



Proceedings of XXIX Workshop ICAR-All India Coordinated Research Project on Spices



4-6th October 2018

**Dr. Y. S. Parmar University of Horticulture and Forestry
Solan, Himachal Pradesh**



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



Proceedings of XXIX Workshop
ICAR-All India Coordinated Research Project on Spices

4- 6th October 2018

at

**Dr. Y. S. Parmar University of Horticulture & Forestry,
Solun, Himachal Pradesh**



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

November 2018

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Programme

4th October 2018

INAUGURAL SESSION

10.00 am – 11.15 am

Rapporteurs: 1. **Dr. Ravinder Singh**, ICAR-NRCSS, Ajmer
2. **Dr. K.S.Krishnamoorthy**, ICAR-IISR, Kozhikode

Invocation
ICAR song

- | | | |
|----------|--|---|
| 10.00 am | Welcome | Dr. A. K. Sharma
Professor & Head,
Dept. of Vegetable Science,
Dr. YSPUH&F, Solan |
| | Lighting the lamp | |
| 10.10 am | Overview of AICRPS | Dr. K. Nirmal Babu
Director, ICAR- IISR, Kozhikode |
| 10.20 am | Presidential Address | Dr. J. N. Sharma
Director of Research,
Dr. YSPUH&F, Solan |
| 10.35 am | Inaugural address by Chief Guest | Dr. H. C. Sharma
Vice-Chancellor
Dr. YSPUH&F, Solan |
| 10.50 am | Presentation of Awards & Release of Publications | |
| 11.00 am | Address by Guest of Honour | Dr. Gopal Lal
Director
ICAR-NRC on Seed Spices, Ajmer |
| | | Dr. Rakesh Gupta
Dean (Horticulture)
Dr. YSPUH&F, Solan |
| 11.10 am | Vote of Thanks | Dr. Meenu Gupta
Asst. Professor
Dr. YSPUH&F, Solan |

National Anthem

4th October 2018

SESSION I : Genetic Resource & Crop Improvement

11.30 - 3.30 pm

Chairpersons: Dr. Gopal Lal, Director, ICAR, NRCSS, Ajmer.

Dr. A. K. Sharma, Professor & Head, Dr. YSPUH&F, Solan

Dr. J. Rema, Head, Division of CI&B, ICAR-IISR, Kozhikode

Rapporteurs: Dr. Sreekrishna Bhat, ICRI, Myladumpara

Mr. V.A. Muhammed Nissar, ICAR-IISR, Kozhikode

Presentations:

- | | | |
|----|----------------|--|
| 1 | Black pepper | Dr. P. M. Ajith, Pepper Research Station, Panniyur |
| 2 | Large cardamom | Dr. Ashutosh Gautam, ICRI Regional Station, Gangtok |
| 3 | Cardamom | Dr. Sreekrishna Bhat, S, ICRI Regional Station, Myladumpara |
| 4 | Ginger | Dr. Parshuram Sial, High Altitude Research Station, Pottangi |
| 5 | Turmeric | Dr. B. Senthamizh Selvi, TNAU, Coimbatore |
| 6 | Tree spices | Dr. R.G. Khandekar, Dr. BSKKV, Dapoli |
| 7 | Coriander | Dr. K. Giridhar, Dr. YSRHU, Guntur |
| 8 | Cumin | Dr. Hiren Patel, SDAU, Jagudan |
| 9 | Fennel | Dr. D. K. Gothwal, SKNAU, Jobner |
| 10 | Fenugreek | Dr. K. Giridhar, Dr. YSRHU, Guntur |
| 11 | Ajowain | Dr. Shrikant Laxmikant Swargaonkar, IGKV, Raigarh |
| 12 | Nigella | Dr. Shrikant Laxmikant Swargaonkar, IGKV, Raigarh |

Project Mode Centers:

- | | | |
|---|-------------|---------------------------------|
| 1 | Nutmeg | Dr. Mini Raj, KAU, Vellanikkara |
| 2 | Seed spices | Dr. K. Umesha, COH, Bengaluru |

Presentation of New Programmes Concerned Scientists

5th October 2018

SESSION II : Crop Management

10.30-2.00 pm

Chairpersons: Dr. Gopal Lal, Director, ICAR-NRCSS, Ajmer

Dr. C. K. Thankamani, Head, Crop Production & PHT, ICAR-IISR, Kozhikode

Rapporteurs: Dr. V. Sivakumar, Dr. Y.S.R.H.U, Chintapalle

Dr. P. M. Ajith, PRS, Panniyur, Raigarh

Presentations:

- | | | |
|---|--------------|--|
| 1 | Black pepper | Dr. M. Shivaprasad, ZAHRS (UAHS), Mudigere |
| 2 | Ginger | Dr. V. Sivakumar, Dr. Y.S.R.H.U, Chintapalle |
| 3 | Turmeric | Dr. B. Mahender, SKLTSHU, Kammarpalli |
| 4 | Coriander | Dr. T. P. Malik, CCSHAU, Hisar |
| 5 | Cumin | Dr. A. C. Shivran, SKNAU, Jobner |
| 6 | Fennel | Dr. Ravindra Singh, ICAR-NRCSS, Ajmer |

Presentation of new programmes Concerned Scientists

5th October 2018

SESSION III : Crop Protection

2.00 pm – 4.00 pm

Chairpersons: 1. Dr. Santhosh J. Eapen, Head, Crop Protection, ICAR-IISR, Kozhikode
2. Dr. Y. K. Sharma, Principal Scientist, ICAR-NRCSS, Ajmer

Rapporteurs: Dr. R. Praveena, ICAR-IISR, Kozhikode
Dr. C. Ushamalini, TNAU, Coimbatore

Presentations:

- | | | |
|---|----------------|---|
| 1 | Black pepper | Dr. R. Suseela Bhai, ICAR-IISR, Kozhikode |
| 2 | Large cardamom | Dr. R. Chandramani Raj, ICAR , Gangtok |
| 3 | Cardamom | Dr. K. A. Saju, ICRI RS, Sakaleshapura |
| 4 | Ginger | Dr. Meenu Gupta, Dr. YSPUHF, Solan |
| 5 | Turmeric | Dr. C. Ushamalini, TNAU, Coimbatore |
| 6 | Coriander | Dr. A.K. Singh, IGKV, Raigarh |
| 7 | Cumin | Dr. Y. K. Sharma, ICAR-NRCSS, Ajmer |

Presentation of new programmes Concerned Scientists

5th October 2018

SESSION IV : TRANSFER OF TECHNOLOGY

4.00 – 5.00 pm

Chairpersons: **Dr. K. K. Jindal**, Former DOR, Dr. YSPUHF, Solan & CAU, Pasighat
Dr. S. J. Ankegowda, Head, ICAR-IISR Regional Station, Appangala

Rapporteurs: **Dr. K. Giridhar**, Dr. YSRHU, Guntur
Ms. S. Aarthi, ICAR-IISR, Kozhikode

1. Turmeric polyhouse cultivation technology – Raigarh
2. Coriander performance under field, insect proof selfing net and polyhouse condition – Raigarh
3. Management of coriander powdery mildew by new generation fungicide – Coimbatore
4. Bio-fertilizers for yield enhancement of coriander – Dholi
5. Drip irrigation and fertigation in coriander – Jobner
6. Bio-efficacy of newer molecules of insecticides against cumin aphid – Jagudan
7. Chemical management schedule for cumin blight – Jagudan
8. Drip fertigation in fennel – Jobner
9. Organic farming in cardamom – Pampadumpara

6th October 2018

SESSION V : VARIETY RELEASE

9.30 –11.00 am

Chairpersons : Dr. T. Janakiram, Asst. Director General (HS II.), ICAR, New Delhi
Dr. Homey Cheriyan, Director, DASD, Kozhikode

Rapporteurs : Dr. S. S. Meena, ICAR-NRCSS, Ajmer
Ms. H. J. Akshitha, ICAR-IISR RS, Appangala

Sl. No.	Crop	Name of the variety	Organization
1.	Ginger	Solan Giriganga	Dr YSPUH&F, Solan
2.	Turmeric	TCP 129	UBKV, Pundibari
3.	Nutmeg	Konkan Sanyukta	Dr BSKKV, Dapoli
4.	Coriander	Rajendra Dhanias 3	Dr RPCAU, Dholi
5.	Coriander	JD(SI)1	JNKVV, Jabalpur
6.	Coriander	Ajmer Coriander 3	ICAR-NRCSS, Ajmer
7.	Coriander	Chhattisgarh Sri Chandrahasini Dhanias - 2	IGKV, Raigarh
8.	Fennel	Ajmer fennel 3	ICAR-NRCSS, Ajmer
9.	Fenugreek	HM 425	CCSHAU, Hisar
10.	Fenugreek	Narendra Richa (NDM 79)	NDUA&T, Kumarganj
11.	Cumin	Gujarat cumin 5	SDAU, Jagudan

6th October 2018

SESSION VI

Plenary Session

11.30 – 2.00 pm

Chairpersons : **Dr. T. Janakiram**, Asst. Director General (HS II.), ICAR, New Delhi
Dr. Vijay Singh Thakur, Former VC, Dr YSPUH&F, Solan
Dr. J. N. Sharma, Director of Research, Dr YSPUH&F, Solan
Dr. Rakesh Gupta, Dean (Horticulture), Dr YSPUH&F, Solan

Rapporteurs: **Dr. K. A. Saju**, ICRI, Sakaleshapura
Mrs. Aarthi. S, ICAR-IISR, Kozhikode

11.30 am Rapporteurs report

11.45 am Highlights of XXIX AICRPS workshop & new focus on research

12.00 pm Remarks of Chairpersons

Dr. Vijay Singh Thakur, Former VC, Dr YSPUH&F, Solan

Dr. T. Janakiram, Asst. Director General (HS II.), ICAR, New Delhi

Dr. J. N. Sharma, Director of Research, Dr YSPUH&F, Solan

Dr. Rakesh Gupta, Dean (Horticulture), Dr YSPUH&F, Solan

12.45 pm Vote of Thanks

Dr. K. Kandiannan

Principal Scientist, ICAR-IISR, Kozhikode

National Anthem

INAUGURAL SESSION

The XXIX Workshop of ICAR-All India Coordinated Research Project on Spices jointly organized by Dr. Y.S. Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh and ICAR-AICRP on Spices, Kozhikode, Kerala was inaugurated by Dr. Hari C. Sharma, Hon'ble Vice Chancellor, Dr. YSPUH & F, Solan on 4th October 2018 who opined that modern molecular tools such as transgenics, MAS, CRISPER, metabolomics etc., may be utilized for crop improvement and also to enhance secondary metabolite content. He remarked that AICRPS is the strongest spices research and development network in the country, hence staff position should be enhanced to meet the requirements. He emphasized that rhizome rot is the major threat for ginger cultivation in Himachal and measures/ technologies need to be developed to eradicate the same. Also, GI tag should be utilized for quality spice production in different geographical regions.

Dr. J.N. Sharma, Director of Research, Dr. YSPUH & F, Solan presided over the function and Dr. A. K. Sharma, Professor and Head, Department of Vegetable Science, Dr YSPUH&F, Solan welcomed the gathering. In his presidential address, Dr. J.N. Sharma, emphasised the vast potential of spice cultivation in Himachal Pradesh and the necessity of the youth to enter into the field of agriculture. Dr. K. Nirmal Babu, Director, ICAR-IISR & Project Coordinator (Spices), Kozhikode highlighted that spices are the fourth largest commodity in terms of export and focus has to be given for high value compounds present in spices. The major concern is to produce pesticide free safe to consume spices for which organic farming needs to be encouraged. Also, he remarked that research institutions and industries should interact and work in collaboration to meet industry and consumer demands.

Dr. Gopal Lal, Director, ICAR-NRC for Seed Spices, Ajmer and Dr. Rakesh Gupta, Dean, College of Horticulture, Dr. YSPUH & F, Solan were the Guest of Honour and offered felicitations. Dr. Gopal Lal suggested that there should be road map for future and also emphasized on maximisation of farmers income through IFS model, maximum utilization of cultivable space and value chain development. Luminaries like Dr. K.K Jindal, Former ADG (Hort.), ICAR, New Delhi and Former DOR, Dr. YSPUHF, Solan & CAU, Pasighat, Dr. Homey Cheriyan, Director, DASD, Kozhikode also participated in the workshop.

During the inaugural session the "Best AICRPS Centre Award 2017-18" was presented to Pepper Research Station, Panniyur (KAU), Kerala for its contribution towards black pepper production and development. Thirteen booklets/pamphlets on spices production technologies in English and local languages from different AICRPS centres were released during the occasion. Vote of thanks was proposed by Dr. Meenu Gupta, Asst. Professor, Dr YSPUH&F, Solan. The representatives of State and Central Research Institutes, industry and farming fraternity participated in the event.

