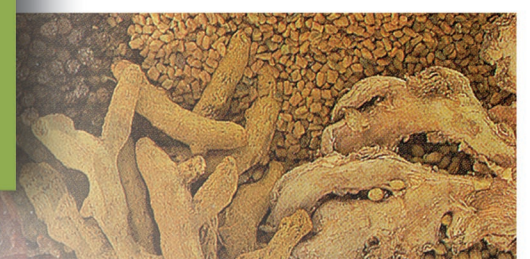


XXXI वीं कार्यशाला का कार्यवृत्त Proceedings of XXXI Workshop



भाकृअनुप-अखिल भारतीय समन्वित मसाला अनुसंधान परियोजना ए आई सी आर पी एस
ICAR-All India Coordinated Research Project on Spices
AICRIPS

29-30 September 2020

ICAR-Indian Institute of Spices Research
Kozhikode, Kerala.

ICAR-All India Coordinated Research Project on Spices
ICAR- Indian Institute of Spices Research
Kozhikode - 673 012, Kerala

PROCEEDINGS OF XXXI ANNUAL WORKSHOP
ICAR-All India Coordinated Research Project on Spices

29 - 30 September 2020

ICAR-IISR, Kozhikode



ICAR- ALL INDIA COORDINATED RESEARCH PROJECT ON SPICES
ICAR-Indian Institute of Spices Research
Kozhikode -673 012, Kerala

November 2020

Compiled & edited by
Mr. John George
Dr. Sharon Aravind
Dr. K.S. Krishnamurthy
Dr. E. Radha
Dr. S.J. Eapen

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Preface

Spices are literally a ‘mixed bag of crops’ with varying plant habits/stature and life span, from fleshy rhizomatous and herbaceous annuals to perennial woody climbers and trees, varying in morphology, constituents/active ingredients, and useful parts/uses, collectively contributing substantially to the agricultural export basket of India.

The ICAR-AICRP on Spices is the largest spices research system in India, focusing on 17 mandate crops, with a network of 19 regular, 11 co-opting, 8 voluntary and 2 project mode centers. The AICRP on Spices has contributed substantially, ever since its inception, in developing high yielding varieties with desirable agronomic traits, technologies for increasing the production and productivity, and management strategies for combating pests and pathogens, substantially reducing crop losses.

The XXXI Annual Group Meeting of ICAR-All India Coordinated Research Project on Spices was organized on 29th and 30th September 2020 at ICAR-Indian Institute of Spices Research, Kozhikode on virtual mode (through video conferencing) in view of the prevailing COVID-19 pandemic. During the technical sessions, work done and progress made under each project during 2019-20 at the centres were reviewed threadbare and technical programmes for the year 2020-21 were formulated. The brief achievements and technologies developed were discussed and recommended for transfer to extension agencies. It is heartening to mention that four new varieties viz., Acc. 247 (high quality bold and plump ginger variety by ICAR-IISR, Kozhikode), Lam Turmeric 1 (lemon yellow colour turmeric powder and high dry recovery by Dr. YSRHU, Guntur), Rajendra Haldi 1 (high yield and high curcumin turmeric variety by Dr. RPCAU, Dholi) and HM-257 (high yielding powdery mildew and downy mildew resistant fenugreek variety by CCSHAU, Hisar) were recommended for release.

Of the 72 ongoing projects of 2019-20, 55 were recommended for continuation and 17 for conclusion, while ten new projects to be initiated in 2020-21. The outline of work and specific decisions/ recommendations on ongoing projects (grouped under three sessions, Genetic Resources and Crop Improvement, Crop Management, and Crop Protection) are given in this document, while the experimental details/observational regime in the case of new experiments are documented in minute detail under “New Research Programmes”.

I would like to record my sincere gratitude to Dr. A. K. Singh, DDG (Hort. Sci.), and Dr. V. K. Pandey, ADG (Hort. Sci. II), ICAR, New Delhi for their support and constant guidance. I place on record my gratitude to Dr. N.K. Krishna Kumar, formerly DDG (Hort. Science) and presently, Chairman, RAC for his participation and guidance during the XXXI AGM of AICRP on Spices. Thanks are also due to Dr. Gopal Lal, Director, ICAR – NRCS, Ajmer, Dr. K. Nirmal Babu, former Director & Project-Coordinator of ICAR-IISR, Heads of Divisions and colleagues at ICAR-IISR for their constant support in functioning of ICAR-AICRP on Spices.

I am extremely thankful to the Scientists working in different centres for providing the information in time. Commendable efforts taken by Dr. Sharon Aravind, Shri. John George, Dr. K.S. Krishnamurthy and Dr. E. Radha in compiling and bringing out this document is highly appreciated.

Kozhikode
26th November, 2020

(Santhosh J. Eapen)
Project Coordinator (Spices)

XXXI Annual Workshop of ICAR-All India Coordinated Research Project on Spices

Venue: ICAR-IISR, Kozhikode (Virtual Meeting through Video Conference)

Date: 29 - 30 September 2020 (28 September - Pre workshop meeting)

Organized by: ICAR-AICRPS, ICAR-IISR, Kozhikode

INAUGURAL SESSION (10.00 AM - 11.30 AM)

10.00 AM - 10.05 AM	ICAR Song	
10.05 AM - 10.10 AM	Welcome Address	Dr. Santhosh J Eapen Project Co-ordinator (Spices) ICAR-IISR, Kozhikode
10.10 AM - 10.20 AM	Address by Guest of Honour	Dr. Vikramaditya Pandey Asst. Director General (HS II) ICAR, New Delhi
10.20 AM - 10.35 AM	Presidential Address	Dr. A. K. Singh Deputy Director General (HS), ICAR, New Delhi
10.35 AM - 11.00 AM	Inaugural Address	Dr. R. Chandra Babu Vice Chancellor, KAU Thrissur
11.00 AM - 11.25 AM	Felicitations	Dr. Homey Cheriyan Director, DASD, Kozhikode Dr. Gopal Lal Director ICAR-NRC on Seed Spices, Ajmer Dr. K. Nirmal Babu Former Project Coordinator & Director, ICAR-IISR, Kozhikode
11.25 AM - 11.30 AM	Vote of Thanks	Dr. K. S. Krishnamurthy Principal Scientist ICAR-IISR, Kozhikode

TECHNICAL SESSIONS

29 September 2020

SESSION I : Genetic Resources & Crop Improvement	11.30 AM - 4.30 PM
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Chairpersons: 1. **Dr. J. Rema**, Head, Division of CI&B, ICAR-IISR, Kozhikode
2. **Dr. Dhirendra Singh**, Former Sr. Breeder, SKNAU, Jobner

Rapporteurs: 1. **Mr. V.A. Mohammed Nissar**, ICAR-IISR, Kozhikode
2. **Dr. Sharon Aravind**, ICAR-IISR, Kozhikode

Presentations:

1	Black pepper	Dr. P. M. Ajith, Pepper Research Station, Panniyur
2	Large cardamom	Dr. R. Chandramani Raj, ICAR Research Complex for NEH, Gangtok
3	Small cardamom	Dr. K. Pradip Kumar, Indian Cardamom Research Institute, Myladumpara, Idukki, Kerala
4	Ginger	Dr. Parsuram Sial, High Altitude Research Station, Pottangi
5	Turmeric	Dr. B. Senthamizh Selvi, TNAU, Coimbatore
6	Tree spices	Dr. J.P. Devmore, Dr. BSKKV, Dapoli
7	Coriander	Dr. K. Giridhar, Dr. YSRHU, Guntur
8	Cumin	Dr. Surabhi S Chauhan, SDAU, Jagudan
9	Fennel	Dr. D.K. Gothwal, SKNAU, Jobner
10	Fenugreek	Dr. Shrikant Laxmikant Swargaonkar, IGKV, Raigarh
11	Ajwain	Dr. S.S. Meena, ICAR-NRCSS, Ajmer
12	Nigella	Dr. Anupam Pariari, BCKV, Mohanpur

Project Mode centres:

1	Nutmeg	Dr. Mini Raj, KAU, Vellanikkara
2	Saffron	Dr. Basheer Ahamed, Sher-e-Kashmir University of Agricultural Science and Technology, Kashmir

30 September 2020

SESSION II :	Crop Management	9.30 AM -10.30 AM
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Chairpersons: 1. **Dr. Gopal Lal**, Director, ICAR-NRC on Seed Spices, Ajmer
2. **Dr H.P. Maheswarappa**, Project Coordinator, Palms, ICAR-CPCRI, Kasaragod
3. **Dr. C. K. Thankamani**, Head, Crop Production & PHT, ICAR-IISR, Kozhikode

Rapporteurs: 1. **Dr. K. Anees**, ICAR-IISR, Kozhikode
2. **Ms. R. Sivaranjani**, ICAR-IISR, Kozhikode

Presentations:

1	Black pepper	Dr. P. C. Mali, (Dr. BSKKV), Dapoli
2	Small cardamom	Dr. M. Shivaprasad, UAHS, Mudigere
3	Ginger	Dr. V. Sivakumar, Dr. YSRHU, Chintapalle
4	Turmeric	Dr. Vishambhar Dayal, ICAR Research Complex for NEH, Mizoram
5	Coriander	Dr. A. K. Mishra, Rajendra Prasad Central Agricultural University, Dholi
6	Cumin	Dr. A. C. Shivran, SKNAU, Jobner
7	Fenugreek	Dr. T. P. Malik, CCSHAU, Hisar
8	Large cardamom	Dr. R. Chandramani Raj, ICAR Research Complex for NEH, Gangtok

30 September 2020

SESSION III :	Crop Protection	10.30 AM-11.30 AM
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Chairpersons: 1. **Dr. Santhosh J Eapen**, Project Coordinator, ICAR-IISR, Kozhikode
2. **Dr. Y.K. Sharma**, Principal Scientist, ICAR-NRCSS, Ajmer

Rapporteurs: 1. **Dr. R. Praveena**, ICAR-IISR, Kozhikode
2. **Dr. C. Sellaperumal**, ICAR-IISR, Kozhikode

Presentations:

1	Black pepper	Dr C.K. Yamini Varma, PRS, Panniyur
2	Small cardamom	Dr. K. A. Saju, ICRI, Myladumpara
3	Ginger	Dr. Meenu Gupta, Dr. YSPUHF, Solan
4	Turmeric	Dr. B. Mahender, SKLTSHU, Kammarpalli
5	Coriander	Dr. Ajit Kumar Singh, IGKV, Raigarh
6	Cumin	Dr. S.K. Tehlan, CCSHAU, Hisar
7	Large cardamom	Dr. R. Chandramani Raj, ICAR RC for NER, Gangtok

SESSION IV	:	Variety Release	11.30 AM-1.00 PM
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Chairpersons: 1. **Dr. Vikramaditya Pandey**, Asst. Director General (HS II), ICAR, New Delhi
2. **Dr. K. Nirmal Babu**, Former PC & Director, ICAR-IISR, Kozhikode

Rapporteurs : 1. **Dr. C. Sarathambal**, ICAR-IISR, Kozhikode
2. **Dr. Sharon Aravind**, ICAR-IISR, Kozhikode

SESSION V	:	Transfer of Technology	1:30 PM - 3.30 PM
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Chairpersons: 1. **Dr. Homey Cheriyan**, Director, DASD, Calicut
2. **Dr. Gopal Lal**, Director, ICAR-NRCSS, Ajmer
3. **Dr. A.B. Remashree**, Director (Research), Spices Board, Kochi

Rapporteurs: 1. **Dr. Lijo Thomas**, ICAR-IISR, Kozhikode
2. **Dr. A. Jeevalatha**, ICAR-IISR Regional Station, Appangala

SESSION VI	:	Plenary Session	3:30 PM - 4.30 PM
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Chairpersons: 1. **Dr. N.K. Krishna Kumar**, Former DDG (Hort.) ICAR, New Delhi & Chairman, RAC ICAR-IISR, Kozhikode
2. **Mr. D. Sathiyam IFS**, Secretary, Spices Board, Kochi

Rapporteurs : 1. **Dr. C. N. Biju**, ICAR-IISR, Kozhikode
2. **Dr. Lijo Thomas**, ICAR-IISR, Kozhikode

3:30 pm Presentation by Rapporteurs of different sessions

4:00 pm Address by the Chairpersons **Mr. D. Sathiyam IFS**
Secretary
Spices Board, Kochi

Dr. N.K. Krishna Kumar
Former DDG (Hort.)
ICAR, New Delhi & Chairman,
RAC ICAR-IISR, Kozhikode

4.25 pm Vote of Thanks **Dr. Sharon Aravind**
Scientist
ICAR-IISR, Kozhikode

National Anthem

INAUGURAL SESSION

The XXXI Workshop of ICAR-All India Coordinated Research Project on Spices (AICRPS) was conducted during 29-30 September 2020 at ICAR- Indian Institute of Spices Research, Kozhikode through virtual platform. The workshop was inaugurated by Dr. R. Chandra Babu, Hon'ble Vice Chancellor, Kerala Agricultural University, Thrissur on 29 September 2020. In his inaugural address, he emphasized the necessity to facilitate adoption of technologies by the farming community and to develop climate resilient and high quality spice varieties with minimal pesticide residue so as to improve the export potential. Dr. A. K. Singh, Deputy Director General (Horticultural Science), Indian Council of Agricultural Research, New Delhi presided over the function. He pointed out the rise in export demand of spices at the global level despite the COVID-19 pandemic situation and urged the scientific community to utilize the opportunity to produce quality spices suitable for export market. Dr. Vikramaditya Pandey, Assistant Director General (Horticultural Science), ICAR, New Delhi was the Guest of Honour and he highlighted the various researchable issues related to spices and the need to work on problem solving mode to satisfy farmers, industry as well as consumers. Dr. Santhosh J. Eapen, Project Coordinator, AICRPS welcomed the gathering. During the inaugural session the "Best AICRPS Centre Award 2019-20" was presented to AICRPS centre at IGKV, Raipur (Raigarh), Chhattisgarh. Ten booklets/pamphlets on spices production technologies in English and local languages from different AICRPS Centres were released during the occasion. Also one video showcasing the activities of AICRPS centre at Pasighat, Arunachal Pradesh was released. Dr. Homey Cheriyan, Director, DASD, Kozhikode, Dr. Gopal Lal, Director, ICAR-NRC for Seed Spices, Ajmer and Dr. K. Nirmal Babu, Former Director, ICAR-IISR & Project Coordinator (Spices), Kozhikode offered felicitations. Dr. K. S. Krishnamurthy, Principal Scientist, ICAR- IISR, Kozhikode proposed the vote of thanks.

The salient points that emerged during the session are:

- Efforts on development of organic production systems in spices and production technologies on production of healthy planting material need to be further strengthened.
- Influence of soil nutrition and microflora on quality aspects across agro-climatic zones shall be investigated.
- Prioritize crop based issues and address problems encountered by farming community and industry considering production to export chain.
- Publication of text books, documentation of technologies released state-wise and pan nation shall be undertaken and a policy paper delineating the quality standards of various spices and factors contributing to the import despite appreciable area expansion as well as production shall be brought out.
- Issues like pesticide residues in major spices, label claims, mechanization, value addition, intensification of research on high value compounds and integrating good agricultural practices and varieties with specific quality traits to enhance production as well as productivity need to be addressed.

TECHNICAL SESSION: I
GENETIC RESOURCES AND CROP IMPROVEMENT

General recommendations

- IC number should be obtained for each accession and originality of entries must be maintained.
- Collaborative germplasm exploration with ICAR–NBPGR and other centres have to be undertaken for collection of seed spices and only trait-specific collection need to be undertaken.
- The entries in CVTs should not be submitted for state release without conducting trial and without approval from PC Cell.
- Seed spices centres should undertake quality analysis of spices.
- AICRPS centres should give high priority to IET and CVT.

Specific recommendations

Black pepper

PEP/CI/2.1: Inter-varietal hybridization to evolve high yielding varieties (Panniyur)

- The trial may be concluded and final report has to be submitted to PC Unit.
- The promising lines has to be multiplied and has to be brought into next CVT

PEP/CI/2.2: Hybridization to evolve varieties tolerant to biotic and abiotic stresses (Panniyur)

- The trial may be concluded and final report has to be submitted to PC Unit.
- The promising lines has to be multiplied and has to be brought into next CVT

PEP/CI/3.3: CVT 2006 Series VI (Chintapalle, Dapoli, Panniyur, Pampadumpara, Sirsi, Yercaud, Pechiparai)

- The trial may be concluded and the final report has to be submitted to the PC Unit.

Small cardamom

CAR/CI/1.1: Germplasm collection, characterization, evaluation and conservation (Mudigere, Pampadumpara)

- 100 seed weight and 100 capsule weight may be recorded while characterizing the accessions
- Influence of pollinators on fruit set in different genotypes may be studied

CAR/CI/2.1: Hybridization and selection in cardamom (Mudigere)

- The trial may be concluded and the final report has to be submitted to the PC Unit.

CAR/CI/3.8: CVT 2015 on Farmers varieties of cardamom-Series VIII (Appangala, Mudigere, Pampadumpara, Sakleshpur, Myladumpara)

- The entries except local check should be uniform in all centres

CAR/ CI/4.3: Initial Evaluation Trial – 2012 (Pampadumpara)

- The trial may be concluded and the final report has to be submitted to the PC Unit.

CAR/CI/4.4: Multi Location Evaluation of thrips tolerant cardamom lines (Appangala, Mudigere, Pampadumpara, Myladumpara, Sakleshpur)

- Method of sampling thrips has to be relooked and it should be scientific
- Capsule borer infestation may also be recorded

Large cardamom

LCA/CI/1.1: Germplasm collection and evaluation of large cardamom (ICAR Regional Station, Gangtok, ICRI Regional Research Station, Gangtok)

- Priority has to be given to collect local germplasm accessions from major large cardamom growing tracts
- Special care must be taken to avoid Chirkey and Furkey virus infested plants while collecting germplasm
- Information from other large cardamom growing countries may be gathered submitted to PC Unit.

