RARS Anakapalle. UAS Raichur)

Objective		To demonstrate the bioefficacy of multiple insecticide tolerant *Trichogramma chilonis*for the management of fall armyworm in maize
Crop		Maize
Variety		Location specific recommended variety
Area		10 ha
Location		Ranasthalammandal, Srikakulam district
Treatments	:	T1: Multiple insecticide tolerant *Trichogramma chilonis* cards (50,000 eggs/ha) (2 releases, first release after one week of sowing & second one after one week of first release) T2: POP recommendation (Insecticidal check : Spraying Azadirachtin 1500 ppm @ 2 ml/L at 15 days after sowing + Chlorantraniliprole

		18.5 SC@ 0.4 ml/L at 25 days after sowing + Emamectin benzoate 5SG@ 0.4gm/L at 35 days after sowing
Observations	:	Number of damaged plants per plot; Number of dead larvae per plot; Percent egg parasitism; Number of predators per plant; Grain yield; 50 plants will be randomly selected for FAW incidence and larval mortality

1.3 Large scale demonstration of BIPM module for the management of maize FAW (RARS Anakapalle; SKAUST Jammu; MPKV Pune; TNAU Coimbatore; ICAR-IIMR Hyderabad; UAS Raichur; PAU Ludhiana; AAU Jorhat; PJTSAU Hyderabad; ICAR-IIMR (WN) Hyderabad; ICAR-NBAIR Bengaluru; CAU Pasighat, AAU Anand)

Objective		To demonstrate the BIPM module for the management of maize FAW
Crop		Maize
Variety		Location specific recommended variety
Plot size /Replication		5 ha
Treatments	:	T1:BIPM module • Installation of pheromone trap @ 10 traps/acre • Release of *Trichogramma chilonis*(1,00,000 eggs/ ha) (2 releases, first release after one week of sowing & second one after one week of first release) • NBAIR Bt-25 @ 10ml/L (1-2 sprays depending on pest incidence, first spray after 20 days after sowing to target early instars of FAW larvae) • ICAR-NBAIR *Metarhizium anisopliae* (Ma-35) @ 5g/L (1-2 sprays depending on pest incidence), first spray 10 days after first spray of Bt-25 to target late instars of FAW larvae • Collection and destruction of egg masses of fall armyworm at regular interval T2: POP recommendation (Spraying Azadirachtin 1500 ppm @ 2 ml/L at 15 days after sowing + Chlorantraniliprole 18.5 SC@ 0.4 ml/L at 25 days after sowing + Emamectin benzoate 5SG@ 0.4gm/L at 35 days after sowing
Observations	:	50 plants will be randomly selected for FAW incidence and larval mortality Number of damaged plants per plot Number of dead larvae(due to bacteria/virus/fungus) per plot Percent egg parasitism Number of predators per plant Final yield

MILLETS

2. SORGHUM

2.1 Demonstration of BIPM module for the management of FAW on Sorghum and Millets (ICAR-IIMR, Hyderabad, UAS Raichur)

Objective		To demonstrate the efficacy of BIPM module for the management of sorghum FAW
Crop		Sorghum
Location		03 (Warangal, Solapur, Bellary)
Cultivar		CSV 29R
Plot size /Area		2 ha
Treatments	**:**	T1: Biointensive module: Release of *Trichogramma chilonis* 1 lakh/ha (2 releases, first release one week of planting & second one after one week of release + spray of *Metarhizium anisopliae* NBAIR Ma 35 @ 5 ml/litre at 20, 45 DAE T2:POP recommendation (Seed treatment with Fortanza duo @ 6 ml/kg of seed) T3: Untreated control
Observations	**:**	**Select 20 plants per plot and take observations on following parameters**: • Number of egg patches per plot what is plot size??? • Number of larvae per plant/plot • Number of damaged plants/plot • Number of dead larvae (bacteria/virus/fungus) per plot • Percent egg parasitism • Final grain?? Yield

PULSES

3. Chickpea

3.1. Biological suppression of chick pea pod borer *Helicoverpa armigera* and soil borne diseases of chickpea (Fusarium wilt, Dry root rot and Collar rot) (AAU Anand, MPUAT-Udaipur; PAU Ludhiana; UAS Raichur, IGKV Raipur; AAU Jorhat, SKUAST Jammu, COA Tripura)

Objective	:	To biologically suppress the pod borer, *Helicoverpa armigera* infesting chickpea
Crop		Chickpea
Variety	:	Location specific recommended variety
Design of experiment	:	Randomized Block Design.
Treatment	:	4

Replication/	:	5
Plot size/ Replication	:	$40m^2$
Cropping season	:	Rabi
Treatment details	:	T1: Seed treatment with @10g/Kg and soil application twice @5kg/ha of *Trichoderma harzianum* NBAIR strain at 25 & 50 days after sowing + *Spraying of Bacillus thuringiensis* NIBSM Bt 18 1% @10ml/L two sprays at pod initiation and pod formation stage at 15 days interval T2: Pheromones traps @ 25/ ha (NBAIR Product) T3: POP recommendation (Quinalphos 25EC @250g a.i/ha – recommended newer generation biorational insecticide may be incorporated and Carbandazim+ Mancozeb soil drenching@ 1g/L at 25 & 50 days after sowing T4: Untreated control
Observations	:	• Number of larvae/ m row length before spray and 3, 7, 10 and 15 days after spray • Disease incidence at 30, 60, 90 days after sowing • Total and damaged pods at harvest. • Record natural enemies from 5 plants in each plot. • Pod yield will be recorded on whole plot basis.

3.2. Large scale demonstration of bioefficacy of *Bacillus thuringiensis* against chickpea pod borer (PAU, Ludhiana)

Objective	:	Large scale demonstration of bioefficacy of *Bacillus thuringiensis* against chickpea pod borer
Crop	:	Chickpea
Location		Bathinda, Mansa and Sangrur, Ludhiana
Variety	:	Location specific recommended variety
Area	:	4 ha
Treatments	:	T1: *Bacillus thuringiensis kurstaki* NBAIRBt G4 10ml/L T2: POP recommendation (*Bacillus thuringiensis kurstaki* DOR Bt 10ml/L 2 sprays (First spray at pod initiation and second 10 days after)
Observations	:	• Number of larvae/ m row length before spray and 3, 7 and 10 after each spray • Total and damaged pods at harvest • Natural enemies / m row length • Pod yield • Incremental benefit cost ratio

3.3. Large scale demonstration of entomopathogenic fungi, *Metarhiziumrileyi* against chick pea pod borer, *Helicoverpaarmigera* (UAS, Raichur)

Objectives	:	Large scale demonstration of entomopathogenic fungi, *Metarhizium rileyi* against chick pea pod borer, *Helicoverpa armigera*
Crop	:	Chickpea
Variety	:	Region specific recommended variety
Location		Dhummansur Village, Humnabad Taluk, Bidar district, Karnataka
Area	:	50 ha
Treatments	:	T1: *Metarhizium rileyi* KK-Nr-1 (1×10^8 spores/g) @ 5 g/L T2: POP recommendation (Emamectin benzoate 5 SG @ 0.2 gm/L) 2 sprays (First spray at pod initiation and second 10 days after)
Observations		Number of defoliating larvae of *H. armigera*per meter row length - and grain yield will be recorded

4. RED GRAM

4.1. Evaluation of bio-control agents against pod borers in red gram (UAHS, Shimmoga, COA Tripura, Lembucherra)

Objective	:	Evaluation of bio-control agents against pod borers in red gram
Crop	:	Red gram
Variety	:	BRG-5
Design of experiment	:	Randomized Block Design.
Treatments		3
Replications		7
Plotsize/Replication	:	40^2
Cropping season	:	Kharif
Treatments	:	T1: *Bacillus thuringiensis* (NBAIR *Bt*G4 2%) @ 10ml/L T2*:* POP recommendation (Chlorantraniliprole 18.5% SC@ 0.4 ml/lit) T3: Untreated control 3 sprays at pre flowering, post flowering and pod formation stage
Observations	:	• Number of larvae/ m row length before spray and 3, 7, 10 and 15 days after spray • Total and damaged pods at harvest. • Record natural enemies from 5 plants in each plot. • Pod yield will be recorded on whole plot basis
Approved to continue the experiment with one best organism		

5. GREEN GRAM

5.1. Evaluation of different entomopathogens against spotted pod border, *Maruca vitrata* in green gram (AAU Anand; SKUAST Jammu; TNAU Coimbatore; RARS Anakapalle)

Objective	:	Evaluation of different entomopathogens against spotted pod border, *Maruca vitrata* in green gram
Crop	:	Green gram
Variety	:	Location specific recommended variety
Design of experiment	:	Randomized Block Design.
Treatment	:	3
Replication	:	7
Plotsize/Replication	:	$40m^2$
Treatments		T1: *Bacillus thuringiensis* NBAIR *Bt*G4 2% @ 10 ml/lit T2: POP recommendation (Azadirachtin 1% 1500ppm @ 2 ml/L T3: Untreated control Two sprays : First spray at flowering stage and second spray 15 days after first spray
Observations	:	• Pod damage (%) recorded at 15 days after spraying • Number of larvae/meter row length • Yield (q/ha)

6. COWPEA

6.1 Evaluation of entomopathogens against cowpea sucking pests (MPKV- Pune; SKUAST, Jammu; KAU, Vellayani; KAU Kumarakoam)

Objective	:	Evaluation of entomopathogens against cowpea sucking pests
Crop	:	Cowpea
Variety	:	Location specific recommended variety
Design of experiment	:	Randomized Block Design.
Treatments	:	3
Replications	:	7
Plot size /Replication	:	$40m^2$
Treatments	:	T1: *Lecanicillium saksenae* KAU (1×10^8cfu/ml) @5ml/L T2: POP (Thiamethoxam 50 WP @ 2g/10 L seed treatment??? Or select recommended biorational insecticides for foliar application T3: Untreated control

		Two sprays at 15 days interval when the pest reaches ET
Observations	:	Aphids: Pre-spraying count and post-spraying count of aphids on five randomly selected plants (terminal shoots) of each plot before as well as 3, 7 and 10 days after each treatment Pod bug: Pre-spraying count and post-spraying count of pod bugs per plot before as well as 3, 7 day and 10 days after each treatment. Yield (kg)

Oil Seeds

7. GROUNDNUT

7.1 Evaluation of entomopathogens against leaf miner and tobacco caterpillar in groundnut (UAS Raichur; ANGRAU Anakapalle; TNAU Coimbatore)