TECHNICAL SESSION: I
GENETIC RESOURCES AND CROP IMPROVEMENT

General Comments:

- Utmost care has to be taken to avoid loss of germplasm accessions
- Importance has to be given for quality and biotic resistance while evaluating germplasm
- Uniform procedure has to be followed by all centres while screening for pest and diseases.
- The best performing entries in the CVT can be recommended for the respective states even though it has not performed across the locations
- Quality profile has to be included in all the varietal release proposals
- Evaluation trials on Mango ginger (*Curcuma amada*), Saffron (*Crocus sativus*) and Kala zeera (*Bunium persicum*) may be taken up

Black pepper

PEP/CI/1.1 Germplasm collection, characterization, evaluation and conservation

- Quality parameters of accessions have to be evaluated while characterising germplasm

PEP/CI/2.2 Hybridization to evolve varieties tolerant to biotic and abiotic stresses

- Physiological parameters have to be recorded to confirm drought tolerance
- Resistant lines identified may be tested in disease hot spots

Large cardamom

LCA/CI/1.1- Germplasm collection and evaluation of large cardamom

- Unique accessions may be registered with NBPGR
- Unique cultivars like Green Golsey, Madhusey has to be evaluated for positive traits
- ICRI has to be involved in virus screening process for the transportation of planting materials across the states
- Performance of ICRI released varieties have to be evaluated in Arunachal Pradesh and Nagaland and suitable varieties/cultivars have to be identified for the states
- Priority has to be given to collect leaf blight escapes.

Small cardamom

CAR/CI/2.2 Evaluation of promising small cardamom (*Elettaria cardamom* L. Maton) cultivars/varieties for organic cultivation in the high ranges of Idukki district

- Compiled data for three years may be presented during next workshop

CAR/CI/3.7 CVT of drought tolerance in Cardamom – Series VII

- The planting/gap filling must be completed in all centres by next planting season

CAR/ CI/4.3 Initial Evaluation Trial – 2012

- Compiled data for three years may be presented during next workshop

CAR/CI/4.4 - CVT Multi Location Evaluation of thrips tolerant cardamom lines

- The planting/gap filling must be completed in all centres by next planting season

CAR/CI/3.8 CVT on hybrids of small cardamom-2018 – Series VII

- Sufficient planting material has to be provided by respective centres and the trial may be initiated by the next planting season

Ginger

GIN/CI/1.1 Germplasm collection, characterization, evaluation and conservation

- Duplication in germplasm collection has to be sorted out.
- Accession having >2% oil, and low fibre (<4%) has to be short listed.
- Rhizome rot tolerant lines may be sent to IISR for screening

GIN/CI/2.4 CVT 2015-Series IX

- The programme may be concluded.
- A new CVT on *Ralstonia* and *Pythium* tolerant lines may be initiated

GIN/CI/3.4 Initial Evaluation Trial of bold/vegetable ginger

- The entries with low fibre may be sent to IISR for reconfirming the fibre content.

GIN/CI/4.2 Evaluation of germplasm from other centres

- More accessions from IISR and Pottangi centre may be collected by Solan centre for evaluation

Turmeric

TUR/CI/1.1 - Germplasm collection, characterization, evaluation and conservation

- Genotypes with golden yellow colour suitable for powder industry may be identified
- Kadappa accessions has to be evaluated for quality

Tree spices

TSP/CI/1.1 Germplasm collection, characterization, evaluation and conservation of clove, nutmeg and cinnamon

- Quality evaluation of cinnamon may be attempted

TSP/CI/1.2 Collection of unique germplasm in tree spices

- One set of unique nutmeg accessions of nutmeg may be handed over to IISR

TSP/CI/2.2 – CVT 2001 – Nutmeg

- The trail may be continued. The quality parameters have to be evaluated

TSP/CI/2.4 Coordinated Varietal Trial on Farmers Varieties of Nutmeg

- The trail may be continued. The quality parameters have to be evaluated

Coriander

COR/CI/1.1 – Germplasm collection, characterization, evaluation and conservation

- List of accessions from all the centres with original collection number may be prepared to avoid duplication in germplasm
- Superior genotypes may be collected from important markets also
- Unique characters and special traits may be recorded while characterizing the germplasm

COR/CI/1.3 Identification of drought/alkalinity tolerant source in coriander

- Elite lines has to be registered with NBPGR

COR/CI/1.4 Multilocation evaluation of coriander germplasm – 2015

- The programme may be concluded and report must be submitted to PC unit

COR/CI/2.6 Coordinated Varietal Trial on coriander 2015-Series X

- The programme is concluded
- A new CVT on Powdery mildew resistant types may be initiated
- A new CVT on leafy coriander type may be initiated

Cumin

CUM/CI/1.1 - Germplasm collection, characterization, evaluation and conservation and screening against diseases

- The unique accession with hairy fruit may be registered with NBPGR
- Possibility for single plant pureline selection in cumin may be investigated

CUM/CI/3.5 IET on Cumin 2013

- The programme may be concluded and final report has to be submitted to PC Unit

Fennel

FNL/CI/2.6 Coordinated Varietal Trial on Fennel 2015 – Series IX

- The programme may be concluded

FNL/CI/3.5 Initial Evaluation Trial 2015

- The programme may be concluded
- A new CVT may be initiated

Fenugreek

FGK/CI/1.3 Identification of drought tolerance source in fenugreek

- The drought tolerant lines may be registered with NBPGR

FGK/CI/2.4 Coordinated Varietal Trial of fenugreek 2015 – Series IX

- The programme may be concluded

FGK/CI/3.6 Initial Evaluation Trial 2014

- The programme may be concluded

Project Mode Centres

1. Evaluation of coriander, fenugreek and fennel for growth, yield and quality parameters under Bengaluru conditions – COH, Bengaluru

- The programme is concluded and final report has to submitted to PC Unit.

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, Panniyur, Pundibari, Sirsi, Yercaud	Continued
PEP/CI/2	Hybridization trial		
PEP/CI/2.1	Inter-varietal hybridization to evolve high yielding varieties	Panniyur	Continued
PEP/CI/2.2	Hybridization to evolve varieties tolerant to biotic and abiotic stresses	Panniyur	Continued
PEP/CI/3	Coordinated Varietal Trial (CVT)		
PEP/CI/3.3	CVT 2006 Series VI	Chintapalle, Dapoli, Panniyur, Pampadumpara, Sirsi, Yercaud, Pechiparai	Continued
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, IISR, 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	Continued
CAR/CI/2.2	Evaluation of promising small cardamom (<i>Elettaria cardamom</i> L. Maton) cultivars / varieties for organic cultivation in the high ranges of Idukki district	Pampadumpara	Continued
CAR/CI/3	Coordinated Varietal Trial		
CAR/CI/3.7	CVT of drought tolerance in Cardamom – Series VII	Appangala, Mudigere, Sakaleshapur, 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, Sakaleshapura, Myladumpara, Pampadumpara	Continued
CAR/CI/4	Varietal Evaluation Trial (VET)		
CAR/CI/4.3	Initial Evaluation Trial – 2012	Pampadumpara	Continued
CAR/CI/4.4	Multi Location Evaluation of thrips tolerant cardamom lines	Appangala, Mudigere, Pampadumpara, Myladumpara, Sakleshpura	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/2.4	CVT 2015-Series IX	IISR, Dholi, Pottangi, Pundibari, Kalyani, Solan, Nagaland	Concluded
GIN/CI/3	Varietal Evaluation Trial		
GIN/CI/3.4	Initial Evaluation Trial of bold / vegetable ginger	Pottangi	Continued
GIN/CI/3.5	Initial Evaluation Trial – 2015	Kumarganj	Continued
GIN/CI/3.6	Initial Evaluation Trial – 2016	Pundibari, Pottangi, Solan	Continued
GIN/CI/4	Quality Evaluation Trial		
GIN/CI/4.1	Evaluation of germplasm for quality	Solan	Continued
GIN/CI/4.2	Evaluation of germplasm from other centres	Solan	Continued
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/2.6	CVT on Turmeric – 2016	Chintapalle, Coimbatore, Dholi, Guntur, Kammarpally, Kumarganj, Pundibari,	Continued

		Pottangi, Raigarh, Navsari	
TUR/CI/3	Varietal Evaluation Trial		
TUR/CI/3.7	Initial Evaluation Trial 2015	Kumarganj	Continued
TUR/CI/3.8	Initial Evaluation Trial 2016	Pundibari, Pottangi, Solan	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
Project Mode	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/1.4	Multilocation evaluation of coriander germplasm – 2015	Ajmer, Guntur, Coimbatore, Dholi, Kota, Hisar, Jobner, Jagudan, Kumarganj, Raigarh	Concluded
COR/CI/2	Coordinated Varietal Trial		
COR/CI/2.6	Coordinated Varietal Trial on coriander 2015-Series IX	Ajmer, Coimbatore, Dholi, Guntur, Hisar, Jabalpur, Kota, Jagudan, Jobner, Kumarganj, Navsari, Pantnagar, Raigarh	Concluded
COR/CI/3	Varietal Evaluation Trial		
COR/CI/3.8	Initial Evaluation Trial 2015	Guntur, Jagudan, Kumarganj, Dholi, Raigarh	Concluded
COR/CI/3.9	Initial Evaluation Trial 2016	Dholi	Continued
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/3	Varietal Evaluation Trial		
CUM/CI/3.5	IET on Cumin 2013	Jagudan	Concluded
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/2.6	Coordinated Varietal Trial on Fennel 2015 – Series IX	Ajmer, Dholi, Hisar, Jabalpur, Jagudan, Jobner, Kumarganj, Pantnagar	Concluded
FNL/CI/3	Varietal Evaluation Trial		
FNL/CI/3.5	Initial Evaluation Trial 2015	Jagudan, Kumarganj, Dholi	Concluded
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 2015 – Series IX	Ajmer, Coimbatore, Dholi, Guntur, Hisar, Jagudan, Jabalpur, Jobner, Kumarganj, Pantnagar, Navsari, Raigarh, Kota	Concluded
FGK/CI/3	Varietal Evaluation Trial		
FGK/CI/3.6	Initial Evaluation Trial 2014	Dholi, Hisar	Concluded
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
FGK/CI/3.8	Initial Evaluation Trial 2015	Kumarganj, Jagudan, Jobner	Concluded
Project Mode	Evaluation of Coriander, fenugreek and fennel for growth, yield and quality parameters under Bengaluru conditions.	COH, Bengaluru	Concluded

Ajowain			
AJN/CI/2	Coordinated Varietal Trial		
AJN/CI/2.1	Coordinated Varietal Trial-2016	Ajmer, Guntur, Hisar, Jobner, Jagudan, Kumarganj, Raigarh	Continued
Nigella			
NGL/CI/2	Coordinated Varietal Trial		
NGL/CI/2.1	Coordinated Varietal Trial-2016	Ajmer, Hisar, Kota, Kalyani, Kumarganj, Raigarh, Pantnagar	Continued

TECHNICAL SESSION II

CROP PRODUCTION

General recommendations

- Research on precision farming, vertical farming and nano-technology may be explored in spice crops in future programmes.
- Develop value chain in all spice crops.
- The experimental treatments/methodology/applications should be given in detail in proceedings for newly proposing experiments to execute the experiment uniformly in all centres.
- Soil nutrient status and quality parameters may be recorded in all the organic and micro-nutrients experiments.
- Dr. Basheer Ahmad, Sher-e-Kashmir University of Agricultural Science and Technology of Kashmir has given presentation on scope, importance and economics of Saffron and Kala zeera cultivation in Jammu & Kashmir and proposed few experiments to get Project mode funding from ICAR-AICRP on Spices.

Specific recommendations

Black Pepper

PEP/CM/4.7 Black pepper based mixed cropping system for sustainable productivity and food security

- The Programme may be continued
- Economics/returns may be included for each treatment
- Growth parameters should be recorded for black pepper
- Performance of crops in mixed cropping system may be verified by the Scientists, ICAR-IISR Kozhikode

Ginger

GIN/CM/5.5 Source sink relationship

- Experiments may be concluded and the final report may be submitted to PC cell

GIN/CM/5.6 Organic production of ginger

- Soil analysis and quality analysis data may be included

GIN/CM/5.7 Effect of micronutrients on growth and yield of ginger (Demonstration trial)

- Experiment may be continued at Pottangi centre by foliar application of micro nutrients.

GIN/CM/5.8 Effect of organic manures and bio-fertilizers on partitioning of dry matter in ginger

- Soil analysis and quality analysis data may be included

GIN/CM/5.9 Organic production of ginger

- Soil analysis and quality analysis data may be included in all centres
- SAU Practices have to submitted to the PC cell in detail
- Reasons for less response to the organic cultivation in same centres may be found out at centres

GIN/CM/5.10 Effect of micronutrients on growth and yield of ginger

- Soil analysis and quality analysis data may be included in all centres

Turmeric

TUR/CM/5.9 Source sink relationship in turmeric

- Experiments may be concluded and the final report may be submitted to PC cell, ICAR-IISR, Kozhikode.

TUR/CM/5.10 Organic production of turmeric

- Soil analysis and quality analysis data may be included
- A written communication should be sent from PC cell, AICRPS, IISR to the centre which is not conducting the experiment

TUR/CM/5.14 Organic production of turmeric

- Soil analysis and quality analysis data may be included in all centres
- SAU Practices have to submitted to the PC cell in detail
- Scientist involved in organic cultivation in IISR may visit Dholi centre to examine imposition of treatments
- Reasons for less response to the organic cultivation in same centres may be found out at centres

TUR/CM/5.15 Effect of micronutrients on growth and yield of turmeric

- Soil analysis and quality analysis data may be included

Coriander

COR/CM/5.6 Effect of using varying levels of NPK and bio-fertilizers on growth and yield of coriander

- The experiment may be concluded and final report may be submitted to the PC cell.

COR/CM/5.7 Standardization of drip irrigation and fertigation in coriander

- The experiment may be concluded and final report may be submitted to the PC cell.