Ginger

GIN/CI/1.1: Germplasm collection, characterization, evaluation and conservation (Barapani, Dholi, Kammarpally, Kumarganj, Pundibari, Pottangi, Raigarh, Solan)

- Priority for collection has to be given for specialty traits rather than yield
- Data analysis has to be done with utmost care

GIN/CI/2: Coordinated Varietal Trial (CVT)

GIN/CI/2.5: CVT on disease tolerance in ginger 2019 (Barapani, Chintapalle, Kozhikode, Pundibari, Pottangi, Nagaland, Gangtok, Raigarh)

- As the planting material has been multiplied this year, the trial has to be initiated by all the centres in next season

GIN/CI/3.4: Initial evaluation trial of bold / vegetable ginger (Pottangi)

- The trial may be concluded and the final report has to be submitted to the PC Unit.

GIN/CI/3.5: Initial Evaluation Trial – 2015 (Kumarganj)

- The trial may be concluded and the final report has to be submitted to the PC Unit.

GIN/CI/3.6: Initial Evaluation Trial – 2016 (Pundibari, Pottangi, Solan)

- The trial may be concluded and the final report has to be submitted to the PC Unit.
- CVT on high oil types has to be undertaken

GIN/CI/4.1: Evaluation of germplasm for quality (Solan)

- The trial may be concluded and the final report has to be submitted to the PC Unit.

GIN/CI/4.2: Evaluation of germplasm from other centres (Solan)

- The trial may be concluded and the final report has to be submitted to the PC Unit.

Turmeric

TUR/CI/1.1: Germplasm collection, characterization, evaluation and conservation (Barapani, Coimbatore, Dholi, Guntur, Kammarpally, Kumarganj, Solan, Pasighat, Pottangi, Pundibari, Raigarh)

- Characterization has to be done for new set of accessions every year instead of repeating with the same accessions

TUR/CI/3.7: Initial Evaluation Trial 2015 (Kumarganj)

- The trial may be concluded and the final report has to be submitted to the PC Unit.

Tree spices

TSP/CI/1.1: Germplasm collection, characterization, evaluation and conservation of clove, nutmeg and cinnamon (Dapoli, Pechiparai)

- More importance has to be given for initiation of CVTs in tree spices

TSP/CI/2.2: CVT 2001-Nutmeg (Dapoli, Pechiparai)

- The trial may be continued.
- CVT on other tree spices like cinnamon and clove has to be taken up

TSP/CI/2.4: Coordinated Varietal Trial on farmer's varieties of nutmeg (Dapoli, Pechiparai, Thrissur)

- The trial may be continued
- Trial on crop production aspects of tree spices has to be taken

Coriander

COR/CI/1.1: Germplasm collection, description, characterization, evaluation, conservation and screening against diseases (Coimbatore, Dholi, Guntur, Hisar, Jagudan, Jobner, Kumarganj, Raigarh)

- The yield data has to be presented in terms of gram per plant
- Importance has to be given for identification of male sterile lines and stem gall resistant lines
- Correlation between rainfall pattern and yield has to be worked out
- Infestation of pest damage occurring at different centres has to be analysed

COR/CI/1.3: Identification of drought/ alkalinity tolerant source in coriander (Jobner)

- Promising entries for drought tolerance have to be tested at Kota centre before going for registration

COR/CI/2.7: Coordinated Varietal Trial of fenugreek 2018 – Series X

- (Ajmer, Coimbatore, Dholi, Guntur, Hisar, Jagudan, Jabalpur, Jobner, Kumarganj, Pantnagar, Navsari, Raigarh, Kota)
- Quality data has to be presented in CVT and other centres should send the samples of CVT to Jobner for quality analysis.

COR/CI/3.9: Initial Evaluation Trial 2016 (Dholi)

- The trial may be concluded and the final report has to be submitted to the PC Unit.
- A new IET may be initiated

Cumin

CUM/CI/1.1: Germplasm collection, characterization, evaluation, conservation and screening against diseases (Jagudan, Jobner, Mandor, Sanand)

- Genotypes showing resistance to cumin blight should be identified
- In the mutation studies, effect of gamma rays and sodium azide treatments has to be studied.

CUM/CI/2.4: Coordinated Varietal Trial – 2017 (Ajmer, Jagudan, Jobner, Mandor)

- The trial may be continued for one more year
- Data on disease resistance has to be presented in CVTs
- Quality data has to be presented in CVT and other centres should send the samples of CVT to Jobner for quality analysis.

Fennel

FNL/CI/2.7: Coordinated Varietal Trial on Fennel 2018 – Series X (Ajmer, Dholi, Hisar, Jabalpur, Jagudan, Jobner, Kumarganj, Pantnagar, Navsari)

- The seeds for CVTs should be sent to PC unit for coding well in advance so that it can be coded and distributed among centres in proper time as the planting season has influence on performance of the genotypes
- Quality data has to be presented in CVT and other centres should send the samples of CVT to Jobner for quality analysis.

Fenugreek

FGK/CI/1.1: Germplasm collection, characterization, evaluation, conservation and screening against diseases (Dholi, Guntur, Hisar, Jagudan, Jobner, Kumarganj, Raigarh)

- The germplasm has to be assessed for active ingredients also
- Mutation breeding of fenugreek has to be initiated

FGK/CI/2.4: Coordinated Varietal Trial of fenugreek 2018 – Series X (Ajmer, Coimbatore, Dholi, Guntur, Hisar, Jagudan, Jabalpur, Jobner, Kumarganj, Pantnagar, Navsari, Raigarh, Kota)

- Quality data has to be presented in CVT and other centres should send the samples of CVT to Jobner for quality analysis.

FGK/CI/3.7: Chemo-profiling for identification of industrial types among the released varieties of fenugreek (Ajmer, Coimbatore, Guntur, Dholi, Hisar, Jobner, Kumarganj)

- Chemo-profiling of released varieties of fenugreek may be undertaken and the samples of released variety may be send to IISR for chemo-profiling

Ajwain

AJN/CI/2.2: Coordinated Varietal Trial-2019 (Ajmer, Guntur, Hisar, Jobner, Jagudan, Kumarganj, Raigarh)

- Quality data has to be presented in CVT and other centres should send the samples of CVT to Jobner for quality analysis
- IET may be initiated in centres and IET data has to be presented in the workshop

Nigella

NGL/CI/2.2: Coordinated Varietal Trial-2019 (Ajmer, Hisar, Kota, Kumarganj, Raigarh, Pantnagar)

- Total oil content of the entries has to be analyzed
- Thymoquinone content has to be analyzed
- Data on root rot has to be presented.

Project code	Title	Centres	Comments
Black pepper			
PEP/CI/1	Genetic Resources		
PEP/CI/1.1	Germplasm collection, characterization, evaluation and conservation	Ambalavayal, Chintapalle, Dapoli, Sirsi, Panniyur, Pundibari, Yercaud	Continued
PEP/CI/2	Hybridization trial		
PEP/CI/2.1	Inter-varietal hybridization to evolve high yielding varieties	Panniyur	Concluded
PEP/CI/2.2	Hybridization to evolve varieties tolerant to biotic and abiotic stresses	Panniyur	Concluded
PEP/CI/3	Coordinated Varietal Trial (CVT)		
PEP/CI/3.3	CVT 2006 Series VI	Chintapalle, Dapoli, Panniyur, Pampadumpara, Sirsi, Yercaud, Pechiparai	Concluded
PEP/CI/3.5	CVT 2015 on Farmers varieties of black pepper – Series VII	Chintapalle, Sirsi, Panniyur, Dapoli, Yercaud	Continued
PEP/CI/3.6	CVT on black pepper 2015 - Series VIII	Chintapalle, Sirsi, Panniyur, Dapoli, Yercaud, Kahikuchi	Continued
PEP/CI/3.7	CVT 2018 on black pepper - Series IX	Ambalavayal, Chintapalle, Sirsi, Panniyur, Kozhikode, Dapoli, Yercaud	Continued
Small cardamom			
CAR/CI/1	Genetic Resources		
CAR/CI/1.1	Germplasm collection, characterization, evaluation and conservation	Mudigere, Pampadumpara	Continued
CAR/CI/2	Hybridization		
CAR/CI/2.1	Hybridization and selection in cardamom	Mudigere	Concluded
CAR/CI/3	Coordinated Varietal Trial		
CAR/CI/3.7	CVT on drought tolerance in cardamom – Series VII	Appangala, Mudigere, Sakaleshpur, Myladumpara, Pampadumpara	Continued
CAR/CI/3.8	CVT 2015 on farmers varieties of cardamom-Series VIII	Appangala, Mudigere, Pampadumpara, Sakleshpur, Myladumpara,	Continued
CAR/CI/3.9	CVT on hybrids of small cardamom-2018 – Series IX	Appangala, Mudigere, Sakleshpur, Myladumpara, Pampadumpara	Continued
CAR/CI/4	Varietal Evaluation Trial (VET)		
CAR/ CI/4.3	Initial Evaluation Trial – 2012	Pampadumpara	Concluded

CAR/CI/4.4	Multi location evaluation of thrips tolerant cardamom lines	Appangala, Mudigere, Pampadumpara, Myladumpara, Sakleshpur	Continued
CAR/CI/4.5:	MLT of leaf blight tolerant lines of small cardamom 2018	Appangala, Mudigere, Pampadumpara, Myladumpara, Sakleshpur	Continued
Large cardamom			
LCA/CI/1.1	Germplasm collection and evaluation of large cardamom	ICAR Regional Station, Gangtok, ICRI Regional Research Station, Gangtok	Continued
Ginger			
GIN/CI/1	Genetic Resources		
GIN/CI/1.1	Germplasm collection, characterization, evaluation and conservation	Barapani, Dholi, Kammarpally, Kumarganj, Pundibari, Pottangi, Raigarh, Solan	Continued
GIN/CI/2	Coordinated Varietal Trial (CVT)		
GIN/CI/2.5	CVT on disease tolerance in ginger	Barapani, Chintapalle, Kozhikode, Pundibari, Pottangi, Nagaland, Gangtok, Raigarh	Continued
GIN/CI/3	Varietal Evaluation Trial		
GIN/CI/3.4	Initial Evaluation Trial of bold / vegetable ginger	Pottangi	Concluded
GIN/CI/3.5	Initial Evaluation Trial – 2015	Kumarganj	Concluded
GIN/CI/3.6	Initial Evaluation Trial – 2016	Pundibari, Pottangi, Solan	Concluded
GIN/CI/4	Quality Evaluation Trial		
GIN/CI/4.1	Evaluation of germplasm for quality	Solan	Concluded
GIN/CI/4.2	Evaluation of germplasm from other centres	Solan	Concluded
GIN/CI/4.3	Evaluation of genotypes of ginger for vegetable purpose (observational trial)	Kozhikode, Mizoram, Gangtok, Chintapalle, Pottangi, Pundibari, Nagaland	Continued
Turmeric			
TUR/CI/1	Genetic Resources		
TUR/CI/1.1	Germplasm collection, characterization, evaluation and conservation	Barapani, Coimbatore, Dholi, Guntur, Kammarpally, Kumarganj, Solan, Pasighat, Pottangi, Pundibari, Raigarh	Continued
TUR/CI/2	Coordinated Varietal Trial		
TUR/CI/2.7	CVT on mango ginger	Ambalavayal, Pottangi, Kozhikode, Dholi, Barapani, Pundibari, Raigarh, Navsari	Continued

TUR/CI/2.8	CVT on high yield and high curcumin	Kozhikode, Coimbatore, Guntur, Kammarpally, Pottangi, Kanke, Pasighat, Raigarh, Navsari	Continued
TUR/CI/2.9	CVT on light yellow colour turmeric for specialty market	Kozhikode, Coimbatore, Guntur, Kammarpally, Pottangi, Kanke, Pasighat	Continued
TUR/CI/3	Varietal Evaluation Trial		
TUR/CI/3.7	Initial Evaluation Trial 2015	Kumarganj	Concluded
TUR/CI/3.9	Initial Evaluation Trial 2018	Guntur	Continued
Tree spices			
TSP/CI/1	Genetic Resources		
TSP/CI/1.1	Germplasm collection, characterization, evaluation and conservation of clove, nutmeg and cinnamon	Dapoli, Pechiparai	Continued
TSP/CI/1.2	Collection of unique germplasm in tree spices	Dapoli, IISR, KAU, Pechiparai	Continued
TSP/CI/2	Coordinated Varietal Trial		
TSP/CI/2.2	CVT 2001-Nutmeg	Dapoli, Pechiparai	Continued
TSP/CI/2.4	Coordinated Varietal Trial on farmer's varieties of nutmeg	Dapoli, Pechiparai, Thrissur	Continued
TSP/CI/5.1	Evaluation of nutmeg genotypes	KAU	Continued
Coriander			
COR/CI/1	Genetic Resources		
COR/CI/1.1	Germplasm collection, description, characterization, evaluation, conservation and screening against diseases	Coimbatore, Dholi, Guntur, Hisar, Jagudan, Jobner, Kumarganj, Raigarh	Continued
COR/CI/1.3	Identification of drought/alkalinity tolerant source in coriander	Jobner	Continued
COR/CI/2	Coordinated Varietal Trial		
COR/CI/2.7	Coordinated Varietal Trial of coriander 2018-Series X	Ajmer, Coimbatore, Dholi, Guntur, Hisar, Jabalpur, Kota, Jagudan, Jobner, Kumarganj, Navsari, Pantnagar, Raigarh	Continued
COR/CI/3	Varietal Evaluation Trial		
COR/CI/3.9	Initial Evaluation Trial 2016	Dholi	Concluded
COR/CI/4	Quality Evaluation Trial		
COR/CI/4.1	Quality evaluation in coriander	Jobner	Continued
Cumin			
CUM/CI/1	Genetic Resources		
CUM/CI/1.1	Germplasm collection, characterization, evaluation, conservation and screening against diseases	Jagudan, Jobner, Mandor, Sanand	Continued

CUM/CI/1.3	Identification of drought tolerance	Jobner	Continued
CUM/CI/2	Coordinated Varietal Trial		
CUM/CI/2.4	Coordinated Varietal Trial – 2017	Ajmer, Jagudan, Jobner, Mandor	Continued
CUM/CI/4	Quality Evaluation Trial		
CUM/CI/4.1	Quality evaluation in cumin	Jobner	Continued
Fennel			
FNL/CI/1	Genetic Resources		
FNL/CI/1.1	Germplasm collection, characterization, evaluation, conservation and screening against diseases	Dholi, Hisar, Jagudan, Jobner, Kumarganj	Continued
FNL/CI/2	Coordinated Varietal Trial		
FNL/CI/2.7	Coordinated Varietal Trial on Fennel 2018 – Series X	Ajmer, Dholi, Hisar, Jabalpur, Jagudan, Jobner, Kumarganj, Pantnagar	Continued
FNL/CI/4	Quality Evaluation Trial		
FNL/CI/4.1	Quality Evaluation in fennel	Jobner	Continued
Fenugreek			
FGK/CI/1	Genetic Resources		
FGK/CI/1.1	Germplasm collection, characterization, evaluation, conservation and screening against diseases	Dholi, Guntur, Hisar, Jagudan, Jobner, Kumarganj, Raigarh	Continued
FGK/CI/1.3	Identification of drought tolerance source in fenugreek	Jobner	Continued
FGK/CI/2	Coordinated Varietal Trial		
FGK/CI/2.4	Coordinated Varietal Trial of fenugreek 2018 – Series X	Ajmer, Coimbatore, Dholi, Guntur, Hisar, Jagudan, Jabalpur, Jobner, Kumarganj, Pantnagar, Navsari, Raigarh, Kota	Continued
FGK/CI/3.7	Chemo-profiling for identification of industrial types among the released varieties of fenugreek	Ajmer, Coimbatore, Guntur, Dholi, Hisar, Jobner, Kumarganj	Continued
Ajwain			
AJN/CI/2	Coordinated Varietal Trial		
AJN/CI/2.1	Coordinated Varietal Trial-2019	Ajmer, Guntur, Hisar, Jobner, Jagudan, Kumarganj, Raigarh	Continued
Nigella			
NGL/CI/2	Coordinated Varietal Trial		
NGL/CI/2.1	Coordinated Varietal Trial-2019	Ajmer, Hisar, Kota, Kalyani, Kumarganj, Raigarh, Pantnagar	Continued
Saffron			

SF/CI/5.1	Conservation, evaluation and utilization of exotic and indigenous saffron germplasm lines	Pampore	Continued
Kalazeera			
KZ/CI/5.1	Exploration, collection and conservation of kalazeera from high altitudes of northern Himalayas	Pampore	Continued

TECHNICAL SESSION: II

CROP MANAGEMENT

General recommendations

- Safety and economical viability of spices needs to be taken care of in all experiments under crop management
- PC Cell needs to ensure that multi-location trials are taken up in all the identified centres
- Before finalizing the technical programme of the experiment, a consent to be taken from the participating centers considering the facility available at respective places
- Concluded experiments should result in research articles and technologies

Specific recommendations

Black pepper

PEP/CM/4.7: Black pepper based mixed cropping system for sustainable productivity and food security (Ambalavayal, Sirsi, Panniyur, Dapoli)

- A team led by Dr. C K Thankamani, Principal Scientist, ICAR-IISR may review the project progress and suggest future course of action

Ginger

GIN/CM/5.6: Organic production of ginger (Barapani, Mizoram)

- The trial may be concluded and the final report has to be submitted to the PC Unit.

GIN/CM/5.9: Organic production of ginger (Ambalavayal)

- The trial may be concluded and the final report has to be submitted to the PC Unit.

GIN/CM/5.10: Effect of micronutrients on growth and yield of ginger (Ambalavayal)

- The trial may be concluded and the final report has to be submitted to the PC Unit.

