150 YEARS OF CELEBRATING THE MAHATMA

अखिल भारतीय समन्वित गन्ना अनुसंधान परियोजना

All India Coordinated Research Project on Sugarcane

Project Coordinator's Report 2018-19

Dr A D Pathak

Director & Project Coordinator

भाकृअनुप–भारतीय गन्ना अनुसंधान संस्थान, लखनऊ–226 002

ICAR-Indian Institute of Sugarcane Research

Lucknow - 226 002

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PREFACE

Sugarcane is grown in an area of about 5.0 million hectares in both tropical and sub-tropical regions of the country. India is the second largest sugarcane cultivating country next to Brazil. Sugar industry is also second largest agro-based industry in India after cotton and textiles. Sugar from sugarcane crop is the main source of sweetener and contributes about 80% at international level. Besides this, sugarcane is also used for making brown sugar (khandsari) and jaggery (gur) in the country. During white sugar production, by-products of sugarcane industry like bagasse and molasses are also produced. Bagasse is mainly used as fuel and also used for production of compressed fibre board, paper, plastic etc. Molasses is used in distilleries for manufacturing of ethyl alcohol, butyl alcohol, citric acid and also used as an additive to feeds for livestock. Press mud cake can be used as soil amendment in saline and alkali soils whereas its application on normal soils also increases the organic carbon content of soil besides supplying N,P,K,S and other micronutrients.

The AICRP (Sugarcane) played an important role in accelerating the growth of sugarcane by way of developing location specific improved sugarcane varieties, crop production and protection technologies. This resulted into quick spread of improved sugarcane varieties developed under AICRP(S) and released through CVRC and sustained the cane and sugar yields, despite adverse agro-climatic conditions in different sugarcane growing zones. At present > 90% of area under sugarcane has been occupied by the improved varieties developed under AICRP on Sugarcane network. Consequently, the country has produced 383.89 mt sugarcane with productivity of 74.4 t/ha from 5.15 m ha area. The consolidated efforts viz. increased area under improved varieties, adoption of suitable agro-techniques and plant protection measures significantly enhanced recovery up to 10.85% and sugar production by 32.50 mt which is the highest till now at the national level during 2018-19. It provides the country self-reliance in sugar production which is the important commodity for mass utilization.

Now, in view of self-reliance in sugar production. The sugarcane sector, surplus production is required to be diverted for ethanol production to increase the clean and green fuel. According to the new bio-fuel policy, Government of India aims to achieve a target of 20 per cent ethanol blending with petrol by 2030, and to have 10 per cent blending with petrol by 2022. The average ethanol blending in the country during the first four months of current year from December 2018 to March 2019 has been more than 8 per cent in 10 states. Against a requirement of 330 crore litres of ethanol for 10 per cent blending in the country, excluding J & K, North Eastern States and island territories, ethanol supply contracts have been signed for 237 crore litres for the ethanol supply period 2018-19 (December – November). This is the highest ethanol supply contracts.

Various uses of sugarcane are demanding its increased production from limited land resource under changing climatic scenario. To develop location specific high yielding sugarcane varieties with high sugar, zonal varietal trials of early and mid-late maturing varieties were conducted to screen the promising genotypes. In view of developing abiotic stress tolerant varieties ISH & IGH programmes are being executed at various centers for both drought as well as water-logging conditions. Total twenty five (Early 12, Mid-late 09 and 04 trials combining early and midlate maturity groups) varietal trials were conducted during the year 2018-19. A total of 42 entries in early group, 48 in midlate group and 51 entries combining early and mid-late maturity groups were evaluated. Thus resulting into 12 in early and 13 in midlate and 9 in combining early and midlate maturity groups were found to be promising.

In East Coast zone, 05 clones in early and 02 clones in midlate group were found to be promising and in North West zone, 3 clones in early group and 8 clones in midlate group were found to be promising. Four sugarcane varieties, two in early (Co 10026-Upahar, CoLk 12207-Ikshu-6) and two midlate (Co 12209-Karan-13, CoLk 12209-Ikshu-7) maturing group identified by AICRP on Sugarcane were notified by Central Varietal Release Committee during 2018-19.

To achieve the desired goal, various issues have been addressed for developing sustainable sugarcane production for which response of bio-fertilizer, FYM/compost and also the effect of mulching have been evaluated. Addition of 20 t/ha FYM/ compost along with inorganic fertilizers applied on the basis of soil test crop response for targeted yield or on the basis of general recommendations for the region has shown positive effect on sugarcane growth and yield both in plant and ratoon crops. Response of bio-fertilizers (Azotobacter/ Acetobacter/ Azospirillum/ PSB) was more pronounced in peninsular zone. Planting of sugarcane in paired rows with mulching of trash (6 t/ha) in the inter-row spaces out yielded the conventional flat method with or without mulch at all the centres in north western, north central and north eastern zones. Being in the climatic region of high evaporative demand sugarcane crop responded up to 1.0 IW/CPE irrigation regime in the zones, however, similar yields have been recorded with 0.8 IW/CPE ratio at many centres. Trash mulching could effectively save 20-26% irrigation water over no-mulching. Use of mulch in sub-tropical zones and green manuring followed by mulching and residue incorporation in tropical zones resulted in higher net return.

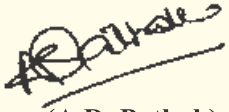
In Plant Pathology, during 2018-2019, eight experiments were allotted to seventeen AICRP(S) centers in different sugarcane producing zones of the country. Differential host studies was conducted at 12 AICRP(S) centres in all the zones with 72 new isolates along with designated pathotypes on the 19 host differentials to identify variation in red rot. More number of pathogenic variants have been isolated from the popular varieties such as Co 89003, CoC 24, CoS 8436, CoSe 92423 and CoSe 95422. The new isolates behaved almost similar to the existing pathotypes however; there is enough indication of emergence of new pathotype(s) from Uttar Pradesh and Haryana. Fifteen AICRP(S) centres have carried out red rot and smut testing, six for wilt and twelve for YLD resistance. Large numbers of entries were identified as R/MR to red rot, smut and wilt from all the four sugarcane producing zones. AICRP(S) centre's recorded YLD resistance in the ZVT entries and reported moderate to severe occurrences of YLD under field conditions on the popular sugarcane varieties.

In Entomology, during 2018-19, six projects were conducted at 9 centres (regular and voluntary) under 3 different sugarcane producing zones of India. In North West Zone, out of all the genotypes/ varieties screened against major insect-pests, highly susceptible were CoPb 14211, CoH 13263 against top borer; CoPant 13244, CoH 13263, Co 14185, Co 0238 against root borer; Co 13034, Co 05011, CoLk 13204, Co 0238 against stalk borer and Co 0238 against internode borer. In peninsular zone, genotypes/ varieties viz., Co 12007, CoSnk 13106, CoSnk 05103, Co 15018, Co 15020, Co 15021, CoVC 15061, CoSnk 05103 were either less or moderately susceptible while rest all were highly susceptible against early shoot borer.

The bioagents, viz., Telenomus dignus, Telenomus beneficiens, Isotima javensis, Cotesia flavipes, Rhaconotus scirpophagae, Encarsia flavoscutellum, Fulgoraesia (Epiricania) melanoleuca, Stenobracon deesae, Stenobracon sp. Tetrasticus pyrillae Encarsia flavoscutellum, Dipha aphidivora, Coccinella septempunctata, Cheilomenes sexmaculata were found active against different insect-pests in sugarcane. Low incidence of insect-pests with higher yield and B:C ratio was recorded in IPM plots as compared to farmers' practice in all the experiments conducted by different centres.

AICRP on Sugarcane is also the nodal agency for conducting a DUS Testing Programme under the Protection of Plant Variety and Farmers Rights Authority at its two cooperating cenres- ICAR-Indian Institute of Sugarcane Research, Lucknow and ICAR-Sugarcane Breeding Institute, Coimbatore.

The salient research achievements of 2018-19 in Crop Improvement, Crop Production, Plant Pathology and Entomology disciplines are being presented in this report.



(A.D. Pathak)
Director & Project Coordinator (Sugarcane)

ACKNOWLEDGEMENTS

The Annual Group Meeting of the AICRP on Sugarcane is a mandatory activity to review the ongoing research projects on sugarcane at all India level and formulate the need based research programme for the next crop season. We wish to express our deep sense of gratitude to Dr. Trilochan Mohapatra, Secretary, DARE and Director General, ICAR for his kind approval for permitting us to organize the Annual Group Meeting at the University of Agricultural Sciences, Dharwad, Krishinagar (Karnataka) during October 14 to 16, 2019.

We are highly grateful to Dr M. B. Chetti, Vice Chancellor, UAS, Dharwad (Karnataka) for hosting the Annual Group Meeting of AICRP on Sugarcane at this premier University and providing all the facilities and support. We are also highly grateful to Dr A.K. Singh, Deputy Director General (CS) and Dr. R.K. Singh, Asstt. Director General (Commercial Crops), ICAR for their valuable guidance and encouragement in effective execution of the research programme of the AICRP on Sugarcane, timely review of the outcome, granting Council's approval for this programme and necessary fund provisions thereon.

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We profusely thank Director of Research, UAS, Dharwad (Karnataka), Dr S.B. Patil, Principal Scientist & Head, ARS, Sankeshwar (Organizing Secretary of Annual Group Meeting) and the staff members of the University involved in different committees and Station Incharges of all the research centres for extending all necessary help in organizing Annual Group Meeting of AICRP on Sugarcane. Our sincere thanks are also to the Chairmen, Co-Chairmen and Rapporteurs of various technical sessions of different disciplines.

Efforts made by the Station Incharges, scientists and staff members associated with the Coordinated projects at the regular as well as voluntary centres in conducting various trials, submission of data and reports are gratefully acknowledged.

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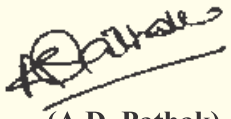

(A.D. Pathak)
Director & Project Coordinator (Sugarcane)

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ABOUT THE ALL INDIA COORDINATED RESEARCH PROJECT ON SUGARCANE

All India Coordinated Research Project on Sugarcane is serving to the Nation by coordinating research work since 1970 through a network of sugarcane research stations of ICAR, State Agricultural Universities, State Govt. Departments and Non-Government Organizations. At present, there are 22 regular centres and 15 voluntary centres for conducting research and multi-location testing of varieties/technologies for wider adoption. The Project also provides forum to the researchers for deliberations on new varieties and making recommendations on crop production and protection technologies. In order to provide fluff to the breeders, a National Hybridization Garden was established in 1972 at the ICAR-Sugarcane Breeding Institute, Coimbatore wherein all the parents so far identified for their specific characters are planted in separate plots and the breeders of the centers make use of these for crossing and fluff production. SBI, Coimbatore also extends facility for crossing work at the National Distant Hybridization Facility established at Agali (District Palakkad, Kerala). The research programmes of the project are decided according to the mandate and objectives of the AICRP (S).

Mandate

- Evaluation of locally adapted sugarcane varieties with improved yield and quality as well as resistance to biotic and abiotic stresses.
- Development of package of practices for higher sugarcane production.
- Development of low cost technologies for sugarcane production.
- Intensifying and extending the networking facility and information generation for transfer of technology to the farmers and sugar industry.

Objectives

- To coordinate multilocation testing of germplasm and advance breeding materials for evaluating appropriate region/location specific improved varieties.
- To organize and conduct strategic and applied research of inter-disciplinary nature for evolving appropriate region/location specific package of practices for crop production.
- To develop region or location specific strategies for integrated disease and pest management.
- Enhancement and maintenance of disease free nucleus seed material for distribution to the cooperating organizations.
- To disseminate generated information and technology.

As per the mandate, main emphasis is laid on the development of improved sugarcane varieties suitable for commercial cultivation under different agro-climatic conditions in the country. Under this programme, 120 sugarcane varieties have been developed and out of these, 67 varieties have been released and notified by Central Varietal Release Committee (CVRC) for commercial cultivation. The improved sugarcane varieties are meant for higher cane yield, sugar recovery and resistance against major insect- pest and diseases.

As regards to production technologies, optimization of planting geometry and wider spacing for mechanization (tropical zone), integrated nutrient management, economy in water use for irrigation by devising micro-irrigation technique (sub-surface drip), mulching in ratoon for water conservation and weed control, integrated weed management and integrated diseases and insect-pest management have been developed and tested under various locations. Introduction of FIRB method for wheat + sugarcane system has facilitated timely planting of sugarcane in the areas where wheat-sugarcane in sequential cropping was popular and due to delayed planting, yield of sugarcane is reduced. Evaluation of various intercrops for increasing farmers income, agrotechniques for multiple ratooning played pivotal role in increasing productivity and sustainability.

For the conduct of zonal varietal trials, following five zones have been identified in the country. At present 22 regular and 15 voluntary centers located at different zones are working under this project.

Development of AICRP Reporter: A web-based reporting system for the AICRP(S) trials

A web based application, AICRP Reporter, has been developed to provide an effective data recording and reporting platform for AICRP on Sugarcane.Software facilitates AICRP data profile management, observation recording, data analysis, report generation; security management and settings. A number of modules are available in the software for managing various profiles viz. Project, Experiment, Centre, Official, Trial, Treatment, Character, Treatment Schedule, Character Observation Schedule, and Event / Activity, Remarks, etc.

Agro-climatic Zones and location of centers (Regular)

A. North West Zone

1. PAU Regional Station, Faridkot - 151 203 (Punjab)
2. PAU Regional Research Station, Kapurthala – 144 601(Punjab)

3. U.P. Council of Sugarcane Research, Shahjahanpur–242 001
4. G.B. Pant University of Agriculture & Technology, Pantnagar – 263 145, Distt. U.S. Nagar
5. Agricultural Research Station (SKRAU), Sriganganagar – 335 001 (Rajasthan)
6. Agricultural Research Station (AU), Ummedganj, P.B. No. 7, GPO – Nayapura, Kaithoon Road, Kota – 324 001 (Rajasthan)
7. ICAR-Indian Institute of Sugarcane Research, Rae Bareli Road, Lucknow – 226 002
8. Regional Research Station, (CCSHAU), Uchani – 132 001, Karnal (Haryana)

B. North Central Zone

1. Sugarcane Research Institute (RAU), Pusa – 848 125, Distt. Samastipur (Bihar)
2. Sugarcane Research Station, Bethuadahari – 741 126 Distt. Nadia (W.B.)

C. North Eastern Zone

1. Sugarcane Research Station (A.A.U.), Buralikson, P.O. Baruabamungaon–785 618 Distt. Golaghat (Assam)

D. Peninsular Zone

1. ICAR-Sugarcane Breeding Institute, Coimbatore – 641 007 (T.N.)
2. Sugarcane Research Station(KAU), Kallungal, Thiruvalla – 689 101 (Kerala)
3. Zonal Agricultural Research Station(UAS), V.C. Farm, Mandya – 571 405 (Karnataka)
4. Regional Sugarcane & Jaggery Research Station (MPKV)., Kolhapur – 416 005
5. Agricultural Research Station (UAS), Sankeshwar – 591 314, Tal. Hukkeri, Belgaum Distt. (Karnataka)
6. Main Sugarcane Research Station (NAU), Navsari – 396 450 (Gujarat)
7. Zonal Agricultural Research Station (JNKVV), Powarkheda – 461 110, Distt. Hoshangabad (M.P.)
8. Sugarcane Research Station (MPKV), P.O. Padegaon Farm – 415 521 Distt. Satara (M.S.)

E. East Coast Zone

1. Sugarcane Research Station (OUA&T), Panipoila, Distt. Nayagarh – 752 070 (Odisha)
2. Regional Agril. Research Station (ANGRAU), Anakapalle – 531 001 (A.P.)
3. Sugarcane Research Station (TNAU), Cuddalore – 607 001 (T.N.)

Future thrust

- To develop suitable varieties for biotic (disease & insect-pests) and abiotic (waterlogging & drought, etc.) conditions.
- There is an urgent need to evaluate more germplasm under different agro-ecological conditions for introgression genes contributing resistance to diseases and insect-pests, abiotic stresses and physiological efficiency of the genotype.
- Since most of the sugarcane varieties developed so far are suited to a particular agro-climatic zone, there is a need to evolve varieties having high productivity, photo insensitivity and resistance to pests and diseases using conventional breeding methods as well as bio-technological tools. Physiological traits like relative water content, membrane injury and Na/K ratio can help in estimating tolerance to moisture stress, high temperature or salinity.
- In view of global competition for sugar and its lower price in the international market, there is a need to developing low cost agro-technologies and cost of sugarcane accounts for over 65 per cent of the total cost of production of sugar in mills.
- The water, being the precious commodity, there is a need to economize on its use by conducting multi-location trials with micro-irrigation systems viz., drip/ sub-surface drip irrigation including fertigation.
- The suddent outbreak of pests and diseases in sugarcane crop like may become economically important and could cause big economic losses at national level, if not managed in time. Recently, a few minor diseases like rust, pokkah boeng and yellow leaf disease and insect-pests like white grub and mealy bug are becoming economically important in sugarcane cultivation. Suitable protection technologies and their management will be taken up. The use of hazardous chemicals is causing environmental pollution. Thus, it is necessary to develop a bio-intensive pest and disease management system in sugarcane.

Staff Position (Since 1st April, 2018)

Sanctioned Strength	Sanctioned		Total (2+3)	No. of Posts Vacant		Total (5+6)
	At headquarters Lucknow	At AICRP(S) centres		At headquarters Lucknow	At AICRP(S) centres	
1	2	3	4	5	6	7
Scientific	04	44	48	-	-	-
Technical	04	44	48	01	-	01
Administrative	03	-	03	02	-	02
Total	**11**	**88**	**99**	**03**	**-**	**03**

CROP IMPROVEMENT

Varietal development is the flagship program of AICRP on Sugarcane, mandated to evolve high yielding and high sugar varieties suitable for all the five sugarcane growing zones of the country. A variety capable of producing high sugar yield with required resistance to major sugarcane diseases is preferred for sustaining higher net income per unit of area and time. In addition, location specific requirements especially resistance / tolerance to various biotic and abiotic stresses are important features to address the problematic areas. Keeping all these in view, varieties are developed for their commercial cultivation in the different zones. During recent past, the sugarcane varieties developed through AICRP on Sugarcane and notified by CVRC have covered substantial area in their recommended zones which resulted in all time high cane and sugar yields at the national level.

In addition, location specific requirement for resistance / tolerance to various biotic and abiotic stresses are being addressed adequately to increase the productivity in problematic areas. A separate programme for 'Evaluation and identification of climate resilient ISH and IGH genetics stocks for both drought and water logging conditions is being implemented at 7 centers in Maharashtra, Andhra Pradesh, Bihar, Punjab and Haryana states. The experiments were conducted by the centers as per the technical program (2018-19) and the relevant data on sugarcane yield, sucrose % in juice and commercial cane sugar (CCS) yields as received from the centers were analyzed and the results have been summarized in this chapter. The highlights of the salient achievements have been summarized under following heads:

- Crossing programme and growing of seedlings from fluff
- B.II- Implementation of Varietal Trials
- B.III- Evaluation & Identification of Climate Resilient ISH and IGH genetics stocks for both drought and water logging conditions.
- Seed multiplication of new varieties at the identified centers for quick dispersal of the seed cane.

In accordance to the technical programme, sugarcane breeders from assigned sugarcane research stations made desired crosses at National Hybridization Garden functioning at ICAR-Sugarcane Breeding Institute, Coimbatore and crossed seeds (fluff) were sent to them for raising seedlings and identifying location specific varieties. Superior clones developed by the breeding centers of each zone are pooled and these common entries are evaluated in ZVT conducted by 39 sugarcane research stations located in five different agro-climatic zones. Under the ZVT, the clones are evaluated for one year in Initial Varietal Trial (IVT) and better performing clones are forwarded to Advanced Varietal Trials (AVT) for evaluation in two plant and one ratoon crops in two years. The qualifying entries are identified based on the performance for cane yield, juice quality and reaction to pest and diseases across the centers in each zone and proposed for identification in AICRP(S) workshop. The major activities under the crop improvement programmes of AICRP(S) during 2018-19 have been summarized here under:

Weather, pests and diseases situation

Normal rainfall was received in many centres during the year 2018-19. The lowest rainfall was reported by Padegaon (357.4 mm) followed by Pugalur (382 mm) and the highest rainfall was received at Thiruvalla (2821 mm). Kota in North West Zone recorded the maximum temperature of 44.6°C during May, 2018 and Muzzafarnagar in North West Zone recorded the lowest temperature (3.2°C) during December, 2018. No major disease was reported by the centres. Minor incidence of insect pests like top borer, stalk borer, stem borer, shoot borer, root borer, plassey borer and other pest like mealy bug, pyrilla etc. were reported by centres. Sporadic incidence of Yellow Leaf Disease, leaf spot and rust (Mandya, Pune and Padegaon), smut and Pokkah boeng (Padegaon) and red rot and smut (Pusa) were noticed. General condition of the trials was good during the period under report.

Table 1.1: AICRP(S) centres participating in fluff supply and ZVT programmes

Zone	No. of centres	Participating centres	
		Fluff receiving and ZVT centres	ZVT – centres alone
Peninsular Zone	17	Rudrur, Perumalapalle, Navasari, Mandya, Sankeshwar, Padegaon, Pune, Powarkheda, Thiruvalla	Sameerwadi, Akola, Pravaranagar, Kolhapur, Basmathnagar, Pugalur, Coimbatore, Raipur
East Coast Zone	5	Anakapalle, Vuyyuru, Cuddalore, Nayagarh	Nellikuppam
North West Zone	10	Faridkot, Lucknow, Shahjahanpur, Pantnagar, Uchani, Kapurthala	Muzaffarnagar, Karnal, Kota, Sriganganagar
North Central Zone	4	Motipur, Pusa, Seorahi, Bethuadahari	-
North Eastern Zone	1	Buralikson	-
Total	**37**	**24**	**13**

Trials conducted and the number of entries evaluated

A total of 25 Zonal Varietal Trials (12 in early, 9 in midlate and 4 trials combining early and midlate maturity groups) were conducted during the year 2018-19. There were 7 IVT and 18 AVT trials. A total of 42 entries in early group, 48 entries in midlate group and 51 entries combining both the maturity groups were evaluated. Of these entries, 12 in early, 13 in midlate and 9 entries with combined trial of early and midlate groups were found to be promising. Details of the trials conducted, number of entries evaluated and the promising clones identified are given below.

Table 1.2: Trials conducted and the number of entries evaluated

Zone / Trials	No. of clones + standards		Promising clones	
	Early	Midlate	Early	Midlate
Peninsular Zone				
AVT II Plant	8 + 3		VSI 12121, CoM 12085, Co 12009	
AVT Ratoon	8 + 3		VSI 12121, CoM 12085, Co 12009	
Pooled analysis	8 + 3		VSI 12121, CoM 12085, Co 12009	
AVT I Plant	17+3		Co 13008, Co 13013, MS 13081	
IVT	26+4		Co15009, Co 15010, PI 15131	
Total entries	**51**		**9**	
East Coast Zone				
AVT II Plant	3+ 3	6 + 3	CoA 14321, CoC 14336	PI 14377
AVT Ratoon	3 + 3	6 + 3	CoA 14321, CoC 14336	PI 14377, Co 13031
Pooled analysis	3 + 3	6 + 3	CoA 14321	-
AVT I Plant	3 + 3	-	CoV 15356	-
IVT	4 + 3	4 + 3	CoV 16356, CoA 16321	-
Total entries	**10**	**10**	**5**	**2**
North West Zone				
AVT II Plant	3 + 2	5 + 4	-	Co 13035, CoH 13263, CoPant 13224
AVT Ratoon	3 + 2	5 + 4	-	Co 13035, CoH 13263, CoPant 13224
Pooled Analysis	3 + 2	5 + 4	-	CoH 13263
AVT I Plant	4 + 3	7 + 3	Co 14034, CoPb 14181, CoPb 14211	CoPb 14185, CoS 14233 CoLk 14204
IVT	9 + 3	11+3	-	CoS 15233, CoLk 15206
Total entries	**16**	**23**	**3**	**8**
North Central & North East Zones				
AVT II Plant	3 + 3	-	-	-
AVT Ratoon	3 + 3	-	CoP 13437	-
Pooled Analysis	3 + 3	-	-	-
AVT I Plant	4 + 3	5 + 3	CoP 14437	CoLk 14208
IVT	9 + 3	10+3	CoLk 15466, CoLk 15467	CoSe 15454, CoLk 15469
Total Entries	**16**	**15**	**4**	**3**
Grand total	**51**		**9**	
Total Entries	**42**	**48**	**12**	**13**

*common entries in II Plant, ratoon and pooled analysis.

Table 2.1: Qualifying entries identified in different trials

Zone	Trial	Entries
Peninsular Zone	Advanced Varietal Trial	VSI 12121, CoM 12085, Co 12009
East Coast Zone	Advanced Varietal Trial (Early)	CoA 14321
North West Zone	Advanced Varietal Trial (Midlate)	CoH 13263

The entries which recorded 10 % improvement for cane yield and numerically superior/on par for juice sucrose % compared to the best standards or entries which recorded 5 % improvement for juice sucrose % and numerically superior/on par for cane yield were selected as qualifying entries and were considered for identification. In Peninsular zone VSI 12121, CoM 12085 and Co 12009, East Coast Zone CoA 14321 (Early) and North West Zone CoH 13263 (Midlate) were identified as the qualifying entries based on the mean performance in two plant and one ratoon crops.

Fluff Supply Programme

During the year 2018-19, National Hybridisation Garden (NHG) was planted with 595 parental clones out of which 404 clones (69.70 %) flowered. Among 24 participating centers of Fluff supply / National Hybridization programme, 22 centres attended the crossing programme (Table 1.1). A total of 125 female and 70 male parents were utilised by the participating centres. Co 86032 and Co 775 were the frequently used female and male parents, respectively.

Twenty two fluff receiving centers were facilitated to make 539 bi-parental, 14 poly crosses, 154 general collections at NHG, ICAR-SBI, Coimbatore. Nine centers utilized National Distant Hybridization Facility (NDHF) established at ICAR-SBI RC, Agali for making 32 bi-parental crosses and 30 general collections. Fluff weighing 26.86 kg of crosses made at NHG and NDHF during 2018 flowering season were supplied to the 22 sugarcane breeding centers of National Hybridization and Fluff Supply Programme.

Zone wise and centre wise crossing programme and seedling raising:

North-West Zone: The centre wise relevant information is given in Table 3.

Faridkot

In Faridkot, total 27 cross (bi-parental 20, poly 4 general 2 and selfing 1) were effected and the centre received 608.5 g fluff of sugarcane. Total 1492 seedlings were planted while 326 (61.22%) survived. Among different crosses, poly crosses obtained maximum number of seedlings (4.58) per g of fluff while the average was worked out to be 2.45 seedlings/g of fluff.

Uchani

In Uchani, total 53 crosses (bi-parental 20, poly 7, general 26) were effected. Total 11033 seedlings were planted while 7819 (70.87%) survived.

Shahjahanpur

The Shahjahanpur centre made 39 bi-parental, 8 poly crosses and 69 general cross. The center received 2617.0 g of fluff. Out of the 24963 seedlings planted, 21878 (87.72%) survived.

Kapurthala

The centre made 30 bi-parental, 8 poly crosses and 34 general cross during 2018-19 and received 1306.5 g of fluff. Total 12720 seedlings were planted, wherein 10326 (81.18%) survived. Among different crosses, general crosses obtained maximum number of seedlings (13.77) per g of fluff while the average was worked out to be 9.74 seedlings/g of fluff.

Table 2.2: Crosses made by the participating centres and fluff (g) despatched from NHG during 2018-19

Zone / Centre	NHG, ICAR-SBI, Coimbatore						NDHF, ICAR-SBI RC, Agali				Total quantity of fluff sent (g)
	Station crosses		General collections		Poly crosses		Station crosses		General collections		
	No.	Fluff weight (g)	No.	Fluff weight (g)	No.	Fluff weight (g)	No.	Fluff weight (g)	No.	Fluff weight (g)	
PENINSULAR ZONE	175	3597.0	173	3716.5	6	285.0	15	239.5	25	301.0	8139.0
EAST COAST ZONE	90	1842	110	2313.5	6	165.5	9	198.5	-	-	4519.5
NORTH WEST ZONE	168	3689	233	5613	8	263.5	6	130	5	49.5	9745.0
NORTH CENTRAL ZONE	106	2442.5	104	1798.5	8	188	2	30	-	-	4459.0
Grand total	**539**	**11570.5**		**13441.5**	**8**	**902.0**	**32**	**598.0**	**30**	**350.5**	**26862.5**

*excluding duplicates

Table 3: North West Zone

Name of centre	Cross		Wt. of fluff sown (g)	No. of seedlings transplanted	No of seedlings obtained/ gm of fluff sown	No. of seedlings survived	% survival
	Type	No.					
Faridkot	Bi-parental	20	483.00	1152.00	2.39	259.00	22.48
	Poly	4	38.00	174.00	4.58	64.00	36.78
	General	2	51.00	153.00	3.00	3.00	1.96
	Selfing	1	36.50	13.00	0.36	0.00	0.00
	Total	27	608.50	1492.00	2.45	326.00	21.85
Uchani	Bi-parental	20	454.0	2540	5.59	1865	73.43
	Poly	7	40.0	221	5.52	210	95.02
	General	26	705.0	8272	11.73	5744	69.44
	Total	53	1199.0	11033	9.20	7819	70.87
Shahjahanpur	Bi-parental	39	907.5	14328	1-110	12055	84.14
	Poly	08	53.0	35	1-5	32	91.42
	General	69	1656.5	10600	1-30	9811	92.56
	Total	116	2617.0	24963	9.54	21898	87.72
Kapurthala	Bi-parental	30	650	3804	5.85	2914	76.60
	Poly	08	56.5	650	11.50	490	75.38
	General	34	600	8266	13.77	6922	83.74
	Total	72	1306.5	12720	9.74	10326	81.18

North Central Zone

The centre wise relevant information is given in Table 4.

Pusa

There were total 63 crosses made by the Pusa centre comprising bi-parental 33, poly crosses 8 and general cross 22 during 2018-19. The centre received 1186.5 g fluff of sugarcane. Out of the 40520 seedlings planted, 26445 (65.26%) survived. Among different crosses, the maximum survival of the seedlings (70.02%) was observed in general cross.

Seorahi

The Seorahi centre made bi-parental 28, poly crosses 08 and general cross 15 during 2018-19 and received 1072 g of fluff. Out of the 8194 seedlings planted, 5629 (68.89%) survived. Among different crosses, general crosses obtained maximum number of seedlings (11.34) per g of fluff while the average was worked out to be 7.64 seedlings/g of fluff.

Bethuadahari

Total 53 crosses were made by the Bethuadahari centre, comprising bi-parental 22, poly 8 and general cross 23 during 2018-19. The centre received 1035 g fluff of sugarcane. Out of the 5791 seedlings planted, 3231 (55.8%) survived.

Table 4. North Central Zones

Name of centre	Cross		Wt. of fluff sown (g)	No. of seedlings transplanted	No of seedlings obtained/ gm of fluff sown	No. of seedlings survived	% survival
	Type	No.					
Pusa	Bi-parental	33	745.00	18996	25.50	11405	60.04
	Poly	08	50.50	615	12.18	400	65.04
	General	22	391.00	20909	53.48	14640	70.02
	Total	63	1186.50	40520	34.15	26445	65.26
Seorahi	Bi-parental	28	650	3811	5.86	2418	63.44
	Poly	08	049	152	3.10	113	74.34
	General	15	373	4231	11.34	3098	73.22
	Total	51	1072	8194	7.64	5629	68.69
Bethuadahari	Bi-parental	22	499.5	2231	4.47	1402	62.8
	Poly	08	51.5	246	4.77	119	48.4
	General	23	484.0	3314	6.85	1710	51.6
	Total	53	1035.0	5791	5.6	3231	55.8

Peninsular Zone

The centre wise relevant information is given in Table 5.

Navsari

Total 68 crosses were made by the Navsari centre, comprising station cross 29, poly crosses 6 and general cross 33. The centre received 1477.5 g fluff. Out of the 17784 total seedlings planted, 13931 (78.33%) survived. The centre observed an average 12.03 seedlings per g of fluff.

Padegaon

The centre effected total 39 crosses including by parental 20, poly crosses 7 and general cross 12 during 2018-19. The center received 780.5 g of fluff and raised 6273 seedlings. Among different crosses, general crosses obtained maximum number of seedlings (9.03) per g of fluff while on an average 8.04 seedlings/g of fluff was recorded.

Mandya

In Mandya centre, total 42 crosses were made comprised of biparental cross 19, poly crosses 7 and general cross 16. The centre received 715 g of fluff. Of the 1510 total seedlings planted. 823 (54.5%) survived. The centre observed an average 2.11 seedlings per g of fluff.

Rudrur

The centre made 35 crosses comprised of 18 station cross, 3 poly cross and 14 general cross. Out of 2884 seedlings planted, 2594 (89.94%) survived.

East Coast Zone

The centre wise relevant information is given in Table 6.

Cuddalore

This centre effected total 50 crosses including bi-parental cross 23, poly crosses 7 and general cross 20 during 2018-19 and received 825 g of fluff. Out of the 3125 seedlings planted, 2949 (94.37%) survived. Among different

Table 5. Peninsular Zone

Name of centre	Cross		Wt. of fluff sown (g)	No. of seedlings transplanted	No of seedlings obtained/ gm of fluff sown	No. of seedlings survived	% survival
	Type	No.					
Navsari	Station	29	563.5	9235	16.38	7402	80.15
	Poly	6	26.5	501	18.90	449	89.62
	General	33	887.5	8048	9.06	6080	75.55
	Total	68	1477.5	17784	12.03	13931	78.33
Padegaon	Biparental	20	445	3265	7.34	-	-
	Poly	7	40.5	343	8.47	-	-
	G.C.	12	295	2665	9.03	-	-
	Total	39	780.5	6273	8.04	-	-
Mandya	Bi-parental	19	374.0	991	2.65	546	55.09
	Poly	07	41.5	20	0.48	08	40.00
	General	16	299.5	499	1.67	269	53.90
	Total	42	715.0	1510	2.11	823	54.50
Rudrur	Station	18	419.5	2297	5.48	2209	96.17
	Poly	3	18	22	1.22	19	86.36
	General	14	307.5	565	1.84	366	64.78
	Total	35	745	2884	3.87	2594	89.94

Table 6. East Coast Zone

Name of centre	Cross		Wt. of fluff sown (g)	No. of seedlings transplanted	No of seedlings obtained/ gm of fluff sown	No. of seedlings survived	% survival
	Type	No.					
Cuddalore	Bi-parental	22	359.5	1867	5.19	1771	94.9
	Poly	07	40.5	150	3.70	124	82.7
	General	20	414.0	1099	2.65	1051	95.6
	Fluff received from SBI-RC-Agali	01	11.0.0	9	0.82	3	33.3
	Total	50	825.0	3125	3.79	2949	94.37
Vuyyuru	Bi-Parental	20	449.0	7265	16.18	4046	55.69
	Poly	7	55.0	945	17.18	499	52.80
	General	22	381.0	4407	11.57	2589	58.75
	Total	49	885.0	12617	14.26	7134	56.54
Perumallapalle	Bi-Parental	17	409	-	-	-	-
	Poly	7	38	-	-	-	-
	General	23	397.5	-	-	-	-
	Total	47	844.5	-	-	-	

crosses, bi-parental crosses obtained maximum number of seedlings (5.19) per g of fluff while on an average 3.79 seedlings/g of fluff was recorded.

Vuyyuru

At Vayyuru centre, total 49 crosses were made which comprised bi-parental cross 20, poly crosses 7 and general cross 22. The centre received 885 g of fluff. Out of the 12617 total seedlings planted, 7134 (56.54%) survived. The centre observed an average 14.26 seedlings per g of fluff.

Perumallapalle

The center reported that the fluff did not germinate; hence information could not be furnished.

B. II Zonal Varietal Trial

North-West Zone

All ten centres of this zone comprising Faridkot, Karnal, Kota, Lucknow, Kapurthala, Mujaffarnagar, Pantnagar, Shahjahanpur, Sriganganagar and Uchani were assigned the experimental trials of early and midlate group of genotypes. The results of trials of these centres on pooled analysis of data are summarized here as under.

IVT Early

In IVT early, 9 genotypes *viz*. Co 15023, Co 15024, Co 15027, CoLk 15201, CoLk 15203, CoLk 15204, CoLk 15205, CoPb 15211and CoPb 15212 were evaluated with three standards CoJ 64, Co 0238 and Co 05009 (Table 7). Among the genotypes, CoLk 15201 and Co 15027 both excelled in terms of CCS yield which was 9.37 and 9.14 (t/ha), respectively against the CCS yield (9.03 t/ha) obtained from the best check CoJ 64. The highest cane yield (79.36 t/ha) was observed in CoLk 15201. However, Co 15027 recorded the highest mean value of sucrose (18.45%) in juice. Overall, CoLk 15201 and Co 15027 were found promising genotypes.

AVT Early Plant I

Four genotypes *viz*. Co 14034, CoLk 14201, CoPb 14181 and CoPb 14211 of early group were tested against three standards CoJ 64, Co 0238 and Co 05009 (Table 7). All the testing entries recorded higher sugarcane yields ranging from 88.17 to 91.83 t/ha than that recorded under the best check (Co 0238) of 84.78 t/ha. However, differences on sugarcane yield data of the testing entries with respect to Co 0238 were statistically on par. All testing genotypes recorded higher sugarcane and commercial cane sugar yields over the best performing standard (Co 0238). However, the differences were statistically non-significant. Sucrose percent in juice was observed to be higher in both Co 14034(18.76%) and CoPb 14181(18.43%) than Co 0238 which recorded 18.32%. Overall, Co 14034, Copb 14181 and Copb 14211 showed promising performance.

AVT Early II Plant

In this, three genotypes *viz*., Co 13034, CoPb 13181 and CoS 13231 were evaluated with three standards CoJ 64, Co 0238 and Co 05009 (Table 8). Among genotypes, CoS 13231 recorded significantly higher sucrose (19.05%) in juice over the best check Co 0238 (18.37%) sucrose in juice. However, sugarcane and sugar yields of all the testing genotypes were lower than the best check (Co 0238). Though, data on sugarcane as well as CCS yields were on par.

AVT Early Ratoon

All the genotypes tested under plant crop II were evaluated for their performance in ratoon crop against same standards (Table 8). Among testing genotypes, Co 013034(18.56%) and CoS 13231(18.67%) recorded comparatively higher sucrose content in juice than out performing standard Co 0238(18.09%). However, in terms of sugarcane and sugar yields, none of the testing genotypes could excel to Co 0238.

IVT Midlate

Under IVT (midlate) eleven genotypes were tested against three standards *viz*., CoS 767, CoPant 97222 and Co 05011 (Table 9). The entries CoLk 15206(18.49%), CoLk 15207(18.6%0, CoS 15233(18.45%) and CoS 15234(18.42%) recorded higher or equal to sucrose percent in juice than the best standard CoPant 97222(18.42%). However, data on sucrose % in juice were non-significant. Entry CoS 15233 recorded the significantly highest cane yield (96.32 t/ha) and CCS yield (12.36 t/ha) over the best check CoPant 97222 which recorded sugarcane and sugar yields as 82.55t/ha and 10.53t/ha, respectively. Overall, Co 15026, CoLk 15206 and CoS 15233 performed better for the yield and quality attributes than the best standard CoPant 97222. CoPb 15214 also recorded higher sugarcane and CCS yields (89.45 t/ha and 11.36 t/ha), respectively than the standard with comparable sucrose percent in juice (18.08).

AVT Midlate Plant I

Seven entries *viz*. Co 14035, CoH 14261, CoLk 14203, CoLk 14204, CoPb 14184, CoPb 14185 and CoS 14233 were evaluated against three checks (Table 9). Among testing genotypes, CoPb 14185 recorded the highest CCS (13.23 t/ha), cane yield (98.19 t/ha) and sucrose (19.35%) in juice. Other two entries viz. CoS 14233 and CoLk 14204 also out performed in terms of CCS and sugarcane yields than the best check (CoPant 97222).

AVT Midlate Plant II

In this, five genotypes were tested against four standards (Table 10). A cursory glance over data revealed that the mean values for sucrose % in juice obtained in CoPant

13224 (18.68), Co 13035 (18.7) and CoH 13263 (18.52) were on par to the best check of Co 05011 (18.58) while the sugarcane and sugar yields of these genotypes were higher than all the standards.

AVT Midlate ratoon

All the entries and standards tested in AVT plant II were evaluated in ratoon (Table 10). CoPant 13224 recorded the highest sugarcane yield (84.67 t/ha), sucrose in juice (17.57%) and commercial cane sugar (10.28 t/ha) than the outperforming check (Co 05011) which recorded sugarcane yield (75.11 t/ha), sucrose (17.49%) in juice) and commercial cane sugar (9.1 t/ha). Genotype Co 13035 recorded the highest sucrose (17.82% in juice) but commercial cane sugar yield was relatively lower (8.6 t/ha) as compared to the standard variety.

Table 7: Performance of genotypes under IVT (Early) and AVT (Early) I Plant, (NWZ), Mean of 9 Centres

Genotypes	IVT Early			Genotypes	AVT Early I Plant		
	Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)		Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)
Co 15023	53.33	16.34	5.95	Co 14034	89.70	18.76	11.71
Co 15024	71.65	18.17	8.95	CoLk 14201	89.47	17.81	11.00
Co 15027	72.18	18.45	9.14	CoPb 14181	88.17	18.43	11.24
CoLk 15201	79.36	17.26	9.37	CoPb 14211	91.83	18.28	11.63
CoLk 15203	74.54	17.33	8.96	-	-	-	-
CoLk 15204	60.36	18.32	7.66	-	-	-	-
CoLk 15205	70.58	17.62	8.63	-	-	-	-
CoPb 15211	75.14	17.36	8.85	-	-	-	-
CoPb 15212	72.99	16.46	8.29	-	-	-	-
Standard							
CoJ 64	71.70	18.36	9.03	CoJ 64	75.99	18.29	9.62
Co 0238	64.05	17.25	7.60	Co 0238	84.78	18.32	10.73
Co 05009	63.28	17.98	7.84	Co 05009	77.98	17.81	9.64
CV(%)	10.02	4.30	11.17	CV(%)	10.71	3.61	11.56
SE(d)	4.89	0.53	0.66	SE(d)	4.31	0.31	0.58
LSD at 5%	9.96	1.08	1.34	LSD at 5%	8.66	0.62	1.18

Table 8: Performance of genotypes under AVT (Early) II Plant and Ratoon, (NWZ), Mean of 9 Centres

Genotypes	AVT Early II Plant			Genotypes	AVT Early Ratoon		
	Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)		Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)
Co 13034	86.53	18.79	11.36	Co 13034	61.81	18.56	8.15
CoPb 13181	86.35	17.59	10.55	CoPb 13181	67.07	17.33	8.21
CoS 13231	79.91	19.05	10.52	CoS 13231	67.39	18.67	8.79
Standard							
CoJ 64	78.05	18.41	9.94	CoJ 64	60.19	18.31	7.76
Co 0238	91.06	18.37	11.58	Co 0238	74.69	18.09	9.51
Co 05009	74.95	17.98	9.38	Co 05009	65.01	17.55	8.08
CV(%)	15.20	3.04	16.24	CV(%)	15.21	3.73	16.56
SE(d)	5.93	0.26	0.80	SE(d)	5.02	0.33	0.69
LSD at 5%	NS	0.53	NS	LSD at 5%	NS	0.68	NS

Table 9: Performance of genotypes under IVT (Midlate) and AVT (Midlate) I Plant , (NWZ), Mean of 8 Centres

Genotypes	IVT (Midlate)			Genotypes	AVT (Midlate) I Plant		
	Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)		Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)
Co 15026	92.50	18.54	11.89	Co 14035	79.88	18.66	10.27
CoLk 15206	90.76	18.49	11.67	CoH 14261	87.03	18.71	11.28
CoLk 15207	80.68	18.60	10.38	CoLk 14203	90.82	18.51	11.63
CoLk 15208	80.11	17.85	9.82	CoLk 14204	92.53	18.59	12.17
CoLk 15209	79.52	18.28	10.10	CoPb 14184	88.89	18.50	11.33
CoPb 15213	83.30	18.08	10.36	CoPb 14185	98.19	19.35	13.23
CoPb 15214	89.45	18.29	11.36	CoS 14233	94.20	18.85	12.32
CoS 15231	72.83	18.23	9.16	-	-	-	-
CoS 15232	86.71	18.14	10.87	-	-	-	-
CoS 15233	96.32	18.45	12.36	-	-	-	-
CoS 15234	86.13	18.42	10.96	-	-	-	-
Standard							
CoS 767	81.78	17.96	10.21	CoS 767	85.82	18.04	10.72
CoPant 97222	82.55	18.42	10.53	CoPant 97222	86.68	18.81	11.33
Co 05011	79.64	18.02	9.92	Co 05011	84.63	18.62	10.89
CV(%)	13.55	3.61	14.91	CV(%)	13.02	3.39	13.67
SE(d)	5.72	0.33	0.79	SE(d)	5.78	0.31	0.78
LSD at 5%	11.36	NS	1.58	LSD at 5%	NS	0.63	1.57

Table 10: Performance of genotypes under AVT (Midlate) II Plant and Ratoon, (NWZ), Mean of 8 Centres

Genotypes	AVT Midlate II Plant			Genotypes	AVT Midlate Ratoon		
	Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)		Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)
Co 13035	93.21	18.70	12.12	Co 13035	73.13	17.82	8.60
CoH 13263	98.51	18.52	12.70	CoH 13263	72.92	17.73	8.93
CoPant 13224	101.87	18.68	13.29	CoPant 13224	84.67	17.57	10.28
CoPb 13182	97.71	18.25	12.45	CoPb 13182	69.69	17.27	8.26
CoLk 13204	85.15	17.89	10.52	CoLk 13204	71.64	16.77	8.29
Standard							
CoS 767	82.10	18.06	10.25	CoS 767	68.49	17.03	8.07
CoS 8436	75.16	18.54	9.61	CoS 8436	58.55	17.50	7.09
CoPant 97222	83.63	18.36	10.62	CoPant 97222	67.58	17.21	8.08
Co 05011	87.13	18.58	11.20	Co 05011	75.11	17.49	9.10
CV(%)	12.85	3.27	15.12	CV(%)	12.53	4.00	13.96
SE(d)	5.74	0.30	0.86	SE(d)	4.77	0.37	0.63
LSD at 5%	11.50	NS	1.72	LSD at 5%	9.60	NS	1.27

North Central and North-Eastern Zone

Total six experiments (four in early, two in midlate group) were conducted and the data received from the centers were analyzed.

IVT Early

In IVT early group, nine genotypes (Table 11) were evaluated against the standard/checks CoLk 94184, CoSe 95422 and CoSe 01421. The data on sucrose % in juice at 10 months crop stage revealed that CoLk 15467 recorded the highest sucrose in juice (18.45%) with comparable sugarcane (72.18 t/ha) and sugar yields(9.14 t/ha) than the best standard CoLk 94184 (71.7 t/ha and 9.03 t/ha).

AVT Early Plant I

In this, four genotypes *viz* CoLk 14206, CoP 14437, CoSe 14451 and CoSe 14454 were evaluated against CoLk 94184, CoSe 95422 and CoSe 01421 (Table 11). The genotype CoLk 14206 recorded sugarcane yield (75.08 t/ha), sucrose in juice (17.87%) and CCS (9.29 t/ha) almost similar to the best performing check (CoLk 94184). Howevr, CoP 14437 showed promising performance with respect to sugarcane yield (79.88 t/ha) and commercial cane sugar (9.72 t/ha). Overall, none of the testing entry exceeded to the best check.

AVT Early Plant II

Three entries *viz* CoP 13437, CoSe 13451and CoSe 13452 were evaluated with three standards CoLk 94184, CoSe 95422 and CoSe 01421(Table 12). Genotype CoSe 13451 recorded the highest sugarcane yield (81.04 t/ha) with comparable sucrose content (18.07 %) in juice and commercial cane sugar (10.18 t/ha) against the best performing standard CoLk 94184 (78.09 t/ha sugarcane yield and 18.71% sucrose in juice). Overall, none of the testing entry was found promising.

AVT Early Ratoon

All the genotypes tested in AVT early plant II were evaluated for their performance in ratoon crop. The data on cane yield and sucrose % in juice were found to be non-significant. Among the standards, CoLk 94184 recorded higher mean values of sucrose (17.78%) and CCS (8.41 t/ha) as well. All three test entries recorded higher relative sugarcane yields (2.5 to 3.0 t/ha) while CCS yields ranged from 8.67 to 8.78 t/ha against CoLk 94184. Overall, none of the entry was found promising (Table 12).

IVT Mid-late

Among ten genotypes, two entries *viz*. CoLk 15469 and CoSe 15457 recorded higher sucrose % in juice than all the checks (Table 13). However, CoSe 15454 and CoSe 15457 recorded higher sugarcane and commercial cane sugar yields than the best standard (CoP 9301) which recorded (18.22%) sucrose in juice. However, none of the entries excelled to the best check.

AVT Mid-late Plant I

Five entries *viz* CoLk 14208, CoLk 14209, CoP 14438, CoP 14439 and CoSe 14455 were evaluated with three standards BO 91, CoP 06436 and CoP 93016. None of the genotypes under testing could record higher sucrose than the best performing standard CoP 06436 (18.6%) in juice. However, data on sugarcane and sugar yields alonwith sucrose percent in juice among testing genotypes were found to be non-significant (Table 13).

Table 11: Performance of genotypes under IVT (Early) and AVT (Early) I Plant (NC&EZ) mean of 5 centres

Genotypes	IVT Early			Genotypes	AVT Early I Plant		
	Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)		Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)
CoBln 15501*	53.33	16.34	5.95	CoLk 14206	75.08	17.87	9.29
CoLk 15466	71.65	18.17	8.95	CoP 14437	79.88	17.58	9.72
CoLk 15467	72.18	18.45	9.14	CoSe 14451	79.18	17.20	9.34
CoP 15436	79.36	17.26	9.37	CoSe 14454	78.31	17.32	9.44
CoP 15437	74.54	17.33	8.96				
CoSe 15451	60.36	18.32	7.66				
CoSe 15452	70.58	17.62	8.63				
CoSe 15455	75.14	17.36	8.85				
CoSe 15456	72.99	16.46	8.29				
Standard							
CoLk 94184	71.70	18.36	9.03	CoLk 94184	75.54	17.89	9.28
CoSe 95422	64.05	17.25	7.60	CoSe 95422	69.71	17.05	8.22
CoSe 01421	63.28	17.98	7.84	CoSe 01421	68.35	17.95	8.39
CV(%)	10.02	4.30	11.17	CV(%)	8.48	2.05	9.42
SE(d)	4.89	0.53	0.66	SE(d)	4.02	0.22	0.54
LSD at 5%	9.96	1.08	1.34	LSD at 5%	8.31	0.46	NS

Table 12: Performance of genotypes under AVT (Early) II Plant and Ratoon (NC&EZ) mean of 5 centres

Genotypes	AVT Early II Plant			Genotypes	AVT Early Ratoon		
	Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)		Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)
CoP 13437	76.14	18.03	9.53	CoP 13437	72.49	17.84	8.78
CoSe 13451	81.04	18.07	10.18	CoSe 13451	73.35	17.34	8.67
CoSe 13452	74.84	17.93	9.01	CoSe 13452	74.53	17.32	8.73
Standard							
CoLk 94184	78.09	18.71	10.05	CoLk 94184	69.89	17.78	8.41
CoSe 95422	69.28	17.68	8.48	CoSe 95422	66.63	17.21	7.71
CoSe 01421	67.94	18.77	8.45	CoSe 01421	64.14	17.43	7.51
CV(%)	8.57	3.20	10.58	CV(%)	8.73	2.62	8.77
SE(d)	4.04	0.36	0.62	SE(d)	3.87	0.29	0.46
LSD at 5%	8.43	0.76	1.29	LSD at 5%	NS	NS	0.96

Table13: Performance of genotypes under IVT (Midlate) and AVT (Midlate) I Plant (NC&EZ) mean of 5 centres

Genotypes	IVT Midlate			Genotypes	AVT Midlate I Plant		
	Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)		Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)
CoBln 15502	55.43	16.62	6.36	CoLk 14208	71.76	18.48	9.02
CoLk 15468	72.31	17.81	8.88	CoLk 14209	69.53	18.20	8.68
CoLk 15469	73.14	18.63	9.45	CoP 14438	73.92	17.97	9.16
CoP 15438	74.93	17.33	8.94	CoP 14439	80.67	17.60	9.74
CoP 15439	75.97	17.74	9.31	CoSe 14455	77.08	18.13	9.50
CoP 15440	76.15	18.15	9.54				
CoP 15441	72.72	17.88	8.93				
CoSe 15453	83.86	17.76	10.32				
CoSe 15454	81.07	18.16	10.26				
CoSe 15457	74.63	18.39	9.53				
Standard							
BO 91	70.31	17.68	8.75	BO 91	72.38	17.73	8.74
CoP 9301	72.33	18.22	9.10	CoP 06436	69.06	18.60	8.66
CoP 06436	75.96	17.19	9.19	CoP 93016	74.69	17.58	9.04
CV(%)	8.37	4.04	10.86	CV(%)	8.78	3.45	7.91
SE(d)	4.367	0.50	0.70	SE(d)	4.57	0.44	0.50
LSD at 5%	8.85	1.03	1.41	LSD at 5%	NS	NS	NS

East Coast Zone

The East coast zone comprises Anakapalle, Cuddalore, Nayagarh, Nellikuppam and Vuyyuru and these centers constitute coastal region of Odisha, A.P and Tamil Nadu. Total seven experiments (except AVT I) were assigned to all the five centres.