COR/CM/5.9 Comparative performance of coriander entries under polyhouse, field and selfing net

- Project may be closed and the final report has to be submitted

Cumin

CUM/CM/5.4 Standardization of drip irrigation and fertigation in cumin

- Design of the experiment at Jagudan centre may be modified to RBD as per technical Programme.

Fennel

FNL/CM/5.5 Standardization of fertigation in fennel

- The Programme may be concluded and final report may be submitted to the PC cell.

Project code	Title	Centres	Comments
Black Pepper			
PEP/CM/4	Nutrient Management Trial		
PEP/CM/4.7	Black pepper based mixed cropping system for sustainable productivity and food security	Ambalavayal, Sirsi, Panniyur, Dapoli	Continued
PEP/CM/4.8	Management of <i>Phytophthora</i> foot rot by mulching	Sirsi	Continued
Ginger			
GIN/CM/5	Nutrient Management Trial		
GIN/CM/5.5	Source sink relationship	IISR, Kanke, Mizoram, Pundibari, Solan, Barapani	Concluded
GIN/CM/5.6	Organic production of ginger	Barapani, Mizoram	Continued
GIN/CM/5.7	Effect of micronutrients on growth and yield of ginger (Demonstration trial)	Pottangi, Chintapalle	Continued
GIN/CM/5.8	Effect of organic manures and bio-fertilizers on partitioning of dry matter in ginger	Dholi	Continued
GIN/CM/5.9	Organic production of ginger	Ambalavayal, Dholi, Pottangi, Chinthapalle, Barapani, Solan, Kammarpally, Kumarganj, Pundibari, Raigarh, Kalyani, Mizoram	Continued
GIN/CM/5.10	Effect of micronutrients on growth and yield of ginger	Pottangi, Chinthapalle, Dholi, Barapani, Kammarpally, Kumarganj, Pundibari, Raigarh, Solan, Kalyani, Ambalavayal	Continued
Turmeric			
TUR/CM/5	Nutrient Management Trial		
TUR/CM/5.9	Source sink relationship in turmeric	Coimbatore, IISR, Guntur, Kammarpally, Dholi, Barapani	Concluded
TUR/CM/5.10	Organic production of turmeric	Barapani, Mizoram	Continued
TUR/CM/5.14	Organic production of turmeric	Barapani, Solan, Dholi, Chinthapalle, Coimbatore, Guntur, Kammarpally, Kumarganj, Mizoram, Pantnagar, Raigarh, Pasighat, Pottangi, Pundibari	Continued

TUR/CM/5.15	Effect of micronutrients on growth and yield of turmeric	Chinthapalle, Solan, Dholi, Coimbatore, Kammarpally, Kumarganj, Pantnagar, Pasighat, Pottangi, Pundibari, Raigarh	Continued
Coriander			
COR/CM/5	Nutrient management trial		
COR/CM/5.5	Response of coriander varieties to various levels of fertility under multi cut management practice	Jagudan	Continued
COR/CM/5.6	Effect of using varying levels of NPK and bio-fertilizers on growth and yield of coriander	Dholi	Concluded
COR/CM/5.7	Standardization of drip irrigation and fertigation in coriander	Ajmer, Jobner, Guntur, Kumarganj	Concluded
Cumin			
CUM/CM/5	Nutrient Management Trial		
CUM/CM/5.2	Organic nutrient and disease management in cumin	Jobner	Continued
CUM/CM/5.4	Standardization of drip irrigation and fertigation in cumin	Jobner, Jagudan, Mandor	Continued
Fennel			
FNL/CM/5	Nutrient Management Trial		
FNL/CM/5.5	Standardization of drip fertigation in fennel	Jobner	Concluded

TECHNICAL SESSION III

CROP PROTECTION

General Recommendation

- Decision and action taken report need to be presented by each centre
- Residue analysis data need to be used for fixing MRL values and label expansion.
- Standard operating procedures need to be developed for *Phytophthora* and nematode management
- A team of experts from IISR will visit all the ginger and turmeric disease management trials being carried out at various centres.
- Standard check need be kept for screening studies
- A training program may be organized at IISR, Calicut for the plant protection scientists working in AICRP Spices

Black pepper

PEP/CP/5.3 Trial on management of *Phytophthora* foot rot of black pepper in new plantation

- Trial may be concluded and final report submitted to PC Unit.

Large cardamom

LCA/CP/1.2 Integrated pest and disease management in large cardamom

- MLT need to be carried out in Arunachal Pradesh and Sikkim
- A standard check for pest and disease management trials should be included

Small cardamom

CAR/CP/6.9 Evaluation of new insecticides for thrips control

- Residue analysis data need to be used for fixing MRL values and label expansion.
- All centres conducting trials need to undertake residue analysis

Ginger

GIN/CP/6.12 Field screening of different varieties of ginger against leaf spot and rhizome rot

- The programme may be concluded and final report submitted to PC Unit.

GIN/CP/6.13 Effect of biocapsule on growth and yield of ginger

- Trial may be modified with disease component and rhizome rot incidence need to be recorded

Turmeric

TUR/CP/7.1 Survey and identification of disease causing organisms in turmeric and screening of turmeric germplasm against diseases (Disease Surveillance)

- Kamarapalli and Guntur centres need to be included
- Trial may be concluded at Dholi centre

TUR/CP/7.4 Management of foliar diseases in turmeric using tolerant lines

- At Dholi and Pundibari, trial may be concluded
- At Kammarapally and Solan, trial may be continued and should include all entries for screening

TUR/CP/7.6 Field screening of different varieties of turmeric against leaf spot and rhizome rot

- Trial may be concluded and final report submitted to PC Unit.

TUR/CP/7.7 Effect of biocapsules on growth and yield of turmeric

- Review may be conducted for re fixing treatments

Coriander

COR/CP/6.2 Survey to identify the disease incidence, collection and identification of causal organism in coriander

- Trial concluded and ten years data need to be compiled and submitted to Projector coordinator

Cumin

CUM/CP/6.8 Integrated pest and disease management in cumin

- Treatments with carbendazim may be avoided in the trial and number of treatments need to be reduced

Project code	Title	Centres	Comments
Black Pepper			
PEP/CP/5	Disease Management Trial		
PEP/CP/5.3	Trial on management of <i>Phytophthora</i> foot rot of black pepper in new plantation	Chintapalle, Mudigere, Dapoli	Concluded
PEP/CP/5.6	Biological Management of Slow Decline in Black Pepper	Panniyur, Sirsi, Dapoli	Continued
PEP/CP/5.7	Studies on management of <i>Phytophthora</i> causing foot rot in black pepper	Panniyur, Sirsi, Dapoli, Mudigere	Continued
Small Cardamom			
CAR/CP/6	Pest and Disease Management Trial		
CAR/CP/6.8	Comparison of effect of chemical treatments as well as bio-control agents against pseudostem rot of cardamom	Mudigere	Continued
CAR/CP/6.9	Evaluation of new insecticides for thrips control	Mudigere, Myladumpara, Pampadumpara, Sakleshpura	Continued
CAR/CP/6.10	MLT on leaf blight tolerant lines of small cardamom 2018	Appangala, Mudigere, Pampadumpara, Myladumpara,	Continued
Large Cardamom			
LCA/CP/1.2	Integrated pest and disease management in large cardamom	ICRI Regional Station, Gangtok, ICAR Regional station,	Continued
Ginger			
GIN/CP/6	Disease Management Trial		
GIN/CP/6.11	Eco-friendly management of rhizome rot of ginger	Kumarganj	Continued
GIN/CP/6.12	Field screening of different varieties of ginger against leaf spot and rhizome rot	Dapoli	Concluded
GIN/CP/6.13	Effect of PGPR biocapsule on growth and yield of ginger	Pottangi, Chintapalle, Dholi, Barapani, Kammarpally, Kumarganj, Pundibari, Raigarh, Solan, Kalyani, Ambalavayal	Continued

GIN/CP/6.14	Management of bacterial wilt of ginger through chemicals and bio agents	Kozhikode, Pottangi, Dholi, Pundibari, Solan, Kalyani, Nagaland, Pasighat, Gangtok	Continued
Turmeric			
TUR/CP/7	Disease Management Trial		
TUR/CP/7.1	Survey and identification of disease causing organisms in turmeric and screening of turmeric germplasm against diseases	Coimbatore, Pundibari, Dholi, Raigarh	Continued
TUR/CP/7.3	Assessment of fungicide and biological control agents against foliar disease of turmeric	Raigarh, Coimbatore	Continued
TUR/CP/7.4	Management of foliar diseases in turmeric using tolerant lines	Dholi, Kumarganj, Pundibari, Raigarh, Kammarapilly, Solan, Guntur	Continued
TUR/CP/7.5	Eco-friendly management of foliar diseases of turmeric	Kumarganj	Continued
TUR/CP/7.6	Field screening of different varieties of turmeric against leaf spot and rhizome rot	Dapoli	Concluded
TUR/CP/7.7	Effect of PGPR biocapsule on growth and yield of turmeric	Chinthapalle, Coimbatore, Dholi, Kumarganj, Pantnagar, Pasighat, Pottangi, Pundibari, Raigarh, Solan	Continued
Coriander			
COR/CP/6	Disease Management Trial		
COR/CP/6.2	Survey to identify the disease incidence, collection and identification of causal organism in coriander	Dholi	Concluded
COR/CP/6.4	Studies on the management of coriander powdery mildew using new generation fungicides	Coimbatore, Raigarh, Jobner, Jagudan, Kumarganj	Continued
COR/CP/6.5	Eco-friendly management of stem gall of coriander (Observational trial)	Kumarganj	Continued
COR/CP/6.6	Integrated management of stem gall disease of coriander	Dholi	Continued

COR/CP/6.7	Integrated pest and disease management in coriander	Ajmer, Coimbatore, Dholi, Hisar, Jabalpur, Raigarh, Jobner, Jagudan, Kumarganj, Navsari, Pantnagar, Kota	Continued
Cumin			
CUM/CP/6	Disease Management Trial		
CUM/CP/6.6	Bio-efficacy of newer molecules of insecticides against cumin aphid	Jagudan, Jobner, Ajmer	Continued
CUM/CP/6.7	Management of powdery mildew in cumin through new chemicals	Jobner	Continued
CUM/CP/6.8	Integrated pest and disease management in cumin	Ajmer, Jobner, Jagudan, Mandor	Continued

TECHNICAL SESSION: IV

VARIETAL RELEASE

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

Sl. No.	Crop	Name of the variety	Organization
1.	Ginger	Solan Giriganga	Dr YSPUH&F, Solan
2.	Turmeric	TCP 129	UBKV, Pundibari
3.	Nutmeg	Konkan Sanyukta	Dr BSKKV, Dapoli
4.	Coriander	Rajendra Dhanias 3	Dr RPCAU, Dholi
5.	Coriander	JD(SI)1	JNKVV, Jabalpur
6.	Coriander	Ajmer Coriander 3	ICAR-NRCSS, Ajmer
7.	Coriander	Chhattisgarh Sri Chandrasini Dhanias - 2	IGKV, Raigarh
8.	Fennel	Ajmer Fennel 3	ICAR-NRCSS, Ajmer
9.	Fenugreek	HM 425	CCSHAU, Hisar
10.	Fenugreek	Narendra Richa (NDM 79)	NDUA&T, Kumarganj
11.	Cumin	Gujarat Cumin 5	SDAU, Jagudan

General recommendations:

- The proposal has to be submitted through proper channel.
- Certificate from pathologist/entomologist for pest and disease resistance has to be included in the release proposal.
- Stability analysis data need to be included in the release proposal.

The recommendations of the committee is as follows

1. Crop: Ginger

Variety: **Solan Giriganga**

Centre: Dr. Y S Parmar University of Horticulture & Forestry, Solan

- The proposal was presented by Dr. Happy Dev Sharma.
- Morphological description has to be presented as per the DUS guidelines.

- Morphology description of the proposed variety in comparison with the existing variety (Himgiri) has to be submitted in the proposal.
- Ascertain whether it is collected from farmer's field and also clarify the difference between the genotype under cultivation in the source of collection.
- Recommended for release in Himachal Pradesh and West Bengal.

2. **Crop: Turmeric**

Variety: **TCP 129**

Centre: UBKV, Pundibari, West Bengal

- The proposal was presented by Dr. Anamika Debnath
- Leaf spot and leaf blotch pathogen has to be clearly mentioned in the proposal.
- Recommended for release in West Bengal, Bihar and Tamil Nadu.

3. **Crop: Nutmeg**

Variety: **Konkan Sanyukta**

Centre: Dr BSKKV, Dapoli

- The proposal was presented by Dr. R. G. Khandekar
- Recommended for state release to Maharashtra.

4. **Crop: Coriander**

Variety: **RajendraDhania 3**

Centre: Dr RPCAU, Dholi

- The proposal was presented by Dr. A. K. Mishra
- Recommended for release for the coriander growing regions of the country.

5. **Crop: Coriander**

Variety: **JD(SI) 1**

Centre: JNKVV, Jabalpur

- The proposal was presented by Dr. B. K. Verma
- Recommended for the state of Madhya Pradesh, provided the completed/revised proposal submitted to PC unit within 15 days.

6. **Crop: Coriander**

Variety: **Ajmer Coriander 3**

Centre: ICAR-NRCSS, Ajmer

- The proposal was presented by Dr. R. S. Meena
- IC number and DNA finger printing data has to be included in the proposal.
- Recommended for release to Rajasthan, provided the completed/revised proposal submitted to PC unit within 15 days.