Turmeric

TUR/CM/5.10: Organic production of turmeric (Barapani, Mizoram)

- The trial may be concluded. The final report to be submitted to PC Cell after including the data on quality analysis

Coriander

COR/CM/5.5: Response of coriander varieties to various levels of fertility under multi cut management practice (Dholi)

The experiment is concluded

- Economics of different fertility levels tested may be calculated for arriving at a conclusion and finalizing the recommendations
- The trial may be concluded and the final report has to be submitted to the PC Unit.

- The two proposals for initiating new experiments on organic nutrient management and intercropping in coriander to be reviewed by PC Cell in consultation with NRCS, Ajmer before final approval

Cumin

CUM/CM/5.5: Micro nutrient management in cumin (Jobner, Jagudan, Mandor, Ajmer)

- Impact of micronutrient application on quality of cumin need to be studied

Fenugreek

FGK/CM/5.9: Standardization of drip irrigation interval and method of micro nutrient fertigation in fenugreek (Ajmer, Coimbatore, Hisar, Jagudan, Jabalpur, Jobner, Kumarganj, Kota, Pantnagar, Navsari, Raigarh)

- The centers which have not submitted the reports may send the report to PC Cell at the earliest for compilation of results

Project code	Title	Centres	Comments
Black pepper			
PEP/CM/4.7	Black pepper based mixed cropping system for sustainable productivity and food security	Ambalavayal, Sirsi, Panniyur, Dapoli	Continued
Small cardamom			
CAR/CM/5.5	Effect of micro nutrients on growth and yield of small cardamom	Appangala, Mudigere, Pampadumpara, Myladumpara, Sakleshpur	Continued
CAR/CM/5.6	Site specific recommendation for varying yield target of cardamom.	Mudigere, Appangala, Myladumpara, Pampadumpara and Sakleshpura	New
Large cardamom			
LAC/CM/5.1	Effect of mulching on yield of large cardamom	Pasighat, ICAR Gangtok, ICRI Gangtok	New
Ginger			
GIN/CM/5.6	Organic production of ginger	Barapani, Mizoram	Concluded
GIN/CM/5.9	Organic production of ginger	Ambalavayal	Concluded
GIN/CM/5.10	Effect of micronutrients on growth and yield of ginger	Ambalavayal	Concluded
GIN/CM/4.1	Evaluation of different ginger based intercropping systems for higher yield and income	Pottangi, Chintapalle, ICAR Gangtok, Solan, Dholi, Pundibari, Kanke, Nagaland, Kalyani, Mizoram, Sirsi	New
Turmeric			
TUR/CM/5.10	Organic production of turmeric	Barapani, Mizoram	Concluded
Coriander			
COR/CM/5.5	Response of coriander varieties to various levels of fertility under multi cut management practice	Dholi	Concluded
Cumin			
CUM/CM/ 5.5	Micro nutrient management in cumin	Jobner, Jagudan, Mandor, Ajmer	Continued
Fenugreek			

FGK/CM/5.9	Standardization of drip irrigation interval and method of micro nutrient fertigation in fenugreek	Ajmer, Coimbatore, Hisar, Jagudan, Jabalpur, Jobner, Kumarganj, Kota, Pantnagar, Navsari, Raigarh	
Fennel			
FNL/CM/5.1	Response of foliar application of iron and zinc on growth, yield and quality of fennel	Jagudan, Jobner, Hisar, Dholi, Kumarganj, Mandor, Pantnagar	New
Seed Spices			
SS/CM/4.1	Intercropping of seed spices with vegetables for higher yield and income	Jobner, Dholi, Kumarganj, Raigarh, Jagudan, Jabalpur, Hisar, Mandor, Pantnagar	New

TECHNICAL SESSION: III

CROP PROTECTION

General recommendations

- New pest, diseases and natural enemies need to be documented by scientists working under AICRP Centers.
- Residue data need to be generated for all crops involving pesticide trials and seed samples immediately after harvest need to be send to ICAR-IISR, Kozhikode.
- For the pest and disease monitoring project in seed spices technical help may be sought from ICAR-IASRI, New Delhi for statistical design.
- AICRPs should generate data on viruses and nematodes associated with seed spices with the help of lead institutes and agricultural universities.

Specific recommendations

Black pepper

PEP/CP/5.8: Evaluation of strobilurin fungicide and actinomycetes for the management of foot rot and slow decline in black pepper (Panniyur, Dapoli, Sirsi, Yercaud, Appangala)

- Cases of new pest and disease incidence need to be reported.
- Experimental locations for the new trial on pollu beetle need to be identified based on pest incidence in consultation with black pepper centres.

Ginger

GIN/CP/6.13: Effect of PGPR biocapsule on growth and yield of ginger (Ambalavayal)

- The trial may be concluded and the final report has to be submitted to the PC Unit.

GIN/CP/6.15: Priming of rhizomes for enhanced germination, vigour and storage rot suppression in ginger (Chintapalle, Dholi, Barapani, Kammarpally, Pundibari, Raigarh, Solan, Kalyani, Pasighat, Kanke, Nagaland, Ambalavayal)

- Residue data need to be generated.

Turmeric

TUR/CP/7.8: Priming of rhizomes for enhanced germination, vigour and storage rot suppression in turmeric (Chintapalle, Dholi, Kammarpally, Pundibari, Raigarh, Solan, Pasighat, Ambalavayal, Mizoram, Kahikuchi, Kanke)

- Residue data need to be generated.

Coriander

COR/CP/6.7 Integrated pest and disease management in coriander (Ajmer, Coimbatore, Dholi, Hisar, Jabalpur, Raigarh, Jobner, Jagudan, Kumarganj, Navsari, Pantnagar, Kota)

- Samples after harvest need to be sent to ICAR-IISR for pesticide residue analysis.

Cumin

CUM/CP/6.8: Integrated pest and disease management in cumin (Ajmer, Jobner, Jagudan, Mandor)

- Samples after harvest need to be sent to ICAR-IISR for pesticide residue analysis.

Project code	Title	Centres	Comments
Black pepper			
PEP/CP/5.8	Evaluation of strobilurin fungicide and actinomycetes for the management of foot rot and slow decline in black pepper	Panniyur, Dapoli, Sirsi, Yercaud, Appangala	Continued
PEP/CP/7.1	Screening of insecticides for pollu beetle, <i>Lanka ramakrishnai</i> in black pepper	Panniyur, Ambalavayal, Pampadumpara, Appangala	New
Small cardamom			
CAR/CP/6.11	Evaluation of fungicides against rhizome rot in small cardamom	Appangala, Mudigere, Pampadumpara and Myladumpara	Continued
CAR/CP/6.12	Evaluation of fungicides against leaf blight in small cardamom	Appangala, Mudigere, Pampadumpara, Myladumpara	Continued
Ginger			
GIN/CP/6.13	Effect of PGPR biocapsule on growth and yield of ginger	Ambalavayal	Concluded
GIN/CP/6.15	Priming of rhizomes for enhanced germination, vigour and storage rot suppression in ginger	Chintapalle, Dholi, Barapani, Kammarpally, Pundibari, Raigarh, Solan, Kalyani, Kanke Ambalavayal Pasighat, Nagaland	Continued
GIN/CP/7.1	Spray schedule optimization of effective insecticides for shoot borer (<i>Conogethes punctiferalis</i>) in ginger	Pottangi, Kahikuchi, Sirsi, Solan, Mudigere, Pundibari, Mizoram, Nagaland, Pasighat, Barapani, Ambalavayal, Kanke	New
Turmeric			

TUR/CP/7.8	Priming of rhizomes for enhanced germination, vigour and storage rot suppression in turmeric	Chintapalle, Dholi, Kammarpally, Pundibari, Raigarh, Solan, Pasighat, Ambalavayal, Mizoram, Kahikuchi, Kanke	Continued
TUR/CP/7.9	Spray schedule optimization of effective insecticides for shoot borer (<i>Conogethes punctiferalis</i>) in turmeric	Pottangi, Kahikuchi, Sirsi, Mudigere, Pundibari, Mizoram, Pasighat, Barapani, Pantnagar, Kammarpally, Guntur, Solan, Ambalavayal, Kanke	New
Coriander			
COR/CP/6.7	Integrated pest and disease management in coriander	Ajmer, Coimbatore, Dholi, Hisar, Jabalpur, Raigarh, Jobner, Jagudan, Kumarganj, Navsari, Pantnagar, Kota	Continued
COR/CP/7.1	Screening of coriander varieties against stem gall disease	Dholi, Kumarganj, Kota, Hisar, Jabalpur	New
Cumin			
CUM/CP/6.8	Integrated pest and disease management in cumin	Ajmer, Jobner, Jagudan, Mandor	Continued
Seed Spices			
SS/CP/7.1	Survey and monitoring of diseases and insect pests of seed spices for development of prediction models	Ajmer, Jobner, Jagudan, Guntur, Kumarganj, Raigarh, Dholi, Kalyani, Sanand, Coimbatore, Kammarpally	New

TECHNICAL SESSION: IV
VARIETY RELEASE

Five varietal release proposals were presented in the session for identification of varieties.

Sl. No	Crop	Centre	Name of the variety
1	Ginger	ICAR-IISR, Kozhikode	IISR Vajra (Acc. 247)
2	Turmeric	Dr. YSRHU, Guntur	LTS - 2
3	Turmeric	RPCAU, Dholi	Rajendra Haldi 1
4	Fenugreek	CCSHAU, Haryana	HM257
5	Nutmeg	Dr. BSKVV, Dapoli	Konkan Sampurna

General recommendations:

- A policy paper needs to be prepared to restrict the import of certain commodities
- An index based proforma for the release proposals has to be framed by including 10 important traits for each crops and weightage to be given accordingly.

The recommendations of the committee is as follows

1. Ginger - IISR Vajra (Acc. 247)

- Recommended for release in states of Kerala, Karnataka, Odisha and West Bengal
- Technology for maximizing the productivity of this variety has to be developed.

2. Turmeric -Lam Turmeric 1(LTS2)

- Recommended for release in states of Andhra Pradesh, Telangana, Tamil Nadu and is suitable for masala industry and is an alternative to the existing cultivars (Mydukur (Andhra Pradesh), Duggirala (Telangana) and Salem (Tamil Nadu) preferred by the curry powder industries.
- The performance of IISR Pratibha variety need to be verified in Guntur.

3. Turmeric -Rajendra Haldi-1

- Recommended for release in states of Bihar, Odisha, Andhra Pradesh

4. Fenugreek Hisar Methi 257

- Recommended for release in states of Bihar, Rajasthan, Chhattisgarh, Gujarat
- The results of the performance of the variety in Madhya Pradesh may be included in the proposal and submit the revised proposal to PC unit

5. Nutmeg Konkan sampurna

- Detailed profile of the variety is required
- The centre has to present additional data in the next work shop

TECHNICAL SESSION V

TRANSFER OF TECHNOLOGY

Seven technologies were presented in the session. The summary of the technologies and the decisions thereof are given below.

1. Evaluation of some new biopesticides and organically permitted insecticides against insect pests of large cardamom- ICAR RC NEHR, Gangtok

Management of insect pest of large cardamom using Spinosad (45 SC @ 0.3 ml L⁻¹) or neem based oil (Azadirachtin 0.15% EC) 1500 ppm @ 3 ml L⁻¹) was recommended under organic protection practice for large cardamom. However, clarification from APEDA and Agriculture Department in Sikkim may be obtained regarding acceptability of Spinosad in organic farming.

2. Application of organic manures and bio-fertilizers for yield enhancement of ginger- RPCAU, Dholi

The trial has to be continued for one more year to confirm the consistency of the data. Besides, other information on nutrient uptake, data on rhizome rot and oil content may be recorded.

3. Management of turmeric foliar diseases- TNAU, Coimbatore

Residue data has to be generated before recommending any pesticide for crop protection.

4. Management of Coriander powdery mildew (*Erysiphe polygoni*) using new generation fungicide- TNAU, Coimbatore

Residue data has to be generated.

5. Eco-friendly management of foliar disease of turmeric- NDUAT, Kumarganj

The technology involves use of botanical oils. The safety of botanical oils has to be ascertained before the technology has to be accepted.

6. Management of stem gall disease of coriander- RPCAU, Dholi

The technology should be tested at Kota Center, under the supervision of NRCSS, Ajmer. Resistant variety should be used to ascertain the combined effect of resistant variety and chemical control. After final conclusion, residue analysis should be carried out. The data may be presented in the next workshop.

7. Management of powdery mildew in cumin through new chemicals- SKNAU, Jobner

Residue data has to be generated and the samples may be submitted to NRCSS for analysis. Residue analysis report has to be sent to PC cell, IISR and after analysis, technology may be released.

PLENARY SESSION

The Plenary session of the XXXI Annual AICRPS workshop was held on 30 September 2020, Mr. D. Sathiyam IFS, Secretary, Spices Board, Kochi chaired the session along with Dr. N. K. Krishna Kumar, Former DDG (Horticulture), ICAR, New Delhi. The Secretary, Spices Board emphasized the need to undertake collaborative research programmes involving ICAR institutes, SAUs, Spices Board, Directorate of Arecanut and Spices Development and other line departments to resolve problems encountered by the farming community. Dr. N. K. Krishna Kumar, Former DDG (Hort.), ICAR suggested to focus on protected cultivation and to strengthen the activities of AICRPS at Andaman and Nicobar islands and North Eastern regions, apart from strengthening research on frontier areas of research.

The major action points that emerged from the deliberations were:

- Research programmes shall be undertaken on a collaborative mode converging ICAR institutes, SAUs, Spices Board, DASD, other line departments with interventions of stakeholders so as to resolve problems encountered by farming community, to resolve issues pertaining to pesticide residues and to draft and implement stringent quality as well as food safety standards.
- Efforts shall be strengthened to cater to the need of farmers through enhancing the production and distribution of planting material of newly released varieties with superior traits.
- Efforts shall be made to collate and analyze information of quality parameters of organically grown spices, contamination with heavy metals/artificial dyes/other adulterants, evolve and evaluate technologies to reduce cost of production, focus on protected cultivation and nematode/virus induced diseases as well as major diseases of large cardamom.
- A webinar on under-utilized/minor spices may be organized.
- Research activities in Andaman and Nicobar Islands as well as North Eastern region may be strengthened.
- Bar coding for specific traits may be attempted in spices.
- Information on global market intelligence shall be developed in spices.

PROJECT COORDINATOR'S REPORT
Dr. Santhosh J Eapen, Project Coordinator
ICAR-All India Coordinated Research Project on Spices
ICAR-Indian Institute of Spices Research, Kozhikode – 673 012, Kerala

ICAR-All India Coordinated Research Project on Spices with 38 centres (19 regular, 11 co-opting and 8 voluntary centres) spread over 14 agro climatic zones in 25 states of the country coordinates the research activities on spice crops like black pepper, large cardamom, small cardamom, ginger, turmeric, mango ginger, cinnamon, nutmeg, clove, coriander, cumin, fennel, fenugreek, ajwain, nigella, saffron and kalazeera. Annual budget for the year 2019 was Rs. 606 lakhs as ICAR share.

New initiatives

- Twenty one varieties of spice crops *viz.*, small cardamom (IISR Avinash), ginger (Suprabha, Suruchi, Suravi), turmeric (Roma, Surama, Rashmi, UBKV Turmeric 2), nutmeg (IISR Keralashree), coriander (Rajendra Dhanian-1, Rajendra Dhanian-2, Ajmer Coriander-2, Ajmer Coriander-3, Suguna, Sushira, Gujarat Coriander 3, Chhattisgarh Sri Chandrahasini Dhanian 2), cumin (Gujarat Cumin 5), fennel (Ajmer Fennel 3) and fenugreek (Ajmer Fenugreek 5, Lam Sonali) were gazette notified by Central Sub- Committee on Crop Standards, Notification and Release of Varieties for Horticultural Crops, New Delhi.
- In line with food safety assurance and minimization of the pesticide residue in spices, evaluation of *strobilurin* fungicides and *actinomycetes* was initiated in black pepper at various black pepper centres of AICRPS.
- For sustainable spice production, new programme on priming of rhizomes for enhanced germination, vigour and storage rot suppression in ginger and turmeric were undertaken in various AICRPS centres of different agro-climatic regions.

Varieties recommended for release in XXX AICRPS workshop

Three varieties of spices for specific traits (one each in fennel, ajwain and nigella) were recommended for release in XXX AICRP on Spices workshop held at Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu.

Climatic resilient variety

- **RF 290:** Fennel variety from SKNAU, Jobner for high yield (20.65 q ha⁻¹) with long and bold seeds, more umbellets and seeds per umbel.

Industry-friendly varieties

- **Ajmer Ajwain 73:** Ajwain variety from ICAR- NRCSS, Ajmer for high yield (10.66 q ha⁻¹) and high essential oil (6.38%).
- **Ajmer Nigella 1:** Nigella variety from ICAR- NRCSS, Ajmer for high yield (9.09 q ha⁻¹) and high oleic acid (3.32%) content.

Technologies recommended during XXX AICRPS workshop

Five location specific technologies in different spice crops for various states developed during the year were recommended during XXX Annual workshop of AICRPS.

Water use efficiency - more crop per drop

- **Drip irrigation and fertigation in cumin:** Fertigation with water equal to 60% of actual evaporation (0.6 IW/CPE ratio) at an interval of 4 days and 80% recommended dose of fertilizers through soluble fertilizers at different growth stages (10, 20, 40, 50, 70 & 80 DAS) is recommended for improving the yield and WUE in cumin in light textured soils of India with 20% water saving and B:C ratio of 1.50.

Soil nutrient management- for boosting farm yield

- **Fertilizer management for multi cut coriander-** Application of NPK as 60:30:00 kg ha⁻¹ as full dose of phosphorus and half dose of nitrogen as basal as well as remaining half dose of nitrogen after first cut i.e. 40-45 DAS for securing maximum yield (18 q ha⁻¹) and B:C ratio (2.5) is recommended.

