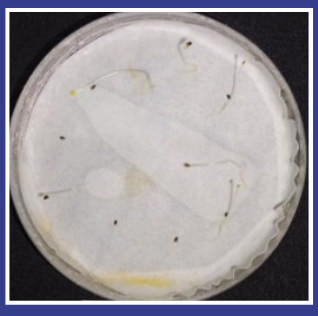
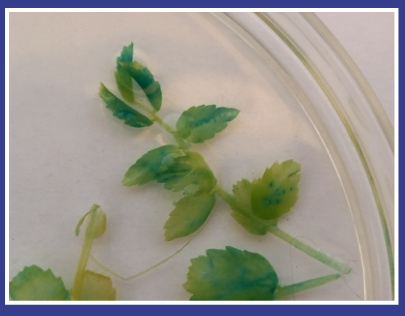
अनुसंधान सलाहकार समिति
की
सातवीं बैठक

7th MEETING
OF
RESEARCH ADVISORY COMMITTEE

8th-9th June, 2022





ICAR-National Institute of Biotic Stress Management

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1. Introduction

The Veerappa Moily Oversight Committee on the implementation of the reservation in higher educational institutions for **expansion, inclusion and excellence,** recommended the establishment of a dedicated research institute of Deemed-to-be-University Status on Biotic Stress Management. This was included in the proposal on establishment of "National Institute of Biotic Stress Management" at Raipur put up by the Department of Agriculture Research and Education (DARE), Ministry of Agriculture to Cabinet in XIIth plan. The legal status of the National Institute of Biotic Stress Management (NIBSM) is Deemed-to-be-University.

The Expenditure and Finance Committee approved 12th five-year plan outlay of National Institute of Biotic Stress Management for Rs 121.10 Crores on 3rd March, 2012 and the Cabinet approval was subsequently granted in May, 2012. After the approval of EFC proposal for the 12th plan outlay of the Institute on 3rd March, 2012, the inspection visit of the identified land by the Site Selection Committee was done on 19th March, 2012. The Foundation Stone of the ICAR-NIBSM at Raipur (Chhattisgarh) was laid on 7th October, 2012 by the then Hon'ble Union Minister for Agriculture and Food Processing Industries, Shri Sharad Pawar in the presence of Dr. Raman Singh, then Hon'ble Chief Minister of Chhattisgarh.

Initially NIBSM office started at IASRI (sub campus of NCIPM) till May 2013. Later in June 2013, Administrative office was shifted from IASRI to DSW office of Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, where four rooms were allotted to run the NIBSM office. Meanwhile the Chhattisgarh Government handed over 50.179 ha land of the erstwhile Dr.Richharia Research and Instructional Farm of IGKV located in the village Baronda, tehsil Tilda (Raipur) to ICAR-NIBSM. Dr. Radheylal Hirelal Richharia, Rice Specialist of the undivided Madhya Pradesh established this research centre that later came under IGKV. The land is fertile and has various edaphic and pedological characteristics that can be utilized in the biotic stress research on crops. Subsequently, existing buildings at Baronda farm were put under renovation for sitting and laboratory space for scientists initially where research and infrastructure development undertaken as make shift arrangement. Recently, the Administrative, Library, Auditorium, Two School buildings (School of Crop Health Management Research & School of Crop Health Biology Research) and boys' hostel are inaugurated by the Hon'ble Prime Minister of India on 28th September 2022. Now the facilities are being established.

The Institute is located at Baronda village of district Raipur (Chhattisgarh) about 30 km from the Railway station, Raipur.

2. Action Taken Report on 6th RAC Proceedings

The recommendations of the 6th RAC meeting of the ICAR-NIBSM held on 12th July 2021 and the actions taken thereon:

S. No.	Recommendations	ICAR Comments	Action Taken
A. Infrastructure and manpower			
1	Develop model farm and state-of-the-art laboratories to undertake quality research, training and collaboration in the field of biotic stress management.	Agreed. All activities should be time line.	The budget provisions have been kept in the new EFC (2021-26) for establishing state-of-the-art laboratories (Rs 6.09 Crores) as well as the model farm development (Rs 2 Crores). Purchase of equipment and establishment of laboratories is in process. Layout of the model farm has been finalized. Submitted to CPWD for preparing estimate. The work is likely to be completed in this financial year. One state-of-the-art laboratory is being developed in each school. 1. Molecular Biology and Genome editing laboratory 2. Chemical ecology laboratory 3. Pest and Pathogen Genetic Resources 4. Pest and Pathogen Monitoring Unit 5. Glass house and Plant growth facility (common facility for all school)
2.	Follow-up at council for deployment of sanctioned strength of staff	Agreed	**Scientific Category Staff:** The revised strength of Scientific Cadre of 60 scientific posts has been proposed in this EFC (2021-26). For 50 vacant positions, institute has continuously pursuing with council to fill all positions. The requirement has been emphasized during EFC (2021-26) meeting with the DG, DDG (CS) and ADG (PP & B). A detailed subject wise checklist for requisition for creation of posts has been submitted to SMD and Personnel section of the ICAR. **Administrative and Finance Category Staff:** Revised cadre strength of ICAR has allotted 39 posts of different categories of Administrative and Finance Staff. Out of which, three posts of administration (SAO, AO and one AAO) have been filled. Another AAO will join soon. Recently, one FAO post is allotted on 20th May 2022 by ICAR. Efforts are being made for filling up of other posts.

			Technical and Skilled Supporting Staff Category Posts: At present technical posts and skilled supporting staff in the institute is NIL. However, technical cadre review is under process at ICAR, with NIBSM likely to get 22 posts. Presently, the research work of the scientists is being managed through contractual staff. Pending the deployment of technical staff, NIBSM has advertised 25 Young Professionals posts to support research.
3.	Effective time management of scientists to be made to undertake research and education.	Agreed	Due to partial availability of administration cadre, scientists are engaged in administrative work and institute building activities. Owing to limited scientific staff, the time allocation of the scientists has been modified as; **Allocation of time for Research and Education** In-charge of school and Principal Scientist – 60%; Senior Scientist: 70%; Scientist: 80% Education -10% for each scientist **Other activities** (i) Extension- 10% for each scientist (ii) Nodal officer/coordinator/Officer of SCSP/TSP/NEH-10% additional in extension. **Allocation of time for institute building activities**: In-charge of school -25%; Principal Scientist-20% Senior Scientist and Scientist-10%.
B. Research			
1.	Institute should focus on basic research aiming at understanding the mechanisms and overall philosophy of host/ pathogen reaction and strategic research to develop knowledge and /or products to be utilized by commodity specific institutes/other	Agreed	Institute has reoriented the research in EFC (2021-26) subsequent to transition to school mode focusing on major five programmes; 1. Forewarning and estimation of crop losses 2. Climate change effects on chemical ecology and one health parameters 3. Ecological foundation of pest dynamics and their control in emerging production systems 4. Novel genes discovery and validation for pest resistance 5. National Strategic Crop Health Monitoring Network

	stakeholders.		
2.	Follow-up action be undertaken on the recommendations of the brainstorming sessions conducted to identify research gaps in various field of biotic stress management (developing GAPs, eg. For GM crops, AI, and understanding common philosophy of biotic stress reactions in major non-cereal crops)	Agreed. Well defined research programme should be made. Additional support may be obtained from externally funded projects.	Seven brain storming sessions have been conducted. 1. Pest dynamic relationship under emerging production system 2. Exploring antimicrobial cyclic lipopeptides producing-bacterial resources for biotic stress management: Prospects and challenges 3. Recent approaches and prospects of utilizing plant volatiles for plant protection 4. One Health under Climate-Change 5. Spatial and machine learning technique for biotic stress management **6.** Prospects and challenges for identification of novel genes for biotic stress mitigation in crops 7. Establishing National Strategic Crop Health Monitoring Network The observations/ recommendations were incorporated in developing new inter-institutional research programmes. Five projects submitted for external funding in DST-SERB and NASF
3.	Leads available in soybean isoflavones gene editing, silicon mediated tolerance to stem borer, endophytes, super-donors to be targeted to develop intermediate products.	Agreed	As per the recommendations, the leads available in soybean isoflavones gene editing, silicon mediated tolerance to stem borer, endophytes, super-donors are targeted to develop intermediate products 1.**Soybean isoflavones gene editing**: Three genes targeted in phenyl proponoid pathway, T1 plants obtained with *Isoflavone synthase* gene. 2. **Silicon mediated tolerance to stem borer**: Application of diatomaceous earth @ 150 kg per ha was found best. Technology under large area field testing against pink stem borer in wheat. The same technology is being tested in rice against yellow stem borer. 3**. Endophytes**: Effectiveness of isolate 53P against collar rot (*Sclerotium rolfsii*) and moisture stress in chickpea was tested in small plots. 4. **Super-donors in rice**: Three way crosses and back crosses were made to obtain multiple genes (5 BLB +2 Blast +2 BPH) in a common background.
4.	School of policy support research should develop effective linkages with other Government agencies	Agreed. It should be as per mandate of the institute.	Establishment of National Strategic Crop Health Monitoring Network (NSCHMN) involving various Govt. organizations is in process. Draft frame work with objectives & network partners were discussed with ICAR institutions (ICAR-NBAIR, ICAR-NBPGR & ICAR-NCIPM).Further

	involved in Policy decisions related to biotic stress management. Novel areas inviting policy interventions be identified and attempted.		meeting with the different Government institutions (NIPHM, ISRO, DRDO. DPPQS) for establishment and formulation of mode of operations will be done in the month of June 2022. Policy on relevant areas (quarantine, pesticide use, formulation and registration of biocontrol agents) will be identified during discussion with different stakeholders.
5.	Develop effective linkages and collaborations with the scientists working in different schools and with other institutions, specifically in the areas of overlapping interests	Agreed	After brainstorming sessions and suggestion of 6th RAC, the new projects have been initiated with effective collaboration with different schools and institutions on common interest. **Projects of interlinking with schools** • Development of plant volatile organic compounds (VOCs) repository for pest management (School of Crop Health Management and School of Crop health Policy). • Monitoring, forewarning and estimation of economic losses due to biotic stress in rice/ wheat crops using special and machine learning techniques (School of Crop Health Management, School of Crop Resistance System and School of Crop health Policy). • Elucidating the effect of Climate change on one health components in different agroclimatic zones of India (School of Crop Health Management, School of Crop Resistance System and School of Crop health Policy) **Projects of interlinking with NIBSM and other institutes** • Pests and disease dynamics and their management under emerging production system (ICAR-IARI, New Delhi and ICAR-DWR, Jabalpur) • Exploring microbiome diversity under emerging production system in agriculture (ICAR-IARI, New Delhi and ICAR-DWR, Jabalpur) • Study of genomic variations related to stress adaptations in weeds from selected agro-ecological zones in India (ICAR-DWR, Jabalpur) • Identification of novel genetic resource and genes in selected crop-pests system against biotic stresses (ICAR-IIHR, Bengaluru) **Inter-institutional projects collaboration for product development**

			• School of Crop Health Management is in collaboration with the Institute of Pesticide Formulation Technology, Gurugram, Haryana for development and evaluation of kairamone nano-emulsion rice yellow stem borer management • School of Crop Health Management is in collaboration with the AICRP-Biocontrol, ICAR-NBAIR, Bengaluru for multi-location testing of NIBSM *Bacillus thuringiensis* against chickpea pod borer • Development of diagnostic kits for quick detection of CTV, HLB and Phytophthora rot diseases in Citrus of North East India (ICGEB, New Delhi; IIT, IASST, Guwahati; ICAR-IARI, New Delhi; CAU, Umiam).
C. Education			
1.	NIBSM should try to develop its own education system in coming years in line with the new National Education Policy, Joint Director (Education) shall develop an education policy in collaboration with the universities / education division and get it approved by the Council.	Agreed. It must be as per new national education policy and prior approval from the council.	Considering the requirement of new educational policy, limitation of faculty at NIBSM and confining only to PG courses, NIBSM may not qualify in its present form for a Deemed University. But to maintain the status quo approved by the Cabinet (Deemed-to-be-university), a concerted efforts and discussion is needed on new education policy at Council level. However, a setup of PG education with IARI has been established and PG students (24) have been enrolled from different disciplines and eight scientists were recognized for guiding students.
2.	Institute must have MoU/ collaboration with other SAUs to attract master's and doctoral students to carry out their research work in the area of biotic stresses in the Institute.	Agreed. As per ICAR guidelines.	MoUs have been signed for research and education with the SAUs such as IGKV, Raipur; JNKVV, Jabalpur; DSVCKV, Durg and Amity University, Raipur, RVSKVV, Gwalior; Pt. Ravishankar Shukla University, Raipur; whereas MoUs are in final stage of signing with VNMKV, Parbhani. Presently eight students (M.Sc and Ph.D.) are already pursuing their research work at NIBSM from IGKV and JNKVV.

3. Vision, Mission and Mandate

VISION

Effective mitigation of biotic stresses for enhancement of farm prosperity

MISSION

Alleviating biotic stresses for increased agricultural production

MANDATE

1. Basic, strategic and adaptive research on biotic stresses in agriculture.
2. Development of quality human resources for academic excellence, linkage with various stakeholders for technology management and policy support research.

4. Organization and Structure

The Institute is headed by the Director & Vice-Chancellor and have four schools. The four schools shall be headed by the Joint Directors which in addition to research will also takeover post-graduate, doctoral and post-doctoral research and teaching. The overall research and teaching mandate shall be managed by Joint Director (Research) and Joint Director (Education), respectively. As per the Cabinet Approval, the Institute has following four schools:

1. Crop Health Management Research (CHMR)
2. Crop Health Biology Research (CHBR)
3. Crop Resistance System Research (CRSR)
4. Crop Health Policy-support Research (CHPR).

The Institute had recommendation of 200 posts from the Expenditure Finance Committee. Out of these, so far 17 posts of scientists including Director (1), Joint Directors (6), and Principal scientists (10) have been approved and created. The rest 183 posts of different cadre including Scientists (50), Technical Staff (77) and Administrative Staff (56) are taken up with the Council and Department of Expenditure, Ministry of Finance for creation of the posts.

Present Staff position at the Institute

Presently, the Institute has Director & Vice-Chancellor, JD-Research, JD-Education (Acting) and JD-School of Crop Health Biology Research (Acting). At present 18 Scientists from different disciplines are on roll of the NIBSM. Recently ICAR has given the Senior Administrative Officer, Administrative officer, Assistant Administrative officer and FAO.

Present available scientific strength at NIBSM and their ARS disciplines

Cadre	Discipline	Number
Principal Scientist (8)	Plant Pathology	1
	Agricultural Entomology	2
	Agricultural Microbiology	1

	Agronomy	1
	Land and Water Engineering	1
	Agricultural Biotechnology	1
	Veterinary Pathology	1
Senior Scientist (5)	Agricultural Biotechnology	1
	Agricultural Entomology	1
	Agricultural Extension	1
	Fish & Fisheries Science	1
	Veterinary Microbiology	1
Scientist (5)	Agricultural Biotechnology	1
	Agricultural Entomology	2
	Plant Biochemistry	1
	Animal Genetics & Breeding	1
	Total	**18**

Following the Cadre Review recommendations from the ICAR, the revised disciplines of the Scientific Cadre has been proposed for approval in the new EFC/SFC (2021-26):

S. No.	**Discipline**	**Principal Scientist/ Professor***	**Senior Scientist/ Associate Professor**	**Scientist/ Assistant Professor**	**Total**
1.	Agronomy	1	1	2	**4**
2.	Agricultural Entomology	2	3	4	**9**
3.	Plant Pathology	2	3	4	**9**
4.	Nematology	-	-	2	**2**
5.	Agricultural Biotechnology	2	1	4	**7**
6.	Bioinformatics	1	1	1	**3**
7.	Agricultural Microbiology	1	1	1	**3**
8.	Plant Physiology	-	1	1	**2**
9.	Soil Sciences	-	1	-	**1**
10.	Agricultural Chemicals	-	1	1	**2**
11.	Plant Biochemistry	-	1	1	**2**
12.	Agricultural Statistics/ Agricultural Physics	-	-	2	**2**
13.	Genetics and Plant breeding	1	1	3	**5**
14.	Veterinary Microbiology	-	-	1	**1**
15.	Fisheries Resource Management	-	-	1	**1**
16.	Veterinary pathology	-	-	1	**1**
17.	Seed science and seed technology	-	1	-	**1**
18.	Agricultural Economics	-	1	1	**2**
19.	Vegetable Science/ Fruit Science	-	-	1	**1**
20.	Agricultural Extension	-	1	1	**2**
	Total	**10**	**18**	**32**	**60**

* 10 PS posts and disciplines already approved and created

5. Research initiatives, Projects and achievements

5.1 Research Programme re-oriented as per EFC (2021-26)

The research programmes have been formulated now in school mode and accordingly proposed in the new EFC (2021-26) along with the establishment of the State-of-Art Laboratories.

Reorienting research programmes under four different schools

The ICAR-NIBSM, Raipur has four schools namely, Crop Health Management Research (CHMR), Crop Health Biology Research (CHBR), Crop Resistance System Research (CRSR) and Crop Health Policy-Support Research (CHPR) for which aims, thrust areas have been defined.

School	**Crop Health Management Research (CHMR)**	**Crop Health Biology Research (CHBR)**	**Crop Resistance System Research (CRSR)**	**Crop Health Policy-support Research (CHPR)**
Aim	*Holistic crop health management issues*	*Understanding the biology of crops as influenced by biotic stresses*	*Utilizing modern frontier science-based plant resistance sourcing and its utilization*	*Develop policies for biotic stress management in agriculture*
Thrust areas	1. Management and the inter – relationships between the host plant, the pest and the agroecology. 2. IPM, biocontrol, need based chemical control 3. To evolve novel technology of biotic stress management with respect to climate change and biorisk fervour in the WTO and IPR regimes	1. Systematics of pests/pathogens, life cycles 2. Adaptations (modes of survival, perpetuation), 3. Responses to the interactions with other organisms of economic importance (host plants, biocontrol agents and endophytes)	1. Identification of novel host resistance/ defense genes and their deployment 2. Understanding Resistance/tolerance mechanisms 3. Novel molecular approaches for understanding and stress mitigation	1. To address contextual policy frameworks that the system demands in crop health research. 2. To implement guidelines and recommendations under the auspices of Sanitary and Phytosanitary Measures (SPS measures) for plant health

New research programmes have been prepared to be taken up in next 5-10 years in above mentioned 4 schools and have been projected in the EFC (2021-26) as follows.