7. **Crop: Coriander**

Variety: **Chhattisgarh Sri Chandrahasini Dhania-2**

Centre: IGKV, Raigarh

- The proposal was presented by Dr. L. S. Shrikanth
- DNA fingerprinting data need to be included in the proposal.
- Stable variety with good performance across the locations is recommended for national release.

8. **Crop: Fennel**

Variety: **Ajmer fennel 3**

Centre: ICAR-NRCSS, Ajmer

- The proposal was presented by Dr. R. S. Meena.
- Recommended for release for the coriander growing regions of the country, provided the completed/revised proposal submitted to PC unit within 15 days.

9. **Crop: Fenugreek**

Variety: **HM 425**

Centre: CCSHAU, Hisar

- The proposal was presented by Dr. S. K. Tehlan
- Recommended for release in Haryana, Rajasthan, Gujarat and Andhra Pradesh.

10. **Crop: Fenugreek**

Variety: **Narendra Richa (NDM 79)**

Centre: NDU&T, Kumarganj

- The proposal was presented by Dr. S. K. Singh
- Performs well in high pH conditions (saline soils) recommended for release in Uttara Pradesh and Andhra Pradesh.

11. **Crop: Cumin**

Variety: **Gujarat cumin 5**

Centre: SDAU, Jagudan

- The proposal was presented by Dr. Hiren Patel
- Variety with wilt resistance recommended for national release.

TECHNICAL SESSION: V
TRANSFER OF TECHNOLOGY

General recommendations

- All the technologies identified may be demonstrated through KVKs of the respective regions of adoption.
- The approved technologies are to be incorporated in the Package of Practices of the state.
- 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.

Technologies proposed with recommendations

1. Turmeric polyhouse cultivation technology – Raigarh

The recommendation of the technology is deferred for want of refinement through the use of fertigation, shade and polybags.

2. Coriander performance under field, insect proof selfing net and polyhouse condition – Raigarh

The technology is not recommended as it involves high cost. The results may be compiled and a final report is to be submitted to the PC cell.

3. Management of coriander powdery mildew by new generation fungicide – Coimbatore

The trial may be continued for one more year for acquiring results from the other coordinating centres.

4. Bio-fertilizers for yield enhancement of coriander – Dholi

Soil application of Phosphate Solubilizing Bacteria (PSB) @15 kg ha⁻¹ or Azospirillum @15 kg ha⁻¹ along with NPK@60:40:30kg/ha-1 is recommended for improving the productivity of coriander.

5. Drip irrigation and fertigation in coriander – Jobner

Fertigation with water equal to 80% of actual evaporation (0.8 IW/CPE ratio) at an interval of 2-3 days and recommended dose of fertilizers through soluble fertilizers at different growth stages (20, 40, 60 & 80 DAS) is recommended for improving the yield and WUE in coriander in light textured soils of India.

6. Bio-efficacy of newer molecules of insecticides against cumin aphid – Jagudan

For effective and economical management of cumin aphid, first foliar spray of thiamethoxam 25WG (25g a.i./ha ; 2.5g/10lit.water) at 10% umbels infestation of aphids followed by thiacloprid 21.7SC (25g a.i/ha ; 2.88g/10lit. water) spray after 10days is recommended for effective control of aphids in cumin growing regions of Gujarat.

7. Chemical management schedule for cumin blight – Jagudan

Spraying of kresoxym methyl 44.3 SC (1 ml/lit), mancozeb 75% WP (3.7 g/lit) and difenaconazole 25 EC (0.5 ml/lit) at 40, 50 and 60 days after germination is recommended for effective management of blight in cumin growing regions of Gujrat.

8. Drip fertigation in fennel – Jobner

Fertigation with water equal to 80% of actual evaporation (0.8 IW/CPE ratio) at an interval of 2-3 days and 75% recommended dose of fertilizers through soluble fertilizers at different growth stages (20, 40, 60, 80 & 100 DAS) is recommended for improving the yield and WUE in fennel in light textured soils of India.

9. Organic farming in cardamom – Pampadumpara

Monthly application of *Jeevamrutha* (20 l/plant) along with 10 g each of biofertilizers (*Azospirillum* and PSB) and bio-control agent (*Trichoderma viride*) along with 30 tonnes of compost is recommended as an organic production practice for the Cardamom Hill Reserves, Kerala.

TECHNICAL SESSION: VI

PLENARY SESSION

Dr. T. Janakiram, ADG (HS-II) in his remarks congratulated the Best AICRPS centres and the scientists involved in developing new varieties & technologies which were approved in the workshop.

PROJECT COORDINATOR'S REPORT

Dr. K. Nirmal Babu, 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, 10 co-opting and 9 voluntary centres) spread over 14 agro climatic zones in 23 states of the country coordinates the research activities on spice crops like black pepper, large cardamom, small cardamom, ginger, turmeric, cinnamon, nutmeg, clove, coriander, cumin, fennel, fenugreek, ajwain and nigella. Annual budget for the year 2017/18 was Rs. 637 lakhs as ICAR share.

New Initiatives

In line with food safety assurance and minimization of the pesticide residue in spices, efficacy trials in coriander and cumin were initiated in various seed spice centres of AICRPS.

For sustainable production of spices, new programme on the management of bacterial wilt of ginger through chemicals and bioagents have been undertaken in various AICRPS centres of different agro climatic regions.

For the evaluation of genotypes for specific traits, various AICRPS centres have undertaken Coordinated varietal trials in spice crops like black pepper, cardamom, coriander, cumin, fennel and fenugreek.

Varieties recommended for release in 28th AICRPS workshop

Six high yielding varieties of spices (2 in turmeric, 2 in coriander, 1 fenugreek and 1 cassia) were recommended for release in XXVIII AICRP on Spices workshop held at Horticultural Research Station, Dr. Y. S. R. Horticultural University, Lam, Guntur, Andhra Pradesh.

High quality varieties- industries need

- **NDH-8** (Narendra Saryu) – turmeric variety from Narendra Dev University of Agriculture & Technology, Kumarganj, Faizabad, Uttar Pradesh with high curcumin content (5-6%), more

number of primaries with yield advantage of 10 % was recommended for release at national level

- **Gujarat Coriander -3** – coriander variety from Centre for Research on Seed Spices (CRSS), (SDAU), Jagudan with high volatile oil (0.52 %), high linalool (72.16 %) and high yield potential (16.94 q ha⁻¹) was recommended for release in Gujarat
- **Ajmer Fenugreek 5-** fenugreek variety developed by ICAR-NRC on Seed Spices, Ajmer with high seed yield (17.21 q ha⁻¹), high antioxidant content (66.428 mg/ BHTE/ ppm) and suitable for green leaf production under shade net condition in summer season was recommended for release at national level.
- **IISR Cassia (D1)-** a new selection of cassia with low coumarin content was developed for the first time in the country by Dr. BS Konkan Krishi Vidhyapeeth, Dapoli in collaboration with ICAR-IISR, Kozhikode and TNAU, HRS, Pechiprai.

Biotic stress varieties- for food safe spice production

- **Ajmer Coriander 2** developed by ICAR-NRC on Seed Spices, Ajmer for stem gall resistance, high linalool content (71.7 %) and early maturing type was recommended for release at national level.
- **CL 34** –turmeric variety developed by Tamil Nadu Agricultural University, Coimbatore with tolerance to leaf spot and leaf blotch and curcumin content of 3% was recommended for release in Tamil Nadu.

Technologies developed in 28th AICRPS workshop

Seven location specific technologies in different spice crops for various states were developed in XXVIII Annual workshop of AICRPS.

More crop per drop- for efficient utilization of water

- **Standardization of drip fertigation in Black pepper under Kerala conditions**
Drip irrigation in black pepper @ 8 litres of water daily and 50 RDF (half the Recommended Dose of Fertilizer as liquid fertilizer – 19:19:19 mixture) in 3 equal splits at weekly intervals during the months of June, September and February was beneficial than the conventional method of irrigation and basal fertilizer application with the highest benefit cost ratio (2.07).
- **Standardization of fertigation in cardamom for Karnataka**
Application of irrigation 9 litres per clump per day along with 100% recommended dose of fertilizers through drips gives the highest capsule yield (316.16 kg ha⁻¹) in cardamom with BC ratio of 3.37.

Organic nutrient management- for sustainable spice production

- **Organics for yield enhancement in small cardamom in Karnataka**

Application of Jeevamrutha (20 l per clump) + *Azospirillum* (10 g/clump) + PSB (10 g/clump) + *Trichoderma* (10 g/clump) improved the yield of cardamom (318.26 kg ha⁻¹) with BC ratio of 1:5.09.

Micro nutrient supplementation- for balanced nutrition

- **Micro nutrient management in fennel in Gujarath**

Application of fertilizer to fennel with RDF of 90 + 30 kg NP per ha along with 200 kg FYM enriched with 3.0 kg Fe + 1.5 kg Zn per hectare as basal application in furrow for light textured soils deficient in iron and zinc produces maximum yield (14.27 q/ha) with a BC ratio of 2.11.

Soil nutrient amendment- for maintaining soil health

- **Liming in cardamom for Kerala**

In acidic loamy soils of Kerala, application of 2 kg dolomite for 3 years improves the yield (2763.30 g plant⁻¹) in cardamom with B: C ratio of 2.42.

- **Management of blight and powdery mildew by spacing and potash application in cumin in Gujarath**

Line sowing of cumin @ 30 x 10 cm and application of Potash @ 20 kg/ha along with recommended dose of fertilizers reduces the incidence of blight (PDI- 17.3) and powdery mildew (PDI- 5.7) with maximum yield (363 kg / ha) and BC ratio of 2.41.

Weed management- for mitigating labour shortage

- **Utilization of herbicides for the effective control of weeds in Ginger for Andhra Pradesh**

Under severe shortage of labour for hand weeding, application of Oxyflurofen as Pre-emergent herbicide @ 500 ml per ha at second day after sowing followed by application of Quazilophop ethyl as Post-emergent herbicide @1 litre per ha at 30 days of crops stage followed by hand weeding at 90 days of crop stage reduces 3-4 manual hand weeding required and gives a BC ratio of 2.96 with a yield of 22.79 t/ ha was recommended for ginger in Chinthapalle condition.

Black Pepper

During 2017-18, Pepper Research Station, Panniyur has collected five black pepper drought tolerant lines and HRS, Sirsi has collected 14 accessions of black pepper bringing the total germplasm holding of black pepper to 844. On evaluating twenty two accessions of black

pepper for quality characters at Sirsi centre revealed that SV-7 recorded highest piperine (5.49%) and oleoresin (10.74%) content. In Coordinated Varietal Trial of black pepper, maximum fresh berry yield was recorded HB 20052 (4500 g vine⁻¹) followed by Acc.no.53 (4380 g vine⁻¹) at Panniyur, Panniyur-1 (637.76 g vine⁻¹) followed by P-8 (507.44 g vine⁻¹) at Chintappalle and Panniyur 1 (1230 g vine⁻¹) at Dapoli. In RARS, Ambalavayal, 100 berry weight was also found to be maximum in HP 813(17.4g) followed by PRS 17 (17 g). In the case of 100 berry volume, highest value was recorded in Coll 1041 (24.41) followed by Panniyur 1 (21.50).

During 2017-18 good yield was obtained in black pepper based mixed cropping system in PRS, Panniyur. Among the intercrops, elephant foot yam recorded maximum yield of 8.53 kg followed by greater yam (7.25) kg) from an inter space of 4 m x 2 m spacing between black pepper. Whereas in RARS, Ambalavayal, on quantifying the economic produce of different intercrops of juvenile black pepper garden revealed that tapioca (10.18 t ha⁻¹) recorded maximum yield followed by arrowroot and elephant foot yam with 4.81 t ha⁻¹ and 3.62 t ha⁻¹ yield respectively.

In an experiment on the biological management of slow decline in black pepper at Dapoli, minimum per cent disease intensity was recorded (6.78) in the treatment with soil application of *Pochonia chlamydosporia* @ 2 kg vine⁻¹ followed by soil drenching with *Pseudomonas fluorescens* IISR-6 @ 2% (10⁶cfu) (drench 3 l vine⁻¹) and was significantly superior to rest of the treatments at Dapoli.

Small Cardamom

A total of 188 cardamom accessions are presently conserved in the gene bank at Cardamom Research Station, Pampadumpara. Among them 73 cardamom accessions (CRSP 1-73) received IC numbers (547920 to 547992) from the National Bureau of Plant Genetic Resources, New Delhi. All the characters including yield and biotic stress characters, except *Azhukal* incidence had shown significant difference among the accessions at 5% confidence levels. HY 13 recorded the highest fresh yield (3.4 kg/plant) followed by HY 12 (2.7 kg/ plant)

Evaluation of new insecticides for thrips control in small cardamom revealed that fipronil 5 SC @ 0.005% showed highest per cent reduction of infestation (88.26%) followed by Imidacloprid 17.8 SL @ 0.0089% with 78.74% infestation. Spinosad 45 SC @ 0.0135% and quinalphos 25 EC @ 0.05% were also found effective in reducing the infestations (75.29% and 70.31% respectively) and were on par with each other.

Large Cardamom

A total of 10 genotypes of large cardamom were collected from different part of Sikkim and are being maintained at ICAR Research Complex for NEH Region, Regional Station at Gangtok. Surveillance of insect-pests on large cardamom in Sikkim at ICAR- NOFRI, Research

farm, Tadong revealed that the infestation of different hairy caterpillar was more during the month of November- December.