IVT Early

Four genotypes *viz*., Co 16321, CoC 16336, CoC 16337 and CoV 16356 along with three standards CoA 92081, CoC 01061 and CoOr 03151 were tested (Table 14). CoV 16356 recorded the significantly highest sucrose (18.94% in juice) and cane yield (117.32 t/ha) on par to the best check CoC 01061 (17.55% sucrose in juice). CoV 16356 also performed better with respect to sugarcane yield (117.32 t/ha) and commercial sugar (15.78 t/ha).

AVT Early I Plant

Three genotypes *viz*. CoC 15336, CoC 15338 and CoV 15356 were tested against three standards CoA 92081, CoC 01061 and CoOr 03151 (Table 14). The entry CoV 15356 having sugarcane yield 101.46 t/ha and sucrose 18.09% in juice recorded the highest CCS (12.75 t/ha). Though, the results were on par to the best check CoC 01061- 96.97 t/ha with 17.45%) cane yield and sucrose content in juice, respectively but the entry CoV 15356 contained 0.75 unit higher sucrose over the best check.

AVT Early Plant II

Among three genotypes, CoC 14336 recorded significantly the highest sucrose % in juice (18.99) than the best performing check CoA 92081 (17.63%). CoA 14321 recorded the highest cane yield (101.54 t/ha) and CCS (14.35 t/ha). Overall, CoC 14336 and CoA 14321 performed better than all the checks (Table 15).

AVT Early Ratoon

Genotypes CoA 14321 and CoC 14336 recorded higher sucrose percent in juice and commercial sugar than the best check (CoC 01061). CoA 14321 recorded 109.03t/ha sugarcane yield and commercial sugar 14.11 t/ha. However, the data for cane yield, sucrose percent in juice and CCS yield were found to be non-significant (Table 15).

IVT Mid late

All four genotypes *viz*. CoA 16322, CoC 16338, CoC 16339 and CoV 16357 recorded higher sugarcane and sugar yields than the best performing check (Co 06030). Among testing genotypes, CoV 16357 recorded the highest sucrose (18.17%) in juice while CoC 16339 recorded the highest commercial cane sugar (14.62 t/ha) and sugarcane yield (118.29t/ha) with sucrose (17.92%) in juice (Table 15).

AVT Mid late plant II

Six genotypes *viz.,* Co 13028, Co 13029, Co 13031, CoA 14323, CoC 14337 and PI 14377 were evaluated against three standards CoV 92102, Co 86249 and Co 06030. The data recorded on sucrose, cane yield and CCS revealed that genotype CoA 14323, CoC 14337 and PI 14377 produced higher cane yields and CCS yields than the best performing check of CoV 92102 (Table 17). These three genotypes were found promising.

AVT midlate ratoon

All the entries tested under AVT midlate II plant crop were also evaluated for their respective ratoons with the same standards. The mean values on cane yield, sucrose content and CCS were non-significant (Table 16). CoA 14323 and PI 14377 recorded higher sugarcane and sugar yields and sucrose percent in juice on par to the check (CoV 92102).

Table 14: Performance of genotypes under IVT (Early) and AVT (Early) I Plant (ECZ) Mean of 5 Centres

Genotypes	IVT Early			Genotypes	AVT Early I Plant		
	Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)		Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)
CoA 16321	103.04	17.67	11.83	CoC 15336	89.96	17.13	10.81
CoC 16336	97.68	16.71	11.43	CoC 15338	102.23	16.58	11.93
CoC 16337	88.92	17.68	10.40	CoV 15356	101.46	18.09	12.75
CoV 16356	117.32	18.94	15.78				
Standard							
CoA 92081	102.22	17.87	12.96	CoA 92081	94.50	17.34	11.71
CoC 01061	107.69	17.55	13.34	CoC 01061	96.97	17.45	11.41
CoOr 03151	113.40	16.71	12.45	CoOr 03151	101.29	16.34	11.30
CV(%)	21.06	5.53	27.82	CV(%)	11.99	5.01	13.31
SE(d)	13.89	0.61	2.21	SE(d)	7.41	0.54	0.98
LSD at 5%	NS	1.26	NS	LSD at 5%	NS	NS	NS

Table 15: Performance of genotypes under AVT (Early) II Plant and Ratoon (ECZ) Mean of 5 Centres

Genotypes	AVT Early II Plant			Genotypes	AVT Early Ratoon		
	Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)		Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)
Co 13023	100.61	17.58	12.25	Co 13023	96.30	17.41	11.80
CoA 14321	111.54	18.37	14.35	CoA 14321	109.03	18.32	14.11
CoC 14336	101.00	18.99	13.37	CoC 14336	99.15	18.30	12.69
Standard							
CoA 92081	96.22	17.63	11.90	CoA 92081	95.42	16.91	11.34
CoC 01061	97.77	17.28	11.71	CoC 01061	93.21	17.80	11.75
CoOr 03151	113.50	16.71	12.24	CoOr 03151	102.30	17.76	12.67
CV(%)	11.81	4.66	10.33	CV(%)	12.81	4.21	14.05
SE(d)	7.72	0.52	0.82	SE(d)	8.03	0.47	1.10
LSD at 5%	NS	1.09	1.72	LSD at 5%	NS	NS	NS

Table 16: Performance of genotypes under IVT (Midlate) (ECZ) Mean of 5 Centres

Genotypes	IVT Midlate		
	Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)
CoA 16322	108.05	17.55	13.12
CoC 16338	115.03	17.77	14.15
CoC 16339	118.29	17.92	14.62
CoV 16357	114.66	18.17	14.55
Standard			
CoV 92102	103.00	18.21	13.01
Co 86249	90.35	16.90	10.63
Co 06030	89.53	18.51	11.21
CV(%)	15.81	4.47	16.50
SE(d)	10.55	0.50	1.36
LSD at 5%	NS	NS	2.80

Table 17: Performance of genotypes under AVT (Midlate) II Plant and Ratoon (ECZ) Mean of 5 Centres

Genotypes	AVT Midlate II Plant			Genotypes	AVT Midlate Ratoon		
	Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)		Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)
Co 13028	101.50	17.78	12.51	Co 13028	86.21	17.68	10.56
Co 13029	114.60	16.49	12.91	Co 13029	88.16	16.61	10.21
Co 13031	95.80	17.96	12.14	Co 13031	85.43	18.34	10.92
CoA 14323	113.21	18.97	15.01	CoA 14323	106.19	18.57	13.71
CoC 14337	112.37	18.39	14.45	CoC 14337	87.58	18.54	11.10
PI 14377	123.46	18.30	15.96	PI 14377	101.10	18.45	13.04
Standard							
CoV 92102	107.65	18.55	13.91	CoV 92102	81.24	18.33	10.38
Co 86249	93.60	17.81	11.69	Co 86249	83.50	17.65	10.28
Co 06030	104.15	18.18	13.58	Co 06030	110.74	17.61	13.83
CV(%)	15.62	4.96	15.78	CV(%)	19.09	6.12	21.45
SE(d)	10.60	0.56	1.35	SE(d)	11.13	0.69	1.56
LSD at 5%	NS	1.15	NS	LSD at 5%	NS	NS	NS

Peninsular zone

The climate of this zone is mainly tropical in nature where long sunny days with cool nights and clear sky favour sugar accumulation. The crushing season is also long. In view of developing high yielding and high sucrose varieties following experiments were assigned to all the 18 centres of the zone situated at Akola, Basmathnagar, Coimbatore, Kolhapur, Mandya, Navasri, Padegaon, Perumalapalle, Powarkheda, Pravaranagar, Pune, Pugalur, Kawardha (Raipur), Rudrur, Sameerwadi, Sankeshwar, Sirugamani, Thiruvalla. The results are summarized here under-

IVT

Twenty six genotypes were evaluated against four standards *viz*. Co 86032, CoC 671, CoSnk 05103 and Co 85004 (Table 18). In terms of sugarcane yield, sucrose percent in juice and commercial sugar, several testing entries *viz*. Co 14005, Co 15005, Co 15006, Co 15007, PI 15131 and VSI 15122 performed on par to the best check (Co 86032). Co 14005 (20.03%) and Co 15005 recorded (20%) sucrose in juice having on par sugarcane and commercial sugar yields performed better against check. However, the second best check (CoC 671) recorded the highest sucrose (20.41%) in juice and moderate cane yield (99.3 t/ha).

AVT Plant I

Seventeen genotypes were evaluated against three standards of Co 86032, CoC 671 and CoSnk (Table 19). The standard Co 86032 performed better in terms of cane yield (110.77 t/ha) and CCS (15.39 t/ha) with moderate sucrose (19.48%) in juice. However, the standard check CoC 671 recorded the highest sucrose (21.1%) in juice. Among the testing entries, several genotypes Co 13013 (19.07%), Co 13018 (19.68%), Co 13020 (19.89%), MS 13081 (19.88%) sucrose in juice recorded on par cane yield and CCS yields while comparing with the best check (Co 86032). However, the highest sucrose in juice was recorded by CoC 671 (21.1%). The entry MS 13081 recorded highest commercial sugar yield (17.17t/ha).

AVT Plant II

In this, eight genotypes *viz*., Co 12007, Co 12008, Co 12009 Co 12012, Co 12019, Co 12024, CoM 12085 and VSI 12121 were evaluated against three standards of Co 86032, CoC 671 and CoSnk 05103 (Table 20). The analysis of pooled data indicated that CoM 12085 and VSI 12121 recorded significantly higher cane yields, sucrose content and CCS yields than the best performing check of Co 86032. However, CoC 671 recorded the highest S (20.76%) in juice. Other genotypes namely Co 12009 and Co 12012 also recoded higher sugarcane yields with on par sucrose content to the better performing check (Co 86032).

AVT Ratoon

In this, eight genotypes *viz*., Co 12007, Co 12008, Co 12009 Co 12012, Co 12019, Co 12024, CoM 12085 and VSI 12121 were evaluated against three standards of Co 86032, CoC 671 and CoSnk 05103 (Table 20). The pooled data on cane yield, sucrose content and commercial sugar indicated that VSI 12121 recorded higher sugarcane yield (110.49 t/ha), sucrose (19.96%) in juice and commercial sugar (15.49 t/ha) in comparison to the better performing check (Co 86032) which recorded cane yield (96.94 t/ha), sucrose (19.43%) and commercial sugar (13.26 t/ha). Co 12009 recorded cane yield (104.3 t/ha) with comparable sucrose in juice (19.76%) and commercial sugar 14.52 t/ha.

Table 18: Performance of genotypes under IVT (Peninsular Zone), Mean of 15 Centres

Genotypes	IVT			Genotypes	IVT		
	Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)		Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)
Co 14005	104.63	20.03	14.69	CoSnk 15103	115.66	18.10	14.89
Co 15002	96.27	19.43	13.11	CoSnk 15014	110.42	18.56	14.43
Co 15005	102.02	20.33	14.74	CoVC 15061	112.70	18.00	14.48
Co 15006	101.79	19.48	14.27	CoVC 15062	100.99	18.22	13.31
Co 15007	104.83	19.73	14.97	CoVC 15063	92.21	19.33	12.58
CoSnk15101	96.47	18.54	12.85	CoVC 15064	95.34	17.53	12.31
CoSnk15102	106.54	19.85	14.97	PI 15131	109.60	18.93	14.72
CoVSI 15121	120.03	17.83	15.35	PI 15132	113.58	19.89	15.72
Co 15009	111.09	19.15	15.28	VSI 15122	118.27	18.18	15.18
Co 15010	113.92	18.54	15.64	**Standard**			
Co 15015	107.21	17.90	13.68	Co 86032	110.60	19.63	15.33
Co 15017	103.18	19.73	14.54	CoC 671	99.30	20.41	14.47
Co 15018	110.52	17.15	13.39	CoSnK 05103	97.23	18.96	13.14
Co 15020	106.38	18.79	14.17	Co 85004	100.47	19.39	13.99
Co 15021	108.29	18.70	14.47	CV(%)	17.12	6.17	18.18
CoN 15071	117.24	18.42	15.20	SE(d)	6.62	0.42	0.94
CoN 15072	94.65	19.11	12.56	LSD at 5%	13.03	0.83	1.86

Table 19: Performance of genotypes under AVT, I Plant (Peninsular Zone) Mean of 14 Centres

Genotypes	AVT, I Plant			Genotypes	AVT, I Plant		
	Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)		Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)
Co 13002	88.44	20.10	12.49	Co 13020	104.23	19.89	14.68
Co 13003	99.80	19.35	13.54	CoN 13073	109.73	18.31	13.96
Co 13004	101.15	19.68	13.89	CoSnK 13103	97.98	19.37	13.50
Co 13072	107.88	18.79	14.30	CoSnK 13106	106.21	19.21	14.60
CoSnK 13101	96.19	19.56	13.22	PI 13132	104.57	19.11	14.02
MS 13081	121.33	19.88	17.17	**Standard**			
Co 13006	103.78	19.72	14.50	Co 86032	110.77	19.48	15.39
Co 13008	107.96	19.15	14.75	CoC 671	93.54	21.10	13.84
Co 13009	103.50	18.90	14.06	CoSnK 05103	100.18	18.89	13.35
Co 13013	121.65	19.07	16.54	CV(%)	14.31	4.84	15.57
Co 13014	104.22	19.22	14.18	SE(d)	5.84	0.36	0.87
Co 13018	100.35	19.68	13.91	LSD at 5%	11.52	0.72	1.72

Table 20: Performance of genotypes under AVT, II Plant and Ratoon (PZ) Mean of 14 Centres

Genotypes	AVT II Plant			Genotypes	AVT Ratoon		
	Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)		Cane Yield (t/ha)	Sucrose (%) in juice	CCS (t/ha)
Co 12007	96.49	19.73	14.09	Co 12007	81.63	19.38	11.10
Co 12008	95.42	19.72	13.88	Co 12008	82.90	19.91	11.45
Co 12009	119.94	19.82	17.84	Co 12009	104.25	19.76	14.52
Co 12012	121.59	18.86	17.27	Co 12012	100.49	18.49	12.71
Co 12019	95.99	19.51	14.06	Co 12019	81.30	19.35	11.06
Co 12024	102.92	18.98	14.89	Co 12024	77.20	18.65	10.08
CoM 12085	127.17	20.17	19.37	CoM 12085	96.32	19.70	13.43
VSI 12121	129.67	20.37	19.88	VSI 12121	110.49	19.96	15.49
Standard							
Co 86032	113.62	19.62	17.15	Co 86032	96.94	19.43	13.26
CoC 671	99.78	20.76	15.54	CoC 671	76.43	20.61	11.01
CoSnk 05103	111.32	18.58	15.92	CoSnk 05103	106.93	18.58	13.79
CV(%)	11.39	3.92	12.81	CV(%)	17.36	5.30	18.42
SE(d)	4.92	0.30	0.82	SE(d)	6.54	0.42	0.94
LSD at 5%	9.75	0.59	1.62	LSD at 5%	12.96	0.83	1.86

B.III Evaluation and identification of climate

Resilient ISH and IGH genetic stocks

This is an important programme for location specific evaluation of climate resilient genetic stocks. The following thirty clones have been reported under multiplication **at** ICAR-SBI, Coimbatore for evaluation by the seven centers located at NWZ, NCNEZ and PZ. These centers include Lucknow, Karnal, Pantnagar, Pusa, Motipur, Sankeswar and Pune. These clones will be evaluated during 2020-21 season for their attributes.

ISH and IGH clones under multiplication

ISH 501, ISH 502, ISH 512, ISH 513, ISH 516, ISH 519, ISH 524, ISH 526, ISH 528, ISH 534, ISH 535, ISH 536, ISH 542, ISH 545, ISH 548, ISH 554, ISH 558, ISH 564, ISH 567, ISH 584, ISH 585, ISH 587, ISH 590, ISH 594, IGH 806, IGH 816, IGH 823, IGH 829, IGH 833 and IGH 834.

Sugarcane varieties developed under AICRP (S) and notified by CVRC during 2018

The following four sugarcane varieties, two in early (Co 10026 (*Upahar*) & CoLk 12207 (*Ikshu*-6) and two mid-late (Co 12029 (*Karan*-13) & CoLk 12209 (*Ikshu*-7) maturing group have been identified in Varietal Identification Committee meeting held on 17.10.2018 during 32nd Biennial Workshop of AICRP on Sugarcane at UAS, Bengaluru (Karnataka). These sugarcane varieties were released & notified in 81st & 82nd Meeting of Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops.

Sl. No.	Description	Photographs
1	**Co 12029 (*Karan*-13):** This variety has been developed by ICAR-SBIRC, Karnal under mid-late group for North-West zone. The variety recorded cane yield by 95.57 t/ha, CCS yield 12.07 t/ha and sucrose 18.10% in juice.	
2	**Co 10026 (*Upahar*):** This variety has been developed by ICAR-SBI, Coimbatore in early group for Peninsular region. The variety exhibited cane yield by 109.06 t/ha, CCS yield 13.86 t/ha and sucrose 17.98% in juice.	
3	**CoLk 12207 (*Ikshu*-6):** This variety has been developed by ICAR-IISR, Lucknow in early group for North Central & North East Zones. The variety has exhibited cane yield by 75.42 t/ha, CCS yield 8.74 t/ha and sucrose 16.90% in juice.	
4	**CoLk 12209 (*Ikshu*-7):** This variety has been developed by ICAR-IISR, Lucknow in mid-late group for North Central & North East zones. The variety has exhibited cane yield by 77.5 t/ha, CCS yield 9.38 t/ha and sucrose 17.65 % in juice.	

Summary

- Total 25 (Early 12, Midlate 9 and 4 trials combining early and midlate groups) varietal trials were conducted during the year 2018-19.
- In Peninsular zone, 9 clones viz., CoM 12085, VSI 12121, Co 12009, Co 13008, Co 13013, MS 13081, Co 15010, Co 15009 and PI 15131 in both (early/midlate) group were found to be promising.
- In East Coast zone, 5 clones, viz., CoC 14336, CoA 14321, CoV 15356 & CoV 16356 and CoA 16321 in early and 2 clones PI 14377 and Co 13031 in midlate group were found to be promising.
- In North West zone, 3 clones viz., Co 14034, CoPb 14181 and CoPb 14211 in erly group 8 clones viz., CoPant 13224, Co 13035, CoPb 14185, CoS 14233, CoLk 14204, Co 15026, CoH 13263 and CoS 15233 in midlate group were found to be promising.
- In North Central & North Eastern Zones, 4 clones viz., CoLk 15467, CoLk 15466, CoP 13437 and CoP 14437 in early group & 3 clones viz., CoLk 14208, CoLk 15469 and CoSe 15454 inmidlate group were found to be promising.
- A total of 42 entries in early group, 48 in midlate group and 51 entries combining early and midlate maturity group were evaluated. Based on pooled analysis of the data on cane yield and quality attributing characters, 12 in early and 13 in midlate and 9 in combining early and midlate maturity groups were found to be promising.
- The maximum quantity of fluff (9745.0 g) was utilized by the North West Zone followed by Peninsular zone (8139.0 g). Among the different zones, North-West zone effected the maximum number of crosses (544).
- Under the programme " Evaluation and Idnetification of climatic resilient ISH and IGH genetics stocks for both drought and water logging conditions, thirty clones have been reported for multiplication at ICAR-SBI, Coimbatore and for evaluation by the seven centres viz., Lucknow, Karnal, Pantnagar from North West zone, Pusa, Motipur from North Central & North Eastern zones and Sankeshwar & Pune from Peninsular zone.
- In peninsular zone, VSI 12121, CoM 12085 and Co 12009; in East Coast Zone, CoA 14321 and in North West zone, CoH 13263 were identified as qualitying entries based on means performance in two plant and one ratoon crops.
- National Hybridization Garden (NHG) was planted with 595 parental clones out of which 404 clones (69.70 %) flowered. A total of 125 female and 70 male parents were utilized by the participating centres. Co 86032 and Co 775 were the frequently used female and male parents respectively.
- Twenty two fluff reciveing centres were facilitated to make 539 by-parental, 14 polly crosses, 154 general collections at NHG, ICAR-SBI, Coimbatore. Nine centre utilized National Distant Hybridization Facility (NDHF) established at ICAR-SBI-RC, Agali for making 32 by-parental crosses and 30 general collections.
- Fluff weighing 26.86 kg of crosses made at NHG and NDHF during 2018 flowering season were supplied to 22 sugarcane breeding centres of Natinal Hybridization and fluff supply programme.
- Four sugarcane varieties, two in early (Co 10026-Upahar, CoLk 12207-Ikshu-6) and two midlate (Co 12209-Karan-13, CoLk 12209-Ikshu-7) maturing group identified by AICRP on Sugarcane were notified by Central Varietal Release Committee.

CROP PRODUCTION

A look on advancements in sugarcane research, its production scenario and the transfer of technology to the stake holders during the recent past evinces encouraging trends and new challenges. On the research front development of new high yielding high sugar varieties supported with suitable production and protection technologies made sugar sector viable on one hand and left ample scope for diversification on the other. During the year 2018-19 as per the latest estimates sugar production is expected to touch an all-time high level of 33-35 million tonnes with record sugarcane production of more than 400 million tonnes produced from 5.43 million hectares. The largest sugarcane and sugar producing state of Uttar Pradesh is estimated to produce about 12 mt of sugar by crushing comparatively less cane with a high recovery of 11.48%. The increased production and sugar recovery have provided scope for diverting sugarcane juice, B-heavy molasses and other substrates for the production of ethanol to be used as bio-fuel for automobiles. With the development of high biomass producing sugarcane cultivars, it is required to develop suitable production technologies for enough anchorage to roots to hold the crop from lodging, enhanced water and nutrient use efficiency in view of price escalation of these resources, technologies for bringing in resilience against adverse impacts of climate change and micro and macro level crop and product diversification to enhance the income of sugarcane growers. For the year 2018-19 the trials under Crop Production discipline of AICRP on Sugarcane were designed and carried out to develop recommendations for addressing these issues. These were concentrated on aspects such as agronomic evaluation of promising genotypes for their performance potential under variable inter-row spacing and enhanced fertility level, integrated nutrient management schedule for sugarcane production system to ensure soil health and crop productivity, carbon sequestration potential of sugarcane based cropping systems impacting soil health, raising water productivity in sugarcane system through mulching and water application regimes and also to assess the water productivity and drought tolerance potential of newly released varieties of sugarcane. Most of the centres carried out these trials in the true research spirit and reported the results as per the prescribed format. However, Akola faced the constraints like scarcity of irrigation water and could not conduct the trials. A summary table showing no. of centres allotted, conducted and not conducted the stipulated experiments during 2018-19 is given in Appendix I.

The experiment wise summary of the results are presented below:

AS 68: Impact of integrated application of organics and inorganics in improving soil health and sugarcane productivity

The trial initiated during the year 2014-15 with allotment to all the centres. However, during the year 2018-19 only 08 centres carried out the trial.

NORTH WEST ZONE

1. FARIDKOT

Ratoon cane yield (91.5 t/ha) was the highest with application of FYM/Compost @ 20 tonnes / ha + inorganic nutrient based on soil test (T6) which was significantly higher than all treatments except no organic + soil test based recommendation T3 (83.3 t/ha) and T5 (88.1 t/ha). These treatments also have the residual effect of FYM applied to plant crop. Same trend was there for CCS t/ha.

2. LUCKNOW

In the first ratoon crop, the highest rate of sprouting (93.4%) was observed under the treatment of only organic matter application along with FYM. Highest number of tillers (180.2 thousand/ha at 120 days after planting), shoot count (175.6 thousand/ha at 180 DAP), number of millable canes (120.5 thousand/ha), cane yield (84.20 t/ha) and sugar yield (10.55 t/ha) were recorded under the treatment where application of FYM @ 20t/ha was done along with soil test (rating chart) based inorganic fertilizer recommendations.

3. SHAHJAHANPUR

Sugarcane ratoon with application of FYM @ 10 tonnes/ha + bio-fertilizers (Azotobacter + PSB) + inorganic nutrients on soil test basis (NPK) produced significantly higher cane yield (99.20 t/ha) than that of other treatments.

4. UCHANI

FYM 20 t/ ha + 100% RDF through inorganic source (T6) and FYM @ 10 t/ ha + biofertilizer (Azotobacter/ Acetobacter + PSB) + soil test basis (T9) were found best and at par treatments in terms of number of tillers (18.4, 142.9 thousands/ha), millable canes (119.1, 116.5 thousands/ha) and ratoon cane yield (96.6, 94.0 t/ha) and sugar yield as compared to rest of the treatments.

PENINSULAR ZONE

SANKESHWAR

The yield and yield attributes recorded in first ratoon cane indicated significant differences among the treatments. Application of trash at 10 tonnes/ha along with soil test based nutrients application recorded highest cane yield

(100.41 t/ha), number of millable canes (80680/ha) and CCS yield (13.65 t/ha).

EAST COAST ZONE

NAYAGARH

Results obtained from first ratoon crop indicated that application of FYM/Compost @ 10t/ha + (Azotobacter + PSB) +100% RDF (T8) and Application of FYM/Compost @ 10t/ha + Azotobacter + PSB + Soil test based (NPK) fertilizer application (T9) recorded higher percentage of germination at 45 DAR i.e. 43.70 and 46.89%, respectively. These treatments subsequently performed better than other treatment combinations leading to higher yield parameters and cane yield.

NORTH CENTRAL ZONE

1. SEORAHI

Sugarcane ratoon with application of FYM@ 10 t/ha + bio-fertilizers (Azotobacter + PSB) + soil test basis NPK application treatment produced significantly higher clump population (34.92 thousand/ha), NMC (107.54 thousand/ha) and cane yield (83.99 t/ha) as compared to other treatments except the treatment T8.

2. PUSA

Integrated application of nutrients was found effective in improving soil fertility and cane yield. The application of fertilizers on soil test basis along with organics @ 20 t/ha was found suitable for boosting cane yield and maintaining soil fertility in calcareous soils of Bihar.

SALIENT FINDINGS

Results of 8 AICRP (S) centres allocated in four different zones revealed that application of FYM/Compost @ 20 tonnes / ha with inorganic nutrient based on soil test (NPK application) recorded the highest cane yields, CCS yields and number of millable canes in North West zone while application of trash @ 10 tonnes/ ha + application of inorganic nutrient based on soil test (NPK application) recorded the highest number of millable cane, single cane weight and cane yield in Peninsular zone. Similarly, application of FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/Acetobacter + PSB*) + inorganic nutrient on soil test basis (NPK) recorded the highest number of millable cane and cane yield in North Central and East coast zones. Application of trash along with inorganic nutrient application based on soil test found quite effective in Peninsular Zone while application of FYM/compost with biofertilizers or without biofertilizers found effective in remaining three zones (North Central, East coast and North West zone) of country (Table 1.1 to1.4).

Table: 1.1/AS 68: Effect of integrated application of organics and inorganics on number of millable cane (000 /ha).

Treatment	North West Zone	Peninsular Zone	North Central Zone	East Coast Zone
T1: Trash at 10 tonnes/ ha + 50% RDF	92.25	64.45	59.59	61.63
T2: Trash at 10 tonnes/ ha + 100% RDF	108.48	65.10	84.28	66.87
T3: Trash at 10 tonnes/ ha + soil test basis (NPK application)	108.18	80.68	94.30	69.08
T4: FYM/Compost @ 20 tonnes / ha + 50% RDF (inorganic source)	103.36	65.63	70.59	64.05
T5: FYM/Compost @ 20 tonnes / ha + 100% RDF (inorganic source)	117.83	78.17	95.42	71.63
T6: FYM/Compost @ 20 tonnes / ha + in organic nutrient based on soil test (NPK application)	122.49	71.00	106.93	72.96
T7: FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter + PSB*) + 50% RDF	109.33	65.73	71.90	68.48
T8: FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter + PSB*) + 100% RDF	118.64	62.35	95.61	76.48
T9: FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/ Acetobacter + PSB*) + soil test basis (NPK)	121.58	66.43	113.03	78.08
CV (%)	5.86	-	9.58	-
SE(d)	4.61	-	6.31	-
LSD at 5%	9.52	15.21	14.55	7.38

Table 1.2/AS 68: Effect of integrated application of organics and inorganics on individual cane weight (g).

Treatment	North West Zone	Peninsular Zone	North Central Zone	East Coast Zone
T1: Trash at 10 tonnes/ ha + 50% RDF	791.67	1400	588	1183
T2: Trash at 10 tonnes/ ha + 100% RDF	918.33	1500	645	1360
T3: Trash at 10 tonnes/ ha + soil test basis (NPK application)	942.00	1530	693	1503
T4: FYM/Compost @ 20 tonnes / ha + 50% RDF (inorganic source)	849.67	1220	684	1257
T5: FYM/Compost @ 20 tonnes / ha + 100% RDF (inorganic source)	971.00	1250	742	1393
T6: FYM/Compost @ 20 tonnes / ha + in organic nutrient based on soil test (NPK application)	1026.33	1440	754	1517
T7: FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/Acetobacter* + *PSB*) + 50% RDF	862.33	1230	688	1370
T8: FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/Acetobacter* + *PSB*) + 100% RDF	1027.67	1330	751	1530
T9: FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/Acetobacter* + *PSB*) + soil test basis (NPK)	1036.00	1470	748	1577
CV (%)	10.62	-	-	-
SE(d)	81.164	-	-	-
LSD at 5%	NS	290	70	235

Table 1.3/AS 68: Effect of integrated application of organics and inorganics on sugarcane yield of ratoon crop (t/ha).

Treatment	North West Zone	Peninsular Zone	North Central Zone	East Coast Zone
T1: Trash at 10 tonnes/ ha + 50% RDF	65.65	89.42	42.44	62.77
T2: Trash at 10 tonnes/ ha + 100% RDF	80.55	97.53	60.51	72.70
T3: Trash at 10 tonnes/ ha + soil test basis (NPK application)	82.40	100.41	70.96	73.47
T4: FYM/Compost @ 20 tonnes / ha + 50% RDF (inorganic source)	74.63	97.53	57.86	64.88
T5: FYM/Compost @ 20 tonnes / ha + 100% RDF (inorganic source)	86.80	97.74	74.49	73.93
T6: FYM/Compost @ 20 tonnes / ha + in organic nutrient based on soil test (NPK application)	91.75	98.87	77.94	74.81
T7: FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/Acetobacter* + *PSB*) + 50% RDF	75.70	81.11	49.82	67.56
T8: FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/Acetobacter* + *PSB*) + 100% RDF	85.98	81.21	77.18	80.49
T9: FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/Acetobacter* + *PSB*) + soil test basis (NPK)	89.78	96.92	81.26	82.09
CV(%)	7.67	-	9.58	-
SE(d)	4.42	-	6.307	-
LSD at 5%	9.12	8.82	14.55	8.15

Table 1.4/AS 68: Effect of integrated application of organics and inorganics on CCS yield (t/ha).

Treatment	North West Zone	North Central Zone
T1: Trash at 10 tonnes/ ha + 50% RDF	7.92	3.58
T2: Trash at 10 tonnes/ ha + 100% RDF	9.67	5.59
T3: Trash at 10 tonnes/ ha + soil test basis (NPK application)	10.19	7.44
T4: FYM/Compost @ 20 tonnes / ha + 50% RDF (inorganic source)	8.96	5.30
T5: FYM/Compost @ 20 tonnes / ha + 100% RDF (inorganic source)	10.67	8.20
T6: FYM/Compost @ 20 tonnes / ha + in organic nutrient based on soil test (NPK application)	11.33	9.97
T7: FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/Acetobacter* + *PSB*) + 50% RDF	9.26	5.33
T8: FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/Acetobacter* + *PSB*) + 100% RDF	10.64	8.25
T9: FYM/Compost @ 10 tonnes / ha + biofertilizer (*Azotobacter/Acetobacter* + *PSB*) + soil test basis (NPK)	10.83	10.15
CV (%)	8.04	-
SE(d)	0.57	-
LSD at 5%	1.17	1.56

IMPORTANT OBSERVATIONS

The experiment was carried out at 08 locations out of 24 allotted. Following salient points emerged from findings:

- Combined application of organic and inorganic sources of nutrients was found conspicuously better over the use of fertilizers alone across the centres located in different agro-climatic conditions.
- Sugarcane trash used as mulch in ratoon crops has little contribution as a source of nutrients as organic amendments like FYM or compost recorded significant improvement in sugarcane and sugar yields over that with trash mulching under the use of recommended dose of fertilizers across the locations.
- Use of organic sources of nutrients in plant-ratoon system brings about substantial enhancement of soil health parameters in most of the sugarcane growing soils.

AS 70: Scheduling irrigation with mulch under different sugarcane planting methods

The trial was initiated during 2016-17 and was allocated to all the centres. In all 11 centres carried out the trial as per common technical programme for the year. Centre wise summary of findings are given below.

NORTH WEST ZONE

1. FARIDKOT

Among the planting methods paired row trench planting with trash mulching recorded significantly higher cane yield(99.7 t/ha) than all othermethods of planting. Trash mulching resulted in significantly higher cane yield than without trash mulching irrespective of planting methods. Apparent water productivity (AWP) and Total water productivity (TWP) were significantly higher in paired row trench planting than conventional planting. Among irrigation schedules, AWP decreased successively with increase in water input from 0.6 to 1.0 IW/CPE.

2. KOTA

Based on the three years of study, it can be concluded that paired row trench planting (30:120 cm row spacing) with organic mulching of sugarcane trash @ 6 t/ha was found better with respect to number of tillers, plant height, millable canes, cane yield, cane diameter, cane weight, brix, CCS yield (t/ha) and water use efficiency. However, irrigation water at IW: CPE ratio of 0.80 was found economical in sugarcane yield when compared with 0.60 and 1.00 IW: CPE ratios. Maximum WUE was recorded at IW: CPE ratio of 0.80 which was significantly higher over IW: CPE ratio of 1.00.Significant enhancement in economics with each successive increase in irrigation regimes from 0.60 to 0.80 IW: CPE ratio was proportionally more than the increase in irrigation water i.e. IW: CPE ratio of 1.00.

3. LUCKNOW

Paired-row trench planting (30:120cm row spacing) with trash mulching (75.19 t/ha) being at par with conventional flat method of planting along with trash mulching (74.22 t/ha) resulted in significantly higher cane yield than that of conventional flat method of planting with no trash mulching (63.42 t/ha). The trash application led to higher sugarcane yields, irrespective of irrigation scheduling. The higher cane yield (73.86 t/ha) under irrigation schedule at

0.8 IW: CPE might be attributed better initial crop growth, higher number of millable cane (92.27 x 000/ha) owing to optimum irrigation frequency with trash mulching at the time of crop establishment. Water use efficiency was found the highest under paired-row trench planting with trash mulching (0.432 t/ha- cm) followed by conventional flat method of planting with trash mulching (0.427 t/ha-cm).

4. SHAHJAHANPUR

Paired row trench planting (120:30 cm row spacing) with organic mulch @ 6 t/ha produced higher cane yield (89.07 t/ha) and maximum water use efficiency (1090.20 kg/ha cm). Irrigation schedule at 1.00 IW/CPE ratio (I3) produced significantly higher cane yield (90.05 t/ha) with minimum water use efficiency (1050.25).

5. UCHANI

No significant differences in growth yield and yield attributing characters were observed among all the irrigation regimes due to frequent rains during pre-monsoon period. Sugarcane yield (95.2 t/ha) was significantly higher under paired-row trench planting with trash mulching than conventional flat method of planting along with trash mulching (82.2 t/ha) followed by paired-row trench planting with no mulching (88.6 t/ha) and conventional flat method of planting with no mulching (75.5 t/ha). Interaction between method of planting and irrigation levels was found non-significant. The highest yield of cane produced/1000 litres of irrigation (13.72 and 13.29 kg) water was recorded in paired row trench planting at 0.6 IW/CPE and 0.8 IW/CPE irrigation schedule with trash mulching.

PENINSULAR ZONE

1. MANDYA

Among the planting methods, 120 cm row spaced furrow planting with *dhaincha* green manure sown 30 DAP and mulching at 75 DAP recorded significantly higher cane yield (161.0 t/ha) as compared to others. However, it was at par with 120 cm row spaced furrow planting with alternate skip furrow irrigation after earthing up + *dhaincha* green manure mulching (155.2 t/ha). Among the irrigation schedules, IW/CPE ratio of 1.0 recorded significantly higher yield (170.8 t/ha) as compared to IW/CPE ratio of 0.60 (131.8 t/ha). Among the interactions, significantly higher cane yield was observed in P2I3 (180.5 t/ha). However, it was on par with P4I3 (170.6 t/ha) and P1I3 (168.1 t/ha). Scheduling of irrigation at IW/CPE ratio of 0.6 consumed lowest amount of irrigation water (1725mm) and saved 18% of irrigation water. While, the highest amount of irrigation water was consumed by IW/CPE ratio of 1.0 (2095 mm).

2. PUNE

The furrow planting of 120 cm spacing with sun hemp green manure mulching and irrigation schedule of 1.00 IW/CPE was found superior for cane yields, however it was at par with cane yield recorded in 120 cm row spaced furrow planting with alternate skip furrow irrigation after earthing up with sun hemp green manure mulching. The highest water use efficiency was recorded in furrow planting of 120 cm row spacing with alternate skip furrow irrigation after earthing up with sun hemp green manure mulching.

EAST COAST ZONE

NAYAGARH

Furrow planting (120 cm row spacing) with alternate skip furrow irrigation after earthing-up + brown mulching method produced higher NMC and cane yield of 90944/ha and 100.35 t/ha, respectively which is closely followed by furrow planting (120 cm row spacing) with brown mulching (NMC and cane yield 90919/ha and 99.906 t/ha, respectively). Irrigating the crop at IW/CPE ratio of 1.0 produced highest NMC and sugarcane yield of 91922/ha and 105.48 t/ha, respectively which is significantly different from irrigating the crop at IW/CPE ratio of 0.6 (NMC and cane yield 85558/ha and 92.19 t/ha, respectively). Planting method x irrigation schedule interaction was found not significant.

NORTH CENTRAL ZONE

1. PUSA

The highest plant population (216100/ha), cane length (333.7 cm), millable canes (143200/ha) and cane yield (104.5 t/ha) were noticed under paired row trench planting (30: 120 cm) with trash mulching @ 6 t/ha (P3) being statistically comparable to paired row trench planting (30: 120 cm) without trash mulching (P4). However, brix, pol and purity percent were found to be non-significant. The number of irrigation was 6, 5 and 3 at IW: CPE ratios 1.00, 0.80 and 0.60, respectively. The total water applied on the basis of depth (7.5 cm) and number of irrigations was 45, 37.5 and 22.5 cm at IW: CPE ratios of 1.00, 0.80 and 0.60, respectively

2. SEORAHI

Paired row trench planting (120:30 cm row spacing) with organic mulch @ 6t/ha gave significantly higher germination, shoot population, NMC and cane yield over conventional flat planting (75 cm row spacing) with organic mulch @ 6t/ha and conventional flat planting (75 cm row spacing) without mulch. Among different irrigation scheduling treatments IW/CPE ratio 1.0 gave significantly higher performance. Cane yield and sucrose per cent increased with increase in the IW/CPE ratio. Sucrose per cent was not affected significantly with different treatments of planting methods and irrigation schedules.

NORTH EASTERN ZONE

BETHUADHARI

Results indicated that the highest cane yield (103.09 t/ha) was obtained with the trench planting (30:120 cm row spacing) with organic mulching @ 6 t/ha followed by that of trench planting without mulching. Among irrigation scheduling treatments keeping IW: CP ratio one brought about highest cane yield (94.53 t/ha) significantly better over the other two IW: CP ratio. Interaction between planning methods and irrigation scheduling was found significant for cane yield being highest (115.32 t/ha) at IW: CP ratio 1.0 when planted in trenches with mulching.

SALIENT FINDINGS

The highest cane yield and number of millable cane were recorded by paired row trench planting (30:120 cm row spacing) with organic mulching of sugarcane trash @ 6 t/ha in North West zone, North Central zone and North East zone of country. The highest water productivity was also recorded by this treatment in North West zone and North Central zone also (Table 1.1). In Peninsular zone, furrow planting (120 cm row spacing) with green manure (dhaincha) sowing at 30 DAP, mulching at 75 DAP and earthing up was recorded the highest cane yield (157.98t/ha). In contrast to peninsular zone, furrow planting (120 cm row spacing) with alternate skip furrow irrigation after earthing up + green manure mulching in East coast zone recorded significantly the highest cane yield (100.36 t/ha) and water productivity (788.17 kg/ha/cm) over other method of planting. Similarly, to East coast zone, this treatment also recorded the highest water productivity in Peninsular zone (784 kg/ha/cm). Irrigating scheduling at IW/CPE ratio of 1.0 produced the highest cane yield and number of millable cane over other schedules in all the zones (Table 1.1, 1.2, 1.3 & 1.4). The highest water productivity was recorded in East Coast zone and Peninsular zone with IW/CPE ratio of 0.60 (Table 1.2). The highest number of millable cane was recorded by furrow planting (120 cm row spacing) with alternate skip furrow irrigation after earthing up + green manure mulching in Peninsular and East Coast Zone (Table 1.4).

Table 1.1/AS 70: Effect of scheduling irrigation with mulch under different sugarcane planting methods on cane yield (t/ha) and water productivity (kg/ha/cm) of sugarcane.

Planting methods and mulching practices	North West Zone		North Central Zone		North East Zone
	Yield (t/ha)	Water productivity (kg/ha /cm)	Yield (t/ha)	Water productivity (kg/ha /cm)	Yield (t/ha)
Conventional flat planting (75 cm row spacing) with organic mulching sugarcane trash @ 6 t /ha	81.57	676.56	82.15	424	79.23
Conventional flat planting (75 cm row spacing) without mulch.	80.54	672.54	78.65	403	70.21
Paired row trench planting (30:120 cm row spacing) with mulching sugarcane trash @ 6 t/ha.	88.61	867.70	107.35	589	103.09
Paired row trench planting (30:120 cm row spacing) without mulch.	86.07	837.84	100.35	539	97.73
CV(%)	5.34	23.70	4.50	-	-
SE(d)	2.84	127.96	4.15	-	-
LSD at 5%	6.20	NS	13.20	-	7.6
Irrigation schedule (IW/CPE)					
I_1:0.60	80.09	804.86	79.65	445	74.75
I_2:0.80	85.96	782.36	92.45	484	85.91
I_3:1.0	86.57	692.84	104.30	534	94.53
CV (%)	3.28	6.18	1.73	-	-
SE(d)	1.75	33.20	1.60	-	-
LSD at 5%	4.03	81.24	6.88	-	8.4

Table 1.2/AS 70: Effect of scheduling irrigation with mulch under different sugarcane planting methods on cane yield and water productivity of sugarcane.

Planting methods and mulching practices	Peninsular zone		Coastal zone	
	Yield (t/ha)	Water productivity (kg/ha/cm)	Yield (t/ ha)	Water productivity (kg/ha/cm)
Furrow planting (120 cm row spacing) without mulching	140.25	607.9	99.82	762.85
Furrow planting (120 cm row spacing) with green manure (dhaincha) sowing at 30 DAP, mulching at 75 DAP and earthing up	157.98	704.10	99.91	772.51
Furrow planting (120 cm row spacing) with alternate skip furrow irrigation after earthing up without mulching	137.99	696.70	99.10	779.86
Furrow planting (120 cm row spacing) with alternate skip furrow irrigation after earthing up + green manure mulching	149.65	784.00	100.36	788.17
CV (%)	2.52	1.13	-	-
SE(d)	3.70	7.90	-	-
LSD at 5%	11.86	25.13	NS	-
Irrigation schedule (IW/CPE)				
I_1:0.60	133.03	699.10	92.19	820.36
I_2: 0.80	147.68	697.65	101.72	777.29
I_3: 1.0	158.70	685.60	105.49	729.90
CV (%)	6.58	6.69	-	-
SE(d)	9.65	46.42	-	-
LSD at 5%	NS	NS	3.26	-

Table 1.3/AS 70: Effect of scheduling irrigation with mulch under different sugarcane planting methods on number of millable cane of sugarcane.

Planting methods and mulching practices	Number of millable cane (000/ha)		
	North west zone	North central zone	North east zone
Conventional flat planting (75 cm row spacing) with organic mulching sugarcane trash @ 6 t /ha	107.04	111.02	109.63
Conventional flat planting (75 cm row spacing) without mulch.	103.30	104.71	97.57
Paired row trench planting (30:120 cm row spacing) with mulching sugarcane trash @ 6 t/ha.	120.11	134.54	121.30
Paired row trench planting (30:120 cm row spacing) without mulch.	116.83	129.47	112.63
CV (%)	5.16	2.38	-
SE(d)	4.08	2.85	-
LSD at 5%	9.24	9.07	10.65
Irrigation schedule (IW/CPE)			
I_1:0.60	107.73	106.59	103.25
I_2:0.80	114.01	120.49	110.85
I_3:1.0	113.78	132.67	116.75
CV (%)	2.48	4.55	-
SE(d)	1.963	5.46	-
LSD at 5%	4.80	NS	6.75

Table 1.4/AS 70: Effect of scheduling irrigation with mulch under different sugarcane planting methods on number of millable cane of sugarcane.

Planting methods and mulching practices	Number of millable cane (000/ha)	
	Peninsular zone	East Coastal zone
Furrow planting (120 cm row spacing) without mulching	85.91	87.13
Furrow planting (120 cm row spacing) with green manure (dhaincha) sowing at 30 DAP, mulching at 75 DAP and earthing up	89.49	90.92
Furrow planting (120 cm row spacing) with alternate skip furrow irrigation after earthing up without mulching	83.89	87.43
Furrow planting (120 cm row spacing) with alternate skip furrow irrigation after earthing up + green manure mulching	86.72	90.94
CV (%)	1.45	-
SE(d)	1.26	-
LSD at 5%	NS	3.00
Irrigation schedule (IW/CPE)		
I_1:0.60	84.02	85.56
I_2:0.80	87.08	89.84
I_3:1.0	88.46	91.92
CV (%)	1.45	-
SE(d)	1.25	-
LSD at 5%	NS	2.85

Important Observations: The experiment was initiated during the year (2016-17) and was carried out by 11 centres as per the technical programme. Salient findings are enumerated below:

- Planting of sugarcane in paired rows (120: 30) with mulching of trash (6 t/ha) in the inter-row spaces out yielded the conventional flat method with or without mulch at all the centres in North Western, North Central and North Eastern zones. Being in the climatic region of high evaporative demand, sugarcane crop responded up to 1.0 IW/CPE irrigation regime in the zones. However, similar yields have been recorded with 0.8 IW/CPE ratio at many centres. Trash mulching could effectively save about 20-26% irrigation water over no-mulching.
- Sugarcane crop in Peninsular and East Coast Zones responded to furrow planting (120 cm) and skip furrow irrigation combined with the use of leguminous crop as green manure till 75 DAP, as mulch during tillering and thereafter residue incorporation. IW/CPE ratio 1.0 resulted in higher cane productivity; however, it can be restricted to 0.8 for getting higher water use efficiency in these zones.
- Use of mulch in sub-tropical zones and green manuring followed by mulching and residue incorporation resulted in higher net return.

AS 71: Carbon sequestration assessment in sugarcane based cropping system

The trial was initiated during 2016-17 with allocation to all the centres. In all 08 centres conducted the trial during 2018-19 in accordance with the approved technical programme.

NORTH WEST ZONE

1. FARIDKOT

The highest cane equivalent yield of the system was obtained with sugarcane plant-ratoon- zero tilled wheat without *Trichoderma* inoculation (115.7 t/ha) followed by plant-ratoon –wheat with trash mulching in ratoon irrespective of *Trichoderma* inoculation (109.6 and 108.7 t/ha).

2. KOTA

Based on the three years study of soil properties, it can be concluded that Soybean-Wheat –Moong bean-wheat (residue retention with *Trichoderma*) (T2) treatment was found better with respect to significant enhancement in OC, infiltration rate, bulk density, WHC and Nutrient status of soil over T3 and T4 treatments. Whereas, in case of ratoon of sugarcane different treatment was noted that with T6 treatment also significantly higher in respect germination, tillers, plant height, cane diameter, cane weight, cane yield as well as in cane quality parameters with rest of treatments. Similarly, wheat succeeding ratoon also recorded higher germination (84.378%), no. of tillers at 90 DAS (9.97 thousand /ha), grain yield (56.83 q/ha) and straw yield (84.67 q/ha) under T6 treatment, which was significantly higher over sugarcane- ratoon-moong/wheat cropping system. In case of soil properties and nutrients status of soil with T6 treatment was found superior over rest of sugarcane- ratoon- wheat/ moong cropping systems with or without Trichoderma and trash mulching & trash removal treatment, by recording organic carbon (0.52 %), WHC (47.07%), bulk density (1.44 Mg/m3), N (332 kg/ha), P (24.10 kg /ha) and K (324.33 kg /ha).

3. LUCKNOW

During the year 2018-19 it was found that Sugarcane - ratoon-wheat system recorded higher total soil organic carbon (0.45%) than the Rice-Wheat system (0.39%) at 0-30 cm depth as compared to initial SOC value of 0.32%. The mean SOC value improved 40.6% in Sugarcane -ratoon-wheat system than 21.8% in rice-wheat system from the initial SOC due to high addition of crop residua in the system. It further subsequently decreased in 30-60 cm depth. Mean available nutrient status in soil decreased as compared to initial status of soil. The conformity experiment was laid out in randomized block design with eight treatments and three replications under rice-wheat and sugarcane-ratoon-wheat systems with same objective to improve the total soil organic carbon build-up and sustain crop yields during 2018-19 with same technical programme.

4. UCHANI

Higher cane equivalent yield was recorded in sugarcane plant- ratoon-wheat cropping system as compared to rice-wheat cropping system. Highest cane equivalent yield of 115.4, 115.0 and 110.0 t/ha was recorded in treatment T7 (sugarcane – Ratoon- Wheat (ZT) without *Trichoderma*, T5 (sugarcane – Ratoon (trash mulch with Trichoderma) – Wheat) and T3 (sugarcane – Ratoon (trash mulch without *Trichoderma*) – Wheat). Physical properties of soil were adversely affected in treatment T1 and T2 after harvest of puddled transplanted rice. The bulk density increased from 1.63 (initial) to 1.72 g/cc after harvest of rice crop. The bulk density and WHC improved after rice residue retention in wheat crop through happy seeder machine in treatment T1 and T2. Sugarcane proved superior in maintaining soil physical properties in comparison to puddled transplanted rice- wheat rotation.