Research Programmes	
Flagship Programme	
1.	National Strategic Crop Health Monitoring Network (NSCHMN)
2.	Novel genes discovery and validation for pest resistance
3.	Forewarning and estimation of crop losses
Inter-institutional Programmes	
1.	Ecological foundation of pest dynamics and their control in emerging production systems.
2.	Climate change effects on chemical ecology and one health parameters.
3.	Dissecting tripartite interaction in crops affected simultaneously with biotic and abiotic stresses
Institutional Programmes	
1	Characterization, conservation and sustainable use of Pathogen and Pest Genetic Resources (PPGR) for biotic stress management
2	Molecular biology of host-pest/pathogen interaction
3	Bio-security for sustainable agriculture

These programmes have been further placed in different schools as per thrust areas and only following five programmes are undertaken on priority as per existing scientific strength. Remaining four inter-institutional and institutional programmes may be taken up in due course with the availability of fund and manpower as per creation.

School	Crop Health Management Research (CHMR)	Crop Health Biology Research (CHBR)	Crop Resistance System Research (CRSR)	Crop Health Policy-support Research (CHPR)
Flagship programme	Forewarning and estimation of crop losses	-	Novel genes discovery and validation for pest resistance	National Strategic Crop Health Monitoring Network (NSCHMN)
Inter-institutional programme	Climate change effects on chemical ecology and one health parameters	Ecological foundation of pest dynamics and their control in emerging production systems.	-	-

Research projects at ICAR-NIBSM, Raipur

A. Institute Funded Projects (completed during 2021-22 and on-going)

S. No.	Schools	Project code	Project title	Duration	Status

1	School of Crop Health Management Research	SCHMR 1	Development of plant volatile organic compounds (VOCs) repository for pest management	2021-26	On-going
		SCHMR 2	Monitoring, forewarning and estimation of economic losses due to biotic stress in rice/ wheat crops using special and machine learning techniques	2021-25	On-going
		SCHMR 3	Impact of climate change on fitness and gut microbial diversity of fall armyworm, *Spodoptera frugiperda*	2021-26	On-going
		SCHMR 4	Elucidating the effect of Climate change on one health components in different agro-climatic zones of India	2022-26	On-going
		4.5	Isolation and development of efficient native biocontrol agents of Chhattisgarh for management of lepidopteran pests	2016-21	Completed
		3.2	Isolation and characterization of secondary metabolites of *Chromobacterium* species for mitigation of biotic stress in agriculture	2018-22	Completed
		1.5	Exploring host-microbial cross-talk in agro-ecosystem of Bastar plateau zone of Chhattisgarh	2018-21	Completed
2	School of Crop Health Biology Research	SCHBR 1	Pests and disease dynamics and their management under emerging production system	2021-26	On-going
		SCHBR 2	Exploring microbiome diversity under emerging production system in agriculture	2021-26	On-going
		SCHBR 3	Study of genomic variations related to stress adaptations in weeds from selected agro-ecological zones in India	2021-26	On-going
		4.6	Evaluation of allelopathic potential in rice and selected weeds for weed management	2018-22	On-going
		3.3	Anti-microbial cyclic lipopeptides (AMLs) producing *Bacillus* species for managing diseases in selected crops (merged with new project)	2020-22	On-going
		1.3	Mapping of genetic groups of *Bemisia tabaci* in India and their begomovirus transmission	2018-22	Completed

			efficiency		
		1.4	Identification and characterization of bacteriophages against rice bacterial leaf blight pathogen *Xanthomonas oryzae* pv. *oryzae*	2018-22	Completed
		2.4	Epigenetic regulation of microRNA genes in response to *Fusarium* stress in chickpea	2018-21	Completed
3	School of Crop Resistance System Research	SCRSR 1	Identification of novel genetic resource and genes in selected crop-pests system against biotic stresses	2021-26	On-going
		SCRSR 2	Deciphering molecular mechanism and metabolic network involved in imparting resistance to biotic stresses in plants	2021-26	On-going
		SCRSR 3	Gene function analysis and mitigation strategies for biotic stresses in the selected crops-biotic stresses	2021-26	On-going
		2.2	Identification of biotic stress induced promoters from resistance source plants	2018-22	On-going
		2.3	Development of super donors in rice carrying tolerance to multiple stresses (Bacterial leaf blight, Brown plant hopper and Blast)	2018-22	On-going
		2.5	Deciphering the role of isoflavones in differential reaction to yellow mosaic disease in soybean	2019-22	On-going
		2.6	Deciphering silicon mediated defence against yellow stem borer in rice	2019-22	On-going
		2.7	Cytological and molecular basis of organ specific resistance to blast disease in finger millet	2020-23	On-going
4	School of Crop Health Policy Support Research	SCPSR1	Pest risk analysis of agriculturally important potential invasive pest and diseases in India	2021-26	On-going
		4.2	Bio-ecology and management of the pink stem borer in wheat	2016-21	Completed

B. External Funded Projects (completed during 2021-22 and on-going)

S. No.	Project Code	Project Title	Year	Funding Agency	Budget (Rs. In Lakh)	Status
1.	EF008	Identification of host factors responsible for infection and development of nano-particle based dsRNA delivery system	2018-21	NASF	317.53 (NIBSM 106 Lakhs)	Completed

		for imparting resistance to begomoviruses				
2	EF005	AICRP on nematodes in cropping systems	2014 onwards	ICAR	6.38 (2021-22)	On-going
3.	EF006	Socio-economic upliftment of tribal farmers through biotic stress management strategies in rice fallow pulse cropping system - An integrated farming approach (Farmer FIRST)	2016-23	ICAR	167.75	On-going
4.	EF009	Establishment of Biotech-KISAN Hub at ICAR-National Institute of Biotic Stress Management	2020-22	DBT	214.00	On-going
5.	EF010	In-situ diagnosis and digital cataloguing of plant-pathogenic fungi through Foldscope Microscopy - A frugal science approach	2020-23	DST	41.11	On-going
6.	EF011	Development of diagnostic kits for quick detection of CTV, HLB and Phytophthora rot diseases in Citrus of North East India	2021-24	DBT	66.968	On-going
7.	EF012	National Agricultural Innovation Fund- Component I	2020 onwards	ICAR	11.04	On-going
			Total		**824.778**	

C. Projects submitted for external funding during 2021-22

S. No.	Project Title	Duration	Funding Agency	Budget (INR lakhs)
1.	Deciphering the silicon-induced secondary metabolites against yellow stem borer (*Scirpophaga incertulas* Walker) in rice (*Oryza sativa* L)	3 years	DST-SERB (CRG)	40.019
2.	Effect of climatic variable-induced changes in host plant preference and volatile emission on fitness of invasive pest, fall army worm	3 years	DST-SERB (CRG)	86.656
3.	CRISPR/Cas9 mediated engineering of phenyl propanoid pathway to divert the metabolic flux towards isoflavone accumulation in soybean for resistance against yellow mosaic disease	3 years	DST-SERB (CRG)	41.420

D. Project proposals submitted for funding under NASF/AMAAS

S. No.	Project title	Lead Centre

1.	Simulating Diffusion of technologies using GIS based mapping resources and techno-socio-psycho-economic-ecological factors (NASF)	ICAR – NRRI, Cuttack
2.	Agripreneurship for Sustainable Agricultural Development: Technological and Institutional Innovations and Strategies (NASF)	ICAR- NAARM, Hyderabad
3.	Use of untapped native microbial resources of Chhattisgarh for biocontrol of key biotic stresses of chickpea (AMAAS)	ICAR-NBAIM, Mau

5.2. Brief Research achievements for the period 2021-22

A total of 32 research projects were carried out during the period of the report (2021-22) including 25 Institute funded and 7 externally funded projects from ICAR-AICRP, ICAR-FFP, ICAR-NASF, DBT and DST. Out of 25 institutionally funded projects 7 are completed and 18 are presently running. Among the seven externally funded projects, one is completed. The details of individual projects and their progress are given in section 10.

The research achievements are summarized and presented school wise

School of Crop Health Management Research (SCHMR)

Research work on host-microbial cross talks in various agro-ecosystems, secondary metabolites of *Chromabacterium* spp., with antimicrobial principles and native biocontrol agents for Lepidoptera pests management were undertaken during the period of report.

- The efficacy of kairomone gel formulation in enhancing the foraging activity of *Trichogramma japonicum* against rice yellow stem borer was evaluated during summer 2021. Application of octadecane 500 ppm, 24 hr after each release of *T.japonicum* reduced the symptoms of dead heart and white ear caused by yellow stem borer over control by 38.1% and 34.1%, respectively while they were 31.16% and 25.60% in wasp alone released plots. Application of kairomone can enhance the biocontrol potential of *T. japonicum* against rice yellow stem borer.
- The bioefficacy of three selected native *Bacillus thuringiensis* isolated from the soils of Chhattisgarh were evaluated in pot cowpea plants against *Spodoptera litura*. The mean leaf damage was the lowest (26.96%) in N*Bt* 18, followed by N*Bt*27 (31.69% leaf damage) and N*Bt*31 (30.77% leaf damage) as compared to control plants (42.60% leaf damage). Three native *Bt* are found to provide good efficacy in causing mortality on *S. litura* both under lab and *in planta* conditions.
- A study on *cry* gene profiling of three promising native *Bt*, using PCR and specific primers indicated the presence of five *cry* genes (*Cry1, Cry2, Cry y3, Cry7, Cry8*) in NBT-18, seven in NBT-27 (*Cry1, Cry2, Cry3, Cry y3, Cry4, Cry9, Cry11*), seven in NBT-31 (*Cry1, Cry2, Cry3, Cry4, Cry9, Cry11, Cyt1*) and six in VLT *Bt* -6 (*Cry1, Cry2, Cry y3, Cry5, Cry7, Cyt1*).
- The secondary metabolites of *Chromabacterium* spp., (W1B-GG, TRFM) suppressed the growth of *Fusarium oxysporum* f. sp. *carthami, F. oxysporum*f. sp. *cumini, Macrophomina phaseolina* (Cluster bean), *M.phaseolina*(Chickpea), *Sclerotium rolfsii* and *Aspergillus fumigates*. Antibacterial activity of W1B-GG and TRFM against *Corynebacterium* spp., was evident. Crude extract of W1B-CG inhibited sporulation and deformation of the oocysts, collected from intestine of Kadaknath breed of poultry. Soaking of *Parthenium* seeds in violet pigment solution extracted from *Chromabacterium* spp. at 1000 ppm inhibited seed germination by 43%.

- In order to study the shift of host system, influencing crop and animal diseases, samples were drawn from different integrated farming systems of Bastar Plateau agro-ecosystems of Chhattisgarh during monsoon, winter and summer seasons. Out of 1145 bacteria recovered, the highest number (435) was recovered from forest based agroecosystem, followed by crop based and animal based agroecosystems. Similarly maximum number of bacteria (605) was recovered during monsoon season. Characterization of these bacteria can be useful to identify economically important bacteria.

School of Crop Health Biology Research (SCHBR)

- In order to identify the genetic groups of whitefly present in the mapped and unmapped areas, a pan India collection of whitefly samples were done from different crops. Out of 365 whitefly samples collected from 10 states of India, five genetic groups including Asia I India, Asia II-5, Asia II-7, MEAM-1 and Asia III were identified. Asia II-7 and MEAM-1 were predominant while Asia III was reported for the first time in Punjab. Further Tomato leaf curl Karnataka virus transmission efficiency by MEAM-1 and Asia II-7 was studied under controlled condition. The begomovirus transmission efficiency was determined to be 50-55% for Asia II-7 and 80-85% for MEAM-1 in tomato. It is concluded that the transmission efficiency of MEAM-1 is higher than Asia II-7.
- Bacteriophage is a potential biocontrol agent to manage crop diseases. During survey in Chhattisgarh, 19 bacteriophages isolates were recovered which belonged to the order Caudovirales and the families, Myoviridae (4 isolates), Siphoviridae (12 isolates), Podoviridae (2 isolates) and unclassified (1 isolate). In a pot plant experiment, rice plants (cv. TN1) infected by *Xanthomonas oryzae* pv. *oryzae* pathogen at 2 x 10^8cfu/ml, followed by bacteriophages at 2 x 10^7cfu/ml significantly reduced the symptoms of BLB in phage treated rice plants compared to untreated control plants.
- Methionine S-methyltransferase (*MSMT*) in chickpea was found to be regulated by few miRNAs when the plant was under *Fusarium* stress. Hence, the study was focused to characterize the *MSMT* in chickpea. Phylogenetic analysis of different varieties of chickpea infected with *Fusarium* wilt indicated the presence of proteins with 32 sequences. Further analysis on 10 unique protein sequences based on phylogenetic relationship indicated that three conserved domains of *MSMT* were found at variable positions across all the homologous protein sequences.
- Soaking of scarified *Parthenium* seeds in benzene extracts of *Malachra capitata* roots for four hours inhibited the *Parthenium* seed germination by 56%.
- Antimicrobial cyclic lipopeptides produced by *Bacillus* spp., have been reported to possess good antimicrobial activity. In order to map the diversity of AMP possessing *Bacillus* in Chhattisgarh, 100 *Bacillus* isolates were recovered from soils of Raipur, Bemetra and Kawardha. Out of them, IS-10, GS-5 and GS-10 isolates significantly inhibited *Fusarium oxysporum* f. sp. *cicris* in chickpea with 67.14, 65.71 and 62.86 % inhibition, respectively.

School of Crop Resistance System Research (SCRSR)

- A novel agroinoculation technique for enhancing infection efficiency of *Mungbean* yellow mosaic India virus (MYMIV), transcriptome profiling of MYMIV infection in *mungbean*(host) and tomato (non host), development of microcage for single whitefly infection study, promoter for isoflavone synthase gene in soybean, rice bacterial leaf blight (BLB) resistant genes *viz., xa13 and Xa 21*, identification of soybean genotypes resistant to MYMIV, role of *Nicotiana benthamiana* seed priming with flavonoids against tomato leaf curl Karnataka virus (ToLCKV), super donor rice to multiple stresses and bacterial

endophyte for management of chickpea fungal diseases are few research leads obtained during the reporting period of SCRSR.

- The acquisition and inoculation efficiency of two begomoviruses, MYMIV and ToLCKV was found to be higher using superior micro-cage (100%) compared to macro-cage method (70-75%). The micro-cage technique is useful for monitoring of whitefly feeding as well as studying its biological parameters and transmission studies of virus.
- Incubation of pin-pricked epicotyl region after removing one cotyledon of *mungbean* sprouted seeds in 1.0 OD of agroculture containing dimeric construct of MYMIV for 2-4 hrs without acetosyringone has induced 100% infection of MYMIV within 10-12 days on first trifoliate leaf. This method has potential to screen the germplasm lines, and will be useful in *mungbean* biological/virological studies and resistance breeding programme in *mungbean* against MYMIV.
- Differential reaction of soybean mini-core sub-set to yellow mosaic virus diseases was studied by artificial inoculation of virus through whitefly on resistant and susceptible soybean genotypes under controlled condition. The genotypes *viz.,* CAT-1318, CAT-156, CAT-1808, CAT-411B, EC-456647 were found to be resistant to MYMIV.
- The influence of flavonoids on the infection of ToLCKV was studied through seed priming. The *N. benthamiana* plant primed with crude extract of flavonoid in seed stage recorded lower load of ToLCKV genomic DNA *ie*., 28 times lesser than the unprimed plants which clearly indicated the role of flavonoids on the inhibition of ToLCKV infection.
- Bacterial endophyte, 53P was found to protect the chickpea plants from *Sclerotium* rot and drought under micro-plot condition.
- In order to develop super donors in rice having genes for multiple stress tolerance genes for BLB, BPH and Blast resistance, crosses were made to introgress BPH and Blast resistance genes in the IRBB66 background namely (i) IRBB66 x BPH resistant lines; (ii) IRBB66 x blast resistance lines followed by (BLB + blast) F1 x Bph line; (BLB+ Bph) F_1 x Blast resistance lines and developed seeds were harvested for further analysis.

School of Crop Health Policy Support Research (SCHPR)

- Soil application of Silicon was evaluated in large plot areas for the management of wheat pink stem borer during *rabi*2020-21. The per cent white ear damage in Si treatment was significantly low (8.54%) in comparison to control (15.24%). Similarly, yield was also significantly higher in Si treatment (2.9 t/ha) in comparison to control (2.03 t/ha).
- During the period of report, 170 trainings, 95 demonstrations, 15 front line demonstration and 11 field days were conducted under FFP, Biotech KISAN and DST SYST Foldscope projects, respectively in which 278 women farmers, 475 village youths, 37 SC farmers and 531 ST farmers were benefitted. A total of 49 technologies were popularized while 1070 technologies and POP were adopted by farmers. A total of 30 extension literature were published to popularize various technologies.
- Under Biotech KISAN project, biocontrol agents were evaluated in Zinco MS rice for management of yellow stem borer during summer 2021. The Zinco MS rice along with YSB pheromone trap and split release of wasps recorded 19.1 per cent reduction in dead heart symptom over control as against Zinco MS rice alone. The reduction in dead heart and white ear symptoms over control were 26.9% and 19.2%, respectively in MTU 1010 rice treated with YSB pheromone trap and split release of wasps.
- A biocontrol lab was established for mass production of native *Trichogramma* spp., in the main hub of Biotech KISAN project, in which A total of 1486 cc of Tricho cards (824 cc of *T. japonicum*, 662 cc of *T. chilonis*) were supplied to farmers which covered 237.76 ha of *kharif* and *rabi* crops for management of key Lepidoptera pests.