In an experiment to evaluate the efficacy of biopesticides *viz.*, neem oil, *Beauveria bassiana*, *Metarhizium anisopliae*, petroleum oil based agrospray, petroleum oil based horticultural spray, *Bacillus thuringiensis* and spinosad against insect pests of large cardamom *viz.*, stem borer, shoot fly, leaf eating caterpillar and tea mosquito bug revealed that all the treatments showed effective results to control insect pests over the control. However, spinosad 45 SC @ 0.3 ml L⁻¹ was found to be most effective to control all the pests (69.91 to 81.32% reduction of infestation over control) followed by neem oil (1500 ppm) @ 4 mL⁻¹ (61.32 to 67.64 % reduction of infestation over control) and petroleum agrospray @ 10 mL⁻¹ (52.22 to 59.47 % reduction of infestation over control).

Ginger

Out of 181 ginger germplasm evaluated at Pottangi, 4 accessions gave more than 10 kg per 3m² of fresh rhizome yield and 30 accessions yielded more than 5 kg per 3m². The range of plot yield being 0.15 Kg (No.6) to 13.0 kg per 3 m² (KG-132) with the mean yield of 3.7 kg per 3 m² in tested germplasms during *Kharif* 2017-18. The highest fresh rhizome yield was recorded by KG-132 (28.9 t ha⁻¹) followed by PGS-41-1 (25.3 t ha⁻¹) and Zo-9 (25.1 t ha⁻¹).

The average fresh rhizome yield for three consecutive years 2015, 2016 and 2017 varied from 5.15 t ha⁻¹ to 18.25 t ha⁻¹. The local genotype Solan Giriganga (IC-593889/SG-26-04) recorded maximum yield 18.25 t ha⁻¹ whereas, local check variety Himgiri yielded 13.25 t ha⁻¹ and National check variety IISR Varada 8.57 t ha⁻¹. The rhizome rot disease incidence varied from 8.93-22.20 % with minimum in Solan Giriganga (IC-593889/ SG-26-04). The high yielding promising genotype is superior/ comparable for quality attributes *viz.*, dry matter recovery (21.01 %), essential oil (1.45 %), oleoresin (4.69 %) and crude fibre content (4.47 %) to the check variety Himgiri. Therefore, keeping in view the consistently good performance, the promising genotype Solan Giriganga (IC-593889/SG-26-04) has been identified as promising variety for Western Himalayan Regions of the country.

Turmeric

In germplasm evaluation trails, 270 turmeric germplasm lines were maintained and conserved at Kammarpally research station. On characterising turmeric lines using DUS descriptors, the accessions *viz.*, Manapasupu (74.80 t ha⁻¹) PCT-17 (67.66 t ha⁻¹), CLI-366 (66.67 t ha⁻¹), West Bengal (65.73 t ha⁻¹), NH-1 (65.0 t ha⁻¹), CLI-Jyothi (64 t ha⁻¹), ACC No. 585 (63.73 t ha⁻¹), were the high yielders as compared to national check, IISR Prathibha (55.0 t ha⁻¹). These lines were also screened against major foliar diseases.

In the coordinated varietal trial of turmeric, twelve genotypes (IT 10, IT 23, IT 36 from Raigarh; RH 9/90, RH 80 from Dholi; TCP 191 from Pundibari, NDH 11, NDH 128 from Kumarganj, PTS 18, PTS 38 from Pottangi and LTS 1, LTS 2 from Guntur) along with two

checks (IISR Prathiba and BSR 2) were evaluated at different centres. The genotype TCP 191 was the top yielder at Pundibari (42.59 t ha⁻¹) and Chintapalle (48.49 t ha⁻¹) whereas the genotypes like NDH 11 (45.00 t ha⁻¹) performed well in Coimbatore, LTS 2 (62.0 t ha⁻¹) in Kammarpally, LTS1(26.2 t ha⁻¹) at Kumarganj, PTS 18 (15.3 t ha⁻¹) at Pottangi, IT 10 (28.00 t ha⁻¹) at Raigarh and IT 23 (26.67 t ha⁻¹) at Navsari.

Survey was conducted in Coochbehar and Jalpaiguri districts of West Bengal to identify and to assess the severity of the diseases in turmeric. Three well distributed locations within the identified areas were selected for the survey. Two major diseases of turmeric namely leaf blotch (*Taphrina spp.*) and leaf spot (*Colletotrichum spp.*) were found to be prevalent in these areas. The survey revealed that leaf blotch disease severity in Coochbehar is on an average PDI of 13.89 and Jalpaiguri is on an average PDI of 12.61. Regarding leaf spot of turmeric it was found that disease severity in Coochbehar and Jalpaiguri block is on an average PDI of 19.87 and 18.57 respectively.

Tree Spices

Among the nutmeg germplasm screened at Dapoli, average no. of fruits ranged from 180-560. The average number of fruits was high in genotypes DBSKKVMF 24 (325), DBSKKVMF 23 (310), DBSKKVMF 19 (280). The genotype DBSKKV 9772 recorded maximum dry nut yield (5152 g) and dry mace yield (599.2 g). The genotype DBSKKVMF 29 is found to be promising considering its fruit weight, nut weight and mace weight. At Pechiparai, the nutmeg accession MF- 4 recorded maximum number of fruits (330 fruits /tree), single fruit weight (46 g) and the mace yield (140 g tree⁻¹).

The clove accession, SA-3 recorded the highest leaf length (18.50 cm), leaf breadth (7.50 cm) and dry bud yield (1.25 kg/ tree) at Pechiparai. Four promising genotypes were selected at Dapoli whose plant height varied from 4.90 to 5.50 m, girth ranged from 33.10 to 38.10 cm and spread varied from 3.5 m to 5.20 m.

In case of cinnamon, among the twelve accessions evaluated at Pechiparai, CV-5 recorded maximum stem girth (26.00 cm), leaf yield (7.40 kg plant⁻¹) and dry bark yield (630 g plant⁻¹) while local check recorded stem girth (25.00 cm), leaf yield (6.80 kg per plant) and dry bark yield (285 g per plant).

Coriander

In Coordinated Varietal Trial of coriander, maximum seed yield was recorded in the entry COR 159 at Coimbatore (18.95q ha⁻¹) and Jabalpur(14.55q ha⁻¹). COR 164 performed better in Kumarganj (15.97q ha⁻¹) and Raigarh (18.8q ha⁻¹). The top entries in other centres viz., Jagudan, Navsari, Kota and Jobner are COR 170 (9.41 q ha⁻¹), COR 99 (15.09 q ha⁻¹), COR 160 (16.66 q ha⁻¹) and COR 125(17.50 q ha⁻¹) respectively.

An experiment on efficacy of new generation fungicides against powdery mildew of coriander was conducted at Jobner. Out of seven treatments, minimum (21.67%) disease intensity and maximum seed yield of 15.13 q ha⁻¹ was recorded with foliar spray of Hexaconazole 5% SC @ 0.1% whereas at Jagudan, the minimum percent disease intensity was observed in T₇, spraying of Dinocap and was at par with T₆, spraying of Propiconazole 0.1%, T₅, Spraying of Hexaconazole 0.1%, T₄, spraying of wettable sulphur 0.2 % and spray of Azoxystrobin 0.1 %.

The fertigation to coriander at 0.8 IW/CPE ratio recorded significantly higher plant height (112.17 cm), umbels/plant (28.22), umbellets/umbel (5.68), seeds/umbel (46.50), test weight (12.84 g), seed yield (20.86 q/ha), net returns (Rs 135946/ha), B:C ratio (3.62) and water use efficiency (6.09 kg/ha-mm) with the water saving of 18.7%. However it remained at par to drip fertigation at 1.0 IW/CPE ratio.

Cumin

Total eighteen entries of cumin were screened for the resistance against *Alternaria* blight, powdery mildew and wilt disease at Jagudan. The minimum blight disease and powdery mildew disease intensity was noticed in Sanand Cumin-5 (12.0 % and 5.0 % respectively). The blight disease incidence ranged from 32.5 to 81.0 per cent.

In a trial on organic nutrient and disease management in cumin, out of thirteen treatments tested, minimum wilt incidence (11.1 %) and maximum seed yield (2.05 q ha⁻¹) were observed in the treatment containing soil application of vermicompost @ 2 t ha⁻¹ + seed treatment with *Trichoderma* @ 6g kg⁻¹ + spray of NSKE @ 5% followed by the treatment of soil application of FYM @ 6t ha⁻¹ + seed treatment with *Trichoderma* @ 6 g kg⁻¹ + spray of NSKE @ 5%, exhibited 15.6% wilt incidence and 1.88 q ha⁻¹ seed yield. Both these treatments were significantly superior over control, where maximum wilt incidence (29.5%) and minimum yield (1.11 q ha⁻¹) were observed.

The fertigation to cumin at 0.6 IW/CPE ratio with 80% RDF recorded significantly higher plant height (29.34 cm), umbels/plant (19.59), umbellets/umbel (5.22), seeds/umbel (26.66), test weight (4.92g), seed yield (456.26 kg/ha), net returns (Rs 37740/ha), B:C ratio (1.85), water use efficiency (2.42 kg/ha-mm) and water saving (22.1%). However it remained at par to drip fertigation at 0.6 IW/CPE ratio with 100% RDF and at 0.8 IW/CPE ratio with 100% RDF.

Fennel

The best performed entries in the CVT during the year were FNL 106 (24.84 q ha⁻¹) at Jobner, FNL 105 (16.88 q ha⁻¹) at Jagudan, FNL 112 (15.34 q ha⁻¹) at Kumarganj and FNL-109 (11.91 q ha⁻¹) at Jabalpur.

The drip fertigation with 75% RDF recorded significantly higher plant height (121.3 cm), umbels per plant (29.22), umbellets per umbel (24.04), seeds per umbel (391.5), test weight (6.15g), seed yield (24.78 q ha⁻¹) and water use efficiency (5.72 kg/ha-mm) along with 18.9 % of water saving at Jobner. However it remained *at par* to drip fertigation with 100% RDF and drip fertigation with 100 % RDN.

Fenugreek

Thirty genotypes of fenugreek were sown in two environments namely irrigated (full supplement of irrigations) and drought (staggered irrigations (half of that given in irrigated treatment)). The genotypes; UM 55, UM 38, UM 58, and UM 46 in normal irrigation while UM 40, UM 52, UM 54 and UM 56 in staggered irrigation conditions were top yielders. Based on stress indices UM 53, UM 54, UM 56 and UM 65 were found to be the desirable entries for moisture stress/ drought conditions.

On evaluating fourteen entries of fenugreek along with two checks in coordinated varietal trial, the highest seed yield was recorded in FGK-118 at Jagudan and Kota whereas the top yielders at different centres like Kumarganj, Navsari, Raigarh and Jobner are FGK 108 (13.33 q ha⁻¹), FGK 83 (14.19 q ha⁻¹), FGK 117 (22.20 q ha⁻¹) and FGK 109 (21.22 q ha⁻¹) respectively.

Ajwain

Ajwain 1 recorded maximum seed yield (6.1 q ha⁻¹) over two checks AA-1 (4.9 q ha⁻¹) and AA - 2 (4.7 q ha⁻¹) at Raigaarh whereas at Jagudan, the genotype JA-187 (15.96 q ha⁻¹) was found to be the paramount genotype. Out of 13 entries of Ajwain evaluated at Kumarganj, maximum yield was found in NDAJ-10 (8.26 q ha⁻¹) followed by AA-6 (7.99 q ha⁻¹) and JA-187 (7.71 q ha⁻¹).

Mean performance of the entries evaluated in CVT of ajwain over 2016-17 and 2017-18 at Jobner revealed superior performance of AA-2 check yielding 7.96 q ha⁻¹ followed by HAJ-18 (7.59 q ha⁻¹) and IA-1 (7.54. q ha⁻¹).

Nigella

In coordinated varietal trial of Nigella, maximum seed yield (6.39 q ha⁻¹) was recorded in the entry AN-23 and AN-1 at Kota, NDBC-20 (8.19 q ha⁻¹) at Kumarganj, Indira Nigella -1 (7.7 q ha⁻¹) at Raigarh and HKL-T (7.7 q ha⁻¹) at Kalyani.

Production and distribution of quality planting material

The AICRPS centres along with DASD have multiplied and distributed 4.16 lakhs rooted cuttings of black pepper, 10338 suckers of cardamom, 50 t of turmeric, 30 t of ginger, 1258 grafts of nutmeg, 247 seedlings of nutmeg, 265 grafts of cinnamon and 3000 seedlings of cinnamon In seed spices 324 q of coriander, 70 q of cumin, 27.6 q of fennel, 80 q of fenugreek and 60.5 kg of Ajwain seed material were produced and distributed.

Transfer of Technology

The scientists of various centres has taken earnest effort to popularize the latest technologies as the research is meaningful only when it reaches to farmers and are benefited out of that. Following are some of the technologies demonstrated during the year.

High yielding varieties- boon to farmers

- ❖ Demonstrations on improved varieties of black pepper in 34 ha at Odisha (Pottangi)
- ❖ Four demonstrations on high yielding ginger varieties (Solan)
- ❖ FLD on 11 high yielding varieties of turmeric (Guntur)
- ❖ Demonstration of high yielding Turmeric variety CO 2 (Coimbatore)
- ❖ Demonstrations of high yielding varieties of turmeric, coriander, fennel and fenugreek (Kumarganj)
- ❖ Six demonstrations on high yielding varieties of fenugreek, cumin and fennel (Jobner).