PENINSULAR ZONE

1. MANDYA

In the third year Cowpea was sown in T2 to T7 treatment and soybean-maize was grown in T1 treatment. The

Cowpea yield was significantly higher in Sugarcane Ratoon – Cowpea (trash mulching with *Trichoderma*) (15.13 q/ha) but it was at par with sugarcane - ratoon- (trash mulching with *Trichoderma*) – Cowpea (15.01 q/ha). In soybean-maize treatment soybean yield was 16.3 q/ha and maize yield was 86.2 q/ha. The soil physico - chemical parameters were not influenced significantly as compared to initial values. However, the trash incorporation treatments recorded significant improvement in soil physical and chemical properties as compare to trash burning / removal treatments. Soil chemical parameters *viz.*, soil pH, EC, OC, BD and soil available N, P_2O_5 and K_2O content after the harvest of ratoon crop were not influenced significantly due to different cropping systems.

2. PUNE

The programme was initiated to assess the carbon sequestration under different cropping sequences. The results concluded that the trash mulching with *Trichoderma* in ratoon crop improved cane yield by 8.9 t/ha as compared to mulching without *Trichoderma* whereas residue retention with *Trichoderma* in wheat recorded maximum grain yield (25.8 t/ha) in plant cane-Ratoon-Wheat cropping sequence.

EAST COAST ZONE

NAYAGARH

The ratoon crop with trash mulching with *Trichoderma* produced highest number of net millable canes (90700/ha), cane (94.14 t/ha) and CCS yield (11.34 t/ha). Total soil organic carbon was found to be better with treatment T5 (sugarcane – ratoon (trash mulching with *Trichoderma*) – cowpea) compared to other treatments. Highest cowpea yield (185.78 kg/ha) was obtained when cowpea was grown after trash incorporation through rotavator and Trichoderma incorporation before sowing of cowpea.

NORTH CENTRAL ZONE

PUSA

Data on growth, yield attributes, ratoon yield and quality of sugarcane and yield of rice, wheat system and organic carbon content on post-harvest soil indicated that none of treatments except straw yield of wheat could establish significant effect in improving the growth, yield, quality and organic carbon content. However, comparatively higher ratoon cane yield (82.0 t/ha) was obtained with sugarcane-ratoon-wheat (trash incorporation through rotavator and *Trichoderma* incorporation before sowing of wheat) (T6). Comparatively higher grain (3.73 and 3.91 t/ha) and straw yield (4.80 and 5.40 t/ha) of rice and wheat, respectively was obtained with rice-wheat-rice-wheat (residue retention with *Trichoderma* cropping system (T2).

SALIENT FINDINGS

The highest cane yield was recorded in Sugarcane – Ratoon (trash mulching with *Trichoderma*) – cowpea in North West zone, Peninsular zone and East Coast zone. Similarly, the maximum cane yield was recorded in North Central zone through Sugarcane – Ratoon – Cowpea (with trash incorporation through rotavator and *Trichoderma* before sowing of Cowpea). There was no significant difference in organic carbon build up in any of the treatment except in East coast zone. However, marginal improvement over initial status was recorded with trash incorporation along with *Trichoderma* inoculation (Table 1.1 & 1.2).

Table 1.1/AS 71: Effect of carbon sequestration assessment on ratoon yield of sugarcane and organic carbon

Treatment	North west zone		North central zone	
	Yield (t/ha)	% OC	Yield (t/ha)	% OC
T1: Rice-wheat-rice-wheat (residue retention without *Trichoderma*)	-	0.41	-	0.51
T2: Rice-wheat-rice-wheat (residue retention with *Trichoderma*)	-	0.42	-	0.51
T3: Sugarcane-Ratoon (trash mulching without *Trichoderma*)-cowpea	100.87	0.43	75.3	0.51
T4: Sugarcane-Ratoon (trash removal without *Trichoderma*)-cowpea	95.11	0.41	75.2	0.50
T5: Sugarcane-Ratoon (trash mulching with *Trichoderma*) – cowpea	104.45	0.44	74.0	0.51
T6: Sugarcane -Ratoon -cowpea (trash incorporation through rotavator and *Trichoderma* incorporation before sowing of cowpea)	93.95	0.44	82.0	0.53
T7: Sugarcane-Ratoon- cowpea (Zero tilled) without *Trichoderma*	102.54	0.42	79.3	0.52
T8: Sugarcane-Ratoon-cowpea (Zero tilled) with *Trichoderma.*	95.76	0.42	76.5	0.52
CV (%)	4.70	6.17	11.1	4.96
SE(d)	3.28	0.02	4.92	0.02
LSD at 5%	7.00	NS	NS	NS

Table 1.2/AS 71: Effect of carbon sequestration assessment on ratoon yield of sugarcane and organic carbon

Treatment	Peninsular zone		East coastal zone	
	Yield (t/ha)	% OC	Yield (t/ha)	% OC
T1 :Cowpea-Sesame -Cowpea - Sesame	-	0.63	-	0.44
T2 :Sugarcane-Ratoon-cowpea	130.62	0.63	85.29	0.48
T3 : Sugarcan-Ratoon (trash mulching without *Trichoderma*) - Cowpea	136.55	0.60	88.52	0.47
T4 :Sugarcane -Ratoon (trash removal without *Trichoderma*) - Cowpea	131.17	0.55	86.52	0.45
T5 : Sugarcane -Ratoon (trash mulching with *Trichoderma*) - Cowpea	139.92	0.61	94.15	0.50
T6: Sugarcane -Ratoon -Cowpea (trash incorporation through rotavator and *Trichoderma* incorporation before sowing of Cowpea)	132.62	0.66	87.05	0.51
T7 : Sugarcane -Ratoon- Cowpea (Zero tilled) without *Trichoderma*	132.52	0.54	85.90	0.51
T8 : Sugarcane -Ratoon-Cowpea (Zero tilled) with *Trichoderma*	133.89	0.59	84.87	0.50
CV (%)	2.43	9.96	-	-
SE(d)	3.25	0.06	1.72	-
LSD at 5%	NS	NS	5.31	-

IMPORTANT OBSERVATIONS

- In the North-West Zone use of sugarcane trash as mulch with or without *Trichoderma* inoculation in the ratoon crop resulted in highest sugarcane equivalent yield (104.45 t/ha) and brought about palpable improvement in soil health indicators.
- Trash mulching along with the use of *Trichoderma* in ratoon crop yielded in highest cane equivalent yield of the system comprising sugarcane- ratoon- cowpea/ green gram crops in Peninsular and East-Coast Zones.
- For North Central Zone rotavator operation after ratoon harvest followed by spray of *Trichoderma* resulted in highest cane equivalent yields in sugarcane – ratoon – wheat cropping system.

AS-72: Agronomic performance of elite sugarcane genotypes

The trial was initiated during 2016-17 and was allotted to all the centres. During the year (2018-19) 12 centres reported the results. Centre wise summary of findings for the year 2017-18 are given below:

NORTH WEST ZONE

1. FARIDKOT

Among early genotypes cane yield was at par at 90 and 120 cm spacing. The number of shoots and millable canes were better at 90 cm spacing but single cane weight was better at 120 cm spacing. The highest cane yield was of CoPb 13181 (134.4 t/ha) followed by Co 5009 (110.6 t/ha). For mid-late genotypes cane yield was significantly better at 90 cm spacing than 120 cm spacing. The number of shoots and millable canes were better at 90 cm spacing. The highest cane yield was of CoH 13263 (141.6 t/ha) which was at par with CoPb 13182 (131.3 t/ha), Co 05011 (128.4 t/ha) and Co 13035 (125.1 t/ha).

2. KOTA

For early maturing genotypes at closer spacing (90 cm), genotype Co 13034 recorded significantly higher germination (49.13 %), single cane length (237.50 cm), cane yield (94.40t/ha), single cane weight (1070.00 gm) and number of millable canes (88.97 thousand/ ha). There was no significant effect of spacing. Mid-late maturing genotype Co 13035 recorded the highest cane yield significantly higher over rest of genotypes and zonal checks.

3. LUCKNOW

The shoot and NMC count for early genotypes were significantly lower at 120 cm spacing compared to 90 cm spacing in all the three genotypes. Significantly higher cane yield (104.0 t/ha) was reported in Co 0238 sown at 90 cm over CoS 13231 and CoJ 64. Further, the genotype CoS 13231 and Co 0238 gave significantly lower cane yield at 120 cm row spacing. Individual cane length, cane diameter, cane weight were higher in Co 0238 than remaining two genotypes. Among mid-late genotypes CoLk 13204 gave the highest cane yield (84.76 t/ha) sown at 90 cm spacing followed by the same genotype sown at 120 cm spacing (68.49 t/ha). The higher yield in CoLk 13204 was mainly attributed to its higher NMC/ha. Brix varied from 17.3 to 21.07 at 10 months stage and 18.87 to 20.72 at 12 months stage in different genotypes.

4. SHAHJAHANPUR

Early genotypes revealed that Co 0238 produced significantly higher cane yield (105.10 t/ha) followed by genotype CoS13231 (77.40 t/ha). Regarding spacing

significantly higher cane yield (82.20 t/ha) was recorded with 90 cm row spacing than that of 120 cm (67.90 t/ha). CCS% in cane at harvest was found significantly higher in Co13034 (12.36) followed by Co0238 (12.03). Co13035 produced significantly higher cane yield (82.55 t/ha) at par with CoPant 13224 (82.00 t/ha) in mid–late group. Regarding spacing significantly higher cane yield was obtained in early and mid-late genotype at 90 cm row spacing.

5. UCHANI

Germination was not affected significantly due to different spacing. Significantly higher number of tillers, number of millable canes, cane yield and sugar yield were recorded at 90 cm spacing as compared to 120 cm spacing irrespective of the maturity group. Cane weight was significantly better at 120 cm as compared to 90 cm spacing. Among early maturing varieties, highest and lowest and cane yield was recorded in variety Co 0238 (85.8 t/ha) and CoS 13231 (68.7 t/ha), respectively. Among mid maturing entries, CoH 13263, CoLk 13204, Co 13035 and CoPant 13224 being at par recorded significantly highest cane yield. Interaction was not found significant.

PENINSULAR ZONE

1. PUNE

The results of the plant crop indicated that for the early genotypes tillering (1.02 & 1.26 lakh/ha) at 90 & 120 DAP, single cane weight (1.43 kg), cane yield (117.32 t/ha) and B:C ratio (1:2.55) was highest in Co11001.The mid-late genotype CoM 11085 performed better in tillering at 90 & 120 DAP (1.03 & 1.18 lakh/ha) and NMC (0.80 lakh/ha) while cane yield (129.20 t/ha), CCS yield (18.38 t/ha), B:C ratio (1:2.81) was higher in Co11012.Whereas, CoM11086 showed superior juice quality.

2. MANDYA

Among the genotypes, Co 12009 found superior with respect to cane yield (122.29 t/ha) as compared to others. But, was on par with CoM12085 (109.25 t/ha) and VSI 12121 (108.4 t/ha). This increased cane yield was due to enhanced yield parameters viz., single cane weight, cane length, cane girth, inter-nodal length, number of internodes and number of millable cane/ha. Quality parameters viz., sucrose % and CCS% did not vary significantly for the genotypes.

3. SANKESHWAR

There was significant difference among the early genotypes tested for yield and yield attributes. Significantly higher cane yield (92.11 t/ha) was recorded in Co 12007 on par with CoC 671(87.95 t/ha). The lowest cane yield (76.81 t/ha) was recorded in Co 12008. The lowest NMC was recorded in CoC 671(49,780/ha) and the highest was recorded in Co 12007 (68,140/ha). For mid-late genotypes significantly higher cane yield (121.43 t/ha) and CCS yield (15.18 t/ha) was recorded in Co 12009 and was on par with Co12012 (115.42 t/ha). The lowest cane yield (106.33 t/ha) was recorded in VSI 12121. The highest NMC (122280/ha) was recorded in Co 12009 and lowest NMC (57550/ha) was recorded in CoM 12085.

4. COIMBATORE

Cane yield differences were non-significant for two row spacing wherein planting sugarcane at 120 cm row spacing recorded higher cane yield (137.09 t/ha) than 150 cm row spacing (120.71 t/ha). In the plant crop the NMC (000/ha) showed significant difference due to varieties, wherein, promising early genotype Co 12012 (129460 NMC/ha) recorded significantly higher NMC than the check varieties Co 86032 (89670 NMC/ha) and CoC 671(76700 NMC/ha).Juice Brix, Sucrose (%), Purity (%) and CCS (%) at harvest showed significant varietal difference. In the plant crop CoC 671 recorded significantly highest mean brix of 22.37 than other elite sugarcane genotypes. Amongst the 11 elite sugarcane genotypes VSI 12121 and Co 12012 was found more promising and recorded marginally higher CCS yield of 22.91 and 20.85 t/ha than the check entries CoC 671(20.41t/ha) and Co 86032 (18.59 t/ha).

EAST COAST ZONE

NAYAGARH

Findings suggested significant variations among the genotypes with respect to germination %, number of tillers at 180 days and number of millable canes ('000/ha). The genotype PI 14377 with 90 cm spacing produced the highest average cane yield of 106.54 t/ha with application of 125 % RD of fertilizer.

NORTH CENTRAL ZONE

1. PUSA

Performance of early genotypes indicates that 90 cm row spacing recorded significantly higher plant population (178800 /ha), millable canes (123700 /ha) and cane yield (101.3 t/ha). Though, marked variation in single cane weight (897.7 g/plant) was obtained due to 120 cm row spacing. Row spacing did not exert significant impact on sucrose content juice.125 % recommended dose of fertilizer significantly increased the plant population (171100 /ha), millable canes (116500 /ha), single cane weight (899.4 g/plant) and cane yield (100.1 t/ha). Though, sucrose content juice remained unaffected due to fertility levels.

2. SEORAHI

In the early group CoSe 13452 genotype obtained significantly higher germination per cent (43.24), shoot population (154.67 thousand per ha) and NMC (89.64 thousand per ha) over check i.e. CoSe 01421

but significantly more cane yield was recorded in this genotype over all the zonal checks. Cane yield of CoSe 13451genotype was recorded significantly higher as compared to zonal checks i.e. CoLk 94184 and CoSe 01421.Effect of row spacing on shoot population, NMC and cane yield was found significantly higher in the treatment of 90 cm row spacing.

IMPORTANT OBSERVATIONS

Best performing genotypes across the centres located in different zones are listed herewith

Sl. No.	Zone	Early genotypes	Mid-late genotypes	Spacing
1	**North Western**	Co 13034, CoPb 13181, CoS 13231	CoH 13263, Co 13035, CoLk 13204	At all the centres, sugarcane yield at 90 cm spacing was significantly superior to 120 cm.
2	**Penin-sular**	Co 12009, Co 12012, CoM 12085, VSI 12121		Significant yield improvement at closer spacing (90 cm).
3	**East Coast**	No entries	PI 14377, CoC 13031	No variation in yield due to row spacing
4	**North Central**	CoSe 13451, CoP 13437, CoSe 13452	No entries	Significant yield improvement at closer spacing (90 cm).

AS-73: Assessment of climate change impact on sugarcane productivity

The trial was initiated during 2018-19 and was allotted to the centres equipped with meteorological observatory. During the year only 02 centres reported. Centre wise summary of findings for the year are given below:

1. LUCKNOW

The long term (1956-2018) weather parameters *viz.*, temperature (minimum and maximum), relative humidity (morning and afternoon), rainfall, evaporation, wind speed and bright sun shine hours were studies to assess the climate change impact on sugarcane productivity at ICAR-Indian Institute of Sugarcane research, Lucknow. The results revealed that all the studied weather parameters showed significant trend either increasing or decreasing at monthly, seasonal or on annual level. Rainfall is one of the important weather parameter which showed decreasing pattern at the rate of 28.97 mm decade^{-1}.

2. NAYAGARH

Nayagarh located in the east-coast zone experiences annual temperature ranging from 22.1 as minimum to 33.05 ^{o}C as maximum. The average annual rainfall for the last 21 years stand at 1576.2 mm with a variation from 1031 to 2129.9 mm showing wide inter-annual variability in the rainfall.

AS–74: Evaluation of sugarcane varieties for drought tolerance

The trial was initiated during 2018-19 and was allotted to all the willing centres. During the year only 09 centres reported. Centre wise summary of findings for the year are given below:

NORTH WEST ZONE

1. FARIDKOT

Well-watered (I1) crop gave significantly higher cane yield than water stressed crop (I2). The yield reduction varied from 6.3 percent (CoPb 92) to 24.4 percent (CoPb 93). During the crop season there was about 462 mm rainfall and most of it was up to September.

2. KOTA

CoPk 05191 was found better with respect to number of tillers, plant height, millable canes, cane yield, brix, CCS yield (t/ha) resulting in significantly higher net return over other varieties under early maturing group and CoS 8436 variety in respect of germination, growth, juice extraction and quality parameters but in respect to cane length, cane diameter, cane yield Co 05011 performed best under mid-late group. The higher GR (239708.33 Rs/ha) and NR (131160.00 Rs/ha) and B:C ratio (2.21) recorded with CoPk 05191 in early maturing group and with Co 05011 in mid-late group with gross return (221833.33 Rs /ha), net return (113285.00 Rs /ha) and B:C ratio (2.04). The higher GR (234834.72Rs/ha) and NR (125138.06 Rs/ha) and B: C ratio (1:2.14) was recorded with I1 (I/W CPE ratio 1.0) irrigation regime over I2 (I/W CPE ratio 0.3) irrigation regime.

3. LUCKNOW

Among the six varieties of sugarcane, CoPK 05191 produced highest NMC, cane length, cane girth, sugarcane yield, juice extraction percentage, CCS t/ha, which may be due to production of higher root dry weight, LAI and average cane weight. Minimum reduction in sugarcane yield (13.7%) due to moisture stress was found with CoPk 05191 followed by CoLk 11206 which was at par with CoLk 94184 (18.38%).

4. SHAHJAHANPUR

Genotype CoLk 94184 produced significantly higher sugarcane yield (92.80t/ha) followed by CoSe 11453 with cane yield of 88.20 t/ha. IW/CPE ratio 1.0 recorded significantly higher cane yield of 85.75 t/ha.

5. UCHANI

No significant differences in terms of growth and yield were observed between 1.0 and 0.3 IW/CPE ratios due to frequent rains during pre-monsoon period. Variety CoH 119 (96.9 t/ha) in mid late and Co 0238(96.2 t/ha) in early group being at par produced significantly higher cane yield as compared to variety CoH 167 (90.5 t/ha), Co 0118 (88.4 t/ha), Co 5011 (91.6 t/ha) and CoH 160 (91.4 t/ha) and later four being at par with each other. Among early varieties Co 0238 (12.97 kg) and CoH 119 (12.99 kg) among mid late varieties produced the highest yield of cane produced/1000 litres of irrigation at irrigation schedule of 0.3 IW/CPE ratio. Total irrigation water applied during pre-monsoon season was calculated 22.5 and 15.0 cm at 1.0 and 0.3 IW/CPE schedule, respectively. Total (pre+ post monsoon) irrigation water of 82.5, and 75 cm was applied at 1.0 and 0.3 IW/CPE irrigation schedule, respectively. Total (Irrigation+ rainfall) water was calculated as 219.9 and 212.4 at 1.0 and 0.3 IW/CPE irrigation schedule, respectively.

PENINSULAR ZONE

SANKESHWAR

At IW/CPE ratio 0.3, genotypes SNK 09227 (mid-late) and SNK 088789 (early) performed better than rest of the genotypes.The cane yield differed significantly due to influence of irrigation regimes and genotypes. Among mid-late genotypes Co 86032 recorded significantly higher cane yield (157.47 t/ha) than SNK 09227 and SNK 09268. In early genotypes SNK 088789 recorded higher yield (133.71 t/ha) over SNK 07680 and CoC 671.

NORTH CENTRAL ZONE

PUSA

It can be concluded that sugarcane varieties CoP 2061, CoP 16437 and CoP 9437 when irrigated at IW: CPE ratio 1.00 are better for higher productivity under Bihar condition.

NORTH EASTERN ZONE

Moisture stress (IW: CPE 0.3) caused significant reduction in cane yield across the varieties. Among the varieties CoLk 94184 performed best with highest yield (94.28 t/ha) followed by BO 91 (90.8 t/ha). These two varieties were found to be most resilient against moisture stress with least reduction in cane yield.

EAST COAST ZONE

2. NAYAGARH

Among early maturing varieties, CoOr 03151 with IW/CPE ratio 0.3 recorded significantly different growth and yield parameters compared to other varieties CoOr 03152, CoOr 05346. Similarly among mid-late maturing varieties, CoOr 04151 with IW/CPE ratio 0.3 recorded significantly different growth and yield parameters compared to other varieties CoOr 10346, Co 86249. So this is possibly due to better drought tolerant capacity of these two varieties compared to other varieties.

IMPORTANT OBSERVATIONS

Moisture stress during pre-monsoon growth phase brought about significant reduction in cane yield across all the zones. The loss in yield ranged within 20 to 35% in different sugarcane growing zones.

Sugarcane varieties found resilient against moisture stress in different sugarcane growing zones are given below:

Zone	Early maturing	Mid-late maturing
North West	CoPb 92, CoPk 05191, CoLk 94184	CoPb 94, Co 05011, CoLk 11206, CoSe 11453, CoH 119
Peninsular	SNK 088789	Co 86032
North central	CoP 16437, CoLk 94184	CoP 2061, BO 91
East coast	CoOr 03151	CoOr 04151

Summary

- Addition of 20 t/ha FYM/ compost along with inorganic fertilizers applied on the basis of soil test, soil test crop response for targeted yield or on the basis of general recommendation for the region has shown positive effect on sugarcane growth and yield both in plant and ratoon crops. Response of bio-fertilizers (*Azotobacter*/ *Acetobacter*/ *Azospirillum*/ PSB) was more pronounced in Peninsular Zone.
- Planting of sugarcane in paired rows (120: 30) with mulching of trash (6 t/ha) in the inter-row spaces out yielded the conventional flat method with or without mulch at all the centres in North Western, North Central and North Eastern Zones. Being in the climatic region of high evaporative demand sugarcane crop responded up to 1.0 IW/CPE irrigation regime in the zones, however, similar yields have been recorded with 0.8 IW/CPE ratio at many centres.
- Trash mulching could effectively save 20-26% irrigation water over no-mulching.
- Sugarcane crop in Peninsular and East Coast Zones responded to furrow planting (120 cm) and skip furrow irrigation combined with the use of leguminous crop as green manure till 75 DAP, as a mulch during tillering and thereafter residue incorporation. As far irrigation regimes, IW/CPE ratio 1.0 was found to result in higher cane productivity, however, it can be restricted to 0.8 for getting higher water use efficiency in these zones.
- Use of mulch in sub-tropical zones and green manuring followed by mulching and residue incorporation resulted in tropical zones resulted in higher net return.
- Evaluation of AVT genotypes at wider row distance and high fertility levels showed significant loss of yield at wider planting across all the zones. Wider row spacing however, helped enhancing single cane weight at several locations.
- Best performing early genotypes across the different zones given *viz.,* North Western zones (Co 13034, CoPb 13181, CoS 13231) and North Central (CoSe 13451, CoP 13437, CoSe 13452) while in **midlate** genotypes North Western zone (CoH 13263, Co 13035, CoLk 13204) and East Coast (PI 14377, CoC 13031). In peninsular zone, best performing genotypes were Co 12009, Co 12012, CoM 12085, VSI 12121 found superior under early and midlate categories.
- Long term weather data provided by 02 centres (Lucknow and Nayagadh) only indicated continuous reduction in rainfall in the North- West Zone combined with conspicuous increase in average annual minimum temperature (0.01^{o}C).
- Moisture stress during pre-monsoon growth phase brought about significant reduction in cane yield across all the zones. The loss in yield ranged within 20 to 35 % in different sugarcane growing zones.
- Sugarcane varieties found resilient against moisture stress in different sugarcane growing zones in early maturing *viz*., North West Zone (CoPb 92, CoPk 05191, CoLk 94184); Peninsular (SNK 088789); North Central (CoP 16437, CoLk 94184) and East Coast (CoOr 03151) while in midlate maturing group North West Zone (CoPb 94, Co 05011, CoLk 11206, CoSe 11453, CoH 119); Peninsular (Co 86032); North Central (CoP 2061) etc.

PLANT PATHOLOGY

Sugarcane is considered income generating crop but it is attacked by number of disease causing microorganisms. These disease causing microorganisms not only reduce crop yield but also quality of the produce. Major sugarcane diseases are red rot, wilt and smut but few minor diseases like pokkah boeng and yellow leaf disease causing economic damage to the crop as well. In Plant Pathology discipline, eight experiments were allotted to seventeen AICRP(S) centers in different sugarcane producing zones of the country during 2018-2019. List of project implemented under AICRP on Sugarcane in discipline Plant Pathology were -

PP 14 & 14 (a): Identification of pathotypes of red rot pathogen

PP 17: Evaluation of zonal varieties for resistance to red rot, smut, wilt & YLD

PP 22: Survey of sugarcane diseases naturally occurring in the area on important sugarcane varieties

PP 23: Assessment of elite and ISH genotypes for resistance to red rot

PP 28 (b): Methodology for screening sugarcane genotypes for resistance to brown rust

PP 31: Screening, epidemiology and management of pokkah boeng in sugarcane

PP 32: Management of brown spot disease of sugarcane

PP 33: Management of yellow leaf disease through meristem culture

The results of the experiments are summarized below.

PP 14 & 14 (a): Identification of pathotypes of red rot pathogen

Objective : To gather information on the major pathotypes of red rot from different areas/zones.

Location : **i) North Western Zone** : Lucknow, Shahjahanpur, Kapurthala, Uchani and Karnal (SBI)

ii) North Central Zone : Pusa, Seorahi

iii) East Coast Zone : Anakapalle and Cuddalore

iv) Peninsular Zone : Navsari, Coimbatore, Thiruvalla

Year of Start : 1983-84 (continuing project)

New isolates showing pathogenic variability from the previously reported pathotypes at different centers will be confirmed at the following centres, Lucknow and Uchani (North West Zone), Anakapalle (East Coast zone) and SBI, Coimbatore (Peninsular zone). The participating centres will deposit such working isolates at the above mentioned centres latest by June 15 of each year. The zonal centers will also maintain the type cultures.

Sugarcane differentials (19): Co 419, Co 975, Co 997, Co 1148, Co 7717, Co 62399, CoC 671, CoJ 64, CoS 767, CoS 8436, BO 91, Baragua (*S. officinarum*), Kakhai (*S. sinense*) and SES 594 (*S. spontaneum*), Co 7805, Co 86002, Co 86032, CoS 95422 and CoV 92102.

No. of isolates: Virulent isolates collected from red rot affected canes of commercially cultivated varieties in the zone.

Method of inoculation: Plug method of inoculation is to be used (Details vide PP 17). Inoculations with each isolate to be done on all the differentials with freshly prepared spore suspension. All inoculations are to be completed in 2 days by last week of August.

Observation: One observation at 60th day after inoculation

Evaluation: The canes are to be split open longitudinally. Inoculated canes free from borer infestation and other damages are taken for evaluation. Based on parameters *viz*. nodal transgression, lesion width, white spots, top yellowing/drying, rind infection and sporulation over the rind, the host reaction is categorized into three groups *viz*., Resistant (R), Susceptible (S) and Intermediate (I) as follows:

R: Lesion width laterally restricted, nodal transgression up to 2 nodes, white spots, rind infection, sporulation over the rind and yellowing/drying of tops absent.

S: Lesion width laterally spreading, nodal transgression more than 2 nodes, white spots progressive or restricted, in case of progressive white spots rind infection, sporulation over the rind and yellowing/drying of tops absent or present.

I: Lesion width laterally restricted or spreading, nodal transgression more than 2 nodes, white spots absent or present (restricted type), rind infection, sporulation over the rind and yellowing/drying of tops absent.

RESULTS

NORTH WEST ZONE

1. LUCKNOW

Sixteen new isolates *i.e.* one isolate from CoLk 8102 (IR-161) and 15 isolates from Co 0238 (IR-155, IR-156, IR-157, IR-158, IR-159, IR-160, IR-162, IR-163, IR-164,

IR-165, IR-166, IR-167, IR-168, IR-169 and IR-170) were evaluated for their virulence along with CF07, CF08 and CF09 on 19 designated differentials. Except Co 0238 isolates, the virulence pattern of other isolates more or less matched with the existing pathotypes of this zone. It was observed that Co 0238 isolates giving I reaction to BO 91, Co 7717, CoJ 64, Co 419, CoSe 95422 and Baragua,S reaction to Co 975, Co 62399, CoC 671, Co 86002, CoV 92102 and Khakai and R to CoS 8436, CoS 767, Co 997, Co 1148, Co 86032 and SES 594 Co 1148. Thus indicating the existence of gained virulence of BO 91, Co 975, Co 62399, Co 86002 and CoV 92102 and loss of virulence of CoJ 64, CoS 767, Co 997, CoS 8436, Co 1148 and Co 86032.The virulence pattern of Co 0238 isolates did not match with the red rot isolate of CoLk 8102 and also with designated pathotypes namely CF07, CF08 and CF09 of sub-tropical zone,thus clearly indicating the existence of gained specific virulence of Co 0238 isolates on its host which is different from the existing pathotypes of this zone.

2. SHAHJAHANPUR

A total of seven pathotypes and three isolates of *C. falcatum* were tested on 19 host differentials. Among all differentials, the varieties CoJ 64 exhibited universal S reaction except CF01, CF02 and Khakai also exhibited S reaction to all isolates except CF11. Two differentials*viz*; CoSe 95422 and SES 594 exhibited R to all the designated pathotypes/ isolates. Baragua exhibited Rraectionexcept CF07 and Cf0238 pathotypes/isolate. Co 1148 behaved as S to all pathotypes/isolates except Cf8436 (R) and Cf 0238 (I). The variety BO 91 exhibited R reaction to all the isolates except I reaction to CF09 and Cf 8436. Two varieties CoJ 64 and CoS 767 exhibited contrast reaction to three local isolates, while same showed S reaction with CF07, CF08 and CF09. Study revealed that the local isolates Cf8436, Cf07250 and Cf0238 exhibited pathogenic variability on host differentials.

3. KAPURTHALA

Eight new isolates *viz*., Cf64 from CoJ 64 (Ajnala sugar mills area), Cf85 from CoJ 85, Cf89003-1, Cf89003-2, Cf89003-3 (Batala sugar mills area) and Cf89003-4 (Morinda sugar mills area) from Co 89003, Cf6/5 from Sel. K 6/5 and Cf12/13 from Sel. K 12/13 (Kapurthala Research Station) along with two pathotypes (CF08 and CF09) were independently inoculated on 19 differentials. Among the isolates, Cf89003-1 and Cf89003-4 were identified as virulent as pathotypes and showed reaction similar to the pathotype CF08. Isolates, Cf89003-3, Cf64 and Cf85 were found quite similar to CF08. Isolates Cf12/13 followed by Cf89003-2 and Cf6/5 were most virulent among tested isolates indicated the newly collected isolates behaved differently from the pathotypes but it needs further confirmation for considering as new pathotype.

4. UCHANI

All the designated pathotypes *viz*., CF01, CF02, CF03, CF07, CF08, CF09 and CF11 along with six isolates *viz*.,XXXII (CoJ 85), RR XXXIII (CoJ 85), RR XXXIV (CoJ 64) and RR XXXV (CoJ 64) and RR XXXVI (Co 89003), RR XXXII (CoS 8436) collected fromdifferent areas of Haryana. Observations indicate that all the isolates exhibited S reaction on Co 997 and CoC 671 and R reaction on BO 91 and SES 594 and Co 419, Co 975, Co 1148, Co 7717, CoJ 64, CoS 767, Co 7805 and Co 86002 exhibited differential reactions. Isolates RR XXXII, RR XXXIII, RR XXVIV and RR XXXV showed R reaction on CoC 671, CoS 8436, BO 91, SES 594, CoSe 95422 and CoV 92102 and S reaction on Co 419, Co 975, Co 997, Co 1148, Co 7717, Co 62399, CoC 671 and CoJ 64 i.e., similarity with CF08.

5. KARNAL

A set of 7 pathotypes and five isolates collected from CoS 8436 (3), Co 89003 (1) and CoJ 88(1) were inoculated on 19 sugarcane differentials. The overall disease reaction indicated that there was a clear pathogenic variation on test host differentials. Among the designated pathotypes, CF11 found to be most virulent followed by CF01, CF09, CF08, CF02, CF03 and CF07. Of the three Cf8436 isolates, Cf8436 (Karnal) and Cf8436 (Bihar) exhibited I / S reactions on CoS 8436 with. Isolate Cf89003 collected from the variety Co 89003 was too virulent and expressed I to S reaction on 11 host differentials, suggests the possible emergence of new pathotype in the subtropics. Further, the isolate Cf88 collected from variety CoJ 88 in UP also expressed S reaction to eight host differentials; whereas the differential SES 594 showed complete R against all the isolates.

NORTH CENTRAL ZONE

1. PUSA

Ten sugarcane differentials were inoculated with the pathotypes CF07 and CF08 and 12 isolates collected from different cane growing areas of Bihar. The result indicated that the differentials Co1148 and Khakai produced S reaction whereas, differentials BO 91 and SES 594 showed R reaction while, differentials Co 419, CoS 8436, Co 62399, Co 975, CoV 92102 and CoSe 95422 showed differential reaction against all the test isolates. The data showed that pathotype CF07 and isolates RR_1, RR_2, RR_3, RR_5, RR_6 and RR_{12} produced R reaction on Co 419 and Co 975,pathotype CF07 and isolates RR_1, RR_2, RR_3, RR_5, RR_6 and RR_{12} showed I reactions on CoS 8436, Co 62399, CoV 92102 and CoSe 95422, i.e., pathotype CF07 and these isolates exhibited similar pathological behavior.

Pathotype CF08 and isolates RR_4, RR_7, RR_8, RR_9, RR_{10} and RR_{11} showed I reaction on differentials Co 419 and Co 975. Pathotype CF08 and isolates RR_4, RR_7, RR_8, RR_9, RR_{10}, RR_{11} showed S reaction on differentials CoS 8436, Co 62399, CoV 92102 and CoSe 95422.

2. SEORAHI

Seven pathotypes CF01, CF02, CF03, CF07, CF08, CF09 and CF11 along with 7 isolates *viz.,* R1601Seo (CoSe 92423), R1602Seo (UP 9530), R1701Seo (Co 0238), R1702Seo (CoS 8436), R1703Seo (CoS 07250), R1704Seo (CoSe 92423) and R1705Seo (CoJ 88) were inoculated on 19 differentials. The virulence pattern of the isolates was found similar to the existing pathotypes of this zone and there was no emergence of new pathotype.

EAST COAST ZONE

1. ANAKAPALLE

Six new isolates collected from sugarcane cultivars CoA 89085, 2017T 275, CoV 89101, Co 62175, 99A 53 and 93V 297 were tested for pathogenic variability on a set of 19 host differentials. Only the isolates recovered from CoA 89085, 2017T 275 and Co 62175 have producedI reaction on the host differential Kakhai. The reaction of the six collected isolates was found similar to the existing pathotype CF06 with minor variations. All the isolates tested were able to breach the resistance of Co 7805. Differential reaction was observed on the differentials Co 419, Co 997, CoC 671, Co J 64, Kakhai and Co 86032. The isolates from CoA 89085, 2017T 275, 99A 53 and 93V 297 collected from Chittoor district have produced I reaction on the host differentials Co 419 and CoC 671, while isolates collected from Co 62175 and CoV 89101 have produced S reaction. Though, minor variations were observed in the reaction of various isolates on host differentials, most of the isolates were similar to the existing pathotype of *C. falcatum* in Andhra Pradesh.

2. CUDDALORE

Nineteen sugarcane differentials were inoculated with *C. falcatum* isolated from varieties *viz.,* CoC 24, CoV 09356, CoM 0265 and TNAU Si 8 and designated pathotype CF06 and CF12. In the differential BO 91, the isolate from CoC 24 and CoV 09356 showed I reaction, while all other isolates registered R reaction. In the differential Co 7717 the isolate from CoC 24 and CoV 09356 recorded susceptible S reaction while it was I reaction to the designated pathotypes CF06 and CF12. In the differential CoJ 64 the isolate from CoC 24 showed S reaction while it was I reaction to CF06. All these reactions indicated that the isolate from CoC 24 and CoV 09356 exhibited variation from the designated pathotype CF06.

PENINSULAR ZONE

1. NAVSARI

Three isolates collected from CoC 671 (CF06), Co 86032(Cf86032), and Co 86002 (Cf86002) were inoculated on 19 differentials. Results revealed that Co 62399, CoJ 64, CoS 8436, BO 91, Baragua and SES 594 showed R reaction for all the isolates, whileentries Co 419, Co 1148, CoS 767 and Co 7805 exhibited I reaction to all the isolates. The entries CoV 92102 and CoSe 95422 showed S reaction to CF06 and I reaction toCf86032 and Cf86002 respectively, whereas entry Co 7717 exhibited I reaction to CF06 and Cf86032 and R reaction to Cf86002. The entries Co 975, Co 997, CoC 671, Khakai, Co86032 and Co 86002 showed S reaction to all the isolates.

2. COIMBATORE

Three new isolates (CfC24-Thandavarayanpattu, Cf06022-Pennadam, CfM0265-RK pet) along with 5 old isolates (Cfv09356-Keerangudi, Cf86027- Nathakadu, Cf2001-13- Perambakkam, Cf06022- Kuttalam and Cf99006-Mundiampakkam) and 2 reference pathotypes (CF06 and CF12) were inoculated on 18 sugarcane differentials and disease intensity was rated. Among them two new isolates CfM0265-RK Pet and CfC24 Thandavarayanpattu and 3 old isolates *viz*., CfV09356-Keerangudi, Cf2001-13- Perambakkam and Cf06022-Kuthalam exhibited more virulence than reference pathotypes. The old isolate Cfv09356-Keerangudi showed high virulence for the second consecutive year and also exhibited differential reaction from both the reference pathotypes. Among the new isolates Cf06022-Pennadam showed least virulence and also exhibited differential reaction on many varieties when compared to theold isolate of Cf06022.

3. THIRUVALLA

Three new isolates *viz*., CfC24 (Thandavarayanpattu), Cf06022 (Pennadam), CfM0265 (RK Pet) and five old isolates *viz*., CfV09356 (Keerangudi), Cf86027 (Nathakadu), Cf2001-13 (Perampakkam), Cf06022 (Kuthalam), Cf99006 (Mundiampakkam) along with the designated pathotypes CF06 and CF12were inoculated and tested against 19 differentials. The results indicated that among the isolates, CfV09356 (Keerangudi), Cf2001-13 (Perampakkam), Cf06022 (Kuthalam) and CfM0265 (RK Pet) behaved differently from the pathotypes CF06 and CF12. These isolates exhibited more virulence than standard pathotypes. All the other isolates showed almost similar reactions to that of CF06 and CF12.

PP17: EVALUATION OF ZONAL VARIETIES FOR RED ROT, SMUT, WILTAND YLD

PP 17A: EVALUATION OF ZONAL VARIETIES FOR RED ROT

Objective: To gather information on the relative

resistance to red rot in entries of Pre-zonal varietal trial/zonal trials of the respective zones

Locations : **i) North West Zone** : Lucknow, Kapurthala, Uchani, Shahjahanpur, Karnal, Pantnagar

ii) North Central Zone : Pusa, Motipur and Seorahi

iii) East Coast Zone : Anakapalle and Cuddalore

iv) Peninsular zone : Thiruvalla, Navsari, Coimbatore

Year of start : 1986-87 (Continuing project)

Varieties: All the centres will test all the entries of early and midlate groups under IVT and AVT of the respective zones. Entries of Inter zonal varietal trial (IZVT) are also to be tested, if listed. The seed material for this programme is to be obtained from the respective breeders of the centres. One 6 metre row of at least 20 clumps for inoculation with each pathotype by plug/nodal method. Any red rot susceptible variety of the same maturity group may be used as standard (check).

Inoculum: (Pathotypes to be used):

North West Zone : CF08 &CF09 (To be inoculated separately)

North Central Zone: CF07 &CF08 (To be inoculated separately)

East Coast Zone : CF04 &CF06 (To be inoculated separately)

Other Zones : Two widely occurring isolates on commercial varieties in the area.

(Note: If pathotypes are not available, CF07, CF08 and CF09 may be obtained from IISR, Lucknow and CF04 &CF06 from RARS, Anakapalle).

Freshly sporulating 7 day old culture in Petri dishes will be taken. The spore mass will be washed with 100 ml of sterile water and collected in a flask. Conidial suspension at a spore concentration of one million spores per ml will be prepared for inoculation. Fresh inoculum should always be used for inoculation.

Methods of inoculation

1. Plug Method: Two canes in each of the 20 clumps to be inoculated. Inoculation is to be done in the middle of the 3rd exposed internode from bottom and two drops of the spore suspension are to be placed with a large syringe in each cane and sealed with plastic clay (plasticine) or modeling clay.

2. Cotton Swab Nodal Method: (All the centres) Two canes in each of 20 clumps will be inoculated by removing leaf sheath (lower most green leaf sheath) and immediately placing cotton swab (dipped in freshly prepared inoculum suspension) around the cane covering nodal region. The cotton swab should be held in place by wrapping parafilm® over the swab.

Evaluation

Cotton Swab Nodal method: One observation at the end of 60 days after inoculation. Observe for spindle infection i.e. presence of mid rib lesions with or without conidia, presence of acervuli at nodes specially on leaf scar, root primordial and growth ring. Record the intensity of the acervuli at node. Scrap the node and see if lesions are developing into stalks. Wherever lesions are progressive towards susceptibility the entries are rated as susceptible. If the lesions are dark and restricted to rind tissues, the clones are rated as resistant. Atleast 15 stalks are to be evaluated to assess disease reaction.

Plug method: The canes to be split open longitudinally sixty days after inoculation along the point of inoculation. Inoculated canes free from borer infestation and other damages are taken for evaluation. This is graded on the international scale of 0-9 as follows:

Variety/ genotype ---------- Method of inoculation ----------

No. of canes evaluated	Condition of tops*	Lesion width**	White spot (WS)***	Nodal transgression (NT)****	Total score	Remarks
1.						
2 to						
15						

*1. Condition of top: Green (G) – 0, Yellow (Y)/Dry (D)-1
**2. Lesion width above inoculated internode is assigned the score of 1, 2 or 3
***3.White spot assigned score of 1 or 2 according to whether it is restricted or progressive
****4.N.T. No. of nodes crossed above the inoculated internode and given the score as:

1 If one node is crossed
2 If two nodes are crossed
3. If three nodes are crossed (maximum) or more
Average Score = Total Score/No. of canes evaluated
Disease reaction: 0-9 Scale

0.0 to 2.0	-R
2.1 to 4.0	-MR
4.1 to 6.0	-MS
6.1 to 8.0	-S
8.0 to 9.0	-HS

Note: Average score is taken into account for assigning the disease reaction.

RESULTS

NORTH WEST ZONE

1. LUCKNOW

In IVT (Early) out of 9 genotypes tested, one genotype Co 15027 was found R by both the method of inoculation against both the pathotypes. Six genotypes *viz*., Co 15023, CoLk 15201, CoLk15203, CoLk15204, CoLk 15205 and CoPb 15212 were rated as MR by plug method and R by nodal method of inoculation against both the pathotypes. One genotype Co 15024was rated as MS by plug method and S by nodal method,one genotype CoPb 15211was rated as MS against pathotype CF08 and S against pathotype CF09 by plug method, whereas resistantR against pathotype CF08 and S against CF09 by nodal method of inoculation.In Advanced Varietal Trial (Early)–I Plant all the 4 genotypes *viz.,* Co 14034, CoLk 14201, CoPb14181 and CoPb14211 were rated as MR by plug method of inoculation and R by nodal method against both the pathotypes.In Advanced Varietal Trial (Early)-II Plant, out of 3 genotypes, two *viz*., Co 13034 and CoPb 13181 were rated as MR by plug method and R by nodal method of inoculation against both the pathotypes. One genotype CoS 13231 was found R by both the methods of inoculation against both the pathotypes.

In IVT (Mid late), out of 11 genotypes tested, 8*viz*., Co 15026, CoLk 15206, CoLk 15207, CoLk 15208, CoLk 15209, CoPb 15213, CoS 15233 and CoS 15234 were rated MR by plug method of inoculation and R by nodal method of inoculation against both the red rot pathotypes. One genotype CoS 15232was rated as MR against pathotype CF08 and MS against pathotype CF09 by plug method, whereas R by nodal method of inoculation against both the pathotypes. Two genotypes CoPb 15214 and CoS 15231 were rated MS by plug method of inoculation and R by nodal method of inoculation against both the red rot pathotypes.In Advanced Varietal Trial (Mid late)-I Plant out of 7 genotypes tested, one genotype CoLk 14203 was found R by both the methods of inoculation against both the red rot pathotypes. Six genotypes *viz*., Co 14035, CoH 14261, CoLk 14204, CoPb 14184, CoPb 14185 and CoS 14233 were rated as MR by plug method of inoculation and R by nodal method of inoculation against both the pathotypes.InAdvanced Varietal Trial (Mid late)-II Plant, all the 5 genotypes *viz*., Co 13035, CoH 13263, CoPant 13224, CoPb 13182 and CoLk 13204 were rated MR by plug method of inoculation and R by nodal method of inoculation against both the red rot pathotypes (Table 1).

2. SHAHJAHANPUR

Thirty nine entries were evaluated for red rot resistance and details of red rot behaviour are given below.

IVT Early:Among 9 entries tested 4*viz*., Co 15023, CoLk 15201, CoLk 15204, CoPb 15211 were rated as R/MR to CF08 by plug and nodal cotton swab method. The four entries *viz*, Co 15023, Co 15024, Co 15027, CoLk 15204 were identified as R/MR to CF09 by plug and nodal cotton swab method. Six entries were screened as R to CF08 and 4 entries were rated as R CF09 by nodal cotton swab method against both pathotypes (Table 2).

IVT Mid late:Out of eleven entries, 8*viz*; Co 15026, CoLk 15206, CoLk 15207, CoLk 15208, CoLk 15209, CoPb 15213, CoS 15232 and CoS 15234 were recorded as R/MR to CF08 and CF09 by plug and nodal cotton swab method. One entry CoPb 15214 was rated as S/HS to both the pathotypes by plug and nodal cotton swab method.

AVT Early (I plant): Among four enreies 2 entries CoLk 14201 and CoPb 14181 were MR by plug method and R by nodal method against both the pathotypes CF08 and CF09. Two entries *i.e*., Co 14034 and CoPb 14211 were evaluated as MS to CF08 and CF09 by plug method. The genotype Co 14034 was rated as S to CF09, while CoPb 14211 behaved as R to both pathotypes by nodal cotton swab method.

AVT Early (II Plant): Among 3 entries were tested CoS 13231 was identified as MR and R to both pathotypes CF08 and CF09 by plug and nodal cotton swab method of inoculation, respectively. Two entries *viz*; Co 13034 and CoPb 13181 were identified as MR and S, respectively to CF08 by plug method. Co 13034 was screened as R against CF08 and CF09 by nodal cotton swab method.

AVT Mid late (I Plant): All seven entries namely Co 14035, CoH 14261, CoLk 14204, CoLk 14203, CoS 14233, CoPb 14185 and CoPb 14184 was identified as R/MR against CF08 by plug and nodal cotton swab method. These all entries also behaved as R/MR against CF09 except CoS 14233 which was MS by plug method. All seven were examined as R against CF08 and CF09 by nodal cotton swab method of inoculation.

AVT Mid late (II Plant): Among5 entries tested 2 entries Co 13035 and CoPb 13182 were assessed as MR by plug and R by nodal cotton swab method against CF08 and CF09. The genotype CoPant 13224 behaved as MR and MS by plug method against CF08 and CF09, respectively while it was rated as R against both the pathotypes by boththe methods.

3. KAPURTHALA

Thirty-nine genotypes along with standard checks were tested against red rot pathotypes CF08 and CF09 separately by plug and nodal cotton swab methods. In IVT (Early) six genotypes *viz*., Co 15023, Co 15024, Co 15027, CoLk 15201, CoLk 15205 and CoPb 15211 behaved as MR/R by plug and nodal cotton swab methods against both the pathotypes. In AVT (Early) Plant I, three entries (CoLk

14201, CoPb 14181 and CoPb 14211) behaved as MR/R by both the methods against two pathotypes. In AVT (Early) Plant II, only one genotype (CoS 13231) showed MR/R reaction. In IVT (Mid late), nine entries namely, Co 15026, CoLk 15206, CoLk 15207, CoLk 15208, CoLk 15209, CoPb 15213, CoS 15232, CoS 15233 and CoS 15234 were found MR/R by plug and nodal cotton swab methods against both the pathotypes. In AVT (Mid late) Plant I, entries namely Co 14035, CoH 14261, CoLk 14203, CoLk 14204, CoPb 14184 and CoPb 14185 behaved as MR/R. In AVT (Mid late) Plant II, two entries (CoPant 13224 and CoPb 13182) found MR/R by plug and nodal cotton swab methods with both the pathotypes (Table 1).

4. UCHANI

In AVT (early) Plant-I, 3 entries *viz*.,Co 14034 and CoLk 14201, showed MR reaction by plug and R by nodal cotton swab methods against boththe pathotypes. However, CoPb 14211 exhibited MS reaction by plug and R reaction by nodal cotton swab method against boththe pathotypes. In AVT (early) plant-II, theentries Co 13034 and CoS 13231 found MR by plug and R by nodal method against CF08 and CF09. However, CoPb 13181 showed MS reaction by both methods against CF08 and CF09. In AVT (mid late) plant-I, 6 entries *viz*., Co 14035, CoH 14261, CoLk 14204, CoPb 14184, CoPb 14185 and CoS 14233 were R/MR by plug and Rby nodal cotton swab method against CF08 and CF09. The genotype CoLk 14203 showed MR/MS reaction by plug method and R reaction by nodal method of inoculation to both CF08 and CF09 pathotypes. In AVT (mid late) Plant-II, 3 entries *viz*., Co 13035, CoH 13263 and CoPb 13182 showed R/MR reaction by plug and R reaction by nodal method against CF08 and CF09. However, entriesCoPant 13224 and CoLk 13204 showed MS reaction by plug and Rby nodal methods. In IVT (early), 6 entries *viz*., Co 15023, Co 15024, Co 15027, CoLk 15204, CoLk 15205 and CoPb15211 showed MR reaction by plug and R by nodal method and CoLk 15203 showed S reaction against CF08 and CF09 by both the methods. However, CoPb 15212 found MS by plug and R by nodal methodagainst CF08 and CF09. In IVT (mid late), 8 entries *viz*., Co15026, CoLk 15206, CoLk 15207, CoLk 15208, CoLk 15209, CoS 15232, CoS 15233 and CoS 15234) showed MR reaction by plug and R reaction by nodal cotton swab method of inoculationand CoLk 15206 and CoS 15234 showed R reaction by plug method to CF09.The entryCoPb 15214 showed S reaction against CF08 and CF09 by both methods, whereas CoS 15231 showed MS reaction by plug and S by nodal cotton swab method (Table 1).

5. KARNAL

Thirty nine zonal varieties along with 7 standards were evaluated for red rot resistance against CF08 and CF09 pathotypes. Two entries i.e. CoLk 15203 IVT (E) and CoPb 15214 IVT (ML) exhibited S/HS reactions with CF08 and CF09 isolates by plug and cotton swab methods of inoculation. Four entries *viz*., CoPb 13181, CoS 15231, CoS 14233 and CoPb 13182 showed MS reaction with CF08 pathotype. However, remaining entries were R or MR to red rot (Table 2).

6. PANTNAGAR

In nodal cotton swabmethod, among 43 genotypes, for CF08, 40 genotypes shown R reaction, whereas 3 genotypes showed S reaction.For CF09, 38 genotypes shown R reaction and 5 genotypes shown S reaction. In plug method, 2 genotypeswere found R, 23 MR and 13 MS, 4 S and 1 HS reaction for CF08 pathotype, whereas, 21 were MR, 13 MS and 8 S and 1 shown HS reaction and none of genotypes were found R for CF09 pathotype (Table 2).