Objective		To evaluate the entomopathogens against leaf miner and tobacco caterpillar in groundnut
Crop		Groundnut
Variety		Regional specific recommended variety
Design of experiment		RBD
Treatments	:	4
Replications	:	5
Plot Size/Replication	:	50 m^2
Treatment Details		T1: *Metarhizium rileyi* KK-Nr-1 (1×10^8 spores/g) @ 5 g/L T2: *Bacillus thuringiensis* RARS TPT-C33 2% @ 1ml/L T3: POP Recommendation (Emamectin benzoate 5 SG @ 0.2 gm/L) T4: Untreated control
Observations	:	Pre and post treatment observations on Number of active leaf miner per 20 leaflet Damaged plants /plot due to *Spodoptera litura* Number of dead larvae (bacteria/virus/fungus) per plot Pod and Halum yield

COMMERCIAL CROPS

8. SUGARCANE

8.1 Field evaluation of ICAR-NBAIR endophytic entomopathogenic strains against shoot borers (*Chilo infuscatellus* and *Chilo sacchariphagus indicus*) in sugarcane (ANGRAU, Anakapalle)

Objective	:	To evaluation of ICAR-NBAIR endophytic entomopathogenic strains against shoot borers
Crop		Sugarcane
Variety		Region specific recommended variety
Design of	:	RBD

experiment		
Treatments		3
Replication		7
Plot size /Replication	:	50 m^2
Cropping season	:	Kharif
Treatments	:	T1: Sett treatment with *Metarhizium anisopliae* NBAIR Ma-35 ($1x10^8$ spores/ml) @ 5 g/L+ Spraying *Metarhizium anisopliae* NBAIR Ma-35 T2: Spraying chlorantraniliprole 18.5@ 0.3 ml/L T3: Untreated Control Sett treatment at planting and spraying 3times at 14 days interval from 25 days after germination.
Observations	:	• Cumulative incidence of early shoot borer up to 120 days after planting • Internode borer incidence (%) in 50 canes • Internode borer intensity (%) i.e., number of bore holes per cane in 10 m row length • Cane yield data (t/ha) and single cane weight (kg/cane) • Sucrose (%) and incremental benefit cost ratio at harvest.

8.2 Field evaluation of *Metarhizium anisopliae* against Sugarcane white grub *Holotrichia serrata* (SBI Coimbatore; PJTSAU Hyderanad; UAS Raichur)

Objective	:	To evaluate entomofungal pathogen *Metarhizium anisopliae* against *Holotrichia serrata*
Crop		Sugarcane
Variety		Region specific recommended variety
Design of experiment	:	RBD
Treatments		3
Replication		7
Plot size /Replication	:	50 m^2
Cropping season	:	Kharif
Treatments	:	T1: *Metarhizium anisopliae*SBI Ma-16 ($1x10^8$spores/ ml) 5 ml/L T2: POP Recommendation (Imidacloprid 40 %+ Fibronil 40% WG 200 g/ acre) T3: Control Two soil applications will be done during July and September
Observations	:	No. of grubs observed in 10 m row length of the crops Cane yield in each treatment
Approved to continue the experiment with one best organism		

8.3 Field evaluation of *Aschersonia placenta* against sugarcane whitefly *Aleurolobus barodensis* in endemic location (SBI Coimbatore)

Objective	:	To evaluation of *Aschersonia placenta* against sugarcane whitefly *Aleurolobus barodensis* in endemic location
Crop		Sugarcane
Variety		Region specific recommended variety
Design of experiment	:	RBD
Treatments		3
Replication		7
Plot size /Replication	:	$50m^2$
Cropping season	:	Kharif
Treatments	:	T1: Application of *Aschersonia placenta* SBI AP 01 ($1x10^8$spores/ ml) 5 ml/L T2: POP Recommendation (Chlorpyriphos 20 EC (300g a.i./ha) T3: Untreated control
Observations	:	The population of whitefly nymph, puparia, and adult per cm^2 will be taken in the top, middle and basal portion of five sugarcane leaves at three spots in treatment plots of 1 cent size, with required replications. Pre-treatment observations on the whitefly population before imposing treatments will be taken. Post-treatment counts will be taken one month after the treatment. Fungal recovery if any would be observed. Natural enemy incidence if any, will be observed among different treatments.

8.4 Large scale demonstration of EPN against white grubs in sugarcane ecosystem (MPKV Pune, SBI Coimbatore)

Objectives	:	To demonstrate Entomopathogenic nematode *Heterorhabditis indica* NBAIR against white grubs in sugarcane ecosystem
Crop	:	Sugarcane
Variety	:	Region specific recommended variety
Location		DondaTal Khel, Pune district
Area	:	6 ha
Treatment		T1*: Heterorhabditis indica* NBAIR WP formulation T2: POP recommendation (Imidacloprid 40 %+ Fibronil 40%WG 200 g/ acre)
Observation		No. of healthy clumps and dead clumps / 1 m row length before application of EPN Percent reduction of white grub population Yield of sugarcane

VEGETABLES

9. TOMATO

9.1 Evaluation of Predatory mite *Neoseiulus longispinosus*for the management of spider mite *Tetranychus urticae* in tomato under polyhouse conditions (Dr YSPUHF Solan)

Objective		To evaluate predatory mite *Neoseiulus longispinosus* for the management of spider mite *Tetranychus urticae* in tomato under polyhouse conditions
Crop		Tomato
Design of experiment		RBD
Treatments		4
Replication		6
Variety	:	Location specific popular variety
Plot size/Replication	:	30 m^2
Treatments	:	T1: 3 releases of predatory mite *Neoseiulus longispinosus*@ 10 per plant at weekly interval T2: 3 releases of an anthocorid predator *Blaptostethus pallescens* @ 20 per plant at weekly interval T3: Chemical control: Spiromesifen 240SC @100 g.a.i ha^{-1} at 15 days interval T4: Control
Observations	:	• First release/ treatment will be initiated at the first appearance of the mite • Observations on mite count will be recorded at weekly intervals. • Yield data at each picking will also be recorded.

10. OKRA

10.1 Evaluation of entomopathogens against sucking pests of Okra (hoppers, aphids and Whitefly) (ICAR-IIHR Bengaluru, AAU Anand)

Objective		**To evaluate entomopathogens against sucking pests (hoppers, aphids and Whitefly) of Okra**
Crop		Okra
Pest		Sucking pests
Variety	:	Region specific recommended variety
Treatments		3
Replications		7
Plot size / Replication	:	50 m^2
Treatments	:	T1: Oil based formulation of *Metarhizium anisopliae* IIHR Strain @5ml /L
		T2: POP Recommendation (Imidacloprid 17.8 SC @0.3ml/l)
		T3: Control

		Five rounds of spray at weekly intervals starts a five days after sowing
Methods and observations	:	Population of hoppers and thrips a day before application and 3rd, 7th day after application (4 leaves/plant) Record hopper damage symptoms and YVMV incidence. Marketable yield at harvest replication wise in each treatment

11. CUCUMBER

11.1 Efficacy of reduviid predator *Sycanus collaris* against tobacco caterpillar *Spodoptera litura* on cucumber in polyhouse (KAU Thrissur, NIPHM Hyderabad)

Objective		To evaluate the reduvid predator *Sycanus collaris* against tobacco caterpillar *Spodoptera litura*on cucumber in polyhouse
Crop		Cucumber
Pest		Tobacco caterpillar *Spodoptera litura*
Variety	:	KPCH 1
Treatments		3
Replications		7
Plot size / Replication	:	10 m^2
Variety	:	KPCH 1
Treatments	:	T1: Release of *Sycanus collaris* @ 20 nymphs/10m^2 T2: Recommended insecticide T3: Control
Methods and observations	:	Third instar larvae of *S. litura* will be released on to the cucumber plant at the rate of ten larvae per plant, 20 days after planting. Fifth instar nymphs of *S. collaris*will be released after two days establishment of pest on crop. Mortality of *Spodoptera litura* will be assessed 1, 3 and 5 days after release of predator Yield per plant

11.2 Demonstration of *Neoseiulus longispinosus* for the management of spider mites in cucumber in Polyhouse (YSPHUF Solan)

Objective	To demonstrate the efficacy of *Neoseiulus longispinosus* for the management of spider mite
Location	Solan district, Himachal Pradesh
Crop	Cucumber
Pest	Spider mite
Variety	University recommended variety
Area	1000m^2
Treatments	T1: Release of *Neoseiulus longispinosus*@ 50 per plant 3-4 times at weekly interval starting from the first appearance of spider mite T2: Spiromesifen 240SC @100g.a.i ha^{-1} at 15 days interval
Methodology and observations	1. Pre-treatment count of mites 2. Post treatment count of mites at 7 days interval

	3. Yield

12. BITTER GOURD

12.1 Evaluation of BIPM practices against sucking pests and fruit flies *Zeugodacus cucurbitae* in bitter gourd (ICAR-IIVR Varanasi, KAU Kumarakoam)

Objective		Evaluation of BIPM practices against sucking pests and fruit flies *Zeugodacus cucurbitae* in bitter gourd
Crop		Bitter gourd
Pest		Sucking pests and fruit flies *Zeugodacus cucurbitae*
Variety	:	Regional specific recommended variety
Treatments		3
Replications		7
Plot size / Replication	:	40 m^2 (follow standard plot size of one cent 8x5 m)
Treatments	:	T1: BIPM practices • Installation of cue lure @ 15/ha for monitoring for fruit flies • Spray of *Lecanicillium lecanii NBAIR* Vl*8* 5 g /L + Neem oil (2.5 ml/L) for sucking pests • *Bacillus thuringiemsis* NBAIR Bt G4 @10ml/Lfor leaf Webber (*Diaphania indica*) T2: POP Recommendation (Jaggary 1% + Malathion 50 EC@2ml/L T3: Untreated control practice
Observations	:	For pre and post treatment observation 5 plants will be selected randomly from each sub plots and per cent damaged fruits will be recorded after imposing each treatment at 7 and 10 day interval. Epilachna beetle, whitefly, jassids, Cucumber moth (*Diaphania indica*) will be observed in each sub plot considering randomly selected 5 plants. Both nymphs and adult of aphid will also be collected on the basis of number of population per leaf. Natural enemy complex will also be recorded per plant basis. Yields of marketable fruits at each harvest will be pooled together to get the average yield.