Rapid multiplication of planting materials- for minimal expenditure

- ❖ Demonstration on protray technology, seed treatment of two budded turmeric seed rhizomes and raised bed method of planting in turmeric (Kammarapally)
- ❖ FLD on performance of turmeric transplants in an area of 3.00 acres (Coimbatore)
- ❖ Training on “Hi- tech production technology for turmeric, ginger, coriander and curry leaf” in collaboration with DASD (Coimbatore)
- ❖ Demonstration of Pro tray propagation technique for ginger and turmeric, , Soft wood grafting technique in nutmeg and kokum, Bush pepper production technology(Dapoli)

Organic farming

- ❖ Demonstration on organic farming in black pepper (Yercaud)
- ❖ Demonstrations on organic ginger production in 4.5 ha at Koraput, Gajapati and Kandhamala districts of Odisha (Pottangi)
- ❖ Four demonstrations on intercrop in coconut, arecanut and multitier cropping system along with cinnamon, pepper, nutmeg grafts and suitable standard for pepper (Panniyur)

Drip Irrigation- for conserving water

- ❖ Demonstration on drip irrigation system in small cardamom (Mudegere)
- ❖ Demonstration on drip irrigation in black pepper (Panniyur)

Mechanization- for minimizing operational expenses

- ❖ Demonstration of Diesel operated Turmeric boiler and Turmeric digger (Guntur)
- ❖ Demonstration of technique of removing bark of cinnamon, Processing of black pepper, Processing of turmeric (Dapoli)

Apart from the above field level demonstrations, the scientists were made technologies more popular by conducting and attending as resource persons in trainings, seminar and also through various media (newspaper, radio talks and TV programs).

Success stories

Intensification of Black pepper- for increased income

Black pepper is one of the important spice crops of Uttara Kannada district of Karnataka. In a present scenario where majority of the farmers consider horticulture as less remunerative and many youngsters migrate towards metros in search of better life, Mr. Ravindra G. Bhat, Kanagodu village of Yellapur, U. Kannada dist, finds success in black pepper cultivation in an area of 4 acres of areca garden (including old and new areas). He has planted Panniyur 5, Pinjar munda and Panniyur 1 in his plantation. He got 15q of black pepper from his 700 old vines and 1700 new vines were planted during June 2016. He has been following scientific cultivation methods and proper drip irrigation system has been laid out as per the advice from horticultural experts. In his plantation, the slow wilt disease is under check as plant protection measures have been taken up regularly as per the package of practices recommended by the University. Proper underground drainage system is laid out using perforated PVC pipes to drain off excess water during rainy season. Though he had no knowledge of scientific cultivation of black pepper before, now he has turned into a young entrepreneur with successful cultivation of pepper and a model for youngsters who would like to become the 'boss to himself'.

Mixed cropping- bonus to farmers

The mixed cropping system ensures additional income to the farmers. Shri. Madhav Marathe of Usgaon, Taluk of Dapoli learned about the concept of mixed cropping system in black pepper in one of the trainings conducted at B.S.K.K.V, Dapoli. He got the idea of planting black pepper in his arecanuts plantation. After discussing with the scientists of B.S.K.K.V, Dapoli, Shri. Madhav planted Black pepper (Panniyur-1) on arecanut based mixed cropping system in an area of about 0.50 ha during the year 2012 . The black pepper has started bearing now and he obtained a high yield of 10 kg of green berries per vine. He has sold the produce in the Mumbai market. The average price of green pepper spikes (fresh weight) is about Rs. 200-225 per kg. With gratitude he remembers the scientist of B.S.K.K.V, Dapoli who has regularly visited the garden to give guidance about package of practices, shade regulation, interculture, training, pruning operations and plant protection measures.

High yielding ginger and turmeric varieties- for reaping profit

Since 1995, young enterprising youths of Pottangi came forward for cultivation of ginger and turmeric with improved package of practices. The planting material of the high yielding varieties of ginger (Suprabha) and turmeric (Roma) were supplied to six progressive farmers and

provided with all improved technology by the scientists of AICRPS centre at HARS, Pottangi. After they became successful in getting a very high return, many unemployed youth and farmers were attracted towards the cultivation of ginger and turmeric. They produced 16.12 tonnes of Ginger and 4.22 tonnes of turmeric from 16.6 ha of land. They sold ginger Rs. 3000/- per quintal and Turmeric (TL seed) @ Rs.2500/- per quintal.

Ramakrishna Reddy from Warangal, is a progressive farmer and produced about 18.0 tonnes of turmeric per acre with the variety Duggirala Red. He adopted completely the package of practices of Turmeric as published in the booklet (Pasupu Sagu) by Turmeric Research Station, Kammarpally.

Chinnareddy Maggidi of Nizamabad has raised the eight varieties of turmeric (Rajendra Sonia, Rajendra sonali, Ac No.48. Acc. No.79. Salem, Duggirala Red, PTS-10 and Rajapuri). A demonstration was also arranged in his field. He obtained a yield of 20 to 22 t per acre and his turmeric crop produce was used for seed material for next season.

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 2008 tribal farmers.

- Post harvest management practices in ginger
- Improving availability of spice varieties and post harvest process in turmeric, pepper and long pepper
- IPM technologies in horticultural crops
- Techniques of bark peeling in cinnamon and propagation techniques in cinnamon and nutmeg
- Organic ginger and turmeric cultivation
- Off season coriander cultivation
- Demonstration of the performance of organic ginger cultivation in Jhankarguda, Pottangi and black pepper cultivation in Gajapati
- Produced 4500 black pepper cuttings, 1500 seedlings of cinnamon, 1000 seedlings of cardamom, 15 t of turmeric, 15 t of ginger and 1.5 q of coriander

North East-exploring the unexplored

For the management of bacterial wilt of ginger, a solarization trial combined with bioagents has been initiated in North east for sustainable spice production.

At Barapani, maximum yield of 37.49 t ha⁻¹ was recorded in the treatment of 75% N requirement of ginger from FYM + micronutrients followed by 36.85 t ha⁻¹ in the treatment of 100% organic manures from FYM + Vermiwash 10%. Dry recovery of 20.37% was recorded

highest in the treatment of 100% organic manures from FYM + micronutrients and lowest at 19.37 by farmers practice. The treatment 75% N requirement of ginger + vermiwash 10% have the highest fiber content of 3.94% while lowest was recorded in recommended package by SAU with 3.55%. Oleoresin content was recorded highest (4.31%) in recommended package by SAU and lowest in the treatment of 75% N requirement of ginger from FYM + vermiwash 10% with 3.82%.

The experiment on organic farming in turmeric at Mizoram revealed that the maximum yield (34.44t ha⁻¹) was recorded the treatment of 100% organic manure equivalent to 75% N requirement of turmeric, followed by the treatment of 100% organic manure equivalent to 100% N requirement of turmeric with a yield of 33.21t ha⁻¹ and 75% N requirement of turmeric + micronutrients with a yield of 32.69 t ha⁻¹. Moreover, dry matter content (13.95%) was found to be highest in the treatment of 100% organic manure equivalent to 100% N requirement of turmeric followed by the treatment of 100% organic manure + (Vermiwash 10%) and the treatment of 100% organic manure + micronutrients with a dry recovery 13.43% and 13.37% respectively.

Collaboration

- AICRP on Spices centres works in collaboration with
- Technologies released from ICAR- IISR, Kozhikode
- Spices Board for popularization of technologies in tribal areas
- MIDH (Mission for Integrated Development for Horticulture) for providing and supplying quality planting material production
- NGOs for popularizing high production technologies to tribal region
- State Department of Agriculture for increasing production, productivity and income for farmers
- Coffee Board for establishing coffee based black pepper cropping system wherever coffee is grown

Monitoring

The research projects and programs undertaken by various AICRPS centres were monitored by Project Coordinator and Scientists from PC unit's visit to various centres and the experimental plots. In this year visits taken up to 11 centres which includes regular, co-opting, voluntary and project mode centres. The activities of the centres were also monitored through monthly reports, half yearly and annual report sent by the centres. The annual workshop was conducted during 10th to 12th October 2017 at Horticultural Research Station, Dr. Y. S. R. Horticultural University, Lam, Guntur, Andhra Pradesh.

ACTION TAKEN REPORT 2017-18

SPEICAL SESSION : BRAINSTORMING ON TURMERIC		
Sl. No.	Decision/Recommendations	Action Taken
1.	Target variety based on market requirement like high curcumin, lemon yellow colour, low oil and good yield.	IISR Prathibha, IISR Pragati, Rajendra Sonia, Rajendra Sonali, Roma, Duggirala Red, Suverna, Mega Turmeric 1 rich in curcumin are multiplied and are being populrised About 70% of the turmeric produced in the country is utilized by Masala industry which prefers light yellow coloured turmeric. AICRPS in collaboration with IISR will be developing a light yellow coloured variety
2.	There is a huge gap between technologies developed & adaptation. There is need to demonstrate them in effective manner Cultivation of turmeric in specific region for specific purpose should be encouraged	LD's on improved varieties, transplanting technique, and drip fertigation Turmeric mainly used for making powder and curcmin extraction, low curcumin varieties are used for powdering purpose and high curcumin varieties are recommended for curcumin industries. 1000 acres of turmeric in Andhra Pradesh and Telangana is occupied by IISR Pragathi. 8000 t of seed materials of Lakadong turmeric is available at Sikkim. Also helped in getting GI was for Kandhamal turmeric
3.	Turmeric is used for various purposes from culinary to pharma. Hence, all the possible biochemical traits should be observed and considered in the varieties	Chemoprofiling has been initiated t IISR to analyze the pharmaceutical compounds viz., curcuminoids, tumerone, turmerol etc. biochemical quality characters / profile will also be included in varietal proposal in future
4.	The ADG (Horti.), ICAR suggested to have MoU with industry like ITC for possible collaborative works.	A consultative meeting on turmeric value chain development was organized at Hyderabad for industry collaboration for value chain development The VERITY KS, under CSR programme is involved in promotion of turmeric in Adilabad district involving high yielding high curcumin varieties, soil and plant health management for yield enhancement in turmeric. The Apollo Hospitals Limited, under CSR has initiated scientific cultivation of turmeric in Kamareddy district to develop a complete value chain in turmeric from scientific cultivation to curcumin extraction.
5.	Government intervention in mechanization and price fixation based on quality is essential.	Farmers started using mechanization in Bed makers , Automatic seed planter, Turmeric digger etc. AICRPS centre at Nagaland in collaboration with ISS has arranged an interactive meeting of buyers and suppliers for getting better prices and the industry is

		willing pay for better product in large quantity
6.	Soil mineral may influence the curcumin and other quality paramteres, hence, soil mapping of turmeric growing areas for nutrient status and heavy metal contaminations should be initiated.	Soil analysis in some turmeric producing regions found micronutrient deficiencies and IISR has come out with site specific nutrient recommendations based on target yield approach and Micronutrient formulations for different pH level also available and licensed. Many farmers are using this products
7.	Promotion of tribal horticulture including spice should be organized	Workshop on post harvest handling and primary processing in spices was organized at Horticulture Research Station, Chintapalli, AP during June 2018
8.	Research on safer fungicide with minimal spray for food safety issues may be initiated	Joint survey by ICAR-IISR and AICRPS Centres Guntur and Kamarapally was conducted during October 2017 in Andhra Pradesh and Telegana (Major turmeric growing regions), The incidence of foliar diseases was found to be very high (60-80 per cent) with the severity ranging from 10-40 percent. Rhizome rot incidence of both fungal and nematode origin was prevalent. Guidelines for reduced use of pesticides has been recommended.
9.	Model for value chain in turmeric should be developed region specific..	ICAR-IISR, Kozhikode and AICRPS, Kamarapally and Guntur, Chintapalli in association with DASD, Dept of Horticulture, Telangana and Andhra organized Consultative meeting on turmeric' . Strategies for enhancing quality and productivity of turmeric in these states was formulated. The scientists, department officials, progressive farmers and leading turmeric processors participated in the discussion on value chain development.
10	Record of the original collection number should be maintained when the genetic resources are exchanged among centres to avoid duplication in germplasm.	Noted
11.	DNA finger printing has to be done for all the released varieties and unique germplasm to be registered.	DNA finger printing has been done for ginger genotypes (Suprabha, Suruchi), turmeric (Roma, Suroma, Rasmi, TCP 64 & TCP 129), coriander (Acr-2) and fenugreek (AFg- 5)
12.	Selection has to be done in the ginger cultivar Nadia for North East giving special emphasis to boldness, low fibre and high oil.	Characterization of genotypes for low fibre and high oil content is being done for identification at Barapani