NORTH CENTRAL ZONE

1. PUSA

Twenty four entries were tested using CF07 and CF08 pathotypesby adopting plug and cotton swab methods of inoculation.By plug method of inoculation, single entry (CoSe 01421) showed R reaction, 21 entries showed MR reaction, whereas 2 entries showed MS reaction against CF07. Single entry CoP 06436 showed R reaction, 19 showed MR reactions, whereas remaining 4 entries showed MS reaction against CF08. In cotton swab method, two entries CoLk 15466 and CoLk 15468 showed S reaction against both the pathotypes. Entry CoSe 15455 showed S reaction to CF08 and entry CoSe 15453 showed S reaction to CF07, rest of the entries showed R to both the pathotypes (Table 3).

2. MOTIPUR

In IVT (Early) out of 9 genotypes tested, seven *viz*., CoLk 15466, CoLk 15467, CoP 15436, CoP 15437, CoSe 15451, CoSe 15455 and CoSe 15456 were rated as MR by plug method of inoculation and R by nodal method of inoculation against CF07 and CF08. Genotype CoSe 15452was rated as MR against pathotype CF07 and MS against CF08 by plug method whereas R by nodal method of inoculation against both the pathotypes.In AVT (Early)-I Plant, out of 4 genotypes, CoSe 14454 was rated as R against both the pathotypes by both the methods. Two genotypes *viz*., CoLk 14206 and and CoSe 14451 were rated MR by plug methodand R by nodal method against both the pathotypes. In AVT (Early)-II Plant, all the three genotypes CoP 13437, CoSe 13451 and CoSe 13452 were rated as MR by plug methodand R by nodal method against CF07 and CF08.

In IVT (Mid late) outof 10 genotypes, 7 *viz*., CoLk 15468, CoLk 15469, CoP 15438, CoP 15439, CoP 15440,

CoP 15441 and CoSe 15454 were rated as MR by plug methodand R by nodal method against both the pathotypes. The clone CoSe 15453 was rated as MS by plug method and R by nodal method against both the pathotypes. In AVT (Mid late)-I Plant, all 5 genotypes *viz.*, CoLk 14208, CoLk 14209, CoP 14438, CoP 14439 and CoSe 14455 were rated MR by plug methodand R by nodal method against both the pathotypes (Table 3).

3. SEORAHI

In IVT (Early), in plug method, 8 genotypes were rated as MR and one genotype (CoBln 15501) as MS to CF07. Seven genotypes were found MR and two genotypes (CoP 15436 and CoP 15437) were rated as MS to CF08 and MR to CF07. In cotton swab method, 9 genotypes were found R to both designated pathotypes. In IVT (Mid late), in plug method,8 genotypes were rated as MR to CF07 and 1 genotype (CoLk 15469) was found MS to CF07 and MR to CF08. Eight genotypes were rated as MR to CF 08, genotype CoP15440 was rated as MS to CF08 and MR to CF07 while genotype CoBln 15502 was rated as HS to CF07 and S to CF08. In cotton swab method, 9 genotypes were rated as R while one genotype CoBln15502 was rated as S to CF07 andall genotypes were R to CF08 pathotype.

Advanced varietal trial (Early): In plug method, none was found resistant,3 genotypes were rated as MR to CF07,one genotype (CoP 14437) was rated as MS to CF07 and MR to CF08, while all the genotypes were found MR to pathotype CF08. In cotton swab method, 4 entries were tested and all were rated as R to both the pathotypes. In AVT (Mid late),in plug method, out offive varieties tested none was found R,4 genotypes were found to be MR to CF07, one genotype (CoP 14438) was rated as MS to CF07 and MR to CF08, while all the genotypes were found MR to CF08. In cotton swab method, 5entries were evaluated and all were rated as R to both pathotypes (Table 3).

NORTH EAST ZONE

BURALIKSON

Under IVT (early) group, CoP 15436 showed R reactions to CF07 and MR to CF08 in plug method. The checkCoSe 95422 showed MS reaction to both the isolates in plug method but S to CF08 in cotton swab method. In IVT (Midlate) CoSe 15453 showed MS reaction to CF07 in plug method and S to CF08 in cotton swab method. In AVT early, CoP 14437 showed R reaction to CF07 in plug method but MR to CF08 and R reaction to both the pathotypes in cotton swab method. In AVT early second plant, CoSe13451 was rated as MS to CF08 in plug as well as in cotton swab method. In AVT midlate group, CoLk 14209 showed R reaction to CF07 in plug method but MR to CF08 (Table 3).

EAST COAST ZONE

1. ANAKAPALLE

The genotypes were tested for their reaction to the pathotype CF06 by cotton swab and plug methods of inoculation. In the cotton swab method, out of 34 entries tested, four checks (Co 419, CoC 671, Co 997, and Co 6907) manifested top drying indicating their susceptibility and the remaining entries reacted as Rto CF06. In plug method of inoculation, five entries and two standards (CoA 16321, CoV 16357, CoC 15336, CoA 14321, Co 13028, CoA 92081 and Co 86249) showed R while 12 entries and 3 standards,Co 13023, Co 13029, Co 13031,CoA 14323, CoA 16322, CoC 14337, CoC 15338, CoC16339, PI 14337, CoV 15356, CoV 16356, Co 01061, CoOr 03151, CoV 92102 and Co 06030showed MR reaction to CF06 (Table 4).

2. CUDDALORE

Among the 20 clones screened in plug method using CF06 pathotype, clones *viz*., Co 13023, Co 13028, Co 13029, Co 13031, CoA 14321, CoA 16321, CoA 16322, CoA 14323, CoC 14336, CoC 15338, CoC 14337, CoC 16336, CoC 16337, CoC 16338, CoC 16339, CoV 15356, CoV 16356, CoV 16357, and PI 14377 were found to be MR andthe entry CoC 15336wasMS to red rot. In cotton swab method all the 20 clones were found to be R (Table 4).

PENINSULAR ZONE

1. NAVSARI

Out of 51 clones evaluated by plug method, none of the entries exhibited R reaction. Twenty nine entries viz., Co 12009, Co 12012, Co 12019, Co 13003, Co 13004, Co 13006, Co 13008, Co 13009, Co 13013, Co 13018, Co 15002, Co 15005, Co 15006, Co 15007, Co 15009, Co 15017, Co 15018,Co 15020, Co 15021,MS 13081, CoN 15071, CoN 15072, CoN 13072,CoN 13073,CoSnk 13101, CoSnk 15101, CoVc 15063, VSI 12121 and VSI 15122 showed MR reaction against red rot. Thirteen entries *viz*., Co 12008, Co 13002, Co 13014, Co 13020, Co 15010, Co 15015, CoSnk 15102, CoSnk 15103, CoVc 15061, PI 15132, CoSnk 13106, PI 13132, and CoM 12085exhibitedMSreaction, rest of the entries displayed S to HS reaction by plug method.In cotton swab method all entries exhibited R reaction and among checks five exhibited R reaction and only CoC 671 showed S reaction (Table 5).

2. THIRUVALLA

In AVT (1st Plant), out of the 17 entries, three *viz.*, Co 13013, CoN 13073, CoSnk 13101exhibited R reaction, 7entries*viz.*, Co13002, Co13009, CoN13072, MS 13081, CoSnk 13103, CoSnk 13106, PI 13132 exhibited MR reaction, 6entries*viz.*,Co 13003, Co 13004, Co 13006, Co

13008, Co 13014, Co 13020 exhibited MS reaction, one entry Co 13018 exhibited S reaction against the pathotype CF06 in plug method of inoculation. Out of the seventeen entries tested against CF12 by plug method of inoculation, one *viz*., Co13009 showed R reaction, 10entries*viz*.,Co13002, Co13003, Co13008, Co13013, CoN13072, CoN13073, MS 13081, CoSnk 13101, CoSnk 13103, PI 13132 showed MR reaction, four entriesCo 13004, Co 13014, Co 13020, CoSnk 13106 showed MS reaction and2entriesCo 13006, Co 13018 showed S reaction. In nodal method, except five entries*viz*., Co 13004, Co 13006, Co13014, Co 13018 and Co 13020 all othersshowed R reaction to both CF06 andCF12.

In AVT (II Plant) against CF06, MR reaction was recorded in two entries *viz*.,Co 12009 and Co 12019, MS reaction in Co 12008, Co 12012 and S reaction Co 12007, Co 12024, CoM 12085, VSI 12121 by plug method of inoculation. Against the isolate CF12, two entriesCo 12008, Co 12012 recorded MR reaction, Co 12009 and Co 12019, VSI 12121 recorded MS reaction and Co 12007, Co 12024, CoM 12085 recorded S reaction in plug method of inoculation.In nodal method, five entries*viz.*, Co 12007, Co 12008, Co 12009, Co 12012, Co 12019 showed R reaction to both the pathotypes CF06 and CF12 (Table 5).

3. COIMBATORE

About 57 IVT entries were evaluated for red rot resistance by plug and nodal methods against *C. falcatum* pathotype CF06. Based on disease severity and rating score, 37 and 47 entries were identified as resistant in plug and nodal methods, respectively (Table 5).

SUMMARY

The entries showing R or MR to red rot by both the methods of evaluation are listed below

NORTH WEST ZONE		
LUCKNOW- Plugand nodal cotton swab method		
IVT (Early)	:	Co 15023, Co 15027, CoLk 15201, CoLk 15203, CoLk 15204, CoLk 15205, CoLk 15212
IVT (Midlate)	:	Co 15026, CoLk 15206, CoLk 15207, CoLk 15208, CoLk 15209, CoPb 15213, CoS 15233, CoS 15234
AVT (Early)-I	:	Co 14034, CoLk 14201, CoPb14181, CoPb 14211
AVT (Early)-II	:	Co 13034, CoPb 13181, CoS 13231
AVT (Midlate)-I	:	Co 14035, CoH 14261, CoLk 14203, CoLk 14204, CoPb 14184, CoPb 14185, CoS 14233
AVT (Midlate)-II	:	Co 13035, CoH 13263, CoPant 13224, CoPb 13182, CoLk 13204
SHAHJAHANPUR–Plug& nodal cotton swab method		
AVT (Early) Plant I	:	CoLk 14201, CoPb 14181
AVT (Early) Plant II	:	CoS 13231
AVT (Midlate) Plant I	:	Co 14035, CoH 14261, CoLk 14203, CoLk 14204, CoPb 14184, CoPb 14185
AVT (Midlate) Plant II	:	Co 13035, CoPb 13182
IVT (Early)	:	Co 15023, Co 15027, CoLk 15201, CoLk 15204, CoPb 15211
IVT (Midlate)	:	Co 15026, CoLk 15206, CoLk 15207, CoLk 15208, CoLk 15209, CoPb 15213, CoS 15232, CoS 15234
KAPURTHALA – Plug & nodal cotton swab method		
AVT (Early) Plant I	:	CoLk 14201, CoPb 14181, CoPb 14211
AVT (Early) Plant II	:	CoS 13231
AVT (Midlate) Plant I	:	Co 14035, CoH 14261, CoLk 14203, CoLk 14204, CoPb 14184, CoPb 14185
AVT (Midlate) Plant II	:	CoPant 13224, CoPb 13182
IVT (Early)	:	Co 15023, Co 15024, Co 15027, CoLk 15201, CoLk 15205, CoPb 15211
IVT (Midlate)	:	Co 15026, CoLk 15206, CoLk 15207, CoLk 15208, CoLk 15209, CoPb 15213, CoS 15232, CoS 15233, CoS 15234
UCHANI – Plug & nodal cotton swab method		
AVT (E) Plant I	:	Co 14034, CoLk 14201, CoPb14181
AVT (E) Plant II	:	Co 13034, CoS13231
AVT (Midlate) Plant I	:	Co 14035, CoH 14261, CoLk 14204, CoPb 14184, CoPb 14185, CoS 14233
AVT(Midlate) Plant II	:	Co 13035, CoH 13263, CoPb 13182
IVT (Early)	:	Co 15023, CoLk 15024, CoLk 15027, CoLk 15204, CoLk 15205, CoPb 15211

IVT (Midlate)	:	Co 15026, CoLk 15206, CoLk 15207, CoLk 15208, CoLk 15209, CoS 15232, CoS 15233, CoS 15234
KARNAL – Plug & nodal cotton swabmethod		
IVT (Early)	:	Co 14034, CoLk 14201, CoLk 14202, CoPant 14222, CoPb 14181, CoPb 14182
IVT (Midlate)	:	Co 14035, CoH 14261, CoH 14262, CoLk 14203, CoLk 14204, CoPb 14184, CoPb 14185, CoPb 14212, CoS 14232
AVT (E) Plant I	:	Co 13034, CoS 13231
AVT (E) Plant II	:	Co 12026, Co 12027
AVT (Midlate) Plant I	:	Co 13035, CoPb 13182
AVT (Midlate) Plant II	:	Co 12029, CoPant 12226, CoS 12232
PANT NAGAR- Plug & nodal cotton swab method		
IVT (Early)	:	Co15023, Co15024, Co15027
IVT (Midlate)	:	Co15026, CoLk15206, CoLk15207, CoPb15213, CoS15231, CoS15233, CoS15234
AVT (E) Plant I	:	CoLk14201
AVT (E) Plant II	:	Nil
AVT (Midlate) Plant I	:	Co14035, CoLk14203, CoLk14204, CoPb14184, CoPb14185, CoS14233
AVT (Midlate) Plant II	:	Co13035, CoLk 13204, CoPb13182
NORTH CENTRAL ZONE		
PUSA- Plug & nodal cotton swab method		
IVT (Early)	:	CoLk 15467, CoP 15436, CoP 15437, CoSe 15451, CoSe 15455, CoSe 15456
IVT (Midlate)	:	CoBln 15502, CoLk 15469, CoP 15438, CoP 15439, CoP 15440, CoSe 15454, CoSe 15457
MOTIPUR - Plug and nodal cotton swab method		
IVT (Early)	:	CoLk 15466, CoLk 15467, CoP 15437, CoSe 15451, CoSe 15455, CoSe 15456
IVT (Midlate)	:	CoLk 15468, CoLk 15469, CoP 15438, CoP 15439, CoP 15440, CoP 15441, CoSe 15454
AVT (Early) I Plant	:	CoLk 14206, CoSe 14451, CoSe 14454
AVT (Early) II Plant	:	CoP 13437, CoSe 13451, CoSe 13452
AVT(Midlate)-I Plant	:	CoLk 14208, CoLk 14209, CoP 14438, CoP 14439, CoSe 14455
SEORAHI – Plug and nodal cotton swab method		
IVT (Early)	:	CoLk 15466, CoLk 15467, CoSe 15451, CoSe 15452, CoSe 15455, CoSe 15456
IVT (Mid late)	:	CoLk 15468, CoP 15438, CoP 15439, CoP 15441, CoSe 15453, CoSe 15454, CoSe 15457
AVT (Early) I Plant	:	CoLk 14206, CoSe 14451, CoSe 14454,
AVT (Mid late)	:	CoLk 14208, CoLk 14209, CoP 14439, CoSe 14455
NORTH EAST ZONE		
BURALIKSON – Plug & nodal cotton swab method		
IVT (Early)	:	CoLk 15466, CoLk 15467, CoP 15436, CoP 15437, CoSe 15451, CoSe 15456
IVT (Midlate)	:	CoLk 15468, CoLk 15469, CoP 15438, CoP 15439
AVT (Early)- I Plant	:	CoP 14437
AVT (Early)- II Plant	:	CoP 13437, CoSe 13452
AVT (Midlate)- I Plant	:	CoLk 14209, CoP 14439
EAST COAST ZONE		
ANAKAPALLE		
IVT Early	:	CoA 16321, CoV 16356
IVT Midlate	:	CoA 16322, CoC 16339, CoV 16357
AVT (Early)- I Plant	:	CoC 15336, CoC 15338, CoV 15356
AVT II (Early)	:	CoC 13023, CoA 14321
AVT(Midlate)-II Plant	:	Co 13028, Co 13029, Co 13031, CoA 14323, CoC 14337, PI 14337
CUDDALORE- Plug and nodal cotton swab method		
IVT (Early)	:	CoA 16321, CoC 16336, CoC 16337, CoV 16356
IVT (Midlate)	:	CoA 16322, CoC 16338, CoC 16339, CoV 16357
AVT- Early (I Plant)	:	CoC 15338, CoV 15356

AVT- Early (II Plant)	:	Co 13023, CoA 14321, CoC 14336
AVT-Midlate(II Plant)	:	Co 13028, Co 13029, Co 13031, CoA 14323, CoC 14337, PI 14377
PENINSULAR ZONE		
NAVSARI – Plug method		
IVT (Early)	:	Co 14005, Co 15002, Co 15005, Co 15006, Co 15007, Co 15009, Co 15017, Co 15018, Co 15020, Co 15021, CoN 15071,CoN 15072, CoSnk 15101, CoVc 15063, VSI 15122
AVT (Early) Plant I	:	Co 13003, Co 13004, Co 13006, Co 13008, Co 13009, Co 13013, Co 13014, Co 13018, CoN 13072, CoN 13073, CoSnk 13101, MS 13081
AVT (Early) Plant II	:	Co 12009, Co 12012, Co 12019, VSI 12121
THIRUVALLA – Plug & nodal cotton swab method		
IVT (Early)	:	
AVT (Early) Plant I	:	Co13002, Co13009, Co 13013, CoN13072, CoN13073, CoSnk 13101,CoSnk 13103, CoSnk 13106, MS 13081, PI 13132
AVT (Early) Plant II	:	Co 12009, Co 12019
AVT (Midlate) Plant II	:	Co 12008, Co 12019
COIMBATORE- Plug & nodal cotton swab method		
	:	Co 13021, Co 14002, Co 14003, Co 14004, Co 14005, Co 14006, Co 14008, Co 14009, Co 14012, Co 14016, Co 14022, Co 14023, Co 14025, Co 14026, Co 14030, Co 14031, Co 14032, Co 15002, Co 15005, Co 15009, Co 15010, Co 15015, Co 15017, Co 15021, CoN 14071, CoSnk 14101, CoSnk 14103, CoT 14366, CoT 14367, CoTl 14111, MS 14081, MS 14082, CoVc 14062, CoVSI 15121, CoVSI 15122, PI 15131

PP 17B: EVALUATION OF ZONAL VARIETIES FOR SMUT

Objective: To gather information on the relative resistance of the entries to smut inoculation in zonal trials of the respective zones

Locations: **i) North West Zone :** Lucknow, Kapurthala, Shahjahanapur, Pantnagar

ii) North Central Zone : Pusa, Seorahi

iii) East Coast Zone : Anakapalle, Cuddalore

iv) Peninsular Zone : Coimbatore, Thiruvalla, Navsari and Pune

Year of Start: 1994-95 (continuous project)

Varieties: All the entries of early and midlate group under IVT and AVT of the respective zones. The seed material is to be obtained from the respective breeders of the centre.

Inoculum: *Sporisorium scitamineum* (Syn. *Ustilago scitaminea*) teliospores freshly collected from smut susceptible sugarcane varieties will serve as source of inoculum.

Storage: Freshly collected whips are air dried by keeping under shade and teliospores are collected in butter paper bags and are stored in desiccators under anhydrous calcium chloride. Spore viability is to be ensured before inoculation.

Three budded setts of the test clones/entries to be pre-soaked in smut teliospore suspension (spore load @ 10^6 spores ml^{-1}) for a period of 30 min along with the respective checks/standards for R and S categories and planted in 6m/20' rows. Field observations to be made from the time of whip emergence (around 45 days) at fortnightly intervals and the number of smut infected clumps to be recorded. Evaluation is based on the percentage of clumps infected (No. of affected clumps/total clumps 100). It is required to maintain at least 15 to 20 clumps in each genotype before arriving at the percentage infection.

The following grading was followed for calculating the disease reaction.

0 %	: Resistant (R)
0.1 to 10 %	: Moderately Resistant (MR)
10.1 to 20 %	: Moderately Susceptible (MS)
20.1 to 30 %	: Susceptible (S)
Above 30%	: Highly susceptible (HS)

RESULTS

NORTH WEST ZONE

1. LUCKNOW

Out of 39 genotypes tested, twelve genotypes *viz.*, Co 15023, Co 15024, Co 13034, CoPb 13181, CoLk 15206, CoLk 15208, CoPb 15213, CoPb 15214, CoS 15231, CoS 15234, Co 14035 and CoH 13263 were rated as R. Six genotypes namely CoLk 15203, CoLk 15205, Co 14034, CoH 14261, CoPb 13182 and CoLk 13204 were rated as MR. Ten genotypes *viz.*, CoPb 15211, CoLk 14201, CoPb14211, CoS 13231, CoS 15232, CoS 15233,

CoLk 14203, CoPb 14185, Co 13035 and CoPant 13224 were rated as MS. Seven genotypes *viz.*, Co 15027, CoPb 15212, CoPb 14181, CoLk 15207, CoLk 15209, CoLk 14204, CoPb 14184 and CoS 14233 were rated as S. Three genotypes namely CoLk 15201, CoLk 15204 and Co 15026 were rated as HS (Table 1).

2. SHAHJAHANPUR

Eleven entries tested in IVT (Mid late) and among them six entries Co 15026, CoLk 15206, CoLk 15208, CoPb 15214, CoS 15233 and CoS 15232 were rated as R. In AVT Early (I Plant), all entries were found MR except Co 14034 which was MS against smut. In AVT Early (II Plant), two entries were observed as R and one CoS 13231 behaved as S against smut. In AVT Mid late (I Plant), the study revealed that five entries CoH 14261, CoLk 14204, CoPb 14185 and CoS 14233 were assessed as R/MR whereas Co 14035, CoPb 14184 and CoLk 14203 were identified as MS against smut. In AVT Mid late (II Plant), three (CoH 13263, CoLk 13204, CoPb 13182) out of five entries were identified as R/MR while Co 13035 and CoPant 13224 rated as MS to smut (Table 2).

3. KAPURTHALA

Out of 39 genotypes, three namely Co 15027, CoLk 15207 and CoH 14261 were rated as R and 24 genotypes *viz.*, Co 15023, Co 15024, CoLk 15201, CoLk 15205, CoPb 15211, CoPb 15212, CoLk 14201, CoPb 14211, CoPb 13181, CoS 13231, CoLk 15206, CoPb 15213, CoPb 15214, CoS 15231, CoS 15232, CoS 15233, CoS 15234, Co 14035, CoLk 14204, CoPb 14184, CoPb 14185, CoS 14233, CoH 13263 and CoPant 13224 were rated as MR. Of the remaining entries, nine genotypes were rated as MS and three entries were rated as S (Table 1).

4. PANTNAGAR

Out of 44 genotypes 12 were found R, 8 MR, remaining genotypes showed various degrees of susceptibility, i.e., 11 MS, 10 S and 3 HS (Table 2).

NORTH CENTRAL ZONE

1. PUSA

Among 24entries tested15 entries *viz.*, CoBln 15502, CoLk 15466, CoLk 15467, CoP 15436, CoP 15437, CoSe 15451, CoLk 94184, CoLk 15468, CoP 06436, CoP 9301, CoP 15438, CoP15439, CoSe 01421, CoSe 15454, CoSe 15457 were graded as R, whereas, 9 entries *viz.*, CoBln 15501, CoP 15440, CoP 15441,CoLk 15469, CoSe 15452, CoSe 15455, CoSe 15456, CoSe 15453 and BO 91 showed MR reaction against smut disease (Table 3).

2. MOTIPUR

Out of 31 genotypes tested, 19 genotypes *viz.*,CoBln 15502, CoLk 15466, CoLk 15467, CoSe 15451, CoLk 14206, CoLk 14208, CoLk 14209, CoLk 15468, CoLk 15469,CoP 14437, CoP 15437,CoSe 14451, CoP 15438, CoP 15439, CoP 14438, CoP 14439,CoSe 15454, CoSe 15457 and CoSe 14455 were rated as R. Nine genotypes *viz.*, CoSe 15452, CoSe 15455, CoSe 15456, CoSe14454, CoP 13437, CoSe 13451, CoSe 13452, CoP 15441 and CoSe 15453 were rated as MR (Table 3).

3. SEORAHI

In IVT (Early), among9 genotypes evaluated 6 were rated as R, 1 as MR, CoP 15436 as MS and CoBln 15501 S. In IVT (Mid late), 10 genotypes were evaluated, of which 7 were rated as R, two as MR and CoP 15440 as MS. In AVT (Early),4clones were evaluated and in that 1 genotype (CoP 14437) was rated as S and rest of the genotypes were found as R/MR. In AVT (Mid late),5 were evaluated andthe genotype CoP 14438 was rated as MS, while reamaining genotypes was found as R/MR (Table 3).

EAST COAST ZONE

1. ANAKAPALLE

Out of 33 genotypes tested, 1 entriyand 3 standards showed R reaction (Co 13023, CoC 01061, Co 06030 and Co 86249), while 7 entries and 2 standards showed MR reaction (Co 7219, Co 13029, Co 13031, CoA 14321, CoC 16337, CoC 16339, CoC 14337, CoV 16356 andCoV 92102) and the remaining entries showed MS to HS reaction (Table 4).

2. CUDDALORE

Among 20 entries screened 6 clones *viz.*, CoA 16321, CoV 16356, CoC 15336, CoC 15338, CoC 16339 and CoC 14337 were found MR, nine *viz.*, Co 13023, Co 13028, Co 13031, CoA 14321, CoA 16322, CoC 16336, CoC 16337, CoV 16357, PI 14377 were MS andfour clones *viz.*, CoV 15356, CoC 14336, CoC 16338 and Co 13029 were S and one clone CoA 14323 was found to be HS (Table 4).

PENINSULAR ZONE

1. KOLHAPUR

Out of 51 genotypes/entries in ZVT, 5 genotypes *viz.*, Co 15006, Co 15015 and Co 15017 from IVT and Co 13002 and CoN 13073 from AVT I were found to be R to smut. In total, 35 genotypes were found to be MR,whereas, 6 genotypes were MS and 7 genotypes *viz.*, Co 15007, CoSnk 15102 and Co 15020 (from IVT) and Co 12007 and Co 12008 (from AVT II plant) were found S to smut (Table 5).

2. PUNE

Out of 49 genotypes including 2 standard checks screened, 21 genotypes *viz.*, Co 12012, Co 12019, Co13002, Co13003, Co13004, Co13006, Co13008, Co13014, Co13020, Co15009, Co15010, Co15018, Co15020, Co15021,

CoN 15071, MS13081, CoSnk13103, CoSnk13106, CoM12085, CoVc 15061 and CoVSI15121 were found R, 3 *viz.,* Co 15007, CoN13073 and VSI12121 were found MR, 15 were found MS, 5 were S and remaining 5 wereHS (Table 5).

3. NAVSARI

Out of 51 entries evaluated 32 entries exhibited R reaction *viz*., Co 12007, Co 12012, Co 12019, Co 12024, Co 13002, Co 13003, Co 13008, Co 13009, Co 13013, Co 13018, Co 15002, Co 15005, Co 15006, Co 15009, Co 15010, Co 15015, Co 15017, Co 15018, CoN 15071, CoN 13072, CoN 13073, CoM 12085, CoSnk 13101, CoSnk 15104,CoVc 15061, VSI 15122, CoVc 15063, CoVc 15064, MS 13081, PI 15131, PI 15132 and PI 13132. Similarly eight entries *viz.,* Co14005, CoVSI 15121,Co 15021, CoN 15072, CoSnk 15103, Co 13004, Co 13020 and Co 12008 showed MR reaction,7 entries Co 12009, Co 13006, CoSnk 15102, CoVC 15062, CoSnk 13103, CoSnk 13106 and VSI 12121 exhibited MS reaction andrest of the entries showed S to HS reaction (Table 5).

4. COIMBATORE

About 20 IVT entries were screened for smut resistance and among themthree entries *viz.,* Co 15006, Co 15009 and Co 15015 were rated as R to smut (Table 5).

SUMMARY

Entries showing R and MR against smut are as follows

NORTH WEST ZONE		
LUCKNOW		
AVT (Early) Plant I	:	Co 14034
AVT (Early) Plant II	:	Co 13034, CoPb 13181
AVT (Midlate) Plant I	:	Co 14035, CoH 14261
AVT (Midlate) Plant II	:	CoH 13263, CoLk 13204, CoPb 13182
IVT (Early)	:	Co 15023, Co 15024, CoLk15203, CoLk15205
IVT (Midlate)	:	CoLk 15206, CoLk 15208, CoPb 15213, CoPb 15214, CoS 15231, CoS 15234
KAPURTHALA		
AVT (Early) Plant I	:	CoLk 14201, CoPb 14211
AVT (Early) Plant II	:	CoPb 13181, CoS 13231
AVT (Midlate) Plant II	:	Co 13035, CoPant 13224, CoPb 13182
IVT (Early)	:	Co 15023, Co 15024, Co 15027, CoLk 15201, CoLk 15205, CoPb 15211, CoPb 15212
IVT (Midlate)	:	CoLk 15206, CoLk 15207, CoPb 15213, CoPb 15214, CoS 15231, CoS 15232, CoS 15233, CoS 15234
SHAJAHANPUR		
AVT (Early) Plant I	:	CoLk 14201, CoPb 14181, CoPb 14211
AVT (Early) Plant II	:	Co 13034, CoPb 13181
AVT (Midlate) Plant I	:	CoH 14261, CoLk 14204, CoPb 14185, CoS 14233
AVT (Midlate) Plant II	:	CoH 14263, CoLk 13204, CoPb 13182
IVT (Early)	:	Co 15023, Co 15024, CoLk 15201, CoLk 15203, CoLk 15204, CoLk 15205, CoPb 15211, CoPb 15212
IVT (Midlate)	:	Co 15026, CoLk 15206, CoLk 15208, CoPb 15214,CoS 15233, CoS 15232, CoS 15234
PANT NAGAR		
AVT (Early) Plant I	:	CoLk14201
AVT (Early) Plant II	:	Co13034, CoPb13181
AVT (Midlate) Plant I	:	CoPb14185, CoS14233
AVT (Midlate) Plant II	:	Co13035, CoH13263, CoLk 13204
IVT (Early)	:	Co15023, Co15024, CoLk15203, CoLk15205, CoPb15212
IVT (Midlate)	:	CoLk15208, CoLk15209, CoPb15213, CoPb15214, CoS15232, CoS15233
NORTH CENTRAL ZONE		
PUSA		
IVT (Early)	:	CoBln 15501, CoLk 15466, CoLk 15467, CoP 15436, CoP 15437, CoSe 15451, CoSe 15452, CoSe 15455, CoSe 15456, CoLk 94184, CoSe 01421

IVT (Mid late)	:	CoBln 15502, CoLk 15468, CoLk 15469, CoP 15438, CoP 15439, CoP 15440, CoP 15441, CoSe 15453, CoSe 15454, CoSe 15457
MOTIPUR		
IVT (Early)	:	CoLk 15466, CoLk 15467, CoP 15437, CoSe 15451, CoSe 15452, CoSe 15455, CoSe 15456
AVT (Early) I Plant	:	CoLk 14206, CoP 14437, CoSe 14451, CoSe 14454
AVT (Early) II Plant	:	CoP 13437, CoSe 13451, CoSe 13452
IVT (Midlate)	:	CoBln 15502, CoLk 15468, CoLk 15469, CoP 15438, CoP 15439, CoP 15441, CoSe 15453, CoSe 15454, CoSe 15457
AVT (Midlate) I Plant	:	CoLk 14208, CoLk 14209, CoP 14438, CoP 14439, CoSe 14455
SEORAHI		
IVT (Early)	:	CoLk 15466, CoLk 15467, CoP 15437, CoSe 15451, CoSe 15452, CoSe 15455, CoSe 15456
IVT (Mid late)	:	CoBln 15502, CoLk 15468, CoLk 15469, CoP 15438, CoP 15439, CoP 15441, CoSe 15453, CoSe 15454, CoSe 15457
AVT (Early) I Plant	:	CoLk 14206, CoSe 14451, CoSe 14454
AVT (Midlate) I Plant	:	CoLk 14208, CoLk 14209, CoP 14438, CoP 14439, CoSe 14455
EAST COAST ZONE		
ANAKAPALLE		
IVT Early	:	CoV 16356
IVT Midlate	:	CoC 16339
AVT (Early) I Plant	:	Nil
AVT- Early (II Plant)	:	Co 13023, CoA 14321
AVT- Midlate II Plant	:	Co 13029, Co 13031, CoC 14337
CUDDALORE		
IVT (Early)	:	CoA 16321, CoV 16356
AVT (Early) I Plant	:	CoC 15336, CoC 15338
AVT- Early (II Plant)	:	Nil
AVT- Midlate II Plant	:	CoC 14337
PENINSULAR ZONE		
KOLHAPUR		
IVT (Early)	:	Co 14005, Co 15002, Co 15006, Co 15009, Co 15010, Co 15015, Co 15017, Co 15018, CoN 15071, CoN 15072, CoSnk 15101, CoSnk 15103, CoSnk 15104, CoVc 15061, CoVc 15062, CoVc 15063, CoVc 15064, CoVSI 15121, VSI 15122
AVT (Early) Plant I	:	Co 13002, Co 13003, Co 13004, Co 13006,Co 13008, Co 13009, Co 13014, Co 13018, Co 13020, CoN 13073, CoN 13072, CoSnk 13101, CoSnk 13103, CoSnk 13106, MS 13081, PI 13132
AVT (Early) Plant II	:	Co12012, Co12019, Co12024, CoM 12085, VSI 12121
PUNE		
IVT (Early)	:	Co 15007, Co 15009, Co 15010, Co 15018, Co 15020, Co 15021, CoN 15071, CoVc 15061, CoVSI 15121
AVT (Early) I Plant	:	Co13002, Co13003, Co13004, Co13006, Co13008, Co13014, Co13020, CoN 13073, CoSnk13103, CoSnk13106, MS13081
AVT (Early) II Plant	:	Co 12012, Co 12019, CoM 12085, VSI 12121
NAVSARI		
IVT(Early)	:	Co 14005, Co 15002, Co 15009, Co 15005, Co 15010, Co 15015, Co 15017, Co 15018, Co 15021, CoVSI 15121, CoN 15071, CoN 15072, CoSnk 15103, CoSnk 15104, CoVC 15061, CoVC 15063, CoVC 15064, PI 15131, PI 15132, VSI 15122
AVT(Early) Plant I	:	Co 13002, Co 13003, Co 13004, Co 13008, Co 13009, Co 13013, Co 13018, Co 13020, CoN 13072, CoSnk 13101, MS 13081, PI 13132
AVT(Early) Plant II	:	Co 12007, Co 12008, Co 12012, Co 12019, Co 12024, CoM 12085
COIMBATORE		
	:	Co 15006, Co 15009, Co 15015

PP 17C: EVALUATION OF ZONAL VARIETIES FOR WILT

Location : Lucknow, Kapurthala, Pusa, Motipur, Anakapalle, Navsari

Year of Start : 2000-2001

Varieties : Entries of AVT of the respective zones for the year

Plot size and Planting: Two rows of 5m length planted under wilt sick soils

Standards : Any wilt susceptible and resistant variety of the zone.

Observations : 1. Germination count at 45 days of planting

2. Appearance of wilt symptoms on the standing canes (on clumps)

3. At the end of 10 months, 10 clumps are to be uprooted with roots. All canes from the clumps will be split open longitudinally and the wilt severity index scored on a 0-4 scale.

Evaluation : 0-4 Scale of wilt severity index

Grade	Symptoms
0	Healthy canes and roots with no external or internal symptoms of wilt.
1	No wilting or drying of leaves, no stunting or shrinking of the stalk or rind, slight pith formation with yellow discolouration of the internal tissues in one or two lower internodes only. No cavity formation or fungal growth seen. Apparently normal and healthy roots.
2	Mild yellowing of top leaves and drying of lower leaves, mild stunting and shrinking of the stalk and rind. Yellowish discolouration of the internal tissuesextends to three or four bottom internodes. Slight cavity formation of the pith, no fungal growth seen, slightly discoloured roots.
3	Mild yellowing of top leaves and drying of lower leaves, mild stunting and shrinking of the stalk and rind. Light brown discolouration of the internal tissues throughout the entire length of the cane except the top. Severe pith and cavity formation. Sparse fungal growth observed in the pith cavities.
4	Complete yellowing and drying of the leaves, marked stunting, shrinking and drying of the stalk and rind, dark brown discolouration of the internal tissues extending throughout the entire length of the cane. Large pith cavities with profuse over growth of the associated fungi. Most of the roots necrotic with dark discoloration and dislodge easily from the stalks. Roots mildly discoloured and slightly necrotic.

The mean wilt severity index is worked out based on the number of canes sampled.

Mean wilt severity index = Sum of wilt indices of individual stalks/Number of stalks sampled

Note: Varieties were screened for wilt resistance in wilt sick plot.

RESULTS

LUCKNOW

Out of 39 genotypes tested under natural infection conditions, 10 genotypes *viz*., Co 14034, Co 15023, Co 15026, CoPb 14185, CoPb 15211, CoPb 15213, CoPb 15214, CoS 13231, CoS 14233 and CoS 15231, were found S to wilt. Remaining 29 genotypes *viz*., Co 13034, Co 13035, Co 14035, Co 15024, Co 15027, CoH 13263, CoH 14261, CoLk 13204, CoLk 14201, CoLk 14203, CoLk 14204, CoLk 15201, CoLk 15203, CoLk 15204, CoLk 15205, CoLk 15206, CoLk 15207, CoLk 15208, CoLk 15209, CoPant 13224, CoPb 13181, CoPb 13182 CoPb 14181, CoPb 14184, CoPb 14211, CoPb 15212, CoS 15232, CoS 15233 and CoS 15234 were found R (Table 1).

KAPURTHALA

Among the 39 evaluated genotypes, 22 were R to wilt, 14 (Co 13034, Co 13035, Co 14035, Co 15024, CoLk 13204, CoLk 14203, CoPant 13224, CoPb 13182 CoPb 14181, CoPb 14184, CoPb 14185, CoPb 15214, CoS 13231 and CoS 14233) were MR and three viz., Co 14034, CoH 13263 and CoPb 14211 were MS (Table 1).

PUSA

Among 24 entries evaluated, eight (CoLk 15466, CoLk 15467, CoP 9301, CoP 06436 CoP 15436, CoP 15437, CoP 15438 and CoP 15439) were found free from wilt, whereas, 11 entries (BO 91, CoBln 15502, CoLk 94184, CoLk 15454, CoLk 15469, CoP 15441, CoSe 01421, CoSe 15451, CoSe 15452, CoSe 15455 and CoSe 15457) were graded as MR, four entries (CoBln 15501, CoSe 15456, CoLk 15468 and CoP 15440) were found as MS and entry CoSe 15453 showed S reaction to wilt (Table 3).

MOTIPUR

Out of 31 genotypes tested under natural condition, three genotypes *viz.,* CoSe 15452, CoSe 13451 and CoBln 15502 were rated as S to wilt. Remaining 28 genotypes viz., CoBln 15501, CoLk 14206, CoLk 14208, CoLk 14209, CoLk 15466, CoLk 15467, CoLk 15468, CoLk 15469, CoP 13437, CoP 14437, CoP 14438, CoP 14439 CoP 15436, CoP 15437, CoP 15438, CoP 15439, CoP 15440, CoP 15441, CoSe 13452, CoSe 14451, CoSe 14454, CoSe 14455, CoSe 15451, CoSe 15453, CoSe 15454, CoSe 15455, CoSe 15456 and CoSe 15457 were found resistance (R) to wilt (Table 3).

ANAKAPALLE

Out of 33 genotypes tested, six entries (Co 86249, Co 06030, Co 13031, CoC 01061, CoOr 03151 and CoV 15356) showed resistant reaction while 12 entries (Co 7706, Co 13023, Co 13028, CoA 14321, CoA 89085, CoA 14323, CoC 14337, CoC 16337, CoC 16338, CoC 16339, CoV 16357 and PI 14337) reacted as MR and remaining showed S to HS reaction (Table 4).

NAVSARI

Out of 25, 17 entries viz., Co 12009, Co 12024 Co 13002, Co 13004, CO 13006, Co 13008, Co 13009, Co 13013, Co 13018, Co 13020, CoN 13072, CoN 13073, CoSnk 13101, CoSnk 13106, MS 13081, PI 13132 and VSI 12121 showed MR reaction. Six entries viz., Co 12007, Co 12019, Co 13003, Co 13014, CoSnk 13103 and CoM 12085 exhibited MS reaction to wilt (Table 5).

SUMMARY

The entries showing R or MR to wilt are listed below

LUCKNOW		
IVT (Early)	:	Co 15024, Co 15027, CoLk 15201, CoLk 15203, CoLk 15204, CoLk 15205 and CoPb 15212
AVT (I Plant, Early)	:	CoLk 14201, CoPb 14181 and CoPb 14211
AVT (II Plant, Early)	:	Co 13034 and CoPb 13181
IVT (Mid Late)	:	CoLk 15206, CoLk 15207, CoLk 15208, CoLk 15209, CoS 15232, CoS 15233 and CoS 15234
AVT (I Plant Mid Late)	:	Co 14035, CoH 14261, CoLk 14203, CoLk 14204 and CoPb 14184
AVT (II Plant midlate)	:	Co 13035, CoH 13263, CoPant 13224, CoPb 13182 and CoLk 13204
KAPURTHALA		
IVT (Early)	:	Co 15023, Co 15024, Co 15027, CoLk 15201, CoLk 15203, CoLk 15204, CoLk 15205, CoPb 15211 and CoPb 15212
AVT (I Plant, Early)	:	CoLk 14201 and CoPb 14181
AVT (II Plant, Early)	:	Co 13034, CoPb 13181 and CoS 13231
IVT (Mid Late)	:	Co 15026, CoLk 15206, CoLk 15207, CoLk 15208, CoLk 15209, CoPb 15213, CoPb 15214, CoS 15231, CoS 15232, CoS 15233 and CoS 15234
AVT (I Plant midlate)	:	Co 14035, CoH 14261, CoLk 14203, CoLk 14204, CoPb 14184, CoPb 14185 and CoS 14233
AVT (II Plant midlate)	:	Co 13035, CoPant 13224, CoPb 13182 and CoLk 13204
PUSA		
IVT (Early)	:	CoLk 15466, CoLk 15467, CoLk 94184, CoP 15436, CoP 15437, CoSe 01421, CoSe 15451, CoSe 15452 and CoSe 15455
IVT (Mid Late)	:	CoBln 15502, CoLk 15469, CoP 06436, CoP 15438, CoP 15439, CoP 15441, CoP 9301, CoSe 15454 and CoSe 15457
ANAKAPALLE		
IVT (Early)	:	CoC 01061, CoC 16337 and CoOr 03151
AVT (I Plant, Early)	:	CoV 15356
AVT (II Plant, Early)	:	Co 13023 and CoA 14321
IVT (Mid Late)	:	CoC 16338, CoC 16339, CoV 16357, Co 06030 and Co 86249
AVT (II Plant midlate)	:	Co 13028, Co 13031, CoA 14323, CoC 14337 and PI 14337
NAVSARI		
AVT (I Plant, Early)	:	Co 13002, Co 13004, Co 13006, Co 13008, Co 13009, Co 13013, Co 13018, Co 13020, CoN 13072, CoN 13073, CoSnk 13101, CoSnk 13106, MS 13081 and PI 13132
AVT (II Plant, Early)	:	Co 12009, Co 12024 and VSI 12121

PP 17D : YELLOW LEAF (YL) DISEASE of SUGARCANE

Yellow Leaf disease symptoms of mid rib yellowing are expressed during 6-8 months crop stage. If disease severity increases, the yellowing spreads to laminar region and later there will be drying of affected mid rib and adjoining laminar tissue from leaf tip downwards along the mid rib. Another important symptom would be bunching of leaves in the crown. Highly susceptible variety will exhibit severe foliage drying during maturity stage. In place of yellow discoloration, purple or pinkish purple discoloration may also be seen on the mid rib and lamina. Canes of the affected plant do not dry. To assess YL severity, the following disease severity grades are to be given during maturity stages of the crop (3 observations by 8th, 10th and 12th months). Each time, minimum of 25 canes (free from other biotic stresses) are to be scored.

YL severity grades

(The colour photographs of YL symptoms displaying severity grades are available in the soft copy of the technical programme).

Disease grade	Description
0	No symptom of the disease
1	Mild yellowing of midrib in one or two leaves, no sign of typical bunching of leaves caused by YL
2	Prominent yellowing of midrib on all the leaves in the crown. No bunching of leaves
3	Progress of midrib yellowing to laminar region in the whorl, yellowing on the upper leaf surface, and bunching of leaves
4	Drying of laminar region from leaf tip downwards along the midrib, typical bunching of leaves as a tuft
5	Stunted growth of the cane combined with drying of symptomatic leaves

Mean of the severity grades to be computed and the following YL severity scale is to be used to assign disease reaction of the variety.

YL severity scale

Disease grade	Description
Score	Disease reaction
0.0 - 1.0	Resistant
>1.0 – 2.0	Moderately resistant
>2.0 – 3.0	Moderately susceptible
>3.0 – 4.0	Susceptible
>4.0 – 5.0	Highly susceptible

RESULTS

LUCKNOW

Out of 39 genotypes tested under natural infection conditions, four genotypes *viz.,* Co 14034, CoPb 15213, CoH 14261 and CoPb 13182 were rated as S against YL. Remaining 35 genotypes *viz.,* Co 13034, Co 13035, CoLk 13204, Co 14035, Co 15023, Co 15024, Co 15026, Co 15027, CoH 13263, CoLk 14201, CoLk 14203, CoLk 14204, CoLk 15201, CoLk 15203, CoLk 15204, CoLk 15205, CoLk 15206, CoLk 15207, CoLk 15208, CoLk 15209, CoPant 13224, CoPb 14181, CoPb 14211, CoPb 13181, CoPb 15211, CoPb 15212, CoPb 15214, CoS 13231, CoS 15231, CoS 15232, CoS 15233, CoS 15234, CoPb 14184, CoPb 14185 and CoS 14233 were found R to YL (Table 1).

SHAHJAHANPUR

Thirty nine entries of the six trials were screened against the incidence of Yellow leaf disease. Study revealed that all entries of six trials wereR/MR against YL (Table 2).

KAPURTHALA

Out of nine entries of IVT (E), 6 entries were found R while two entries *viz*., Co 15027 and CoPb 15212 were MR and one entry (CoLk 15205) as MS. In AVT (E-I), two entries *viz*., Co 14034 and CoPb 14211 were found R and two (CoLk 14201 and CoPb 14181) as MR. In AVT (E-II), two entries (Co 13034 and CoS 13231) were R, while entry CoPb 13181 was found MR. Among 11 entries of IVT (ML), eight *viz*., Co 15026, CoLk 15206, CoLk 15207, CoLk 15209, CoPb 15213, CoS 15231, CoS 15232 and CoS 15234 were found R while three entries (CoLk 15208, CoPb 15214 and CoS 15233) were MR. In AVT (ML-I), five entries (Co 14035, CoLk 14204, CoPb 14184, CoPb 14185 and CoS 14233) were found R and two (CoH 14261 and CoLk 14203) were MR. In AVT (ML-II), 3 entries viz., CoH 13263, CoPant 13224 and CoPb 13182 were found R whereas entries Co 13035 and CoLk 13204 were MR. None of entry showed S or HS reaction (Table 1).

UCHANI

Twenty AVT (early & mid late) and 20 IVT (early & mid late) entries of zonal varietal trials along with standard checks were evaluated for resistance to YL. In AVT (early) Plant-1, only CoLk 14201 entry found moderately resistant against YL. Three varieties namely Co 14034, CoPb 14211 and CoPb 14181 showed moderately susceptible reaction to YL. In AVT (Mid late) Plant-1, entries *viz.*, CoH 14261, CoPb 14184, CoPb 14185 and CoS 14233 showed MR reaction to YL. In AVT (Midlate) –II, entry CoH 13263 showed resistant reaction and in IVT (early) four entries viz. Co 15024, Co 15027 CoPb 15211 and CoPb 15212 were found MR against YL. In IVT (mid late), three entries viz., CoLk 15206, CoLk 15207 and CoLk 15209, showed resistant reaction and three entries namely, Co 15026, CoS 15233 and CoS 15234 exhibited moderately resistant against YL (Table 1).

PANTNAGAR

Out of 43 genotypes, 22 were resistant, 10 were MR, 6 were MS, 4 were S and one was HS against YL (Table 2).

MOTIPUR

Out of 31 genotypes tested under natural condition, five genotypes *viz.,* CoLk 14209, CoP 15437, CoP 15438, CoSe 13451 and CoSe 15453 were rated as susceptible (S) against YL. Whereas remaining 26 genotypes *viz.,* CoBln 15501, CoBln 15502, CoLk 14206, CoLk 14208, CoLk 15466, CoLk 15467, CoLk 15468, CoLk 15469, CoP 13437, CoP 14437, CoP 14438, CoP 14439, CoP 15436, CoP 15439, CoP 15440, CoP 15441, CoSe 14451, CoSe 14454, CoSe 15451, CoSe 15452, CoSe 15455, CoSe 15456, CoSe 13452, CoSe 15454, CoSe 14455 and CoSe 15457 were found resistance (R) to YL (Table 3).

SEORAHI

In, IVT (E), out of nine genotypes six genotypes were rated as resistant, one genotype CoP 15437 as MR and two genotype *viz.* CoBln 15501 and CoLk 15466 were rated as MS to YL. In IVT (Mid-late), eight genotypes exhibited resistance and in AVT (E) of four genotypes evaluated two genotypes exhibited resistance and other two genotypes exhibited moderate resistance. In AVT (Mid late), four genotypes exhibited resistance and one genotype CoP 14438 exhibited moderate resistance against to YL (Table 3).

ANAKAPALLE

Out of 33 genotypes screened under natural conditions, the entries, viz., Co 419, Co 997, Co 6907, Co 7219, Co 7706, Co 06030, Co 13028, Co 13029, Co 13031, CoA 16321, CoA 89085, CoC 671, CoC 16338 and CoV 92102 were found resistant to YL . The genotypes viz., CoA 92081, CoA 14321, CoA 16332, CoC 14336, CoC 14337, CoC 16336, CoC 16337, CoOr 03151 and PI 14337 were found to be MR against YL (Table 4).

NAVSARI

A total of 51 entries along with 6 checks were evaluated for resistance to yellow leaf disease. Out of 51 varieties of zonal trial evaluated to YL, 45 entries showed resistant reaction. Four entries viz., Co 12008, Co 12024, Co 13020 and Co 15018 were exhibited moderately resistant reaction. Two entries viz., CoSnk 15104 and PI 15132 displayed susceptible reaction. Amongst six checks three checks viz, Co 94008, CoC 671 and CoSnk 05103 were found resistant and Co 99004 as moderately resistant. Only one check Co 85004 exhibited MS reaction and Co 86032 was observed susceptible reaction to YL (Table 5).

COIMBATORE

IVT and AVT entries were screened for YL severity based on the 0-5 scale. Of the 26 entries in IVT, 12 entries were apparently free with YL viz. Co 14005, Co 15002, Co 15007, Co 15018, Co 15021, CoN 15071, CoN 15072, CoSnk 15103, CoSnk 15104, CoVc 15061, CoVc 15063, PI 15132, and VSI 15122; three entries, Co 15006, CoVc 15062, and CoVc 15064 had exhibited disease severity grade of more than 3 and the remaining entries had severity grades in the range of 1-3. Out of 17 entries in AVT, 50% of the entries were apparently free from YL and only four entries viz. Co 13013, Co 13004, Co 13018 and CoSnk 13103 had come under the susceptible category with disease severity grades in the range of 2-3. In AVT II plant as well as in ratoon only one entry, Co 12024 was highly susceptible to YL with severity grade more than 3 (Table 5).

PUNE

Out of the 14 genotypes genotypes, 6 *viz.*, 14-22, 59-20, 191-3, Co 419, CoM 9057, CoVSI 9805 and MS 10001 were observed free from the disease. Six varieties *viz.*, Co 94012, CoC 671, CoM 0265, VSI 434, and VSI 08005 showed MR reactions, while Co 86032 and CoVSI 03102 reacted as MS (Table 5).