The outcome of the research reflected in 13 research publications in the refereed journals, three bulletins, 12 book chapters, 31 extension folders and eight popular articles, & 4256 farmers were benefitted due to extension and outreach programmes during the period of reports.

5.3 Meetings, trainings (conducted and received) and participation in conferences/ workshops

During this period 18 international monthly lecture series organized (UK, USA, Ireland, Australia, India, Finland, Netherland and Philippines) and 04 workshops/ training conducted, institute scientists have attended 20 symposia/seminar/training programmes including in virtual mode and three lectures were organized on different occasions (Table 8.3-8.7)

5.4 Publications and Awards

1. **Summary of publications during 2021-22**: (For details Table 8.9)

- Research and review papers: 13
- Book chapters: 12
- Extension bulletins 03
- Extension folders: 31
- Popular articles 08

2. **Awards and fellowship to NIBSM scientists:** Five awards and recognition were received by the NIBSM Scientists (Table 8.10).

6. Progress Report on Education

Education by awarding Post-Graduate, Doctoral and Post-Doctoral degrees to build capacity for state-of-the-art research in the area of biotic stress is one of the important mandates of the ICAR-NIBSM. During the year, ICAR-NIBSM actively persuaded and coordinated for faculty recognition, teaching of courses by NIBSM faculty, finalisation of research topics and admission of students for academic session 2021-22 to address its educational mandate.

(1) Recognition to ICAR-NIBSM Faculty: Previous year 16 scientists from different disciplines were recognized as faculty member for teaching in ICAR-IARI, New Delhi. During 2021-22, four more scientists have been recognized by ICAR-IARI as per their credentials for teaching and / or research dissertation.

(2) Postgraduate Programme: 24 M.Sc. students were admitted in different disciplines for the last two years as given below:

S.No.	Discipline	No of seats allotted for the batch 2020-22	No of seats allotted for the batch 2021-23
1	Agronomy	2	2
2	Agricultural Entomology	2	4
3	Agricultural Microbiology	1	2
4	Molecular Biology & Biotechnology	2	4
5	Plant Pathology	1	2
6	Genetics and Plant Breeding	0	2
	TOTAL=	**8**	**16**

(3) Teaching of M.Sc. Courses: The academic year 2020-21 started with effect from 28 Dec, 2020. However, due to pandemic Covid-19 situation courses were taught online during the first and second semesters. Following faculty members of ICAR-NIBSM were associated with ICAR-IARI faculty in the teaching of M.Sc. courses:

S.No.	Name	Course title
1	Dr. A. Dixit, Principal Scientist & Joint Director (A)	Principles & practices of weed management)
2	Dr. R.K. Murali Baskaran, Principal Scientist	(i) Insect behaviour (ii) Commercial entomology & (iii) Plant biosecurity & biosafety
3	Dr. S.K. Sharma, Principal Scientist	(i) Soil microbiology (ii)Biofertilizer technology
4	Dr. K.C. Sharma, Principal Scientist	(i) Major pests of crops & their management(ii) Agricultural ornithology
5	Dr Vinay Kumar, Senior Scientist	(i) Principles of biotechnology
	Dr Mallikarjuna J, Senior Scientist	(i) Commercial entomology
6	Mr. Lalit L. Kharbikar, Scientist	(i) Genomics
7	Dr. Ashish Marathe, Scientist	(i) Basic biochemistry (ii)Intermediary metabolism

(4) Meetings: Board of Studies committee at ICAR-NIBSM is in place under the Chairmanship of the Director. During the period, education cell organised Board of Studies meeting on 02.03.2022 and taken up various academic issues. A faculty-student interaction meeting was also conducted on 15.01.2022.

7. Linkages and Collaborations

Linkages and collaborations are being developed by the Institute with various institutions, and universities involved in agricultural research and education (Table 11). The collaborations are being done to develop research projects on areas of mutual interest and shall help in sharing of infrastructure and manpower facilities.

The institute has signed MoU for research and education with Indian Agricultural Research Institute (ICAR-IARI), New Delhi; Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur; Indira Gandhi Krishi Vishwavidyalaya, Raipur; Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Durg (Raipur); Rajmata VijayarajeScindia Krishi Vishwa Vidyalaya, Gwalior; Amity University Chhattisgarh, Raipur; Pt. Ravi Shankar Shukla University, Raipur; ICAR-NBAIR, Bengaluru; ICAR-IIAB, Ranchi and ICAR-DWR, Jabalpur; NEHU, Shillong and Institute of Pesticide Formulation Technology, Gurugram.

MoUs are in final stage of signing with Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani; National Institute of Plant Genome Research (NIPGR), New Delhi; and other ICAR institutes. Totally, two M.Sc and six Ph.D. students from these institutes are already pursuing their research work at NIBSM.

As a lead centre of the ICAR-National Agricultural Science Fund (NASF) sponsored research project, the ICAR-NIBSM conducting the research with its partner Institutes, NIPGR, New Delhi, ICAR-IARI, New Delhi and Indian Institute of Technology, Delhi. The NIBSM has collaboration with Indian Institute of Technology, Guwahati; ICAR –IARI, New Delhi; Institute of Advanced Study in Science and Technology, Guwahati and Central Agricultural University, Umiam under DBT project. Collaborations have been made with CGIAR Institutes including IRRI, The Philippines; IITA, Nigeria; and ICRISAT, Patancheru, and also with ICAR-NBPGR, New Delhi and other institutes for introduction of wild species, core collection and germplasm of different crops.

The institute has been in active collaboration with Krishi Vigyan Kendras (KVKs) of Chhattisgarh to undertake its outreach programmes and projects such as Farmer FIRST programme and DBT-BIOTECH-KISAN. The Zonal Project Directorate (Zone VII) collaborated for capacity enhancement programme (CEP) of the subject matter specialists of the KVKs in Chhattisgarh state. Institute has a close collaboration with various departments of the Chhattisgarh state such as Department of Agriculture, Horticulture, Animal Husbandry and Veterinary Services, Fisheries, Rural Development Agencies and SAMETI to identify areas of research and extension activities. Scientists of the Institute participate in the training and extension programmes organized by the various state departments.

8. Tables

Table 8.1**Genbank submissions (During 2021-22)**

S. No.	Details	Accession nos.
1-2	Complete nucleotide sequences of begomovirus infecting *Cajanus scarabaeoides.* (DNA A and B)	OM397101-OM397102
3-4	*Isoflavone synthase 1* CDS from *Glycine max* genotypes CAT-1808 and CAT-313A	OK428549- OK428550
5-6	*Isoflavone synthase 1* Promoter from *Glycine max* genotypes CAT-1808 and CAT-313A	OK428551- OK428552

- 16 Bacteriophage isolates genome have been sequenced and submission is in process
- COI gene sequence of 509 *Bemisia tabaci* samples from pan India is sequenced and submission in GenBank is in process.

Table 8.2 **Extension & Outreach Programmes during 2021-22**

S. No.	Activities	MGMG	SCSP	TSP	NEH
1.	Total farm families covered	1035	584	365	1210
2.	Total villages covered	15	18	20	33
3.	Total Districts covered	02	02	2	10
4.	Capacity building programmes organized	52	06	6	22
5.	Total farmers benefitted under capacity building	960	584*	215	1329
6.	Agricultural interventions	-	5(Scientific cultivation of rice, chickpea and pigeon pea (bund cultivation), Introduction of Medicinal and Aromatic plants, Providing improved and hybrid seeds of vegetables Training & demonstration of apiculture and distribution of apiculture kits and accessories, Promoting use of solar energy by	5 (Apiculture, Floriculture cum apiculture, Quail rearing, Duckery cum fishery & Mushroom cultivation)	10 (Improved composting methods, farm equipment for hill agriculture, mushroom and spawn production. Vermicomposting, value addition, Plant health management of citrus, potato and cole crops, IFS, Silkworm rearing, Scientific poultry and pig rearing, vegetable cultivation and fish farming)

			providing solar pumps)		
	Total allocation (INR lakhs)		138.5 (70 General + 68.8 Capital)	55.0	24.485

* Training cum input distribution programme organized at ICAR-NIBSM, Raipur

Table 8.3 (a) **Workshops/Symposium/Seminar/Conference/training etc organized by the Scientists**

S. No.	Symposia/seminar/training	Period	Venue/organized by	Name of scientist
1.	Two days Training programme on "Designs of experiments and Next Generation Sequencing Data Analysis" (Virtual)	16-17.3.2021	NIBSM, Raipur	Dr. S. K. Jain Dr. Ashish Marathe
2.	Intellectual Property Rights in Agriculture	20.3.2021	NIBSM, Raipur	Dr. S. K. Jain Dr. Ashish Marathe
3.	Rice seed distribution cum training	23-24.6.2021	NIBSM, Raipur	Dr. Vinay Kumar
4.	World Farmers Day	23.12.2021	NIBSM, Raipur	Dr. P. Mooventhan Dr. R. K. Murali-Baskaran
5.	Two-day workshop on Emerging IP Issues and Innovation Changes for better Technologies	15-16.3.2022	NIBSM, Raipur	Dr. S.K. Jain Dr. Ashish Marathe

Table 8.3(b) **Training Organized under FFP, DBT and DST projects running in ICAR-NIBSM**

S. No.	Name of the activity	Place	No. of Participants
1	Training cum demonstration on utility of foldscope microscope	Raipur & Dhamtari	287
2	Training cum demonstration conducted on the various agriculture intervention (mushroom production, biotic stress management of crops, IPM, management of native breed goat and poultry, vegetable cultivation, Soil treatment with biofertilizers, etc)	Kasdol & Rajnandgaon	621
		Sonsaytola, Rajnandgaon	424
		Mahasamund	120
		Korba	258
3	Hand's on training organized on the making and use of low-cost light trap, oyster mushroom production etc	Kasdol	42
		Total=	1752

Table 8.4 **Workshops/Symposium/Seminar/Conference/training etc attended by the Scientists**

S. No.	Symposia/seminar/training attended	Period	Venue/ organized by	Name of scientist

1.	International Conference on Microbial World: Recent Development in Health, Agriculture and Environmental Sciences (Virtual)	3-5.2.2021	Indian Network for Soil Contamination Research (INSCR) in association with TERI, University of Delhi, IARI&INSA	Dr. Lata Jain
2.	Alternative Therapies to Mitigate Microbial Resistance (Virtual)	23-24.2.2021	ICAR-IVRI and NABARD	
3.	One Health Approach for Controlling Zoonoses (Virtual)	6.7.2021	ICAR-NRC on Camel, Bikaner	
4.	Designs of experiments and Next Generation Sequencing Data Analysis (Virtual)	16-17.3.2021	ICAR-IASRI, New Delhi	All scientists
5.	Intellectual Property Rights in Agricultural Research (Virtual)	20.3.2021	ICAR-NIBSM under NAIF	All Scientists of NIBSM, Raipur
6.	FADC virtual meeting	23.3.2021	Bureau of Indian Standards	Dr. S. K. Ambast, JD (Education) i/c
7.	International Conference on Agricultural Extension and Advisory Services: Innovations to Impact (Virtual)	25-27.2.2021	MANAGE, Telangana	Dr. P. Mooventhan
8.	Blockchain-Disrupting the Agriculture Sector (Virtual)	6.3.2021	MANAGE - Centre for Innovation and Agripreneurship, Telangana	
9.	4th meeting of Reconstituted Programme Steering and Monitoring Committee (PSMC) under Biotech-Krishi Innovation Science Application Network (Biotech-KISAN) (Virtual)	20.3.2021	DST, New Delhi	
10.	Centre for Innovation and Agripreneurship: Offerings and Opportunities for Agri-Start-ups (Virtual)	3.4.2021	MANAGE - Centre for Innovation and Agripreneurship, Telangana	
11.	28th Zonal Review Workshop of KVKs of ICAR-ATARI, Jabalpur (Virtual)	26-28.7.2021	ICAR-Agricultural Technology Application Research Institute, Jabalpur, Madhya Pradesh	
12.	International Workshop on Policy Initiatives for Attracting Youth and Preventing Attrition in	6-8.4.2021	Asian Productivity Organization (APO), Japan at Indonesia	

	Agriculture (Virtual)			
13.	26th Meeting of ICAR Regional Committee No. VII (Virtual)	25.8.2021	ICAR-Central Institute of Agricultural Engineering, Bhopal, Madhya Pradesh	
14.	International Conference on Recent advances on Agriculture, Engineering & Biotechnology (ICRAAEBFS) for food Security (Virtual)	25-26.9.2021	Mahima Research Foundation and Social Welfare, BHU, Varanasi and Lovely Professional University, Phagwra (Punjab)	
15.	International Conference on "Vegetable Research and Innovations for Nutrition, Entrepreneurship and Environment (Virtual)	14-16.12.2021	ICAR-IIVR, Varanasi	
16.	First Asian PGPR-Indonesia Chapter International E-conference on Sustainable Agriculture & Eco-tourism (Virtual)	28-30.8.2021	Udayana University, Bali, Indonesia	Dr. S. K. Sharma
17.	International Agronomy Congress on Agri Innovations to Combat Food and Nutrition Challenges	23-27.11.2021	Indian Society of Agronomy, ICAR and PJTSAU, Hyderabad	Dr.Anil Dixit Dr.Mallikarjuna, J.
18.	Virtual MDP on Priority Setting, Monitoring and Evaluation (PME) of Agricultural Research Projects	25-30.10.2021	ICAR-NAARM, Telangana	Dr.S. K. Jain
19.	Virtual training on Wheat Blast and Fusarium Head Blight	16-17.12.2021	CIMMYT in collaboration with ICAR-IIWBR and lead institutions of other countries in S Asia and S East Asia	
20.	A Climate for Change's 2021 Annual General Meeting (Virtual)	21.11.2021	Climate for Change Australia	Dr.S. K. Sharma
21	National Conference of Virology (Virtual mode) on "Emerging and Re-emerging Viral Diseases – Climate Change Impacts and Mitigation (virtual mode)	26-28.03.2022	Department of Microbiology, All India Institute of Medical Sciences, Bibinagar, Hyderabad, Telangana organized Under the aegis of Indian Virological Society	Dr. Lata Jain
22	Workshop on Emerging IP issues and Innovation Changes for better	15-16.03.2022	ICAR-NIBSM, Raipur	

	Technologies			
23	Workshop on Emerging IP issues and Innovation Changes for better Technologies	15-16.03.2022	ICAR-NIBSM, Raipur	Dr. Mallikarjuna, J
24	Online Training on Metagenomics data analysis	19-24-01-2022	ICAR-IASRI, New Delhi	Dr. Vinay Kumar
25	Workshop on Emerging IP Issues and Innovation Changes for better Technologies	15-16.3.2022	ICAR-NIBSM, Raipur	All scientists, students

Table 8.5 **Monthly seminar delivered by international scientists**

S. No.	Topic of seminar	Date	Details
1	Epigenetic Control of Seed Development	27.01.2021	Dr. Marry Gehring, Associate Professor of Biology, Whitehead Institute for Biomedical Research, Cambridge, MA 02142, USA.
2	Biotic and abiotic stress tolerance: A roadmap for sustainable agriculture.	10.02.2021	Dr. Kiran Mysore, Professor, Noble Research Institute, 2510, Sam Noble Parkway, Ardmore, Oklahoma, USA.
3	Novel components of the Polycomb Group pathway and their roles in plant development	10.03.2021	Dr.Sara Farrona, The Ryan Institute Aras de Brun, ADB-2008, National University of Ireland, Galway.
4	Harnessing plant microbiome to manage biotic and abiotic stresses in agriculture	19.04.2021	Dr.Brajesh Singh, Professor, Western Sydney University, Locked Bag 1797, Penrith NSW, Australia
5	Adaptive trait diversity, molecular mechanisms, herbicide resistance evolution, response to climate change and management of Italian ryegrass	24.05.2021	Dr. AniruddhaMaity, Texas A&M University, USA
6	A genomics perspective for managing biotic stress management	15.06.2021	Dr. Rajeev Varshney, ICRISAT, Pattanchru, India
7	Harnessing Plant-Microbiome Interactions for Disease Management	19.06.2021	Dr. Pankaj Trivedi Colorado State University, Fort Collins, CO 80523, USA
8	Modernizing Breeding Programs through Breeding Management System and Linking Various Informatics Solutions	12.08.2021	Dr. Abhishek Rathore, ICRISAT, Pattancheru, **India**
9	How native plants manage complicated ecological interactions	16.08.2021	Prof. Ian T. Baldwin, Max Planck Institute for Chemical Ecology, Jena, **Germany**
10	Use of artificial intelligence for biotic stress management.	28.08.2021	Prof. V K Tiwari, Director, IIT, Kharagpur, **India**
11	Climate-resilient rice hybrids	09.09.2021	Dr. Jauhar Ali, International Rice Research Institute, **Philippines**
12	The root microbiome and plant health	24.09.2021	Prof. M.J. Pieterse, Utrecht University, **Netherlands**
13	NIBSM foundation day Lecture on	07.10.2021	Dr.Sophien Kamoun, The Sainsbury

	"keeping up with Plant Killers"		Laboratory (TSL), Norwich, **UK**
14	The importance of open science in modern data-intensive research	19.10.2021	Dr. Leo Lahti, University of Turku, **Finland**

Table 8.6 **Monthly seminar delivered by ICAR-NIBSM scientists**

S. No.	Topic of seminar	Date	Details
1	IPR in Agriculture-An Overview	30.01.2021	Dr. P. Mooventhan, Scientists of NIBSM, Raipur
2	Plasma technology in plant disease management	29.05.2021	Dr. S.K. Jain, NIBSM, Raipur
3	Silicon mediated resistance against herbivores	26.06.2021	Dr.Mallikarjuna, J., NIBSM, Raipur
4	Quorum sensing in Bacteria	4.8.2021	Dr. B.K. Choudhary, NIBSM, Raipur