TECHNICAL SESSION I: GENETIC RESOURCES AND CROP IMPROVEMENT			
Sl. No.	Decision/Recommendations	Centres	Action Taken
13.	In seed spices the germplasm has to be managed scientifically to maintain purity.	All seed spice Centres	It is being followed and maintained scientifically for purity
14.	In cumin breeding, wilt and blight resistance to be given more thrust.	All seed spice Centres	Efforts are being intensified at Jobner
15.	Breeding programmes to be focused to develop fennel varieties with resistance to <i>Ramularia</i> blight	All seed spice Centres	It is being followed and are being tested at Jagudan sick plots
16.	Seed spices should be tried in non-traditional areas.	All centres	Being tested in Bangalore and Madurai conditions. Seed set was observed.
17.	In CVT for seed spices, the coding will be done during the first year and the same code will be followed for the subsequent years.	All seed spice Centres	Coding done only for first year
18.	Germplasm collection and evaluation of large cardamom with special emphasis on disease resistance needs to be strengthened	Large cardamom centres	Survey was conducted in Dzongu area of North district of Sikkim and collected two unique germplasm of large cardamom
19.	Data on quality analysis for drip irrigation and fertigation trial in coriander may be collected	Jobner	Quality analysis carried out
20.	The planting materials may be multiplied and the trial on Evaluation of thrips tolerant cardamom lines should be laid out during next planting season.	All cardamom centres	Trials were laid out in all centres
21.	Promising nutmeg accessions may be registered with PPVFRA	Thrissur	Four accessions registered with PPVFRA and their on farm testing completed by the PPVFRA regional centre KKVV, Dapoli, Maharashtra
TECHNICAL SESSION II: CROP MANAGEMENT			
22.	Data on quality aspects should be included in all the management trials.	All centres	Quality aspects included
23.	In Black pepper based mixed cropping system - observations on growth parameters of the main crop may also be recorded. Plot size may	All black pepper centres	Being followed

	be fixed as six pepper vines and the intercrop yield in between six pepper vines may be reported		
TECHNICAL SESSION III: CROP PROTECTION			
24.	The expertise of IISR, Kozhikode and identified institutes may be utilized for the identification of pathogens	All centres	This was followed as suggested
25.	In the trials involving biocontrol agents and chemicals, compatibility shall be ascertained.	All centres	This was followed as suggested
26.	The new trials aiming at setting MRL levels shall be initiated	All seed spice centres	Will be done this Rabi season
27.	Evolving disease and pest tolerant lines in large cardamom project may be concluded and the promising leaf blight resistant accessions shall be evaluated	Large cardamom centres	The experiment will be laid out
TRANSFER OF TECHNOLOGY			
28.	The promising technologies may be demonstrated in farmer's field and it has to be included in the Package of Practices of respective states.	All centres	Promising technologies are demonstrated in farmer's field by the respective centres
PLENARY SESSION			
29.	Status report of each AICRPS centres may be published	All centres	Will do this year
30.	HRD to be strengthened and scientist must be encouraged to obtain fellowships like INSA	All centres	2+2 of our scientists got fellowships

This was followed by presentations of recommendations from various sessions by the Rapporteurs.

Genetic Resources & Crop Improvement session: Project wise recommendations were presented by the rapporteur. Some of the new programmes started in Genetic Resources and Crop Improvement were coordinated varietal trials in coriander, fennel and fenugreek.

Crop Management Session: Rapporteur presented the session report. University of Agricultural Science and Technology of Kashmir has given presentation on scope, importance and economics of Saffron and *Kala zeera* cultivation in Jammu & Kashmir and proposed few experiments to get Project mode funding from ICAR-AICRP on Spices.

Crop Protection: Project wise recommendations were presented by the rapporteur. Some of the new programmes started were integrated pest and disease management in coriander and cumin

Transfer of Technology: Rapporteur presented the session report and during this session six technologies were recommended. Some of the general recommendations are as follows

- Centres should take necessary steps and pursue to include these technologies in the respective state/SAUs package of practices.
- Letter from coordinator should go to DDG (Extn.) to demonstrate these technologies in KVKs.
- 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.

Variety Release Session: Rapporteur presented the report of the session in which eleven varieties were recommended for release. It was suggested to prepare the varietal spread document.

Dr. Vijay Singh Thakur, Former VC and Director of Extension Education, Dr. YSPUH&F, Solan, in his remarks emphasized on the land use efficiency of spices in mixed cropping system and also the importance of Imachal grown spices which are rich in flavour and fragrance. Importance should be given for basic agricultural research.

Dr. J. N. Sharma, Director of Research, Dr. YSPUH&F, Solan highlighted the need for identifying niche areas for AICRPS centres and also the new avenue for seed spices at Solan can also be attempted.

Dr. K.K Jindal, Former DOR, Dr. YSPUHF, Solan & CAU, Pasighat and Dr. T. John Zachariah were honoured for their achievements by ADG. Publications on Cultivation aspects of ginger released by ADG and Corriander disease and its management was released by Dr. Vijay Singh Thakur.

Dr. T. Janakiram, ADG (HS-II) in his remarks appreciated the efforts of AICRPS team having won the prestigious ICAR award. He also congratulated the Best AICRPS centre Panniyur and the scientists whose varieties & technologies were approved in the workshop. He also mentioned that a replica of AICRPS ICAR Award can be given to all the centres with certificate from SMD (Horticulture). He also emphasized the importance of spices in doubling farmers income and highlighted the importance of temperate spices crops like Saffron and *Bunium* sp. (Black cumin) for Jammu & Khasmir and Himachal Pradesh conditions. He also addressed on future challenges in spices likes precision farming, artificial intelligence and censor applications, vertical farming system, bio pesticide and residues, gene editing, rationalization of facilities and scientific experts, Accredited nurseries for quality planting material, value addition, E-governance adoption, digitalization of field notebooks, Mobile app development and road map for organic cultivation at North-East with the help of NABARD.

Dr. K. Kandiannan, Principal Scientist, IISR proposed the Vote of thanks and the session was concluded with National Anthem.

Revised Research Programmes

Crop Improvement

Some of the new Research Programmes given in the XXVIII AICRPS workshop proceedings were revised as follows

Crop	Coriander	
Title of the Programme	Coordinated varietal trial on coriander – 2018- Series X	
Centre	Ajmer, Coimbatore, Dholi, Guntur, Hisar, Jabalpur, Jagudan, Jobner, Kumarganj, Navsari, Pantnagar, Kota, Raigarh	
Year of start	2018	
No. of treatments/genotypes	1. DH 208 (Hisar) 2. DH 312 (Hisar) 3. UD 815 (Jobner) 4. UD 808 (Jobner) 5. ND Cor 102 (Kumarganj) 6. ND Cor 110 (Kumarganj) 7. RKD 1 (Kota) 8. RKD 2 (Kota) 9. RD 383 (Dholi) 10. RD 437 (Dholi)	11. Hisar Anand (check) 12. RCr 728 (NC) 13. LCS-12-7 (Guntur) 14. LCS-12-5 (Guntur) 15. RCC 12-7 (Raigarh) 16. JCr- 2013-15 (Jagudan) 17. JCr- 2013-16 (Jagudan) 18. Ac 6 (Ajmer) 19. Ac 7 (Ajmer)
Design	Randomized Block Design	
No. of replications	Three Replications	
Plot size/spacing	3×2.4 m, spacing 30x 10 cm, 240 plants/plot	
Observations to be taken	<ul style="list-style-type: none"> ✓ Germination % ✓ Days to 50% flowering ✓ Plant height (cm) ✓ Branches per plant ✓ Days to maturity ✓ Umbels per plant ✓ Umbellets per umbel ✓ Seeds per umbel ✓ Test weight (g) ✓ Seed yield (kg/ha) ✓ Incidence of pests (mites, aphids) ✓ Incidence of diseases (wilt, powdery mildew, stem gall, blight) 	

Crop	Fennel
Title of the Programme	Coordinated varietal trial on fennel – 2018 Series X
Centre	Ajmer, Dholi, Hisar, Jabalpur, Jagudan, Jobner, Kumarganj, Pantnagar
Year of start	2017-18
No. of treatments/genotypes	<ol style="list-style-type: none"> 1. HF 179 (Hisar) 2. HF 146 (Hisar) 3. UF 289 (Jobner) 4. UD 286 (Jobner) 5. NDF 77 (Kumarganj) 6. NDF 84 (Kumarganj) 7. RF 5 (Dholi) 8. RF 31 (Dholi) 9. AF 05 (Ajmer) 10. AF 04 (Ajmer) 11. JF 2013-19 (Jagudan) 12. JF 2013-16 (Jagudan) 13. RF-101 (check) 14. RF 205 (check)
Design	Randomized Block Design
No. of replications	3 Replications
Plot size/spacing	3x2.5 m Spacing: 50x20 cm
Observations to be taken	<ul style="list-style-type: none"> ✓ Germination % ✓ Days to 50% flowering ✓ Plant height (cm) ✓ Branches per plant ✓ Umbels per plant ✓ Umbellets per umbel ✓ Seeds per umbel ✓ Test weight (g) ✓ Seed yield per plant (g) ✓ Seed yield (kg/ha) ✓ Incidence of pests (aphids) ✓ Incidence of diseases (leaf blight, powdery mildew, gall, bacterial soft rot)

Crop	Fenugreek
Title of the Programme	Coordinated varietal trial on fenugreek – 2018 Series X
Centre	Ajmer, Coimbatore, Dholi, Guntur, Hisar, Jabalpur, Jagudan, Jobner, Kumarganj, Navsari, Pantnagar, Kota, Raigarh
Year of start	2017-18
No. of treatments/genotypes	<ol style="list-style-type: none"> 1. RM 196 (Dholi) 2. RM 201 (Dholi) 3. HM 273 (Hisar) 4. HM 355 (Hisar) 5. NDM 80 (Kumarganj) 6. NDM 120 (Kumarganj) 7. KFG-1 (Kota) 8. KFG- 2 (Kota) 9. Hisar Sonali (check) 10. UM 393 (Jobner) 11. UM 411 (Jobner) 12. IFGS-11 (Raigarh) 13. AFG 06 (Ajmer) 14. AFG 07 (Ajmer) 15. JFG 2013-16 (Jagudan) 16. JFG 2013-02 (Jagudan) 17. HM 444 (Hisar)
Design	Randomized Block Design
No. of replications	Three Replications
Plot size/spacing	3 x 1.5 m spacing : 30x10 cm
Observations to be taken	<ul style="list-style-type: none"> ✓ Germination % ✓ Days to 50% flowering ✓ Plant height (cm) ✓ Branches per plant ✓ No. of pods ✓ Pod length (cm) ✓ Seeds per pod ✓ Test weight (g) ✓ Seed yield per plant (g) ✓ Seed yield (kg/ha) ✓ Incidence of pests (aphids, leaf eating caterpillar, pod borer) ✓ Incidence of diseases (powdery mildew, downy mildew, damping off, rust, root rot, leaf spot)

Crop Protection

Crop	Coriander
Title of the Programme	Integrated pest & disease management in coriander
Centre	Ajmer, Coimbatore, Dholi, Hisar, Jabalpur, Jagudan, Jobner, Kumarganj, Navsari, Pantnagar, Kota, Raigarh
Year of start	2018
No. of treatments/genotypes	<p>T1- Sprays of Propiconazole 25 EC @ 0.05% (10 ml/10 L) (first & second spray) + Two foliar sprays of <i>Lecanicillium lecanii</i> 1.15WP (1x10⁹ cfu/g) (40 g/10 L.)</p> <p>T2- Spray of Propiconazole 25 EC @ 0.05% (10 ml/10 L) (first & second spray) + Two foliar sprays of Acetamiprid 20SP (0.004%)</p> <p>T3- Spray of Carbendazim 50 WP @ 0.1% (20 g/10 L water) (first & second spray) + Two foliar sprays of <i>Lecanicillium lecanii</i> 1.15WP (1x10⁹ cfu/gm) (40g/10 L.)</p> <p>T4- Spray of Carbendazim 50 WP @ 0.1% (20 g /10 L water) (first & second spray) + Two foliar sprays of Acetamiprid 20SP (0.004 %)</p> <p>T5- Two foliar sprays of <i>Lecanicillium lecanii</i> 1.15WP (1x10⁹ cfu/g) (40 g/10 L.) + spray of Propiconazole 25 EC @ 0.05% (10 ml/10 L) (first spray) + spray of Carbendazim @ 0.1% (second spray)</p> <p>T6- Two foliar sprays of <i>Lecanicillium lecanii</i> 1.15WP (1x10⁹ cfu/g) (40g/10 L) + spray of Carbendazim 50 WP @ 0.1% (20 g/10 L water) (first spray) + spray of Propiconazole 25 EC @ 0.05% (10 ml/10 L) (second spray)</p> <p>T7- Two foliar sprays of Acetamiprid 20SP (0.004%) + spray of Propiconazole 25 EC @ 0.05% (10 ml/10 L) (first spray) + spray of Carbendazim 50 WP @ 0.1% (20 g/10L water) second spray)</p> <p>T8- Two foliar sprays of Acetamiprid 20SP (0.004%) + spray of Carbendazim 50 WP @ 0.1% (20 g/10 L water) (first spray) + spray of Propiconazole 25 EC @ 0.05% (10 ml/10 L) (second spray)</p> <p>T9- Package developed by respective SAUs</p> <p>T10- Untreated control</p>
Design	Randomized Block Design
No. of replications	Three Replications
Plot size/spacing	3 x 1 m spacing : 30x20 cm

Observations to be taken	<ul style="list-style-type: none"> ✓ Germination % ✓ Days to 50% flowering ✓ Umbels per plant ✓ Umbellets per umbel ✓ Seeds per umbel ✓ Test weight (g) ✓ Seed yield (kg/ha) ✓ Oil content (%) ✓ Per cent Disease Index (blight, powdery mildew), Per cent Disease Incidence (wilt) – Record monthly ✓ Pest count (3,7,15, 21 days after spray) ✓ Residue analysis
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General treatment: Seed treatment with *Trichoderma harzianum* @10g/kg + Soil application of Neem cake 0.5 t/ha enriched with *Trichoderma harzianum*