SUMMARY

The entries showing R or MR to YL are listed below

LUCKNOW		
IVT (Early)	:	Co 15023, Co 15024, Co 15027, CoLk 15201, CoLk 15203, CoLk 15204, CoLk 15205, CoPb 15212 and CoPb 15211
AVT (Early) Plant - I	:	CoLk 14201, CoPb 14181 and CoPb 14211
AVT (Early) Plant - II	:	Co 13034, CoPb 13181 and CoS 13231
IVT (Mid Late)	:	CoLk 15206, CoLk 15207, CoLk 15208, CoLk 15209, CoPb 15214, CoS 15231, CoS 15232, CoS 15233 and CoS 15234
AVT (Mid Late) Plant - I	:	Co 14035, CoLk 14203, CoLk 14204, CoPb 14184, CoPb 14185 and CoS 14233
AVT (Mid Late) Plant - II	:	Co 13035, CoH 13263, CoPant 13224 and CoLk 13204
KAPURTHALA		
IVT (Early)	:	Co 15023, Co 15024, Co 15027, CoLk 15201, CoLk 15203, CoLk 15204, CoPb 15211 and CoPb 15212
AVT (Early) Plant - I	:	Co 14034, CoLk 14201, CoPb 14181 and CoPb 14211
AVT (Early) Plant - II	:	Co 13034, CoPb 13181 and CoS 13231
IVT (Mid Late)	:	Co 15026, CoLk 15206 , CoLk 15207, CoLk 15208, CoLk 15209, CoPb 15213, CoPb 15214, CoS 15231, CoS 15232, CoS 15233 and CoS 15234
AVT (Mid late) Plant - I	:	Co 14035, CoH 14261, CoLk 14203, CoLk 14204, CoPb 14184, CoPb 14185 and CoS 14233
AVT (Mid late) Plant - II	:	Co 13035, CoH 13263, CoPant 13224, CoPb 13182 and CoLk 13204

UCHANI		
AVT (Early) Plant - I	:	CoLk 14201
IVT (Early)	:	Co 15024, Co 15027, CoPb 15211 and CoPb 15212
IVT (Mid Late)	:	Co 15026, CoLk 15206, CoLk 15207, CoLk 15209, CoS 15233 and CoS 15234
AVT (Mid Late) Plant - I	:	CoH 14261, CoPb 14184, CoPb 14185 and CoS 14233
AVT (Mid Late) Plant - II	:	CoH 13263
SHAHJAHANPUR		
IVT (Early)	:	Co 15023, Co 15024, Co 15027, CoLk 15201, CoLk 15203, CoLk 15204, CoLk 15205, CoPb 15211, CoPb 15212, Co 0238, Co 05009 and CoJ 64
IVT (Mid Late)	:	Co 05011, Co 15026, CoJ 64, CoLk 15206, CoLk 15207, CoLk 15208, CoLk 15209, CoPant 97222, CoPb 15213, CoPb 15214, CoS 15231, CoS 15233, CoS 15232 and CoS 15234
AVT (Early) Plant - I	:	Co 14034, CoJ 64, CoLk 14201, CoPb 14181 and CoPb 14211
AVT (Early) Plant - II	:	Co 13034, CoPb 13181 and CoS 13231
AVT (Mid Late) Plant - I	:	Co 05011, Co 14035, CoJ 64, CoH 14261, CoPb 14185, CoPb 14184, CoLk 14203, CoLk 14204, CoPant 97222, CoS 767, CoS 8436 and CoS 14233
AVT (Mid Late) Plant - II	:	Co 13035, CoH 13263, CoLk 13204, CoPant 13224, CoPb 13182
PANTNAGAR		
IVT (Early)	:	Co 15023, Co 15024, Co 15027, CoLk 15201, CoLk 15203, CoLk 15204, CoLk 15205 and CoPb 15211
AVT (Early) Plant - I	:	Co 14034, CoPb 14181 and CoPb 14211
AVT (Early) Plant - II	:	Co 13034 and CoPb 13181
IVT (Mid Late)	:	Co 15026, CoLk 15206, CoLk 15207, CoLk 15209, CoPb 15213, CoS 15232, CoS 15233 and CoS 15234
AVT (Mid late) Plant - I	:	Co 14035, CoLk 14203 and CoPb 14184
AVT (Mid late) Plant - II	:	Co 13035, CoPant 13224, CoPb 13182 and CoLk 13204
SEORAHI		
IVT (Early)	:	CoLk 15467, CoP 15436, CoP 15437, CoSe 15451, CoSe 15452, CoSe 15455 and CoSe 15456
IVT (Mid Late)	:	CoBln 15502, CoLk 15468, CoLk 15469, CoP 15438, CoP 15439, CoP 15440, CoSe 15453 andCoSe 15457
AVT (Early) Plant - I	:	CoLk 14206, CoP 14437, CoSe 14451 andCoSe 14454
AVT I Mid late	:	CoLk 14208, CoLk 14209, CoP 14438, CoP 14439 and CoSe 14455
MOTIPUR		
IVT (Early)	:	CoBln 15501, CoLk 15466, CoLk 15467, CoP 15436, , CoSe 15451, CoSe 15452, CoSe 15455 and CoSe 15456
AVT (Early) Plant - I	:	CoLk 14206, CoP 14437, CoSe 14451 and CoSe 14454
AVT (Early) Plant - II	:	CoP 13437 and CoSe 13452
IVT (Mid Late)	:	CoBln 15502, CoLk 15468, CoLk 15469, CoP 15439, CoP 15440, CoP 15441, CoSe 15454 and CoSe 15457
AVT (Mid Late) Plant - I	:	CoLk 14208, CoP 14438, CoP 14439 and CoSe 14455
ANAKAPALLE		
IVT (Early)	:	CoA 16321, CoC 16336 and CoC 16337
IVT (Mid Late)	:	CoA 16322 and CoC 16338
AVT II Early	:	CoA 14321 and CoC 14336
AVT (Mid Late) Plant - II	:	Co 13028, Co 13029, Co 13031, CoC 14337 and PI 14337
NAVSARI		
IVT (Early)	:	Co 14005, Co 15002, Co 15005, Co 15006, Co 15007, Co 15009, Co 15010, Co 15015, Co 15017, Co 15018, Co 15020 ,Co 15021, CoN 15071, CoN 15072, CoSnk 15101, CoSnk 15102, CoSnk 15103, CoVc 15061, CoVc 15062, CoVc 15063, CoVc 15064, CoVSI 15121, PI 15131 and VSI 15122
AVT (Early) Plant - I	:	Co 13002, Co 13003, Co 13004, CoN 13072, Co 13006, Co 13008, Co 13009 Co 13013, Co 13014, Co 13018, Co 13020, CoN 13073, CoSnk 13101, CoSnk 13103, CoSnk 13106, MS 13081 and PI 13132
AVT (Early) Plant - II	:	Co 12007, Co 12008, Co 12009, Co 12012, Co 12019, Co 12024, CoM 12085 and VSI 12121
COIMBATORE		
IVT (Early)	:	Co 14005, Co 15002, Co 15005, Co 15007, Co 15015, Co 15017, Co 15018, Co 15020, Co 15021, CoN 15071, CoN 15072, CoSnk 15103, CoSnk 15104, CoVc 15061, CoVc 15063, PI 15132, VSI 15121 and VSI 15122
AVT (Early) Plant - I	:	Co 13002, Co 13003, Co 13006, Co 13008, Co 13009, Co 13014, Co 13020, CoN 13072, CoN 13073, CoSnk 13101, CoSnk 13106, MS 13081 and PI 13132
AVT II Early	:	Co 12008, Co 12009, Co 12012, Co 12019, CoM 12085 and CoVSI 12121
AVT - Ratoon	:	Co 12009, Co 12012, Co 12019 and CoM 12085

PP 22: SURVEY OF SUGARCANE DISEASES NATURALLY OCCURRING IN THE AREA ON IMPORTANT VARIETIES

Objectives : To gather information on the diseases naturally occurring in the area on varieties to compile all India status report yearly.

Location : Lucknow, Karnal (SBI), Uchani, Pantnagar, Shahjahanpur, Kapurthala, Pusa, Seorahi, Buralikson, Anakapalle, Cuddalore, Nayagarh, Coimbatore, Padegaon, Tiruvalla, Navsari, Pune, Sankeshwar, Kolhapur and Akola.

Year of Start : 1989-1990

Observations : Periodic observations in June, September and December in all locations to gather information on the %incidence of diseases on all varieties of the area (General survey).

RESULTS

NORTH WEST ZONE

1. LUCKNOW

Incidence of red rot was found associated in the varieties *viz.*, Co 0238, CoSe 95422, CoJ 64, CoS 8436, CoS 88230, CoS 95255, CoSe 01424 and CoS 91269. Variety Co 0238 was noticed with red rot infection at most of the location of Uttar Pradesh to the tune of 10% to 55%. In general, incidence of red rot was low on the other varieties. Whereas in some fields of CoSe 95422, CoS 8436, and CoSe 92423 the red rot incidence was also recorded up to 25%. Incidence of smut was observed in CoSe 92423, CoS 88230, CoS 91269 and Co 0238. Incidence GSD was noticed in CoS 91269 (20-30%). The incidence of the minor disease Pokkah boeng was higher up to the 25% in the variety Co 0238.

2. KAPURTHALA

Red rot was observed with an incidence from traces to 10% on varieties Co 89003, CoJ 64 and CoJ 85. Wilt incidence of traces to 6.0 per cent was observed on Co 89003 and CoS 8436. Smut incidence was observed on varieties Co 0238, Co 89003 and CoJ 88from traces to 16%. Pokkah boeng disease was observed on varieties Co 0238 and CoPb 91 (traces to 25%). Red stripe/top rot disease was observed in traces on CoJ 85 and GSD was observed with an incidence of traces to 4% on Co 0238.

3. UCHANI

Red rot was observed on plant and ratoon crop of varieties like Co 89003, CoJ 85 and CoS 8436 ranging from 2 to 17 per cent. Top rot was also observed on Co 0238, CoJ 85 and CoH 119 ranging from 2 to 40 per cent. Wilt was noticed in Co 89003, Co 05011, CoS 8436 and CoH 119 ranging from 5 to 25 per cent. Wilt in association with root borer and red rot was also noticed in Co 89003. Severe incidences of smut ranging from 5-40 percent recorded in Co 89003, Co 0118, Co 0238, Co 05011, CoH 119 and CoH 160. Grassy shoot disease was observed in Co 89003, Co 0118, Co 0238, CoH 119, CoH 160, CoS 767 and CoS 8436. Pokkha boeng appeared on varieties Co 89003, Co 0118, Co 0238, Co 05011, CoH 119, CoH 160, CoJ 85 and CoS 8436 ranging from traces - 40 percent. Yellow leaf disease (YL) was noticed in traces- 10 % on varieties viz., Co 89003, Co 0238, Co 05011, CoH 119, CoH 160 and CoS 8436 incidence of mosaic in traces was observed in Co 89003, Co 0118, CoH 119 and CoS 8436. Incidence of brown spot ranging from 5-45 percent was noticed in Co118, Co 0238, CoH 167 and CoH 160.

4. SHAHJAHANPUR

Incidence of red rot severity varied from traces to 98 percent on Co 0238 and from 5% to 25% on CoJ 88, CoS 97264, CoPant 84211 was observed. Smut was reported on Co 0238, Co 0118, CoJ 88 and CoS 13231. Mixed infection of red rot and wilt also noticed from 5-50 percent on the variety Co 0238. Grassy shoot disease was observed on Co 0238, Co 0118, Co 98014, CoS 08279, UP 05125 and CoLk 94184 ranging from trace to 50 percent. The incidence of pokkah boeng varied from trace to 50 percent on Co 0238, Co 0118, CoS 08272, CoS 8436, CoS 08279, CoLk 94184, CoS 97264, UP 05125 and CoJ 88. YL was noticed on CoS 09232, Co 0238 and CoS 08272 ranging from 10 to 30 per cent. Sugarcane mosaic, top rot, leaf binding diseases and leaf scald were also noticed on various varieties.

5. PANTNAGAR

Red rot was observed in the variety CoS 8436 and smut icidence upto 30% was observed in Co 0238 and CoPant 99214. Low incidence of wilt was observed in CoS 8436 and CoJ 85.Low incidence of GSD seen in Co 0118, Co 0238, CoPant 5224, CoPant 03220, CoSe 1434 and CoS 88230. YL wasseen in some pockets in CoPant 3220, CoPant 84212, CoPant 5224, CoS 767 and CoPanrt 90223. Ring spots and eye spots were seen on CoPant 99214, CoJ 85 and CoS 7250. The cultivars viz., Co 0238, Co 0239 and CoPant 03220 were found infected with PB.

6. KARNAL

Red rot was noticed in the variety CoS 8436 and CoJ 88. Smutincidence was observed in traces to 5% in Co 89003, Co 0238, Co 05011, Co 89003, CoH 160, CoH 160, Co 89003. Pokkah boeng was prevailing in most of the cultivated varieties in the zone with trace to 17.5% incidence. Top rot was noticed in the varieties Co 89003, Co 0238, CoH 160, CoH 167, CoJ 85 and CoS 8436. Trace

of GSD was recorded in varieties CoJ 88 and Co 0238 and wilt on variety Co 89003. Incidence of *Sugarcane bacilliform virus* was also found (5%) on variety Co 89003.

NORTH CENTRAL ZONE

1. PUSA

Red rot (2%) incidence was observed on Co 0235 and wilt incidence was noticed in all most all sugarcane growing areas of Bihar ranging from 5-20% on BO 141, Co 0118, Co 0233, Co 0235, Co 0238, Co 03234 and CoPant 97222. Varieties Co 0233, Co 0238, Co 03234, CoP 2061 and CoV 92102 were found affected with smut ranging from (trace to 2%). Pokkah boeng disease was observed on varieties BO 153, BO 154, Co 0118, Co 0233, Co 0238 and Co 03234 ranged between (2-5%). Yellow leaf disease was noticed on Co 0233, Co 0238, CoPant 97222 and CoV 92102 ranging from traces to 2% while, single variety CoLk 94184 was affected with ratoon stunting disease in traces.

2. SEORAHI

Red rot was recorded with 20 to70 % incidence in Co 0238 and 1 to 10% incidence in varieties CoSe 92423 and UP 9530. Wilt was observed in the varieties Co 0238 (40%), CoP 9301 (35%) and CoS 08272 (10%) and 1 to 6 per cent incidence in Co 0233, Co 0238, CoP 9301 and CoPb 05191. The incidence of smut varied from 1 to 6% in various varieties such as Co 0118, Co 0238, CoLk 94184, CoS 08279, CoSe 08452, CoSe 01434, CoSe 11453 and CoSe 92423. GSD was noticed with 1 to 6 per cent incidence in Co 0118, Co 0238, CoS 08279, CoSe 01424, CoSe 08452, CoSe 11453, CoLk 94184 and CoS 08272. The incidence of pokkah boeng disease varied from 1 to 10 per cent in cultivars Co 0118, Co 0238, CoLk 94184, CoS 08279, CoSe 01434, CoSe 11453 and CoSe 08452. Stinking rot was recorded in varieties Co 0238 and CoS 08279 and ratoon stunting disease (1 to 3%) was found in CoS 08279 and Co 0238. YL incidence was recorded up to 2 -10 per cent in Co 0118, CoLk 15469, CoLk 15467, CoP 14439 CoP 06436, CoSe 14454, and UP 05125. In the experimental trial at Seorahi stray incidence of mosaic was noticed in genotypes CoP 13437, CoP 14430, CoP 15440, CoSe 01421, CoSe 13451, CoSe 13452 and CoSe 15453.

3. MOTIPUR

The incidence of red rot was recorded in the varieties namely Bo 130, Co 0238, CoP 06436 and CoSe 95422 to the tune of 3-12 %. Variety Co 0238 was recordedwith red rot infection to the tune of 5 % to 20 %. Yellow Leaf Disease was noticed in the varieties viz., BO 130, Co 0118, Co 0238, CoLk 94184 and CoP 06436. Pokkah boeng was observed in varieties viz., BO 130, BO 154, Co 0118, Co 0238, Co 0239, CoLk 94184, CoP 112, CoP 06436, CoP 9301 and CoSe 95422. The incidence of Pokkah boeng was found increased in the variety Co 0238 (15-30%).

NORTH EASTERN ZONE

BURALIKSON

Red rot was observed upto 4.76-10.53% in Co 740 and Co 997 and wilt was observed in plant as well as ratoon crop ranging from 2.12 to 19.42. Wilt in association with red rot and borer was also observed in Co 740. It was also observed that foliar disease like ring spot was common in all the cane growing areas irrespective of cultivars. The incidence of pokkah boeng varied from traces to 13.15% in many popular varieties of sugarcane. YL infection seems to be increasing as compared to last year,

EAST COAST ZONE

1. ANAKAPALLE

Red rot incidence was observed in areas where the susceptible varieties like 93V 297, 81V 48, 99A 53 and Co 62175 are being cultivated. Smut incidence (2-20%) was observed in almost all the areas surveyed in Andhra Pradesh in the variety CoA 9208. Yellow leaf disease incidence of 5 to 60% incidence was observed in Visakhapatnam, East Godavari and Chittoor districts. The incidence of YL was found to be higher in areas where the ratoon crops of the varieties, CoV 09356, CoA 92081 and Co 86032. Grassy shoot disease incidence ranging from 1-10% was observed in the varieties, CoA 14321, CoV 09356, Co 86032 and 2003T 121.

2. CUDDALORE

The incidence of red rot in varieties *viz.,* Co 86032, CoC 24, CoM 0265 and CoV 09356 and the disease severity ranged from 2 to 28 %. Smut disease was recorded in the varieties Co 86032, CoC 22, CoC 25 and TNAU Si 8 and the disease severity ranged between 2 and 14 %. Wilt was observed in Co 86032 and CoV 09356 with disease severity between 4 and 12 %. Yellow leaf disease was noticed in Co 86032, PI 1401, PI 1110, CoC 24 and CoV 09356 (5 to 25 %). Grassy shoot diseases incidence was noticed in traces.

PENINSULAR ZONE

1. PUNE

The incidence of smut has been increased in Central Maharashtra and Marathwada during last year due to drought. The incidence was more in ratoon crops of Co 86032. The incidence of grassy shoot is increasing in all commercially cultivated varieties. The incidence is more in ratoon crops of Co 419, Co 86032 and CoM 0265. The incidence of foliar diseases on sugarcane crop *viz.,* rust, Pokkah boeng, yellow leaf, brown spot and eye spot was common. Rust was severe in Western Maharashtra than other areas. The incidence of brown spot was severe in western part of the state. The incidence of yellow leaf disease in sugarcane was noted on Co 86032, CoM 0265 and VSI 08005 up to 20%. The incidence of eye spot and

pineapple was observed in sugarcane crop. Pineapple was observed in heavily irrigated sugarcane plots. The practice of settling transplanting is increasing and therefore the disease incidence is reduced.

2. NAVSARI

Wilt, red rot and whip smut were the major diseases in South Gujarat region. The incidence of whip smut was recorded on varieties like Co 86002, Co 97009, Co 99004 and CoM 0265 and CoSi 95071. The wilt incidence noticed in Co 86002, Co 86032, CoC 671, CoM 0265, CoSi 95071 and MS 10001 varieties. The red rot was recorded in the varieties of Co 86002, Co 86032, Co 97009, Co 0323 and CoC 671. Highest wilt and red rot incidence was noticed in variety CoC 671 and minimum in Co 86032. In addition to these diseases, the incidence of Pokkhah boeng was observed in Co 99004 and CoM 0265. Grassy shoot was observed on Co 86032, CoC 671 and CoM 0265. Yellow leaf disease was noticed on Co 86002, Co 86032 and CoC 671.

3. THIRUVALLA

The foliar diseases *viz*., ring spot, rust and sheath blight were very common but they were not found in such a severe form to cause any drastic yield loss. The other diseases observed were Pokkah Boeng and mosaic. But none of the diseases were in a severe stage to cause any drastic yield decline.

4. COIMBATORE

Extensive damage to sugarcane crop due to red rot was found in the cvCoM 0265 in Thiruvallur district. Frequent infections of sugarcane viruses and GSD-phytoplasmas were found in many nursery plots in Sathyamangalam areas. New red rot infections were found on the varieties CoC 24 from Thandavarayanpattu, Mandagapattu and Nellikuppam, an unknown variety (Erikuppam), Co 06022 (Pennadam), Co 86027 (ACSM), Co 06031 (Mundiampakkam and Perambalur), Co 86032 (Nellikuppam) and C 20141 (Nellikuppam) in Tamil Nadu.

PP 23: ASSESSMENT OF ELITE AND ISH GENOTYPES FOR RESISTANCE TO RED ROT

Objective : To gather information on *Saccharum* sp. and elite genotypes for resistance to red rot, so that the resistant genotypes could be used in breeding programme as possible donor for resistance.

Locations : Kapurthala, Uchani, Karnal, Shahjahanpur, Lucknow, Pusa, Seorahi, Anakapalle, Cuddalore, and Navsari

Plot Size : One, six metre row of at least 10 clumps.

No. of isolates : As indicated in PP 17 experiment.

Method of inoculation : Plug method only.

Inoculum : As per details given under PP 17 (Pathotypes to be inoculated individually only).

Method of evaluation : As per details in PP 17.

RESULTS

NORTH WEST ZONE

1. LUCKNOW

Out of 26 ISH genotypes tested, 7 genotypes namely AS 04-635, BA 1003143, BM 1010168, GU 07-2276, GU 07-3849, SA04-454 and SA 98-13 were rated as R againstboth the pathotypes(CF08 and CF09) by both plug and nodal the methodsof inoculation. Two genotypes BM 1009-163 and PG 9869137 were rated S to both the pathotypes (CF08 and CF09) by both methods. Two genotypes AS 04-245 and GU 073-774 were rated HS against both the pathotypes by plug method and S by nodal method. Four genotypes BM 1022-173, AS 04-1687, CYM-07986 and MA5/51 were rated as MS against both the pathotypes by plug method whereas R by nodal method whereas the other 11 genotypes *viz*.,AS 04-2097, AS 04-1689, BM-1009149, MA 5/5, MA/5/22, MA/5/37, MA 5/99, SA 04-390, SA 04-409, SA 04-472 and SA 04-496 were rated as moderately resistant (MR) to both the pathotypes by plug method and R by nodal method.

2. KAPURTHALA

Twenty-seven ISH genotypes were inoculated by plug method using red rot pathotypes CF08 and CF09. Of the 27 genotypes, none behaved as resistant against any of the pathotypes. Thirteen genotypes were found MR against CF08 and eight against CF09. Three genotypes *viz*., BM 10-22173, SA 04-409 and SA 04-472 and were found MS to both the pathotypes. Genotypes AS 04-635, BM 1003143,MA 5/37 and SA 98-13 behaved as MR to CF08 and MS to CF09 whereas genotypes AS 04-2097, BM 1010168, BM 1009163, MA 5/5 and PG 9869137 and behaved as MS to CF08 and S against CF09 . Three genotypes (AS 04-245, CYM 07-986 and SA 04-458) were HS to both the pathotypes by plug method of inoculation whereas MA 5/22 was S to CF08 and MS to CF09. Eight genotypes namely, AS 04-1689, BM 1005149, GU 07-2276, MA 5/51, MA 5/99, SA 04-390, SA 04-454 and SA 04-496 were found MR against both the pathotypes.

1. UCHANI

Twenty five ISH clones/genotypes were evaluated for resistance to red rot by plug method using pathotype

CF08. Thirteen clones namely, BM-100-3143, BM-1005-149, BM-1022-173, CUM-07-986, GV-07-3849, GV-07-2276, MA-5-22, MA-5-99, SA-04-390, SA-04-409, SA-98-13, SA04-472 and SA04-496 and were found resistant/ moderately resistant whereas, eleven clones viz., AS-04-245, AS-04-635, AS -04-1687, AS -04-1689, AS -04-2097, BM-1009-163, BM-1010-168, GV-07-3734-212, MA-5-5, MA-5-37 and MA-5-51, showed moderately susceptible/ susceptible reaction against red rot pathotype CF08.

2. SHAHJAHANPUR

A total of 23 ISH genotypes were tested for red rot resistance against CF08 and CF09 by plug method of inoculation. Of 23 genotypes, five genotypes namely AS 04-390, BM 1010168, MA 5/99, SA 04-454 and SA 04-496 were identified as MR while SA 98-13 was found R against CF08 and CF09. Two genotypes *viz*; BM 1005149 and GU 07-2276 were behaved as MS to CF08 and MR to CF09. The genotypes AS 04/1687, AS 04/2097, BM 1003143, CYM 07-986, GU 07-3849, MA 5/51 and SA 04-472 behaved as MS to both the pathotypes. Four genotypes AS 04-635, AS 04-1689, PG 9869137 and SA 04-409 and were rated as MR to CF08 and MS to CF09. Two genotypes such as AS 04-245 and GU 07-3774 were behaved as HS against CF08 and CF09 and MA 5/5 as S to CF08. One genotype MA 4/22 was found as MS to CF08 and S to CF09.

3. KARNAL

Twenty seven ISH clones were inoculated with CF08 and CF09 isolates by plug method of inoculation for red rot resistance. Among the test clones, 15 showed R/ MR reaction, two MS and ten S/HS reactions with CF08 isolate, while nine were MR, seven MS and eleven S/HS with CF09 isolate by plug method of inoculation.

NORTH CENTRAL ZONE

1. PUSA

Twenty seven elite and ISH clones were evaluated artificially for resistance to red rot with pathotypesCF07 and CF08 by plug method of inoculation. Out of 27 clones none of the clones were found resistant while, 10 clones (AS 04-390, AS 04-454, AS 04-496, AS 04-1687, AS 04-1689, AS 04-2097, AS 04-98/13, BM-1010168,GU 07/2276 and MB-1005149) were found to be MR. Six clones (AS 04-635, BM 1009163, CYMO 7986, MA 5/22, MB 1022173 and SA 04/ 472) were found as MS to CF07pathotype. However, three clones AS 04-635, AS 04/ 472 and MB 1022173 were observed MS to the pathotype CF08,whereas, 11 clones were found SagainstCF07 and 14 were S to the pathotypeCF08.

2. SEORAHI

Twenty seven ISH genotypes were evaluated against red rot pathotypesCF07 and CF08. Of these, 6 genotypes were rated as MR, 8 genotypes as MS, 5 genotypes as S and 6 genotypes as HS to CF07, while 7 genotypes were rated as MR, 7 genotypes as MS, 4 genotypes as S and 7 genotypes as HS to CF08.

EAST COAST ZONE

1. ANAKAPALLE

Out of 27 ISH genotypes tested by plug method of inoculation, one entry (PG 9869137) showed R reaction while 6 entries, AS 04-2097, GU 07-2276, MA 5/51, MA 5/37, MA 5/99, SA 04-496 and SA 04-454 and showed MR reaction to the pathotype CF06 and remaining were MS to HS.

2. CUDDALORE

Twenty seven elite and ISH clones screened for resistance to red rot disease by plug method of inoculation using CF06 pathotype. Among the clones,Gu 07-2276 recorded resistant reaction. Twelve genotypes *viz*., AS 04-2097, BM 1005149, BM 1010168, Gu 07-3849, MA 5/22, MA 5/37, MA 5/99, PG 9869137, SA 04-390, SA 04-409, SA 04-454 and SA 98-13 were MR to red rot. Six genotypes *viz*., AS 04-635, AS 04-1687, AS 04-1689, CYM 07-986, SA 04-472 and SA 04-496 were MS. Three genotypes *viz*., AS 04-245, BM 1003143 and MA 5/5 showed S reaction and the genotypes BM 1022173, BM 1009163, GU 07-3774, MA 5/51 and SA 04-458, and were found to be HS to red rot.

PENINSULAR ZONE

1. NAVSARI

Of the 30 elite and ISH genotypes, SES 594 and BM 10 1068 gave R reaction. Fifteen genotypes, viz., AS 04-1687, CyM 07 986, GU 07-2276, ISH 58, ISH 100, ISH 111, ISH 114, ISH 115, ISH 117, ISH 118, ISH 147, ISH 267, MA 5/99, MA 5/22 and SA 04-454 showed MR reaction. Six genotypes viz., AS 04-2097, ISH 12, ISH 50, ISH 175, ISH 229 and ISH 287 and showed MS reaction. Four genotypes viz., ISH 41, ISH 69, MA 5/5 and MA 5/51 exhibited S reaction. Whereas, three genotypes viz., ISH 9 and ISH 43 and ISH 176 showed HS reaction by plug method.

2. COIMBATORE

One set of materials were evaluated and new set of materials will be tested in the coming season.

PP 28B : METHODOLOGY FOR SCREENING SUGARCANE GENOTYPES FOR RESISTANCE TO BROWN RUST (*Puccinia melanocephala*)

Objective : To standardize methodology for inoculation of uredospores of brown rust and rating of resistance.

Year of Start : 2013-14

Locations : Pune, Kolhapur, Sankeshwar, Padegaon, and Anakapalle

1. Inoculation methodology

(i) Clip inoculation in leaf whorl

As soon as brown rust appears in field, select rust affected leaves, cut leaf bits (clips) measuring 8-10 cm. Select ten rust-free plants of the same susceptible variety in a different location. In three shoots of each plant (clump), insert 2-3 clips in the leaf whorl of each shoot.

(ii) Leaf whorl inoculation

As soon as brown rust appears in field, collect rust affected leaves. Make a suspension of uredospores in sterilized distilled water (10^4-10^5 spores/ml). Pour 1 ml freshly prepared uredospores suspension in each leaf whorl. Inoculate in 10 clumps (three shoots per clump) of same susceptible variety.

In the aforementioned two methods, plants to be inoculated may be marked by cutting one-third of the tips of the uppermost leaves so that they can easily be identified during recording observations.

Observations : After 4 weeks, record symptoms on leaves by counting –

(i) Average number of rust pustules per square inch.

(ii) Number of leaves bearing rust pustules.

(iii) Rating of resistance: To be taken up after standardization of inoculation method

RESULTS

PUNE

The number of pustules on leaves was recorded after one month of inoculation. It was observed that leaf whorl inoculation method was superior to clip inoculation method. Numberof rust pustules was higher (21.60/sq.inch) under leaf whorl method whereas in clip inoculation method, the average numbers of rust pustules per square inch were 11.30.

PP 31: SCREENING, EPIDEMIOLOGY AND MANAGEMENT OF POKKAH BOENG IN SUGARCANE

Objectives : To study the development of pokkah boeng disease in relation to weather parameters and its management in sugarcane crop.

Location : Kapurthala, Uchani, Shahjahanpur, PUSA, Seorahi, Anakapalle, Pune and Akola

Year of Start : 2011-2012

Observations to be recorded: Screening the desirable varieties for the incidence of pokkah boeng, correlation of climatic factors in relation to disease development and management of pokkah boeng under field conditions if the disease reaches acute phases.

(i) Screening:

Symptoms to be observed:

Mild -Green plants with pokkah boeng (curling/twisting of spindle leaves, twisting of leaves, whitish/chlorotic streaks on the leaves) at varying intensities.

Moderate -Yellowing of 3rd/4th leaf followed by complete yellowing of foliage and expression of top rot symptom

Severe -Yellowing of leaves + Discoloration (Light colored) of silk + wilting symptom in opened.

Observe for the presence of above symptoms and grade it as given below :

Varieties	% Infected Plants				Disease reaction
	Mild	Moderate	Severe	Total incidence	
VI					
V2					
V3					

* No restriction on number of varieties to be studied

Disease Reaction:

0-5% - Resistant; >5-10% - Moderately Susceptible; 10-20% - Susceptible;

20% - Highly Susceptible

(ii) Epidemiology

Record temperature, relative humidity and rainfall from May to September and establish correlation with disease incidence

(iii) Management – (To be taken up during second year of the Project)

Varieties: Two susceptible varieties

Treatments:

T-1 Sett treatment – Overnight soaking with Carbendazim – 0.1% a.i.

T-2 Foliar spray – Carbendazim – 0.05% a.i. (3 sprays at 15 days interval from May 15th)

T-3 – Sett treatment (T1) +Foliar spray with carbendazim (T2)

T-4 Control

Replications: 4

Observations: Record disease incidence of pokkah boeng displaying symptoms of top rot or wilt or both and present the date in a tabular form.

RESULTS

I. SCREENING FOR POKKAH BOENG RESISTANCE

KAPURTHALA

Out of 39 entries screened, 12 were MS and 4 were S and remaining showed resistance to PB. However, both the check varieties Co 0238 and CoJ 85 behaved as HS.

UCHANI

Sixty eightvarieties of sugarcane were screened against PB disease under natural conditions.Forty seven varieties included in ZVT and ISH/ IGHgenotypes viz., AS-04-1687, AS-04-1689, AS-04-2097, AS-04-245, AS-04-635, BM-100-3143, BM-1005-149 , BM-1009-163, BM-1010-168, Co 05011, Co 13035, Co 14034, Co 14035, Co 15023, CoH 13263, CoH 14261, CoLk 14201, CoLk 14203, CoLk 14204, CoLk 15024, CoLk 15201, CoLk 15203, CoLk 15204, CoLk 15205 , CoLk 15206, CoLk 15207, CoLk 15209, CoPant 97222, CoPb 13181, CoPb 13182, CoPb 14181, CoPb 14184, CoPb 14185, CoPb14211, CoPb 15211, CoPb 15212, CoPb 15213, CoPb 15214, CoS 767, CoS 14233, CoS 15232, GV-07-2276, GV-07-3734-212, GV-07-3849, MA-5-22, MA-5-51, SA-04-390 and SA-98-13 were found resistant to PB (0-4.76%).Ten varieties namely, Co 13034, CoLk 13204,CoLk 15027, CoLk 15208, CoPant 13224, CoS13231, CoS 15233, CoS 15234and MA-5-99 showed MS reaction(5.26-7.89 %) to PB.Six genotypes viz.,Co 05009, Co 15026, CoJ 64, CoS 8436, MA-5-5 and MA-5-37 exhibited S reaction (10.52-19.56%) to PB. However, five genotypes viz,. BM-1022-173, Co 0238, CoS 15231, SA04-472 and SA04-496 showed HS reaction (20.93-47.3%) against PB.

SHAHJAHANPUR

Eight out of 18 genotypes/varieties behaved as R whereas, six genotypes/varieties were MS. Four genotypes/varieties *viz*; 4619/07, Co 0238, CoS 8436 and CoSe 15455 and were susceptible to PB.

PUSA

Out of 24 varieties, 13 (BO 91, BO 153, CoP 151, CoP 153, CoP 155, CoP 2061, CoP 9301, CoP 11438, CoP 12436, CoP 12438, CoP 13439, CoP 16437and CoSe 13452) showed R reactions, whereas 10 varieties (BO 139, BO 156, CoBln 14502, CoLk 12207, CoP 154, CoP 11437, CoSe 12451, CoP 13437, CoSe 13453 andCoP 16440 and the check (CoSe 95422) showed MS reaction against PB.

SEORAHI

Out of 18 varieties, 11 showed resistant (R), 5 moderately susceptible (MS) and two showed susceptible (S) behavior to PB.

ANAKAPALLE

Out of 33 genotypes screened against top rot disease under natural conditions, only one genotype CoC 14336was rated as resistant. Six genotypes (Co 01061, CoA 92081, CoA 14321, CoC 16338, CoC 16339 and CoV 16357) recorded MS reaction. The remaining entries were found to be susceptible to highly susceptible.

PUNE

Out of the 14 genotypes, CoVSI 03102 was observed free from the disease, while remaining 13 varieties *viz.*, 14-22, 59-20, 191-3, Co419, Co 86032, Co94012, CoC 671, CoM 0265, CoM 9057, CoVSI 9805, MS 10001, VSI 434, and VSI 08005 were found S. Maximum disease incidence was noted in CoVSI 9805 (24.33%) and Co 94012 (18.89%).

II. EPIDEMIOLOGY

KAPURTHALA

The incidence of the disease initiated from 1st fortnight of June and gradually increased till September. The average maximum temperature of 34.94°C (32.83-38.23°C), average minimum temperature 25.95°C (22.53-27.13°C), average relative humidity 70.08 per cent (54.6-77.64%) and higher total rainfall of 424 mm, respectively were recorded from June to September. The severe incidence of the disease was observed in the months from July to September due to high rainfall, relative humidity and temperature. Higher relative humidity and rainfall favoured the growth and development of pathogen.

UCHANI

Pokkah boeng incidence was found highest in February - March sowing. The average maximum temperature 33.6°C (29.6-38.9°C) and minimum 25.3°C (21.6-26.9°C), average relative humidity morning 85.4 per cent (58.0-95.6) and evening 64.9 per cent (30.1-83.3) and with total rainfall 178.9 mm (av. 9.9mm) were recorded from June-

September (22- 39 met. week). Pokkah boeng incidence starts increasing during rainfall with high humidity conditions. Popular varieties viz., CoS 0238 (27.8 %), CoS 8436 (19 7 %), CoJ 64(19.6 %) and CoH 119 (8.0 %) exhibited b severe disease incidences during June-September, 2018.

SHAHJAHANPUR

Pokkah boeng incidence appeared during Ist fortnight of June and gradually increased till July to September due to high rainfall and humidity. Rainfall in July, August and September were recorded 612.8 mm, 324.4 mm and 102.6 mm, respectively. Similarly maximum relative humidity was recorded up to 83%, 87% and 81% and maximum temperature also recorded as 33.2^{0}C, 31.8^{0}C and 32.5^{0}C in aforesaid months, respectively. Temperature, rainfall and relative humidity played a major role in the incidence and spreading of Pokkah boeng disease.

PUSA

The disease appeared in the last week of May and remains till 1st week of September. The maximum incidence was observed during 2nd week of June to last week of July and gradually decreased. The minimum and maximum temperature ranged between 23.9 to 34.7°C, relative humidity 64.7 to 90.5% and rainfall 43.8 to 432.6 mm, respectively were recorded from May to September. Humidity and rainfall play an important role in PB incidence.

SEORAHI

It was noticed that temperature (26 to 31°C), relative humidity (70- 90%) and rainfall (240- 398 mm) during the year favored disease development. The disease incidence was found maximum in first week of July which gradually increased till last week of August. Maximum rainfall and high humidity favored the development of PB. The reduction in disease incidence was observed from the second week of July.

ANAKAPALLE

Pokkah boeng disease was initiated in sugarcane cultivar, 2003A 255 Simhadri during the second fortnight of May and high incidence was recorded in the months of June, July and August. The disease incidence gradually reduced by the end of September, 2018. The disease incidence was found to be highly influenced by minimum temperature followed by number of rainy days. As the minimum temperature reduced from the first fortnight of October, the disease also reduced. It was observed that PB incidence started from 65 days after planting and persisted upto 200 days. However, high incidence of the disease was observed from first fortnight of June to second fortnight of July which was found to be influenced by minimum temperatures and number of rainy days.

III. POKKAH BOENG MANAGEMENT

KAPURTHALA

The efficacy of Carbendazim fungicide for management of PB was tested on two susceptible varieties *viz*., Co 0238 and CoJ 85. The results revealed that fungicide Carbendazim was significantly better than control. Overnight soaking along with foliar spray at 15 days interval starting from May 15th was the most effective in checking the disease which gave higher germination and low disease incidence of 10.0 and 8.75 per cent in Co 0238 and CoJ 85 in comparison to other treatments.

UCHANI

Overnight cane soaking with Carbendazim 0.1% and foliar sprays with Carbendazim was found most effective in checking the the PB which gave lowest disease incidence of 6.4 per cent and 4.8 per cent in Co 0238 and CoS 8436, respectively and also increased per cent germination.

PUSA

Sett treatment with Carbendazim @ 0.1% followed by foliar spraying (Carbendazim 0.1%) three sprays at 15 days interval resulted in low disease of 5.0% compared to 20.3% PB in control. Sett treatment with Carbendazim @ 0.1% alone resulted in 11.3% PB disease incidence.

ANAKAPALLE

Sett treatment with Carbendazim @ 0.1% followed by foliar spraying of Carbendazim -0.05% recorded low (9.71%) top rot incidence compared to control which was on par with foliar spray with Carbendazim @ 0.05%.

PUNE

Both the fungicides *viz*., Carbendazim and Mancozeb are found effective to control PB effectively, when these two fungicides are sprayed thrice after 15thMay onwards. However, Mancozeb found more effective than the Carbendazim. The maximum disease control (77.05 %) was obtained by 3 foliar sprays of Mancozeb @ 0.3% at an interval 15 days from 15th May onward. However, Sett treatment with Carbendazim @ 0.1% and foliar spraying (Carbendazim 0.1%) three sprays at 15 days interval was also effective.

PP 33: MANAGEMENT OF YELLOW LEAF THROUGH MERISTEM CULTURE

RESULTS

ANAKAPALLE

Tissue culture plantlets of sugarcane cultivars, CoA 92081 and CoV 09356 were raised and transplanted under field conditions in the months of April and June, 2018. Yellow leaf incidence was not observed in breeder seed crop of CoA 92081. However, 1-5% incidence of YL was recorded

in the foundation seed crop of the variety, CoV 09356 planted in June, 2018 which was adjacent to the field with 50 per cent YL incidence. This may be attributed to the high amount of ScYLV inoculum adjacent to the transplanted field and prevalence of viruliferous aphids in the early stages of crop growth.Virus indexing of tissue culture plantlets of sugarcane through RT-PCR revealed the absence of ScYLV in tissue culture plantlets of sugarcane cultivars, CoA 92081 and CoV 09356 obtained from tissue culture lab, RARS, Anakapalle.

COIMBATORE

A field trial was conducted with healthy and disease-affected planting materials of three popular cvs Co 86032, Co 0238 and Co 11015 and assessed impact of YLD on cane growth and yield under field conditions. In all the three varieties virus-infected materials exhibited a poor crop stand. The diseased crops were found to have poor vigour and lacked uniform crop stand as that of virus-free plants. In all the three varieties, virus-infected canes recorded significantly lesser cane and juice yield than the healthy ones.

PUNE

The tissue culture plantlets of Co 86032 and VSI 08005 were produced and properly hardened TC plantlets were transplanted in the field for the production of breeder seed and observed throughout the year for the incidence of YL. During the production of breeder seed, the crop remained free from YL. The sugarcane setts obtained from breeder seed plot were planted for production of foundation seed in the field. The ratoon of the breeder crop was also maintained and is under inspection for the disease occurrence.

Table 1: Reaction of Zonal Varietal Trials entries for red rot, smut and wilt (North West Zone-I)

Sl. No.	Genotype	Red rot													Smut		Wilt		YLD	
		Lucknow				Kapurthala				Uchani										
		Plug Method		Nodal Method		Plug Method		Nodal Method		Plug Method		Nodal Method								
		CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	YLD	Lucknow	Kapurthala	Lucknow	Kapurthala	Lucknow	Kapurthala
Initial Varietal Trial (Early)																				
1.	Co 15023	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	S	R	MR	S	R	-	R
2.	Co 15024	MS	MS	S	S	MR	MR	R	R	MR	MR	R	R	MR	R	MR	-	MR	-	R
3.	Co 15027	R	R	R	R	MR	MR	R	R	MR	MR	R	R	MR	S	R	-	R	-	MR
4.	CoLk 15201	MR	MR	R	R	MR	MR	R	R	MR	MS	R	R	MS	HS	MR	-	R	-	R
5.	CoLk15203	MR	MR	R	R	HS	S	S	S	S	S	S	S	MS	MR	MS	-	R	-	R
6.	CoLk15204	MR	MR	R	R	MS	MR	R	R	MR	MR	R	R	MS	HS	MS	-	R	-	R
7.	CoLk 15205	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	MS	MR	MR	-	R	-	MS
8.	CoPb 15211	MS	S	R	S	MR	MR	R	R	MR	MR	R	R	MR	MS	MR	S	R	-	R
9.	CoPb 15212	MR	MR	R	R	MR	MS	R	R	MS	MS	R	R	MR	S	MR	-	R	-	MR
Advanced Varietal Trial (Early)-I Plant																				
1.	Co 14034	MR	MR	R	R	MS	MS	R	R	MR	MR	R	R	MS	MR	MS	S	MS	S	R
2.	CoLk 14201	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	MR	MS	MR	-	R	-	MR
3.	CoPb14181	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	MS	S	MS	-	MR	-	MR
4.	CoPb14211	MR	MR	R	R	MR	MR	R	R	MS	MS	R	R	MS	MS	MR	-	MS	-	R
Advanced Varietal Trial (Early)-II Plant																				
1.	Co 13034	MR	MR	R	R	MS	MS	R	R	MR	MR	R	R	S	R	MS	-	MR	-	R
2.	CoPb 13181	MR	MR	R	R	MS	MS	R	R	MS	MS	R	R	MS	R	MR	-	R	-	MR
3.	CoS 13231	R	R	R	R	MR	MR	R	R	MR	MR	R	R	MS	MS	MR	S	MR	-	R
Initial Varietal Trial (Midlate)																				
1.	Co 15026	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	MR	HS	MS	S	R	-	R
2.	CoLk 15206	MR	MR	R	R	MR	MR	R	R	MR	R	R	R	R	R	MR	-	R	-	R
3.	CoLk 15207	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	R	S	R	-	R	-	R
4.	CoLk 15208	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	MS	R	S	-	R	-	MR
5.	CoLk 15209	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	R	S	MS	-	R	-	R
6.	CoPb 15213	MR	MR	R	R	MR	MR	R	R	MS	MR	R	R	S	R	MR	S	R	S	R
7.	CoPb 15214	MS	MS	R	R	MS	MS	R	R	S	S	S	S	MS	R	MR	S	MR	-	MR
8.	CoS 15231	MS	MS	R	R	MS	MS	R	R	MS	MS	S	S	S	R	MR	S	R	-	R
9.	CoS 15232	MR	MS	R	R	MR	MR	R	R	MR	MR	R	R	MS	MS	MR	-	R	-	R
10.	CoS 15233	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	MR	MS	MR	-	R	-	MR
11.	CoS 15234	MR	MR	R	R	MR	MR	R	R	MR	R	R	R	MR	R	MR	-	R	-	R
Advanced Varietal Trial (Mid late)-I Plant																				
1.	Co 14035	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	MS	R	MR	-	MR	-	MR
2.	CoH 14261	MR	MR	R	R	MR	MR	R	R	R	MR	R	R	MR	MR	R	-	R	S	R

Sl. No.	Genotype	Red rot													Smut		Wilt		YLD	
		Lucknow				Kapurthala				Uchani										
		Plug Method		Nodal Method		Plug Method		Nodal Method		Plug Method		Nodal Method								
		CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	YLD	Lucknow	Kapurthala	Lucknow	Kapurthala	Lucknow	Kapurthala
3.	CoLk 14203	R	R	R	R	MR	MR	R	R	MR	MS	R	R	MS	MS	S	-	S	-	S
4.	CoLk 14204	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	S	S	MR	-	MR	-	MR
5.	CoPb 14184	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	MR	S	MR	-	MR	-	MR
6.	CoPb 14185	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	MR	MS	MR	S	MR	-	MR
7.	CoS 14233	MR	MR	R	R	S	MS	R	R	MR	MR	R	R	MR	S	MR	S	MR	-	MR
Advanced Varietal Trial (Mid late)-II Plant																				
1.	Co 13035	MR	MR	R	R	S	MS	R	R	MR	MR	R	R	MS	MS	MS	-	MR	-	MR
2.	CoH 13263	MR	MR	R	R	S	S	R	R	MR	MR	R	R	R	R	MR	-	MS	-	R
3.	CoPant 13224	MR	MR	R	R	MR	MR	R	R	MS	MS	R	R	MS	MS	MR	-	MR	-	R
4.	CoPb 13182	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	MS	MR	MS	-	MR	S	R
5.	CoLk 13204	MR	MR	R	R	MS	MS	R	R	MS	MS	R	R	MS	MR	S	-	MR	-	MR
Check																				
1	CoJ 64	HS	S	-	-	HS	HS	S	S	HS	S	S	S	MS	MR	S	-	-	-	-
2	CoS 767	MS	S	-	-	HS	HS	S	S	S	MS	S	S	HS	R	S	-	-	-	-
3	Co 1158	-	-	-	-	-	-	-	-	-	-	-	-	-	S	HS	-	-	-	-
4	CoLk 7701	-	-	-	-	-	-	-	-	-	-	-	-	-	S	-	-	-	-	-
5	Co 0238	-	-	-	-	MR	MR	R	R	MR	MR	R	R	S	-	S	-	-	-	-
6	Co 05009	-	-	-	-	MR	MR	R	R	MR	MR	R	R	S	-	MR	-	-	-	-
7	CoS 8436	-	-	-	-	MR	MR	R	R	MR	MR	R	R	S	-	-	-	-	-	-
8	CoPant97222	-	-	-	-	S	S	S	S	S	MS	S	S	HS	-	MS	-	-	-	-
9	Co 05011	-	-	-	-	MR	MR	R	R	MR	MR	R	R	MS	-	MR	-	-	-	-
10	Co 7915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MR	-	-	-	-
11	Co 62175	-	-	-	-	-	-	-	-	-	-	-	-	-	-	HS	-	-	-	-
12	NCO 310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	HS	-	-	-	-
13	Katha	-	-	-	-	-	-	-	-	-	-	-	-	-	-	HS	-	-	-	-
14	Co 7717	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	HS	-	-
15	Co 89003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	HS	-	-

Table 2: Reaction of Zonal Varietal Trial entries for red rot, smut and wilt (North West Zone-II)

Sl. No.	Genotype	Red rot													Smut		YL	
		Shahjahanpur				Pantnagar				Karnal								
		Plug Method		Nodal Method		Plug Method		Nodal Method		Plug Method		Nodal Method						
		CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	YLD	Shahjahanpur	Pantnagar	Shahjahanpur	Pantnagar
AVT Early (I Plant)																		
1	Co 14034	MS	MS	R	S	MS	MS	R	R	MR	MR	R	R	R	MS	S	R	R
2	CoLk 14201	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	MR	MR	MR	MR	S
3	CoLk 14202	-	-	-	-	-	-	-	-	MR	MR	R	R	MR	-	-	-	-
4	CoPant 14222	-	-	-	-	-	-	-	-	MR	MR	R	R	R	-	-	-	-
5	CoPb 14181	MR	MR	R	R	MR	MS	R	R	MR	MR	R	R	R	MR	S	R	R
6	CoPb 14182	-	-	-	-	-	-	-	-	MR	MR	R	R	R	-	-	-	-
7	CoPb 14211	MS	MS	R	R	MS	S	R	S	MS	MS	R	R	R	MR	MS	R	R
AVT Early (II Plant)																		
1	Co 13034	MR	MS	R	R	MS	S	R	R	R	R	R	R	R	R	R	R	R
2	CoPb 13181	S	S	S	R	S	S	R	S	S	MS	R	R	MS	R	R	R	R
3	CoS 13231	MR	MR	R	R	NP	NP	NP	NP	MR	MR	R	R	MS	S	NP	R	NP
4	Co 12026	-	-	-	-	-	-	-	-	MR	MR	R	R	MR	-	-	-	-
5	Co 12027	-	-	-	-	-	-	-	-	MR	R	R	R	MR	-	-	-	-
6	CoLk 12203	-	-	-	-	-	-	-	-	MS	MR	R	R	MR	-	-	-	-
7	CoPant 12221	-	-	-	-	-	-	-	-	MS	MR	R	R	MR	-	-	-	-
AVT Mid late (I Plant)																		
1	Co 14035	MR	MR	R	R	MR	MR	R	R	R	MR	R	R	MR	MS	S	R	R
2	CoH 14261	MR	MR	R	R	NP	NP	NP	NP	R	MR	R	R	MR	MR	NP	R	NP
3	CoH 14262	-	-	-	-	-	-	-	-	R	R	R	R	MR	-	-	-	-
4	CoPb 14183	-	-	-	-	-	-	-	-	MS	MS	R	R	R	-	-	-	-
5	CoPb 14184	R	R	R	R	MR	MR	R	R	MR	R	R	R	R	MS	S	MR	R
6	CoPb 14185	MR	MR	R	R	MR	MS	R	R	MR	R	R	R	R	MR	R	R	MS
7	CoPb 14212	-	-	-	-	-	-	-	-	MR	MR	R	R	R	-	-	-	-
8	CoLk 14203	MR	R	R	R	MR	MR	R	R	R	MR	R	R	MS	MS	S	MR	MR
9	CoLk 14204	R	MR	R	R	MR	MR	R	R	R	MR	R	R	R	R	HS	R	MS
10	CoLk 14205	-	-	-	-	-	-	-	-	MR	MS	R	R	R	-	-	-	-
11	CoS 14231	-	-	-	-	-	-	-	-	R	MR	R	R	MS	-	-	-	-
12	CoS 14232	-	-	-	-	-	-	-	-	R	MR	R	R	R	-	-	-	-
13	CoS 14233	MR	MS	R	R	MR	MR	R	R	MR	MS	R	R	R	MR	R	R	MS
AVT Mid late (II Plant)																		
1	Co 13035	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	MR	MS	R	R	R
2	CoH 13263	HS	HS	S	S	MS	S	R	R	MS	MS	R	R	R	R	MR	R	S
3	CoLk 13204	MS	S	R	S	R	MR	R	R	MS	MS	R	R	MR	MR	MR	R	R