13. CAULIFLOWER

13.1 Large scale field evaluation of Biointensive management practices for the pests of cauliflower (YSPUHF Solan, CAU Pasighat)

Objective		To evaluate the Biointensive management practices for cauliflower pests
Crop		Cauliflower

Pest		Aphids, *Brevicoryne brassicae* and *Pieris brassicae*
Variety	:	Region specific recommended variety
Design of experiment		RBD
Treatments		3
Replications		7
Plot size / Replication	:	500 m^2
Treatments	:	T1: BIPM • Mustard as trap crop • One spray of Azadirachtin 1500 ppm (1%EC) (2ml/L) • Release of *Chrysoperla zastrowi sillemi* (4 larvae/infested plant) will be released 7 days after the application of Azadiractin concentration • Mechanical destruction of egg masses and early gregarious larval instars of *Pieris brassicae* • Two sprays of *Bacillus thuringiensis* NBAIR BTG4 10ml/L). First spray with the initiation of lepidopteran pest and subsequent spray at ten days interval T2: POP recommendation () T3: Control
Observations	:	Aphid and caterpillar counts will be recorded at weekly interval starting from the first appearance of the pest until harvest

14. ONION

14.1 Evaluation of Bio-efficacy of entomopathogens against onion thrips (*Thrips tabaci* L.) (TNAU Coimbatore, AAU Anand)

Objective		**To evaluate the Bio-efficacy of entomopathogens against onion thrips (*Thrips tabaci* L.)**
Crop	:	Onion
Variety		Region specific recommended variety
design of experiment		RBD
Treatments		3
Replications		7
Plot size/ Replication		20 m^2
Pest	:	Onion thrips

Treatments	:	T1: *Lecanicillium lecanii* NBAIR Vl8 (1x 10^8 spores/g) @ 5g/L) + Azadirachtin 1500ppm @ 2 ml/lit T2: POP recommendation (Dimethoate 30 EC) T3: Control First spray will be carried out with the initiation of pest and subsequent two sprays will be carried out at ten days interval. Five plants will be randomly selected from net plot area and observations will be recorded. Number of thrips per plant will be recorded before treatment application and at 3rd, 7th and 10th day after each spray.
Observations		No. of thrips/ plant Bulb yield - kg/plot

Fruit Crops

15. BANANA

15.1 Evaluation of entomopathogens against banana Pseudostem weevil, *Odoiporous longicollis* (KAU Vellayani, KAU Kumarakoam)

Objective		To evaluate entomofungal pathogens against banana Pseudostem weevil *Odoiporous longicollis*
Crop	:	Banana
Variety		Nendran
design of experiment		RBD
Treatment		3
Replications		7
Plot size/Replication		50 m^2
Pest	:	Pseudostem weevil
Treatments	:	T1: Sucker treatment with talc formulation of Beauveria bassiana NBAIR Bb5a @ 20g/L + Soil drenching with NBAIR Bb5a @ 20g/L + Application of NBAIR Bb5a capsules in the leaf axils at 5,6 and 7 MAP + Application of NBAIR B5a capsules into the bore holes T2 : POP recommendation(application of Fipronil 0.3 G or Carbosulfan at 0, 3,and 5 months after planting T3: Control
Observations		No of plants showing symptom of weevil attack on pseudostem Yield per plot

15.2 Evaluation of entomopthogens against banana rhizome weevil *Cosmopolites sordidus* (KAU Vellayani, KAU Kumarakoam)

Objective		To evaluate of entomopthogens against banana rhizome weevil *Cosmopolites sordidus*
Crop		Banana
Variety		Nendran

design of experiment		RBD
Treatment		3
Replications		7
Plot size/Replication		50 m^2
Major Pest		Banana rhizome weevil *Cosmoplitus sordidus*
Treatments		T1: Rhizome treatment with talc based *Metarhizium anisopliae* NBAIR Ma4 20g/L before planting + pit application of NBAIR Ma4 capsules @ 4 capsules per plant at 0, 3, 5, and 7 MAP T2: POP recommendation (Fipronil 0.3G @ 10g /plant at 0.2 and 5MAP) T3: control
Observations		No. of infested rhizomes per plot Yield per plot

16. Apple

16.1. Demonstration on management of apple root borer using *Metarhizium anisopliae* (YSPUHF Solan, SKUAST Srinagar)

Objective		To demonstrate the bioefficacyof *Metarhizium anisopliae* against apple root borer
Crop		Apple
Variety	:	Region specific recommended variety
Location		Kotkhai, Rohru and Kalpa blocks
Plot size/Area		5 ha
Treatment details		T1: Powder formulation of *Metarhizium anisopliae* NBAIR Ma 4 ($1x10^8$ spores/g) @ 30g per tree mixed with enriched FYM as soil application during July- August, i.e., at the time of emergence of new grubs) T2: POP Recommendation (Chlorpyriphos 20 EC @ 0.04%)
Observation to be recorded		Number of live and dead larvae will be counted at the time of basin preparation and percent mortality will be calculated

16.2. Demonstration of Biointensive pest management module for codling moth, *Cydiapomonella*infesting apple in Ladakh (SKUAST–K Srinagar)

Objective		To demonstrate the bioefficacy of Biointensive pest management module for the management of codling moth, infesting apple in Ladakh sucking pests in cotton
Crop	:	Apple
Variety	:	Red delicious and others
Location	:	Nurla, Mingy and Saliskot Villages, Kargil &Leh (Ladakh)
Area		1 ha
Treatment	:	T1 :BIPM module • Three sprays of Liquid formulation of *Bacillius thuringienis*

		(Commercial formulation) @ 2 ml/ L • Pheromone dispensers at the time of biofix • Pheromone traps @ 20 traps/ ha for trapping male adults (SK-CM Lure, SKUAST-K Product) • Pheromone traps @ 20 traps/ ha for trapping both male and female (SK-Combo Lure, SKUAST-K Product • Cydia Granulosis virus, (CpGV) @ $1x10^{12}$ OBs/ha • Trunk banding with gunny material for 1 st generation summer larvae and another at pre-harvest of fruits for trapping overwintering larvae. T2: POP Recommendation (Chlorpyriphos 1 ml/L)
Observations	:	• % fruit damage • % reduction in damage over control • Yield • C:B ratio

PLANTATION CROPS

17. COCONUT

17.1 Area-wide demonstration of biological suppression of black headed caterpillar using *Goniozus nephantidis* and *Bracon brevicornis* (ICAR-CPCRI Kayankulum)

Objective		To demonstrate of the bioefficacy of parasitoids *Goniozus nephantidis* and *Bracon brevicornis* for the management of coconut black headed caterpillar
Crop		Coconut
Location	:	
Area		10 ha
Treatments	:	T1: Augmentative release of *Goniozus nephantidis* and *Bracon brevicornis* @ 20 parasitoids/palm T2:POP Recommendation (Chlorantraniliprole 18.5 SC@ 0.4 ml/L)
Observations	:	Pest incidence/ leaflet, Infested leaflets in a frond, parasitism percentage, Pre-release and post-release data on pest incidence.

17.2 Area wide demonstration of an entomofungal pathogen *Metarhizium majus* for the management of coconut rhinoceros beetle (ICAR-CPCRI Kayankulum)

Objective		Area wide demonstration of an entomofungal pathogen *Metarhizium majus* for the management of coconut rhinoceros beetle
Crop		Coconut
Location	:	Vallikunnan Panchayat, Mavelikara
Area		1500 ha
Treatments	:	T1: *Metarhizium majus* CPCRI Mm 601) $5x10^{11}$spores m^{-3}(5g/L) followed by *in situ* incorporation of *Clerodendrum infortunatum* along with crown cleaning and leaf axil filling with botanical

		cakes T2: POP Recommendation (Wooden ash 1kg/ m^3cowdung pit)
Observations	:	Pre-treatment and post-treatment pest incidence level (six-monthly interval) Palm health improvement

18. PLANT DISEASES EXPERIMENTS

18.1. Large scale demonstration of Pant Bioagent (PBAT-3) for the management of rice sheath blight (GBPUAT, Pantnagar, NCIPM New Delhi, PAU Ludhiana)

Objective	To demonstrate the Pant Bioagent (PBAT-3) for the management of rice diseases
Crop	Rice
Variety	Region specific recommended variety
Location	Udham Singh Nagar, Nainital District, Uttarakhand.
Area	GBPUAT, Pantnagar- 200 ha NCIPM New Delhi 2 ha
Treatments	T1: PBAT -3 formulation • Seed bio-priming through Pant Bioagent formulation, PBAT-3 (*T.harzianum*Th14 + *Pseudomonas fluorescens* Psf 173) @ 10g/kg of seeds. • Seedling dip with PBAT 3@ 10 g/ L for about 30 minutes. • Two sprays of PBAT 3 @ 10 g/ L on standing crop (Tillering phase) at 10-12 days intervals T2 : POP Recommendation (Carbendazim 2g/L drenching and spraying)
Observations to be recorded:	• Disease incidence (Sheath blight**)** • Grain yield of crop (kg/ha) • Cost-benefit ratio.

18.2. Demonstration of the bioefficacy of *Trichoderma asperullum* KAU strain application for the management Fusarium wilt in cowpea (KAU, Kumarakoam, KAU Vellayani)

Objective		To demonstrate the bioefficacy of *Trichoderma asperullum* KAU strain application for the management Fusarium wilt in cowpea
Crop		Cowpea
Variety	:	Region specific recommended variety
Plot size /Replication		1 ha
Treatment details		T1: Talc based formulation of the *Trichoderma asperullum* KAU strain 2×10^6 spores @ 20 g $kg^{-1}$of seed + basal application (multiplied in cowdung + neemcake 9:1 ratio) @ 250 g /plant and soil drenching @20 g/L at 20,40 and 60 DAS T2: POP Recommendation (Seed treatment with carbendazim @ 2g kg^{-1} of seed followed by soil drenching @ 0.2 per cent at 15 DAS)

Observation to be recorded		• Disease incidence (%) at 30, 45, 60 DAS • Shoot and root growth (in cm) • Yield (kg/ha) • C:B ratio`

18.3. Demonstration of the bioefficacy of *Trichoderma asperullum*for the management of Fusarium wilt and root rot of pea (Dr YSRUHF Solan, GBPUAT Pantnagar)

Objective		To demonstrate the bioefficacy of *Trichoderma asperullum* UHFTa1for the management *Fusarium* wilt and root rot of pea
Crop		Pea
Variety	:	Region specific recommended variety
Plot size/Replication		5 ha
Treatment details		T1: Talc based formulation of the *Trichoderma asperullum*UHFTa1 2×10^6 spores /g seed treatment @ 20 g $kg^{-1}$of seed + basal application (multiplied in cowdung + neemcake 9:1 ratio) @ 50 g /plant and soil drenching @20 g/L at 20,40 and 60 DAS T2: POP Recommendation (Seed treatment with carbendazim @ 1g kg^{-1} of seed followed by soil drenching @ 0.2 per cent at 15 DAS)
Observation to be recorded		i) Disease incidence (%) ii) Shoot and root growth (in cm) iii) Pod yield (kg/ha) iv) C:B ratio

18.4. Large scale demonstration of Pant Bioagent (PBAT-3) for the management of fusarial wilt of pea (GBPUAT, Pantnagar, Dr YSRUHF Solan)

Objective	Large scale demonstration of Pant Bioagent (PBAT-3) for the management of fusarial wilt of pea
Crop	Pea
Variety	Region specific recommended variety
Location	Nainital District, Uttarakhand.
Area	25 ha
Treatments	T1: Seed bio-priming through Pant Bioagent formulation, PBAT-3 (*T. harzianum*Th14 *Pseudomonas fluorescens* Psf 173) @ 10g/kg of seeds+ Soil application of PBAT @5 kg/ha +Spray of PBAT 3 @ 10 g/L on standing crop at 10-12 days intervals T2: POP Recommendation (carbaendazim Seed treatment @1g/kg and drenching @1g/ L)
Observations to be recorded:	• Disease incidence (wilt**)** • Grain yield of crop (kg/ha) • Cost-benefit ratio.