Table 8.7 **Lectures delivered by NIBSM scientists on different occasions**

S. No.	Topic of seminar	Date	Organized by	Delivered by (Dr.)
1.	World Water Day	22.3.2021	ICAR-IIPR, Kanpur; ICAR-CIAE, Bhopal	S. K. Ambast, JD (Edn.) (Acting)
2.	Value of Water for Agriculture	22.3.2021	ICAR-NIBSM, Raipur	
3.	IPM and IRM in chilli thrips	29.11.2021	Vellore Institute of Technology, Vellore, Tamil Nadu	Yogesh Yele, Scientist (Entomology)

Table 8.8 **Brainstorming conducted virtually at ICAR-NIBSM during 2021-22**

S. No.	Title	Date	Participating Institutes
School of Crop Health Management Research			
1.	Recent approaches and prospects of utilizing plant volatiles for plant protection	24.6.21	ICAR-NBAIR, Bengaluru, ICAR-IIHR, Bengaluru, NCBS, Bengaluru, IIIT, Raipur, CICR-CECRI, Karaikudi
2.	Spatial and machine learning technique for biotic stress management	9.8.21	ICAR-IARI, New Delhi, IIIT, Raipur, VNMKV, Parbhani, ICAR-NCIPM, New Delhi, IIWBR, Karnal
3.	One health under Climate Change	9.8.21 & 13.12.21	ICAR-NRC on Meat, Telangana, ICAR-IVRI, Izatnagar, ICAR-IIAB, Ranchi, GADVASU Ludhiana, ICAR-CIFT, Kochi
School of Crop Health Biology Research			
4.	Pest dynamics in conservation agriculture	7.8.21	ICAR-IARI, New Delhi, ICAR-DWR, Jabalpur, ICAR-CSSRI, Karnal
5.	Exploring antimicrobial cyclic lipopeptides (AMLs) producing bacterial resources for biotic stress management: Prospects and challenges	1.12.21	ICAR-NBAIM, Mau, TNAU, Coimbatore, ICAR-IARI, New Delhi, SRM Science and Technology, Chennai
School of Crop Resistance System Research			
6.	Prospects and challenges for identification of novel genes for biotic stress mitigation in crops	7.7.21	NIPGR, New Delhi, ICAR-DOG, Pune, ICAR-IIPR, Kanpur, ICAR-IIASM, Baramati, ICAR-NIPB, New Delhi, NCBS, Bengaluru
School of Crop Health Policy Support Research			

7	Discussion on "Establishment of National Strategic Crop Health Monitoring Network (NSCHMN)	23.05.2022	ICAR-NBAIR, Bangalore, ICAR-NBPGR, New Delhi; ICAR- NCIPM, New Delhi

Table 8.9 **Details of Publications (2021-22)**

S. No	Authors	Title	Journal	Vol: Page/ DOI	NAAS score
Published in refereed Journals					
2022					
1.	Murali Baskaran, R.K., P. Mooventhan, D. Das, A. Dixit, K.C. Sharma, S. Senthil-Nathan, P. Kaushal and P.K. Ghosh.	The future of plant volatile organic compounds (pVOC) research: Advances and applications for sustainable agriculture.	Environmental and Experimental Botany.	doi.org/10.1016/j.envexpbot.2022.104912 (Accepted)	**11.55**
2	Murali Baskaran, R.K., S.K. Jain and P. Kaushal..	Screening of pigeonpea mini-core sub-set for tolerance to pod borers and wilt	Indian J. Agric. Sciences	(Accepted)	**6.37**
3	Mallikarjuna, J., Y. Yele, K.C. Sharma, N.B. Prakash and A. Marathe.	Exogenous application of different silicon sources and potassium reduces pink stem borer damage and improves photosynthesis, yield and related parameters in wheat.	Silicon	DOI:13.10.1007/s12633-020-00481-7. (Accepted)	**8.67**
4	Rai, A., P.N. Sivalingam and M. Senthil-Kumar.	A spotlight on non-host resistance to plant viruses.	Peer J	10:e12996.	**8.98**
5	Mooventhan, P. and M. Choudhary.	Assessment of frozen semen quality through foldscope microscopy-A novel application of frugal science to reduce the infertility rate.	Indian Journal of Animal Research	DOI: 10.18805/IJAR.B-4699.	**6.44**
2021					
1.	Dey, A., P. R. Shashank, N. M. Meshram, S. Subramanian, M. Jeer, C. M. Kalleshwaraswamy, S. M. Chavan, J. Jindal, and S. B. Suby	Molecular diversity of *Sesamia inferens* (Walker, 1856) (Lepidoptera: Noctuidae) from India.	3 Biotech	11: 134	**8.41**
2.	Dokka, N., M. M. Mahajan, B. Sahu, A. Marathe, H. K. Singh and P. N. Sivalingam.	Molecular analysis, infectivity and host range of Tomato leaf curl Karnataka virus associated with Corchorus yellow vein	Virus Research	303:198521	**9.30**

		mosaic betasatellite.			
3.	Ghosh, P. K., M.Jeer, P. N. Sivalingam, B. Parameshwari, H. K. Singh, V. K. Choudhary, K. Kiran Kumar, B. Sahu, S. Muthappa, A.Dixit and A. Das.	Agronomic innovations in biotic stress management and its combined effect with abiotic stresses in crop production.	Indian Journal of Agronomy	66: S237-S257.	**5.55**
4.	Kumar, J., R. K. Murali-Baskaran, S. K. Jain, P. N. Sivalingam, A. Dixit, J. Mallikarjuna and P. K. Ghosh..	Biotic stresses of agricultural crops in India: re-visiting national status and mitigation strategies	Current Science	120: 264-265.	**7.1**
5.	Kumar, J., R. K. Murali-Baskaran, S. K. Jain, P. N. Sivalingam, J. Mallikarjuna, V. Kumar, K. C. Sharma, J. Sridhar, P. Mooventhan, A. Dixit and P. K. Ghosh.	Emerging and re-emerging biotic stresses of agricultural crops in India and novel tools for their better management.	Current Science	121: 26-36.	**7.1**
6.	Murali-Baskaran, R. K., J. Sridhar, K. C. Sharma and L. Jain.	Kairomone gel formulations enhance biocontrol efficacy of *Trichogramma japonicum* Ashmead on rice yellow stem borer, *Scirpophaga incertulas* Walker.	Crop Protection	146: 105655.	**8.57**
7.	Sahu, B., D. Dokka, M. M. Mahajan, K. C. Sharma, H. K. Singh, A. Marathe, B. P. Dewangan, P. Mooventhan, Y. Yele, J. Sridhar, V. Kumar, P. N. Sivalingam, J. Kumar, P. Kaushal and P. K. Ghosh..	Begomoviruses affecting pulse and vegetable crops are unevenly distributed in distinct agroecological zones of the eastern India.	Journal of Phytopathology	169: 209-228	**7.79**
8.	Sivalingam, P. N., N. Dokka, M. M. Mahajan, B. Sahu, A. Marathe, P. Kaushal and P. K. Ghosh.	Achieving maximum efficiency of Mungbean yellow mosaic India virus infection in mungbean by agroinoculation.	3Biotech	12: 29	**8.41**
Book chapter (2021)					
1.	Ghosh, P. K., P. N. Sivalingam, P. Kumar, D. Chakraborty and D. Mandal.	Governance and Policy Reforms,. In: (P. K. Ghosh, P. Kumar, D. Chakraborty, D. Mandal, P. N. Sivalingam eds.),	New India Publishing Agency, New Delhi. 810p (ISBN: 978-98-	749-762 pp	

		Innovations in Agriculture for self-reliant India,	90591-53-4)	
2.	Ghosh, P. K., P. N. Sivalingam, P. Kumar, D. Chakraborty and D. Mandal	Indian Agriculture: Issues, Challenges and Priorities, In: (P. K. Ghosh, P. Kumar, D. Chakraborty, D. Mandal, P. N. Sivalingam eds.), Innovations in Agriculture for self-reliant India,	New India Publishing Agency, New Delhi. 810p (ISBN: 978-98-90591-53-4)	1-14pp
3.	Jeer, M., M. P. Sahu, and V. K. Choudhary.	Novel Approaches for Biotic Stress Management in the Emerging Production System, In: (P. K. Ghosh, P. Kumar, D. Chakraborty, D. Mandal, P. N. Sivalingam eds.), Innovations in Agriculture for self-reliant India,	New India Publishing Agency, New Delhi, 810p. (ISBN: 978-98-90591-53-4)	305-330pp
4	Kiran Kumar, J. Sridhar, V. K. Choudhary, H. K. Singh, B. Parameshwari, K.M. Senthil Kumar, B. Sahu, N. Dokka and P. N. Sivalingam.	New Innovations and Approaches for Biotic Stress Management of Crops. In: (P. K. Ghosh, P. Kumar, D. Chakraborty, D. Mandal, P. N. Sivalingam eds.), Innovations in Agriculture for self-reliant India,	New India Publishing Agency, New Delhi, 810p. (ISBN: 978-98-90591-53-4)	265-292pp
5	Innovations in Agriculture for self-reliant India	Kumar, J., P. N. Sivalingam, Mallikarjuna, J., S. K. Jain, Sridhar, J., K. Kiran Kumar, Sujay Anand and P. K. Ghosh. Innovations in Agriculture: An Overview, In: (P. K. Ghosh, P. Kumar, D. Chakraborty, D. Mandal, P. N. Sivalingam eds.),	New India Publishing Agency, New Delhi, 810p. (ISBN: 978-98-90591-53-4)	15-32pp
6	Mooventhan, P., R. R. Burman and S. Ghosh.,	Innovations on Extension Models for Self-Reliant India, In: (P. K. Ghosh, P. Kumar, D. Chakraborty, D. Mandal, P. N. Sivalingam eds.), Innovations in Agriculture for self-reliant India	New India Publishing Agency, New Delhi, 810p.(ISBN: 978-98-90591-53-4)	705-720pp
2022				
7	Nagesh, M., Sridhar, J., Shah, M.A., Venkateswarulu, V. and Bhatnagar, A.	Biological Suppression of Insect Pests of Potato. In *Sustainable Management of Potato Pests and*	Springer, Singapore	435-452pp

		Diseases		
8	Mallikarjuna, J.	Recent developments in silica-nanoparticles mediated insect pest management in agricultural crops. In: *Silicon and Nano-silicon in Environmental Stress Management and Crop Quality Improvement*. Hassan Etesami et al (Eds.)	Elsevier, UK.	229-239pp
9	Mooventhan, P. and U. Singh.	Alternative Livelihood Options for Tribal farmers,. In: (M. L. Sharma, A. K. Gupta, M. A. Khan eds.), Sustainable livelihood Options for Rural Communities	Biotech Book Publishing Agency, New Delhi, 119p. (ISBN 978-81-7622-517-5)	25-38pp
10	Mooventhan, P. and U.Singh.	Kadaknath: Farming of Peculiar Poultry Breed for Profit Maximization,. In: (M.L. Sharma, A. K. Gupta, M. A. Khan eds.), Sustainable livelihood Options for Rural Communities	Biotech Book Publishing Agency, New Delhi, 119p. (ISBN 978-81-7622-517-5)	119p
11	Murali-Baskaran, R. K., P. Mooventhan, P. Kaushal and P. K. Ghosh.	Invasive and Transboundary pests	Springer	NA
12	Nebapure, S., Soumia, P. S., Yele, Y., Pandi, G. G. P. and Prasannakumar, N. R.	Semiochemicals: In Reproductive Strategies in Insects	CRC Press. Taylor & Francis	243-257pp

Abstracts published conference/symposia/workshop and others (2021)				
1	Jain, L., V. Kumar and S. K. Jain.	Isolation and characterization of bacteriophages against *Xanthomonas oryzae* pv. *oryzae* as a potent bio-control for bacterial leaf blight of rice.	Annual International e-Conference on Microbial world: recent Development in Health, Agriculture and Environmental Sciences,	Organized by Association of Microbiologist of India (AMI) in collaboration with INSCR, TERI, DU, IARI and INSA, held during February 3-5, 2021 (virtual mode).
2	Jeer, M., Yele, Y., Sharma K. C. and Prakash, N. B.	Silicon and potassium nutrition enhances the defense reaction of wheat plants to pink stem borer, *Sesamia inferens*.	Presented in the International Agronomy Congress on Agri Innovations to Combat Food and Nutrition Challenges	Organized by Indian Society of Agronomy, ICAR and PJTSAU, Hyderabad held during November 23-27, 2021.
3	Mooventhan, P., A. Dixit	Role of farmer FIRST programme in doubling	International Conference on	Organized by Mahima Research Foundation and

	and U. Singh.	Tribal farmer's income and food security (Presented in the Online)	"Recent advances on Agriculture, Engineering & Biotechnology (ICRAAEBFS) for food Security"	Social Welfare, BHU,Varanasi and jointly in collaboration with Lovely Professional University, Phagwara (Punjab) held during September 25-26, 2021.
4	Marathe, A., D.V. Pawar, P.N. Sivalingam, N. Dokka, V. Kumar, L.L. Kharbikar, P. Kaushal and P.K. Ghosh	Exploring the role of GmFS1 in mediating resistance against yellow mosaic disease and demonstrating the stress inducible nature of GmFS1 promoter in contrasting germplasm lines of soybean (*Glycine max* (L.) Merr.)"	National symposium on "Emerging Innovations in Plant Molecules for achieving Food and Nutritional Security	DPMBB, ACHF, NAU, Navsari & Division of Biochemistry, IARI in association with SPBB, New Delhi held during January 6-7, 2022.
5	B.K. Choudhary, M.Choudhary and S.B. Barbuddhe	Polymicrobial spectrum of cultivable microbiota from fresh water aquaculture system of central India	National Seminar on Contemporary Issues in Fisheries and aquaculture	College of Fisheries, GBPUAT, Pantnagar, Uttarakhand held during May 19-20, 2022

Extension Bulletins (2021)	
1	Mooventhan, P., A. Dixit, M. A. Khan, G. L. Sharma, L. K. Verma, P. Verma and P. K. Ghosh. FFP Photo Atlas 2021. Farmer FIRST Innovation: A role model for doubling of Chhattisgarh tribal farmers income,74p.
2	Jha, G., B. S. Rajput, T. Nisad, P.Banvashi, A. Dixit and P. Mooventhan. 2021. उघानिकी फसलों में मांल्चिंग का उपयोग एवं महत्व (Use and importance of mulching in horticultural crops). KVK, Rajnandgaon, Biotech KISAN Hub Bulletin).
3	Jha, G.,B. S., Rajput, T.Nisad, P.Banvashi, A. Dixit and P. Mooventhan. 2021. उघानिकी फसलों में टपक सिंचाई का उपयोग एवं महत्व (Importance of drip irrigation in horticultural crops). KVK, Rajnandgaon, Biotech KISAN Hub Bulletin).
Popular Articles (2021)	
1	Mooventhan, P., Singh, S. R. K., Venkatesan, P. and Singh. U. 2021. Waste Decomposer to improve soil and plant health: A success story from the tribal belt of Chhattisgarh under the Farmer FIRST Initiative. Harit Dhara, 4(1): 7-9.
2	Mallikarjuna, J., P. Mooventhan, M. Choudhary and R. K. Murali-Baskaran. 2021. ICAR-NIBSM: Rendering solution to biotic stresses, ICAR-NIBSM publication, Raipur, 32p.
3	Mooventhan, P., R. K.Sahu, M. K.Sahu and P.Banvashi. 2021. बटेर पालन एक लाभकारी व्यवसाय (Quail farming: a profitable business). Ropan 12: 15-16.
4	Mooventhan, P., R. K.Sahu and D. K.Patle. 2021. बकरी पालन एक उत्तम व्यवसाय (Goat Farming: A remunerative business). Krishi World 50: 35-36.
5	Mooventhan, P. and R. K.Sahu. 2021. टमाटर में कीट–रोग की रोकथाम (Pest and Disease Management in Tomato). Krishi Jagat, 50: 9.
6	Mooventhan, P., R. K.Sahu, P.Banwashi and T.Nisad. 2021. छत्तीसगढ़ में अगेती फूलगोभी की वैज्ञानिक खेती (Scientific cultivation of early cauliflower in Chhattisgarh). Ropan, 4: 17 -18.

7	Mooventhan, P., R. K.Sahu and M. K.Sahu. 2021. **चने की उन्नत खेती एवं उत्पादन तकनीक** (Improved cultivation and production technology of Chickpea). Ropan, 4: 23-24.
8	Mooventhan, P., M. K.Sahu, Yogita, R. K.Sahu, and H. K. Singh. 2021. **फोल्डस्कोप माइक्रोस्कोपः फसलों के रोगों के पहचान में महत्वपूर्ण भूमिका** (Foldscope Microscope: Important role in identification of diseases of crop). Ropan, 1: 23.