Sl. No.	Genotype	Red rot													Smut		YL	
		Shahjahanpur				Pantnagar				Karnal								
		Plug Method		Nodal Method		Plug Method		Nodal Method		Plug Method		Nodal Method						
		CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	YLD	Shahjahanpur	Pantnagar	Shahjahanpur	Pantnagar
4	CoPant 13224	MR	MS	R	R	MS	MS	R	R	MS	MS	R	R	R	MS	MS	R	R
5	CoPb 13182	MR	MR	R	R	MR	MR	R	R	MR	MR	R	R	R	R	MS	R	MR
6	Co 12029	-	-	-	-	-	-	-	-	MR	MR	R	R	R	-	-	-	-
7	CoH 12263	-	-	-	-	-	-	-	-	MS	MS	R	R	R	-	-	-	-
8	CoLk 12205	-	-	-	-	-	-	-	-	MS	MS	R	R	MR	-	-	-	-
9	CoPant 12226	-	-	-	-	-	-	-	-	MR	MR	R	R	MR	-	-	-	-
10	CoPb 12211	-	-	-	-	-	-	-	-	S	MS	R	R	MR	-	-	-	-
11	CoS 12232	-	-	-	-	-	-	-	-	MR	MR	R	R	MR	-	-	-	-
IVT Early																		
1	Co 15023	R	MR	R	R	MR	MR	R	R	-	-	-	-	-	R	MR	R	R
2	Co 15024	MS	MR	R	R	MR	MR	R	R	-	-	-	-	-	R	R	R	MR
3	Co 15027	-	MR	-	R	MR	MR	R	R	-	-	-	-	-	MS	NP	R	MR
4	CoLk 15201	MR	-	R	-	MS	MS	R	S	-	-	-	-	-	R	MS	R	MR
5	CoLk 15203	-	HS	-	S	S	S	R	R	-	-	-	-	-	MR	R	R	MR
6	CoLk 15204	MR	MR	R	R	MS	S	R	R	-	-	-	-	-	R	S	R	MR
7	CoLk 15205	-	-	-	-	MS	MS	R	R	-	-	-	-	-	R	R	R	R
8	CoPb 15211	MR	-	R	-	MS	MS	R	R	-	-	-	-	-	R	MS	R	R
9	CoPb 15212	S	S	R	S	MS	MS	R	R	-	-	-	-	-	R	R	R	MS
IVT Mid late																		
1	Co 15026	R	R	R	R	MR	MR	R	R	-	-	-	-	-	R	HS	R	MR
2	CoLk 15206	MR	MR	R	R	MR	MR	R	R	-	-	-	-	-	R	MS	R	R
3	CoLk 15207	MR	MR	R	R	MR	MR	R	R	-	-	-	-	-	MS	MS	MR	R
4	CoLk 15208	MR	MR	R	R	NP	NP	NP	NP	-	-	-	-	-	R	MR	R	NP
5	CoLk 15209	MR	MR	R	R	MS	MS	R	R	-	-	-	-	-	MS	MR	R	R
6	CoPb 15213	MR	MR	R	R	MR	MR	R	R	-	-	-	-	-	MS	MR	R	R
7	CoPb 15214	HS	HS	S	S	HS	HS	S	S	-	-	-	-	-	R	R	R	HS
8	CoS 15231	MR	MS	R	R	MR	MR	R	R	-	-	-	-	-	S	NP	MR	S
9	CoS 15232	MR	MR	R	R	MR	MS	R	R	-	-	-	-	-	R	R	R	R
10	CoS 15233	-	-	-	-	R	MR	R	R	-	-	-	-	-	R	MR	R	MR
11	CoS 15234	MR	MR	R	R	MR	MR	R	R	-	-	-	-	-	MS	MS	R	R
Check																		
1	Co 0238	MR	MR	R	R	MS	MS	R	R	MR	R	R	R	MR	R	S	R	R
2	Co 05009	MR	-	R	-	MR	MR	R	R	-	-	-	-	-	R	MS	R	MS
3	CoJ 64	HS	HS	S	S	S	S	R	S	S	S	S	S	S	R	MS	R	R
4	Co 1158	-	-	-	-	-	-	-	-	-	-	-	-	-	HS	S	-	-

Sl. No.	Genotype	Red rot													Smut		YL	
		Shahjahanpur				Pantnagar				Karnal								
		Plug Method		Nodal Method		Plug Method		Nodal Method		Plug Method		Nodal Method						
		CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	CF08	CF09	YLD	Shahjahanpur	Pantnagar	Shahjahanpur	Pantnagar
5	CoS 767	HS	HS	S	S	S	S	S	R	S	S	S	R	S	R	S	R	MR
6	CoS 8436	MR	R	R	R	MS	MS	S	R	MR	MR	R	R	MS	R	HS	R	MS
7	CoPant 97222	-	-	-	-	MR	MR	R	R	MS	MS	R	R	MR	R	MS	R	R
8	Co 05011	MR	MR	R	R	MR	MS	R	R	-	-	-	-	-	R	R	R	S
9	Co1148	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	-	-
10	CoPant 84211	-	-	-	-	-	-	-	-	MS	MS	R	R	S				

Table 3: Reaction of Zonal Varietal Trials entries for red rot, smut and wilt (North Central & North East Zones)

S. No	Genotypes	Red rot																	Smut		Wilt		YL	
		Motipur				Seorahi				Pusa				Buralikson										
		CF07		CF08		CF07		CF08		CF07		CF08		CF07		CF08								
		Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Motipur	Seorahi	Pusa	Motipur	Pusa	Motipur	Seorahi
IVT (Early)																								
1.	CoBln 15501	MS	R	MR	R	MS	R	MR	R	MR	R	MS	R	MR	R	MS	R	S	S	MR	-	MS	-	MS
2.	CoLk 15466	MR	R	MR	R	MR	R	MR	R	MR	S	MR	S	MR	R	MR	R	R	R	R	-	R	-	MS
3.	CoLk 15467	MR	R	MR	R	MR	R	MR	R	MR	R	MR	R	MR	R	R	R	R	R	R	-	R	-	R
4.	CoP 15436	MR	R	MS	R	MR	R	MS	R	MR	R	MR	R	R	R	MR	R	MS	MS	R	-	R	-	R
5.	CoP 15437	MR	R	MR	R	MR	R	MS	R	MR	R	MR	R	MR	R	MR	R	R	MR	R	-	R	S	MR
6.	CoSe 15451	MR	R	MR	R	MR	R	MR	R	MR	R	MR	R	MR	R	MR	R	R	R	R	-	MR	-	R
7.	CoSe15452	MR	R	MS	R	MR	R	MR	R	MS	R	MS	R	MS	S	MS	R	MR	R	MR	S	MR	-	R
8.	CoSe 15455	MR	R	MR	R	MR	R	MR	R	MR	R	MR	S	MR	S	MS	R	MR	R	MR	-	MR	-	R
9.	CoSe 15456	MR	R	MR	R	MR	R	MR	R	MR	R	MR	R	MR	R	MR	S	MR	R	MR	-	MS	-	R
AVT (Early)-I Plant																								
1.	CoLk 14206	MR	R	MR	R	MR	R	MR	R	-	-	-	-	MR	S	MS	S	R	R	-	-	-	-	R
2.	CoP 14437	MS	R	MR	R	MS	R	MR	R	-	-	-	-	R	R	MR	R	R	S	-	-	-	-	S
3.	CoSe 14451	MR	R	MR	R	MR	R	MR	R	-	-	-	-	MR	S	MS	S	R	MR	-	-	-	-	MR
4.	CoSe14454	R	R	R	R	MR	R	MR	R	-	-	-	-	MS	R	MR	S	MR	R	-	-	-	-	R
AVT (Early)-II Plant																								
1.	CoP 13437	MR	R	MR	R	-	-	-	-	-	-	-	-	MR	R	MR	R	MR	-	-	-	-	-	-
2.	CoSe 13451	MR	R	MR	R	-	-	-	-	-	-	-	-	MR	R	MS	S	MR	-	-	S	-	S	-
3.	CoSe 13452	MR	R	MR	R	-	-	-	-	-	-	-	-	MR	R	MR	R	MR	-	-	-	-	-	-
IVT (Mid late)																								
1.	CoBln 15502	S	S	S	S	HS	S	S	R	MR	R	MR	R	MR	R	MR	S	R	R	R	S	MR	-	R
2.	CoLk 15468	MR	R	MR	R	MR	R	MR	R	MR	S	MR	S	MR	R	MR	R	R	R	R	-	MS	-	R
3.	CoLk 15469	MR	R	MR	R	MS	R	MR	R	MR	R	MR	R	R	R	MR	R	R	MR	MR	-	MR	-	R
4.	CoP 15438	MR	R	MR	R	MR	R	MR	R	MR	R	MR	MR	MR	R	MR	R	R	R	R	-	R	S	R
5.	CoP 15439	MR	R	MR	R	MR	R	MR	R	MR	R	MR	MR	MR	R	MR	R	R	R	R	-	R	-	R
6.	CoP 15440	MR	R	MR	R	MR	R	MS	R	MR	R	MR	MR	MR	R	MR	S	MS	MS	MR	-	MS	-	R
7.	CoP 15441	MR	R	MR	R	MR	R	MR	R	MR	R	MS	MS	MR	R	MR	S	MR	R	MR	-	MR	-	MS
8.	CoSe 15453	MS	R	MS	R	MR	R	MR	R	MS	S	MS	MS	MS	R	MR	S	MR	MR	MR	-	S	S	R
9.	CoSe 15454	MR	R	MR	R	MR	R	MR	R	MR	R	MR	MR	-	-	-	-	R	R	R	-	MR	-	MS
10.	CoSe 15457	MR	R	MS	R	MR	R	MR	R	MR	R	MR	MR	-	-	-	-	R	R	R	-	MR	-	R
AVT (Mid late)-II Plant																								
1.	CoLk 14208	MR	R	MR	R	MR	R	MR	R	-	-	-	-	MR	R	MR	S	R	R	-	-	-	-	R
2.	CoLk 14209	MR	R	MR	R	MR	R	MR	R	-	-	-	-	R	R	MR	R	R	MR	-	-	-	S	R

S. No	Genotypes	Red rot																	Smut		Wilt		YL	
		Motipur				Seorahi				Pusa				Buralikson										
		CF07		CF08		CF07		CF08		CF07		CF08		CF07		CF08								
		Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Motipur	Seorahi	Pusa	Motipur	Pusa	Motipur	Seorahi
3.	CoP 14438	MR	R	MR	R	MS	R	MR	R	-	-	-	-	MS	R	MR	S	R	MS	-	-	-	-	MR
4.	CoP 14439	MR	R	MR	R	MR	R	MR	R	-	-	-	-	MR	R	MR	R	R	R	-	-	-	-	R
5.	CoSe 14455	MR	R	MR	R	MR	R	MR	R	-	-	-	-	MR	R	MR	R	R	R	-	-	-	-	R
Checks																								
	CoSe 95422	S	S	S	S	S	MR	S	MR	MS	S	MS	S	MS	R	MS	S	MR	R	MR	-	MS	-	R
	CoJ 64	HS	-	HS	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-
	Co 1158	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	S	-	-	-	-	-
	CoLk 7701	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-
	CoLk 94184	-	-	-	-	MR	R	MR	R	MR	R	MR	R	MR	R	MR	R	-	R	R	-	MR	-	R
	CoSe 01421	-	-	-	-	MR	R	MR	R	R	R	MR	R	MR	R	MR	R	-	R	R	-	MR	-	R
	BO91	-	-	-	-	MR	R	MR	R	MR	R	MR	R	MR	R	MR	R	-	R	MR	-	MR	-	R
	CoP 9301	-	-	-	-	MR	R	MR	R	MR	R	MR	R	MR	R	MR	R	-	R	R	-	R	-	R
	CoP 06436	-	-	-	-	MS	R	MR	R	MR	R	R	R	-	-	-	-	-	R	R	-	R	-	R
	Akipura	-	-	-	-	-	-	-	-	-	-	-	-	MS	S	MS	S	-	-	-	-	-	-	-

Table 4: Reaction of Zonal Varietal Trials entries for red rot, smut and wilt (East Coast Zone)

Sl. No.	Genotypes	Anakapalle					Cuddalore			
		Red rot(CF06)		Smut	Wilt	YLD	Red rot(CF06)		Smut	YLD
		Plug	Nodal				Plug	Nodal		
IVT – Early										
1.	CoA 16321	R	R	MS	HS	R	MR	R	MR	MS
2.	CoC 16336	MS	R	MS	MS	MR	MR	R	MS	MS
3.	CoC 16337	MS	R	MR	MR	MR	MR	R	MS	MR
4.	CoV 16356	MR	R	MR	MS	S	MR	R	MR	MR
IVT- Midlate										
1.	CoA 16322	MR	R	S	HS	MR	MR	R	MS	MS
2.	CoC 16338	MS	R	HS	MR	R	MR	R	S	MS
3.	CoC 16339	MR	R	MR	MR	MS	MR	R	MR	MR
4.	CoV 16357	R	R	MS	MR	MS	MR	R	MS	MS
AVT – Early I Plant										
1.	CoC 15336	R	R	MS	S	MS	MS	R	MR	MS
2.	CoC 15338	MR	R	HS	S	MS	MR	R	MR	MS
3.	CoV 15356	MR	R	HS	R	MS	MR	R	S	MS
AVT – Early II Plant										
1.	Co 13023	MR	R	R	MR	MS	MR	R	MS	MR
2.	CoA 14321	R	R	MR	MR	MR	MR	R	MS	MS
3.	CoC 14336	MS	R	HS	MS	MR	MR	R	S	MS
AVT- Midlate Plant II										
1.	Co 13028	R	R	MS	MR	R	MR	R	MS	MS
2.	Co 13029	MR	R	MR	MS	R	MR	R	S	MR
3.	Co 13031	MR	R	MR	R	R	MR	R	MS	MR
4.	CoA 14323	MR	R	HS	MR	MS	MR	R	HS	MS
5.	CoC 14337	MR	R	MR	MR	MR	MR	R	MR	MS
6.	PI 14337	MR	R	HS	MR	MR	MR	R	MS	MR
Checks										
1	Co 419	HS	S	HS	S	R	-	-	-	-
2	CoC 671	HS	S	MS	S	R	HS	S	-	-
3	Co 997	HS	S	MS	HS	MR	-	-	-	-
4	CoA 89085	MS	R	MS	MR	R	-	-	-	-
5	Co 6907	S	S	MS	S	R	-	-	-	-
6	Co 7219	S	R	MR	S	R	-	-	-	-
7	Co 7706	S	R	S	MR	R	-	-	-	-
8	CoA 92081	R	R	HS	MS	MR	-	-	HS	S
9	Co Or 03151	MR	R	HS	R	MR	-	-	-	-
10	CoC 01061	MR	R	R	R	MS	-	-	-	HS
11	Co 86249	R	R	R	R	MS	R	R	-	-
12	Co 97009	-	-	-	-	-	-	-	HS	-
13	CoC 22	-	-	-	-	-	-	-	HS	-

Table 5: Reaction of Zonal Varietal Trials entries for red rot, smut and YLD (Peninsular Zone)

Sl No.	Genotypes	Red rot										Smut				YLD		
		Coimbatore				Thiruvalla				Navsari								
		CF06		CF12		CF06		CF12										
		Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Coimbatore	Navsari	Pune	Kolhapur	Coimbatore	Navsari	Kolhapur
IVT Early																		
1	Co 13021	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Co 13022	S	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Co 14002	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Co 14003	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Co 14004	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Co 14006	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Co 14008	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	Co 14009	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	Co 14012	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Co 14016	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	Co 14022	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	Co 14023	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Co 14025	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	Co 14026	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	Co 14027	MS	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	Co 14030	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	Co 14031	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	Co 14032	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	CoN 14071	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	CoN 14072	MS	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	CoN 14073	MS	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	CoN 14074	MS	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	CoSnk 14101	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	CoSnk 14102	MS	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	CoSnk 14103	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	CoT 14366	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	CoT 14367	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	CoTl 14111	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	CoTl 14112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	MS 14081	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	MS 14082	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32	CoVc 14061	HS	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Sl No.	Genotypes	Red rot										Smut				YLD		
		Coimbatore				Thiruvalla				Navsari								
		CF06		CF12		CF06		CF12										
		Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Coimbatore	Navsari	Pune	Kolhapur	Coimbatore	Navsari	Kolhapur
33	CoVc 14062	MR	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34	Co 14005	MR	R	-	-	-	-	-	-	S	R	MS	MR	-	MR	-	R	MS
35	Co 15002	R	R	-	-	-	-	-	-	MR	R	HS	R	MS	MR	-	R	MS
36	Co 15005	MR	R	-	-	-	-	-	-	MR	R	HS	R	MS	MS	-	R	R
37	Co 15006	MS	R	-	-	-	-	-	-	MR	R	R	R	MS	R	-	R	S
38	Co 15007	MS	R	-	-	-	-	-	-	MR	R	HS	HS	MR	S	-	R	R
39	Co 15009	MR	R	-	-	-	-	-	-	MR	R	R	R	R	MR	-	R	R
40	Co 15010	MR	R	-	-	-	-	-	-	MS	R	MS	R	R	MR	-	R	MR
41	Co 15015	MR	R	-	-	-	-	-	-	MS	R	MR	R	MS	R	-	R	MR
42	Co 15017	MR	R	-	-	-	-	-	-	MR	R	RT*	R	MS	R	-	R	R
43	Co 15018	MS	S	-	-	-	-	-	-	MR	R	S	R	R	MR	-	MR	MS
44	Co 15020	MS	R	-	-	-	-	-	-	MR	R	RT*	HS	R	S	-	R	MS
45	Co 15021	MR	R	-	-	-	-	-	-	MR	R	HS	MR	R	MS	-	R	MR
46	CoN 15071	MS	R	-	-	-	-	-	-	MR	R	S	R	R	MR	-	R	R
47	CoN 15072	-	-	-	-	-	-	-	-	MR	R	-	MR	MS	MR	-	R	R
48	CoSnk 15101	HS	S	-	-	-	-	-	-	MR	R	S	S	HS	MR	-	R	MS
49	CoSnk 15102	HS	S	-	-	-	-	-	-	MS	R	HS	MS	MS	S	-	R	R
50	CoSnk 15103	-	-	-	-	-	-	-	-	MS	R	-	MR	HS	MR	-	R	MR
51	CoSnk 15104	-	-	-	-	-	-	-	-	S	R	-	R	MS	MR	-	S	MR
52	CoVc 15061	-	-	-	-	-	-	-	-	MS	R	-	R	R	MR	-	R	S
53	CoVc 15062	-	-	-	-	-	-	-	-	HS	R	-	MS	-	MR	-	R	MR
54	CoVc 15063	-	-	-	-	-	-	-	-	MR	R	-	R	MS	MR	-	R	R
55	CoVc 15064	MS	R	-	-	-	-	-	-	HS	R	HS	R	-	MR	-	R	MR
56	CoVSI 15121	MR	R	-	-	-	-	-	-	HS	R	S	MR	R	MR	-	R	MR
57	CoVSI 15122	MR	R	-	-	-	-	-	-	MR	R	HS	R	MS	MR	-	R	R
58	PI 15131	MR	R	-	-	-	-	-	-	S	R	RT*	R	-	MS	-	R	S
59	PI 15132	HS	S	-	-	-	-	-	-	MS	R	RT*	R	MS	MS	-	S	MS
AVT (I Plant)																		
1	Co13002	-	-	-	-	MR	R	MR	R	MS	R	-	R	R	R	-	R	MS
2	Co 13003	-	-	-	-	MS	R	MR	R	MR	R	-	R	R	MR	-	R	R
3	Co 13004	-	-	-	-	MS	S	MS	S	MR	R	-	MR	R	MR	-	R	R
4	Co 13006	-	-	-	-	MS	S	S	S	MR	R	-	MS	R	MR	-	R	MR
5	Co 13008	-	-	-	-	MS	R	MR	R	MR	R	-	R	R	MR	-	R	MR
6	Co 13009	-	-	-	-	MR	R	R	R	MR	R	-	R	HS	MR	-	R	R

Sl No.	Genotypes	Red rot										Smut				YLD		
		Coimbatore				Thiruvalla				Navsari								
		CF06		CF12		CF06		CF12										
		Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Plug	Nodal	Coimbatore	Navsari	Pune	Kolhapur	Coimbatore	Navsari	Kolhapur
7	Co 13013	-	-	-	-	R	R	MR	R	MR	R	-	R	S	MS	-	R	MR
8	Co 13014	-	-	-	-	MS	S	MS	S	MS	R	-	S	R	MR	-	R	R
9	Co 13018	-	-	-	-	S	S	S	S	MR	R	-	R	MS	MR	-	R	MS
10	Co 13020	-	-	-	-	MS	S	MS	S	MS	R	-	MR	R	MR	-	MR	R
11	CoN13072	-	-	-	-	MR	R	MR	R	MR	R	-	R	MS	MR	-	R	MS
12	CoN 13073	-	-	-	-	R	R	MR	R	MR	R	-	R	MR	R	-	R	MR
13	MS 13081	-	-	-	-	MR	R	MR	R	MR	R	-	R	R	MR	-	R	MR
14	CoSnk 13101	-	-	-	-	R	R	MR	R	MR	R	-	R	MS	MR	-	R	MR
15	CoSnk 13103	-	-	-	-	MR	R	MR	R	S	R	-	MS	R	MR	-	R	MR
16	CoSnk 13106	-	-	-	-	MR	R	MS	R	MS	R	-	MS	R	MR	-	R	MR
17	PI 13132	-	-	-	-	MR	R	MR	R	MS	R	-	R	MS	MR	-	R	R
AVT (II Plant)																		
1	Co 12007	-	-	-	-	MS	R	MS	R	HS	R	-	R	S	S	-	R	MR
2	Co 12008	-	-	-	-	MR	R	MS	R	MS	R	-	MR	S	S	-	MR	MR
3	Co 12009	-	-	-	-	MS	S	MS	S	MR	R	-	MS	HS	MS	-	R	R
4	Co 12012	-	-	-	-	MS	R	MS	R	MR	R	-	R	R	MR	-	R	R
5	Co 12019	-	-	-	-	MR	R	MS	R	MR	R	-	R	R	MR	-	R	MR
6	Co 12024	-	-	-	-	S	S	S	S	S	R	-	R	S	MR	-	MR	MR
7	CoM 12085	-	-	-	-	S	S	S	S	MS	R	-	R	R	MR	-	R	R
8	VSI 12121	-	-	-	-	MS	S	S	S	MR	R	-	MS	MR	MR	-	R	MR
Checks																		
1	CoC 671	HS	S	-	-	HS	S	HS	S	HS	S	-	MR	-	MR	-	R	MS
2	Co 94012	HS	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Co 96007	-	-	-	-	-	-	-	-	-	-	HS	-	-	-	-	-	-
4	Co 97009	-	-	-	-	-	-	-	-	-	-	HS	HS	-	-	-	-	-
5	Co 6806	-	-	-	-	-	-	-	-	-	-	MR	MR	-	-	-	-	-
6	CoSnk 05103	-	-	-	-	MR	S	MR	S	MR	R	-	MR	-	MR	-	R	MR
7	Co 86032	-	-	-	-	MS	R	MS	R	HS	R	-	MR	-	MR	-	S	MS
8	Co 85004	-	-	-	-	-	-	-	-	S	R	-	S	-	-	-	MS	-
9	Co 94008	-	-	-	-	-	-	-	-	MR	R	-	-	-	-	-	R	-
10	Co 99004	-	-	-	-	-	-	-	-	MR	R	-	MS	-	-	-	MR	-
11	Co 86002	-	-	-	-	-	-	-	-	-	-	-	HS	-	-	-	-	-
12	Co 740	-	-	-	-	-	-	-	-	-	-	-	-	HS	HS	-	-	MR

Summary

- In Plant Pathology discipline during 2018-2019, eight experiments were allotted to seventeen AICRP(S) centers in different sugarcane producing zones of the country.
- Differential host studies was conducted at 12 AICRP(S) centres in all the zones with 72 new isolates along with designated pathotypes on the 19 host differentials to identify variation in red rot. More number of pathogenic variants have been isolated from the popular varieties such as Co 89003, CoC 24, CoS 8436, CoSe 92423 and CoSe 95422. The new isolates behaved almost similar to the existing pathotypes however; there is enough indication of emergence of new pathotype(s) from Uttar Pradesh and Haryana.
- Fifteen AICRP(S) centres have carried out red rot and smut testing, six for wilt and twelve for YL resistance. Large numbers of entries were identified as R/MR to red rot, smut and wilt from all the four sugarcane producing zones.
- AICRP(S) centre's recorded YL resistance in the ZVT entries and reported moderate to severe occurrences of YL under field conditions on the popular sugarcane varieties.
- Survey for natural incidence of sugarcane diseases across the country revealed that still red rot continues to occupy prime importance in traditional sugarcane growing areas and there is also growing importance of smut in subtropical region of the country. Epidemic occurrence of red rot in few pockets in the subtropical region is of serious concern and there is a need to closely monitor emergence of new pathotypes from them. Prevalence of red rot has been reported in the tropical region at moderate level mostly in Tamil Nadu. In addition, occurrence of YL, grassy shoot, wilt, rust, *pokkah boeng* and brown spot to varying proportions were recorded in different states of the country.
- AICRP(S) centres have evaluated ISH and IGH clones for red rot resistance.
- AICRP(S) centres have confirmed rust inoculation methods and also *pokkah boeng* epidemiology, tolerance in sugarcane varieties and fungicidal management.
- AICRP(S) centres have demonstrated the impact of YL disease on sugarcane by comparing virus-free and virus-infected seed canes the farmers.

ENTOMOLOGY

Sugarcane, being long duration crop is vulnerable to various biotic stresses. Amongst wide array of biotic stresses, insect pests are one of the major impediment in sugarcane crop production. About two dozen insect pests cause severe damage to the crop and thereby invite attention of the researchers for their management. Efforts put forth on managing the menace would essentially focus on eco-friendly and economical approaches. In varietal development programme, screening of different genotypes of sugarcane against insect pests for their tolerance/ resistance in different zones of India under AICRP (Sugarcane) is one of the strongest tool to manage these pests without reliance on pesticides. Major research focus is inclined towards non-pesticide tools including utilization of bio-agents, pheromone technology and IPM. Due emphasis has been given on survey and monitoring of insect pests and their bio-agents to take stock of the situation and formulate the strategy accordingly.

During the year 2018-2019, following programmes were conducted in Entomology discipline.

E.4.1 : Evaluation of zonal varieties/genotypes for their reaction against major insect-pests

E. 28 : Survey and surveillance of sugarcane insect-pests

E. 30 : Monitoring of insect-pests and bio-agents

E. 34 : Standardization of simple and cost effective techniques for mass multiplication of sugarcane bio-agents

E. 38 : Formulation and validation of IPM Module of sugarcane insect-pests

E. 39 : Pilot evaluation of waterless pheromone traps and water basin pheromone traps against sugarcane borers

E. 4.1: Evaluation of zonal varieties/genotypes for their reaction against major insect pests

Data on percent incidence of different insect pests was recorded on different varieties/ genotypes. In few cases, data on percent intensity and infestation index, number of insects/ leaf, number of insects/ sq cm of leaf etc. is calculated and grading is done accordingly. Details of grading for major insect pests is mentioned in table 4.1.

Table 4.1 Grading of insect pest reaction against sugarcane varieties/ genotypes

Sl. No.	Pest	Grades		
		Less Susceptible (LS)	Moderately Susceptible (MS)	Highly Susceptible (HS)
1.	Early shoot borer (% incidence)	Below 15.0	15.1-30.0	Above 30.0
2.	Root borer (% incidence)	Below 15.0	15.1-30.0	Above 30.0
3.	Stalk borer (Infestation index)	Below 2.0	2.1-5.0	Above 5.0
4.	Internode borer (% incidence)	Below 20.0	20.1-40.0	Above 40.0
5.	Top borer (% incidence)	Below 10.0	10.1-20.0	Above 20.0
6.	Pyrilla (Nymph+Adult / leaf)	Below 5.0	5.1-20.0	Above 20.0
7.	Mealy bug (% incidence)	Below 5.0	5.1-30.0	Above 30.0
8.	Scale insect (% incidence)	Below 10.0	10.1-35.0	Above 35.0
9.	White fly (Nymph + Puparia / sq. inch)	Below 2.0	2.1-5.0	Above 5.0
10.	Sugarcane Woolly Aphid (% leaf area covered by aphid colony)	Below 25.0	25.1-50.0	Above 50.0

North Western Zone

AVT (EARLY) I PLANT

1. Karnal

Four genotypes viz., Co 14034, CoPb 14181, CoLk 14201, CoPb 14211 alongwith one standard (checks) Co 0238 were evaluated against major insect pests of the area. All the genotypes were less susceptible against early shoot borer (ESB) and top borer. While, Co 14034, CoPb 14181 and CoPb 14211 were moderately susceptible against stalk borer and Co 14034 was also moderately susceptible against root borer. Co 0238 was highly susceptible (41.8%) againt root borer (Table 4.2).

2. Lucknow

Altogether, four genotypes viz., Co 14034, CoPb 14181, CoLk 14201, CoPb 14211 alongwith two standard checks viz., Co 05009 and Co 0238 were evaluated against major insect pests of the area. All the genotypes were moderately susceptible against top borer except Co 14034, which was less susceptible and CoPb 14211 was highly susceptible. It is noteworthy that all the genotypes were less susceptible against stalk borer and opposed to it all the genotypes were moderately susceptible except Co 0238, which was highly susceptible. (Table 4.2).

3. Shahjahanpur

Four genotypes viz., Co 14034, CoPb 14181, CoLk 14201, CoPb 14211 alongwith three standard checks viz., Co 05009, CoJ 64 and Co 0238 were evaluated against major insect pests of the area.

Based on cumulative incidence of shoot borer all the genotypes including standard checks showed less susceptible reaction to shoot borer. At harvest all the genotypes including Co 0238 were less suscetible while two standard checks viz., Co 05009 and CoJ 64 showed moderate susceptible reaction to top borer. Regarding the stalk borer infestation only CoPb 14211 alongwith standard checks Co 05009 were less susceptible while rest of the varieties viz., Co 14034, CoPb 14181, CoLk 14201 including standards check CoJ 64, Co 0238 showed moderate susceptible to stalk borer. (Table 4.2).

AVT (EARLY) II PLANT

1. Karnal

Three genotypes viz., Co 13034, CoPb 13181, CoS 13231 and one standard check Co 0238 were evaluated against major insect pests. All the genotypes including standard check evaluated were less susceptible against ESB and top borer. CoPb 13181 was less susceptible, while all others were moderately susceptible to root borer. Co 13034 and Co 0238 were highly susceptible to stalk borer, while Co Pb 13181 was moderately susceptible and CoS 13231 was less susceptible (Table 4.3).

2. Lucknow

One genotypes, CoS 13231 and two standard checks viz., Co 05009 and Co 0238 were evaluated against major insect pests. Both the standard checks were moderately susceptible to top borer, while less susceptible to CoS 13231. All the genotypes including standard checks evaluated were less susceptible against stalk borer. CoS 13231 was less susceptible to internode borer, while Co 05009 was moderately susceptible and Co 0238 was highly susceptible against internode borer. (Table 4.3).

2. Shahjahanpur

Three genotypes viz., Co 13034, CoPb 13181, and CoS 13231 alongwith three standard (checks) viz., Co 05009, CoJ 64 and Co 0238 were evaluated against major insect pests. Based on cumulative incidence of early shoot borer only the Co 13034 genotype alongwith standard checks Co 0238 were moderately susceptible while rest of the tested genotypes alongwith standard checks showed less susceptibility to early shoot borer infestation. Co 13034 along with standard check Co 05009 were moderate susceptible and rest of the genotypes alongwith standard checks showed less susceptibility to top borer. Regarding stalk borer infestation only the standard checks CoJ 64 showed less susceptibility while all the genotypes alongwith standards check were moderately susceptible (Table 4.3).

AVT (MIDLATE) I PLANT

1. Karnal

Eight genotypes viz., Co14035, CoLK14203, CoLK14204, CoPb14184, CoPb14185, CoS14233, Co14261 and Co 05011 were evaluated against major insect pests. All the genotypes evaluated were less susceptible against ESB and top borer. Except Co 05011, which was highly susceptible otherwise four genotypes were moderately susceptible and three were less susceptible against stalk borer. Except CoPb 14185 (highly susceptible) and CoLk 14204 (Moderately susceptible), all other genotypes were less susceptible to root borer (Table 4.4).

2. Lucknow

Altogether 8 genotypes, inluding 7 genotypes viz., CoLk 14203, CoLk 14204, CoH 14261, Co 14035, CoPb 14184, CoPb 14185, CoS 14233 alongwith one standard check viz CoPant 97222 were evaluated against major insect pests .

Based on per cent incidence of top borer in 3rd and 4th brood, four genotypes viz., Co 14035, CoLk 14203 CoPb 14185, CoS 14233 were moderately susceptible while rest others including standard check were less susceptible. Regarding stalk borer infestation, all the

genotypes were less susceptible except CoPb 14185, which was moderately susceptible. All the genotypes were moderately susceptible against internode borer except CoLk 14203 and CoH 14261, which were less susceptible. (Table 4.4)

3. Shahjahanpur

Altogether 10 genotypes, inluding 7 genotypes viz., Co 14035,CoLk 14203, CoLk 14204, CoPb 14184, CoPb 14185, CoS 14233, and CoS 14261 alongwith three standard checks viz, CoS 767, Co 05011 , CoPant 97222 were evaluated against major insect pests .

Based on cumulative incidence of early shoot borer only standard check CoS 767 showed moderate susceptible rest of the genotypes alongwith two standard checks were less susceptible to early shoot borer.

At harvest, only the genotype CoS 14261 showed moderate susceptible and rest of the genotypes alongwith three standard checks were less susceptible to top borer infestation. Regarding the stalk borer infestation all the genotypes were moderate susceptible to stalk borer. The infestation index ranged from 2.27 in CoLk 14203 and Co 14035 to 3.88 in Co 05011 . (Table 4.4)

AVT (MIDLATE) II PLANT

1. Karnal

Six genotypes viz., Co13035, CoPb13182, CoLk 13204, CoPant 13224, CoH 13263 and standard check Co 05011 were evaluated against major insect pests. All the genotypes evaluated were less susceptible against ESB and top borer. Except CoPb 13182 and CoPant 13224, which were moderately susceptible, all other genotypes were less susceptible against stalk borer. Co 05011 and CoLk 13204 were less susceptible against root borer, while Co 13035 and CoPb 13182 were moderately susceptible and CoPant 13224 and CoH 13263 were highly susceptible(Table 4.5).

2. Lucknow

Overall 6 genotypes viz., Co13035, CoPb13182, CoLk 13204, CoPant 13224, CoH 13263 and standard check CoPant 97222 were evaluated against major insect pests. All the genotypes including standard check were less susceptible against top borer, except Co13035, which was moderately susceptible and CoH 13263 was highly susceptible. Data taken on stalk borer revealed that CoLk 13204 and CoPant 13224 were moderately susceptible and rest others were less susceptible. However, data on incidence of internode borer was just reverse to the observation in stalk borer. Interestingly, genotypes CoLk 13204 and CoPant 13224 were less susceptible and rest other genotypes were moderately susceptible against internode borer. (Table 4.5).

3. Shahjahanpur

Altogether 9 genotypes, including 6 genotypes viz., Co 13035, CoPb 13182, CoLk 13204, CoPant 13224, CoH 13263, and CoS 8436 alongwith three standard checks viz., CoS 767, Co 05011 and CoPant 97222 were evaluated against major insect pests. All the genotypes evaluated were less susceptible against ESB and top borer. Co 13035 and CoH 13263 showed less susceptibility to stalk borer, while CoLk 13204 was highly susceptible and all other genotypes were moderately susceptible to stalk borer (Table 4.5).

AVT (Early) Ratoon

Shahjahanpur

A total of 6 genotypes, including 3 genotypes viz., Co 13034, CoPb 13181, and CoS 13231 alongwith three standard checks viz., Co 05009, CoJ 64 and Co 0238 were evaluated against major insect pests. All the genotypes showed less susceptibility to early shoot borer. At harvest, only the genotype CoS 13231 alongwith standard Co 0238 showed moderate susceptibility and rest of the genotypes alongwith standard checks were less susceptible to top borer. Regarding the stalk borer, all the genotypes alongwith standard checks were moderate suseptible to stalk borer infestation (Table 4.6).

AVT (Midlate) Ratoon

Shahjahanpur

Altogether 9 genotypes, including 6 genotypes viz., Co 13035, CoPb 13182, CoLk 13204, CoPant 13224, CoH 13263 and CoS 8436 alongwith 03 standard Checks viz., Co 05011, CoS 767 and CoPant 97222 were evaluated against major insect pests of the area. All the genotypes alongwith standard checks were less susceptible to early shoot borer. Two genotypes viz., CoPant 13224 and CoH 13263 showed moderate susceptibility while rest of the genotypes alongwith standard checks were less susceptible to top borer. Regarding stalk borer infestation, only Co 13035 showed less susceptible and rest of the tested genotypes alongwith standard were moderately susceptible to stalk borer (Table 4.7).

Table 4.2. AVT (Early) I Plant (NW Zone)

Sl. No.	Variety/ Genotypes	Early Shoot Borer		Stalk Borer			Top Borer			Internode Borer	Root Borer
		Karnal	Shahjahanpur	Karnal	Lucknow	Shahjahanpur	Karnal	Lucknow*	Shahjahanpur	Lucknow	Karnal
1	Co 14034	LS	LS	MS	LS	MS	LS	LS	LS	MS	MS
2	CoPb 14181	LS	LS	MS	LS	MS	LS	MS	LS	MS	LS
3	CoLk 14201	LS	LS	LS	LS	MS	LS	MS	LS	MS	LS
4	CoPb 14211	LS	LS	MS	LS	LS	LS	HS	LS	MS	LS
5	Co 05009	-	LS	-	LS	LS	-	MS	MS	MS	-
6	CoJ 64	-	LS	-	-	MS	-	-	MS	-	-
7	Co 0238	LS	LS	LS	LS	MS	LS	MS	LS	HS	HS

* Highest grade is taken out of 3rd and 4th brood.

Table 4.3. AVT (Early) II Plant (NW Zone)

Sl. No.	Variety/ Genotypes	Early Shoot Borer		Stalk Borer			Top Borer			Internode Borer	Root Borer
		Karnal	Shahjahanpur	Karnal	Lucknow	Shahjahanpur	Karnal	Lucknow*	Shahjahanpur	Lucknow	Karnal
1	Co 13034	LS	LS	HS	-	MS	LS	-	MS	-	MS
2	CoPb 13181	LS	MS	MS	-	MS	LS	-	LS	-	LS
3	CoS 13231	LS	LS	LS	LS	MS	LS	LS	LS	LS	MS
4	Co 05009	-	LS	-	LS	MS	-	MS	MS	MS	-
5	CoJ 64	-	LS	-	-	LS	-	-	LS	-	-
6	Co 0238	LS	MS	HS	LS	MS	LS	MS	LS	HS	MS

* Highest grade is taken out of 3rd and 4th brood.

Table 4.4. AVT (Midlate) I Plant (NW Zone)

Sl. No.	Variety/ Genotypes	Early Shoot Borer		Stalk Borer			Top Borer			Internode Borer	Root Borer
		Karnal	Shahjahanpur	Karnal	Lucknow	Shahjahanpur	Karnal	Lucknow*	Shahjahanpur	Lucknow	Karnal
1	Co 14035	LS	LS	LS	LS	MS	LS	MS	LS	MS	LS
2	CoLk 14203	LS	LS	LS	LS	MS	LS	MS	LS	LS	LS
3	CoLk 14204	LS	LS	LS	LS	MS	LS	LS	LS	MS	MS
4	CoPb 14184	LS	LS	MS	LS	MS	LS	LS	LS	MS	LS
5	CoPb 14185	LS	LS	MS	MS	MS	LS	MS	LS	MS	HS
6	CoS 14233	LS	LS	MS	LS	MS	LS	MS	LS	MS	LS
7	CoS 14261	LS	LS	MS	LS	MS	LS	LS	MS	LS	LS
8	CoS 767	-	MS	-	-	MS	-	-	LS	-	-
9	Co 05011	LS	LS	HS	-	MS	LS	-	LS	-	LS
10	CoPant 97222	-	LS	-	LS	MS	-	LS	LS	MS	-

* Highest grade is taken out of 3rd and 4th brood.

Table 4.5. AVT (Midlate) II Plant (NW Zone)

Sl. No.	Variety/ Genotypes	Early Shoot Borer		Stalk Borer			Top Borer			Internode Borer	Root Borer
		Karnal	Shahjahanpur	Karnal	Lucknow	Shahjahanpur	Karnal	Lucknow*	Shahjahanpur	Lucknow	Karnal
1	Co 13035	LS	LS	LS	LS	LS	LS	MS	LS	MS	MS
2	CoPb 13182	LS	LS	MS	LS	MS	LS	LS	LS	MS	MS
3	CoLk 13204	LS	LS	LS	MS	HS	LS	LS	LS	LS	LS
4	CoPant 13224	LS	LS	MS	MS	MS	LS	LS	LS	LS	HS
5	CoH 13263	LS	LS	LS	LS	LS	LS	HS	LS	MS	HS
6	CoS 8436	-	LS	-	-	MS	-	-	LS	-	-
7	Co 05011	LS	LS	LS	-	MS	LS	-	LS	-	LS
8	CoS 767	-	LS	-	-	MS	-	-	LS	-	-
9	CoPant 97222	-	LS	-	LS	MS	-	LS	LS	MS	-

* Highest grade is taken out of 3rd and 4th brood.

Table 4.6. AVT (Early) Ratoon (NW Zone)

Sl. No.	Variety/ Genotypes	Early Shoot Borer			Stalk Borer			Top Borer		
		Karnal	Lucknow	Shahjahanpur	Karnal	Lucknow	Shahjahanpur	Karnal	Lucknow	Shahjahanpur
1	Co 13034	-	-	LS	-	-	MS	-	-	LS
2	CoPb 13181	-	-	LS	-	-	MS	-	-	LS
3	CoS 13231	-	-	LS	-	-	MS	-	-	MS
4	Co 05009	-	-	LS	-	-	MS	-	-	LS
5	CoJ 64	-	-	LS	-	-	MS	-	-	LS
6	Co 0238	-	-	LS	-	-	MS	-	-	MS

Table 4.7. AVT (Midlate) Ratoon (NW Zone)

Sl. No.	Variety/ Genotypes	Early Shoot Borer			Stalk Borer			Top Borer		
		Karnal	Lucknow	Shahjahanpur	Karnal	Lucknow	Shahjahanpur	Karnal	Lucknow	Shahjahanpur
1	Co 13035	-	-	LS	-	-	LS	-	-	LS
2	CoPb 13182	-	-	LS	-	-	MS	-	-	LS
3	CoLk 13204	-	-	LS	-	-	MS	-	-	LS
4	CoPant 13224	-	-	LS	-	-	MS	-	-	MS
5	CoH 13263	-	-	LS	-	-	MS	-	-	MS
6	CoS 8436	-	-	LS	-	-	MS	-	-	LS
7	Co 05011	-	-	LS	-	-	MS	-	-	LS
8	CoS 767	-	-	LS	-	-	MS	-	-	LS
9	CoPant 97222	-	-	LS	-	-	MS	-	-	LS

Peninsular Zone

IVT

1. Akola

Altogether 30 genotypes were evaluated against major insect pests of the area. All the genotypes were less susceptible against ESB and Pyrilla except CO 15015, which was moderately susceptible against ESB. Out of the 30 genotypes, 18 genotypes were highly susceptible to scale insects while 12 were moderately susceptible. None of the genotypes were less susceptible to scale insect (Table 4.8).

2. Coimbatore

Twenty seven genotypes were evaluated against major insect pests of the area. Cumulative shoot borer incidence in IVT entries ranged from 4.7% (Co 15006) to a maximum of 49.7% (PI 15132). Out of 27 entries, 8 genotypes were less susceptible, 12 were moderately susceptible while rest 7 were highly susceptible. Internode borer incidence, recorded at the time of harvest, ranged from nil (CoSnk 15103 & CoVC 15064) to 70% (CoN 15071) and the intensity ranged from nil to 4.4 (CoN 15072). Out of 27 entries, four entries were rated less susceptible, 10 were moderately susceptible and 13 were highly susceptible (Table 4.8).

3. Mandya

Altogether 30 genotypes, including 26 genotypes with their Zonal checks (Midlate Co 86032 and early checks CoSnk 05103, CoC 671 and Co 85004) were screened for their reaction against major insect pests. Amongst these, Co 15021, CoVC 15062, CoVC 15063, PI 15131and CoN 15071 coming under midlate group registered less susceptible reaction against major borer pests. Similarly genotypes Co 15010, Co 15009, CoSnk 05103 and VSI 15122 coming under early maturity group shown less susceptible reaction against major borer pests (Table 4.8).

4. Padegaon

Altogether 30 genotypes were evaluated against major insect pests of the area. the cumulative per cent infestation of ESB ranged from 21.15 to 52.98 per cent. Six entries were moderately susceptible and 24 entries were highly susceptible against early shoot borer. All the genotypes showed highly susceptible reaction to mealy bug. The mealy bug incidence ranged from 45.00 to cent per cent. Five entries showed moderately susceptible reaction and 25 entries highly susceptible to internode borer. In case of scale insect, the incidence ranged from 0 to 20 per cent. Eight entries were moderately susceptible while rest all entries were less susceptible against scale insects (Table 4.8).

5. Pune

Out of 30 genotypes screened, CoC 671(Std.), Co 15009, CoVc 15064, Co 15021, Co 86032(Std.), Co 15002, Co 15017, CoSnk 15103, Co 14005, CoSnk 15104, Co 15006, CoVSI 15121 and Co 15010 showed moderately susceptible reaction to ESB and Co15005, Co 15017 and CoSnk 15103 showed moderately susceptible reaction to internode borer. Rest other genotypes were less susceptible against ESB and internode borer (Table 4.8)..

AVT - I Plant

1. Akola

Altogether 20 genotypes were evaluated against major insect pests of the area. Out of these, 12 genotypes were moderately susceptible, whereas, remaining entries were found less susceptible against ESB. Co 13003, CoSnk 13101, Co 13006, Co 13008, Co 13009 and Co 13013 were found to be Highly susceptible and remaining varieties were found moderately susceptible and PI 13132 was found less susceptible against scale insect. All the genotypes evaluated were less susceptible against *Pyrilla* (Table 4.9).

2. Coimbatore

Out of 19 genotypes evaluated under AVT-I Plant, only one entry (Co 13013) was less susceptible, eight entries were moderately susceptible and the rest ten were highly susceptible against ESB. Cumulative ESB incidence ranged from 14.2% (Co 13013) to a maximum of 49.4% (CoSnk 13101). Similarly, six genotypes were rated as less susceptible, eight were moderately susceptible and the rest five were highly susceptible (Table 4.9). Overall incidence of internode borer was moderate ranging from 10% in CoN 13073 to 46.7% in CoSnk 13103.

3. Mandya

Out of 20 genotypes evaluated against major insect pests of the region, all the genotypes were less susceptible against ESB. Only four genotypes (Co 13004, Co 13009, Co 13018 and Co 13020) were less susceptible against internode borer and rest others were moderately susceptible. Similarly, only three genotypes (Co 13008, Co 13009 and CoSnk 13103) were moderately susceptible to top borer and rest others were less susceptible. (Table 4.9).

4. Padegaon

Altogether 20 genotypes were evaluated against major insect pests of the area. Only CoSnk 05103 was less susceptible and CoSnk 13106 was moderately susceptible, otherwise all the genotypes were highly susceptible against ESB. Cumulative per cent infestation of ESB ranged from 14.61 to 58.06 per cent. All the genotypes tested were highly susceptible against internode borer. Its incidence ranged from 43.33 to 80.00 per cent. Only 5 genotypes were moderately susceptible against mealy bugs and rest were highly susceptible. Mealybug incidence ranged from 23.33 to 63.33 per cent. All the genotypes were less susceptible to scale insects except genotype CoSnk 13106, which was moderately susceptible (Table 4.9).

5. Pune

Out of 20 genotypes screened all genotypes showed less susceptible reaction to early shoot borer except Co 86032 (Std) and CoC 671 (Std), which showed moderately susceptible reaction to it. Co 13002, Co 13003, CoSNK 101, MS 13081, Co 13008 and Co 13009 showed moderately susceptible reaction to internode borer rest other were less susceptible. Out of 20 genotypes, 7 were moderately susceptible and rest were less susceptible to mealy bug infestation. Similarly, 4 genotypes were moderately susceptible, while rest others were less susceptible to sugarcane wooly aphid infestation. (Table 4.9).

AVT - II Plant

1. Akola

Altogether 11 genotypes were evaluated against major insect pests of the area. Out of these, two genotypes (Co 12024 and CoM 12085) were moderately susceptible, whereas, remaining entries were found less susceptible against ESB. All the genotypes evaluated were less susceptible against *Pyrilla*. Co 12012 was highly susceptible against scale insects, while CoM 12085 was less susceptible and rest other entries were moderately susceptible against scale insect (Table 4.10).

2. Coimbatore

Out of ten genotypes evaluated, five were less susceptible, three moderately susceptible and only two were highly susceptible against ESB. Incidence of ESB ranged from 11.7% (Co 12024) to 34.2% (Co 12008). Against internode borer, three entries were less susceptible, four were moderately susceptible and the rest three were highly susceptible. Incidence of the internode borer ranged from 10% (Co 12009) to 46.7% (Co 12007) (Table 4.10). Overall incidence of top borer across the entries was less than 5% and the root borer incidence was in traces.

3. Mandya

Out of 11 genotypes evaluated against major insect pests of the region, all the genotypes were less susceptible against ESB. Only four genotypes (Co 12009, Co 12012, CoM 12085 and VSI 12121) were less susceptible against internode borer and rest others were moderately susceptible. Similarly, only three genotypes (Co 12007, Co 12008 and Co 12019) were moderately susceptible to top borer and rest others were less susceptible. (Table 4.10).

4. Padegaon

Altogether 11 genotypes were evaluated against major insect pests of the area. Only Co 12007, Co 12008 and CoSnk 05103 were moderately susceptible, otherwise all the genotypes were highly susceptible against ESB. Cumulative per cent infestation of ESB ranged from 24.53 to 53.37 per cent. Co 86032 was moderately susceptible to internode borer and rest others were highly susceptible. Incidence of internode borer ranged from 30.00 to 63.33 per cent. All the genotypes were highly susceptible against

mealy bugs except VSI 12121, which was moderately susceptible. The mealy bug incidence ranged from 23.33 to 83.33 per cent. All the genotypes were less susceptible against scale insect except Co 12009 and CoC 671 which were moderately susceptible (Table 4.10). Scale insect incidence ranged from 0 to 26.67 per cent across the genotypes.