18.5. Management of stem rot *Macrophominaphaseolina* in sesame using biocontrol agents (RARS, Anakapalle, SKUAST, Jammu)

Objective		To manage the stem rot *Macrophomina phaseolina* in sesame using biocontrol agents
Crop		Sesame
Variety	:	Regional specific recommended variety
design of experiment		RBD
Treatments		3
Replications		7
Plot size/Replication		40 m^2
Treatment details		T1: *Pseudomonas fluorescens* NBAIR-PFDWD soil application @ 5 kg/ha T2: POP Recommendation(Carbendazim seed treatment @1g/kg seed + carbendazim soil drenching @ 1g/L) T3: Untreated Control
Observation to be recorded		• Germination (%) • Root and shoot length (in cm) • Stem rot incidence (%) at 30 and 60 days after sowing • Grain yield (kg/ha) • C:B ratio

18.6. Evaluation of biocontrol agents against sugarcane red rot, smut and wilt (Centre: SBI, Coimbatore, MPKV Pune)

Objective		To evaluate the biocontrol agents sugarcane red rot, smut and wilt
Crop		Sugarcane
Variety	:	Region specific recommended variety
design of experiment		RBD
Treatments		3
Replications		7
Plot size/Replication		50 m^2
Treatment details		T1:Mechanized sett treatment+ soil application of (45 & 90 DAP with *Paenibacillus alvei* AFG 3 + *T. harzianum* SBI T20 T2*:* POP Recommendation (Azoxystrobin 23 SC 0.5 ml/L) T3:Control Liquid formulations of the bioagents 2×10^6spores/ml and fungicide will be applied as sett treatment using sett treatment device developed at Plant Pathology Lab, Sugarcane Breeding Institute
Observation to be recorded		• Per cent germination (30DAP) • Per cent Disease incidence (45DAP, 60DAP, 90DAP) • No. of healthy shoots/ stalks (120DAP, 180DAP, 240DAP) • Yield (kg/ha)

		• C:B ratio

18.7. Evaluation of microbial antagonists for the management of ginger rhizome rot (CAU, Pasighat, AAU Jorhat)

Objective		**To evaluate the microbial antagonists for the management of ginger rot disease**
Crop		Ginger
Variety	:	Region specific recommended variety
design of experiment		RBD
Treatments		3
Replications		7
Plot size/Replication		$50m^2$
Treatment details		T1: Powder formulation of *Trichoderma harzianum*AAU-MC2:Rhizome treatment (@ 20 g kg^{-1}+basal application (multiplied in cowdung + neemcake 9:1 ratio) @ 100 g /plant and soil drenching @20 g/L at 10,20 and 40 DAP T2: POP Recommendation (Copper hydroxide soil drenching @2g/L) T3: Control
Observation to be recorded		Disease incidence during cropping stage Disease incidence after harvest Yield data (Kg/ha) C:B ratio

Foumulation of technical programme (2022 to 2025)

Ongoing Experiments

I. BIODIVERSITY OF BIOCONTROL AGENTS FROM VARIOUS AGRO-ECOLOGICAL ZONES

Objectives: To study the diversity of natural enemies of insect pests and plant pathogens crops in different agro-ecological zones catered by the all the AICRP centers.

II. SURVEILLANCE FOR PEST OUTBREAK AND ALIEN INVASIVE PESTS

III.

Name of the study/trial	:	**Surveillance for pest outbreak and alien invasive pests - Crop Pest Outbreak Report (CPOR)**
Objectives	:	To monitor and report the incidence, buildup and outbreaks of insects and diseases of different crops in the region catered by the AICRP center.
Trial allotted centers	**:**	**All Centres**
Method	:	Visit, survey and surveillance and interaction with state/line department officials and local farmers.
Periodicity	:	Once in a month.
Target area	:	Covering the district where centre is located and 2-3 adjoining districts. In case of pest outbreaks, affected area may be specifically visited.
Desirable important information	:	1. Specific site & date visited-District, Mandal (Taluk), village (Give specific GPS coordinates, if available). 2. Area covered in ha 3. No. of crops specifically examined and Variety grown 4. Major insects and disease (s) noticed and natural enemy occurrence 5. Severity of damage (low, moderate, severe) 6. Age of crop in severely damaged field(s) (in DAT/DAS and years for field and tree/ horticultural crops, respectively) 7. Previous crop grown in the area 8. Occurrence of the pest in weeds in surrounding area of the crop 9. Plant protection measures adopted by the farmer prior to the visit 10. Advice given to the farmer and follow up report if any

Crop Pest Outbreak Report Proforma

Name of Centre: Date visited:

1.	Site details	Village(s) with GPS Co-ordinates, Mandal/Taluk/ District

2.	Crop details	Crop*: Variety : Age of Crop (DAS/DAT/: Years in case of perennial crop: Area cultivated (ha) :
3.	Pest Scenario: Insects Natural enemy occurrence	Name of Insect: Level of infestation: Low/Moderate/Severe Predators: (Coccinellids/ Chrysopids/Spiders/Others) Parasitoids:
4.	Disease Scenario	Name of Disease: Per cent disease incidence:
5	Previous crop grown in the area	
6	Occurrence of the pest in weeds (identification where possible)in surrounding area of the crop	
7	Plant Protection measures followed by the farmer	
8	Advice given to the farmer	
9	Sender's name	

*for each crop separate proforma to be used

For each insect, level of infestation, *viz*., Low/Moderate/Severe should be specified,

- **Low-**Pest is present at lower population with no significant damage to the crop
- **Moderate-**Pest population is nearing Economic Threshold Level (ETL) and needs constant monitoring to prevent economic damage
- **Severe** -Pest damage is higher and the crop needs control measure to avoid crop losses

Submission of report

- **As early as possible by e-mail (aicrp.nbaii@gmail.com),but not later than 5th of each month.**
- Send the insects and its natural enemies including spiders if any, desired for identification to the Director, ICAR-NBAIR, H A Farm Post, P B No 2491, Bellary Road, Hebbal, Bengaluru 560024.
- Photographs of the insect and disease damage symptoms, life stages of insects, natural enemies and field visits (wherever possible) should be sent along with this report.
- In case of no pest outbreak in the centres for the reporting period, Nil report should be sent.

Cropwise Programme

CEREALS

1. RICE

1.1. Evaluation of entomopathogens against sucking pests of rice (Rice bug *L.acuta*, and Green leafhopper and Plant hopper (*Sogatella* sp))MPKV Pune; ICAR-IIRR Hyderabad)

Objective		To evaluate the entomopathogens against sucking pests of rice
Crop		Rice
Variety	:	Regional specific recommended variety
Treatments		5
Replications	:	4
Design of experiment	:	RBD
Plot size/Replication		$40m^2$
Date of sowing	:	As per the package of practice
Treatments	:	T1- *Lecanicillium saksenae* KAU ITCC7714 ($1x10^8$ spores/g) @ 5 g/l T2- *Beauveria bassiana* NBAIR Bb 5a ($1x10^8$ spores/g) @ 5 g/l T3- POP of university (Thiamethoxam 0.2 g/L) T4- Untreated First spray at panicle initiation and second spray two weeks after the first spray.
Observations	:	The population of bug and plant hoppers and leafhopper will be recorded from 25 hills selected at random at weekly interval starting from 20 days after transplanting

1.2. Field evaluation of entomopathogens and plant growth promoting bacteria against Rice stem borer, Leaf folder, Brown planthopper (ICAR-NRRI, Cuttack; TNAU-TRRI Aduthurai; UASRaichur;ICAR-IIRR Hyderabad)

Objective		To evaluatethe entomopathogens against rice stem borer, leaf folder, Brown planthopper Suggestion: Actual species name for stem borer to be mention in the report.
Crop		Rice
Variety	:	Region specific recommended variety
Design of experiment	:	RBD
Treatments	:	4
Replications		6
Plot size/Replication		$40\ m^2$
Treatments	:	T1. *Bacillus albus* NBAIR BATP (1×10^8cfu/ml) 10ml/L T2. *Bacillus thuringiensis* NRRI BtBiocb 7 (1×10^8cfu/ml) 10ml/L T3. POP of University (Thiamethoxam 0.2 g/L) T4.Control (Untreated) Three rounds of foliar sprays of liquid formulations of entomopathogens has to be given at 14 days' interval
Observations	:	• Mean No. of dead heart/white ear/sq. m. (weekly intervals) • Mean No. of damaged leaves per sq. m. (weekly intervals)

		• The population of plant hoppers will be recorded from 25 hills selected at random at weekly interval starting from 30 days after transplanting (DAT) from each plot. • The population of predators will be also recorded at weekly intervals. • Growth promotion character viz., plant height (cm), biomass (gm) • Yield (kg/plot)

1.3 Management of rice stem borer and leaf-folder using entomopathogens (KAU Thrissur)

Objective		To evaluate entomopathogens against stem borer and leaf folder in rice
Crop		Rice
Variety	:	Jyothi
Design of experiment	:	RBD
Treatments	:	5
Replications		4
Plot size/Replication		40 m^2
Treatments	:	T_1: *Heterorhabditis indica* NBAIR strain@ $1.2x10^9$ IJs ha^{-1} T_2:*Bacillus thuringiensis* NBAIR BtG4 10 ml/L T_3: *Beauveria bassiana* NBAIR Bb5a ($1x10^8$ spores/g) @ 5 g/l T_4: POP Recommendation (Flubendiamide (formulation 20 %WG) 25g.a.i.ha^{-1} T_5: Untreated control Treatments will be applied twice based on ETL
Observations	:	• Mean No. of dead heart/white ear/sq. m. • Mean No. of rolled leaves per sq. m. • Yield kg/plot

1.4. Large scale demonstration of bio-intensive pest management on rice

(KAU Thrissur; PAU Ludhiana; OUAT Bhubaneswar; RARS Anakapalle; AAU Jorhat; IGKV Raipur;ICAR-NCIPM New Delhi;ICAR-IIRR Hyderabad; UBKV Pundibari; CAU Pasighat)