Integrated pest and disease management- for sustainable spice production

- **Organic nutrient and disease management in cumin-** Soil application of vermicompost (2 t ha⁻¹) + seed treatment with *Trichoderma* (6 g kg⁻¹) and spray of neem seed kernel extract 5% were recommended for organic production and management of diseases like blight and wilt of cumin with B:C ratio of 2.29.
- **Management of powdery mildew in coriander using new generation fungicides-** Foliar spray of hexaconazole 5% SC (1.0 ml litre⁻¹ of water) at the time of initial appearance of disease and second spray after 15 days interval controls powdery mildew of coriander with B:C ratio of 4.75.
- **Bacterial wilt management in ginger-** For organic system of cultivation, adopting soil solarization along with the biocontrol agent, *Bacillus licheniformis* (GAP107 MTCC12725) launched as *Bacillich* controls bacterial wilt in ginger with B:C ratio of 3.23. For inorganic system of cultivation, CaCl₂ along with soil solarization controls the disease with B:C ratio of 2.88 (both treatments to be imposed at the time of planting and at 30, 45, 60 and 90 days after planting).

Research Achievements

Black pepper

During 2019, Pepper Research Station, Panniyur maintained 343 cultivated types, 57 wild and related types and 3 exotic types of black pepper. The collected germplasm accessions (58) from Konkan region has been maintained in the germplasm block at Department of Horticulture, Dr. B.S. KKV, Dapoli. Berry set was observed in 28 accessions at Yercaud. In the inter varietal hybridization trial conducted at Panniyur, the hybrids *viz.*, PRS 160, PRS 161 and PRS 165 were found to be promising with mean green berry yield of 6.12 kg/vine, 6.63 kg/vine and 4.84 kg/vine respectively. The hybrid PRS 161 was the most promising with respect to yield and yield attributing characters.

For the trial, biological management of slow decline in black pepper, soil application of *Trichoderma viride* + neem cake @ 2 kg/vine (T1), soil application of *Pochonia chlamydosporia* @ 50g/vine

followed by soil drenching with *P. fluorescens* @ 2% (T4) were significantly superior in reducing yellowing due to slow decline disease in black pepper at Panniyur. At Sirsi, per cent disease intensity was minimum (39.17) in soil drenching with copper oxy chloride @ 0.3% and cartap hydrochloride @ 15g/vine (T₆) during onset of monsoon (June) and again during the third week of august and it was on par (40.83) with soil application of *Trichoderma harzianum* @ 50g/vine and neem cake @ 2kg/vine (T₁) as compared to other treatment.

Small cardamom

A total of 320 cardamom accessions have been maintained which includes 132 at Mudigere and 188 at Pampadumpara. There was significant difference among the accessions of farmer's varieties of small cardamom with respect to their vegetative characters at Appangala, Sakleshpur, Myladumpara and Pampadumpara. At Appangala, the genotype *Thiruthali* recorded highest plant height (208.74 cm), more number of tillers (24.26), number of bearing tillers (11.39), number of panicles (18.53) and panicle length (49.15 cm). In Sakleshpur, number of tillers was significantly more in ICRI 8 (16.50), number of panicles (5.17) was significantly more in *Thiruthali* and number of racemes/panicles (16.33) was significantly more in *Paupali*.

At Pampadumpara, the genotypes viz., *Njallani Green Gold* and *Thiruthali* registered highest plant height of 166.30 and 160.63 respectively. Maximum number of tillers was produced by *Thiruthali* (16.53) followed by Patchakai (14.97) whereas more number of tillers were produced in Wonder cardamom (47.00), *Njallani Green Gold* (46.00) and *Thiruthali* (45.33) at Myladumpara. Significantly more panicles were found in *Thiruthali* (18) and *Panikulangara1* (17.33).

Large cardamom

Out of total 308 accessions at ICRI, Gangtok, 301 have been registered with NBPGR, New Delhi and obtained IC number for the same. Passport data of remaining seven accessions (SCC 302-308) has been sent to NBPGR, New Delhi for the allotment of IC numbers. Survey was conducted in the state of Sikkim to collect new accessions. ICRI, Gangtok also supplied 1650 planting units of large cardamom to ICAR- NOFRI, Tadong, ICAR- RC NEH, Barapani and beneficiaries from Arunachal Pradesh and Nagaland.

Ginger

Out of 198 ginger germplasm studied at Pottangi, 34 entries yielded more than 5 kg/3m² fresh rhizome. The range of plot yield being 0.10 kg (PGS-119) to 9.5 kg/3 m² (PGS-163) with the mean yield of 3.1 kg /3 m² in tested germplasms during Kharif 2019. At Raigargh, Indira Ginger -1 (9.9 t ha⁻¹) recorded maximum yield over two national checks Suprabha (7.5 t ha⁻¹) and Suruchi (8.3 t ha⁻¹) followed by IN-4 (7.2 t ha⁻¹) and IN-3 (6.4 t ha⁻¹). At Barapani, out of the 43 genotypes, IC-584354 recorded the highest yield with 20.95 t ha⁻¹. Highest dry matter (25.09%) and oleoresin (7.07%) content were recorded in IC-584353 and IC-584343 respectively.

The variety Maran recorded the maximum yield of 26.75 t ha⁻¹ and 25.92 t ha⁻¹ in IISR organic package and KAU organic package respectively at Ambalavayal. Between two organic packages (IISR organic package and RPCAU, Bihar organic package), both were on par. Among the three varieties evaluated at Dholi, (Nadia, Surabhi and Suprabha), all the varieties were on par for yield.

Between two organic packages (IISR organic package and RPCAU, Bihar organic package), both were also on par. At Kumarganj, the maximum yield was observed in V1T3 treatment (14.75 t ha⁻¹) followed by V2T3 (13.00 t ha⁻¹) and V3T3 (12.67 t ha⁻¹).

Turmeric

A total of 275 genotypes were conserved at Coimbatore and all the genotypes were evaluated and characterized. Statistical analysis of data revealed wide variations for growth, yield and quality parameters. Fourteen out of sixty seven accessions maintained at Dholi recorded high yield ranging from 50.25 to 54.17 t ha⁻¹ against the check variety Rajendra Sonia (49.83 t ha⁻¹) and eight accession compared to Rajendra Sonali (52.33 t ha⁻¹). Out of the 180 accessions maintained and evaluated at Kumarganj, maximum yield was recorded in NDH-74 (275 g/plant) followed by NDH-86 (265 g/plant). At Pundibari, 176 germplasm accessions were maintained. Five genotypes showed above 40 t ha⁻¹ yield, 16 genotypes showed 31 t ha⁻¹ to 40 t ha⁻¹ and 22 genotypes showed 25 t ha⁻¹ to 30 t ha⁻¹.

In turmeric organic trial, the maximum yield was recorded in T₂ (100% organic manure equivalent to 75% N requirement of turmeric), with a yield of 28.29 t ha⁻¹, followed by T₁ (100% organic manure equivalent to 100% N requirement of turmeric) with a yield of 27.42 t ha⁻¹, T₆ (75% N requirement of turmeric + micronutrients) with a yield of 26.39 t ha⁻¹ at Mizoram whereas at Barapani, maximum yield (22.00 t ha⁻¹) was recorded in T₃ (100% organic manures + micronutrients).

At Coimbatore, combined application of capsule formulation of *Trichoderma* and GRB 35 in BSR-2 recorded minimum incidence of leaf spot (5.5 PDI) and leaf blotch (14.0 PDI) compared to control that recorded 19.9 and 26.2 PDI of leaf spot and leaf blotch respectively. Maximum yield was observed in V2T2 treatment (32.00 t ha⁻¹) followed by V2T1 (30.92 t ha⁻¹) and V2T3 (30.67 t ha⁻¹) at Kumarganj. Significantly lowest leaf blotch disease was recorded in Rajendra Sonia (PDI=28.89) and Rajendra Sonali (PDI=30.00) against control (PDI=58.52) at Dholi.

In the coordinated varietal trial of mango ginger, NVMG 2 registered high per plant yield (142.7 g) followed by Acc 347 (136.7 g) and NVMG 10 (134.7 g) at Ambalavayal whereas at Raigarh, Indira Mango Ginger 1 (IMG 1) recorded highest rhizome yield 28.6 t ha⁻¹ followed by IMG 2 (27.5 t ha⁻¹) and IMG 4 (25.4 t ha⁻¹).

Tree spices

Among the nutmeg accessions conserved at Pechiparai, MF- 1 recorded maximum tree height (9.14 m) and stem girth (58.55 cm) and MF 4 recorded maximum leaf length (20.14 cm), leaf breadth (9.15 cm), no. of fruits (667), single fruit weight (53.0 g) and mace yield (286 g/ tree). At Dapoli, the genotypes DBSKKVMF 29 (972), DBSKKVMF 9772 (507) and DBSKKVMF 22 (498) recorded maximum average number of fruits respectively. The genotype DBSKKV 29 recorded maximum dry nut yield (9817.20 g) and dry mace yield (2721.60 g).

Among the germplasm of clove planted during the year 1996-97 at Dapoli, four promising genotypes were selected. The plant height varied from 5.89 to 7.15 m, girth ranged from 35-40 cm and spread varied from 2.50 m to 3.05 m. Among the 24 accessions at Pechiparai, SA-1 recorded the highest tree height of 11.78 m, followed by SA-3 (11.63 m) compared with local check tree height (9.31 m).

Among the twelve accessions of cinnamon evaluated at Pechiparai, CV-5 recorded maximum tree height (2.81 m), number of shoots (10) and stem girth (16.84 cm).

Coriander

One hundred forty accessions of coriander were evaluated along with Hisar Sugandh, Hisar Bhoomit and Hisar Anand as checks at Hisar. The seed yield ranged from 32.4 g per plant (DH-292) to 97.5 g per plant (DH-227). The most promising accessions for seed yield were DH-218, DH-224, DH-227, DH-240, DH-244, DH-280, DH-293, DH-313, DH-316 and DH-329. Out of 230 accessions, 45 accessions were better than best check variety RCr-475 (33.14 g) on the basis of seed yield per 5 plants at Jobner.

Cutting management, varieties and fertility levels affected significantly on coriander seed equivalent yield. Adopted one cut at 45 DAS recorded significantly higher coriander seed equivalent yield over two cut and without cut. GDLC 1 produced significantly higher coriander seed equivalent yield over GCo2. Application of 60:30:00 kg NPK / ha recorded significantly the highest coriander seed equivalent yield over rest of the treatments.

Among the six fungicides tested, the disease incidence in propiconazole sprayed plants was less at Coimbatore (5.30 PDI) and Jagudan (18.94 PDI) whereas at Kumarganj and Raigarh foliar spray of wettable sulphur (0.2%) showed minimum disease intensity of 4.25 and 5.4% respectively. The minimum (10.80%) disease intensity and maximum seed yield of 17.183 q ha⁻¹ were recorded with foliar spray of hexaconazole 5% SC @ 0.1% at Jobner.

Cumin

Ten entries of cumin under CVT and IET were tested for volatile oil content during Rabi 2018-19. The analysis of variance revealed significant differences among the entries for volatile oil (%) both in CVT and IET. The maximum volatile oil of 4.33% was observed in CUM-42 and RZ-345 followed by 3.60% in CUM-38, while minimum of 2.80% was recorded in CUM-39 and GC-4 in CVT.

Pooled analysis of three years data from Jobner, revealed that maximum mean reduction in aphid population (79.09 %) and seed yield (2.59 q ha⁻¹) were recorded with thiamethoxam 25 WG @ 25 g a.i./ha followed by clothianidin 50 WDG @ 20 g a.i./ha (T₂) with 1.74 B:C ratio. It was statistically at par with treatment of spray with thiamethoxam 25 WG @ 25 g a.i./ha followed by thiacloprid 21.7 SC @ 25 g a.i./ha (T₁) which exhibited 76.01 % mean reduction in aphid population and seed yield (2.44 q ha⁻¹) with a B:C ratio of 1.64. Whereas maximum (39.00) mean aphid population per plant and minimum seed yield (1.35 q ha⁻¹) was recorded in untreated control (T₁₀). In all the treatments, the percentage of volatile oil differed non significantly.

Fennel

During *Kharif* season, thirteen entries of fennel were screened under natural conditions at Jagudan. The minimum intensity of *Ramularia* blight was noticed in JF-2012-8 (10.0%) while the maximum intensity was recorded in JF-2016-05 (30.0%). The disease intensity ranged from 10.0 to 30.0 per cent.

Among 14 entries tested in CVT at Kumarganj, FNL-125 recorded maximum yield (15.06 q ha⁻¹) followed by FNL-123 (14.37 q ha⁻¹) and FNL-121 (14.02 q ha⁻¹). At Hisar, maximum seed yield was recorded in FNL-116 (21.51 q ha⁻¹) followed by FNL-117 (20.10 q ha⁻¹) and FNL-123 (19.30 q ha⁻¹). The CVT at Jagudan revealed that FNL-124, 127 and FNL-119 ranked in top three positions. Fifteen genotypes of fennel were evaluated at Pantnagar. Highest seed yield was observed in FNL-128 (19.91q ha⁻¹) followed by FNL-121 (19.49 q ha⁻¹). At Navsari, FNL-123 (28.04 q ha⁻¹), FNL-118 (25.52 q ha⁻¹), FNL-126 (25.34 q ha⁻¹), FNL-119 (25.22 q ha⁻¹) and FNL-127 (25.12 q ha⁻¹) were regarded as promising genotypes due to their higher seed yield.

Fenugreek

FGK 123 recorded maximum seed yield of 21.23 q ha⁻¹ and 16.25 q ha⁻¹ at Jobner and Kumarganj whereas FGK-122 recorded significantly highest seed yield at Navsari (20.78 q ha⁻¹) and Raigarh (16.1 q ha⁻¹). At Coimbatore FGK 124 (22.66) recorded maximum number of pods per plant and FGK 134 (11.60) recorded the lowest. Seed yield per plot (2 m²) varied from 98.07 to 174.67 g with a mean of 124.06 g.

Ajwain

Out of 13 entries of Ajwain evaluated at Kumarganj, maximum yield was recorded in IA-1 (8.53 q ha⁻¹) followed by NDAJ-10 (8.26 q ha⁻¹) and HAJ-7-187 (8.19 q ha⁻¹). Among the entries evaluated at Guntur, highest yield was recorded in LS-14-3 (9.66 q ha⁻¹) followed by LS-14-8 (9.38 q ha⁻¹), AA-73 (9.38 q ha⁻¹) and AA-6 (8.73 q ha⁻¹) which were on par and significantly superior to the best check Lam Selection-1 (7.93 q ha⁻¹).

Nigella

At Kumarganj, maximum yield was recorded in NDBC-20 (8.88 q ha⁻¹) followed by AN-1 (7.77 q ha⁻¹) and IN-1 (7.29 q ha⁻¹) and three years pooled data showed maximum yield in NDBC-20 (8.40 q ha⁻¹) followed by AN-1 (7.61 q ha⁻¹) and IN-1 (7.24 q ha⁻¹). At Kalyani, highest yield per hectare was recorded by IN1 (7.00 q ha⁻¹). At Kota, the seed yield ranged from 4.56 - 9.90 q ha⁻¹.

Saffron

200 germplasm accessions of saffron collected from various hot spots of Jammu and Kashmir including 36 exotic collections are maintained at Saffron Research Station, SKUAST, Kashmir. Among 200 accessions, 22 were found promising with regard to yield and quality.

The results on *in vitro* efficacy of isolated rhizospheric fungi (nonpathogenic to saffron crop) against mycelial growth of corm rot pathogen (*Fusarium oxysporum*) of saffron revealed that *Trichoderma viride* showed significantly superior performance as compared to other isolates including the control.

Kalazeera

The germplasm comprising of 70 accessions collected from foot hills of Northern Himalayas as well as germplasm available at Saffron Research Station, SKUAST-K are conserved. Some of the

promising accessions with regard to yield and essential oil content identified are SRS-KZ-192, SRS-KZ-158, SRS-KZ-172, SRS-KZ-177, SRS-KZ-170, SRS-KZ-149 and SRS-KZ-167.

Production and distribution of quality planting material

The AICRPS centres have multiplied and distributed 4.16 lakh rooted cuttings of black pepper, 10338 suckers of cardamom, 50 tons of turmeric, 30 tons of ginger, 1294 grafts of nutmeg, 1048 seedlings of nutmeg, 150 grafts of cinnamon and 250 seedlings of cinnamon. In seed spices, 324 q of coriander, 70 q of cumin, 30.5 q of fennel, 61.71 q of fenugreek and 10 kg of ajwain seed material were produced and distributed.

Transfer of technology

The scientists of various centres have taken earnest effort to popularize the latest technologies as the research is meaningful only if farmers are benefited through technologies. Following are some of the technologies demonstrated during the year.

High yielding varieties- boon to farmers

- ❖ Demonstration of transplanting of Rajendra Sonia variety of turmeric (Guntur)
- ❖ Demonstration of high yielding turmeric variety CO 2 (Coimbatore)
- ❖ Demonstration of TCP-129 turmeric variety for yield and tolerance to foliar diseases (Pundibari)

Rapid multiplication of planting materials- for minimal expenditure

- ❖ Production of black pepper plants using rapid multiplication method (Pechiparai)
- ❖ Protray technology popularization in turmeric in Paderu, Dumbriguda and Araku in collaboration with KVK, Kondempudi, Visakhapatnam (Chintapalle)
- ❖ Protray cultivation technique for quality seed production of ginger & turmeric (Pottangi, Nagaland)
- ❖ Demonstration of protray propagation technique for ginger and turmeric, soft wood grafting technique in nutmeg and kokum, bush pepper production technology (Dapoli)

Processing and value addition- for capturing market

- ❖ Preparation of preserve and chutney from nutmeg rind (Dapoli)
- ❖ Processing of turmeric (Dapoli)

Plant protection- for improving plant health

- ❖ Demonstration of biocontrol agents for black pepper wilt control at *Karadiyur* village (Yercaud)
- ❖ Rhizome treatment with propiconazole @0.2% + foliar spray with propiconazole @0.1% at 90, 105 & 120 DAP in turmeric in 0.5 acres (Dholi)

Apart from the above field level demonstrations, the scientists popularised technologies by conducting trainings and attending as resource persons in trainings and seminars and also through various media (newspaper, radio talks and TV programmes). ICAR-IISR in collaboration with AICRPS has developed ICAR Turmeric, ICAR Ginger and ICAR Black pepper mobile apps to help the farmers by providing relevant information on varietal wealth, cultivation, management and protection aspects.