5. Pune

Out of 11 genotypes screened Co 12009, Co 12019 and Co 86032 (Std.) were highly susceptible while Co 12008, Co 12024 were less susceptible and rest others were moderately susceptible against ESB. All varieties/ genotypes were less susceptible to internode borer and mealy bug. Only two genotypes viz., Co 12008 , Co 12012 were moderately susceptible to sugarcane wooly aphid, otherwise all others were less susceptible against wooly aphid. (Table 4.10).

AVT - Ratoon

1. Akola

Altogether 11 genotypes were evaluated against major insect pests of the area. Out of these, five genotypes (Co 12007, VSI 12121, Co 86032, CoC 671 and CoSnk 05103) were moderately susceptible while all other entries were less susceptible against ESB. CoM 12085 was less susceptible against scale insect and all other entries were moderately susceptible. All the genotypes evaluated were less susceptible against *Pyrilla*. (Table 4.11).

2. Padegaon

Altogether 11 genotypes were evaluated against major insect pests of the area. Contrary to AVT-II trial, in AVT-Ratoon, none of the genotype was highly susceptible. Co 12007, Co 12019 and Co 12024 were moderately susceptible and rest other genotypes were less susceptible against ESB. Cumulative per cent infestation of ESB ranged from 8.53 to 18.75 per cent. Only one genotype Co 12007 was highly susceptible and Co 12012 were less susceptible, otherwise all the entries were moderately susceptible to internode borer. Incidence of internode borer ranged from 13.33 to 53.33 per cent. All the genotypes were highly susceptible against mealy bug and scale insect. It is noteworthy, that none of the genotype was highly susceptible in plant crop, while all were highly susceptible in ratoon crop. (Table 4.11).

3. Pune

Out of 11 genotypes screened Co 12007, Co 12008, Co 12009, Co 12019, Co 12085 and Co 86032 showed moderately susceptible reaction to ESB and rest others were less susceptible. Co 12007 and CoC 671 (Std) showed moderately susceptible reaction to mealy bug and rest others were less susceptible. All varieties/genotypes were less susceptible to internode borer and Scale insect. (Table 4.11)

Table 4.8. IVT (Peninsular Zone)

Sl. No.	Variety/ Genotypes	Early Shoot Borer					Internode Borer				Top Borer	Mealy bug	Pyrilla	Scale Insect	
		Akola	Coimbatore	Mandya	Padegaon	Pune	Coimbatore	Mandya	Padegaon	Pune	Mandya	Padegaon	Akola	Akola	Padegaon
1	Co 14005	LS	MS	LS	HS	MS	MS	MS	HS	LS	LS	HS	LS	HS	LS
2	Co 15002	LS	LS	LS	HS	MS	HS	MS	HS	LS	LS	HS	LS	HS	MS
3	Co 15005	LS	LS	LS	HS	LS	HS	MS	HS	MS	LS	HS	LS	MS	LS
4	Co 15006	LS	LS	LS	HS	MS	MS	MS	HS	LS	LS	HS	LS	MS	LS
5	Co 15007	LS	HS	LS	HS	LS	MS	MS	HS	LS	LS	HS	LS	HS	LS
6	CoSnK 15101	LS	MS	LS	HS	LS	LS	MS	MS	LS	LS	HS	LS	MS	LS
7	CoSnk 15102	LS	MS	LS	HS	LS	HS	MS	MS	LS	LS	HS	LS	HS	LS
8	CoVSI 15121	LS	LS	LS	HS	MS	HS	MS	HS	LS	LS	HS	LS	HS	LS
9	Co 15009	LS	LS	LS	HS	MS	MS	LS	HS	LS	LS	HS	LS	HS	LS
10	Co 15010	LS	HS	LS	HS	MS	HS	LS	HS	LS	LS	HS	LS	HS	LS
11	Co 15015	MS	HS	LS	HS	LS	HS	MS	HS	LS	LS	HS	LS	HS	LS
12	Co 15017	LS	HS	LS	HS	MS	LS	MS	HS	MS	LS	HS	LS	HS	MS
13	Co 15018	LS	LS	LS	MS	LS	MS	MS	HS	LS	LS	HS	LS	MS	MS
14	Co 15020	LS	MS	LS	MS	LS	HS	MS	HS	LS	LS	HS	LS	HS	LS
15	Co 15021	LS	MS	LS	MS	MS	HS	LS	HS	LS	LS	HS	LS	HS	MS
16	CoN 15071	LS	MS	LS	HS	LS	HS	LS	HS	LS	LS	HS	LS	MS	MS
17	CoN 15072	LS	HS	LS	HS	LS	MS	MS	HS	LS	LS	HS	LS	HS	LS
18	CoSnk 15103	LS	MS	LS	HS	MS	LS	LS	HS	MS	LS	HS	LS	MS	LS
19	CoSnk 15104	LS	-	LS	HS	MS	-	MS	HS	LS	LS	HS	LS	HS	LS
20	CoVC 15061	LS	MS	LS	MS	LS	MS	MS	HS	LS	LS	HS	LS	HS	LS
21	CoVC 15062	LS	MS	LS	HS	LS	HS	LS	MS	LS	LS	HS	LS	MS	MS
22	CoVC 15063	LS	LS	LS	HS	LS	HS	LS	MS	LS	LS	HS	LS	MS	LS
23	CoVC 15064	LS	MS	LS	HS	MS	LS	LS	MS	LS	MS	HS	LS	MS	LS
24	PI 15131	LS	HS	LS	HS	LS	HS	LS	HS	LS	LS	HS	LS	MS	LS
25	PI 15132	LS	HS	LS	MS	LS	MS	MS	HS	LS	LS	HS	LS	HS	LS
26	VSI 15122	LS	MS	LS	HS	LS	HS	LS	HS	LS	LS	HS	LS	HS	MS
27	Co 86032	LS	LS	LS	HS	MS	MS	MS	HS	LS	LS	HS	LS	MS	MS
28	CoC 671	LS	-	LS	HS	MS	-	MS	HS	LS	LS	HS	LS	HS	LS
29	CoSnk 05103	LS	-	LS	MS	LS	-	MS	HS	LS	LS	HS	LS	HS	LS
30	Co 85004	LS	-	LS	HS	LS	-	MS	HS	LS	LS	HS	LS	MS	LS

Table 4.9. AVT - I Plant (Peninsular Zone)

Sl. No.	Variety/ Genotypes	Early Shoot Borer					Internode Borer				Top Borer	Mealy bug		Pyrilla	Scale Insect		SWA
		Akola	Coimbatore	Mandya	Padegaon	Pune	Coimbatore	Mandya	Padegaon	Pune	Mandya	Padegaon	Pune	Akola	Akola	Padegaon	Pune
1	Co 13002	MS	HS	LS	HS	LS	HS	MS	HS	MS	LS	HS	LS	LS	MS	LS	LS
2	Co 13003	LS	MS	LS	HS	LS	LS	MS	HS	MS	LS	HS	LS	LS	HS	LS	MS
3	Co 13004	LS	MS	LS	HS	LS	MS	LS	HS	LS	LS	HS	MS	LS	MS	LS	LS
4	CoN 13072	MS	MS	LS	HS	LS	HS	MS	HS	LS	LS	MS	MS	LS	MS	LS	LS
5	CoSnk 13101	MS	HS	LS	HS	LS	HS	MS	HS	MS	LS	HS	MS	LS	HS	LS	LS
6	MS 13081	LS	HS	LS	HS	LS	MS	MS	HS	MS	LS	HS	LS	LS	MS	LS	LS
7	Co 13006	LS	MS	LS	HS	LS	LS	MS	HS	LS	LS	HS	LS	LS	HS	LS	LS
8	Co 13008	MS	HS	LS	HS	LS	MS	MS	HS	MS	MS	HS	LS	LS	HS	LS	LS
9	Co 13009	LS	MS	LS	HS	LS	LS	LS	HS	MS	MS	MS	MS	LS	HS	LS	MS
10	Co 13013	MS	LS	LS	HS	LS	HS	MS	HS	LS	LS	HS	LS	LS	HS	LS	LS
11	Co 13014	MS	HS	LS	HS	LS	MS	MS	HS	LS	LS	MS	LS	LS	MS	LS	MS
12	Co 13018	MS	HS	LS	HS	LS	MS	LS	HS	LS	LS	HS	MS	LS	MS	LS	LS
13	Co 13020	MS	HS	LS	HS	LS	MS	LS	HS	LS	LS	MS	LS	LS	MS	LS	LS
14	CoN 13073	MS	HS	LS	HS	LS	LS	MS	HS	LS	LS	HS	LS	LS	MS	LS	LS
15	CoSnk 13103	LS	MS	LS	HS	LS	LS	MS	HS	LS	MS	HS	LS	LS	MS	LS	LS
16	CoSnk 13106	LS	HS	LS	MS	LS	MS	MS	HS	LS	LS	HS	MS	LS	MS	MS	LS
17	PI 13132	LS	HS	LS	HS	LS	HS	MS	HS	LS	LS	HS	MS	LS	LS	LS	LS
18	Co 86032	MS	MS	LS	HS	MS	LS	MS	HS	LS	LS	HS	LS	LS	MS	LS	MS
19	CoC 671	MS	MS	LS	HS	MS	MS	MS	HS	LS	LS	MS	LS	LS	LS	LS	LS
20	CoSnk 05103	MS	-	LS	LS	LS	-	MS	HS	LS	LS	HS	LS	LS	MS	LS	LS

Table 4.10. AVT - II Plant (Peninsular Zone)

Sl. No.	Variety/ Genotypes	Early Shoot Borer					Internode Borer				Top Borer	Mealy bug		Pyrilla	Scale Insect		SWA
		Akola	Coimbatore	Mandya	Padegaon	Pune	Coimbatore	Mandya	Padegaon	Pune	Mandya	Padegaon	Pune	Akola	Akola	Padegaon	Pune
1	Co 12007	LS	LS	LS	MS	MS	HS	MS	HS	LS	MS	HS	LS	LS	MS	LS	LS
2	Co 12008	LS	HS	LS	MS	LS	MS	MS	HS	LS	MS	HS	LS	LS	MS	LS	MS
3	Co 12009	LS	MS	LS	HS	HS	LS	LS	HS	LS	LS	HS	LS	LS	MS	MS	LS
4	Co 12012	LS	LS	LS	HS	MS	HS	LS	HS	LS	LS	HS	LS	LS	HS	LS	MS
5	Co 12019	LS	MS	LS	HS	HS	MS	MS	HS	LS	MS	HS	LS	LS	MS	LS	LS
6	Co 12024	MS	LS	LS	HS	LS	MS	MS	HS	LS	LS	HS	LS	LS	MS	LS	LS
7	CoM 12085	MS	HS	LS	HS	MS	MS	LS	HS	LS	LS	HS	LS	LS	LS	LS	LS
8	VSI 12121	LS	MS	LS	HS	MS	LS	LS	HS	LS	LS	MS	LS	LS	MS	LS	LS
9	Co 86032	LS	LS	LS	HS	HS	LS	MS	MS	LS	LS	HS	LS	LS	MS	LS	LS
10	CoC 671	LS	LS	LS	HS	MS	HS	MS	HS	LS	LS	HS	LS	LS	MS	MS	LS
11	CoSnk 05103	LS	-	LS	MS	MS	-	MS	HS	LS	LS	HS	LS	LS	MS	LS	LS

Table 4.11. AVT - Ratoon (Peninsular Zone)

Sl. No.	Variety/ Genotypes	Early Shoot Borer					Internode Borer				Mealy bug		Pyrilla	Scale Insect		
		Akola	Coimbatore	Mandya	Padegaon	Pune	Coimbatore	Mandya	Padegaon	Pune	Padegaon	Pune	Akola	Akola	Padegaon	Pune
1	Co 12007	MS	-	-	MS	MS	-	-	HS	LS	HS	MS	LS	MS	HS	LS
2	Co 12008	LS	-	-	LS	MS	-	-	MS	LS	HS	LS	LS	MS	HS	LS
3	Co 12009	LS	-	-	LS	MS	-	-	MS	LS	HS	LS	LS	MS	HS	LS
4	Co 12012	LS	-	-	LS	LS	-	-	LS	LS	HS	LS	LS	MS	HS	LS
5	Co 12019	LS	-	-	MS	MS	-	-	MS	LS	HS	LS	LS	MS	HS	LS
6	Co 12024	LS	-	-	MS	LS	-	-	MS	LS	HS	LS	LS	MS	HS	LS
7	CoM 12085	LS	-	-	LS	MS	-	-	MS	LS	HS	LS	LS	LS	HS	LS
8	VSI 12121	MS	-	-	LS	LS	-	-	MS	LS	HS	LS	LS	MS	HS	LS
9	Co 86032	MS	-	-	LS	MS	-	-	MS	LS	HS	LS	LS	MS	HS	LS
10	CoC 671	MS	-	-	LS	LS	-	-	MS	LS	HS	MS	LS	MS	HS	LS
11	CoSnk 05103	MS	-	-	LS	LS	-	-	MS	LS	HS	LS	LS	MS	HS	LS

East Coast Zone

Anakapalle

In AVT (early)-I Plant, Out of 7 entries evaluated against major insect pests of the area, four genotypes, CoC 15336, CoC 15338, CoA 92081 and CoOr 03151 were less susceptible to ESB and rest others were moderately susceptible. Two genotypes viz., CoA 92081 and CoOr 03151were moderately susceptible to internode borer and rest others are highly susceptible (Table 4.12).

In AVT (early)-II Plant, out of 7 entries, only three entries viz., CoC 14321, CoC 14336 and CoOr 03151 were less susceptible against ESB, rest other entries were moderately susceptible. Only two genotypes, CoA 92081 and 93A 145 were highly susceptible against internode borer and rest others were moderately susceptible. (Table 4.12).

In AVT (mid-late)-II Plant, out of 9 genotypes screened against ESB and internode borer, four genotypes Co 13028, Co13031, Co A 14323, 93 A 145 (SC) were moderately susceptible and rest others were less susceptible against ESB. Co 13028, Co 13029 were less susceptible, Co A 14323, PI 14377 and 93 A 145 (SC) were highly susceptible and rest other genotypes were moderately susceptible against internode borer. (Table 4.13).

Project No. E. 28. Survey and surveillance of sugarcane insect-pests

North Western Zone

1. Karnal

Survey was carried out under the command areas of 07 Co-operative sugar mills of Haryana, 05 sugar mills of western Uttar Pradesh and Uttarakhand. Sugarcane whorl weevil, plant hopper and blister mites were identified as new pests of sugarcane in Haryana, western Uttar Pradesh and Uttarakhand. Early shoot borer, top borer, root borer, stalk borer; pyrilla, black bug and termites were listed as key pests of sugarcane in Haryana. Gurdaspur borer, pink borer and blister mite were identified as minor pest of Sugarcane in Haryana, UP and UK. Pyrilla, army worm, grass hopper, white fly, yellow mites, mealy bug and thrips were recorded as occasional pest of sugarcane under the zone.

The incidence of these three new insects was found increasing severely where whorl weevil, plant hopper and blister mites incidence was up to 2.0, 3.0 and 0.3 weevils/ whorl; up to 65, 22.00 and 40 adults/nymphs/ whorl and up to 80.0, 90.0 and 60.0% in Haryana, western Uttar Pradesh and Uttarakhand respectively. Early shoot

Table 4.12. AVT (Early)-I Plant & II Plant (East Coast Zone)- Location: Anakapalle

Sl. No.	Variety/ Genotypes	AVT (Early)- I Plant		AVT (Early)- II Plant		
		Early shoot borer	Internode borer	Variety/ Genotypes	Early shoot borer	Internode borer
1	CoV 15356	MS	HS	Co 13023	MS	MS
2	CoC 15336	LS	HS	CoA 14321	LS	MS
3	CoC 15338	LS	HS	CoC 14336	LS	MS
4	CoA 92081	LS	MS	CoOr 03151	LS	MS
5	CoC 01061	MS	HS	CoA 92081	MS	HS
6	CoOr 03151	LS	MS	CoC 01061	MS	MS
7	93 A 145 (SC)	MS	HS	93 A 145 (SC)	MS	HS

Table 4.13. AVT (Midlate)-II Plant (East Coast Zone)- Location: Anakapalle

Sl. No.	Variety/ Genotypes	AVT (Midlate)- II Plant	
		Early shoot borer	Internode borer
1	Co 13028	MS	LS
2	Co 13029	LS	LS
3	Co13031	MS	MS
4	Co A 14323	MS	HS
5	Co C 14337	LS	MS
6	PI 14377	LS	HS
7	Co V92102	LS	MS
8	Co86249	LS	MS
9	93 A 145 (SC)	MS	HS

borer and pink borer incidence was up to 12.5, 6.0 and 8.0% in Haryana, western Uttar Pradesh and Uttarakhand respectively. Top borer incidence was up to 60.0, 90.0 and 70.0% in Haryana, western Uttar Pradesh and Uttarakhand, respectively wherever farmers have not applied control measures properly. Root borer incidence was up to 20.0, 30.0 and 25.0% in Haryana, western Uttar Pradesh and Uttarakhand respectively. Stalk borer incidence was up to 15.0, 10.0 and 15.0% in Haryana, western Uttar Pradesh and Uttarakhand respectively. Black bug incidence varied from traces to 15.0, individuals/ tiller in newly ratooned crops in surveyed area. White grub incidence varied from 0 to trace, trace to 4.0 grubs/$m^{2,}$ trace to 2.0 grubs/ m^2mostly in sandy soils in Haryana, western Uttar Pradesh and Uttarakhand respectively. White grub, early shoot borer, top borer, root borer, stalk borer; pyrilla, black bug and termites were identified as key pests in western Uttar Pradesh and Uttarakhand (Table 4.14).

2. Lucknow

Survey was conducted in the command area of different sugar mills of central and eastern Uttar Pradesh viz., Chilbaria Sugar Mill; Nanpara Sugar Mill, Bahraich; Hata Sugar Mill, Deoria; Hata Sugar Mill, Hata; four units of DSCL Group (Rupapur, Haryawan, Loni, Ajbapur); three units of Balrampur Group; Sekseria Sugar Mill, Biswan, Sitapur; Rosa Sugar Works Rosa; K. M. Sugar Mill Masodha; Oudh Sugar Mill, Hargaon; Dalmia Chini Mill, Ramgarh and IPL Chini Mill were surveyed. The incidence of ESB (30.00%), root borer (47.0%), cumulative incidence of top borer (33.33%) was observed. In the command area of DSCL Sugar Mill, Loni during May and July 2018. In few fields, early shoot borer was recorded to the tune of 15-20% in variety Co 0238. Occurrence of top borer, stalk borer, internode borer, pyrilla was in traces. In general crop condition was good in the surveyed area. The sporadic incidence of army worm (*Spodoptera* sp.) was recorded to the tune of 25-30% in Bahraich. In ratoon crop, top borer was the major problem and an incidence of 20-25% was recorded. Black beetle (*Heteronychus* sp.) was observed gnawing the basal portion of young shoots and causing dead hearts. Its incidence was wide spread but only around 5-10% in Chilbaria Sugar Mill, and Nanpara Sugar Mill area.

In few sugarcane fields in District, Muzaffarnagar of western Uttar Pradesh, a black Delphacid Plant Hopper, *Eoeurysa flavocapitata* was observed in *Akheypur* and *Charkheda* villages and UPCSR, Shahjahanpur. Both stages (adult and nymphs) were hiding in leaf funnel/ whorl of sugarcane. Owing to sucking of the plants, sticky honey dew was observed on under surface of newly opened leaves that invited black sooty mould. Apart from yield loss to the crop, it made the green cane tops unfit for cattle feed .

3. Shahjahanpur

Sugarcane fields in command areas of 11 sugar mills in central U.P. were surveyed for major insect pests of the area. During hot weather, the incidence of early shoot borer was low and ranged from 1.5 to 3.0%. Similarly minimum (1.5%) infestation of top borer was recorded in Khambarkhera, Maqsudapur and Pallia while maximum (4.5%) around Rouza factory zones. The infestation of stalk borer was recorded low in all surveyed factory zone. It ranged from 4.0% around Khambarkhera, Maqsudapur and Pallia factory zones to 8.0% around Kumbhi and Biswan factory zones. Regarding the sucking pest, the infestation of thrips was recorded in some of the factory zones. It's infestation was recorded low (5.0%) in Kumbhi to moderate (15.0%) around Gola factory zones. The infestation of mealy bug was recorded low (2.5%) around gola, Kumbhi, Rouza, Khambarkhera, Maqsudapur, Gularia and Pallia factory zones while maximum (35.0%) around Biswan factory zones. Web-mite infestation was observed moderate 15.0% and 20.0% around Gularia and Hargaon respectively and high incidence of 60.0% was recorded around Khambarkhera factory zones. Sporadic occurrence of termite, white fly and gurdaspur borer was found in some factory zones. (Table 4.14).

Peninsular Zone

1. Coimbatore

A survey of fall army worm *Spodoptera frugiperda* at Bannari Amman Sugars, Sathyamangalam showed an average of 7.2% incidence on sugarcane in a field where the previous crop was maize and currently *Bacillus thuringiensis* and *Beauveria bassiana* had been sprayed. In a sugarcane field with five rows of maize as border crop, only maize had been infested with *S. frugiperda*. Low incidence of fall army worm was noticed in an experimental field in the main campus of the Institute which ranged from nil to 7.1%. An entomopathogenic fungus recovered from *S. frugiperda* cadavers collected from the survey sites (Sathyamangalam) was identified as *Nomuraea rileyi*. Other pests recorded are mentioned in the table 4.14.

2. Mandya

Survey was conducted at monthly interval in three sugar factory areas of Mandya district. During the survey eleven insect pests two species of mites and the activity of two white flies was recorded on sugarcane. This year because of more rains during pre monsoon season, the incidence of early and top shoot borer was less.

For the first time egg laying by coconut white fly (*Aleurodicus rugiperculatus*) was recorded on sugarcane and maize at V.C.Farm, Mandya. Incidence of woolly aphid was moderate and it was kept under check by its

natural enemies viz: *Dipha aphidivora* and *Encarsia flavoscutellum.* Other pests recorded are mentioned in the table 4.14.

3. Padegaon

Early shoot borer is the key pest of this area and per cent insect infestation was highest in *suru* planting than *adsali* and *pre-seasonal.* The incidence of early shoot borer ranged from 6.5 to 32.80 per cent, whereas average incidence was recorded 12.46 per cent. The per cent incidence of internode borer ranged from 13.33 to 23.33 and intensity ranged from 0.66 to 1.67 per cent. The incidence of mealy bug ranged from 15.00 to 38.68 per cent, where as intensity ranged from 1.92 to 4.69 per cent. The incidence of top shoot borer, root borer, sugarcane woolly aphid, pyrilla, whitefly, thrips, scale insects, white grub and termites were in traces to low level.

4. Pune

Incidence of early shoot borer was maximum 10.71 % in December 2018 ratoon crop of Co 86032. Incidence of internode borer was maximum 8.00 % in Co 86032 planted in the month of July 2018. Incidence of root borer was 25% in December 2018 ratoon crop of Co 86032. (Table 4.14).

East Coast Zone

Anakapalle

Surveys were conducted in Visakhpatnam, Viziangaram and East Godavari districts and observed incidence of oriental thrips (*Fulmekiola serrata* Kobus) on tender leaves in central whorls of the sugarcane (3-6 thrips/ leaf) during April- May months. Maximum incidence of early shoot borer (30-50%) was observed on single node seedlings of 87 A 298 at 30 days after transplantation during the month of June at Kovvada village of Vizinagaram district and Maximum incidences of aphids *viz.*, sugarcane aphid, *Melanaphis sacchari* (30-50/leaf) and rusty plum aphid, *Hysteroneura setariae* (30-40/leaf) were observed during the month of August at Lakkavaram village of Visakhapatnam. Maximum incidence of internode borer was observed during August month (50-70%) on 20003 A 255 variety at Lakkidam village of Vizianagaram district. Maximum incidences of scale insect, *Melanaspis glomerata* (60-80%) was observed on variety, 87 A 298 (ratoon crop) and sugarcane woolly aphid, *Ceratovacuna lanigera* (20-50%) were observed during January- February months. In case of whitefly, along with *Aluerolobus barodensis* another whitefly species *Neomaskellia bergii* (Spotted whitefly) was also observed during the crop season with maximum incidence during August month (15-40 adults/leaf). Incidence of cut worm, *Agrotis* spp (20- 40%) in some isolated pockets of Srikakulam district after receding of flood water due to Titli cyclone occurred during 1st week of October. Incidence of Fall army worm , *Spodoptera frugiperda* was observed for the first time in Research farm of RARS, Anakapalle on 6-3-2019 and confirmed morphologically. The incidence gradually spread to many experimental fields which were planted during March month in research station (5-10%) and taken immediate plant protection measures and interim prophylactic measures for the management of FAW were also suggested to the sugarcane farmers & the pest is under check. Extracted DNA from the fall army worm larval samples collected on sugarcane and amplified DNA by PCR was sent for sequencing and also confirmed molecularly that it is fall army worm, *Spodoptera frugiperda*. (Table 4.14).

Table 4.14. Status of insect pests of sugarcane in different states of India based on survey and surveillance report.

Location	Insect pest	Incidence (%)	Varieties	Period	Any other information
Andhra Pradesh					
Arabupalem, Munagapaka,, Vadrapalli, (Visakhapatnam)	Early shoot borer,	11.5	87 A 298	April, 2018	Due to high temperatures low to moderate incidence of early shoot borer was observed on all commercial varieties
	Oriental thrips, *Fulmekiola serrata* Kobus	4.5			
	Red mite, *O. sacchari*	3.0			
Arabupalem, Munagapaka,, Vadrapalli, (Visakhapatnam)	Early shoot borer (%)	7.5	87 A 298 (Ratoon)	May, 2018	-
	Mealybug, *S. sacchari*	8.0			-
	Sugarcane aphid, *M. sacchari*	8.0			-

Sitharamapuram, Tondangi	Early shoot borer	1.5	2003 V 46 (June planting)	July, 2018	-
P.Chemavaram	Mealybug, *S.sacchari*	7.5	87 A 380		-
Kandrakota Siriwada	Sugarcane aphid, *M.sacchari* Rusty plum aphid, *H.setariae*	17.5 18.5	87 A 298 (8th Ratoon)		-
Jutthada	Internode borer	12.5	Co 62175 (Ratoon)		-
Lakkavaram, (Visakhapatnam)	Early shoot borer	35.0	87 A 298(Plant)		Rainfed sugarcane
	Rusty plum aphid, *H. setariae*	15.0	87 A 298 (Ratoon)		Mosaic disease was observed
	Mealy bug, *S. sacchari*	7.5			
	Rusty plum aphid, *Neomaskella bergii*	30.0 27.5	Co 7508 87 A 298	August, 2018	Severe incidence of YLD (on Co 7508) was observed
Nakkapalli,	Sugarcane aphid , *M.sacchari*	40.0	87 A 298		Mosaic incidence was observed
	Pyrilla perpusilla	1.5			-
Lakkidam, Gantyada (Vizianagaram)	*C. infuscatellus* damage on internodes (%)	40.0	Co 7508 87 A 298		-
	Pink mealy bug(%) *S. sacchari*	7.5	2003 A 255		-
	Internode borer (%) *C. infuscatellus*	15.0	2000 A 56		-
	Internode borer	15.0	2009 A 107		Grassy shoot disease was observed
Jami (Vizianagaram)	Sugarcane aphid *M.sacchari*	55.0	2003 A 255 2009 A 107		Mosaic incidence observed (2%)
	Rusty plum aphid *H.setariae*	80.0			-
Jami (Vizianagaram)	*Pyrilla perpusilla*	1.5	87 A 298		Severe incidence of mosaic (60%)
	Pyrilla perpusilla	1.5	2009 A 107		Mosaic incidence observed (2%)
Sithanagaram (Vizianagaram)	Internode borer	11.0	87 A 298	September, 2018	Observed severe incidence of mosaic disease on 87 A 298 (ratoon) (40-60%) Incidence of grassy shoot (1-2%) Moderate to severe incidence of YLD (30-50%) were observed
Makaravapalem (Vizianagaram)	*Pyrilla perpusilla*	1.5	2003 A 46 (Ratoon)		
Lakkavaram (Vizianagaram)	Rusty plum aphid, *H. setariae*	15.0	Co 7508 (Ratoon)		
	Neomaskella bergii	6.5			
	Internode borer, *C.sachariphagus indicus* (%)	7.5			
	Internode borer	15.0	87 A 298 (Ratoon)		Severe incidence of mosaic (> 60%) was observed
Bennavara (East Godavari)	Spotted whitefly, *N.bergii*	9.0	87 A 298		
Kolimeru, Tuni	Internode borer	15.0	87A 298 (Ratoon)		Severe incidence of mosaic disease (60%)
	Pyrilla	7.5			
	Yellow mite (*Schizotetranichus* spp)	5.5			Low incidence of mosaic incidence (2%)

Thummapala, Anakapalle	Spotted whitefly,*N.bergii*	9.0	87 A 298	October, 2018	-
	Internode borer	7.5			-
In some isolated pockets of Srikakulam district	Cut worm, *Agrotis* spp	30.0			Observed after receipt of flood water due to titli cyclone
	Pyrilla perpusilla	8.5			-
	Derbid leaf hopper, *Proutista moesta*	4.5			-
	Pink mealy bug, *S. sacchari (%)*	10.0			-
	Rusty plum aphid, *H.setarie*	9.0			-
	Sugarcane aphid, *M. sacchari*	10.0			-
	Spotted whitefly, *N. bergii*	9.5			-
Sithanagaram village of Vizianagaram	Internode borer	11.0	87 A 298	November, 18	-
	Internode borer	12.5	2003 A 255		-
Bobbili	Spotted whitefly, *N.bergii*	10.5	87 A 298		-
	Pyrilla perpusilla	1.5			-
Vaddadi	Internode borer	10.0	2000 A 225	December, 18	-
Bennavaram	Spotted whitefly, *N.bergii (Adults/leaf)*	9.0	87 A 298		-
Arabupalem & Research station, Anakapalle, Visakhapatnam	Whitefly, *A.barodensis* (puparia/2.5cm leaf area)	23.0	2009 A 107	January,19	-
	White woolly aphid, *Ceratovacuna lanige*ra	35.0	93 A 145, 2009 A 107		-
	Scale insect (%) *M. glomerata*	43.5	87 A 298, 2001 A 63, 93 A 145 (Ratoon)		-
	Sugarcane aphid, *M. sacchari*	10.5	2009 A 107		-
Bejjupalem village in Srikakulam	Internode borer	12.5	87 A 298 (Ratoon)	February, 19	-
	Scale insect (%) *M.glomerata*	55.5	-		-
	White woolly aphid (%)	35.0	-		-
In isolated patches in RARS, Anakapalle, Chuchukonda, Visakhpatnam district and in some parts of East Godavari district.	Fall army worm, *Spodoptera frugiperda*	7.5	87 A 298, 2009 A 109 93 A 145 *etc*	March, 19	First appearance on sugarcane crop during 2019

Maharashtra					
Alegaon (Pune)	Early shoot borer	10.71	Co 86032 (Ratoon)	-	Early shoot borer and root borer was more in December 2018 ratoon crop of Co 86032. Incidence of internode borer was maximum in Co 86032 planted in the month of July 2018.
Vadgaondarekar (Pune)	Early shoot borer	0.97	Co 86032 (Ratoon)	-	
	Internode borer	4.0	CoM 265	-	
	Early shoot borer	2.73	Co 86032	-	
	Internode borer	4.0	CoM265	-	
Nimgaon Khalu (Pune)	Early shoot borer	4.37	VSI 08005 (Ratoon)	-	
	Internode borer	8.0	Co 86032	-	
	Early shoot borer Root borer	9.66 25.0	Co 86032 (Ratoon)	-	
Kautha (Pune)	Internode borer	8.0	Co 86032	-	
Ravangaon (Pune)	Early shoot borer	2.90	CoM265 (Ratoon)	-	
	Early shoot borer	2.89	MS10001 (Ratoon)	-	
	Early shoot borer	4.88	CoM265 (Ratoon)	-	
	Internode borer	4.0	CoM265	-	
Malad (Pune)	Early shoot borer	2.60	CoM265 (Ratoon)	-	
Padegaon	Early shoot borer	12.46	Co 86032 CoM 0265 MS 10001	-	-
Ashta	Top shoot borer	0.10		-	-
Koregaon	Internode borer	16.67		-	-
Padegaon	Root borer	3.44		-	-
Padali, Masur (Karad)	Woolly aphid (Average grade)	4.66		-	-
Padegaon	Scale insect (% incidence/% intensity)	02.67		-	-
Padegaon	Mealy bug	26.40		-	-
Kasurdi (Daund)	White grub	18.22		-	-
Koregaon	Termite	1.33		-	-
Karnataka					
Three sugar mill area of Mandya District	Early shoot borer	5.0– 12.0		-	-
	Top shoot borer	3.0 – 10.5		-	-
	Internode borer	12.5 – 24.75		-	-
	Sugarcane pyrilla	<0.50adult / nymph / clump		-	-
	Mealy bug	12.25			
	Woolly aphid	40 – 50 %		-	-
	Mite	10 -15 %		-	-
	White fly *N.bergi*	In traces		-	-
	White fly *A. rugiperculatus*			-	-
	Termite			-	-
	White grub	3 – 5 grubs / clump		-	-

Tamil Nadu					
Telungupalayam (Coimbatore)	Shoot borer	11.23	Co 86032	-	-
	Internode borer	9.80		-	-
	Top borer	1.75		-	-
	Pink mealy bug	Traces		-	-
	Scale insect	Traces			-
	Woolly aphid	2.68		-	*Micromus, Dipha, Encarsia* present
	Pyrilla	Traces		-	-
Athipalayam (Coimbatore)	Shoot borer	1.26		-	-
	Top borer	0.63		-	-
Annur (Coimbatore)	Internode borer	Traces		-	-
	Pyrilla	Traces			*Epiricania* 1-2 coccons/ leaf
Sathyamangalam (Coimbatore)	White grub	36 Grubs/ mt length		-	-
Sathyamangalam	Fall army worm	7.2	CoVC 14061	-	*Nomuraea rileyi* recorded
Udumalpet (Coimbatore)	Fall army worm	3.0	Co 86032	-	-
Modakuruchi (Coimbatore)	Fall army worm	14.20		-	-
Pugalur (Coimbatore)	Fall army worm	32.21		-	-
Haryana					
	Early shoot borer	0.0 to 12.5	-	-	-
	Pink borer	0.0 to 8.5	-	-	-
	Top borer	0.0 to 60.0	-	-	-
	Root borer	0.0 to 20.0	-	-	-
	Stalk borer	0.0 to 15.0	-	-	-
	Blister mite	0.0 to 80.0	-	-	New pest
	White grub	Trace	-	-	-
	Plant hopper	0.0 to 65.0/ whorl	-	-	New pest
	Whorl weevil	0.0 to 2.0/ whorl	-	-	New pest
	Black bug	0.0 to 12.0/ tiller	-	-	-
Uttarakhand				-	-
Milak, Narayanpur	Early shoot borer	0.0 to 8.0	-	-	
	Pink borer	0.0 to 10.3	-	-	-
	Top borer	0.0 to 70.0	-	-	-
	Root borer	0.0 to 25.0	-	-	-
	Stalk borer	0.0 to 15.0			
	Blister mite	0.0 to 60.0	-	-	New pest
	White grub	0.0 to 2.0/m^2	-	-	-
	Plant hopper	0.0 to 40.0 / whorl	-	-	New pest
	Whorl weevil	0.0 to 3.0 /whorl	-	-	New pest
	Black bug	0.0 to 15.0 / tiller	-	-	-

Uttar Pradesh					
Gola (Lakhimpur Kheri)	Early shoot borer	1.50	Co 0238,	-	-
	Top shoot borer	2.50		-	-
	Thrips	15.00		-	-
	Mealy bug	2.50		-	-
	Stalk borer	7.50		-	-
Hargaon (Sitapur)	Early shoot borer	3.00	Co 0238, CoLk 94184 CoS 08272, Co 0118	-	-
	Top shoot borer	2.00		-	-
	Webmite/leaf	20.00		-	-
	Stalk borer	6.50		-	-
Kumbhi (Kheri)	Early shoot borer	3.00	Co 0238, Co 0118	-	-
	Top shoot borer	2.50		-	-
	Thrips	5.00		-	-
	Mealy bug	4.00		-	-
	Stalk borer	8.00		-	-
Rouza (Shahjahanpur)	Early shoot borer	3.00	Co 0238, CoPk 05191	-	-
	Top shoot borer	4.50		-	-
	Thrips	7.00		-	-
	Mealybug	5.00		-	-
	Stalk borer	5.50		-	-
Khambarkhera (Kheri)	Early shoot borer	1.50	Co 0238, Co 0118, Co 98014	-	-
	Top shoot borer	1.50		-	-
	Stalk borer	4.00		-	-
	Mealy bug	3.00		-	-
	Webmite	60.00		-	-
Maqsudapur (Shahjahanpur)	Early shoot borer	1.50	Co 0238, CoLk 94184	-	-
	Top shoot borer	1.50		-	-
	Stalk borer	4.00		-	-
	Mealy bug	2.50		-	-
	Thrips	9.00		-	-
	Termite	7.50		-	-
Nigohi(Shahjahanpur)	Early shoot borer	2.50	Co 0238, CoLk 98184	-	-
	Top shoot borer	2.50		-	-
	Stalk borer	7.00		-	-
	Thrips	7.50		-	-
	Webmite	12.50		-	-
Gularia (Kheri)	Early shoot borer	1.50	Co 0238, CoS 08279 Co 98014 CoS 08272, Co 0118	-	-
	Top shoot borer	2.50		-	-
	Stalk borer	6.00		-	-
	Mealy bug	7.00		-	-
	Thrips	7.00		-	-
	Webmite	15.00		-	-
Biswan (Sitapur)	Early shoot borer	2.50	Co 0238, CoLk 94184, Co 0118, CoPk 05191, CoS 08272, CoS 08276, CoS 8436 Co 98014	-	-
	Top shoot borer	2.00		-	-
	Stalk bore	8.00		-	-
	Gurdaspur borer	1.50		-	-
	Mealy bug	35.00		-	-
	Thrips	9.50		-	-
	White fly	7.00		-	-

Pallia (Kheri)	Early shoot borer	1.50	Co 0238, Co 98014 UP 05125, CoS 08272, CoJ 88	-	-
	Top shoot borer	1.50		-	-
	Stalk borer	4.00		-	-
Ajabapur (Kheri)	Early shoot borer	2.00	Co 0238, Co 05011	-	-
	Top shoot borer	2.50		-	-
	Stalk borer	4.50		-	-
	Mealy bug	3.00		-	-
Deoband, Khatauli, Raninangal and Sabitgarh Sugar mill area in Western Uttar Pradesh	Early shoot borer	0.0 to 6.0	-	-	-
	Pink borer	0.0 to 9.0	-	-	-
	Top borer	0.0 to 90.0	-	-	-
	Root borer	0.0 to 30.0	-	-	-
	Stalk borer	0.0 to 10.0	-	-	-
	Blister mite	0.0 to 90.0	-	-	New pest
	White grub	0.0 to 4.0/ m^2	-	-	-
	Plant hopper	0.0 to 22.0/ whorl	-	-	New pest
	Whorl weevil	0.0 to 3.0/ whorl	-	-	New pest
	Black bug	0.0 to 15.0/ tiller	-	-	-
Loni (Hardoi)	Early shoot borer	15-20	Co 0238	May-July, 2018	-
	Top borer	20-25			-
Chilbaria and Nanpara Sugar Mill area	Black beetle, *Heteronychus* sp.	5-10	-	-	-
Akheypur and Charkheda (Muzaffarnagar)	Plant hopper, *Eoeurysa flavocapitata*	Low to moderate	-	-	-

Invasive pest, Fall Army Worm (Spodoptera frugiperda) in sugarcane : Fall army worm (FAW) a native to North America was reported from Africa in 2016 and from India and many Asian countries in 2018. This invasive pest has wreaked havoc in ravaging many crops especially maize. Survey of sugarcane crop during 2018-19 revealed the presence of FAW in sugarcane in parts of Tamil Nadu and Andhra Pradesh as reported by ICAR-SBI, Coimbatore and RARS, Anakapalle centres of AICRP (S). Some photographs of FAW taken in sugarcane crop are shown in figure 1 & 2 (Photo Courtesy: Dr B. Bhavani, RARS, Anakapalle).

Fig 1 :FAW feeding on sugarcane

Fig 2: Grown up larva of FAW

Project No. E. 30 : Monitoring of insect-pests and bio-agents

North Western Zone

1. Karnal

A non-replicated experiment with sugarcane variety, Co 0238 was carried out and monitored the incidence of major insect pests and their bio agents of sugarcane at regular interval. The cumulative incidence of pink borer right from shoot stage till harvest of the crop was 9.0 per cent. The incidence of early shoot borer and top borer was below ETL (<15.0 and <10%, respectively). Root borer and termite incidence was 12.6 and 4.4.0%, respectively. It was also observed that black bug; an insect pest of sugarcane ratoon, infested the planted sugarcane crop also during July to October. The mean population of black bug was 1.9/tiller in ratoon and 13.0/canes. Stalk borer incidence, intensity and infestation index were 24.8%, 11.5% and 2.8, respectively. The Pyrilla population was 0.2 individual/20 leaf. Among bio agent's, *Epiricania melanoleuca*, identified as an effective parasitoid of pyrilla nymphs and adult's with 2.6 per cent parasitisation. *Tetrasticus pyrillae*, an egg parasitoid of pyrilla, parasitized 3.3 per cent egg masses. *Isotima javensis* and *Stenobracon deesae* parasitisation of top borer larvae was 2.3 and 1.6 per cent respectively. *Cotesia flavipes* was identified as a larval cum pre pupal parasitoid of stalk borer which parasitized 3.3 % stalk borer larvae during the month of September to March in cane.

2. Lucknow

Experiment on monitoring of insect pests of sugarcane was carried out with CoLk 94184. Planting was done in October 17, 2017. Recommended agronomic practices were followed to raise a good crop. Average germination was recorded to the tune of 44.51 per cent. Periodic observations on incidence of insect pests and parasitoids of pests were recorded. Due to termites attack, bud damage ranged from 10 to 25 per cent. Per cent cut end damage of sett was high but in most of the cases buds were intact. Complete sett damage was 0.5 to 1.0 per cent and live workers were also seen (5 to 25 per sett).

Incidence of top borer I, II, III and IV brood was 16.28 to 27.79, 14.25 to 23.11, 5.36 to 30.47 and 5.24 to 18.64 per cent, respectively. Incidence of root borer was 11.76 to 52.94 per cent in September. Incidence of internode borer was 0.00 to 43.47, while the incidence of stalk borer was 8.69 to 58.33 percent. The incidence of *Pyrilla perpusilla* was in traces and its adult and nymph parasitoid, *Fulgoraesia* (*Epiricania) melanoleuca* was also noticed. Mealy bug and black bugs were present in every clump. Parasitoids like *Telenomus beneficiens* (65.0 % on egg mass basis) was recorded to parasitize on top borer eggs. Total parasitisation of top borer was 33.33 %, which was due to *Stenobracon* sp. (4.76%), *Rhaconotus* sp. (18.81%) and *Isotima javensis* (10.39%) and predatory fauna comprising of Coccinellids, spiders and ants at different stages of the crop. Parasitization of internode borer was recorded in traces by *Cotesia flavipes*.

3. Shahjahanpur

An experiment was conducted on sugarcane crop planted in 0.2 ha area with UP 05125 cultivars at Shahjahanpur to monitor the key insect pests and their bio-agents. The incidence of early shoot borer was recorded maximum 5.20% during 24th SMW followed by 4.00%, 3.00% and 2.60% during 20th, 29th and 16th SMW, respectively. The incidence of top borer was recorded maximum 4.50% during 35th SMW followed by 3.20%, 3.00%, 1.50% and during 31st , 26th, 22nd and 38th SMW, respectively. The percent incidence of stalk borer (on cane basis) was recorded maximum 17.50% during 43rd followed by 13.25% during 38th SMW, respectively. The bio-agents viz., *Telenomus beneficiens, Isotima javensis, Rhaconotus scirpophagae* and *Stenbracon deesae* were recorded as major parasitoids of top borer. *Cotesia flavipes*, a larval parasitoid of stalk borer was also recorded from fields. The peak activity of egg-parasitoid, *T. beneficiens* was observed to be 10.00% during 31st SMW and declined up to 2.50% during 35th SMW. A parasitisation of larvae by *Isotima javensis* was observed from 22nd SMW (1.00%) and increases up to 4.00% during 31th SMW thereafter decreases up to 1.00% during 38th SMW. The parasitisation of top borer by *Rhaconotus scirpophagae* was recorded minimum (1.00%) during 26th SMW which increased up to 4.00% during 35th SMW thereafter decreases up to 1.50% during 38th SMW. The parasitisation of *Stenobracon deesae* was ranged from 1.50% during 31st SMW to 3.10% during 38th SMW. The parasitisation of stalk borer larvae by *Cotesia flavipes* was recorded maximum 9.10% during 43rd SMW (Table 3a, b).

Peninsular Zone

1. Akola

The insect pests recorded on sugarcane var. Co-86032 during 2018-19 were early shoot borer, scales, *Pyrilla*, White fly and aphids. However, the incidence of aphids, white fly and *Pyrilla* was patchy and very meager. The seasonal incidence revealed that the damage due to early shoot borer was initiated during the 7th meteorological week i.e. 12th Feb 2018 (10.47% DH) and it was continued up to 30th MW. The incidence of scale insect initiated during 37th MW (40% incidence and 8.18% intensity) and it continued up to 52nd MW. The incidence of *Pyrilla* initiated during 30th MW (0.78 per leaf) and it continued up to 42nd MW. The maximum *Pyrilla* per leaf was observed on 35th MW (2.25 per leaf, respectively). The Meager population of aphids was noticed. The incidence started from 27th

MW and it continued up to 47th MW and the maximum incidence was noticed on 33rd MW i.e. 27 aphids per 3 leaves.The meager population of White fly was noticed. The incidence started from 27th MW and it was continued up to 46th MW the maximum incidence was noticed on 41st MW i.e. 9 white flies per 3 leaves. The natural enemies such as Ladybird beetles and spiders were observed from 7th MW and continued up to 52nd MW.

The data obtained were subjected to correlation study with incidence of pests and weather parameters. Early shoot borer incidence has shown non-significant correlation with morning relative humidity, evening relative humidity, rainfall and maximum temp. Similarly, in case of scales, the incidence of scales has also shown non-significant correlation with rainfall and relative humidity at evening and it showed significant correlation with relative humidity at morning hours, max. temperature and min. temperature. In case of *Pyrilla*, it showed significant correlation with relative humidity at morning and evening hours and max. temperature and non-significant with min. temperature and rainfall.

2. Coimbatore

In monitoring plot, early shoot borer incidence was 6.56, 3.36, 6.48 and 3.48 in the months of March, April, May and June 2018 respectively. Pyrilla and sheath mite were found in traces in April. Highest internode borer incidence (7.2%) was observed in December 2018. *Telenomus dignus* was active against internode borers throughout year and maximum parasitization was recorded up to 100%. Woolly aphid was observed during October-November 2018 in two small patches with an average leaf rating of 0.9. The parasitoid *Encarsia flavoscutellum* was active at 9.0% parasitism level.

3. Mandya

Cumulative incidence of early shoot borer in Co 86032 sugarcane variety was 23.35 % in the first four months after planting. Incidence of top borer was 23.98% at 7th month. Incidence of internode borer was 29.60%. Low incidence of aphid, whitefly, and pyrilla recorded. Woolly aphid incidence was observed at 150 and 180 days after sowing and it was restricted to few clumps. *Dipha* (2-3 larva/leaf), *Micromus* (2larva/leaf) and *Encarsia* (7-8 adults/leaf) kept the woolly aphid under control. Sugarcane pink mealy bug *S. sacchari* infested 8.50% millable canes with 22.65% intensity.

4. Padegaon

Incidence of early shoot borer ranged from 0.88 to 30.29 per cent. The peak incidence of early shoot borer was observed to the tune of 30.29 per cent in 19 MW (7 to 13 May, 2018). The parasitism of *T. chilonis* was observed during 16 to 27 MW to the maximum parasitization of 2.33 per cent. The incidence of *Pyrilla* per leaf ranged from 1 to 5. Up to 40% parasitization of eggs by *T. pyrillae* and up to 30% paratization of *Pyrilla* by *E. melanoleuca* was observed. The first incidence of woolly aphid was observed in 32 MW (Aug. 6 to 12) and it was 1 woolly aphid per leaf. However, the peak incidence was observed in 40 MW (Oct. 1 to 7) and it was 21.64 woolly aphid per leaf. The parasitoid, *Encarsia flavoscutellum* population ranged from 1 to 84 per 150 leaves and peak was observed in 45 MW of 2018 (Nov. 05 to 11). The predator, *Micromus igorotus* population ranged from 1 to 16 per 150 leaves and peak was observed in 43 MW of 2018 (22-28 Oct). The peak predatism of *D. aphidivora* on woolly aphid was observed in 40 MW (Oct. 1 - 7) and it was 31 *Dipha* per 150 leaves. The Syrphids were observed since 42 MW to 49 MW and peak activity was recorded in 45 MW. The chrysopids were observed in traces. The mealybug incidence ranged from 1.10 to 7.27 per cent and incidence was observed since 35 to 44 MW. *Coccinella septempunctata* were recorded up to 4 nos. per cane and *Cheilomenes sexmaculata* up to 2 nos. per cane.

5. Pune

The per cent incidence of early shoot borer was maximum 7.11 per cent in April 2018. The incidence, intensity and infestation Index of internode borer was to the maximum of 10, 1.30 and 0.13 per cent in August 2018. while it was free from it in June 2018. The incidence and intensity of Mealy bug was 1.0 and 0.30 per cent in the month June 2018. The experimental plot was free from scale insect infestation.

East Coast Zone

Anakapalle

Incidence of early shoot borer was observed with maximum incidence during the month of June (10.60% DH) on 93 A 145 variety due to distributed rainfall during formative stage of the crop. Parasitization by *T. chilonis* was recorded up to 5.9 per cent. Incidence of internode borer was recorded up to 32 per cent in December, 2018. Along with incidence of sugarcane aphid (*Melanaphis sacchari),* rusty plum aphid, *Hysteroneura setariae* were also observed from July month with maximum incidence during August month (33-44/leaf & 68-80/leaf). Very low incidence of *Pyrilla perpusilla* and derbid leaf hoppers (*Proutista moesta*) were observed from August-November months with maximum parasitisation of *Encarsia* (6.0%) and *Epiricania* (2.0%) during the month of November. In case of whitefly, along with *Aluerolobus barodensis* another whitefly species *Neomaskellia bergii* (Spotted whitefly) was also observed during the crop season. The spotted whitefly, *Neomaskellia bergii* initiated from September month with peak incidence

during December month (5-10/leaf), whereas *Aluerolobus barodensis* observed during December- January months. Maximum incidence of white woolly aphid, *Ceratovacuna lanigera* (>50-100% leaf area) was observed during the month of January due to low minimum temperatures (14-220C) and high relative humidity (86-92%) prevailed during November-December months and maximum incidence of scale insect, *Melanaspis glomerata* (22%) was observed during the month of February due to drought conditions prevailed during grand growth stage.

E.34: Standardization of simple and cost effective techniques for mass multiplication of sugarcane bio-agents

North Western Zone

Lucknow

Eumicrosoma spp. (Hymenoptera : Scelionidae) is a potential egg parasitoid of black bugs of sugarcane, *Cavelerious sweeti* Myamoto and *Dimorphopterus gibbus* and other Hemipteran insect pests. *Eumicrosoma* spp. is mass multiplied in the laboratory on laboratory reared black bugs of sugarcane. Black bugs are mass multiplied on natural host plant in the laboratory and *Eumicrosoma* spp. mass multiplied on eggs of black bug through the method developed by Maha Ram Singh at ICAR: IISR, Lucknow in 2007.