Objective		To demonstrate the bio-intensive pest management on rice
Crop		Rice
Variety	:	Region specific popular rice variety
Location		Farmersfields
Plot size/ Area		KAU Thrissur(150 ha), PAU(50 ha), OUAT(10 ha), RARS Anakapalle(30 ha), AAU Jorhat (50 ha); IGKV (5ha), ICAR-NCIPM (1ha), IIRR (3 ha), UBKV Pundibari (3 ha)
Treatments	:	T1 = BIPM Package • Seed bio-priming with *Pseudomonas fluorescens* 10g/L • Seedling root dip with *Pseudomonas fluorescens*@10 g/L for 1hour before transplanting • Need based application of azadirachtin 1500 ppm@

		2ml/L/ *Beauveria bassiana*NBAIR Bb 5a foliar spray @5g/kg for sucking pests. • Two sprays of *Pseudomonas fluorescens*@ 10g/L against foliar diseases after transplanting and 20 days after transplanting. • Releases of *Trichogramma chilonis* and *Trichogramma japonicum* @ 100,000/ha (5-6 releases to be made during season) at 7 days interval starting from 30 DAT for stem borer and leaf folder infestation T2 = POP recommendation
Observations	:	• Observation on diseases incidences and plant growth parameters (number of tillers/hill, root and shoot length, fresh and dry weigh of root and root etc) • Observations on pest incidence as well as natural enemies will be recorded on total of 50 hills in BIPM block & 50 hills in FP block at vegetative stage (45 and 60 DAT for dead heart and leaf folder damage) and at reproductive stage (for white ear damage). • Observations on natural enemies like predators and parasitoids by visual or sweep net count and by collection of egg masses for stem borer. • At each observation, record total tillers, dead hearts, total leaves, damaged leaves, total panicle bearing tillers, white ear heads and number of plant hoppers/ hill • Record the yield from 6 places of 5x5 m area from each replication • Cost-benefit ratio to be worked out

2. MAIZE

2.1. Large scale demonstration of *Trichogramma chilonis* against maize stem borer *Chilo partellus* (MPUAT Udaipur and UAHS Shivamogga)

Objective		To demonstratethebioefficacy of *Trichogramma chilonis* against maize stem borer*Chilo partellus*
Crop		Maize
Variety	:	Location specific recommended variety
Area		MPUAT Udaipur (2 ha) UAHS Shivamogga (4 ha)
Locations		
Treatments	:	T1: Three releases of*Trichogramma chilonis* @ 100,000/ha/release at 15, 22 and 29 days after crop germination. T2: POP recommendation(Quinolphos 25EC 2ml/L)

Observations		• Dead hearts from 20 randomly selected plants at 30 DAS • Yield (t/ha) and incremental benefit cost ratio • Percent parasitism

3. MUSTARD

3.1 Evaluation of entomopathogens against mustard aphid (SKUAST-K Srinagar; SKUAST- Jammu; CAU Pasighat)

Objective		To evaluate the entomopathogens against mustard aphid
Crop		Mustard
Variety		Regional specific recommended variety
Design of experiment		RBD
Treatments	:	7
Replications	:	3
Plot Size/Replication	:	40 m^2 /plot
Treatment Details		T1- *Beauveria bassiana* NBAIR Bb 5a (1×10^8 spores/g) @ 5g/L + Azadirachtin 1500 ppm @ 2 ml/L T2- POP recommendation (Imidacloprid 17.8 SL @ 0.4ml/L) T3- Control Spray schedule: Two sprays at 15 days interval when the pest reaches ET
Observations	:	No. of aphids per 10 cm twig from ten randomly selected plants No. of Coccinellids per five plants Seed Yield

4. COTTON

4.1.Evaluation of efficacy of entomofungalpathogens for the management of sucking pests in cotton(UAS Raichur; TNAU Coimbatore; AAU Anand ANGRAU Anakapalle; PJTSAU Hyderabad; PDKV Akola)

Objective		To evaluate the efficacy of entomofungal pathogens for the management of sucking pests in cotton
Crop		Cotton
Design of experiment		RBD
Treatments	:	3
Replications	:	7
Plot Size /Replication	:	400 m^2
Variety		Region specific recommended variety
Treatment Details		T1: Powder formulation *Lecanicillium lecanii* NBAIRVl 8 ($1x10^8$spores /g) @ 5 g/l T2: POP Recommendation (biorational insecticide i.eSpiromesifen 240SC @ 7 ml/10 L) T3: Control

		Two sprays will be given at 15 days interval soon after the incidence starts
Observations	:	• Aphids, Jassids, whiteflies and thrips / 3 leaves (top, middle and lower canopy) in 5 randomly selected plants in each plot will be recorded before spray, 3 and 7 days after spray will be recorded. • Cadavers without apparent sporulation along with leaves will be brought in the laboratory and incubated under optimal condition. After 5 days cadavers will be observed for signs of fungal infection and sporulation. • Yield (Q/ha)

4.2 Large scale evaluation of biointensive management of pink bollworm on *Bt* cotton (UAS Raichur; TNAU Coimbatore; AAU Anand, PJTSAU Hyderabad; PAU Ludhiana)

Objective		To evaluate bio-intensive module for the management of pink bollworm in Bt cotton
Crop		Cotton
Variety		Region specific recommended variety
Design of experiment		RBD
Treatments		3
Replication		10
Plot size / Area		400 m^2
Treatment details	:	T1: Standard practice of plant protection till 55th day or appearance of PBW. The following inputs to be provided for PBW. • Timely sowing (upto Mid-May) • Erection of pheromone traps (Funnel type) @ 2 trap/ acre for Monitoring and 20 trap/acre for Mass trapping • Releases of *Trichogrammatoidea bactrae* 100,000/ha, five releases starting from 55 days after germination (Two release at flowering time and third release at boll formation stage • Application of azadirachtin 1500 ppm @ 2ml/L of water T2: POP recommendation (Lambda-cyhalothrin/ Profenophos 50EC 2ml/L) T3: Control Note: Isolation distance of 100m should be maintained if Trichogramma is used in the experiment.

5. SUGARCANE

5.1. Large scale demonstrations of *Trichogramma* spp. (ICAR-NBAIR HTTS) against borers (early shootborer, top borer and stalk borer) in sugarcane (PAU Ludhiana; OAUT Bhubaneswar; UAS Raichur)

Objective		To demonstrate the bioefficacy of *Trichogramma* spp. against sugarcane borers
Crop		Sugarcane
Variety	:	Location specific recommended variety
Plot size/ Area		PAU Ludhiana (2000 ha) OUAT Bhubaneswar (20 ha) UAS Raichur (20 ha)
Treatment	:	T1: • Eight releases of *T. chilonis* @ 50,000/ha at weekly interval from mid-April to end-June (for early shoot borer, *Chilo infuscatellus* • Eight releases of *T. japonicum* @ 50,000/ha at weekly interval from mid-April to end-June (for top borer, *Scirpophaga excerptalis*) • 10-12 releases of *T. chilonis* @ 50,000/ha at weekly interval from July to October (for stalk borer, *Chilo auricilius*) T2: POP Recommendation (Chlorantraniliuprole 18.5 SC 375 ml /ha)
Observations	:	• Pre-release infestation, *i.e.*, per cent dead hearts due to early shoot borer and top borer • Post-release count of percent dead hearts at fortnight interval up to 3 months • Per cent cane attacked at harvest • Cane yield data • Incremental benefit cost ratio

6. TOMATO

6.1 Demonstration of bio intensive pest management practices for the management of insect pests (fruit borer/pinworm/ sucking pests) of tomato (UBKV Pundibari; YSPUHF Solan; MPUAT Udaipur; SKUAST-K Srinagar; CAUPasighat; AAU Jorhat; PJTSAU Hyderabad)

Objective		To demonstrate the efficacy of bio intensive pest management practices for the management of insect pests (fruit borer/pinworm/ sucking pests) of tomato
Crop		Tomato
Variety	:	Location specific popular variety
Location		Farmers fields
Plot size/ Area	:	5 ha
Treatment	:	T1:BIPM Module • Spraying of *Lecanicillium lecanii* NBAIR VI-8 (1×10^8spores/g) @ 5g/L and installation of yellow sticky trap @50 number/ha for sucking pests • Installation of Pheromone traps @ 20/ha against fruit borer and pinworm (NBAIR Product) • Release of *Trichogramma chilonis* @ 50,000/ha per release

		(6 releases) from flower initiation stage at weekly intervals for fruit borer • *Trichogramma achaeae* @ 50,000/ ha per release (6 releases) for pinworm • Spraying of Azadirachtin 1500 ppm @ 2 ml/lit T2: POP Recommendation The treatment applications will be started at initial occurrence of fruit borer/pinworm. Six releases of parasitoids at weekly interval and three sprays of biopesticides will be given during evening hours at fortnightly interval.
Methodology and observations	:	• Randomly select 10 plants/40m^2 crop area and observe all the leaves for presence of leaf mine / sucking pests caused by the larva. • Randomly select 10 plants/ 40m^2 crop area and observe all the fruits for presence of holes/ damage caused by the larva. Observations will be recorded at fortnightly interval from fruit formation to last harvest. • Sucking pests if any, data will be recorded as per standard protocol • Fruit damage percentage and yield will be recorded • Cost-benefit ratio.

7. BRINJAL

7.1 Evaluation of entomopathogens against *Myllocerous subfasciatus* on brinjal (ICAR-IIHR Bengaluru, CAU Pasighat)

Objective		To evaluatetheentomopathogens against *Myllocerous subfasciatus* on brinjal
Crop		Brinjal
Design of experiment		RBD
Treatments		7
Replication		5
Variety	:	Location specific popular variety
Plot size/Replication	:	40 m^2
Treatments	:	T1: *Metarhizium anisopliae* IIHR Strain oil formulation (1x10^8 spores/ml) @5 ml/L T2: *Beauveria bassiana* IIHR Strain (1x10^8 spores/g)WP formulation @5 g/L T3: *Metarhizium anisopliae* NBAIR Ma4 (1x10^8 spores /g) WP formulation @5 g/L @ 5g/L T4: *Beauveria bassiana*NBAIR Bb-5a (1x10^8 spores /g) WP formulation @5 g/L T5: *Heterorhabditis indica* NBAIR H38@ 2.5 10^9 IJs ha^{-1} T6: POP recommendation (Chlorpyriphos 2 ml /L)

		T7: Untreated control
Observations	:	Pre and post treatment infestation at fortnightly interval. Destructive sampling may be done to count the grubs Yield of healthy marketable fruits and cost-benefit ratio.