Extension Folders

S. No.	Title	Authors Name	Institute Number
1	अजोला उत्पादन तकनीक	P. Mooventhan, A. Dixit, M.A. Khan, G.L. Sharma, P. Varma, L. Verma, U.Singh, B. Kumar, S.Xaxa	NIBSM/EF/2021-39
2	कृषि कीटों का जैविक नियंत्रण		NIBSM/EF/2021-40
3	धान में तनाछेदक कीट, जानकारी एवं नियंत्रण		NIBSM/EF/2021-41
4	सब्जियों के लिए नर्सरी (पौधशाला) उत्पादन तकनीक		NIBSM/EF/2021-42
5	पैरामशरूम उत्पादन तकनीकी		NIBSM/EF/2021-43
6	तिवड़ा (लाखड़ी) उत्पादन तकनीक		NIBSM/EF/2021-44
7	गृहवाटिका द्वारा पोषण सुरक्षा		NIBSM/EF/2021-45
8	कृषि रसायनों का सुरक्षित उपयोग एवं रखरखाव		NIBSM/EF/2021-46
9	हेचरी यूनिट में अण्डे की हेचिंग		NIBSM/EF/2021-47
10	केंचुआ खाद उत्पादन तकनीक		NIBSM/EF/2021-48
11	सोलैनेसियस सब्जी फसलों में पाए जाने वाले सूत्रकृमि नाशीजीव और उनका प्रबंधन	Mallikarjuna, J.	NIBSM/EF/2021-49
12	धान की खेती में जड़.विगलन सूत्रकृमि (*मेलोइडोजाइन ग्रामिनिकोला*) नाशीजीव का एकीकृत प्रबंधन		NIBSM/EF/2021-50
13	दलहन फसलों की खेती में सूत्रकृमि नाशीजीव और उनका प्रबंधन		NIBSM/EF/2021-51
14	संरक्षित/पॉलीहाउस के तहत खेती में सूत्रकृमि नाशीजीवों का प्रबंधन		NIBSM/EF/2021-52
15	महत्वपूर्ण फल फसलों की खेती में सूत्रकृमि नाशीजीव और उनका प्रबंधन		NIBSM/EF/2021-53
16	कद्दूवर्गीय सब्जी फसलों की खेती में सूत्रकृमि नाशीजीव और उनका प्रबंधन		NIBSM/EF/2021-54
17	बकरी पालन : एक लाभकारी व्यवसाय	P. Mooventhan, R. K. Mahobia, B. S. Rajput, G. Jha, U. Singh and R. K. Sahu	NIBSM/EF/2021-55

18	बटेर पालन तकनीक	P. Mooventhan, S. K. Verma, G. Jha, U. Singh and R.K. Sahu	NIBSM/EF/2021-56
19	कृषि तकनीक में नवाचार पेपर आधारित माइक्रोस्कोपः फोल्डस्कोप	P. Mooventhan, M. K. Sahu, U. Singh and Yogita	NIBSM/EF/2021-57
20	फोल्डस्कोप माइक्रोस्कोपः फसलों के रोगों के पहचान में महत्वपूर्ण भूमिका	P. Mooventhan, M. K. Sahu, U. Singh and Yogita	NIBSM/EF/2021-58
21	पॉलीहाऊस में संरक्षित सब्जी पौध उत्पादन तकनीक	P. Mooventhan, G. L. Sharma, U. Singh, B. Kumar and S. Xaxa	NIBSM/EF/2021-59
22	पौधों के आवश्यक तत्व एवं उनके कार्य	P. Mooventhan, G. L. Sharma, M. A. Khan, U. Singh, B. Kumar and S. Xaxa	NIBSM/EF/2021-60
23	जैविक कीटनाशक– किसानों के लिए लाभकारक	L.L. Kharbikar, V. Kumar, L. Jain, M. Choudhary, J. Sridhar, K.C. Sharma, P. Mooventhan, S.K. Sharma and A. Dixit	NIBSM/EF/2021-61
24	मधुमक्खी पालन– एक लाभदायक व्यवसाय	J. Sridhar, K.C. Sharma, M. Choudhary, B. Choudhary, V. Kumar, L. Jain, L.L.Kharbikar, P.Mooventhan, S.K. Sharma and A. Dixit	NIBSM/EF/2021-62
25	बटेरपालन	M. Choudhary, B. Choudhary, V. Kumar, L. Jain, L. L. Kharbikar, J. Sridhar, K.C. Sharma, P. Mooventhan, S.K. Sharma and A. Dixit	NIBSM/EF/2021-63
26	कृषि अवशेष कम्पोस्ट के फायदे	S.K. Sharma, V. Kumar, L. Jain, M. Choudhary, L.L. Kharbikar,B. Choudhary, J. Sridhar, K.C. Sharma,P.Mooventhan and A. Dixit	NIBSM/EF/2021-64
27	ट्राइकोडर्माः जैविक खेती का अमूल्य उपहार	S.K. Sharma, V. Kumar, L. Jain, M. Choudhary, L.L. Kharbikar,B. Choudhary, J. Sridhar, K.C. Sharma,P.Mooventhan and A. Dixit	NIBSM/EF/2021-65
28	कम्पोस्टःएक नैसर्गिक खाद	S.K. Sharma, V. Kumar, L. Jain, M. Choudhary, L.L. Kharbikar,B. Choudhary, J. Sridhar, K.C. Sharma,P.Mooventhan and A. Dixit	NIBSM/EF/2021-66
29	जैवउर्वरकों (बायोफर्टिलाइज़र) की आधुनिक खेती में उपयोगिता	V. Kumar, S.K. Sharma, L. Jain, L.L. Kharbikar, M. Choudhary, J. Sridhar, K.C. Sharma, B.K. Choudhary, P.Mooventhan and A. Dixit	NIBSM/EF/2021-67
30	आयस्टर मशरूम उत्पादन	M. Choudhary, B. Choudhary, L.L. Kharbikar, V. Kumar, L. Jain, J. Sridhar, K.C. Sharma, P. Mooventhan, S.K. Sharma, A. Dixit and SK Varma	NIBSM/EF/2021-68
31	दुधारू पशुओं के प्रमुख संक्रामक रोग एवं उनके स्वास्थ्य प्रबंधन	M. Choudhary, B. Choudhary, V. Kumar, L. Jain, L.L. Kharbikar, J. Sridhar, K.C. Sharma, P. Mooventhan, S.K. Sharma, S. Dash and A. Dixit	NIBSM/EF/2021-69

Table 8.10 **Awards/Recognitions received by Scientists of NIBSM**

S. No.	Scientists (Dr./Mr./Ms.)	Name of Awards/ Recognition	Name of Organization /conference/society

1.	P. Mooventhan	Fellowship	Bose Science Society (BSS)
2.		Mahima Best Extension Scientist Award	Mahima Research Foundation and Social Welfare, Banaras Hindu University (BHU), Varanasi and Lovely Professional University, Phagwra (Punjab)
3.		Best Oral Presentation Award	
In-house awards from the ICAR-NIBSM, Raipur on 10th Foundation Day (7th October 2021)			
4.	Best Review Paper Award		Dr. R. K Murali Baskaran, Dr.Senthil-Nathan, Dr.W. B. Hunter
5.	Best Scientist Award		Dr. P.N. Sivalingam

Table 8.11 **Collaborations and linkages**

S. No.	Participating Institutes	Area
1.	AICRP networks	Nematodes, AICRPs on other crops
2.	NIPGR, New Delhi, ICAR-IARI, New Delhi & IIT, Delhi	National Agricultural Science Fund (NASF) sponsored research project, NIBSM as Lead centre
3.	ICAR-NRRI, Cuttack	Pyramiding and stacking of genes in rice
4.	ICAR-NIASM, Baramati	Biotic-abiotic interaction effects, Stress induce promoters
5.	ICAR-IIAB, Ranchi	Development of super donor(s) in rice with multiple stress tolerance; Transcriptome analysis and identification of genes for stress tolerance in finger millet.
6.	ICAR-IGFRI, Jhansi	Alien introgressions and ploidy effects on improving fodder traits and stress tolerance in pearl millet and guinea grass.
7.	ICAR-NBAIR, Bengaluru	Identification of Insect-pest resources
8.	ICAR-NBAIM, Mau	Proposed for inclusion in AMAAS project
9.	MANAGE, Hyderabad	Training and Extension for technology transfer
10.	IGKV, Raipur; JNKVV, Jabalpur; DSVGKV, Durg; Amity University, Chhattisgarh;	Education and Research
11	ICAR-IIHR, Bangalore	Biotic stress study on vegetable crops
12	IPFT, Gurgaon	Chemical formulation development for kairomone
13	ICAR-IARI, New Delhi	Biotic stresses in emerging production system
14	ICAR-DWR, Jabalpur	Genomic study on invasive weeds
15	IRRI, The Philippines; IITA, Nigeria; and ICRISAT, Patancheru,	Introduction of germplasm/ wild species/ core collections

9. Budget and Finance

(2021-22)

a. Budget Allocation

S. No.	Head	Allocation (Rs. in Lakh)				
		Other than NEH & TSP	TSP	NEH	SCSP	Total
1.	G-I-A- Capital	525.00	19.33	12.19	68.50	625.02
2.	G-I-A- Salary	616.59	--	--	--	616.59
3.	G-I-A- General					
	(1) Pension	--	--	--	--	--
	(2) Others	709.00	30.00	21.00	70.00	830.00
Grand Total		1850.59	49.33	33.19	138.50	2071.61

b. Budget Expenditure

S. No.	Head	Expenditure (Rs. in Lakh)				
		Other than NEH & TSP	TSP	NEH	SCSP	Total
1.	G-I-A- Capital	524.98	16.48	12.19	67.82	621.47
2.	G-I-A- Salary	615.50	--	--	--	615.50
3.	G-I-A- General					
	(3) Pension	--	--	--	--	--
	(4) Others	706.10874	28.43244	20.59562	69.44598	824.58278
Grand Total		1853.48644	44.91248	32.78562	137.26335	2068.44

Utilization of fund= 99.84 %

10. Summary of individual project

School of Crop Health Management Research

A. Institute Projects

Project 4.5: Isolation and evaluation of native biocontrol agents for management of Lepidoptera pests
(R.K. Murali Baskaran, K.C. Sharma, Lata Jain, J. Sridhar)
Duration: 2016-21

Objectives:
1. To isolate and characterize native *Trichogramma* spp. and *Bacillus thuringiensis* from various eco-systems
2. To find out efficient/virulent *Trichogramma* spp. and *Bacillus thuringiensis* through *in vivo* bioassay
3. To optimize field dose of efficient *Bacillus thuringiensis* against lepidopteran pests of tomato and chickpea
4. To develop and evaluate kairomone formulation to enhance field activity of *Trichogramma* spp. against rice yellow stem-borer

Achievements:
- Three kairomones, n-hexadecanoic acid, n-octadecanoic acid and octadecane detected from yellow stem borer damaged rice plant were potential to enhance the biocontrol activities of *Trichogramma japonicum* against rice YSB
- Four releases of *T. japonicum* at weekly interval on the 32nd, 39th, 46th and 53rd day after transplanting of rice during *kharif* reduced the damage symptoms caused by YSB by 52.8% dead heart (2.51%) and 66.1% white ear (0.62%)
- Application of octadecane gel (500 ppm) 24 hr after each release of *T. japonicum* on 32nd, 39th, 46th, 53rd DAT enhanced the reduction of damage caused by YSB by 30.01 to 37.06% during *kharif*2018
- Two rounds of application of NIBSM *Bacillus thuringiensis* 18 @ 1 x 10^8cfu/ml in chickpea on 73rd and 83rd day after sowing during *rabi*2021-22 reduced the pod damage (*Helicoverpa armigera*)by 47.43% (7.07 larvae/plant) as compared to control plots.

Project 3.2: Isolation and Characterization of secondary metabolites of *Chromobacterium* species for mitigation of biotic stresses in agriculture
(B.K. Choudhary, Mamta Choudhary, R.K. Murali Baskaran, J. Sridhar, S.K. Sharma)
Duration: 2018-2022

Objective
1. Isolation, extraction, purification and characterization of purple pigment from *Chromobacterium* spp.
2. Characterization of bio-efficacy of secondary metabolites for therapeutic properties in mitigation of agricultural biotic stresses

Achievements:
- Characterization of ethanolic extract of crude purple pigment of *Chromobacterium* spp., using Liquid Chromatography coupled with Electrospray-Orbitrap Mass Spectrometry revealed the presence of precursors of voilaceaum and other metabolites including kumarnanin, vitexin, muscone, taxifolin, rotenone, sirolimus, nigericin, and L-tyrosine and

reported to possess various properties including anti-fibrotic, anti-inflammatory, anti-oxidant, anti-apoptotic and anti-tumor.

- Secondary metabolites of *Chromobacterium* spp., have been identified to possess various properties including insecticidal (35% chickpea pod borer mortality and 29.3% inhibition of adult emergence at 1000 ppm of violacein), antifungal (suppression of mycelia growth and conidia formation of *Fusarium cucumerium, Fusarium oxysporum*, *Sclerotium rolfsii*) and suppression of seed germination of non-economical crop (50 to 70% inhibition of *Parthenium* seed germination at 500 ppm violacein).
- Studies on whole genome sequencing of *Chromobacterium piscinae* (W1BCG) indicated to have genome size of 4,751,077 bp with 3873 protein-coding and 95 RNA genes. DNA sequencing, using the Illumina HiSeq 4000 system revealed a genome size of 4,751077 bp with a GC-content of 64.89%. The CDS included 1,261 hypothetical proteins and 3,311 proteins with functional assignments. Also seven putative genes involved in efflux pump and conferring multidrug antibiotic resistance were identified.

Project 1.5: Exploring host-microbial cross talk in agro-ecosystem of Bastar plateau zone of Chhattisgarh
(Mamta Choudhary, B.K. Choudhary, L.L. Kharbikar)
Duration: 2018-2021

Objectives
1. Isolation, identification and characterization of resident and transient microorganisms of agroecosystem of Bastar plateau zone of Chhattisgarh
2. Investigation of interactions of plant and animal pathogenic microorganisms.

Achievements
- Out of 1145 bacterial isolates recovered from 252 agroecological samples of Bastar zone of Chhattisgarh, 73% belonged to Gram -ve Bacilli, 6% to Gram +ve Cocci and 4% to unclassified groups. Bacterial isolates were found to belong to 90 different genus and species and further classified into eight different groups based on their functional traits.

Project SCHMR 1: Development of plant volatile organic compounds (VOCs) repository for pest management
(R.K. Murali Baskaran; Mr. Yogesh Yele and Dr. K.C. Sharma)
Duration: 2021-2026

Objectives
1. To collect, detect and develop herbivoure-induced (HIPVs) plant volatile repository
2. To identify signature VOCs favourable to herbivoures' natural enemies
3. To optimize field dose of synthetic elicitor for imparting resistance in plants against Lepidoptera pests, including enhanced VOCs emission

Progress
- Two foliar application of jasmonic acid @ 5 mM in wheat on 35th and 45th DAS reduced the pink stem borer induced dead heart and white ear symptoms by 34.01% (3.74% dead heart) and 31.17% (5.3% white ear), respectively while they were 5.67% and 7.70% in control plots.
- Two rounds of foliar application of jasmonic acid @ 5 mM in chickpea on 30th and 40th DAS reduced the larval population and pod damage caused by *Helicoverpa armigera* by

25.80% (25.80 larvae/10 plants) and 29.88% (8.59% pod damage), respectively as compared to control plots with 36.73 larvae/10 plants and 12.25% pod damage.

Project SCHMR 2: Monitoring, forewarning and estimation of economic losses due to biotic stress in rice/ wheat crops using special and machine learning techniques
(S.K. Ambast; R.K. Murali Baskaran, S.K. Jain, K.C. Sharma and Mallikarjuna J.)
Duration: Four years (2021-25)

Objectives:
1. To develop methodology for real time surveillance, disease detection and forewarning system using satellite remote sensing data
2. To develop integrated predictive model for estimation of economic losses due to biotic stresses

Progress:
- Retrieved satellite remote sensing data from Earth Explorer platform (Sentinel - 2; Resolution - 10 m; Date of Pass - 22.10.2021 & 27.10.2021)
- Pre-processed remotely sensed data
- Prepared base map of the study area
- Extracted geometrically corrected image of the study area (Raipur district)

Project SCHMR 3: Impact of climate change on fitness and gut microbial diversity of fall armyworm, *Spodoptera frugiperda*
(Yogesh Yele; R.K. Murali Baskaran, Mamta Choudhary and B.K. Choudhary)
Duration: 2021-2026

Objectives:

1. To study the climate change driven altered life parameters and host response of fall armyworm, *Spodoptera frugiperda*
2. To study and characterize the gut microbial diversity in different population of FAW
3. To study the insecticide resistance response of fall armyworm

Progress:
- Gauged the natural incidence of fall armyworm on maize at NIBSM, Raipur fields
- Successfully cultured the fall armyworm population on natural diets in laboratory

Project SCHMR 4: Elucidating the effect of Climate change on one health components in different agroclimatic zones of India
(B.K. Choudhary; Mamta Choudhary, Lata Jain, Soumya Dash and Yogesh Yele)
Duration: 2022-26

Objectives:

1. Isolation and identification of resident and transient microbial pathogens from different agroclimatic zones of India
2. To explore pathobiotic interactions of common microbes recovered from agroecosystems under different changing climatic conditions (Increase Temperature, CO_2, pH etc.)
3. To study the prevalence and epidemiology of zoonotic/ pythonesses including vector borne diseases

Progress:
- Taken as a lead from cross talk project with a total of 252 agroecological samples from Bastar zone of Chhattisgarh were subjected for isolation of microorganism and 1145

bacterial isolates have been identified by 16S rDNA sequence analysis. Percentage of recovered isolates from target agroecosystem was reported to be Gram Negative Bacilli (73%), Gram Positive Bacilli (18%), Gram Positive Cocci (6), Unclassified isolates (4%).We have identified bacterial pathogens causing diseases in plant, animals and humans and they belong to more 90 different genus and species and their interaction.

- The identified and characterized bacterial isolates are classified into eight different groups.
- Validation of Taqman based RT-PCR kits developed specific for targeted genes for identification of vector borne diseases (Mycobacterium Bovis, Q-fever, Leptospirosis and Scrub Typhus), is under progress with positive samples and preliminary RT -PCR data shows kits developed are working well.