Success stories

High yielding varieties- for income maximization

Under AICRP on Spices at Dholi centre, high yielding varieties of different spices crop *viz.*, turmeric (Rajendra Sonia and Rajendra Sonali), coriander (Rajendra Dhanian-1, Rajendra Dhanian-2 and Rajendra Swati), fenugreek (Rajendra Kanti and Rajendra Abha), nigella (Rajendra Shyama), fennel (Rajendra Saurabh) and ajwain (Rajendra Mani) have been developed. During 2019, about 43.3 tonnes of turmeric seed was produced which was procured by progressive farmers, various government and non-governmental organizations of Bihar as well as adjoining states. Because of high productivity and high curcumin content of turmeric varieties like Rajendra Sonia and Rajendra Sonali, they were procured by the farmers of other states *viz.*, Uttar Pradesh, Gujarat, Jharkhand, Telangana, and Andhra Pradesh. Seed spices (15q each of coriander, fenugreek, fennel, nigella and ajwain) were produced and made available to farming community for area expansion under spices cultivation. Cultivation of most of traditional varieties of spices were replaced by above mentioned released varieties and thus occupying major area under spices cultivation in the state and in some pockets in other state.

Biocontrol agents- for sustainable spice production

The bio control laboratory funded by the SHM is functioning in the Cardamom Research Station at Pampadumpara from 2012 onwards. Through this laboratory, biocontrol agents such as, *Pseudomonas fluorescens*, *Trichoderma viride*, *Metarhizium anisopliae*, *Lecanicilium lecanii*, *Paecilomyces lilacinus* and *Beauveria bassiana* have been produced on a large scale and is being supplied to the farmers. During 2019, about 17038 kg of biocontrol agents were distributed to the farmers. Promising thing is that more and more farmers are using biocontrol agents for pest and disease management of cardamom and black pepper. As per the feedback received, the farmers were more convinced about the quality and effect of biocontrol agents being supplied. The centre is looking forward to make more farmers aware about eco-friendly pest/disease management through the use of biocontrol agents and thus reduce the environmental chemical contamination and degradation of cardamom hill reserve (CHR) area to a greater extent.

Ginger seed storage- for prosperity

Ginger is known as poor man's cash crop of farmers of Himachal Pradesh especially of Sirmour and Solan districts. The area under its cultivation is reducing in the state year after year as the main problem in ginger cultivation is storage of healthy seed for next season as rhizome rot is the major menace resulting in poor rhizome yield. Hence, a modified storage method for healthy ginger seed rhizomes was employed and demonstrated which enhanced ginger production and income of farmers.

Modified storage method consists of

- Digging a pit of 1x1 m³ size in moisture free area and laying stones on the sides.
- Putting a layer of sand of 10-15 cm thickness in the pit.
- Treating the healthy rhizomes in a mixture of 250 g mancozeb per 100 litre of water for one hour and then drying the rhizomes in shade for 48 hours to remove excess of moisture.

- The treated rhizomes are kept in pits leaving free 10-15 cm area from top for aeration and then covered with cow dung paste.
- The temperature is maintained at 12-13° C with a relative humidity of 65 per cent (pit).
- The rhizomes are taken out of the pits, dried in shade and selected before planting by culling out rotten pieces in April and May-June respectively in mid and low hills.
- The diseased rhizomes are buried in soil.
- Rhizomes with watery spots are dipped in streptocycline solution (20g/100l water) for 30 minutes and then shade dried. Treated rhizomes are again kept in pits till planting.

With the adoption of this storage method of ginger, a dramatic increase in area and production of ginger in the state has been observed even in the non-conventional ginger growing areas of the state like Kangra, Mandi, Hamirpur, Una, Chamba and Bilaspur districts.

Tribal welfare measures – Reaching the unreached

ICAR-AICRP on spices under Tribal Sub Plan has 3 centres viz., Pottangi in Odisha, Chintapalle in Andhra Pradesh and Raigarh in Chhattisgarh. These centres uplift the tribals through conducting Farmers training programmes on the following aspects benefitting 2000 tribal farmers. In addition to this, scheduled caste sub plan was also launched for the betterment of the SC/ST population.

- Training programmes on black pepper, ginger and turmeric cultivation
- training programme on Post harvest management practices in turmeric
- Importance of quality planting materials, cultivation of seed spices and production techniques
- IPM technologies in horticultural crops
- Training on organic ginger and turmeric cultivation
- Off season coriander cultivation

Asset creation at various AICRPS centres

- Shade net house of 792 sq m with micro-irrigation facilities at Pottangi
- Micro sprinklers for poly house, weed mat for poly house, shade net replacements was done at HRS, Chintapalle
- Net house under construction for planting material production at Raigarh
- Poly house construction at Pasighat

North East- exploring the unexplored

North East has a great potential for cultivation of vegetable ginger. In a trial on the evaluation of ginger genotypes for vegetable purpose, highest yield (19.00 t ha⁻¹) was recorded in bold Nadia followed by *Gorubathan* (16.00 t ha⁻¹) and *Bhaise* (16.00 t ha⁻¹) at Nagaland, whereas maximum yield of 24.60 t ha⁻¹ was recorded in *Bhaise* at Mizoram followed by *Gorubathan* (19.35 t ha⁻¹) and bold Nadia (16.75 t ha⁻¹). This clearly indicates high yield potential and the utility of these genotypes for vegetable purpose. Organic ginger production and micronutrient trials were taken up by Barapani and Mizoram centres and very good ginger yields were recorded in both the trials at both the centres, thus providing a great encouragement for organic production and also with the use of micronutrients.

At Pasighat also, micronutrients spray in turmeric produced significantly higher yield, indicating that production levels of turmeric in the state can be enhanced successfully through micronutrients spray.

Collaboration and Networking

AICRP on Spices centres works in collaboration with

- ICAR- IISR, Kozhikode and ICAR-NRCSS, Ajmer (for technologies)
- Spices Board for popularization of technologies in tribal areas and north eastern region
- MIDH (Mission for Integrated Development for Horticulture) for providing and supplying quality planting material production
- NGOs for popularizing high production technologies in tribal areas and value chain development
- State Department of Agriculture for increasing production, productivity and income of farmers
- Coffee Board for establishing coffee based black pepper cropping system

Monitoring

The research projects and programmes undertaken by the centres were monitored by Project Coordinator and Scientists from PC unit's visit to various centres and the experimental plots. During this year, five centres were visited which included regular, co-opting, voluntary and project mode centres. The activities of the centres were also monitored through monthly reports, quarterly, half yearly and annual report sent by the centres. The XXX Workshop of ICAR-All India Coordinated Research Project on Spices was conducted at Tamil Nadu Agricultural University, Coimbatore during 14-16 November 2019 to discuss the progress made in each of the projects during the year, shortfalls and the programme for the ensuing year.

A Quinquennial Review Team (QRT) was constituted to review the work of AICRP on Spices for the period 2013-2018. The AICRPS has provided QRT team with input document on AICRPS activities and achievements and the same was reviewed by the team. Detailed interactions were held with the scientists of various AICRPS centres who made detailed presentations on various aspects such as mandate of the centre, budget allocation, varieties and technologies developed, publications, HRD and extension activities, future programmes and the constraints etc. QRT also visited some of the AICRPS centres, experimental fields, laboratories, Pesticide Residue Laboratory at Regional Agricultural Research Institute, Durgapura, Jaipur and some farmer's fields also and made useful recommendations for improvement of AICRPS as a whole.

ACTION TAKEN REPORT 2019-20

Sl.N o	Decisions/Recommendations	Centres	Action taken
TECHNICAL SESSION I: GENETIC RESOURCES & CROP IMPROVEMENT			
1.	Compiled/pooled data of genetic resources of all locations should be presented.	All the centres maintaining germplasm	Currently data is presented individually. However, pooled data will be presented in future.
2.	Proposal for release at national level should go through PC, AICRPS.	All centres	All the proposals are received by the PC cell now. Moreover, PC cell is also monitoring and informing the centres, if it is not received.
3.	Coding of entries has to be made compulsory	All centres	PC cell is coding all the CVT genotypes of seed spices and sending back to centres for taking up the trial.
4.	Unique type must be registered with NBPGR	All centres maintaining germplasm	Black pepper accession PRS 161, seven accessions of large cardamom, two accessions of turmeric and unique cumin germplasm accessions were submitted to NBPGR for registration
5.	Promising accessions should be included in the germplasm collection, evaluation & characterisation trial	All black pepper centres	Top performers among the promising accessions identified up to 2017 have been included in different CVTs.
6.	Quality analysis of promising lines of large cardamom needs to be done. The centres should concentrate on producing quality disease free planting material.	All large cardamom centres	Quality analysis has been done in association with ICAR-IISR. Planting material production will be scaled up.
7.	Curcumin content of accessions in CVT may be verified at IISR and Spices Board.	Coimbatore	Rhizomes of CVT entries were processed for verification of curcumin at IISR and Spices Board
8.	Proposal for release of A9-150 may be drafted in consultation with IISR.	Dapoli & Pechiparai	Variety proposal will be presented in the ensuing workshop
9.	Faizabad, Dholi and Kota are hot spot for coriander diseases, hence may be included in screening for stem gall and Jagudan for powdery mildew screening	Dholi, Kumarganj, Kota, Jagudan	New trial is being taken up this year on disease survey and these will be included
10	Mutation breeding of cumin may be	Sanand	Cumin variety GC 4 was

	taken up for creating variability.	Jagudan Jobner	subjected <i>Gamma</i> rays treatment and promising genotype SC-5 was identified during 2018-19 for inducing mutation. From M ₂ generation, 31 individual plants were selected during <i>Rabi</i> 2019-20 for further evaluation. It will be taken up after conducting initial trials in other centres.
11	Leaf blight tolerant line in cumin may be developed.	Jobner Jagudan Sanand	Screening is going on in Jobner but tolerance is not observed yet. Screening facility for blight disease is currently not available in other centres and it will be developed.
12	The drought tolerant lines of fenugreek may be registered with NBPGR	All fenugreek centres	A few accessions have been identified and these will be sent for registration

TECHNICAL SESSION II : VARIETY RELEASE

22	List of varieties released in particular crop and their salient features must be studied before submitting the proposal.	All centres	All the breeders have been advised to look in to it. If a variety is already available for a particular trait, then the proposed variety will be released only if it has additional traits.
23	Detailed information on breeding methods and evolution of variety must be included in proposal. Stability analysis should be included.	All centres	It is included in most of the proposals. However, it will be included/ modified wherever needed.
24	Role of developers and collaborators should be mentioned clearly and the signature of all the people should be included in the proposal.	All centres	Instruction will be followed
26	Trails must be taken up in disease hotspots area or should be screened artificially for claiming resistance and certificate from pathologist/ entomologist must be obtained for claiming resistance in variety release.	All centres	This will be taken up especially in resistance screening trials.

TECHNICAL SESSION III : TRANSFER OF TECHNOLOGY

General recommendation

13	All the technologies identified may be	All centres	Some centres such as Guntur,
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	demonstrated through KVKs of the respective regions for adoption and approved technologies should be incorporated in the package of practices of the state.		Dholi and Panniyur are following. It will be made mandatory for all other centres to demonstrate technologies through KVKs and also inclusion in PoP of the respective states.
14	The recommended technologies must be prepared in a brochure form covering application methodology, preparation of materials/chemicals, ingredients and sources of availability in detail and submitted to PC cell.	Jobner	It will be submitted.
15	TECHNICAL SESSION IV : CROP MANAGEMENT		
16	Soil and quality analysis data may be included in all nutrient management trials and the centres should restrict to the treatments as per the approved technical programme without deviation.	All centres	This data is being recorded in most of the experiments. Data will be included wherever it is missing.
17	New trials in crop management are to be formulated in cumin and fenugreek jointly by Jobner, Jagudan and ICAR-NRC on Seed spices centres.	Jobner, Jagudan NRCSS	Formulated one trial each in cumin and fenugreek and the experiment is in progress
18	Economics may be included for each treatment and performance of crops in mixed cropping system may be verified by the scientists of ICAR- IISR.	IISR, Ambalavayal, Sirsi, Dapoli, Panniyur	Instruction will be followed
19	Pest and disease incidence in intercrop as well as black pepper should be recorded.	Ambalavayal, Sirsi, Dapoli, Panniyur	Observations on pests and diseases were recorded in black pepper as well as inter crops.
TECHNICAL SESSION V: CROP PROTECTION			
20	All the raw data need to be sent to IISR for pooled analysis and field recommendation for the trial Studies on the management of coriander powdery mildew using new generation Fungicides	Jagudan Jobner	Data has been submitted to the PC cell and the data is being analysed.

NEW RESEARCH PROGRAMMES

Crop Production

Project Code: GIN/CM/4.1	Title: Evaluation of different ginger based intercropping systems for higher yield and income
Crop	Ginger
Centers	Pottangi, Chintapalle, ICAR Gangtok, Solan, Dholi, Pundibari, Kanke, Nagaland, Kalyani, Mizoram, Sirsi
Year of Start	2021-22
Duration	3 years (2021-22 to 2023-24)
Plan of work	<p>Treatments:</p> <p>T1- Sole ginger</p> <p>T2- Ginger + Papaya + Leafy coriander (Grow papaya with a spacing of 180 x 180 cm. Between two lines of papaya ginger will be sown in a spacing of 30 x 25 cm and leafy coriander will be broadcasted in the border area. After harvesting of leafy coriander, the mulching will be imposed.)</p> <p>T3- Ginger + Banana (Grow banana with a spacing of 200 x 200 cm. Between two lines of banana ginger will be sown in a spacing of 30 x 25 cm. Banana may be grown once in two years)</p> <p>T4- Ginger + Coriander + leafy vegetables (Grow ginger and coriander in 2:2 ratio. After harvesting of coriander, grow leafy vegetables in place of coriander)</p> <p>T5- Ginger + Maize (2:1 or 2:2) (Grow sweet corn in Kharif, Rabi and Summer- 3 times)</p> <p>T6- Ginger + French Bean (2:2) (Grow French bean in Kharif, Rabi and Summer- 3 times)</p> <p>T7- Ginger + Arhar (3:1) (Grow arhar in Kharif)</p> <p>T8- Ginger + Taro (2:2) (Grow taro in Kharif)</p> <ul style="list-style-type: none"> ● Crop variety: Popular improved variety of respective centre/area. ● Experimental design: RBD ● Treatments : 8 ● Replication: 3
Methodology to be adopted	<ul style="list-style-type: none"> ● Standard package of practices should be followed in all the crops.
Observations to be recorded	<ul style="list-style-type: none"> ● Growth parameters ● Yield and its attributes ● Test weight of seed spices ● Essential oil of seed spices ● Economics- BCR, Gross returns, net returns

Project Code: LAC/CM/5.1	Title: Effect of mulching on yield of large cardamom
Crop	Large cardamom
Centre	CAU Pasighat, ICAR Gangtok, ICRI Gangtok
Place of Experiment	At farmers fields
Year of start	2020
Duration of the project	3 years
No. of treatments (6)	T1 – Leaf mould T2 – Fresh leaf litter T3 – Paddy straw T4 – Paddy husk T5 – Black polyethylene sheets T6 - Control
Design	Randomized Block Design
No. of replications, no. of plants/replication	Four
Plot size/Spacing	4.5 x 4.5 m and 1.5 x1.5 m
Observations to be taken	<ul style="list-style-type: none"> ✓ Plant height ✓ Number of leaves/tiller ✓ Number of tillers/clump ✓ Number of productive tillers ✓ Leaf length ✓ Leaf breadth ✓ Number of days to flowering ✓ Number of days to maturity ✓ Number of spike/clump ✓ Number of capsule/spike ✓ Number of seed/capsule ✓ Fresh yield/ plant and per hectare ✓ Dry yield/plant and per hectare ✓ Physico - chemical parameters of soil : pH, nutrient status ✓ Diseases and insect pests (if any) ✓ Economics, BC ratio

Project Code: CAR/CM/5.6	Title: Site-specific recommendation for varying yield target of cardamom
Crop(s)	Small cardamom
Centers	Mudigere, Appangala, Myladampara, Pampadampara and Sakleshpura
Year of Start	2020-21
Duration	3 years (2020-21 to 2022-23)
Plan of work	<p>Treatment Details:</p> <p>T₁- Existing POP. based fertilizer application T₂- Soil test based fertilizer recommendation (NPK) for current yield level TY (Targeted yield)* T₃- Target yield level II T₄- Target yield level III T₅- Yield target level IV</p> <ul style="list-style-type: none"> • Crop variety: Popular improved variety of respective centre/area. • Experimental design: RBD • Treatments : 5 • Replication: 4 • Plot Size : 2 x 2m, 12 plants per plot
Methodology to be adopted	<ul style="list-style-type: none"> • Soil test analysis will be done for current yield level (T₂) based on current yield level, their higher yield will be fixed (T₃, T₄, T₅) fertilizer storage will be worked out for these yield levels.
Observations to be recorded	<ul style="list-style-type: none"> • Growth parameters • Yield and its attributes • Quality attributes • Soil test analysis before and end of cropping season growth • Economics- BCR, gross returns, net returns