7.2 Demonstration of bio intensive management practices for the management of pests (fruit borer/ sucking pests) of Brinjal (KAU Vellayani; KAU Kumarakoam; AAU Anand; OUAT, Bhubaneswar; TNAU Coimbatore; PJTSAU, Hyderabad; CAU Pasighat)

Objective		To demonstrate the efficacy of bio intensive management practices for the management of insect pests of brinjal
Crop		Brinjal
Variety	:	Location specific popular variety
Location		
Plot size/ Area	:	3 ha (KAU Vellayani& KAU Kumarakoam: 0.5 acre**)**
Treatment	:	T1:BIPM Module • Use of pheromone traps for mass trapping @30/ha against fruit borer (Sun Agro's product) • Release of *Trichogramma chilonis* @ 100,000/release against brinjal fruit and shoot borer, 10-12 releases to be made at 30 days after transplanting & need based spray of *Bacillus thuringiensis* (NBAIRBtG4) 2ml/L • *Lecanicillium lecanii*Vl 8(1 x 10^8 spores/ ml @ 5g/L) for sucking pests. • *Heterorhabditis indica* NBAIR H38@ 2.5 10^9 IJs ha^{-1} T2 = POP Recommendation The treatments will be imposed at initial occurrence of fruit borer/sucking pests. 10 to 12 releases of parasitoids at weekly interval and three sprays of biopesticides will be given during evening hours at fortnightly interval.
Methodology and observations	:	For Brinjal fruit and shoot borer • Pre-release observation –No. of shoots damaged. For this, ten plants from each replication will be selected, tagged and observation will be taken at 15 days interval. • Observations such as number of damaged fruits, weight of damaged fruits, number of total fruits and weight of total fruits from each plot will be taken to calculate the per cent infestation. Observation will be recorded at 5 days interval. For sucking pests: • Pre-treatment observations on no. of nymphs and adults of sucking pests (mealybug/whitefly) per leaf will be taken before application of the treatment, and post-treatment observations will be taken at 5, 10 and 15 days after each treatment (DAT). Observations of sucking pest population (no. of nymphs and adults per leaf) will be recorded on leaves from the top, middle and bottom of 10 randomly selected plants per treatment.

		• Yield of healthy marketable fruits and cost benefit ratio will be worked out.

8. OKRA

8.1. Demonstration of bio-intensive management practices for the management of pests in okra (IGKV Raipur; CAU Pasighat; ICAR-IIHR Bengaluru)

Objective		To demonstrate the BIPM practices against pests of Okra
Crop		Okra
Variety	:	Region specific recommended variety
Location		
Area		2.5 ha
Treatments	:	T1: BIPM • Installation of pheromone trap for *Helicoverpa armigera* & *Earias vittella*@ 30 traps/ha at 30 DAS. • Yellow sticky traps @20/ha for maintaining of sucking pests. • Six releases of *Trichogramma chilonis*@ 50000/ ha at weekly interval with the initiation of pest. • Two sprays of *Bacillus thuringiensis* NBAIR BTG4 ($2x10^8$cfu/g) 1% WP 10g/L. First spray with the initiation of lepidopteran pest and subsequent spray at ten days interval • One spray of Azadirachtin 1500 ppm (1% EC) @ 2ml/L with the initiation of sucking pest and subsequent spray with *Lecanicillium lecanii*NBAIR Vl-8 ($1x10^8$cfu/g) 1% WP (5g/L) at ten days interval. T2: POP Recommendation
Observations	:	Catches of *Helicoverpa armigera* and *Earias vittella*in pheromone trap will be recorded at weekly interval from the installation of pheromone trap. The observations on larval population of *H. armigera* and *E. vittella*will be recorded from ten randomly selected plants per repetition at weekly interval with the initiation of pest. The observations on sucking pest population will be recorded from three leaves (upper, middle and lower) of ten randomly selected plants per repetition at weekly interval with the initiation of pest. Natural enemies: The population of natural enemies will be recorded from 10 plants of each quadrate at 15 days interval Fruit damage (%) - The observations on fruit damage on number and weight basis will be recorded from each treatment at each picking. Fruit yield (healthy marketable fruit) q/ha C:B ratio

9. CHILLI

9.1 Evaluation of entomopathogens againstsucking pests of chilli (thrips, aphids and Whitefly) of chilli*)* (ICAR-IIHR Bengaluru; UAS Raichur; MPKV Pune; PJTSAU Hyderabad, HRS Ambajipetta; CAU Pasighat)

Objective		To evaluate of entomopathogens against sucking pests of chilli
Crop		Chilli
Pest		Sucking pests
Variety	:	Region specific recommended variety
Treatments		4
Replications		5
Plot size / Replication	:	30 m^2
Treatments	:	T1: Oil based formulation of *M. anisopliae* IIHR Strain ($1x10^8$ spores/g)@5ml /L T2: Powder formulation *Beauveria bassiana* NBAIR Bb5a ($1x10^8$spores/g) @5 g/ L T3: POP Recommendation (Imidacloprid @0.3ml/L) T4:Control Five rounds of spray at weekly intervals starts a five days after transplanting
Methods and observations	:	• Population of white fly, aphids and thrips a day before application and 3^{rd}, 7^{th} day after application. (4 leaves/plant) • Record hopper damage symptoms and ChLCVincidence. • Marketable Yield at harvest replication wise in each treatment

10. CABBAGE

10.1 Evaluation ofBiointensive management practices for the cabbage pests (aphids *Brevicoryne* spp. / *Myzus* spp. and Diamond back moth, *Plutella xylostella*)(MPKV Pune; CAU Pasighat)

Objective		To evaluate theBiointensive management practices for cabbage pests (Sucking pests and DBM)_
Crop		Cabbage
Pest		Aphid and Diamond back moth
Variety	:	Region specific recommended variety
Design of experiment		RBD
Treatments		3
Replications		7
Plot size / Replication	:	100 m^2
Treatments	:	T1 : BIPM • Growing Indian bold seed mustard as trap crop @25:2 • Installation of pheromone trap for *Plutella xylostella*@ 12 traps/ha at 30 DAT • Eight releases of *Trichogramma chilonis*@ 100000/ ha at weekly

		interval with the initiation of pest • Two sprays of *Bacillus thuringiensis* NBAIR BTG4 (2×10^8cfu/g) 1% WP (5g/ L). First spray with the initiation of lepidopteran pest and subsequent spray at ten days interval • One spray of azadirachtin 1500 ppm (1%EC) (2ml/L) with the initiation of sucking pest/aphid and subsequent two sprays with *Lecanicillium lecanii*NBAIR Vl-8 (1×10^8cfu/g) 1% WP (5g/L) at ten days interval. T2: POP Recommendation (Spraying 5% NSKE) T3: Control
Observations	:	Catches of *Plutella xylostella* in pheromone trap will be recorded at weekly interval from the installation of pheromone trap. The observations on larval population/plant of lepidopteran pest will be recorded from ten randomly selected plants per repetition at weekly interval with the initiation of pest. The observations on aphid population/plant will be recorded from ten randomly selected plants per repetition at weekly interval with the initiation of pest. Fruit damage (%) - The observations on fruit damage on number basis will be recorded from each treatment at each picking. Yield (healthy marketable cabbage heads) q/ha C: B ratio

11. CITRUS

11.1. Evaluation ofentomopathogens against citrus thrips and green mites (rust and green mites) (CRS Tirupati)

Objective		**To evaluate entomopathogens against citrus thrips and mites**
Crop		Citrus
Variety	:	Sathugudi
Design	:	RBD
Treatments	:	3
Replications		7
Plot size		50 m^2
Treatments	:	T1: *Beauveria bassiana* NBAIRBb5a *(*1×10^8 spores/g) @ 5.0 g/L T2: POP Recommendation (Acephate 75 SP@0.1%) T3: Control Spray should be initiated immediately after fruit set (10 days after flowering). First spray at the peak activity of the pest and second at 14 days after first spray
Observations	:	The per cent leaf infestation due to thrips on foliage at 0 days (pre count) and 3, 7 and 14 days after second spray and for fruits, the percent infested fruits will be counted. The population counts of mitesbefore and 3, 7 and 14 days after treatmentwill be recorded. In case of rust mites, observation on infested fruits (%) before harvest will be noted The yield data (tonnes/ha.)

12. LITCHI

12.1 Bio-intensive pest management practices for the management of Litchi fruit borer, *Conopomorpha sinensis* in litchi (PAU ludhiana)

Objective		To evaluate the Bio-intensive pest management practices for the management of Litchi fruit borer
Crop	:	Litchi
Variety		Region specific recommended variety
design of experiment		RBD
Treatments		3
Replications		7
Plot size/ Replication		100 m^2
Pest	:	Litchi fruit borer
Treatments	:	T1: BIPM • Ploughing in orchard during March-April • Regular clean cultivation throughout the year • Regular collection and destruction of fallen infested fruits during May-June • Light trap @ 1 per acre • Releases of *Trichogramma embryophagum* @ 4000 parasitized eggs per tree 5-7 times at 7-10 days interval starting from initiation of flowering to colour break stage T2: POP Recommendation (T3: Untreated control
Observations		Total and infested fruits from 5 trees in each unit to work out per cent damage Marketable yield

13. COCONUT

13.1. Biological suppression of rugose spiralling and nesting whiteflies on coconut (CPCRI Kayankulum,DRYSRHU HRS Ambajipetta, UBKV Pundibari)

Objective		To suppress rugose spiralling and nesting whiteflies on coconut
Crop		Coconut
Design of experiment		RBD
Treatments	:	3
Replications	:	7
Plot Size/Replication	:	4palms for each replication
Variety		Region specific recommended variety
Treatment Details		T1: Foliar application of *Isaria fumosorosea* (Pfu-5) 1 x10^8 spores/ml (5 gm /L) plus Tween 80 1 ml/L (two spray at 15 days interval) T2: POP Recommendation (Neem oil 0.5% plus 0.005% soap powder)

		T3: Control (Two sprays at 15 days intervals).