Note

- Fungicide - 2 sprays (First spray at the onset of disease and second spray at 15 days after first spray)
- Two foliar sprays of respective Insecticides/ bio-pesticides will be given. First spray will be made at threshold level 1.5 aphid index and second spray to be made at 10 days of the first spray.
- The aphid index will be fixed as per Patel (1980) for estimating the population of aphid and average aphid index will be worked out by adopting formula.

$$\text{Average aphid index} = \frac{0N + 1N + 2N + 3N + 4N + 5N}{\text{Total number of plants observed}}$$

Total number of plants observed

Where, 0, 1, 2, 3, 4, 5 are the aphid index,

N = Number of plants showing respective aphid index

- Insecticides/ bio-pesticides & fungicides are not to be mixed

Crop	Cumin
Title of the Programme	Integrated pest & disease management in cumin
Centre	Ajmer, Jagudan, Jobner, Mandor
Year of start	2018
No. of treatments/genotypes	<p>T1- Three sprays of Hexaconazole 5 EC @ 0.005% (10 ml/ 10 L water) +Two foliar sprays of thiamethoxam 25WG (0.0084%)</p> <p>T2- Three sprays of Hexaconazole 5 EC @ 0.005% (10 ml/10 L water) + Two foliar sprays of <i>B. bassiana</i> (1x10⁹ cfu/g) (40 g/ 10L)</p> <p>T3- Three sprays of Hexaconazole 5 EC @ 0.005% (10 ml/10L water) +Two foliar sprays of <i>Lecanicillium lecanii</i> 1.15WP (1x10⁹ cfu/g) (40g/10 L)</p> <p>T4- Three sprays of Kresoxym methyl 44.3 SC @ 0.044% (10 ml/ 10 Lwater) +Two foliar sprays of thiamethoxam 25WG (0.0084%)</p> <p>T5- Three sprays of Kresoxym methyl 44.3 SC @ 0.044% (10 ml/ 10 L water) + Two foliar sprays of <i>B. bassiana</i> (1x10⁹ cfu/ g) (40g/10L)</p> <p>T6- Three sprays of Kresoxym methyl 44.3 SC @ 0.044% (10 ml/ 10 L water) + Two foliar sprays of <i>Lecanicillium lecanii</i> 1.15 WP (1x10⁹ cfu/g) (40g/10 L)</p> <p>T7- Three sprays of Hexaconazole 5 EC @ 0.005% (10 ml/10 L water) + First foliar spray of thiamethoxam 25WG (0.0084%) and second foliar spray of <i>B. bassiana</i> (1x10⁹ cfu/gm) (40 g/ 10 L)</p> <p>T8- Three sprays of Kresoxym methyl 44.3 SC @ 0.044% (10 ml/ 10 Lwater) + First foliar spray of thiamethoxam 25WG (0.0084 %) and second foliar spray of <i>B. bassiana</i> (1x10⁹ cfu/g) (40g/10 L)</p> <p>T9- Three sprays of Hexaconazole 5 EC @ 0.005% (10 ml/ 10 L water) + First foliar spray of thiamethoxam 25WG (0.0084%) and second foliar spray of <i>Lecanicillium lecanii</i> .15WP (1x10⁹ cfu/ g) (40g/10 L)</p> <p>T10- Three sprays of Kresoxym methyl 44.3 SC @ 0.044% (10 ml/ 10 L water) + First foliar spray of thiamethoxam 25WG (0.0084%) and second foliar spray of <i>Lecanicillium lecanii</i> 1.15WP(1x10⁹ cfu/g) (40g/10 L)</p> <p>T11- Three sprays of Hexaconazole 5 EC @ 0.005% (10 ml/ 10L water) + First foliar spray of <i>B. bassiana</i> (1x10⁹ cfu/g) (40g /10 L) and second spray of <i>Lecanicillium lecanii</i> 1.15WP (1x10⁹ cfu/g) (40g/10 L)</p> <p>T12- Three sprays of Kresoxym methyl 44.3 SC @ 0.044% (10 ml/ 10 L water) + First foliar spray of <i>B. bassiana</i> (1x10⁹ cfu/g) (40 g/ 10 L) and second spray of <i>Lecanicillium lecanii</i> 1.15WP (1x10⁹ cfu/g) (40g/ 10L)</p> <p>T13- Package developed by respective SAUs</p> <p>T14- Untreated control</p>
Design	Randomized Block Design
No. of replications	Three Replications
Plot size/spacing	3 x 2.4 m spacing : 30x5 cm

Observations to be taken	✓	Germination %
	✓	Days to 50% flowering
	✓	Umbels per plant
	✓	No. of pods per plant
	✓	Pod length (cm)
	✓	Test weight 1000 seeds(g)
	✓	Seed yield (kg/ha)
	✓	Oil content (%)
	✓	Per cent Disease Index (blight, powdery mildew), Per cent Disease Incidence (wilt) – Record monthly
	✓	Pest count (3,7,15, 21 days after spray)
✓	Residue analysis	

General treatment: Seed treatment with *Trichoderma harzianum* @10g/kg + Soil application of Neem cake 0.5 t/ha enriched with *Trichoderma harzianum*

Note

- Fungicide - 3 sprays (First spray at the onset of disease and subsequent sprays at an interval of 15 days after first spray)
- Two foliar sprays of respective Insecticides/ bio-pesticides will be given. First foliar spray will be made at initiation of aphid and the second spray will be given after 10 days of the first spray
- Insecticides/ bio-pesticides & fungicides are not to be mixed.

New Research Programmes

Crop Improvement

Crop	Ginger
Title of the Programme	CVT on disease tolerance trial in ginger
Centre	Barapani, Chintapalli, IISR, Pottangi, Pundibari, Nagaland, Gangtok, Raigarh
Year of start	2019
No. of treatments/genotypes	11 Genotypes 1. R 1.25/4 (IISR) 2. G 1.00/4 (IISR) 3. HP 05/ 15 (IISR) 4. HP 0.5/2 (IISR) 5. V 0.5/2 (IISR) 6. V1E4 1 (Pottangi) 7. V1E4 5 (Pottangi) 8. V2E5 2 (Pottangi) 9. IISR Varada (control) 10. Indira Ginger
Design	Randomized Block Design
No. of replications	Three replications
Plot size/spacing	3×1 m, spacing- 25x 25 cm
Observations to be taken	<ul style="list-style-type: none"> ✓ Sprouting percentage ✓ Plant population at 50 DAS ✓ Plant height (cm) ✓ Number of tillers per clump ✓ Fresh weight of clump (g) ✓ Fresh rhizome yield /ha (t) ✓ Dry rhizome yield /ha (t) ✓ Dry recovery (%) ✓ Boldness of rhizome ✓ Fiber content ✓ Oleoresin (%) ✓ Essential oil (%) Disease (bacterial wilt, rhizome rot) and pest (shoot borer) incidence, if any

Crop	Mango Ginger
Title of the Programme	CVT on mango ginger
Centre	Ambalavayal, Barapani, Dholi, IISR, Pottangi, Navsari, Pundibari, Raigarh
Year of start	2019
No. of treatments/genotypes	9 Genotypes 1. Acc 265 (IISR) 2. Acc 347 (IISR) 3. CAM 2 (Pottangi) 4. CAM 3 (Pottangi) 5. RH 408 (Dholi) 6. NVMG 2 (Navsari) 7. NVMG 9 (Navsari) 8. NVMG 10 (Navsari) 9. Amba (control) 10. Indira Mango Ginger
Design	Randomized Block Design
No. of replications	Three replications
Plot size/spacing	3×1 m, spacing- 25x 25 cm
Observations to be taken	<ul style="list-style-type: none"> ✓ Sprouting percentage ✓ Plant population at 50 DAS ✓ Plant height (cm) ✓ Number of tillers per clump ✓ Fresh weight of clump (g) ✓ Fresh rhizome yield /ha (t) ✓ Dry rhizome yield /ha (t) ✓ Dry recovery (%) ✓ Boldness of rhizome ✓ Fiber content ✓ Oleoresin (%) ✓ Essential oil (%) Disease (bacterial wilt, rhizome rot) and pest (shoot borer) incidence, if any

Crop	Turmeric
Title of the Programme	IET on Turmeric
Centre	Guntur
Year of start	2018-19
No. of treatments/genotypes	11 Genotypes 11. AC-94 12. CL-15 13. CL-19 14. CL-335 15. CL-4 16. CL-8 17. CLI-342-1 18. CLT-355 19. GLP-1 20. GLP-2 21. PTS-4 22. RH-8/80 23. Rajapuri 24. ST-10 25. ST-365 26. LTS-20 27. BSR-2 (C) 28. Mydukur (C)
Design	Randomized Block Design
No. of replications	Two replications
Plot size/spacing	1.2 × 4 m, spacing- 60 x 20 cm
Observations to be taken	<ul style="list-style-type: none"> ✓ Plant height (cm) ✓ Number of leaves per plant ✓ Leaf length ✓ Leaf width ✓ Number of tillers per clump ✓ No. of mother rhizomes per clump ✓ Weight of mother rhizomes ✓ No. of primary rhizomes per clump ✓ Weight of primary rhizomes ✓ Fresh weight of clump (g) ✓ Fresh rhizome yield /ha (t) ✓ Dry rhizome yield /ha (t) ✓ Dry recovery (%) ✓ Curcumin (%) Disease and pest incidence, if any

Crop	Small Cardamom
Title of the Programme	Effect of micro nutrients on growth and yield of small cardamom
Centre	Appangala, Mudegere, Pampadumpara, Myladumpara, Sakleshpur
Year of start	2019
Design	RBD
Variety	Any three varieties
Plot size/spacing	2×2 m, 12 plants per plot
No. of treatments/genotypes	T 1: Recommended package of practice (control) T2: Recommended package of practice + IISR cardamom micro nutrient four sprays at March, April, May, June @ 5 g/ 1
No. of replications	3 Replications
Observations to be taken	<p>Physio chemical properties of the soil: pH, nutrient status (major, secondary and micro nutrients)</p> <p>Growth parameters</p> <ul style="list-style-type: none"> ✓ Plant height (cm) ✓ Number of tillers per clump ✓ Number of bearing tillers per clump ✓ Number of panicles per clump ✓ Panicle length (cm) ✓ Number of capsules per clump ✓ Fresh capsule yield per panicle (g) ✓ Fresh capsule yield per clump (g) ✓ Fresh capsule yield per hectare (kg) ✓ Dry capsule yield per hectare (g) ✓ Dry recovery (%) ✓ % of bold capsules (8 mm) ✓ Oil content (%) ✓ 1,8 cineole content (%) ✓ Incidence of pests (shoot borer, shoot fly, thrips) ✓ Incidence of diseases (rhizome rot, leaf blight)

Crop	Fenugreek
Title of the programme	Standardization of drip irrigation interval and method of micro nutrient fertigation in fenugreek
Objectives	1. To determine drip irrigation interval with fixed quantity of water 2. To determine appropriate method of micro nutrients application
Centres	Ajmer, Coimbatore, Hisar, Jabalpur, Jagudan, Jobner, Kumarganj, Navsari, Pantnagar, Kota, Raigarh
Year of start	2019
Duration of the project	3 years
Design	SPD
No. of treatments with details	Main plot (drip irrigation interval) 1. 2 days 2. 4 days 3. 6 days 4. 8 days Sub plot (method of micro nutrient (Zn, Fe, Mn, B, Mo) fertigation) 1. Control 2. Soil application 3. Foliar application 4. Fertigation
Replications	3
Plot size/spacing	4.5 x 5 m, 30 x 10 cm
No. of plants per treatment	16
Date of sowing/season	Rabi, 2018
Methodology & Procedure to be adopted	Recommended package of practices
Observations to be recorded in detail	<ul style="list-style-type: none"> ✓ Germination % ✓ Days to 50% flowering ✓ Plant height (cm) ✓ Pods per plant ✓ Seeds per pod ✓ Test weight (g) ✓ Seed yield (kg/ha) ✓ Water use efficiency ✓ Incidence of pests (aphids, leaf eating caterpillar, pod borer) ✓ Incidence of diseases (powdery mildew, downy mildew, damping off, rust, root rot, leaf spot)

Treatment detail:

1. Water applied at 0.6 IW/CPE in drip irrigation as per recommended package of practice. In 2 days interval it will be $\text{Evap.} = 0.6 \times 0.85 \times 0.6$ (pan factor) X 0.6 (IW/ CPE ratio), in 4 days interval it will be $\text{Evap.} = 0.6 \times 0.85 \times 0.6$ (pan factor) X 0.6 (IW/ CPE ratio), and so on.
2. The micro nutrients include Zn as zinc sulphate, Fe as iron sulphate, Mn as manganese sulphate, B as borax and Mo as ammonium molybdate. The recommended dose of micro nutrients will be applied as soil application (fixed dose of all micro nutrients as per prevailing recommendation or soil status), foliar spray (fixed dose of all micro nutrients as per prevailing recommendation or soil status) and fertigation (fixed dose of all micro nutrients as per prevailing recommendation or soil status).

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86-91	Six
92-107	COMMITTEE MEMBERS AND SPECIAL INVITEES (15 Members)



TCP 129



Solan Giriganga



Konkan Sanyukta



Rajendra Dhania 3



Ajmer Coriander 3



Chhattisgarh Sri Chandrasini Dhania - 2



Ajmer fennel 3



Gujarat cumin 5



Narendra Richa (NDM 79)



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