Project Code: SS/CM/4.1	Title: Intercropping of seed spices with vegetables for higher yield and income
Crop(s)	Fennel, Coriander, Garlic, Carrot, Cabbage
Centers	Jobner, Dholi, Kumarganj, Raigarh, Jagudan, Jabalpur, Hisar, Mandor, Pantnagar
Year of Start	2020-21
Duration	3 years (2020-21 to 2022-23)
Plan of work	<p>Treatments:</p> <ol style="list-style-type: none"> 1. Fennel + Garlic 2. Fennel + Carrot 3. Fennel + Cabbage 4. Coriander + Garlic 5. Coriander + Carrot 6. Coriander + Cabbage 7. Fennel sole 8. Coriander sole 9. Garlic sole 10. Carrot sole 11. Cabbage sole <ul style="list-style-type: none"> • Crop variety: Popular improved variety of respective centre/area. • Experimental design: RBD • Treatments : 11 • Replication: 3 • Plot Size : 4m x 3m
Methodology to be adopted	<ul style="list-style-type: none"> • Crop geometry for fennel: 60cm x 30cm, for coriander 40cm x10cm. • Standard package of practices should be followed in all the crops.
Observations to be recorded	<ul style="list-style-type: none"> • Growth parameters • Yield and its attributes • Test weight of seed spices • Essential oil of seed spices • Economics- BCR, gross returns, net returns

Project Code: FNL/CM/5.1	Title: Response of foliar application of iron and zinc on growth, yield and quality of fennel
Crop	Fennel
Centers	Jagudan, Jobner, Hisar, Dholi, Kumarganj, Mandor, Pantnagar
Year of Start	2020-21
Duration	3 years (2020-21 to 2022-23)
Plan of work	<p>Treatments:</p> <ul style="list-style-type: none"> • Treatment combinations: 16 <ul style="list-style-type: none"> T1- Foliar spray of FeSO₄ (0.2%) T2- Foliar spray of FeSO₄ (0.4%) T3- Foliar spray of FeSO₄ (0.6%) T4- Foliar spray of ZnSO₄ (0.2%) T5- Foliar spray of ZnSO₄ (0.4%) T6- Foliar spray of ZnSO₄ (0.6%) T7- Foliar spray of FeSO₄ (0.2%)+ ZnSO₄ (0.2%) T8- Foliar spray of FeSO₄ (0.2%)+ ZnSO₄ (0.4%) T9- Foliar spray of FeSO₄ (0.2%)+ ZnSO₄ (0.6%) T10- Foliar spray of FeSO₄ (0.4%)+ ZnSO₄ (0.2%) T11- Foliar spray of FeSO₄ (0.4%)+ ZnSO₄ (0.4%) T12- Foliar spray of FeSO₄ (0.4%)+ ZnSO₄ (0.6%) T13- Foliar spray of FeSO₄ (0.6%)+ ZnSO₄ (0.2%) T14- Foliar spray of FeSO₄ (0.6%)+ ZnSO₄ (0.4%) T15- Foliar spray of FeSO₄ (0.6%)+ ZnSO₄ (0.6%) T16- Control (water spray) • Replication: 3 • Experimental design: Factorial RBD • Crop variety: Popular improved variety of respective centre/area. • Method of application: Foliar • No. of application: 3 • Stage of application: 60, 75 and 90 days after sowing.
Methodology to be adopted	<ul style="list-style-type: none"> • Crop geometry for fennel: 60cm x 30cm. • Standard package of practices (other than treatments) should be followed. • Calculated amount of lime to neutralize the pH and a measured quantity of sticker should be added.
Observations to be recorded	<ul style="list-style-type: none"> • Plant growth parameters • Biomass accumulation • Leaf nutrient content (one day before first spray, 05 days after 3rd spray and at harvest) • Yield parameters such as umbels per plant, umbellate per umbel and seeds per umbellate, seed yield, stover yield and test weight. • Seed quality (Essential oil) • Economics- BCR, gross returns, net returns • Soil nutrient content before and after the experiment

Crop Protection

Project Code: PEP/CP/5.9	Title: Screening of insecticides for pollu beetle, <i>Lanka ramakrishnai</i> in black pepper
Crop	Black pepper
Centers	Panniyur, Ambalavayal, Appangala, Pampadumpara
Year of Start	2021-22
Duration	3 years (2021-22 to 2023-24)
Plan of work	<p>Treatments:</p> <p>T1- Chlorantraniliprole @ 0.3 ml L⁻¹</p> <p>T2- Chlorantraniliprole @ 0.5 ml L⁻¹</p> <p>T3- Flubendiamide @ 0.3 ml L⁻¹</p> <p>T4- Flubendiamide @ 0.5 ml L⁻¹</p> <p>T5- Spinetoram @ 0.3 ml L⁻¹</p> <p>T6- Spinetoram @ 0.5 ml L⁻¹</p> <p>T7- Quinalphos @ 2 ml L⁻¹</p> <p>T8- Control (water spray)</p> <p>Crop variety: Popular improved variety of respective centre/area.</p> <ul style="list-style-type: none"> • Experimental design: RBD • Treatments : 8 • Replication: 4
Methodology to be adopted	<p>Date of first sprays: August</p> <p>Subsequent sprays: at monthly interval (limited to a total of 4 sprays)</p>
Observations to be recorded	<ul style="list-style-type: none"> • Growth parameters • Yield and its attributes • % damage • Economics- BCR, gross returns, net returns • Residue analysis

Sample observation procedure

Spike no.	T1R1	
	Total no of berries	Infested berries
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
% damage		

Project Code: BP/CP/5.10	Title: Observational trial on the efficacy of <i>Trichoderma asperellum</i> & <i>Pochonia chlamydosporia</i> for the management of <i>Phytophthora</i> foot rot and nematodes in black pepper
Crop	Black pepper
Centers	Panniyur, Appangala, Sirsi
Year of Start	2021-22
Duration	2 years (2021-22 to 2022-23)
Plan of work	<p>Treatments:</p> <p>T1- Control</p> <p>T2- <i>T. asperellum</i> talc formulation (Mass multiply in cowdung :neem cake mixture (9:1). Mix <i>T. asperellum</i> talc formulation @1-2 kg /100kg mixture. Apply 2-5kg <i>T. asperellum</i> mass multiplied mixture /plant)</p> <p>T3- <i>T. asperellum</i> biocapsule formulation (1biocapsule /100L water. Apply 2-3L solution /plant)</p> <p>T4- Metalaxyl-mancozeb (Drench the fungicidal solution (0.125 %)</p> <p>T5- <i>Pochonia chlamydosporia</i> liquid formulation (Drench @1ml/L)</p> <p>T6- Recommended nematicide (Drench the nematicidal solution)</p> <p>Crop variety: Popular improved variety of respective centre/area.</p> <ul style="list-style-type: none"> • Experimental design: RBD • Treatments : 6 • Replication: 4 • Total no. of vines24
Methodology to be adopted	Date of application: Apply 2 times- May-June and September-October
Observations to be recorded	<ul style="list-style-type: none"> • Growth parameters • Yield and its attributes • Disease incidence • Soil population of <i>Phytophthora/Pythium/nematodes</i> (soil samples can be sent to IISR for analysis. Samples has to be taken before imposing treatments & after imposing treatments @ July- August and Oct-Nov) • Economics- BCR, gross returns, net returns • Residue analysis

Project Code: CAR/CP/6.13	Title: Observational trial on the efficacy of <i>Trichoderma asperellum</i> & <i>Pochonia chlamydosporia</i> for the management of rhizome rot and nematodes in small cardamom
Crop	Small cardamom
Centers	Appangala, Myladumpara, Pampadumpara
Year of Start	2021-22
Duration	2 years (2021-22 to 2022-23)
Plan of work	<p>Treatments:</p> <p>T1- Control</p> <p>T2- <i>T. asperellum</i> talc formulation (Mass multiply in cowdung :neem cake mixture (9:1).Mix <i>T. asperellum</i> talc formulation @1-2 kg /100kg mixture. Apply 2-5kg <i>T. asperellum</i> mass multiplied mixture /plant)</p> <p>T3- <i>T. asperellum</i> biocapsule formulation (1biocapsule /100L water. Apply 2-3L solution /plant)</p> <p>T4- Metalaxyl-mancozeb (Drench the fungicidal solution (0.125 %)</p> <p>T5- <i>Pochonia chlamydosporia</i> liquid formulation (Drench @1ml/L)</p> <p>T6- Recommended nematicide (Drench the nematicidal solution)</p> <p>Crop variety: Popular improved variety of respective centre/area</p> <ul style="list-style-type: none"> • Experimental design: RBD • Treatments : 6 • Replication: 4 • Plot size: 3m
Methodology to be adopted	Date of application: Apply 2 times- May-June and September-October
Observations to be recorded	<ul style="list-style-type: none"> • Growth parameters • Yield and its attributes • Disease incidence • Soil population of <i>Fusarium</i> /<i>Pythium</i>/nematodes (soil samples can be sent to IISR for analysis. Samples has to be taken before imposing treatments & after imposing treatments @ July- August and Oct-Nov) • Economics- BCR, gross returns, net returns • Residue analysis

Project Code: GIN/CP/6.16	Title: Spray schedule optimization of effective insecticides for shoot borer (<i>Conogethes punctiferalis</i>) in ginger
Crop	Ginger
Centers	Pottangi, Kahikuchi, Sirsi, Solan, Mudigere, Pundibari, Mizoram, Nagaland, Pasighat, Barapani, Kanke, Ambalavayal
Year of Start	2021-22
Duration	3 years (2021-22 to 2023-24)
Plan of work	<p>Treatments:</p> <p>T1- Chlorantraniliprole @ 0.3 ml L⁻¹</p> <p>T2- Chlorantraniliprole @ 0.5 ml L⁻¹</p> <p>T3- Flubendiamide @ 0.3 ml L⁻¹</p> <p>T4- Flubendiamide @ 0.5 ml L⁻¹</p> <p>T5- Spinosad @ 0.3 ml L⁻¹</p> <p>T6- Spinosad @ 0.5 ml L⁻¹</p> <p>T7- Chlorantraniliprole + Spinosad @ 0.5 ml L⁻¹ (alternatively)</p> <p>T8- Control (water spray)</p> <p>Crop variety: Popular improved variety of respective centre/area.</p> <ul style="list-style-type: none"> • Experimental design: RBD • Treatments : 8 • Replication: 4 • Plot size: • Spacing • No. of beds/ treatment
Methodology to be adopted	<p>Date of first sprays: 45 days after planting</p> <p>Subsequent sprays: at fortnightly intervals (maximum no of sprays limited to 7)</p>
Observations to be recorded	<ul style="list-style-type: none"> • Growth parameters • Yield and its attributes • Pre-treatment count (no of shoots/clump and no of infested shoots/clump) • Final count: 15-20 days after the last spray (no of shoots/clump and no of infested shoots/clump) • Economics- BCR, gross returns, net returns • Residue analysis

Project Code: GIN/CP/6.17	Title: Observational trial on the efficacy of <i>Trichoderma asperellum</i> & <i>Pochonia chlamydosporia</i> for the management of rhizome rot and nematodes in ginger
Crop	Ginger
Centers	Kozhikode, Chintapalli, Pottangi, Barapani
Year of Start	2021-22
Duration	2 years (2021-22 to 2022-23)
Plan of work	<p>Treatments:</p> <p>T1- Control</p> <p>T2- <i>T. asperellum</i> talc formulation (Mass multiply in cowdung :neem cake mixture (9:1). Mix <i>T. asperellum</i> talc formulation @1-2 kg /100kg mixture. Apply 2-5kg <i>T. asperellum</i> mass multiplied mixture /plant)</p> <p>T3- Metalaxyl-mancozeb (Drench the fungicidal solution (0.125 %))</p> <p>T4- <i>Pochonia chlamydosporia</i> liquid formulation (Drench @1ml/L)</p> <p>T5- Recommended nematicide (Drench the nematicidal solution)</p> <p>Crop variety: Popular improved variety of respective centre/area.</p> <ul style="list-style-type: none"> • Experimental design: RBD • Treatments : 5 • Replication: 4 • Bed size: 3 x1m • Spacing: 15x30 cm • Total no. of beds: 20
Methodology to be adopted	<p>Date of application: At the time of planting</p> <p>30 days after planting (DAP)</p> <p>60 days after planting(DAP)</p>
Observations to be recorded	<ul style="list-style-type: none"> • Growth parameters • Yield and its attributes • Disease incidence • Soil population of <i>Fusarium/Pythium/nematodes</i> (soil samples can be sent to IISR for analysis. Samples has to be taken before imposing treatments & after imposing treatments @ July- August and Oct-Nov) • Economics- BCR, gross returns, net returns • Residue analysis

Project Code: TUR/CP/7.9	Title: Spray schedule optimization of effective insecticides for shoot borer (<i>Conogethes punctiferalis</i>) in turmeric
Crop	Turmeric
Centers	Pottangi, Kahikuchi, Sirsi, Mudigere, Pundibari, Mizoram, Pasighat, Barapani, Pantnagar, Kammarpally, Guntur, Kanke, Ambalavayal
Year of Start	2021-22
Duration	3 years (2021-22 to 2023-24)
Plan of work	<p>Treatments:</p> <p>T1- Chlorantraniliprole @ 0.3 ml L⁻¹ T2- Chlorantraniliprole @ 0.5 ml L⁻¹ T3- Flubendiamide @ 0.3 ml L⁻¹ T4- Flubendiamide @ 0.5 ml L⁻¹ T5- Spinosad @ 0.3 ml L⁻¹ T6- Spinosad @ 0.5 ml L⁻¹ T7- Chlorantraniliprole + Spinosad @ 0.5 ml L⁻¹ (alternatively) T8- Control (water spray)</p> <p>Crop variety: Popular improved variety of respective centre/area.</p> <ul style="list-style-type: none"> • Experimental design: RBD • Treatments : 8 • Replication: 4 • Plot size: • Spacing • No. of beds/ treatment
Methodology to be adopted	<p>Date of first sprays: 45 days after planting</p> <p>Subsequent sprays: at fortnightly intervals (maximum no of sprays limited to 7)</p>
Observations to be recorded	<ul style="list-style-type: none"> • Growth parameters • Yield and its attributes • Pre-treatment count (no of shoots/clump and no of infested shoots/clump) • Final count: 15-20 days after the last spray (no of shoots/clump and no of infested shoots/clump) • Economics- BCR, gross returns, net returns • Residue analysis

Sample sheet for observations
Screening of insecticides against *Conogethes* in turmeric/ginger
Date of planting: -----; Date of observation: -----Location: -----

Plant no.	T1R1		T1R2		T1R3		T2R1		T2R2		T2R3		T3R1		T3R2		T3R3	
	Total	Inf.	Total	Inf.	Total	Inf.	Total	Inf.	Total	Inf.	Total	Inf.	Total	Inf.	Total	Inf.	Total	Inf.
1																		
2																		
3																		
4																		
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Project Code: TUR/CP/7.10	Title: Observational trial on the efficacy of <i>Trichoderma asperellum</i> & <i>Pochonia chlamydosporia</i> for the management of rhizome rot and nematodes in turmeric
Crop	Turmeric
Centers	Kozhikode, Coimbatore, Guntur, Barapani
Year of Start	2021-22
Duration	2 years (2021-22 to 2022-23)
Plan of work	<p>Treatments:</p> <p>T1- Control</p> <p>T2- <i>T. asperellum</i> talc formulation (Mass multiply in cowdung :neem cake mixture (9:1).Mix <i>T. asperellum</i> talc formulation @1-2 kg /100kg mixture. Apply 2-5kg <i>T. asperellum</i> mass multiplied mixture /plant)</p> <p>T3- Metalaxyl-mancozeb (Drench the fungicidal solution (0.125 %))</p> <p>T4- <i>Pochonia chlamydosporia</i> liquid formulation (Drench @1ml/L)</p> <p>T5- Recommended nematicide (Drench the nematicidal solution)</p> <p>Crop variety: Popular improved variety of respective centre/area.</p> <ul style="list-style-type: none"> • Experimental design: RBD • Treatments : 5 • Replication: 4 • Bed size: 3 x 1m • Spacing:15x30cm • Total no. of beds: 20
Methodology to be adopted	Date of application: At the time of planting, 30 days after planting (DAP), 60 days after planting(DAP)
Observations to be recorded	<ul style="list-style-type: none"> • Growth parameters • Yield and its attributes • Disease incidence • Soil population of <i>Fusarium</i> /<i>Pythium</i>/nematodes (soil samples can be sent to IISR for analysis. Samples has to be taken before imposing treatments & after imposing treatments @ July- August and Oct-Nov) • Economics- BCR, gross returns, net returns • Residue analysis

Project code: SS/CP/7.1	Title: Survey and monitoring of diseases and insect pests of seed spices for development of prediction models
Crop	Cumin, Coriander, Fenugreek, Fennel, Ajwain, Nigella
Centres	Ajmer, Jobner, Jagudan, Guntur, Kumarganj, Raigarh, Dholi, Kalyani, Sanand, Coimbatore and Kammarpally
Year of start	Rabi 2020-21
Duration	Five years
Plan of work	<p>A. Field survey of diseases and insect pests of seed spices (cumin, coriander, fenugreek, fennel, ajwain and nigella)</p> <p>Proposed areas of survey:</p> <ul style="list-style-type: none"> • Cumin- Rajasthan and Gujarat • Coriander- Rajasthan, U.P., Chhattisgarh, Bihar, Tamil Nadu • Fenugreek- Rajasthan, U. P., Chhattisgarh, Bihar, Tamil Nadu • Fennel- Gujarat, Rajasthan, UP • Ajwain- Rajasthan, Gujrat, M.P., Telangana, Andhra Pradesh • Nigella- Rajasthan, M.P., Bihar, Telangana, Andhra Pradesh, Chhatisgarh, West Bengal <p>B. Monitoring diseases and insect pests of seed spices on the Institute farm</p> <ul style="list-style-type: none"> • Cumin: <i>Alternaria</i> blight, powdery mildew, aphids and thrips • Coriander: Stem gall, powdery mildew, aphids, seed wasps • Fenugreek: Powdery mildew, downy mildew, aphids, jassids • Fennel: <i>Ramularia</i> blight, powdery mildew, aphids, seed wasps • Ajwain: Root rot, aphids, lygus bug • Nigella: Root rot, termite, capsule borer
Methodology to be adopted	<ul style="list-style-type: none"> • Survey will be conducted on farmers' fields of cumin, coriander, fenugreek, fennel, ajwain and nigella for the prevalence of various diseases and insect pests during the cropping season. • The local popular/ susceptible variety of cumin, coriander, fenugreek and fennel crops will be planted in experimental plots. • Plots (5m x 5m) will be kept natural conditions without any plant protection measures for any of the pests/ disease on seed spice crop. Observations for diseases and pests along with meteorological factors will be taken from crop germination to maturity at weekly interval. • Standard package of practices should be followed except plant protection measures.
Observations to be recorded:	<ul style="list-style-type: none"> • Disease score of root diseases and DI will be calculated. • Disease score of foliar diseases and PDI will be calculated • Number of insects /umbel/5cm twig/percentage seed /plant damage • Meteorological data & mapping of disease hot spots • Correlation between meteorological parameters and disease/ pest distribution/ incidence

Project code: COR/CP/7.1	Title: Screening of coriander varieties against stem gall disease in coriander
Crop	Coriander
Centres	Dholi, Kumarganj, Kota, Hisar
Year of start	Rabi 2020-21
Duration	Three years (2020-21 to 2022-23)
Plan of work	<ul style="list-style-type: none"> • No. of treatments/ genotypes: As decided in the CVT trial * • No. of rows/replication: 3 • Row length: 3m • Spacing: 30cm × 10cm • Sowing Time : October - November
Methodology to be adopted	<ul style="list-style-type: none"> • The entries will be sown in stem gall sick plot. One susceptible and resistant line will be planted after every 5 test entries. • Standard package of practices should be followed
Observations to be recorded	<ul style="list-style-type: none"> • Disease score of stem gall at vegetative, flowering and seed maturity stage and PDI will be calculated accordingly. • Seed yield

- The coded CVT seed materials can be used as the genotypes for the trial along with stem gall tolerant and susceptible checks.
- The susceptible genotype available at the respective centres may be used as a susceptible check while the tolerant genotype will be provided by the Ajmer centre.