13.2 Large scale suppression of coconut rugose spiralling whitefly using parasitoid *Encarsia guadeloupae* and *Apertochyrsa astur* (TNAUCoimbatore)

Objective		To suppresscoconut rugose spiralling whitefly
Crop		Coconut
Variety		Region specific recommended variety
Pest		Rugose spiralling whitefly
Location	:	Chinnapampalayam
Area		25 ha
Treatments	:	T1: *Encarsia guadeloupae* natural conservation + release of *Apertochyrsa astur* eggs @1000/ha + yellow sticky traps @ 20/ha T2:POPRecommendation(Neem oil 0.5% plus 0.005% soap powder)

13.3 Large scale demonstration on management of coconut rugose spiralling whitefly using entomofungal pathogen, *Isaria fumosorosea* (ANGRAU Anakapalle)

Objective		To demonstrate the bioefficacy of entomofungal pathogen *Isaria fumosorosea* for the management of rugose spiralling whitefly on coconut
Crop		Coconut
Location	:	Farmers fields in Srikakulam, Vizianagaram districts
Area		40 ha
Treatments	:	T1: Spraying *Isaria fumosorosea* (Pfu-5) @ 1 x10^8 spores/ml (5 ml /L) Three sprays at 15 days interval covering the entire leaflet, fronds and directed lower side of leaves. T2 POP Recommendation(Neem oil 0.5% plus 0.005% soap powder)
Observations	:	<u>Palm infestation :</u> Pre (one day before) and post treatment count on 7 and 14 days after treatment: 1. Percentage of leaves infested/palm (no. of leaves infested by RSW /total leaf per palm), 2. Intensity of pest damage from 10 infested leaflet/fronds per palm from the outer/middle whorl representing four directions (no. of leaflets infested by RSW/ total leaflets per leaf) 3. Ten leaflets from each palm for assessment live colonies (Low: 0-10 live egg spiral or adult/leaflet; Medium: 11-20 live egg spiral or adults/leaflet; Severe: more than 20 egg spirals or adults /leaflets), pest stages. <u>*Isaria* infection can be observed on eggs, nymphs, adults:</u> Mycelial growth on eggs (shrunken egg, dark brownish egg), nymphs (reddish spot, shrinken body, turn into pale yellowish brownish over the time) and on adults (mummified adults: newly emerged adults unable to expand the wings, fly). Natural parasitism by *Encarsia guadeloupae* may be also observed

14. PLANT DISEASES EXPERIMENTS

14.1 Evaluation of antagonistic microbes against brown spot, blast and sheath blight of rice (Centres: ICAR-NRRI Cuttack; AAU Anand; AAU Jorhat; PAU Ludhiana; UAS Raichur)

Objective		To evaluate the antagonistic microbes against brown spot, blast and sheath blightof rice
Crop		Rice
Variety	:	Region specific recommended variety
design of experiment		RBD
Treatments		3
Replications		7
Plot size /Replication		$50m^2$
Treatment details		T1: *Pseudomonas fluoresens* NBAIR PFDWD (Seed treatment @10 g/litre +Seedling dip @ 10 gm / litre+ Foliar spray @ 10 gm/litre on standing crop at 10 days interval, i.e. 40, 50, 60 and 70 days after transplanting (DAT). T2: *Bacillus amyloliquefaciens* NRRI BS-5 (Seed treatment @10 g/litre +Seedling dip @ 10 gm / litre+ Foliar spray @ 10 gm/litre on standing crop at 10 days interval, i.e. 40, 50, 60 and 70 days after transplanting (DAT). T3:POP Recommendation (Application of Tebuconazole 50%+ Trifloxystrobin 25 %((75% WG) 1g/L T4: Untreated control
		• Per cent disease index (PDI) • Shoot and root growth (in cm) • Grain yield (Kg/ha) • C:B ratio

14.2. Evaluation of *Bacillus subtilis* TNAU BS1 against major diseases of rice (Blast and brown spot) (TNAU Coimbatore)

Objective		To evaluate the *Bacillus subtilis* TNAU BS1 against major diseases of rice
Crop		Rice
Variety	:	Region specific recommended variety
Design of experiment	:	RBD
Treatments	:	3
Replications		7
Plot size/Replication		$50\ m^2$

Treatments	:	T1-*Bacillus subtilis* TNAU BS1 (Seed treatment (10g/kg) + soil application @ 5 kg/ha+ Foliar spray @10 g/L) T1-*Bacillus subtilis* NBAIR BS1 (Seed treatment (10g/kg) + soil application @ 5 kg/ha+ Foliar spray @10 g/L) T3-POP Recommendation(Application of Tebuconazole 50%+ Trifloxystrobin 25 % (75% WG) 1g/L T3 – Control
Observations	:	• Disease incidence • Shoot and root growth • Grain yield (Kg/ha) • C:B ratio

14.3. Large scale demonstration of Plant Bioagent (PBAT-3) for the management of root rot complex disease of tomato (GBPUAT, Pantnagar, IGKV Raipur)

Objective	Large scale demonstration of Plant Bioagent (PBAT-3) for the management of root rot complex of tomato
Crop	Tomato
Variety	Region specific recommended variety
Location	Golapar area, Nainital district,Uttarakhand
Area	25 ha
Treatments	T1:PBAT -3 formulation • Seed bio-priming through Pant Bioagent formulation, PBAT-3 (*T. harzianum* Th14 + *Pseudomonas fluorescens* Psf 173) @ 10g/kg of seeds. • Seedling dip with PBAT 3@ 10 g/ L for about 30 minutes. • Two sprays of PBAT 3 @ 10 g/ L on standing crop (Tillering phase) at 10-12 days intervals T2:POP Recommendation (Carbendazim drenching @1g/L)
Observations to be recorded:	• Disease incidence (root rot complex**)** • Grain yield of crop (kg/ha) • Cost-benefit ratio.

Programme Shedule

Day 1 October 20, 2022 (Thursday)		
09.30-10.00	Registration	
10.00- 11.15	Inaugural Session	
10.00- 10.05	ICAR Song	
10.05- 10.10	Lighting of lamp	
10.10- 10.25	Welcome & Project Coordinator's report by Project Coordinator, AICRP-BC & Director, ICAR- NBAIR, Bengaluru	Dr. S. N. Sushil
10.25- 10.35	Release of publications / Technologies/ Video films/ Distribution of certificates	
10.35 -10.45	Address by Guest of Honour, Assistant Director General (PP&BS), ICAR, New Delhi	Dr. S. C. Dubey
10.45 -10.55	Address by Guest of Honour, Registrar, UAS, Bengaluru	Dr Basave Gowda
10.55 -11.10	Inaugural address by Chief Guest, Deputy Director General (CS), ICAR, New Delhi	Dr. T. R. Sharma
11.10- 11.15	Vote of thanks by PC Cell Incharge, AICRP-BC, ICAR-NBAIR, Bengaluru	Dr. G. Sivakumar
11.15 - 11.30	High Tea	
PRESENTATION OF PROGRESS REPORTS		
11.30 – 12.15	SESSION I: Panel discussion for collaboration between institutes and AICRPs	
Chair	Dr. T. R. Sharma, Deputy Director General (CS), ICAR, New Delhi	
Co Chairs	Dr. S. C. Dubey, Assistant Director General (PP&BS), ICAR, New Delhi	
	Dr. S. N. Sushil, Director, ICAR-NBAIR, Bengaluru	
Rapporteurs	Dr. A. Kandan, Principal Scientist, ICAR-NBAIR, Bengaluru Dr.Omprakash Navik, Scientist, ICAR-NBAIR, Bengaluru	
Speakers		
11.15-11.20	Dr.S.N.Sushil, Director, ICAR-NBAIR, Bengaluru	
11.20-11.25	Dr. Murali Bhaskar, Principal Scientist, ICAR-NIBSM, Raipur	
11.25-11.30	Dr. Alok K. Srivastava, Director, ICAR- NBAIM, Mau	
11.30-11.35	Dr. Subash Chander, Director, ICAR-NCIPM, New Delhi	
11.35-11.40	Dr. A. S. Baloda, Network Coordinator, AINP on White grubs& Other Soil Arthropods	
11.40-11.45	Dr.Vipin Chaudhary, Coordinator, AINP on Vertebrates Pest management	
11.45-11.50	Dr. C. Chinnamade Gowda, Network Coordinator, AINP on Acarology	
11.50-11.55	Dr Meenakshi Sundram, Director, ICAR – IIRR, Hyderabad	
11.55-12.00	Dr. Y.G. Prasad, Director, ICAR-Central Institute for Cotton Research, Nagpur	
12.00-12.05	Dr Prakash Patil, Project Coordinator (Fruits),ICAR-IIHR ,Bengaluru	
12.05-12.10	Dr. Ravi Bhat, Project Coordinator (Palms). ICAR-CPCRI, Kasaragod	
12.10-13.10	SESSION II: Basic research on biodiversity and natural enemies of insect pests at NBAIR and biological control of plant diseases	
Chair	Dr.Chandish. R. Ballal, Former Director, ICAR-NBAIR, Bengaluru	
Co –Chair	Dr.T.Venkatesan, Head (GR), ICAR-NBAIR, Bengaluru	
Rapporteurs	Dr. Deepa Bhagat, Pr. Scientist, ICAR-NBAIR, Bengaluru. Dr. B. S. Gotyal, Sr. Scientist, ICAR-NBAIR, Bengaluru	
12.15-12.20	Remark by chair	Dr.Chandish. R. Ballal
12.20-12.25	Remark by Co-chair	Dr.T.Venkatesan

12.25-12.40	Biodiversity, Biosystematics, Molecular Characterization and Biocontrol potential of bioagents (NBAIR works)	Dr.R.GandhiGracy, ICAR-NBAIR, Bengaluru
12.40-12.55	Biodiversity and Pest Outbreak reports	Dr. M. Sampath Kumar, ICAR-NBAIR, Bengaluru
12-55-13.10	Biological Control of Plant diseases	Dr.Raghunandan, AAU, Anand
13.10-13.55	Lunch	
14.00-15.10	SESSION III: Biological suppression of pests of food and fibre	
Chair	Dr. Subash Chander, Director, ICAR-NCIPM, New Delhi	
Co-Chair	Dr. Sunil Joshi, Head (DCC), ICAR-NBAIR, Bengaluru	
Rapporteurs	Dr.M.Mohan, ICAR-NBAIR, Bengaluru, Dr. B. L. Raghunandan, AAU, Anand	
14.00-14.05	Remark by chair	Dr. Subash Chander
14.05-14.10	Remark by Co-chair	Dr. Sunil Joshi
14.10-14.25	Rice	Dr. Chitra Shanker, ICAR-IIRR, Hyderabad
14.25-14.35	Maize & Sorghum	Dr.ArunkumarHosamani, UAS, Raichur
14.35-14-50	Sugarcane	Dr. P.S. Shera, PAU, Ludhiana
14.50-15.00	Tea	
15.00-15.15	Cotton	Dr. G. Anitha, PJTSAU, Hyderabad
15.15-15.30	Coconut	Dr. A. Joseph Rajkumar,CPCRI,Kayankulam
15.40 - 16.30	SESSION IV: Biological suppression of pests of oil seeds and pulses	
Chair	Dr. H. C. Sharma, Former Vice Chancellor, YSPUHF, Nauni, HP & Chairman, RAC, ICAR NBAIR, Bengaluru	
Co-Chair	Dr.A.N.Shylesha, Head (DGCU), ICAR-NBAIR, Bengaluru	
Rapporteurs	Dr. K. Selvaraj, ICAR-NBAIR, Bengaluru Dr.Shyamal Sahoo, UBKV, Pundibari	
15.40-15.45	Remark by chair	Dr. H. C. Sharma
15.45-15.50	Remark by Co-chair	Dr.A.N.Shylesha
15.50-16.10	Pulses	Dr.M.Visalakshi, ANGRAU, Anakapalle
16.10-16.30	Oil seeds	Dr.Jeyarajan Nelson, TNAU, Coimbatore
Day 2 October 21, 2022 (Friday)		
9.30 - 10.40	SESSION V: Biological suppression of pests of fruits, vegetables and polyhouse crops	
Chair	Dr. H. B. Singh, Head (Rtd), Department of Mycology & Plant Pathology, Institute of Agricultural Sciences, BHU, Varanasi	
Co- Chair	Dr. Murali Bhaskar, Principal Scientist, ICAR- NIBSM,Raipur	
Rapporteurs	Dr. P. S. Shera, PAU, Ludhiana Dr. M. Sampath Kumar, ICAR-NBAIR, Bengaluru	
09.30-09.35	Remark by chair	H. B. Singh
09.35-09.40	Remark by Co-chair	Dr. Murali Bhaskar
09.40-10.00	Tropical fruits	Dr.Gundappa, ICAR-NBAIR, Bengaluru
10.00-10.20	Temperate fruits	Dr.S.C.Verma, DrYSPUHF, Solan
10.20-10.40	Vegetables, Polyhouse crops & Flowers	Dr. B. R. Jayanthi Mala, ICAR-IIHR, Bengaluru
10.40-10.50	Tea	
10.50-13.00	SESSION VI: Technical programme for 2022-25	
Chair	Dr. S.C. Dubey, ADG (PP&BS), ICAR, New Delhi	