School of Crop Health Biology Research
A. Institute Projects

Project 4.6: Evaluation of allelopathic potential in rice and selected weeds for weed management.
(Anil Dixit, B.K. Choudhary)

Duration: 2018-2022

Objectives:

1. To screen the rice varieties for weed suppression ability confirming possible allelopathic effect
2. To study the interaction effect between selected weeds Parthenium and Malachracapitata
3. Characterization of chemical for confirming the allelopathic potential/factors in plants

Progress:

- 250 rice genotypes in augmented paired row screened against the weeds for possible allelopathic potential for these rice lines.
- The experimental field was infested with *Ammannia baccifera, Ludwigia parviflora, Alternanthera sessilis, Fimbristylis miliacea, Eriocaulonsie boldianum, Lepto chloachinensis, Commelina benghalensis, Echinochloa colona*. Some of the weed seed germination was significantly affected by the allelopathic effect of few test rice varieties
- The seeds of *Parthenium hysterophorous* and *Malachra capitata* were sown individually and in combinations. The seeds were exposed to different cultures for making them germinated. The treatments of hot water and scarification could make some impact of germination
- In the allelopathic studies the treatment of organic root extract of *Malachara* delayed the seed germination of *Parthenium* by one to two weeks, and also has lethal effect on the vegetative growth of P*arthenium*. Further studies are underway to explore the mechanism of cidal/static effects.

Project 1.4: Identification and characterization of bacteriophages against rice bacterial leaf blight pathogen *Xanthomonas oryzaepv. oryzae*
(Lata Jain, Vinay Kumar, S.K. Jain)
Duration: 2018 - 2022
Objectives:

1. Isolation of bacteriophages against *Xanthomonas oryzae* p*v. oryzae (Xoo)*
2. To characterize bacteriophages using physico-chemical, biological and molecular approaches

Achievements:

- Total of 19 bacteriophages (14 from Chhattisgarh, one Madhya Pradesh and one from Telangana state) were isolated against *Xoo* from rice field water and soil samples of 26 districts of Chhattisgarh the adjoining seven states. Presence of phages were indicated by clear round plaques (size 2 to 10 mm in dia), and clearance of bacterial growth around streaked lines.
- Xoo Phages were highly genus and species specific not even having lytic activity for *X. campestris*.
- And they can survive in environment in temperature range of 4-50 °C; pH range of 5-9.
- On Transmission Electron Microscopy, all phages were found to belong in order *Caudovirales* (having head and tail), and families *Myoviridae* (5), *Siphoviridae* (12), *Podoviridae* (1) and Unclassified (1). The length of head and tail varies from 60 to 75 nm and 135 to 265 nm, respectively.
- All the 19 phages were found to have ds-DNA as genetic material. Sixteen phages were whole genome sequenced using illumina based sequencing approach. The genome size range from 43.6 kbp to 203 kbp, GC content ranging between 46 to 67 % and having predicted number of genes ranging from 56 to 418.
- In-vitro efficacy studies in liquid culture medium shows up to 99.99% bactericidal activity for the host bacteria.
- Efficacy against BLB in rice pots: Rice plants were infected with *Xanthomonas oryzae* pv. *Oryzae* pathogen at concentration of $2x10^8$ cfu/ml. After 72 hours of BLB infection, plants were treated with selected bacteriophages at concentration of 2×10^7 pfu/ml using spray method. Preliminary protective efficacy of phage against BLB infection in rice pots shows significant reduction in symptoms of BLB in phage treated plants compared to untreated control plants.

Project 1.3: Mapping of genetic groups of *Bemisia tabaci* in India and their begomovirus transmission efficiency

(J. Sridhar, R.K. Murali Baskaran)

Duration: 2018-2022

Objectives:

1. To characterize genetic groups of whiteflies (*Bemisia tabaci*) occurring and distributing in India using molecular markers.
2. To determine the begomovirus transmission efficiencies of the dominant genetic groups of *B. tabaci*.

Achievements:

- Collected/procured 1225 *B tabaci* samples from 20 states of India.
- Isolated and amplified mitochondrial DNA from individual whiteflies and generated >509 sequences of *B. tabaci*.
- Identified eleven distinct genetic groups of *Bemisia tabaci*, Asia 1, Asia I India, Asia II-1, Asia II-3, Asia II-5, Asia II-6, Asia II-7, Asia II-8, Asia II-11, Asia III, MEAM-1 of which Asia II-3, Asia II-6 & Asia III new to India and reported for the first time.
- A total of seven distinct genetic groups of *B. tabaci* has been found to occur in Chhattisgarh state.
- The begomovirus transmission efficiency was determined to be 50-55% for genetic group, Asia II-7 and 80-85% for MEAM-1 in tomato. It clear that MEAM-1 having very high transmission efficiencies with respect to begomovirus transmission. However, Asia II-7 also transmit begomovirus up to 50-55%.

Project 2.4: Epigenetic regulation of microRNA genes in response to *Fusarium* stress in chickpea
(L.L. Kharbikar, Ashish Marathe)
Duration: 2018 to 2021

Objectives:
1. To map the available information from different sources on DNA methylation, chromatin related proteins and sRNAs on *Fusarium* responsive genes (FRGs).
2. To characterization the FRGs based on a number of molecular features (gene ontology, proteome).
3. To validate the epigenetic features those are regulated by miRNAs and play a role in *F. oxysporum* response.

Achievements:
- 3-hydroxy-3-methyl-glutaryl coenzyme A reductase (HMGCR) was negatively correlated (-1.00) with genes encoding pathogenesis-related (PR) and detoxification proteins and xylanase inhibitors (XI).
- Thiopurine S-methyltransferase (*TPMT*)and miR9678 expressed in both healthy and wilt infected samples of chickpea varieties, AKG 9303 - 12 (AKG) and Indira Chana 1 (I C 1), respectively only under infected conditions.
- Sixteen methylation-related genes were down-regulated in a *Fusarium* wilt susceptible variety, JG62 compared to a *Fusarium* wilt resistant variety, Digvijay.
- GO analysis associated the genes encoding pathogenesis-related and detoxification proteins as well as xylanase inhibitors with methionine S-methyl transferase activity (p-value 0.001).
- Co-expression analysis of the FW S JG62 transcriptome with methionine S-methyl-transferase gene (MSM; TraesCS1A02G013800) resulted in 3-hydroxy-3-methyl-glutaryl coenzyme A reductase (HMGCR; TraesCS5A02G269300.
- A microRNA, miR9678, expressed in both resistant and susceptible chickpea varieties, ICC 4918 and ICC 10755, respectively only under infected conditions.

Project: 3.3 Antimicrobial Cyclic Lipopeptides (AMLs) Producing *Bacillus* for Antagonistic Activity
(SK Sharma; Lata Jain)
Duration: 2020-22

Objectives:
- Selection of antagonistic Bacillus having cyclic lipopeptide production ability isolated from different agroecosystems
- Characterization and identification of cyclic lipopeptide produced by Bacillus species

Progress:
- More than 100 putative bacilli recovered from rhizosphere soils of chickpea growing in different regions of Chhattisgarh state. Some of the isolates were identified as *Bacillus formosus, B. invictum, B. tequilensis, B. subtilis, B. carbrielesii, B. paramycoides, B. velezensis, B. siamensis and B. licheniformis* based on 16S rRNA gene sequences.
- Some isolates like IS-10, KS-8, IS-8, IS-10, GS-7, GS-6 and GS-5 were found potentially antagonistic to *F. oxysporum* f.sp. *ciceris, F.oxysporum* f.sp. *lycopersici* and *Sclerotium rolfsii.*

- *B. carbrielesii* IS-10 has shown ability to produce biosurfactant type molecules that inhibited growth of phytopathogens such as *F.oxysporum* f.sp. *ciceris* and *F.oxysporum* f.sp. *lycopersici* using disc impregnation method.
- Biosurfactant of property of crude extract of *B. carbrielesii* IS-10 was confirmed by emulsification and oil spread assays using different oil sources and parafilm M test.
- Probably, *B. carbrielesii* IS-10 is reported first time from soils of Chhattisgarh state.

Project SCHBR 1: Pest dynamics and their management under conservation agricultural production system
(ICAR-NIBSM-J Sridhar, LL Kharbikar, Anil Dixit; Collaborating Institutes: ICAR-IARI-TK Das; ICAR-DWR; VK Choudhary)
Duration: 2022-26

Objectives:
1. To study the status of pests under conservation agriculture (CA)
2. To understand the spatial and temporal distribution of insect-pest, weed and their correlation with abiotic factors in the CA-based cropping system
3. To identify the mechanism of emergence of pests, weeds in CA system

Progress:
- Data base on weed, insect pests, natural enemies & beneficial microbes in long term CA system will be generated.
- Better understanding of the impact of climatic factors on the occurrence of insect pests, weeds and degree of damage in CA system.
- Possible causes of emergence of insect pests and weeds in CA system for taking appropriate management.

Project SCHBR 2. Exploring microbiome diversity under emerging production system in agriculture
(Lata Jain; S.K. Sharma)
Duration: Five years (2022-26)

Objectives:
1. To isolate and identify the culturable microbes present in location-specific systems under conservation agriculture.
2. To investigate microbial diversity under conservation agriculture using metagenomics approach.
3. To develop repository of potential microbes to be explored as pathogen and/or bio-control agents.

Progress:
Recently project has been approved and preparation and research project proposal-I has been submitted.
Project SCHBR3: Study of genomic variations related to stress adaptation in weed species from India
(Lalit L Kharbikar; Anil Dixit (ICAR-NIBSM); V.K. Choudhary and Deepak Kumar (ICAR-DWR),)
Duration: 2021 to 2026

Objectives:

1. To collect five most important weed species in India.
2. To analyze the morphological and molecular diversity in five most important weeds in India.
3. To identify genes and mechanisms for invasive traits/ stress adaptations in five most important weeds in India.

Progress:

- Seeds of five weed species viz., Parthenium weed (*Parthenium hysterophorus*), Malachra (*Malachra capitata*), Deenanath grass (*Pennisetum pedicellatum*), Sessile joy weed (*Alternanthera sessilis*), Leaf flower (*Phyllanthus urinaria*) have been collected from Raipur and Jabalpur.
- A pot experiment has been conducted to study the morphology of five weed species.
- DNA from all the weed species in pot experiment has been extracted.
- A local database for sequences of unexplored defense-related genes/ molecules in five weed species/ related species has been created.

B. Externally funded Projects

Project EF011: Development of diagnostic kits for quick detection of CTV, HLB and *Phytophthora* rot diseases in citrus of North East India
(L. L Kharbikar; Anil Dixit)
(Collaboration with IIT, Guwahati (lead centre), ICAR-IARI, New Delhi; Institute of Advanced Study in Science and Technology, Guwahati; Central Agricultural University, Umiam).
Duration: 2021 to 2024

Objectives:

1. Development of the LAMP assay-based point-of-care diagnostic kit for the detection of CTV infections in Khasi mandarin.
2. Development of the LAMP-based point-of-care diagnostic kit for detection of *Phytophthora* rot.

Progress:

- *Phytophthora* and CTV infected along with healthy citrus leaves as well as soil samples from North East (Assam, Meghalaya) and Central India (Vidarbha) regions have been collected.
- Protocol for extraction of DNA from *Phytophthora* and CTV infected as well as healthy citrus leaves samples was optimized.
- Optimized LAMP assay for the detection of CTV and *Phytophthora* from infected citrus leaves samples.
- Optimum reaction time, temp and detection limit of LAMP assay for the diagnosis of *Phytophthora* pathogen from infected citrus leaves samples (Figure 3 and Figure 4) has been determined.
- Development of LAMP-LFA is in progress.

School of Crop Resistance System Research

A. Institute Projects

Project 2.5: Deciphering the role of isoflavones in differential reaction to yellow mosaic disease in soybean
(Ashish Marathe, P.N. Sivalingam, L.L. Kharbikar)

Duration: 2019-2022)

Objectives:
1. To screen mini core germplasm of soybean for differential reaction to yellow mosaic disease
2. To estimate the isoflavone content in lines with contrasting reaction to YMD
3. To optimize CRISPR/Cas9 for targeted mutagenesis in gene(s)/ microRNA involved in isoflavone biosynthesis

Progress:
- On the basis of field screening of mini-core germplasm subset during *kharif* 2020, the resistance and susceptible lines were identified based on guidelines by AICRP MuLLaRP. These were further subjected to artificial inoculation using viruliferous whitefly under controlled condition. Soybean lines viz. CAT-1809, CAT-1921A, CAT-411B, UPSM-57, CAT-313A showed susceptible reaction while CAT-1318, CAT-156, CAT-1808, CAT-411B, EC-456647 were resistant to *Mungbean yellow mosaic India virus.* Few lines viz. CAT-2050, CAT-2059, CAT-140A showed medium resistance to *Mungbean yellow mosaic India virus.*
- Expression of *IFS1* gene was studied in CAT-1808 (Resistant) and CAT313-A (Susceptible) which showed high expression of *IFS1* in CAT-1808 with lower in that of CAT-313-A.
- Priming of *Nicotiana benthamiana* with crude flavonoid extract of soybean seeds showed lower virus load of *Tomato leaf curl Karnataka virus* (ToLCKV) upon agroinoculation compared to that of unprimed seeds through qPCR, demonstrating the antiviral property of flavonoids *in-planta.*
- DS-9712 variety of soybean was genetically transformed with plant transformation vector containing the Cas9 gene and sgRNA for targeted mutation in *IFS1* gene. Putative transformants were subjected to PCR diagnosis using transgene (*Phosphinothricin acetyl tranferase-PAT)* gene which showed positive for transgene integration.

Project 2.6: **Deciphering silicon mediated defense against yellow stem borer in rice**
(Mallikarjuna, J., Vinay Kumar)
Duration: 2019-2022

Objectives:
1. Identification of Si induced differentially expressed genes in rice infested with YSB using transcriptomics approach.
2. Validation of selected differentially expressed genes in transcriptome using Real time PCR.
3. To study the morphological changes in rice plants and histopathological changes in YSB larvae upon Si application

Progress:
- Standardized the methodology for YSB larval rearing in Swarna variety and stage of larvae
- Optimization of Si dose and larval infestation
- Estimation of defense enzymes in Si-treated and non-treated rice plants is in progress.
- The samples were submitted for transcriptome analysis and final analysis is in progress.
- SEM and EDS analysis carried out for Si deposition in rice stem tissues.

Project 2.2: Identification of biotic stress induced promoters from resistant source plants
(P.N. Sivalingam, S.K. Jain, Vinay Kumar, L.L. Kharbikar, Ashish Marathe**)**
Duration: 2017-2022

Objectives:
1. To identify upregulated transcript/genes upon infection by pathogen by transcriptome profiling
2. To identify possible promoters and regulating elements by *in silico* analysis
3. To study functional analysis of promoter elements in model plant system

Progress:
1. Activity of promoter of *IFS1* gene in resistance and susceptible cultivars to Mungbean yellow mosaic India virus (MYMIV) in soybean has been demonstrated through histochemical assay.
2. Promoter of IFS1 gene from soybean has been characterized. The promoter activity was higher upon infection of MYMIV in susceptible cultivar than the resistant cultivar
3. Isolation of promoters for bacterial leaf blight resistance genes *xa13* and *Xa21* from resistance/ wild species and susceptible cultivars was done sequencing is in progress.
4. PCR amplification of promoter of methionine S-methyl transferase gene was done to test against wilt disease of chickpea

Project 2.3: Development of super donors in rice carrying tolerance to multiple stresses (Bacterial Leaf Blight, Brown Plant Hopper and Blast)
(Vinay Kumar, S.K. Jain; P.N. Sivalingam, Mallikarjuna, J.)
Duration: 2017-2022

Objectives:
1. Pyramiding and stacking of genes for multiple biotic stresses BLB, Blast and BPH and their confirmation in the recipient genome.
2. To study the effect of gene interaction among the multiples stress responsive genes.
3. Attempt to study the master regulator genes regulate multiples biotic stresses.

Progress:
- In order to develop super donors in rice having genes for multiple stress tolerance genes for BLB, BPH and Blast resistance, crosses were made to introgress BPH and Blast resistance genes in the IRBB66 background namely (i) IRBB66 x BPH resistant lines; (ii) IRBB66 x blast resistance lines followed by (BLB + blast) F1 x Bph line; (BLB+ Bph) F_1 x Blast resistance lines and developed seeds were harvested for further analysis. BLB, Blast and Bph resistance gene linked primers being used identification of presence of resistance genes in rice progenies.
- In an attempt to identify and characterize the Broad-spectrum resistance (BSR) genes, gene specific primers were designed for amplification from cultivated and wild rice lines and identification of conserved regions.
- Ten rice lines were identified as highly resistance to bacterial leaf blight diseases under artificial inoculation with BLB pathogen. These lines will be explored for identification of novel resistance genes.
- Blast disease causing pathogen, *Magnaporthe oryzae* was isolated for screening of rice seedlings and breeding material for blast disease reaction under artificial conditions.

- Wild species of rice namely *Oryza nivara; O. minuta; O. glumaepatula, O, grandiglumis, O. rufipogon* and *O. longistaminata* and donor rice lines for BPH, BLB and Blast diseases were multiplied for use in breeding programme and identification of BSR genes.

Project 2.7: Cytological and molecular basis of organ specific resistance to blast disease in finger millet
(S.K. Jain, Mamta Choudhary, Ashish Marathe)
Duration : 2020 to 2023

Objectives:
1. Comparison of the *Pyricularia grisea* infection process in different organs in finger millet.
2. Histo-chemical analysis including role of reactive oxygen species and anti-oxidative enzymes in leaf, neck and finger infections in compatible and incompatible interaction.
3. Expression analysis of defence-related genes in organ-specific response in finger millet-*P. grisea* interaction.

Progress:
- Standardized the inoculation methods for leaf (spray inoculation), neck (injection method) and finger (cotton swab method) blast for artificial inoculation in pots.
- Disease reaction of resistant and susceptible genotypes of finger millet confirmed in pots by artificial inoculation for leaf and neck blast. However, finger blast resistance could not be confirmed from field reaction in 10 accessions. It will be repeated with more genotypes to find resistant accession.
- Resistant and susceptible genotypes inoculated for leaf and neck blast and samples at 0,24,48,72 and 96 HAI harvested for enzyme extraction.
- Peroxidase activity in finger millet lines GEC 164, GPU 45 (Resistant) and Udurumalliage (susceptible) was measured in response to leaf and neck blast. GPU 45 showed an increase in the per minute change in activity of peroxidase from 24 hai (0.053 units) to 96 hai (0.116 units), while the activity change recorded was maximum for UM (0.170 units) at 96 hai. GEC 164 also showed an increase in the activity change per min with a maximum at 96 hai (0.078 units). For neck blast, linear increase in per minute change in activity was observed in GEC 164 with a maximum of 0.188 Units, followed by UM (0.116 Units) and GPU 45 (0.105 Units).Studies are in progress for other enzymes.
- Samples harvested for RNA extraction for gene expression over time points for leaf blast and further extraction and gene expression studies are in progress.