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1.	Dr. A.K. Singh, Deputy Director General (Hort.Science)
2.	Dr. Vikramaditya Pandey, Assistant Director General i/c (HS II.)
Special Invitees	
3.	Dr. R. Chandra Babu, Vice-Chancellor, KAU, Thrissur
4.	Shri D. Sathiyam IFS, Secretary, Spices Board, Kochi
5.	Dr. N.K. Krishna Kumar, Former DDG (Hort. Science), ICAR & Chairman, RAC, ICAR-IISR, Kozhikode
6.	Dr. K. Nirmal Babu, Former Director, ICAR-IISR & Project Coordinator, ICAR-AICRP on Spices, Kozhikode
7.	Dr. Homey Cheriyan, Director, Directorate of Arecanut & Spices Development, Kozhikode
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32.	Mr. K. Jayarajan, ACTO
Project Coordinator's Unit	
33.	Dr. K.S. Krishnamurthy, Principal Scientist
34.	Dr. Sharon Aravind, Scientist
35.	Dr. E. Radha, ACTO
ICAR-IISR Regional Station, Appangala-571 201, Coorg Dist., Karnataka	
36.	Dr. S. J. Ankegowda, Head
37.	Dr. Muhammed Faisal Peeran, Scientist

38.	Dr. Honnappa Asangi, Scientist
39.	Dr. Balaji Rajkumar, Scientist
ICAR-NRC on Seed Spices, Ajmer-305206, Rajasthan	
40.	Dr. Gopal Lal, Director
41.	Dr. Y. K. Sharma, Principal Scientist
42.	Dr. R. S. Meena, Senior Scientist
43.	Dr. S. S. Meena, Senior Scientist
Coordinating Centres	
Cardamom Research Station (Kerala Agricultural University), Pampadumpara – 685 553, Dist. Idukki, Kerala	
44.	Dr. Nimisha Mathews, Associate Professor (Agron/Hort.)
Pepper Research Station, (Kerala Agricultural University), PB No. 113, Kanjirangadu (P.O.), Karimbam (via), Taliparamba, Panniyur – 670 142, Kannur Dist., Kerala	
45.	Dr. V. P. Neema, Professor & Head
46.	Dr. P.M. Ajith, Asst. Professor (Genetics & Pl. Breeding)
47.	Dr. Yamini Varma, C.K., Asst Professor (Plant Pathology)
48.	Dr. Airina, C.K., Asst. Professor (Agron / Hort)
Zonal Agricultural & Horticultural Research Station, AICRP on Spices, Mudigere-577 132	
49.	Dr. M. Shivaprasad, ADR & OIC- AICRPS
Horticultural Research Station, (University of Horticultural Sciences, Bagalkot), Sirsi	
50.	Mr. Sudheesh Kulkarni, Assistant Professor
Horticultural Research Station, (TNAU), Yercaud, Tamil Nadu	
51.	Dr. M. Anand, Jr. Breeder (Hort.)
Dept. of Spices and Plantation Crops, HC & RI, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu	
52.	Dr. R. Senthamizh Selvi, Asst. Professor (Horticulture)
53.	Dr. S. Sundravadana, Jr. Pathologist (Pathology)
Turmeric Research Station (SKLTHU), Kammarpally-503 308, Nizamabad Dist., Telangana	
54.	Dr. B. Mahender, Scientist (Pl. Pathology), OIC-AICRPS
55.	Dr. P. Srinivas, Scientist (Hort.)
Horticultural Research Station, Dr. Y.S.R. Horticultural University, Chintapalle, 531 111, AP	
56.	Dr. V. Sivakumar, Asst. Prof. (Hort.)
Horticultural Research Station, Dr. Y.S.R. Horticultural University, Guntur, 522 034, AP	
57.	Dr. K. Giridhar, Jr. Breeder
58.	Dr. Tanuja Priya, Jr. Horticulturist
Department of Vegetable Science, College of Horticulture (Dr YS Parmar Univ. of Horticulture & Forestry), Solan-173 230, Himachal Pradesh	
59.	Dr. Meenu Gupta, Jr. Plant Pathologist
High Altitude Research Station, (Odisha Univ. of Agrl. & Technology), Pottangi-764 039, Dist. Koraput, Odisha	
60.	Dr. Parshuram Sial, Sr. Breeder & Officer-in-charge, AICRPS
Dept. of Plant Breeding & Genetics, SKN College of Agriculture (Sri Karan Narendra Agricultural University), Jobner-303 329, Dist. Jaipur, Rajasthan	
61.	Dr. A.C. Shivran, Sr. Agronomist
62.	Dr. D.K. Gothwal, Breeder
63.	Mr. G.L. Kumawat, Asst. Plant Pathologist

Centre for Research on Seed Spices (CRSS), Sardarkrushinagar Dantiwada Agricultural University (SDAU), Jagudan – 382 710, Dist. Mehsana, Gujarat	
64.	Dr. N R Patel, Plant Pathologist
65.	Dr. Surabhi S. Chauhan, Asst. Research Scientist (Pl. Br.)
Department of Vegetable Science, (Chaudhary Charan Singh Haryana Agril. University), Hisar – 125 004, Haryana	
66.	Dr. T.P. Malik, Principal Scientist
67.	Dr. S. K. Tehlan, PI & Head of AICRPS
Department of Horticulture, Tirhut College of Agriculture (Rajendra Agril. University), Dholi - 843 121, Musaffarpur, Bihar	
68.	Dr. A.K. Mishra, Jr. Plant Pathologist
69.	Dr. C. Mukhim, Horticulturist
Department of Vegetable Science, (Narendra Deva University of Agril. & Technology), Narendra Nagar Post, Kumarganj, Faizabad - 224 229, Uttar Pradesh	
70.	Dr. Pradip Kumar, Jr. Pathologist
Faculty of Horticulture, Uttara Banga Krishi Vishwavidyalaya, North Bengal Campus, Pundibari P.O, Dist. Cooch Behar, West Bengal – 736 165	
71.	Dr. Anamika Debnath, Assistant Professor (Plant Pathology)
Department of Horticulture, (Konkan Krishi Vidyapeeth), Dapoli-415 712	
72.	Dr. Devmore, Jr. Breeder
73.	Dr. P. C. Mali, Associate Professor
Regional Agril. Research Station, (Indira Gandhi Agricultural University), Boirdadar Farm, Raigarh – 496 001, Dist. Raigarh, Chhattisgarh	
74.	Dr. Ajit Kumar Singh, Jr. Pathologist, OIC, AICRPS
75.	Dr. Shrikant Lakxmikant Sawargaonkar Jr. Breeder
Co-opting Centres	
Indian Cardamom Research Institute, Myladumpara, Kailasanadu – 685 553, Idukki Dist.	
76.	Dr. K. Pradip Kumar, Scientist-C
77.	Dr. K.A. Saju, Scientist-C
Indian Cardamom Research Institute, Sakleshpur	
78.	Dr. Sreekrishna Bhat, Scientist-C
ICRI Regional Station (Spices Board), Yakthung, Tadong, Gangtok – 737 102, Sikkim	
79.	Dr. Ashuthosh Goutam, In-Charge, AICRPS
Regional Agricultural Research Station, (Kerala Agril. University), Ambalavayal – 673 593,	
80.	Dr. Najeeb Naduthodi, Assistant Professor
Horticultural Research Station (TNAU), Pechiparai – 629 161, Kanyakumari Dist., Tamil Nadu	
81.	Dr. T. Prabhu, Asst. Professor (Hort)
82.	Dr. Bini Sundar, Asst. Professor (Hort)
ICAR Research Complex for NEH Region, Umroi Road, Ri-Bhoi-79 3 103, Barapani, Meghalaya (Umiam)	
83.	Dr. Veerendra Varma, Scientist
84.	Dr. M. B. Devi, Scientist
ICAR Res. Complex for NEH Region, Regional Station, Mizoram Centre, Kolasib – 796 081, Mizoram	
85.	Dr. Vishambar Dayal, Scientist
ICAR Res. Complex for NEH Region, Regional Station, Sikkim Centre, Tadong, Gangtok -	

737 102, Sikkim	
86.	Dr. R. Chandramani Raj, Scientist (Plant Pathology)
Department of Horticulture, SASRD, Nagaland University, Medziphema-797 106, Dimapur, Nagaland	
87.	Dr. C. S. Maiti, Associate Professor (Hort.)
Horticultural Research Station, Assam Agricultural University, Jorhat- 785013, Assam	
88.	Dr. Kusum Kr. Deka, Sr. Scientist (Hort.)
College of Horticulture & Forestry, Central Agricultural University, Pasighat-791 102, Arunachal Pradesh	
89.	Dr. Mariam Anal, Assistant Professor
Voluntary Centres	
Govind Ballabh Pant University of Agriculture and Technology, College of Agriculture, Pantnagar-263 145, Distt. Udham Singh Nagar, Uttarakhand	
90.	Dr. Dharendra Singh, Professor
BIRSA Agricultural University, Kanke, Ranchi-834006, Jharkhand	
91.	Dr. Arun Kumar Tiwari, Scientist (Hort.)
Bidhan Chandra Krishi Vishwa Vidhyalay, Directorate of Research, Faculty of Horticulture, Kalyani-741 235, Dist. Nadia, WB	
92.	Dr. Anupam Pariari, Professor & PI of AICRP on Spices
Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur-482004, Madhya Pradesh	
93.	Dr. SK Pandey,
94.	Dr. Reena Nair, Asst. Professor
95.	Mr. Bhupesh Kumar Verma T.A.
Seed Spices Research Station, Anand Agricultural University, Sanand, Dist. Ahmedabad, Sanand-382 110	
96.	Dr. T.T. Patel, Asst. Research Scientist
Agricultural University, Jodhpur, Mandor-342304	
97.	Dr. Motilal Mehriya, Asst. Professor (Agro.)
Agricultural Research Station, AUK, Kota-324001	
98.	Dr. Preethi Verma, Asst. Professor
NM College of Agriculture, Navsari Agricultural University, NAVASARI-396450	
99.	Dr. Ritesh K. Patel, Assoc. Professor (Hort.)
Project Mode Centres	
Kerala Agricultural University, Vellanikkara-680 656, Kerala	
100.	Dr. Mini Raj, Professor, Dept. of Plantation Crops & Spices
SRS, Sher-e-Kashmir Univ. of Agricultural Sciences & Technology, Kashmir, Shalimar Campus, Srinagar 190 025, Jammu & Kashmir	
101.	Dr. Basheer Ahamed, Professor (Agronomy)

Research programme at a glance (crop-wise)

Crop	Crop Improvement			Crop Management			Crop Protection			Ongoing 2020-21
	Ongoing projects	Closed projects	New projects	Ongoing projects	Closed projects	New projects	Ongoing projects	Closed projects	New projects	
Black pepper	4	3	-	1	-	-	1	-	1	7
Small cardamom	6	-	-	1	-	1	2	-	-	10
Large cardamom	1	-	-	-	-	1	-	-	-	2
Ginger	3	5	-	-	3	1	1	1	1	6
Turmeric	5	1	-	-	1	-	1	-	1	7
Tree spices	5	-	-	-	-	-	1	1	-	6
Coriander	4	1	-	-	1	-	1	-	1	6
Cumin	4	-	-	1	-	-	1	-	-	6
Fennel	3	-	-	-	-	1	-	-	-	4
Fenugreek	4	-	-	1	-	-	-	-	-	5
Ajwain	1	-	-	-	-	-	-	-	-	1
Nigella	1	-	-	-	-	-	-	-	-	1
Saffron	1	-	-	-	-	-	-	-	-	1
Kalazeera	1	-	-	-	-	-	-	-	-	1
Seed Spices	-	-	-	-	-	1	-	-	1	2
Total	43	10	-	4	5	5	8	2	5	65

Research programme at a glance (Centre-wise)

	Centre	Crop Improvement			Crop Management			Crop Protection			Ongoing (2020-21)
		Ongoing projects	Closed projects	New projects	Ongoing projects	Closed projects	New projects	Ongoing projects	Closed projects	New projects	
1	Pampadumpara (KAU)	6	2	-	1	-	1	2		1	11
2	Panniyur (KAU)	4	3	-	1	-	-	1		1	7
3	Mudigere (UAHS)	6	1	-	1	-	1	2		2	12
4	Sirsi (UHS)	4	1	-	1	-	1	1		2	9
5	Yercaud (TNAU)	4	1	-	-	-	-	1			5
6	Coimbatore (TNAU)	7	-	-	1	-	-	1	-	2	11
7	Chintapalle (Dr YSRHU)	6	1	-	-	-	1	2		2	11
8	Kammarpally (SKLTSHU)	4	-	-	-	-	-	2		2	8
9	Guntur (Dr YSRHU)	10	-	-	-	-	-	-	-	3	13
10	Solan (YSPUHF)	2	3	-	-	-	1	2	-	2	7
11	Pottangi (OUAT)	7	2	-	-	-	1	-		2	10
12	Jobner (SKNAU)	16	-	-	2	-	2	2		1	23
13	Jagudan (SDAU)	9	-	-	2	-	2	2		1	16

14	Hisar (HAU)	9	-	-	1	-	2	1	-	1	14
15	Dholi (RAU)	7	1	-	-	1	2	3	-	1	13
16	Kumarganj (NDUAT)	11	2	-	1	-	2	1	-	4	19
17	Pundibari (UBKVV)	6	1	-	-	-	1	2	-	2	11
18	Dapoli (KKV)	8	1	-	1	-	-	1	-	-	10
19	Raigarh (IGKVV)	11	-	-	1		1	3	-	2	18
20	Ambalavayal (KAU)	3	-	-	1	2	-	2	1	3	9
21	Pechiparai (TNAU)	4	1	-	-	-	-	-	-	-	4
22	Gangtok (ICRI)	1	-	-	-	-	1	-	-	-	2
23	Sakleshpur (ICRI)	5	-	-	1	-	-	-	-	-	6
24	Myladumpara (ICRI)	5	-	-	1		1	2	-	-	9
25	ICAR R C NEHR, Barapani	4	-	-	-	2	-	1	-	2	7
26	ICAR R C NEHR, Mizoram	1	-	-	-	2	1	1	-	2	5
27	ICAR R C NEHR, Gangtok	3	-	-	-	-	2		-	-	5
28	Nagaland (Nagaland AU)	2	-	-	1	-	1	1	-	1	6

29	Kahikuchi (AAU)	1	-	-	-	-	-	1	-	2	4
30	Pasighat (CAU)	3	-	-	-	-	1	2	-	2	8
31	Pantnagar (GBPUAT)	4	-	-	1	-	2	1	-	2	10
32	Kanke (BIRSAAU)	2	-	-	-	-	1	2	-	2	7
33	Kalyani (BCKVV)	1	-	-	-	-	1	1	-	1	4
34	Kota (AUK)	3	-	-	1	-		1	-	1	6
35	Navasari (NAU)	4	-	-	1	-	-	1	-		6
36	Jabalpur (JNKV)	3	-	-	1	-	1	1	-	1	7
37	Mandor (AUJ)	2	-	-	1	-	2	1	-		6
38	Sanand (AAU)	1	-	-	-	-	1	-	-	1	3
39	Thrissur (KAU)	3	-	-	-	-	-		-	-	3
40	Pampore (SRS)	2	-	-	-	-	-	-	-	-	2