Rearing of black bug, Dimorphopterus gibbus (Fabricius) and Cavelerius Sweeti Myamoto

Rearing of black bug is carried out in two steps.

Muslin bag for oviposition: Three to four cut tops of sugarcane with 5 cm leaf portion were kept in a muslin bag measuring 20.0 x 8.0 cm and field collected male & female (1:1) were released into the bag. In one bag 50 pairs of insect can be accommodated. After release of insects open end of bag were closed with rubber bands and kept in tray for egg laying. Eggs are found glued to the bottom of tray which were collected daily and stored in homoeopathic vials at ambient room temperature for further development. Fresh eggs are rice shaped and creamy white in colour. At maturity eggs become dark orange in colour.

Paper cone for nymph development: Paper cone was developed from a sterilized paper of 25 cm^2 size and cut cane (8-10) with leaf sheath. One such cut piece of sugarcane stalk was placed at the lower left corner of the paper and rolled in a manner that it takes the shape of cone without touching the upper end of the cut stalk. Narrow end of the paper cone was tightened with the help of rubber bands. Mature egg (orange in colour) or freshly hatched nymphs were released to the paper cone and its upper broader end is closed by folding twice and inserting the rear corner of the second fold into the first one. Dried out setts and leaf tops were changed at an interval of 4-5 days in summer and 5-6 days in winter and rainy seasons. During change of insect from old cone to new ones due precaution of mechanical damage should be taken care. Incubation, nymphal and total period of lifecycle varied from 6.0 to 10, 23 to 47, 31 to 57 days, respectively.

Mass multiplication of Eumicrosoma sp. (Hymenoptera: Sceilionidae) an egg parasitoid of Lygaeid bugs of sugarcane

Eumicrosoma sp. is a potential egg parasitoid of black bug of sugarcane. Biology and rearing of *Eumicrosoma* sp. was developed at IISR, Lucknow. Nucleus culture of the parasitoid was maintained in the laboratory. *Eumicrosoma* sp. is a black shiny Sceilionid wasp. Eggs of black bug *D. gibbus* were used as laboratory host. Fresh eggs (fresh or 24 hour old) are offered to the gravid female in homoeopathic vials for parasitization. Parasitized eggs became blackish in colour from one end and in few days turned completely black to shiny black just before hatching. No super parasitism was observed. Parasitization ranged from 38.00 to 89.00 percent. Single gravid female could parasitize on an average of 15.67 eggs with a range of 5-22 eggs. Development period of parasitoid varied from 7-11 days. Parasitisation and longevity of adults varied from 62.5 to 82.50 per cent and 1-3 days, respectively.

Peninsular Zone

1. Coimbatore

For economizing mass culture of entomopathogenic fungi (EPF), media based on agricultural by products and several grains were assessed with and without addition of peptone at different concentrations (5, 10 and 15%). For production of *Metarhizium anisopliae*, no differences among the concentrations used was observed among the byproducts *viz*., extracts of rice bran, wheat bran, red gram husk, sesame seed cake, groundnut cake, cotton seed cake along with peptone supplement which were compared with Jaggery and SD medium. The spore production ranged between 2.13 x 10^9/100ml (cotton seed cake) to 8 x 10 ^{9}/100ml (wheat bran). When the media was assessed without peptone supplement, irrespective of the concentration, the effect of media showed overlapping levels of significant variation. Cotton seed cake was the best (7.3 x 10^9/100ml) which was on par with Jaggery, wheat bran, groundnut cake (4.8 x 10^9/100ml) and SD broth (5.2 x 10^9/100ml). For *Beauveria brongniartii* , irrespective of concentrations tested many media *viz*., coconut seed cake (11.93 x 10^7 / ml), rice bran extract (11.02 x 10^7 /ml), wheat bran (11.67 x 10^7 /ml), red gram husk (8.27 x 10^7 /ml) and cotton seed cake (5.8 x 10^7 /ml) were on par and significantly better than the others. Wheat bran at 15% and rice bran extract at 15% were most cost effective.

2. Padegaon

The allotted bio-agent for multiplication was *Chrysoperla carnea*. This bio-agent was tried to multiply on sugarcane woolly aphid in field. The experiment was planted on 13.03.2018 with regular variety Co 86032. The incidence of woolly aphid occurred in 32 MW i.e. 06-12 August of 2018 (1 woolly aphid per leaf). However, it was continued up to 51 MW of 2018. The fifty per cent green shade net of 5 m x 5m x 5m were erected for mass multiplication of *Chrysoperla carnea (Chrysoperla zastrowi sillemi)***.** The inundative releases of woolly aphids were done since 34 to 48 MW for more development of woolly aphid culture in shade net. Overall 26 to 42 per cent leaves were covered with woolly aphid by 39 MW. Egg masses (1-3) and larvae (4-5) of *Chrysoperla zastrowi sillemi* were released in 41-45 MW in shade net. The honey and water solution in Petri-plates were also kept in shade net. The caster flowers were also kept for alternate days to enhance the fecundity of *Chrysoperla.* Average 2-5 neonate larvae were observed per stool from 45 MW to 51 MW of 2018. However, the bio agents, *viz., Micromus igorotus, Dipha aphidivora* and *Encarsia flavoscutellum* were also observed in shade net. In conclusion, *Chrysoperla carnea (Chrysoperla zastrowi sillemi)* can be multiplied 2-5 numbers neonate larvae per stool of sugarcane in fifty per cent green shade net.

3. Pune

During 2018-19, Entomology Section produced Corcyra eggs 1265.2 cc (251.24 lac) with a monthly average of 104.68 cc (20.94 lac). Produced 976 Tricho cards of *Trichogramma chilonis* parasitoids with a monthly average 81.33 cards. Supplied 671 Tricho cards for the control of borers on 44.33 ha area and 125 cc Corcyra Eggs to Govt. Bio-control lab in Maharashtra state as nucleus culture.

East Coast Zone

Anakapalle

Pyrilla adults were collected from the field and reared under laboratory at 25^0 to 26^0C temperature. The glass jar, having 15 cm diameter and 20 cm height, was used for rearing. The bottom of the jar was filled with 4 to 5 cm thick layer of sterilized moist sand. About 10 cm long leaf cut, 6 to 7 per jar were vertically thrust in the sand layer of glass jar. In each jar, 4-5 pairs of male and female *Pyrilla*, collected from the field, were released for egg laying purpose. The top of the jar was covered with muslin cloth by using rubber band. On hatching of the eggs, the nymphs were transferred daily with the help of a fine hair brush to same type of glass jar, prepared for rearing adults. After allowing 4-5 days feeding without disturbance in the same jar, the nymphs were transferred to another jar, wherein they were further reared for 4-5 days and transferred to next jar. The same process continued till adult emergence. After production of *Pyrilla* nymphs and adults, field collected egg mass or cocoons of *Fulgoraecia melanoleuca* were released in the glass jars. Fresh leaves of sugarcane were added at 3 to 4 days interval simultaneously, dried leaves were removed from the Jar. By this technique, harvested eggs and cocoons of *F. melanoleuca* was produced and utilised for field release programme. A total of 171 cocoons and 23 egg masses of *F. melanoleuca* were multiplied and utilized for release in IPM module plot .

E. 38: Formulation and validation of IPM Module of sugarcane insect-pests

North Western Zone

Shahjahanpur

The experiment was conducted on half acre plot size with variety UP 05125 as a treated and half acre plot as untreated. Both the plots were separated by keeping 100 meter distance. All the IPM module of sugarcane insect pests was adopted in treated plot. The IPM treatments included deep ploughing for exposure of white grub predation, cane setts planting of healthy cane setts treated for 2 minutes in the solution of chlorpyriphos 25% EC @ 40 ml in 10 liter of water, soil application of chlorantraniliprole 0.4G @ 22.5 kg/ha at the time of planting, collection and destruction of egg masses and damaged shoots, setting up of sex pheromone traps two week of planting @ 27/ha (lure changed at an interval of 45 days), spraying of chlorantraniliprole 18.5 SC @ 375 ml/ha at 60 DAP, detrashing of lower leaves, removal of egg masses of pyrilla and infested canes at 90 days, detrashing of lower leaves after 150 days & spraying of clothianidin 50 WDG @ 250 gm/ha after detrash lower leaves. The untreated block was raised under farmer's practice. The IPM block recorded 53.13 percent germination against 45.15 percent in untreated block. The treated block recorded minimum cumulative incidence of shoot borer (1.48%), 3rd brood of top borer (0.21%), 4th brood of top borer (2.40%) and at harvest (6.67%) against 3.87, 2.28, 5.08 and 8.67 percent in the untreated block, respectively. Regarding the stalk borer infestation the infestation index was 2.52 in IPM block against 3.67 in untreated block. The IPM block recorded higher number of tillers (107000/ha), millable canes (78000/ha) and cane yield (57.20 MT/ha) against 85000, 69000/ha and 48.5 MT/ha, respectively in the untreated block. The per cent increase in germination, no. of tillers, millable canes and cane yield was 17.67%, 25.88%, 13.04% and 17.93% respectively in IPM over untreated block,. Regarding the growth attributes the IPM block received average total cane height (2.36 m) millable cane height (1.59 m), number of internodes (21) and cane girth (1.39 mm) against 2.29, 1.30 and 20 and 1.37 respectively in untreated block.

Peninsular Zone

1. Mandya

In IPM plot, the incidence of major pests was low compared to farmers practice plot. Apart from this, the yield of IPM plot was 24.18 percent more than the farmers practice plot, with the cost benefit ratio of 1:4.36 in favour of IPM practice.

2. Padegaon

Lowest cumulative incidence of early shoot borer recorded in IPM block (6.40 %) as compare to farmers practice block (27.10%). Internode borer incidence and intensity was less in IPM block 16 and 1.43 per cent as compare to farmers practice 32 and 4.06 per cent during harvesting stage. IPM block recorded 80.82 thousand millable canes per ha as compare to farmers practice 70.90 thousand /ha. In IPM block higher cane yield (105.86 t /ha) was recorded as compare to farmers practice (78.35 t /ha).

3. Pune

The cumulative percent incidence of early shoot borer was 1.84 per cent in IPM block, while 11.23 per cent in farmers practice block. At harvest plant population per ha was statistically high 65643 in IPM Block and it was 51714 in farmers practice block. At harvest sugarcane yield per ha was high 179.20 in IPM block and it was 115.84 in farmers practice Block. B:C ratio was 4.66 in IPM plot, while it was 3.36 in farmers practice block.

East Coast Zone

Anakapalle

In IPM module less incidence of early shoot borer, internode borer and more number of shoot population at 120 DAP (4.62 % DH, 48.43% , 69,330 /ha) were recorded compared to zonal recommendation (15.48% DH, 64.98%, 64,875 / ha) whereas in untreated control, high incidence of early shoot borer, internode borer (31.81 % DH, 80 %,) and less number of shoots at 120 DAP (52,515 /ha) were recorded. Growth parameters *viz.*, average total cane length (2.26m), millable cane length (2 m), number of nodes (21) and cane girth (2.46cm) were relatively more in IPM module compared to zonal recommendation (1.90 m, 1.75m, 19 & 2.4cm). Superior cane yield was recorded in IPM module (70.20t/ha) compared to zonal recommendation (68.80t/ ha) whereas in untreated control it was 57.80 t/ha.

E. 39 : Pilot evaluation of waterless pheromone traps and water basin pheromone traps against sugarcane borers

Peninsular Zone

1. Mandya

Four different types of waterless pheromone traps were compared with wota water trap for their efficacy in trapping sugarcane borer pests. This experiment was conducted with eight treatments with four replications against ESB for six weeks. All the waterless traps and wota water trap failed to trap more than one moth per week. This may be because of lower incidence of the pest or it may be because of the problem associated with the trap.

2. Padegaon

The highest mean number of moth catches in case of early shoot borer, internode borer and stalk borer were recorded in 20 MW (15.5 numbers) i.e. during 14 to 20 May of 2018 followed by 19 MW (10.75 numbers). In case of 20th MW Waterless pheromone trap (Delta-Plus) and Waterless pheromone trap (Delta-no windows) recorded highest total number of moth i.e. 29 and 23, respectively. In treatment Water basin pheromone trap (standard-check) moth caches were very negligible as compared with other treatments. No caches were found in 17 MW i.e. during 23 to 29 April of 2018. Overall 8, 65, 67 and 39 moths were caught in Water basin pheromone trap (standard-check), Waterless pheromone trap (Delta-Plus), Waterless pheromone trap (Delta-no windows) and Waterless pheromone trap (Delta-Small) respectively.

Pune

Maximum 0.83 Early shoot borer adults were trapped per week in waterless pheromone trap (Delta small), while in water basin pheromone trap (Standard) early shoot borer adults were not trapped. Internode borer adults were not trapped in any of the four traps.

East Coast Zone

Anakapalle

Water less pheromone trap-Delta plus captured highest number of early shoot borer (19 ESB moths/trap) and internode borer (68 INB moths/trap) and found effective in capturing sugarcane borer moths compared to Waterless pheromone trap (Delta-no windows) (14 ESB moths/trap; 22 INB moths/trap), Waterless pheromone trap (Delta – Small) (5 ESB moths/trap; 22 INB moths/trap) and water basin pheromone trap (4 ESB moths/trap; 0 INB moths/ trap).

Field incidence of early shoot borer ranged from 22.60 per cent DH in Water trap (T1) to 25.5 per cent DH in Delta-plus trap (T2) and showed positive correlation with ESB moth catches. However, no significant difference was observed in between treatments where as field incidence of internode borer ranged between 50.0 per cent in Delta traps - no windows (T3-) and 56.67% in water less pheromone traps-Delta plus traps (T2) and showed positive correlation with INB moth catches. No significant differences were observed among the treatments with respect to cane yield and the cane yield ranged between 57.93 t/ha in Delta plus trap (T2) and 58.80 t/ha in Delta- trap-no windows (T3).

Summary

- During the year 2018-19, six projects were conducted in entomology discipline of AICRP (S) at 9 centres (regular and voluntary) under 3 different sugarcane producing zones of India.
- In North West Zone, out of all the genotypes/ varieties screened against major insect pests, highly susceptible were CoPb 14211, CoH 13263 against top borer; CoPant 13244, CoH 13263, Co 14185, Co 0238 against root borer; Co 13034, Co 05011, CoLk 13204, Co 0238 against stalk borer and Co 0238 against internode borer. Rest other genotypes/ varieties were either less of moderately susceptible.
- In Peninsular Zone, genotypes/ varieties viz., Co 12007, CoSnk 13106, CoSnk 05103, Co 15018, Co 15020, Co 15021, CoVC 15061, CoSnk 05103 were either less or moderately susceptible while rest all were highly susceptible against early shoot borer. In AVT (Ratoon) none of the genotype were highly susceptible early shoot borer. Against internode borer, all the genotypes were highly susceptible except CoSnk 15101, CoVC 15065, Co 86032. In AVT (Ratoon) except Co 12007, all genotypes were either less of moderately susceptible internode borer. All the genotypes were highly susceptible against mealy bugs except CoN 13072, Co 13009, Co 13014, Co 13020, CoC 671, VSI 12121. Genotypes/ varieties viz. Co 13003, CoSnk 13101, Co 13006, Co 13008, Co 13009, Co 13013, Co 14005, Co 15002, Co 15007, CoSnk 15102, CoVSI 15121, Co 15009, Co 15010, Co 15015, Co 15017, Co 15020, Co 15021, CoN 15072, CoSnk 15104, CoVC 15061, PI 15132, VSI 15122, CoC 671 and CoSnk 05103 were highly susceptible against scale insects and rest others were either less or moderately susceptible. None of the genotypes/ varieties were highly susceptible to Pyrilla, top borer and sugarcane woolly aphid.
- In East Coast Zone, none of the genotypes/ varieties were highly susceptible to early shoot borer. Genotypes/ varieties viz., CoV 15356, CoC 15336, CoC 15338, CoC 01061, CoA 92081, CoA 14323, PI 14377 and 93 A 145 were highly susceptible to internode borer and rest others were either less or moderately susceptible.
- High incidence of sugarcane insect pests viz., early shoot borer, root borer, internode borer, top borer, cut worm, white grub, scale insect, white fly, mealy bug, web mite, sugarcane woolly aphid, rusty plum aphid, thrips, black bug were reported from different parts of the country. Some uncommon insect pests viz., plant hopper (*Eoeurysa flavocapitata*), blister mite, whorl weevil were also reported. Invasive insect pest, Fall army worm (*Spodoptera frugiperda*) was reported on sugarcane from Andhra Pradesh and Tamil Nadu by RARS, Anakapalle and ICAR-SBI, Coimbatore.
- The bioagents, viz., *Telenomus dignus, Telenomus beneficiens, Isotima javensis, Cotesia flavipes, Rhaconotus scirpophagae, Encarsia flavoscutellum, Fulgoraesia* (*Epiricania*) *melanoleuca, Stenobracon deesae, Stenobracon* sp. *Tetrasticus pyrillae Encarsia flavoscutellum, Dipha aphidivora, Coccinella septempunctata, Cheilomenes sexmaculata* were found active against different pests in sugarcane.
- Mass multiplication of sugarcane bio-agents using cost effective techniques was done for *Trichogramma chilonis, Eumicrosoma* sp., *Chrysoperla zastrowi sillemi, Fulgoraecia melanoleuca , Beauveria brongniartii* and *Metarhizium anisopliae* for use against various insect pests.
- Low incidence of insect pests with higher yield and B:C ratio was recorded in IPM plots as compared to farmers' practice in all the experiments conducted by different centres.
- Waterless pheromone trap (Delta trap) was found better in catching moths of early shoot borer and internode borer over water basin pheromone trap. However, erratic results at few centres could be due to low natural population of the moths.

EXECUTION OF AICRP (S) TRIALS AT DIFFERENT CENTERS DURING 2018-19

S. No.	Name of the Centre	Discipline	Trials assigned	Trials conducted	
				YES	NO
PENINSULAR ZONE					
1.	Akola	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	IVT, AVT-I P, AVT-II P,	AVT-R
		Agronomy	AS 68, AS 70, AS 71, AS 72, AS 73, AS 74	NIL	ALL
		Plant Pathology	PP 31	ALL	NIL
		Entomology	E 4.1, E 28, E 30, E 38,	E 4.1, E 30	E 28, E 38,
2.	Coimbatore	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	ALL	NIL
		Agronomy	AS 68, AS 70, AS 71, AS 72, AS 74	AS 72	AS 68, AS 70, AS 71, AS 74
		Plant Pathology	PP 14, PP 14A, PP 17A, PP 17B, PP 17D, PP 22, PP 33	ALL	NIL
		Entomology	E 4.1, E 28, E 30, E 34, E 38,	E 4.1, E 28, E 30, E 34	E 38
3.	Kolhapur	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	ALL	NIL
		Agronomy	AS 68, AS 70, AS 71, AS 72, AS 73, AS 74	AS 68, AS 72, AS 73	AS 70, AS 71, AS 74
4.	Mandya	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	ALL	NIL
		Entomology	E 4.1, E 28, E 30, E 34, E 38,	E 4.1, E 28, E 30, E 34	E 38,
5.	Navsari	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	ALL	NIL
		Plant Pathology	PP 14, PP 17A, PP 17B, PP 17C, PP 17D, PP 22, PP 23	ALL	NIL
6.	Padegaon	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	ALL	NIL
		Entomology	E 4.1, E 28, E 30, E 34, E 38, E 39	ALL	NIL
7.	Perumalapalle	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	ALL	NIL
8.	Powarkheda	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	ALL	NIL
		Agronomy	AS 68, AS 69, AS 70, AS 71, AS 72	Not reported	
9.	Pravaranagar	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	ALL	NIL
10.	Pugalur	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	IVT	AVT-I P, AVT-II P, AVT-R
11.	Basmath Nagar	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	IVT, AVT-I P, AVT-II P	AVT-R
12.	Kawardha	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	IVT	AVT-I P, AVT-II P, AVT-R
13.	Pune	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	ALL	NIL
		Agronomy	AS 68, AS 70, AS 71, AS 72, AS 73, AS 74	AS 70, AS 71, AS 72	AS 68, AS 73, AS 74
		Plant Pathology	PP 17B, PP 17D, PP 22, PP 31, PP 32, PP 33	PP 17B, PP 17D, PP 22, PP 31, PP 33	PP 32
		Entomology	E 4.1, E 28, E 30, E 34, E 38, E 39	ALL	NIL
14.	Rudrur	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	ALL	NIL
15.	Sameerwadi	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	ALL	NIL

16.	Sankeshwar	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	ALL	NIL
		Agronomy	AS 68, AS 70, AS 71, AS 72, AS 73, AS 74	AS 68, AS 71, AS 72, AS74	AS70, AS 73
17	Thiruvalla	Plant Breeding	IVT, AVT-I P, AVT-II P, AVT-R	ALL	NIL
		Plant Pathology	PP 14, PP 14A, PP 17A, PP 17D, PP 22, PP 17 B	PP 14, PP 14A, PP 17A, PP 17 D, PP 22	PP 17B
		Entomology	E 4.1, E 28, E 30, E 34, E 38	NIL	ALL
East Coast Zone					
1.	Anakapalle	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-II P, AVT (M)-R	ALL	NIL
		Plant Pathology	PP 14, PP 14A, PP 17A, PP 17B, PP 17C, PP 17D, PP 22, PP 23, PP 31, PP 33	ALL	NIL
		Entomology	E 4.1, E 28, E 30, E 34, E 38, E 39	ALL	NIL
2.	Cuddalore	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-II P, AVT (M)-R	ALL	NIL
		Plant Pathology	PP 14, PP 14A, PP 17A, PP 17B, PP 17D, PP 22, PP 23, PP 31, PP 33	ALL	NIL
3.	Nayagarh	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-II P, AVT (M)-R	ALL	NIL
		Agronomy	AS 68, AS 70, AS 72 (M), AS 72 (E), AS 74	AS 68, AS 70, AS 72 (M), AS 74	AS 72 (E)
4.	Nellikuppam	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-II P, AVT (M)-R	ALL	NIL
5.	Vuyyuru	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-II P, AVT (M)-R	ALL	NIL
North Central Zone					
1.	Bethuadahari	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P	ALL	NIL
		Agronomy	AS 70, AS 72 (M), AS 72 (E), AS 73, AS 74	AS 70, AS 72 (M), AS 72 (E), AS 74	AS 73
2.	Motipur	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P	ALL	NIL
		Plant Pathology	PP 17A, PP 17B, PP 17C	ALL	NIL
3.	Pusa	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P	ALL	NIL
		Agronomy	AS 68, AS 70, AS 71, AS 72(E), AS 72 (M), AS 73, AS 74	AS 68, AS 70, AS 72(E), AS 72 (M), AS 74	AS 71, AS 73
		Plant Pathology	PP 14, PP 14A, PP 17A, PP 17B, PP 17C, PP 17D, PP 22, PP 23, PP 31	ALL	NIL

4.	Seorahi	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P	ALL	NIL
		Agronomy	AS 68, AS 70, AS 71, AS 72 (E), AS 72 (M), AS 73, AS 74	AS 68, AS 70, AS 72 (E), AS 72 (M)	AS 71, AS 73, AS 74
		Plant Pathology	PP 14, PP 14A, PP 17A, PP 17B, PP 17D, PP 22, PP 23, PP 31	ALL	NIL
North Eastern Zone					
1.	Buralikson	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P	AVT (E)-I P, AVT (E)-II P, AVT (E)-R	IVT (E), IVT (M), AVT (M)-I P
		Plant Pathology	PP 17A, PP 22	ALL	NIL
North West Zone					
1.	Faridkot	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P, AVT (M)-II P, AVT (M)-R	ALL	NIL
		Agronomy	AS 68, AS 70, AS 71, AS 72(E), AS 72(M), AS 73, AS 74	ALL	NIL
2.	Karnal (SBI)	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P, AVT (M)-II P, AVT (M)-R	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R,	IVT (M), AVT (M)-I P, AVT (M)-II P, AVT (M)-R
		Plant Pathology	PP 14, PP 14A, PP 17A, PP 17D, PP 22, PP 23	ALL	NIL
		Entomology	E 4.1, E 28, E 30, E 38	E 4.1, E 28, E 30	E 38
3.	Kota	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P, AVT (M)-II P, AVT (M)-R	IVT (E), AVT (E)-I P, AVT (E)-II P, IVT (M), AVT (M)-I P, AVT (M)-II P,	AVT (E)-R, AVT (M)-R
		Agronomy	AS 68, AS 70, AS 71, AS 72(E), AS 72(M), AS 73, AS 74	AS 70, AS 71, AS 72(E), AS 72(M), AS 73, AS 74	AS 68
4.	Lucknow	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P, AVT (M)-II P, AVT (M)-R	ALL	NIL
		Agronomy	AS 68, AS 70, AS 71, AS 72(E), AS 72(M), AS 73, AS 74	ALL	NIL
		Plant Pathology	PP 14, PP 14A, PP 17A, PP 17B, PP 17C, PP 17D, PP 22, PP 33, PP 23	PP 14, PP 14A, PP 17A, PP 17B, PP 17C, PP 17D, PP 22, PP 23	PP 33,
		Entomology	E 4.1, E 28, E 30, E 34, E 38, E 39	E 4.1, E 28, E 30, E 34	E 38, E 39
5.	Kapurthala	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P, AVT (M)-II P, AVT (M)-R	ALL	NIL
		Plant Pathology	PP 14, PP 14A, PP 17A, PP 17B, PP 17C, PP 17D, PP 22, PP 23, PP 31	ALL	NIL
6.	Muzaffarnagar	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P, AVT (M)-II P, AVT (M)-R	ALL	NIL

7.	Pantnagar	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P, AVT (M)-II P, AVT (M)-R	ALL	NIL
		Plant Pathology	PP 17A, PP 17B, PP 17D, PP 22, PP 33	PP 17A, PP 17B, PP 17D, PP 22	PP 33
8.	Shahjahanpur	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P, AVT (M)-II P, AVT (M)-R	ALL	NIL
		Agronomy	AS 68, AS 70, AS 71, AS 72(E), AS 72(M), AS 73, AS 74	ALL	NIL
		Plant Pathology	PP 14, PP 14A, PP 17A, PP 17B, PP 17D, PP 22, PP 23, PP 31	ALL	NIL
		Entomology	E 4.1, E 28, E 30, E 38, E 39	ALL	NIL
9.	Sriganga-nagar	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P, AVT (M)-II P, AVT (M)-R	ALL	NIL
		Agronomy	AS 68, AS 70, AS 71, AS 72, AS 73, AS 74	NIL	ALL
10.	Uchani	Plant Breeding	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R, IVT (M), AVT (M)-I P, AVT (M)-II P, AVT (M)-R	IVT (M), AVT (M)-I P, AVT (M)-II P, AVT (M)-R	IVT (E), AVT (E)-I P, AVT (E)-II P, AVT (E)-R
		Agronomy	AS 68, AS 70, AS 71, AS 72(E), AS 72(M), AS 73, AS 74	ALL	NIL
		Plant Pathology	PP 14, PP14A, PP 17A, PP 17 B, PP 17D, PP 22, PP 23, PP 31, PP 33	ALL	NIL

PERFORMANCE OF CENTRES IN CONDUCTING AICRP (S) DURING 2019-19

The performance of all the centres in experimentation in the last three years 2016-17, 2017-18 and 2018-19 (Table-1), their mean performance (Table 2) and performance of centres in conducting experiments in 2018-19 have been appended in Table 3. In 2018-19, 9 AICRP(S) centres have been ranked as Excellent while 8 as Very Good, 4 as Good and 1 as Average on the basis of experimentation of Crop Improvement trials.

Table 1 : Performance of centers in conducting AICRP(S) trials during 2016-17 to 2018-19

Sl. No.	Centre	2016-17				2017-18				2018-19*			
		Conductance (%)	Grading % of conducted trials	Grading incorporating conductance %	Final grading	Conductance (%)	Grading % of conducted trials	Grading incorporating conductance %	Final grading	Conductance (%)	Grading % of conducted trials	Grading incorporating conductance %	Final grading on the basis of conductance and field performance
		A	B	C	D	A	B	C	D	A	B	C	D
Peninsular Zone													
1	SBI, Coimbatore	88.00	90.00	79.20	Very Good	82.61	78.95	65.22	Very Good	100	95.00	95.00	Excellent
2	RS&JRS, Kolhapur	81.82	58.89	48.18	Good	85.36	75.00	64.02	Very Good	100	80.00	80.00	Very Good
3	ZARS, Mandya	100.00	58.89	58.89	Good	82.35	61.43	50.59	Good	100	95.00	95.00	Excellent
4	MSRS, Navsari	100.00	84.80	84.80	Excellent	95.65	73.64	70.44	Very Good	100	95.00	95.00	Excellent
5	CSRS, Padegaon	100.00	90.83	90.83	Excellent	100.00	79.13	79.13	Very Good	100	95.00	95.00	Excellent
6	ZARS, Powarkheda	95.45	60.95	58.18	Good	78.95	65.12	51.41	Good	100	60.00	60.00	Good
7	ARS, Sankeshwar	95.00	85.26	81.00	Excellent	89.47	68.23	61.04	Very Good	100	95.00	95.00	Excellent
8	SRS, Thiruvalla	100.00	55.79	55.79	Good	100.00	71.76	71.76	Very Good	100	70.00	70.00	Very Good
East Coast Zone													
9	RARS, Anakapalle	86.21	83.20	71.73	Very Good	93.10	86.67	80.69	Very Good	100	82.86	82.86	Excellent
10	ARS, Cuddalore	94.44	95.29	89.99	Excellent	94.74	75.56	71.58	Very Good	100	60.00	60.00	Good
11	SRS, Nayagarh	75.00	81.33	61.00	Very Good	85.71	75.56	64.76	Very Good	100	77.14	77.14	Very Good
North Central Zone													
12	SRS, Bethuadahari	64.29	46.67	30.00	Average	53.85	62.86	33.85	Average	100	80.00	80.00	Very Good
13	SRI, Pusa	100.00	88.15	88.15	Excellent	96.15	60.80	58.46	Good	100	66.67	66.67	Very Good
North Eastern Zone													
14	SRS, Buralikson	100.00	58.75	58.75	Good	81.25	56.92	46.25	Good	50	53.33	26.66	Average
North West Zone													
15	RSPAU, Faridkot	100.00	80.00	80.00	Very Good	100.00	78.67	78.67	Very Good	100	100.00	100.00	Excellent
16	ARS, Kota	84.61	56.36	47.69	Good	78.18	80.10	62.54	Very Good	75	56.25	42.19	Good
17	IISR, Lucknow	96.30	76.15	73.33	Very Good	96.43	79.26	76.43	Very Good	100	46.87	46.87	Good
18	RRSPAU, Kapurthala	96.43	68.89	66.43	Very Good	100.00	85.38	85.38	Excellent	100	100.00	100.00	Excellent
19	GBPUAT, Pantnagar	78.95	53.33	42.10	Good	88.46	69.33	61.33	Very Good	100	68.75	68.75	Very Good
20	UPCSR, Shahjahanpur	92.59	88.80	82.22	Excellent	96.15	83.20	80.00	Very Good	100	71.87	71.87	Very Good
21	ARS, Sriganganagar	100.00	68.00	68.00	Very Good	76.92	74.00	56.92	Good	100	75.00	75.00	Very Good
22	RRS, Uchani	91.30	59.05	53.91	Good	100.00	87.62	87.62	Excellent	100	100.00	100.00	Excellent

$$\text{Conductance (\%) } A = \frac{\text{No. of trials conducted}}{\text{No. of trials allotted}} \times 100$$

$$\text{(Grading \% of conducted trials) } B = \frac{\text{Numerical value of grades for experiments (as per D)}}{100}$$

$$C = \frac{A \times B}{100}$$

***Grading of AICRP trials for Crop Improvement 2018-19.**

D = Final grading as per following table

Sl. No.	Score (%) obtained	Rating
1.	81-100	Excellent
2.	61-80	Very Good
3.	41-60	Good
4.	21-40	Average
5.	0-20	Poor

Table 2 : Mean performance of centres in conducting AICRP(S) trials during last three years 2016-17 to 2018-19*

Sl. No.	Centre	Conductance (%)	Grading % of conducted trials	Grading incorporating conductance %	Final grading on the basis of conductance and field performance
		A	B	C	D
1	SBI, Coimbatore	90.20	87.98	79.36	Very Good
2	RS&JRS, Kolhapur	89.06	71.30	63.50	Very Good
3	ZARS, Mandya	94.12	71.77	67.55	Very Good
4	MSRS, Navsari	98.55	84.47	83.24	Excellent
5	CSRS, Padegaon	100.00	88.32	88.32	Excellent
6	ZARS, Powarkheda	91.47	53.13	48.60	Good
7	ARS, Sankeshwar	94.82	82.83	78.54	Very Good
8	SRS, Thiruvalla	100.00	65.85	65.85	Very Good
9	RARS, Anakapalle	93.10	84.24	78.43	Very Good
10	ARS, Cuddalore	96.39	76.95	74.17	Very Good
11	SRS, Nayagarh	86.90	78.01	67.79	Very Good
12	SRS, Bethuadahari	72.71	63.18	45.94	Good
13	SRI, Pusa	98.72	71.87	70.95	Very Good
14	SRS, Buralikson	77.08	56.33	43.42	Good
15	RSPAU, Faridkot	100.00	86.22	86.22	Excellent
16	ARS, Kota	79.26	64.24	50.92	Good
17	IISR, Lucknow	97.58	67.43	65.80	Very Good
18	RRSPAU, Kapurthala	98.81	84.76	83.75	Excellent
19	GBPUAT, Pantnagar	89.14	63.80	56.87	Good
20	UPCSR, Shahjahanpur	96.25	81.29	78.24	Very Good
21	ARS, Sriganganagar	92.31	72.33	66.77	Very Good
22	RRS, Uchani	97.10	82.22	79.84	Very Good

$$\text{Conductance (\%) A} = \frac{\text{No. of trials conducted}}{\text{No. of trials allotted}} \times 100$$

$$\text{(Grading \% of conducted trials) B} = \frac{\text{Numerical value of grades for experiments (as per D)}}{100}$$

$$\text{C} = \frac{\text{A X B}}{100}$$

*Grading of AICRP trials for Crop Improvement 2018-19.

D = Final grading as per following table

Sl. No.	Score (%) obtained	Rating
1.	81-100	Excellent
2.	61-80	Very Good
3.	41-60	Good
4.	21-40	Average
5.	0-20	Poor

Table 3 : Mean performance of AICRP(S) centres in conducting experiments trials during 2018-19*

Sl. No.	Centre	Conductance (%)	Grading % of conducted trials	Grading Incorporating conductance %	Final grading on the basis of conductance and field performance
		A	B	C	D
1	**SBI, Coimbatore**	**100**	**95.00**	**95.00**	**Excellent**
2	RS&JRS, Kolhapur	100	80.00	80.00	Very Good
3	**ZARS, Mandya**	**100**	**95.00**	**95.00**	**Excellent**
4	**MSRS, Navsari**	**100**	**95.00**	**95.00**	**Excellent**
5	**CSRS, Padegaon**	**100**	**95.00**	**95.00**	**Excellent**
6	ZARS, Powarkheda	100	60.00	60.00	Good
7	**ARS, Sankeshwar**	**100**	**95.00**	**95.00**	**Excellent**
8	SRS, Thiruvalla	100	70.00	70.00	Very Good
9	**RARS, Anakapalle**	**100**	**82.86**	**82.86**	**Excellent**
10	ARS, Cuddalore	100	60.00	60.00	Good
11	SRS, Nayagarh	100	77.14	77.14	Very Good
12	SRS, Bethuadahari	100	80.00	80.00	Very Good
13	SRI, Pusa	100	66.67	66.67	Very Good
14	SRS, Buralikson	50	53.33	26.66	Average
15	**RSPAU, Faridkot**	**100**	**100.00**	**100.00**	**Excellent**
16	ARS, Kota	75	56.25	42.19	Good
17	IISR, Lucknow	100	46.87	46.87	Good
18	**RRSPAU, Kapurthala**	**100**	**100.00**	**100.00**	**Excellent**
19	GBPUAT, Pantnagar	100	68.75	68.75	Very Good
20	UPCSR, Shahjahanpur	100	71.87	71.87	Very Good
21	ARS, Sriganganagar	100	75.00	75.00	Very Good
22	RRS, Uchani	100	100.00	100.00	**Excellent**

Conductance (%) A = $\frac{\text{No. of trials conducted}}{\text{No. of trials allotted}}$ **X 100**

(Grading % of conducted trials) B = $\frac{\text{Numerical value of grades for experiments (as per D)}}{100}$

C = $\frac{\text{A X B}}{100}$

D = Final grading as per following table

Sl. No.	Score (%) obtained	Rating
1.	81-100	Excellent
2.	61-80	Very Good
3.	41-60	Good
4.	21-40	Average
5.	0-20	Poor

***On the basis of grading provided monitoring team for Crop Improvement discipline.**

Action Taken Report on the recommendations of the 32nd Biennial Workshop of AICRP on Sugarcane held at the University of Agricultural Sciences, Bengaluru (Karnataka) during October 17-18, 2018 are as under

S. No.	Recommendation	Action Taken
1	It was observed that some of the canters are testing elite clones in Station / multi-location trials in their respective states with selection numbers and entries are being released in the name of selection numbers, which is not as per the AICRP(S) norms. Entries which are entering into station trials must have the AICRP(S) allotted slot numbers. Hence AICRP(S) number may be assigned by the proposing centre for the new entries within the slot number allotted for the centre and proposed for inclusion in the ZVT in the AICRP(S) workshop/group meeting. This will ensure the maintenance of uniform number for the new entries in both station trials and ZVT **(All centres)**	The centre have informed to the Project Coordinator (S), in this regards, most of the centres will be testing elite clones in station/multiplications trials with the AICRP(S) allotted slot number in future. However, Faridkot and Kapurthala centres are already following this procedure.
2	The data submitted by the centre must be carefully scrutinized by the scientist before sending to Principal Investigator (CI). ADG (Commercial crop) has viewed it seriously and noncompliance of the recommendations will invite review of budget of the concerned centre. **(Action: PC and All Centres)**	All the centres have been informed by the Project Coordinator(S) for proper reporting of the data. However, if any discrepancy observed, the necessary action will be taken as per the recommendations.
3	An undertaking must be taken from the farmers / factories when pre released clones are given to them for Adaptive Research Trial. The elite clones may be characterized with DUS morphological descriptors and if possible, DNA finger printing before giving to them. This will give protection to the centres which developed the clones and to avoid wrong claim made by other parties. **(All Centres)**	All the AICRP(S) centres have informed, the undertaking will be taken from the farmers/factories when ever pre-released clones are given to them for Adoptive Research Trials. The elite clones will be characterized with DUS morphological descriptors and DNA finger printing will be done before giving to them.
4	Determination of optimum spacing for planting under experiment AS 72 of Crop Production was differed for the next meeting of AICRP on Sugarcane. It was decided that a consensus should be evolved for optimum spacing in different zones. **(Action: PC(S)/PI (Crop Production)**	Efforts were made to evolve a consensus on the optimum spacing for evaluating AVT genotypes to assess their agronomic potential in different sugarcane producing AICRP (S) zones. Based on feedback from scientists engaged in conducting the trial AS 72 in various zones and also on the basis of results of the field trials for the last 03 consecutive years it is evident that a row distance of 90 cm gives higher cane yield over that of 120 cm in north western, north central and north eastern zones. For peninsular and east coast zones 120 cm row spacing yields higher over 150 cm spacing. Hence the optimum spacing for sub-tropics may be taken as 90 cm and for tropics 120 cm subject to approval in next AICRP (S) meeting as recommended.

5	Under experiment PP14 of Crop Protection, the occurrence of red rot pathotypes in Co 0238 especially in Lucknow, Shahjahanpur, Karnal and Pusa regions of the subtropical India was discussed in detail. It was consented that a rigorous screening and validation was required prior to reporting about the presence of new red rot pathotype. **(Action: PI (Crop Protection–Plant Pathology/ PI (Crop Improvement))**	During the 32nd Biennial Workshop held at UAS Bengaluru, October, 18-19, 2018, the centres in the subtropical region reported red rot in the varieties such asCoS 8436, CoS 07250, Co 89003, Co 0238, CoSe 92423 and CoSe 95422 in varying intensities. These varieties hitherto remained to be free from the disease,have picked up red rot and this indicates that apart from the existing *C. falcatum*pathotypes CF07, CF08 and CF09, new pathogenic variant(s) would have emerged. During workshop the scientists presented data on pathogenic behavior of the isolates from the varieties CoS 8436, CoS 07250, Co 89003 and Co 0238 on the host differentials and the same was discussed in detail. It was felt that without a new pathogenic variant, these resistant varieties would not have succumbed to the disease under field conditions. During the 2018-19 season, about 37 *C. falcatum*isolates isolated from the different varieties CoLk (2), Co 0238 (17), CoS 8436 (6), CoS 97264 (1), CoS 07250 (2), Co 89003 (6), CoSe 92423 (2) and CoSe 95422 (1) were tested on the host differentials. The results indicated a variable disease reaction from the reference pathotypes and results will be discussed in the forthcoming workshop. A clear cut identification of newly emerging pathotypes is essential for an efficient resistance screening in sugarcane. This has been done in the past also by replacing CF01, CF02 and CF03 with CF08 and CF09 in the North West zone and CF07 and CF08 in the North Central zone for red rot testing. As suggested, a thorough testing is being done for the past three seasons on emergence of pathogenic variation in *C. falcatum*in the subtropical region and new emerging pathotype will be designated based on the disease reactions on host differentials.
6	Strict vigil and adequate quarantine measures are required to check the spread of the diseases through seed material . A letter should be written to all the State Govt. Agencies, ISMA, DSTA, SISTA, NISSTA for issuing advisory to all the sugar factories to follow the strict vigil and adequate quarantine measures while importing the seed material from abroad. **(Action: PC(S)**	The Project Coordinator (S) have issued the letters, vide letter no. 2-11(Quarantine) /2019-PCS dated 29th August, 2019 and 5th September, 2019 to all state govt. agencies, ISMA, DSTA, NISSTA, SISTA for issuing advisory to all the sugar factories to follow the strict vigil and adequate quarantine measures while importing the seed material from abroad.
7	The Chairman suggested that at least one/two recommendations regarding preventive measures should also come from entomology discipline for different regions. **(Action: PI (Crop Protection- Entomology)**	No recommendations have been received from the centres.
8	A meeting of all the researchers working on sugarcane may be convened by the PC (S) to discuss and modify the Technical Programme 2018-19 as per the new policy of the Government. **(Action: PC(S)**	An international conference Sugarcon-2019 on "Green technologies for sustainable development of sugar and integrated industries" was organized at ICAR-IISR, Lucknow in collaboration with SSRP during Feb. 16-19, 2019. More than 300 scientists, sugar millers, state govt. officials associated with sugarcane participated. About 30 international delegates from 10 countries also participated in the conference. Various issues including policy issues were discussed in the different technical sessions.

VISIT SCHEDULE OF THE MONITORING TEAMS DURING 2019-20 CROP SEASON

Monitoring Teams for different zones	Centres monitored	Visit schedule
North West Zone		
Team Leader • Dr Sanjeev Kumar, Breeder, ICAR-IISR, Lucknow **Members** • Dr Jyoti Rekha Patnaik, Agronomist, SRS, Nayagarh • Dr Sujeet Pratap Singh, Pathologist, UPCSR, Shahjahanpur • Dr A.B. Tambe, Entomologist, CSRS, Padegaon	Lucknow, Shahjahanpur, Muzaffarnagar, Pantnagar, Karnal, Uchani, Kapurthala, Faridkot, Sriganganagar and Kota	29.11.2019 to 10.12.2019
North Central & North East Zone		
Team Leader • Dr S.N. Sushil, Entomologist, ICAR-IISR, Lucknow **Members** • Dr D.N. Kamat, Breeder, SRI, Pusa • Dr A.P. Dwivedi, Agronomist, ICAR-IISR, Lucknow • Dr Mahaveer Bochalya, Pathologist, RRS, Uchani	Gorakhpur, Seorahi, Pusa, Motipur, Muzaffarpur, Bethuadahari and Buralikson	28.11.2019 to 07.12.2019
East Coast Zone		
Team Leader • Dr S.K. Pandey, Entomologist, SBI-RC, Karnal **Members** • Dr Gulzar S. Sanghera, Breeder, PAURRS, Kapurthala • Dr S.N. Singh, Agronomist, ICAR-IISR, Lucknow • Dr R.C. Patel, Pathologist, MSRS, Navsari	Nellikuppam, Cuddalore, Vuyyuru, Anakapalle and Nayagarh	04.12.2019 to 13.12.2019
Peninsular Zone-I		
Team Leader • Dr S.N. Swamy Gowda, Breeder, ZARS, Mandya **Members** • Dr V.P. Jaiswal, Agronomist, ICAR-IISR, Lucknow • Dr Geeta Sharma, Pathologist, GBPUAT, Pantnagar • Dr Arun Baitha, Entomologist, ICAR-IISR, Lucknow	Coimbatore, Pugalur, Thiruvalla, Mandya Sankeshwar, Sameerwadi, Kolhapur and Perumalapalle	25.11.2019 to 08.12.2019
Peninsular Zone-II		
Team Leader Dr P. Govindaraj, Breeder, ICAR-SBI, Coimbatore **Members** • Prof. S.B. Deshmukh, Agronomist, RS&JRS, Kolhapur • Dr V. Ravichandran., Pathologist, SRS, Cuddalore • Mr R.G. Yadav, Entomologist, VSI, Pune	Pune, Pravaranagar, Padegaon, Akola, Powarkheda, Navsari and Rudrur	05.12.2019 to 13.12.2019

FACILITATOR FOR MONITORING TEAM FOR 2019-2020 CROP SEASON

Sl. No.	Zone	Name & Designation	Contact details
1.	North Central & North Eastern Zones	**Dr S.K. Yadav,** Scientist (Agronomy)	E-mail: sanjaybhu05@rediffmail.com Mob.: 094021-34428
2.	Peninsular Zone-I	**Dr Lalan Sharma,** Scientist (Plant Pathologist)	E-mail: sharmanbaim@gmail.com Mob.: 080040-81721; 08887960911
3.	Peninsular Zone-II	**Dr S.K. Awasthi,** Chief Technical Officer	E-mail: awasthi.shashivind.09@gmail.com Mob.: 094159-11964
4.	East Coast Zone	**Shri Adil Zubair,** Asstt. Chief Technical Officer	E-mail: adizubi64@gmail.com Mob.: 09451086378

CENTRE-WISE FUNDS RELEASED DURING 2018-19 OF AICRP ON SUGARCANE

Table A: B.E. / R.E. sanctioned under AICRP (S) for the year 2018-19

Sl. No.	Grant in Aid Component	Other than NEH	NEH	Total (2+3)
	1	2	3	4
Budget Estimates (B.E.)				
1.	**Grant-in-aid-Salaries**	**877.00**	**85.00**	1015.00
2.	**Grant-in-aid-General**	**153.25**	**0.00**	153.25
Total		1030.25	85.00	1115.25
Revised Estimates (R.E.)				
1.	Grant-in-aid-Salaries	**1140.00**	**85.00**	1225.00
2.	Grant-in-aid-General	**133.00**	**6.00**	139.00
Total		1273.00	91.00	1364.00

Table B: Funds released to AICRP (S) centres during 2018-19

Sl. No.	Name of centre	Pay & allowances	TA & contingencies	Total (2+3)
	1	2	3	4
I. Regular centres				
1	Anakapalle (ANGRAU, Hyderabad)	186.38	5.18	**191.56**
2	Buralikson (AAU, Jorhat)	85.00	6.00	**91.00**
3	Cuddalore (TNAU, Coimbatore)	30.11	3.45	**33.56**
4	Faridkot (PAU, Ludhiana)	62.32	3.45	**65.77**
5	Kolhapur (MPKV, Rahuri)	43.63	3.45	**47.08**
6	Kota (MPUA&T Udaipur)	39.51	3.45	**42.96**
7	Kapurthala (PAU, Ludhiana)	101.56	3.45	**105.01**
8	Mandya (UAS, Banglore)	47.90	3.45	**51.35**
9	Navsari,(NAU, Navsari)	53.37	3.45	**56.82**
10	Nayagarh (OUA&T, Bhubaneshwar)	40.47	3.45	**43.92**
11	Padegaon (MPKV, Rahuri)	33.48	3.45	**36.93**
12	Pantnagar (GBPUA &T, Pantnagar)	88.73	3.45	**92.18**
13	Powarkheda (JNKVV, Jabalpur)	81.90	3.45	**85.35**
14	Pusa (RAU, Samastipur)	2.27	5.18	**7.45**
15	Sankeshwar (UAS, Dharwad)	95.86	3.45	**99.31**
16	Shahjahanpur (UPCSR,U.P.)	102.01	5.18	**107.19**
17	Sriganganagar (RAU, Bikaner)	36.75	3.45	**40.2**
18	Thiruvalla (KAU, Trichur)	36.72	5.18	**41.9**
19	Uchani (CCSHAU, Hisar)	57.03	5.18	**62.21**
Total		**1225.00**	**76.75**	**1301.75**
II. Voluntary centres				
1	G.S. Sugarcane Breeding & Research Institute (UPCSR) **Seorahi** (U.P.)	-	**5.00***	**5.00**
2	Vasantdada Sugar Institute, **Pune** (M.S.)	-	**5.00***	**5.00**
3	Sugarcane Research Station, **Vuyyuru,** Distt. Krishna (A.P)	-	**3.00***	**3.00**
4	Dr. Panjabrao Deshmukh Krishi Vidyapeeth, **Akola** (M.S.)	-	**3.00***	**3.00**
5	Indira Gandhi Krishi Vishwavidyalaya, Kawardha, **Raipur** (Chhattisgarh).	-	**3.00***	**3.00**
Total		-	**19.00***	**19.00**
Grand total (I + II)		**1225.00**	**95.75**	**1320.75**
***Funds released under contingencies.**				

CONTACT DETAILS OF REGULAR AND VOLUNTARY CENTRES UNDER AICRP (SUGARCANE) IN DIFFERENT ZONES

Name of Centre full address	Incharge / Address	Contact No./ E-mail
A. NORTH WEST ZONE		
1) Faridkot	Dr. Pankaj Rathore, Director, PAU Regional Station, Faridkot - 151 203 (Punjab) (PAU, Ludhiana)	Phone No.: 01639-251244; Fax : 01639-256949 Mob: 094640-51995 E-mail: rsdirector-faridkot@pau.edu; kuldeep@pau.edu
2) Kapurthala	Dr. Paramjit Singh, Director, PAU Regional Research Station, Kapurthala – 144 601(Punjab) (PAU, Ludhiana)	Mob: 098146-93189 E-mail: director-kapurthala@pau.edu
3) Karnal*	Dr. N. Kulshreshtha, Pr. Scientist & Head, Sugarcane Breeding Institute Regional Centre, P.B.No. 52, Karnal (Haryana) – 132 001 (ICAR-SBI, Coimbatore)	Phone No.: 0184-2268096; Fax : 0184-2265723 Mob: 093153-82163 E-mail: headsbirc@gmail.com; kulshreshthan@yahoo.com
4) Shahjahanpur	Dr. J. Singh, Director, U.P. Council of Sugarcane Research, Shahjahanpur – 242 001	Phone No.: 05842-222509 / 222102 Mob: 094550-38993 Fax : 05842-222509 E-mail: dirupcsr@gmail.com; jyotsnendra@yahoo.com
5) Pantnagar	Prof. S.P. Singh, Deptt. of Genetics & Plant Breeding, G.B. Pant University of Agriculture & Technology, Pantnagar – 263 145, Distt. U.S. Nagar	Phone No.: 05944-233075; Fax : 05944-233473 Mob: 094111-60075 (Dr. S.P. Singh): 075002-41511 (Dr. A.S. Jeena) E-mail: panwar588@gmail.com; dr.asjeena@gmail.com
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