Project SCRSR1: **Identification of novel genetic resources and genes in selected crop-pests**
(Mallikarjuna J.P.N. Sivalingam, Vinay Kumar, Sridhar, J., Ashish Marathe)
Duration: 2021-2026

Objectives:
1. Gene pool profiling of various genetic resources of crops (Okra and brinjal) against biotic stresses
2. Identification and characterization of novel genes responsible for resistance to biotic stresses

Progress:
- Procurement of germplasm lines of okra and brinjal is completed.
- Seed multiplication of germplasm is in progress

- Screening of okra and brinjal germplasm against major biotic stresses is in progress.

Project SCRSR2: Deciphering molecular mechanism and metabolic network involved in imparting resistance to biotic stresses in plants
(Vinay Kumar; P.N. Sivalingam and Ashish Marathe)
Duration: 2021-2026

Objectives:
1. To understand resistance mechanisms in response to plant-pests and endophytes using multi-omics approach.
2. To identify regulatory elements, genes and biomolecules involved in mitigating biotic stresses using system biology approach.

Progress:
- Bacterial endophytes isolated from different legume crops and medicinal plants were characterized and *invitro* screened for their potential antimicrobial activities against soil borne fungal pathogens namely *Sclerotium* and *Fusarium*.
- *Inplata* validation of bacterial endophytes having antimicrobial activities against *Fusarium* wilt pathogen of chickpea.
- In order to identify defence and resistance related pathways probably involved in imparting resistance to fungal pathogens, literature surveyed, primers designed and synthesized for the genes and regulatory elements for detection of differential expression of genes involved in imparting resistance to *Sclerotium* and *Fusarium* in Chickpea.

Project SCRSR3: Gene function analysis and mitigation strategies for biotic stresses in the selected crops-biotic stresses
(Ashish Marathe; P.N. Sivalingam, Vinay Kumar and Mallikarjuna)
Duration: 2021-2026

Objectives:
1. Genome editing for metabolic engineering of trichome biochemistry in soybean
2. Editing of *Flavonone 3 hydroxylase* (*F3H*) and *Flavone synthase* (*FNS*) genes for enhanced tolerance to pod borer (*Helicoverpa armigera*) in pigeon pea.

Progress:
- Edited T_1 soybean plants raised and subjected to D,L- Phosphinothricin treatment for confirming trans-gene integration

B. Externally funded Projects

Project EF008: Identification of host factors responsible for infection and development of nano-particle based dsRNA delivery system for imparting resistance to begomoviruses
(P.N. Sivalingam, J. Sridhar, Vinay Kumar, L.L. Kharbikar**)**

Lead centre : ICAR-NIBSM
Co-operating centres: NIPGR, New Delhi; ICAR-IARI, New Delhi and IIT-Delhi;
Duration: August 2018- December 2021

Objectives:

1. To understand the host factors responsible for infection and replication in the identified hosts and non-hosts to begomoviruses (NIBSM & NIPGR)
   Activity 1: Developing infectious clones of MYMV/ MYMIV and ToLCNDV/ begomovirus infecting tomato (NIBSM)
   Activity 2: Technique to identify virus replication and movement in hosts and non-hosts (NIBSM)
   Activity 3: Localization of virus in different tissue to track the virus in host and non-host
   Activity 4: Molecular analysis of host factors interacting with begomovirus infection in the host and non-host species upon inoculation of selected begomovirus (NIBSM)
   Activity 5: Plant gene silencing by VIGS and functional validation of involvement of plant factors in virus infection/multiplication/spread
2. To develop efficient delivery system of dsRNA conjugated with nano materials (IARI & IIT-D).
3. To study efficiency of ds RNA conjugated with nanoparticles in vector transmission and begomovirus infection (IARI & IIT-D).

Achievements:

- Developed single whitefly transmission technique and epicotyls region agro-inoculation suitable for viral replication and infection of MYMIV and ToLCKV.
- Identified differentially expressed transcripts upon infection of MYMIV on host (mungbean) and non-host (tomato).
- Identified 48 differentially expressed transcripts were identified that host factors. Out of these four transcript factors are initially validated for involving in infection of begomovirus.

Project EF005: AICRP on Nematodes in Agriculture
(Mallikarjuna J)
Duration: 2014 onwards
Objectives:
1. To develop distribution maps of nematodes in the State
2. To validate and document crop losses and nematode management technology in irrigated and rain-fed cropping systems
3. To identify sources of resistance and develop nematode-resistant cultivars
4. To demonstrate nematode management technologies in various crops

Progress:

- First report of rice root knot nematode from Chhattisgarh state.
- Evaluated many germplasms of various crops like rice, green gram, chickpea, brinjal, pigeons against root knot nematode for identification resistant sources.
- Evaluation and demonstration of various technologies for the management of root knot nematode problem in rice, cucumber.

School of Crop Health Policy Support Research
A. Institute Projects

Project 4.2: Bio-ecology and management of pink stem borer in wheat
(K.C. Sharma, Mallikarjuna, J.)
Duration: 2016-2021

Objectives:
1. To record seasonal incidence of pink stem borer in Chhattisgarh and adjacent region.

2. To screen different popular wheat varieties/germplasm for tolerance/resistance against pink stem borer.
3. To study nutritional (K and Si) basis of resistance against pink stem borer.

Achievements:

- Surveyed nine districts of Chhattisgarh, 1-10% infestation of pink stem borer in wheat crop observed.
- Three varieties and 3 germplasm were found resistant to pink stem borer.
- Exogenous application of different silicon sources and potassium reduced the pink stem borer damage in wheat and recorded enhanced photosynthesis, activated defence reaction and increased yield.
- Large scale technology evaluation of silicon application using two wheat varieties (CG Gehun-4 and CG Amber) conducted in two acre area. The silicon application significantly reduced the pink stem borer in wheat and increased yield achieved.

Project SCPSR1: Pest risk analysis of agriculturally important potential invasive pest and diseases in India

(K. C. Sharma; S.K. Jain, P. Mooventhan and Soumya Dash)

Duration: Five years (2021-26)

Objectives:

1. To identify and list the insect pest and diseases, that can enter, establish, spread and cause significant loss in the country and their pathways of introduction.
2. To analyze risk factors for selected pest and disease outbreaks if introduced in the country and to identify areas/regions in the country likely to be affected more.
3. To suggest efficient management strategies to reduce crop losses.

Progress:

- Work initiated to collect information on the pests which are not present in the country and have the potential to enter the country through various means.
- Crop diseases like Maize lethal necrosis or Corn lethal necrosis, Banana Xanthomonas wilt (BXW), wheat blast, downy mildew of soybean etc. were identified which are not present in India.
- Information on conducive environment, movement, modes of perpetuation and transmission of these diseases and other pests is in progress.

B. Externally funded Projects

Project EF006: ICAR Farmer FIRST Programme: Socio-economic upliftment of tribal farmers through suitable agricultural enterprises integration in rice fallow pulse cropping system - A participatory approach for doubling the farmer's income.

(P. Mooventhan, Anil Dixit; M.A. Khan, Praveen Kumar, Lokesh Varma, G.L. Sharma)

Duration: 2016-2022

Objectives:

1. To study the existing rice fallow pulse cropping system, livelihood pattern, problem identification, priority setting, information need, perceived constraint and socio-economic profiling of the resource poor farmers.

2. To augment the capacity building at field level for farmer-participatory research and extension in adoption and expansion of selected interventions on crop, livestock, horticulture and NRM based enterprises.
3. To develop, establish and evaluate the sustainability of integrated livelihood generating farming models for resource poor rural farmers.
4. To evolve suitable up scalable farm technologies for women farmers to address drudgery reduction, income enhancement and livelihood security.
5. To develop and test the effectiveness of Educational Multimedia Training Modules (EMTMs) on biotic stress management technologies in rice fallow pulse cropping system.
6. Research backstopping for further improvement of crop, livestock, horticulture, rice fallow pulse and NRM based enterprises for desirable traits preferred by the farmers and stakeholders.

Progress:

- Under the crop-based module, improved high yielding rice varieties demonstrated in 54 ha area, and 42 hectares rice fallow land were covered with *rabi* pulses and oilseeds crops.
- Under horticulture-based module scientific vegetable and turmeric production demonstrated in 12.80 ha area using improved varieties and eco-friendly pest and disease management technologies were promoted.
- Under the livestock-based module up-scaled the Kadaknath farming cum hatchery units with 1500 chicks and health camp organized for Kadaknath and goat.
- Under the enterprise-based module, established two oyster, paddy straw and one milky mushroom production units. Rice, spices, flour and pulse processed at the village level agro-processing centers.
- To reduce the cost and assure the availability of feed under poultry and goat farming, established 14 low-cost Azolla production units. In addition, waste decomposer culture has been multiplied and applied in the rice and vegetable field to improve the soil fertility.
- More than 54 promising agricultural technologies popularized and disseminated in the farmer's fields and covered 634 tribal farm families. In total Rs. 28.98 lakhs generated as additional income (Rs. 7017/- per farm families).
- To disseminate the latest agricultural technologies, information, advisories and provide need-based information, utilized WhatsApp group, Facebook page and YouTube channel. Further, more than 1310 message, photos and videos circulated and 324 farmers benefitted under the ICT based module.
- As a part of capacity building, 61 training, 64 demonstrations, group discussion, online interface and farmers meetings conducted at the field level, benefitting more than 2494 tribal farmers.

Project EF009: DBT "Establishment of Biotech - KISAN Hub at ICAR- NIBSM, Raipur"

(P. Mooventhan; Anil Dixit; R.K. Murali Baskaran; R.K. Mahobia; S.K. Verma)

Duration: 2020 to 2022

Objective:

1. To adopt and disseminate the biotech intervention to farmers
2. Popularization of improved rice varieties such as drought tolerant, BHP resistant varieties, nutri-rich varieties (developed through biotechnological approaches).

3. Application/use of bioagents (like *Trichogramma spp*., NPV, BT, *Trichoderma viride* and *Pseudomonas*) along with complete package of practice at farmer's level in rice and pulses.
4. Demonstration of low-cost protected cultivation if vegetable such as colored capsicum, cucumber and tomato.
5. Demonstration of scientific goat farming with the introduction of Sirohi, Jamunapari, Black Bengal and Barbari breeds.

Progress:

- Seventy two hectare area covered under biofortified rice cultivation, rice fallow pulse and vegetable production with poly-mulch and drip system. A total 150 farm families were covered during 2021-22 which includes 8 SC and 49 ST farm families.
- Overall 29 technological interventions introduced at farmer's fields which also include 9 units of Low-cost shade net-house to produce cucumber and tomato. Demonstrated the scientific goat farming with Sirohi breeds.
- Three FPGs and One FIG (Vegetable, Goat and Biopesticides) formed.
- Total 1486 cc (worth of 1.48 lakh) of native *Trichogramma* spp*, (T.japonicum* and *T.chilonis)* was produced and distributed to farmers. About 297.76 ha of crops covered during *rabi/ kharif* and 740 farm families benefitted.
- Rs. 56.17 lakhs/- of additional income generated (Rs. 37,420 / Farm Family).
- As a capacity building programme initiative, 122 trainings, 57 demonstrations, 21 field day programmes organized. A total of 9,622 farmers benefited under various capacity building programmes. Further, GEO-TAGGING photographs uploaded in the Biotech-KISAN portal (https://icarbiotechkisanhub.in/).
- Sixty farmers benefitted under Farmers Fellowship programme from three aspirational districts namely Korba, Mahasamund and Rajnangaon.
- Four HRD programme (five days) were organized at KVKs viz. Mahasamund and Rajnandgaon during 6-10 December 2021; Korba&Rajnandgaon during 16 to 20 February 2022 as a part of Azadi ka Amrit Mahotsav.

Project EF010: DST-SYST "In situ diagnosis and digital cataloging of plant pathogenic fungi through Foldscope microscopy- A frugal science approach"
(P. Mooventhan, H.K. Singh)
Duration: 2020-2023

Objective:

1. To develop digital catalogue of plant-pathogenic fungi from various diseased plant parts using Foldscope Microscopy.
2. To develop protocols for in-situ diagnosis of major plant-pathogenic fungi through Foldscope Microscopy at field level.
3. To educate and upscale the knowledge of rural youths and field level extension workers on Foldscope microscopy for field level diagnosis.

Progress:

- Various disease samples were collected from the tribal farmers, Research Centre and SAUs. In-situ diagnosis of 26 samples have been done successfully viz. *Ustilaginoidea virens* (False smut of rice), *Magnaporthe grisea* (Blast of rice), *Alternaria solani* (Early blight of tomato), *Alternaria porri* (Purple blotch of onion), *Cercospora* spp (Leaf spot of okra) and *Aspergillus* spp. (Grapes) etc. through Foldscope microscope.

- Five biopesticides tested and two bioagent viz. *Trichoderma viride* and *Pacelomyces* spp. observed successfully under Foldscope. Also tested two fruiting bodies of mushroom, whereas *Pleurotus* spp (oyster mushroom) was observed in situ under Foldscope.
- Observed two mushroom pathogens *viz. Trichoderma spp* (Mushroom bag) and *Aspergillus* spp (Mushroom spawn) under Foldscope.
- As a capacity building initiative 19 events organized on foldscope demonstration cum hands-on training, awareness campaign on in-situ diagnosis of plant pathogenic fungi through Foldscope microscope to rural farmers, youth, college students, agriculture extension officers, horticulture extension officers and teaching faculty of institute. A total of 503 participants were benefitted including 143 are rural farmers, 7 female farmers, 305 college and school students and 48 agricultural extension officers/Scientist/Professor.
- Posted 23 documented observations/event and published in online platform of MICROCOSMOS (https://microcosmos.foldscope.com/) Foldscope Community.

11. List of RAC members of ICAR-NIBSM, Raipur

1.	**Dr. A.N. Mukhopadhyay** Ex-vice chancellor, Assam Agricultural University, Jorhat	Chairman
2i)	**Dr. T.K. Adhya** Ex-Director, ICAR-NRRI, Cuttack	Member
ii)	**Dr.ChandishBallal** Ex-Director, ICAR-NBAIR, Bangalore	Member
iii)	**Dr. A.R. Sharma** Director (Research), RLBCAU, Jhansi	Member
iv)	**Dr. R. Srinivasan** Ex-Director, ICAR-NIPB, New Delhi	Member
v)	**Dr. V.K. Baranwal** National Professor, Plant Pathology, ICAR-IARI, New Delhi	Member
3.	**Dr. P.K. Ghosh** Director, ICAR-NIBSM, Raipur	Member
4.	**Dr. S.C. Dubey** Asst. Director General (PP & B), ICAR, New Delhi	Member
5.	Two persons representing agriculture/rural interests on the Management Committee of the Institute in terms of Rule 66 (a) (5) for the period of their membership of the Management Committee (Proposal is under process)	Member
6.	**Dr. P.N. Sivalingam** Principal Scientist (Agricultural Biotechnology), I/c SCRSR, ICAR-NIBSM, Raipur	Member Secretary

ANNEXURES

Proceedings of the 6th meeting of the Research Advisory Committee (RAC)

ICAR-National Institute of Biotic Stress Management (ICAR-NIBSM)
Raipur, Chhattisgarh

(12th July 2021)

Sixth meeting of the Research Advisory Committee (RAC), ICAR-NIBSM, Raipur was held on 12th July, 2021 under the Chairmanship of Dr. C.D. Mayee, Former Chairman, ASRB, New Delhi. He attended the meeting physically at NIBSM campus alongwith Dr. P.K. Ghosh (Director & Vice Chancellor, ICAR-NIBSM, Raipur) and Dr. P. Kaushal (Joint Director -Research & Member Secretary- RAC), ICAR-NIBSM, Raipur). Other RAC members who attended the meeting in virtual mode included Dr. V.V. Ramamurthy (Ex-Principal Scientist, Division of Entomology; ICAR-IARI, New Delhi), Dr. S.S. Singh (Ex-Director, ICAR-IIWBR, Karnal), and Dr. S.C. Dubey ADG (PP&B), ICAR, New Delhi.

This meeting was also attended by Dr. Anil Dixit (Acting JD-SCHBR), School In-charges; Dr. S.K. Jain, PS (Plant Pathology) & I/c SCHPR; Dr. R.K. Murali-Baskaran, PS (Agricultural Entomology) & I/c SCHMR and Dr. P.N. Sivalingam, PS (Biotechnology) and I/c SCRSR. Scientists of the Institute also attended the meeting through virtual mode.

Dr. P.K. Ghosh, in his Directors' remarks, complemented and thanked the RAC for providing suitable guidance and recommendations for the progress of the Institute. It was also highlighted that all the recommendations made during the 5th RAC meeting (2020) were accepted by the Council. He shared that NIBSM has received the ISO 9001:2015 certificate. The transition from *Sections-mode* to *Schools-mode* has also been made, as recommended by the RAC. He also thanked Dr. C.D. Mayee and all the members for their prolonged association with the Institute that helped its proper establishment and development. He further elaborated the new initiatives undertaken in research and education and the progress made by the Institute during the previous year. He also briefed the progress in infrastructure development which is now completed and ready for inauguration. Regarding new EFC (2021-2026) proposal, he mentioned that the new research and teaching programmes have been presented in the EFC meetings in the presence of Honble' DG and DDG (CS) in the ICAR, and bears in-principle approval of the Council. NIBSM now has adequate infrastructure and shall have sufficient funds after the EFC approval to take over new programmes. The only major issue to be addressed now is the shortage of manpower for which pro-active efforts are being made at the Council/Ministry.