Scientific Personnel and projects handled

Sl. No.	Centre	Scientist	List of projects involved
REGULAR CENTRES			
	Pampadumpara (KAU)	Dr. Nimisha Mathews, Associate Professor (Agron/ Hort.)	CAR/CI/1.1, CAR/CI/3.7, CAR/CI/3.8, CAR/CI/3.9, CAR/CI/4.4, CAR/CI/4.5, CAR/CM/5.5, CAR/CM/5.6, CAR/CP/6.11, CAR/CP/6.12, PEP/CP/7.1
	Panniyur (KAU)	Dr. P.M. Ajith, Asst. Professor (Genetics & Pl. Breeding)	PEP/CI/1.1, PEP/CI/3.5, PEP/CI/3.6, PEP/CI/3.7
		Dr. Yamini Varma, Asst Professor (Plant Pathology)	PEP/CP/5.8, PEP/CP/7.1, PEP/CM/4.7, PEP/CI/3.6, PEP/CI/3.7
		Dr. Airina, C.K., Asst. Professor (Agron / Hort)	PEP/CM/4.7, PEP/CI/1.1, PEP/CI/3.5, PEP/CP/5.8, PEP/CP/7.1
	Mudigere (UAHS)	Dr. M. Shivaprasad, ADR & OIC- AICRPS	CAR/CI/1.1, CAR/CI/3.7, CAR/CI/3.8, CAR/CI/3.9, CAR/CI/4.4, CAR/CI/4.5, CAR/CM/5.5, CAR/CM/5.6, CAR/CP/6.11, CAR/CP/6.12, GIN/CP/7.1, TUR/CP/7.9
	Sirsi (UHS)	Mr. Sudheesh Kulkarni, Assistant Professor	PEP/CI/1.1, PEP/CI/3.5, PEP/CI/3.6, PEP/CI/3.7, PEP/CM/4.7, GIN/CM/4.1, PEP/CP/5.8, GIN/CP/7.1, TUR/CP/7.9,
	Yercaud (TNAU)	Dr. M. Anand, Jr. Breeder (Hort.)	PEP/CI/1.1, PEP/CI/3.5, PEP/CI/3.6, PEP/CI/3.7, PEP/CP/5.8,
	Coimbatore (TNAU)	Dr. (Mrs.) R. Senthamizh Selvi, Asst. Professor (Horticulture)	TUR/CI/1.1, TUR/CI/2.8, TUR/CI/2.9, COR/CI/1.1, COR/CI/2.7, FGK/CI/2.4, FGK/CI/3.7, FGK/CM/5.9, COR/CP/6.7, COR/CP/7.1, SS/CP/7.1
		Dr. S. Sundravada, Jr. Pathologist (Pathology)	TUR/CI/1.1, TUR/CI/2.8, TUR/CI/2.9, COR/CI/1.1, COR/CI/2.7, FGK/CI/2.4, FGK/CI/3.7, FGK/CM/5.9, COR/CP/6.7, COR/CP/7.1, SS/CP/7.1
	Chintapalle (Dr YSRHU)	Dr. V. Sivakumar, Asst. Prof. (Hort.)	PEP/CI/1.1, PEP/CI/3.5, PEP/CI/3.6, PEP/CI/3.7, GIN/CI/2.5, GIN/CI/4.3, GIN/CM/4.1, GIN/CP/6.15, TUR/CP/7.8, GIN/CP/7.1, TUR/CP/7.9
	Kammarpally	Dr. B. Mahender, Scientist	GIN/CI/1.1, TUR/CI/1.1, TUR/CI/2.8, TUR/CI/2.9, GIN/CP/6.15,

	(SKLTSHU)	(Pl. Pathology), OIC-AICRPS	TUR/CP/7.8, TUR/CP/7.9, SS/CP/7.1
		Dr. P. Srinivas, Scientist (Hort)	GIN/CI/1.1, TUR/CI/1.1, TUR/CI/2.8, TUR/CI/2.9, GIN/CP/6.15, TUR/CP/7.8, TUR/CP/7.9, SS/CP/7.1
	Guntur (Dr YSRHU)	Dr. K. Giridhar, Jr. Breeder	TUR/CI/1.1, TUR/CI/2.8, TUR/CI/2.9, TUR/CI/3.9, COR/CI/1.1, COR/CI/2.7, FGK/CI/1.1, FGK/CI/2.4, FGK/CI/3.7, AJN/CI/2.1, TUR/CP/7.9, COR/CP/7.1, SS/CP/7.1
		Dr. Tanuja Priya, -----	TUR/CI/1.1, TUR/CI/2.8, TUR/CI/2.9, TUR/CI/3.9, COR/CI/1.1, COR/CI/2.7, FGK/CI/1.1, FGK/CI/2.4, FGK/CI/3.7, AJN/CI/2.1, TUR/CP/7.9, COR/CP/7.1, SS/CP/7.1
	Solan (YSPUHF)	Dr. Meenu Gupta, Jr. Plant Pathologist	GIN/CI/1.1, TUR/CI/1.1, GIN/CM/4.1, GIN/CP/6.15, GIN/CP/7.1, TUR/CP/7.8, TUR/CP/7.9
	Pottangi (OUAT)	Dr. Parshuram Sial, Sr. Breeder & Officer-in-charge, AICRPS	GIN/CI/1.1, GIN/CI/2.5, GIN/CI/4.3, TUR/CI/1.1, TUR/CI/2.7, TUR/CI/2.8, TUR/CI/2.9, GIN/CM/4.1, GIN/CP/7.1, TUR/CP/7.9,
	Jobner (SKNAU)	Dr. A.C. Shivran, Sr. Agronomist	CUM/CM/ 5.5, FGK/CM/5.9, FNL/CM/5.1, SS/CM/4.1, COR/CP/6.7, CUM/CP/6.8, SS/CP/7.1, COR/CI/1.1, COR/CI/1.3, COR/CI/2.7, COR/CI/4.1, CUM/CI/1.1, CUM/CI/1.3, CUM/CI/2.4, CUM/CI/4.1
		Dr D.K. Gothwal, Breeder	COR/CI/1.1, COR/CI/1.3, COR/CI/2.7, COR/CI/4.1, CUM/CI/1.1, CUM/CI/1.3, CUM/CI/2.4, CUM/CI/4.1, FNL/CI/1.1, FNL/CI/2.7, FNL/CI/4.1, FGK/CI/1.1, FGK/CI/1.3, FGK/CI/2.4, FGK/CI/3.7, AJN/CI/2.1
		Mr. G.L. Kumawat, Asst. Plant Pathologist	COR/CP/6.7, CUM/CP/6.8, SS/CP/7.1, FNL/CI/1.1, FNL/CI/2.7, FNL/CI/4.1, FGK/CI/1.1, FGK/CI/1.3, FGK/CI/2.4, FGK/CI/3.7, AJN/CI/2.1
	Jagudan (SDAU)	Dr. N R Patel, Plant Pathologist	COR/CI/1.1, COR/CI/2.7, CUM/CI/1.1, CUM/CI/2.4, FNL/CI/1.1, FNL/CI/2.7, FGK/CI/1.1, FGK/CI/2.4, AJN/CI/2.1, CUM/CM/ 5.5, FGK/CM/5.9, FNL/CM/5.1, SS/CM/4.1, COR/CP/6.7, CUM/CP/6.8, SS/CP/7.1
		Dr. Surabhi S. Chauhan, Asst. Research Scientist (Pl. Br.)	COR/CI/1.1, COR/CI/2.7, CUM/CI/1.1, CUM/CI/2.4, FNL/CI/1.1, FNL/CI/2.7, FGK/CI/1.1, FGK/CI/2.4, AJN/CI/2.1, CUM/CM/ 5.5, FGK/CM/5.9, FNL/CM/5.1, SS/CM/4.1, COR/CP/6.7, CUM/CP/6.8,

			SS/CP/7.1
	Hisar (HAU)	Dr. S. K. Tehlan, PI & Head of AICRPS	COR/CI/1.1, COR/CI/2.7, FNL/CI/1.1, FNL/CI/2.7, FGK/CI/1.1, FGK/CI/2.4, FGK/CI/3.7, AJN/CI/2.1, NGL/CI/2.1, FGK/CM/5.9, FNL/CM/5.1, SS/CM/4.1, COR/CP/6.7, COR/CP/7.1
		Dr. T.P. Malik, Principal Scientist	COR/CI/1.1, COR/CI/2.7, FNL/CI/1.1, FNL/CI/2.7, FGK/CI/1.1, FGK/CI/2.4, FGK/CI/3.7, AJN/CI/2.1, NGL/CI/2.1, FGK/CM/5.9, FNL/CM/5.1, SS/CM/4.1, COR/CP/6.7, COR/CP/7.1
	Dholi (RAU)	Dr. A.K. Mishra, Jr. Plant Pathologist	GIN/CI/1.1, TUR/CI/1.1, TUR/CI/2.7, COR/CI/1.1, COR/CI/2.7, FNL/CI/1.1, FNL/CI/2.7, FGK/CI/1.1, FGK/CI/2.4, FGK/CI/3.7, GIN/CM/4.1, FNL/CM/5.1, SS/CM/4.1, GIN/CP/6.15, TUR/CP/7.8, COR/CP/6.7, COR/CP/7.1, SS/CP/7.1
		Dr. C. Mukhim, Horticulturist	GIN/CI/1.1, TUR/CI/1.1, TUR/CI/2.7, COR/CI/1.1, COR/CI/2.7, FNL/CI/1.1, FNL/CI/2.7, FGK/CI/1.1, FGK/CI/2.4, FGK/CI/3.7, GIN/CM/4.1, FNL/CM/5.1, SS/CM/4.1, GIN/CP/6.15, TUR/CP/7.8, COR/CP/6.7, COR/CP/7.1, SS/CP/7.1
	Kumarganj (NDUAT)	Dr. Pradip Kumar, Jr. Pathologist	GIN/CI/1.1, TUR/CI/1.1, COR/CI/1.1, COR/CI/2.7, FNL/CI/1.1, FNL/CI/2.7, FGK/CI/1.1, FGK/CI/2.4, FGK/CI/3.7, AJN/CI/2.1, NGL/CI/2.1, FGK/CM/5.9, FNL/CM/5.1, SS/CM/4.1, COR/CP/6.7, GIN/CP/7.1, TUR/CP/7.9, COR/CP/7.1, SS/CP/7.1
	Pundibari (UBKVV)	Dr. Anamika Debnath, Assistant Professor (Plant Pathology)	PEP/CI/1.1, GIN/CI/1.1, GIN/CI/2.5, GIN/CI/4.3, TUR/CI/1.1, TUR/CI/2.7, GIN/CM/4.1, GIN/CP/6.15, TUR/CP/7.8, GIN/CP/7.1, TUR/CP/7.9,
	Dapoli (KKV)	Dr. P. C. Mali, Associate Professor	PEP/CI/1.1, PEP/CI/3.5, PEP/CI/3.6, PEP/CI/3.7, TSP/CI/1.1, TSP/CI/1.2, TSP/CI/2.2, TSP/CI/2.4, PEP/CM/4.7, PEP/CP/5.8,
		Dr. J.P. Devmore, Jr. Breeder	PEP/CI/1.1, PEP/CI/3.5, PEP/CI/3.6, PEP/CI/3.7, TSP/CI/1.1, TSP/CI/1.2, TSP/CI/2.2, TSP/CI/2.4, PEP/CM/4.7, PEP/CP/5.8,
	Raigarh (IGKVV)	Dr. Ajit Kumar Singh, Jr. Pathologist, OIC, AICRPS	GIN/CI/1.1, GIN/CI/2.5, TUR/CI/1.1, TUR/CI/2.7, TUR/CI/2.8, COR/CI/1.1, COR/CI/2.7, FGK/CI/1.1, FGK/CI/2.4, AJN/CI/2.1, NGL/CI/2.1, FGK/CM/5.9, SS/CM/4.1, GIN/CP/6.15, TUR/CP/7.8, COR/CP/6.7, COR/CP/7.1, SS/CP/7.1
		Dr. Shrikant Lakxmikant Swargaonkar, Jr. Breeder	GIN/CI/1.1, GIN/CI/2.5, TUR/CI/1.1, TUR/CI/2.7, TUR/CI/2.8, COR/CI/1.1, COR/CI/2.7, FGK/CI/1.1, FGK/CI/2.4, AJN/CI/2.1, NGL/CI/2.1, FGK/CM/5.9, SS/CM/4.1, GIN/CP/6.15, TUR/CP/7.8,

			COR/CP/6.7, COR/CP/7.1, SS/CP/7.1
CO-OPTING CENTRES			
Ambalavayal (KAU)	Dr. Najeeb Naduthodi, Assistant Professor		PEP/CI/1.1, PEP/CI/3.7, TUR/CI/2.7, PEP/CM/4.7, PEP/CP/7.1, GIN/CP/6.15, GIN/CP/7.1, TUR/CP/7.8, TUR/CP/7.9
Pechiparai (TNAU)	Dr. Bini Sundar, -----		TSP/CI/1.1, TSP/CI/1.2, TSP/CI/2.2, TSP/CI/2.4,
Gangtok (ICRI)	Dr. Ashuthosh Goutam, In-Charge, AICRPS		LCA/CI/1.1, LCA/CM/5.1,
Sakleshpur (ICRI)	Dr. Sreekrishna Bhat, ----		CAR/CI/3.7, CAR/CI/3.8, CAR/CI/3.9, CAR/CI/4.4, CAR/CI/4.5, CAR/CM/5.5, CAR/CM/5.6
Myladumpara (ICRI)	Dr. K. Pradip Kumar, Scientist-C		CAR/CI/3.7, CAR/CI/3.8, CAR/CI/3.9, CAR/CI/4.4, CAR/CI/4.5, CAR/CM/5.5, CAR/CM/5.6, CAR/CP/6.11, CAR/CP/6.12
	Dr. K.A. Saju, Scientist-C		CAR/CI/3.7, CAR/CI/3.8, CAR/CI/3.9, CAR/CI/4.4, CAR/CI/4.5, CAR/CM/5.5, CAR/CM/5.6, CAR/CP/6.11, CAR/CP/6.12
ICAR R C NEHR, Barapani	Dr. Veerendra Varma, Scientist ()		GIN/CI/1.1, GIN/CI/2.5, TUR/CI/1.1, TUR/CI/2.7, GIN/CP/6.15, GIN/CP/7.1, TUR/CP/7.9,
	Dr. M. B. Devi, Scientist ()		GIN/CI/1.1, GIN/CI/2.5, TUR/CI/1.1, TUR/CI/2.7, GIN/CP/6.15, GIN/CP/7.1, TUR/CP/7.9,
ICAR R C NEHR, Mizoram	Dr. Sunilkumar Sunani, Scientist		GIN/CI/4.3, TUR/CP/7.8, GIN/CM/4.1, GIN/CP/7.1, TUR/CP/7.9,
ICAR R C NEHR, Gangtok	Dr. Amit Kumar, Scientist (Plant Pathology)		LCA/CI/1.1, GIN/CI/2.5, GIN/CI/4.3, LC/CM/5.1, GIN/CM/4.1,
Nagaland (Nagaland AU)	Dr. C. S. Maiti, Associate Professor (Hort.)		GIN/CI/2.5, GIN/CI/4.3, CUM/CM/ 5.5, GIN/CM/4.1, GIN/CP/6.15, GIN/CP/7.1
Kahikuchi (AAU)	Dr. Kusum Kr. Deka, Sr. Scientist (Hort.)		PEP/CI/3.6, TUR/CP/7.8, GIN/CP/7.1, TUR/CP/7.9,
Pasighat (CAU)	Dr. P. S. Mariam Anal, Assistant Professor		TUR/CI/1.1, TUR/CI/2.8, TUR/CI/2.9, LC/CM/5.1, GIN/CP/6.15, TUR/CP/7.8, GIN/CP/7.1, TUR/CP/7.9,
VOLUNTARY CENTRES			

	Pantnagar (GBPUAT)	Dr. Dharendra Singh, Professor	COR/CI/2.7, FNL/CI/2.7, FGK/CI/2.4, NGL/CI/2.1, FGK/CM/5.9, FNL/CM/5.1, SS/CM/4.1, COR/CP/6.7, GIN/CP/7.1, TUR/CP/7.9,
	Kanke(BIRSAAU)	Dr. Arun Kumar Tiwari, Scientist (Hort.)	TUR/CI/2.8, TUR/CI/2.9, GIN/CM/4.1, GIN/CP/6.15, GIN/CP/7.1, TUR/CP/7.8, TUR/CP/7.9
	Kalyani (BCKVV)	Dr. Anupam Pariari, Professor & PI of AICRP on Spices	NGL/CI/2.1, GIN/CP/6.15, GIN/CM/4.1, SS/CP/7.1
	Kota (AUK)	Dr. Preethi Verma,	COR/CI/2.7, FGK/CI/2.4, NGL/CI/2.1, FGK/CM/5.9, COR/CP/6.7, COR/CP/7.1,
	Navasari (NAU)	Dr. Ritesh K. Patel,	TUR/CI/2.7, TUR/CI/2.8, COR/CI/2.7, FGK/CI/2.4, FGK/CM/5.9, COR/CP/6.7,
	Jabalpur (JNKV)	Dr. Reena Nair, Asst. Professor	COR/CI/2.7, FNL/CI/2.7, FGK/CI/2.4, FGK/CM/5.9, SS/CM/4.1, COR/CP/6.7, COR/CP/7.1
	Mandor (AUJ)	Dr. Motilal Mehriya, Asst. Professor (Agro.)	CUM/CI/1.1, CUM/CI/2.4, CUM/CM/ 5.5, FNL/CM/5.1, SS/CM/4.1, CUM/CP/6.8
	Sanand (AAU)	Dr. T.T. Patel, Asst. Research Scientist	CUM/CI/1.1, SS/CM/4.1, SS/CP/7.1
PROJECT MODE CENTRES			
	Thrissur (KAU)	Dr. Mini Raj, Professor, Dept. of Plantation Crops & Spices	TSP/CI/1.2, TSP/CI/2.4, TSP/CI/5.1
	Pampore (SRS)	Dr. Basheer Ahamed, Professor (Agronomy)	SAF/CI/5.1, KZ/CI/5.1
		Dr. Mudasir H. Khan, Asst. Professor	SAF/CI/5.1, KZ/CI/5.1

- New projects are marked in red
- In the centres with 3 scientists (Panniyur & Jobner), projects have been redistributed among the three, considering the number of projects/work load and discipline



VARIETIES RECOMMENDED FOR RELEASE DURINGXXXI AICRPS WORKSHOP



IISR Vajra



LTS -2



Rajendra Haldi-1



HM - 257

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