Co-chair	Dr.S.N.Sushil, Director, ICAR-NBAIR, Bengaluru	
Rapporteurs	Dr. Jagadeesh Patil Sr. Scientist, ICAR-NBAIR, Bengaluru Dr.B.S.Gotyal Sr. Scientist, ICAR-NBAIR, Bengaluru	
	Presentation of technical programme 2022 to 20 25	Dr. A. Joseph Rajkumar, ICAR- CPCRI, Kayankulum Dr. Jagadeesh Patil, ICAR-NBAIR, Bengaluru
13.00-14.00	Lunch	
14.00 - 15.00	SESSION VII: Institute and industry interactions	
Chair	Dr. T.M. Manjunath, Director (Rtd.), Mansanto Pvt Ltd, Bengaluru	
Co chair	Dr. M. Nagesh, Principal Scientist ICAR- NBAIR, Bengaluru	
Rapporteurs	Dr. Ramya, Scientist, ICAR-NBAIR, Bengaluru Dr. Jaydeep Halder, Sr. Scientist ICAR- IIVR, Varanasi	
Panelists (14.00-14.20)	Dr. H. C. Sharma, Former Vice Chancellor, YSPUHF, Nauni, HP & Chairman, RAC, ICAR NBAIR, Bengaluru Dr. Abraham Verghese, Former Director, ICAR- NBAIR, Bengaluru Dr. H. B. Singh, Former Professor& Head , Plant Pathology, BHU, Varanasi Dr.S.N.Sushil, Director, ICAR-NBAIR, Bengaluru Dr. S. J. Rahman, Professor, ANGRAU, Hyderabad	
Speakers (14.20-15.00)	Dr. K. Subaharan, ICAR- NBAIR, Bengaluru (NBAIR biocontrol technologies) Representatives from Private industries (5 minutes each) Dr. S. K. Ghosh, Multiplex Biotech Pvt ltd, Bengaluru Dr. Kumar S, Multiplex Biotech Head, Tumkuru Dr. Barkat Hussain Bhat, SKUAST, Srinagar	
15.00-15.20	Tea	
15.20 -17.00	SESSION VIII: Valedictory and Plenary	
Chair	Dr. T. R. Sharma, Deputy Director General (CS), ICAR, New Delhi	
Co chair	Dr.S.N.Sushil, PC, AICRP-BC & Director, NBAIR, Bengaluru	
Rapporteur	Dr. Richa Varshney, ICAR- NBAIR, Bengaluru Dr. K.T. Shivakumara, NBAIR, Bengaluru	
15.20-15.30	Presentation of recommendations by rapporteurs of each sessions	Dr. Mahesh Yandigeri, ICAR- NBAIR, Bengaluru
15.30-15.40		Dr. A. Kandan, ICAR- NBAIR, Bengaluru
15.40-15.50		Dr. Deepa Bhagat, ICAR- NBAIR, Bengaluru
15.50-16.00		Dr. M. Mohan, ICAR- NBAIR, Bengaluru
16.00-16.10		Dr. K. Selvaraj, ICAR-NBAIR, Bengaluru
16.10-16.20		Dr.M.Sampath Kumar, ICAR-NBAIR, Bengaluru
16.20-16.30		Dr. Jagadeesh Patil, ICAR- NBAIR, Bengaluru
16.30-16.40		Dr.Ramya, ICAR- NBAIR, Bengaluru
16.40-17.45	Remarks	Dr. H. B. Singh, Head (Rtd), BHU, Varanasi
16.45-16.50	Remarks	Dr. H. C. Sharma, Vice Chancellor, YSPUHF, Solan, HP
16.50-17.00	Remarks	Dr. S. C. Dubey, Assistant Director General (PP&BS), ICAR, New Delhi
17.00-17.15	Remarks by Chairman	Dr. T. R. Sharma, Deputy Director General (CS), ICAR, New Delhi
17.15.-17.30	Vote of Thanks	Dr.A. N. Shylesha, Principal Scientist, ICAR- NBAIR, Bengaluru

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Sl.No	Centres	Name of the Scientist/s
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2	AAU, Jorhat	Dr. AnjumoniDevee (PI)
3	ANGRAU, Anakapalle	Dr. M. Visalakshi (PI)
4	GBPUAT, Pantnagar	Dr. Roopali Sharma (PI)
		Dr.Bhupesh
5	KAU, Thrissur	Dr. Smitha R
6	MPKV, Pune	Dr. B. A. Bade (PI)
		Dr.N.D.Tamboli
7	PAU, Ludhiana	Dr.Kamaldeep Singh Sangha (PI)
		Dr. Neelam Joshi
		Dr. P. S. Shera
8	PJTSAU, Hyderabad	Dr. G. Anitha (PI)
9	SKUAST, Srinagar	Dr. Barkat Hussain Bhat (PI)
10	TNAU, Coimbatore	Dr. Jeyarajan Nelson (PI)
11	YSPUHF, Solan	Dr. S. C. Verma (PI)
Contingency Centres		
12	UAS, Raichur	Dr. ArunkumarHosamani (PI)
13	ICAR-CPCRI, Kayangulam	Dr. Joseph Rajkumar (PI)
		Dr. K. M. Anes
14	ICAR-IIHR, Bangalore	Dr. B. R. Jayanthi Mala (PI)
15	ICAR-IIMR, Hyderabad(Millets)	Dr. Rajesha Dr. Stanley
17	ICAR-IIRR, Hyderabad	Dr. Chitra Shanker (PI)

18	ICAR-NCIPM,New Delhi	Dr. Anoop Kumar (PI)
19	DRYSRUH, Ambajapeta	Dr. N. B. V. Chalapathi Rao (PI)
		Mrs. B. Neeraja
20	IGKV, Raipur	Dr. Jayalakshmi Ganguli (PI)
21	KAU, Kumarakom	Dr. M.K.Dhanya (PI)
22	KAU, Vellayani	Dr. RejiRani,O. P (PI)
Voluntary Centres		
23	PDKV, Akola	Dr. D. B. Undirwade (PI)
24	SKUAST - Jammu	Dr. Reena (PI)
25	UHAS, Shivamogga, Karnataka	Dr. S. Pradeep
26	DRYSRUH, Tirupati	Dr. Srinivasa Reddy (PI)
27	ICAR-SBI, Coimbatore	Dr. N. Geetha (PI)
		Dr. P. Malathi
28	WNC-ICAR-IIMR, Hyderabad	Dr. J. C. Sekhar (PI)
29	NIPHM, Hyderabad	Ms. N. Lavanya (PI)
		Dr. S. Jesu Rajan
30	College of Agriculture, Lembucherra, Agartala, Tripura	Dr. Navendunair (PI)
31	ICAR-NRRI, Cuttack	Mr. Annamalai M (PI)
		Dr. S. R. Prabhukarthikeyan
32	Manufacturers of Biocontrol Agents/Biopesticides	Dr. S. K. Ghosh, Multiplex Biotech Pvt ltd, Bengaluru Mr. S. Kumar, Multiplex Biotech Pvt ltd, Tumkuru

ACRONYMS

AAU-A	Anand Agricultural University, Anand
AAU-J	Assam Agricultural University, Jorhat
ANGRAU	Acharya N.G. Ranga Agricultural University, Anakapalle
GBPUAT	Gobind Ballabh Pant University of Agriculture and Technology, Pantnagar
KAU	Kerala Agricultural University, Thrissur
MPKV	Mahatma Phule Krishi Vidyapeeth, Pune
PAU	Punjab Agricultural University, Ludhiana
PJTSAU	Pandit Jayashankar Telangana State Agricultural University, Hyderabad
SKUAST	Sher-e-Kashmir University of Agricultural Science & Technology, Srinagar
TNAU	Tamil Nadu Agricultural University, Coimbatore
YSPUHF	Y.S. Parmar University of Horticultural and Forestry, Solan
CAU	Central Agricultural University, Pasighat
MPUAT	Maharana Pratap University of Agriculture & Technology, Udaipur
OUAT	Orissa University of Agriculture & Technology, Bhubaneswar
UAS-R	University of Agricultural Sciences, Raichur
IGKV	Indira Gandhi Krishi Viswavidhyalaya, Raipur
KAU	RARS KAU-Regional Agricultural Research Station, Kumarakom
KAU	RARS KAU-Regional Agricultural Research Station, Vellayani
YSRUH	Dr. Y S R Horticultural University, Ambajipeta
UBKV	Uttar Banga Krishi Vishwavidyalaya, Pundibari, West Bengal
CISH	Central Institute of Subtropical Horticulture, Lucknow
CPCRI	Central Plantation Crops Research Institute, Kayamkulam
CTRI	Central Tobacco Research Institute, Rajahmundry
IIHR	Indian Institute of Horticultural Research, Bengaluru
IIRR	Indian Institute of Rice Research, Hyderabad
IIMR	Indian Institute of Millet Research, Hyderabad
IIVR	Indian Institute of Vegetable Research, Varanasi
NCIPM	National Centre for Integrated Pest Management, New Delhi