In opening remarks of the Committee, the Chairman and the members appreciated the efforts made for establishing the infrastructure and developing the research leads which has resulted quality publications and products albeit constraints of manpower and funds. They strongly insisted for pro-active efforts in enriching the manpower (including scientists, admin, technical and supporting staff) and effective time-management of scientists for further growth of the Institute. The committee expected the Institute to develop research programmes and active collaborations with other

institutes/organizations for addressing larger issues of biotic stress management, particularly targeting basic and strategic research as per the mandate of the Institute.

Dr. S.K. Jain, I/c PME, presented the action taken report (ATR) of the recommendations of the 5th RAC meeting. All issues related to Infrastructure, Research, Education and HRD were discussed in detail. It was suggested that the available research leads may appropriately be studied for basic mechanisms and/or development of intermediate products (strategic research). It was also emphasised to strengthen the digitization for its possible utilization in diagnostics. Regarding education, the Committee expressed that the hybrid mode with IARI is good at the moment; however, NIBSM should try to develop its own education system in coming years. Joint Director (Education) shall develop an education policy in collaboration with the universities / education division and get it approved. The Chairman expressed satisfaction and pleasure that all recommendations of the 5th RAC meeting were accepted by the Council, without any change. The proceedings of the 5th RAC meeting were confirmed by the Committee.

Dr. P. Kaushal, JD (Research) presented the Institute's performance in terms of research projects and achievements, publications, awards, recognitions and attracting research grants through externally funded projects during the previous year. He also presented aims, thematic areas, flagship and other major programmes of the four schools of ICAR-NIBSM, subsequent upon the recommendation of the RAC to move from *Sections-mode* to *Schools-mode* for Research and Education. An overview of the new programmes /projects proposed in the new EFC (2021-2026) was also presented. It was also mentioned that all the major programmes are developed with active collaboration with other NARES Institutes and other organizations. Progress on education and the roadmap ahead was presented by Dr. R.K. Murali Baskaran, Member Education Cell. Future thrust areas and detailed research programmes including major areas of work under various schools were presented by the School In-charges/JD schools. Brief outline of the proposed projects under different programmes of four schools were also presented. The members RAC appreciated the research progress, as evident through publications in high impact journals, as well as the proposed programmes addressed/relevant to various national programmes, SDGs, and Third-party evaluation reports.

A detailed discussion followed the presentation of research and education progress, and projections:

The Chairman appreciated the infrastructure setup as highly imposing buildings have been developed with good laboratories, library, teaching and conference facilities. He emphasized to undertake basic research that has larger application and interest to the other Institutes involved in strategic and basic research, and development of effective linkages with other organizations. He said that there should be more focus on major non-cereal crops like pulses and oilseeds where appreciable information related to basic science of plant protection is limited. He again stressed that the Council be approached to provide adequate administrative manpower so that scientists get sufficient time to focus on research. He further added to develop state of the art laboratories to attract researchers from other

institutions. NIBSM must have MoU/ collaboration with nearby and other SAUs to attract Masters and Doctoral students to carry out their research work in the area of biotic stresses in the institute. This will strengthen the Institute and improve its visibility. Institute may also plan to work in collaboration with the Institutes such as IIAB and NIASM in overlapping research areas. Basic research with larger applications in knowledge generation or strategic needs must be strengthened in the schools of Crop Health Management, Crop Health Biology and Crop Resistance System Research. School of Policy-support may develop a section/ area in the institute library which may contain books, research and policy papers as well as digitalized documents for better visibility of policies on biotic stress in agriculture. He expressed that the policy-support research is important as quality issues and global standards of quality products will be the key for acceptable product development and delivery. Some of these inputs may be provided to organizations like APEDA. Opportunities to collaborate with similar organizations may be explored. He suggested to enrich the library facilities and advised the scientists to keep an update of recent developments in their disciplines. He appreciated the contribution of scientists in research and institute building activities. He further emphasised to undertake second phase of works, including the residential complexes, to provide better and comfortable working environments to the staff of the Institute.

Dr. V.V. Ramamurthy expressed that the Institute is progressing in right direction during the past three years. Institute should excel in biotic stress research and high-quality education, in days to come. He said that the Institute must keep a focus on basic research. Research programmes may be focused on combating biotic stresses together. The programmes planned for the years 2021-22, and the next few years may address this issue, with at least 50% of the time spent by the scientists on such programmes. The institute must have Inter-school collaboration in terms of sharing of scientists in different projects as inter-disciplinary collaborative projects are essential for better growth of the institute. Progress in state-of-art-laboratory development, purchase of high end equipments may be prioritized. Institute must focus on productive MoUs and linkages with other institute for collaborative programmes. Education programmes need to be strengthened. The need for developing/ approval of a discipline in the ICAR Education division and consequently in the ARS/ senior fellowship towards this effect was stressed. Only this can justify the deemed university status for NIBSM. The prominence of biotic stress as a teaching discipline solely rests with NIBSM and all the courses developed must have this as a core. Institute must develop a Model farm and should follow good laboratory practices and bio-safety levels to establish state-of-the-art facilities to undertake biotic stress researches. NABL/BSL accreditations for the developed infrastructure must be pursued. Effective time management of the Scientists should be planned, keeping sufficient time for research (50%), education (25%) and other activities, including outreach and institute building. He also emphasised on follow-up action on the recommendations of the brainstorming sessions conducted to identify research gaps in various fields of biotic stress management, developing GAPs, e.g. for GM crops, and understanding common philosophy of biotic stress reactions.

Dr. S.S. Singh agreed with the comments and concerns raised by Dr. Ramamurthy. He further emphasized that basic research in collaboration with other Institutes must be the focus which should additionally provide the basic material for crop-based Institutes. Especially he mentioned to strengthen attempts to identify/generate novel genetic stocks including donors of desirable alleles and their stacking in desirable genotypes, as well as key gene sequences involved in regulation of biotic stress mechanisms. He emphasised to get these materials properly registered with appropriate agencies and keep a track of their utilization by other researchers and Institutions. When other Institutes develop any high yielding, biotic stress resistant varieties utilising these materials it should be highlighted in Annual Report as a contribution of NIBSM. Emphasis should also be given on forecasting of biotic stresses, strains, races, or pathotypes and understanding the pathways of action and molecular mechanisms.

Dr. S.C. Dubey, ADG (PP&B) complemented the Institute for doing good work with available manpower and funds. He said that ICAR has given the open choice for transfer of scientists from other Institutes and sufficient posts of administrative cadre have been approved recently. He also mentioned that the Institute is created with a specific mandate; it should focus on basic research and avoid the duplication of the work being done by other institutes on applied or technology generation programme. There is need to prioritize and have focussed programmes on crops/pest combinations. He emphasised that the research programmes need to be precise and specific in generating desired information/product. The Institute has to work in active collaboration with other Institutes, specially with Plant Protection Institutes, in overlapping areas of interest to conduct quality research. He also suggested that various projects developed under research programmes should be precisely clear and specific in the objectives and the activities therein.

Dr. P. Ananda Kumar complimented all the scientists for their research work and suggested few points for future research, based on the RAC document and other programme details provided to him, as he could not attend the meeting due to some urgency. He suggested that Soybean isoflavones e.g. isoflavone synthase (IFS) acts as the key metabolic entry point for the formation of all kinds of isoflavones which are associated with many health benefits. Single nucleotide polymorphisms (SNPs) in *IFS1* gene can be exploited by genome editing to enhance isoflavones. *IFS1* polymorphisms may serve as important molecular markers for breeding. Relevant studies may be undertaken regarding silicon-mediated resistance to pink stem borer in wheat and yellow stem borer in rice which can be extrapolated to pink bollworm resistance in cotton. Also, look for endophytes isolated from pigeon-pea if they can confer protection against sterility mosaic virus. Development of multiple stress tolerance in elite varieties of rice vis-à-vis BLB, BPH and Blast may be extended to YSB and Gall midge also since validated markers are available for these two important pests. He also emphasised the importance of generating novel information and material in emerging areas of biotic stress management.

In the end, Dr. P.K. Ghosh, Director, ICAR-NIBSM informed the RAC about the concerns and points raised. Regarding inter-school collaboration, he informed that all school have multidisciplinary team of scientists. In addition, under One Health

programme, animal scientists of all the schools are associated. Institute also plan to work on medicinal plants for exploration of novel resources like biomolecule and endophytes. The programmes were well discussed in various high-level meetings and now individual projects will be framed to address specific issues in phase-wise manner in the EFC duration, as suggested and discussed.

The meeting ended with the formal vote of thank proposed by Dr. Anil Dixit, JD - Acting (SCHBR).

28.07.21

(P. Kaushal)
Member Secretary, RAC

(C. D. Mayee)
Chairman, RAC

List of RAC members and invitees who attended the 6th RAC meeting held at ICAR-NIBSM, Raipur on 12th July 2021:

1. **Dr. C. D. Mayee***, Chairman RAC and Former Chairman ASRB. New Delhi.
2. **Dr. S.S. Singh****, Member RAC, Ex-Director, ICAR-IIWBR, Karnal.
3. **Dr. V.V. Ramamurthy****, Member RAC, Ex-Principal Scientist, Division of Entomology, ICAR-IARI, New Delhi.
4. **Dr. P. K. Ghosh***, Member RAC, Director& Vice Chancellor, ICAR-NIBSM, Raipur.
5. **Dr S. C. Dubey****, Member RAC, Assistant Director General (PP&B), ICAR, New Delhi
6. **Dr. Anil Dixit***, PS, JD (Acting)-School of Crop Health Biology Research, NIBSM Raipur.
7. **Dr. S.K. Jain***, PS, I/C PME& I/c School of Crop Health Policy support Research, NIBSM Raipur.
8. **Dr. R.K. Murali Baskaran***, PS & I/c School of Crop Health Management Research, NIBSM Raipur.
9. **Dr. P.N. Sivalingam***, PS& I/c School of Crop Resistance System Research, NIBSM, Raipur.
10. **Dr. P. Kaushal***, Joint Director (Research) & Member Secretary, RAC, NIBSM, Raipur.

* Attended physically

** Attended online/virtual mode

Recommendations of the 6th RAC – NIBSM held on 12.07.21

A.	Infrastructure and manpower
1	Develop Model farm and state-of-the-art laboratories to undertake quality research, training and collaboration in the field of biotic stress management.
2	Follow-up at Council for deployment of sanctioned strength of staff.
3	Effective time-management of scientists be made to undertake research and education
B.	Research
1	Institute should focus on *Basic research* aiming at understanding the mechanisms and overall philosophy of host-pest/pathogen reaction and *Strategic research* to develop knowledge and/or products to be utilized by commodity specific institutes and other stake holders.
2	Follow-up action be undertaken on the recommendations of the brainstorming sessions conducted to identify research gaps in various fields of biotic stress management (developing GAPs, eg for GM crops, AI, and understanding common philosophy of biotic stress reactions in major non- cereal crops).
3	Leads available in soybean isoflavones gene editing, silicon-mediated tolerance to stem borers, endophytes and super-donors be targeted to develop intermediate products.
4	School of Policy Support Research should develop effective linkages with other government agencies involved in Policy decisions related to biotic stress management. Novel areas inviting policy interventions be identified and attempted.
5	Develop effective linkages and collaborations with the scientists working in different schools and with other Institutions, specifically in the areas of overlapping interests.
C.	Education
1	NIBSM should try to develop its own education system in coming years in line with the new National Education Policy. Joint Director (Education) shall develop an education policy in collaboration with the universities / education division and get it approved by the Council.
2	Institute must have MoU/ collaboration with other SAUs to attract Masters and Doctoral students to carry out their research work in the area of biotic stresses in the institute

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File no. CS 13-1/2021-PP

Dated: 09.06.2021

Subject:-Proceedings and recommendation of 6th Research Advisory Committee (RAC) meeting of the ICAR-National Institute of Biotic Stress Management (NIBSM), Raipur, Chhattisgarh.

The 6th Research Advisory Committee (RAC) meeting of ICAR-National Institute of Biotic Stress Management (NIBSM), Raipur, Chhattisgarh was conducted under the chairmanship of Dr. C.D. Mayee, (Former chairman, ASRB, New Delhi) on 12 July 2021. The other members of RAC namely Dr. P.K. Ghose, (Director & Vice Chancellor, ICAR-NIBSM, Raipur), Dr. P. Kaushal, Joint Director (Research) & Member Secretary, RAC, Dr. V.V. Ramamurthy (Ex-Principal Scientist, Division of Entomology), ICAR-IARI, New Delhi, Dr. S.S. Singh, (Ex-Director, ICAR-IIWBR, Karnal), Dr. S.C. Dubey, ADG (PP&B), ICAR-New Delhi, Dr. Anil Dixit, (Acting JD-SCHBR, School In Charges) NIBSM, Raipur, Dr. S.K. Jain, Principal Scientist, (Plant Pathology & I/c SCHPR), Raipur, Dr. R.K. Murli Baskaran, Principal Scientist (Agricultural Entomology & I/c SCHMR), Raipur and Dr. P.N. Sivalingam, Principal Scientist (Biotechnology & I/c SCRSR), Raipur and Scientists of the Institute were attended the meeting.

The recommendation along with comments of Crop Science Division are placed below for necessary action.

S.No.	Recommendation of RAC	Comments by SMD
1.	Develop Model farm and state-of-the-art laboratories to undertake quality research, training and collaboration in the field of biotic stress management.	Agreed. All activities should be time line.
2.	Follow-up at Council for deployment of sanctioned strength of staff.	Agreed.
3.	Effective time-management of scientists be made to undertake research and education.	Agreed.
4.	Institute should focus on Basic research aiming at understanding the mechanisms and overall philosophy of host-pest/pathogen reaction and Strategic research to develop knowledge and/or products to be utilized by commodity specific institutes/other stake holders.	Agreed. Well defined research programme should be made. Additional support may be obtained from externally funded projects.
5.	Follow-up action be undertaken on the	Agreed.

	recommendations of the brainstorming sessions conducted to identify research gaps in various fields of biotic stress management (developing GAPs, eg for GM crops, AI, and understanding common philosophy of biotic stress reactions in major non- cereal crops).	
6.	Leads available in soybean isoflavones gene editing, silicon mediate tolerance to stem borers, endophytes, super-donors, be targeted to develop intermediate products.	Agreed.
7.	School of Policy Support Research should develop effective linkages with other government agencies involved in Policy decisions related to biotic stress management. Novel areas inviting policy interventions be identified and attempted.	Agreed. It should be as per mandate of the Institute.
8.	Develop effective linkages and collaborations with the scientists working in different schools and with other Institutions, specifically in the areas of overlapping interests.	Agreed.
9.	NIBSM should try to develop its own education system in coming years in line with the new National Education Policy. Joint Director (Education) shall develop an education policy in collaboration with the universities / education division and get it approved by the Council.	Agreed. It must be as per new national education policy and prior approval from the council.
10.	Institute must have MoU/ collaboration with other SAUs to attract Masters and Doctoral students to carry out their research work in the area of biotic stresses in the institute	Agreed. As per ICAR guideline.

The competent authority desired that overall structure of the institute need re-discussion and reorientation in a brain storming session since there is lot of overlaps between the school.

The Director is also advise to take all necessary steps to implement the advisory given by the RAC.

This Issues with the approval of competent authority i.e. DDG (CS), ICAR.

Dubey 9/8/2021

(S.C. Dubey)

To

Director,
ICAR-National Institute of Biotic Stress Management (NIBSM),
9RJG+46M, Baronda, Raipur - 493225
Chhattisgarh

दिनांक 11/1/2022

EMail

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F.No.CS.19/7/2013-IA-III(e 5495) Dated the: 5th January, 2022

OFFICE ORDER

In supersession of Council's Office Order dated 29.12.2021, under the provisions of Rule 71 A(a) of the Rules of Indian Council of Agricultural Research Society, the Director General, Indian Council of Agricultural Research has been pleased to re-constitute the Research Advisory Committee of ICAR-National Institute of Biotic Stress Management (NIBSM), Raipur with the following Members:-

Rule 71 A (a)	Name and Designation	Nominated as
1.	Dr. AN Mukhopadhyay, EX-Vice Chancellor, Assam Agriculture University, Jorhat	Chairman
2. i)	Dr. TK Adhya, Ex-Director, NRRI, Cuttack	Member
ii)	Dr. Chandish R Ballal, Ex-Director, NBAIR, Bangalore	Member
iii)	Dr. AR Sharma, RLBCAUI, Jhansi	Member
iv)	Dr. Srinivasan, Ex-Director, NIPB, New Delhi	Member
v)	Dr. VK Barnwal, Plant Pathology, IARI, New Delhi	Member
3.	Director, ICAR-NBISM, Raipur	Member
4.	ADG(PP), ICAR Krishi Bhavan New Delhi	Member
5.	*Proposal is under process*	*Member*
6.	Dr. P .N. Sivlingam Pirncipal Scientist & In-Charge School (Biotechnology), ICAR-NIBSM, Raipur	Member Secretary

...continued..

Dr. Sivlingam / Dr. S. K. Jain / Sh. Pasuca

10/1/22

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The term of Chairman and other nominated Members will be for a period of three years w.e.f. 19.12.2021 except for the Members at Sl. No.5.

The Functions, Powers etc of the RAC will be as contained in ICAR notification No. 6(10)/93- CSC, dated 10.7.94.

(Yashoda Nayal)
Under Secretary (CS)
Telephone - 23046422

Distribution:-

1. The Chairman & all members of RAC (Through Director, ICAR-NIBSM, Raipur).
2. Director, ICAR- NIBSM, Raipur.
3. Adm. Officer, ICAR- NIBSM, Raipur.
4. ADG(PP), ICAR
5. PPS to DDG (CS),
6. Sr. PPS to DG, ICAR.
7. Dr. S.K. Mallik, Principal Staff Officer of Secretary (DARE) & DG, ICAR.
8. Guard file

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Rendering solution to biotic stresses