भाकृअनुप
ICAR

भारतीय गन्ना अनुसंधान संस्थान, लखनऊ
ISO 9001 : 2008

ANNUAL REPORT
2013-14

भारतीय गन्ना अनुसंधान संस्थान, लखनऊ
Indian Institute of Sugarcane Research, Lucknow

भाकृअनुप
ICAR

वार्षिक प्रतिवेदन
Annual Report

2013-14

भारतीय गन्ना अनुसंधान संस्थान, लखनऊ
ISO 9001 : 2008

भारतीय गन्ना अनुसंधान संस्थान

लखनऊ - 226 002, उत्तर प्रदेश, भारत

Indian Institute of Sugarcane Research

Lucknow - 226 002, Uttar Pradesh, India

Director's Desk

The Indian sugar industry has an enviable status in the world sugar scenario, with an annual sugar production around 25 million tonnes. In addition, sugarcane based integrated industries produce over 2.3 billion litres ethanol, 2800 MW bioelectricity and many value added products like papers, boards, chemicals, fertilizers etc. We are also the second largest producer of sugarcane in the world and striving to attain 600 million tonnes by 2030 to meet the ever-growing demand of sugar, ethanol and electricity. In order to boost sugarcane and sugar production in the country, many policy incentives including deregulation of the industry were introduced. Besides, many associated reforms, like a stable external trade policy regime with 5-10% tariff levels, phasing out cane reservation areas, removing the minimum distance restriction between the mills, sugarcane price fixation based on FRP and sharing of 70 per cent of the value of sugar and each by-product, including bagasse, molasses and press-mud (ex-mill), as cane dues payable to farmers for supplies. These reforms may bring some respite to the sugar industry but ultimate stability will come, if sugarcane production and productivity is sustained at farmers field.

Despite having the largest sugar consumption base in the world, India is self-sufficient with respect to its sugar requirement and has been able to generate exportable surpluses. The emerging role of sugar industry as a source of renewable energy also makes the industry a substantial partner, in bringing about energy security and reducing the foreign exchange outgo. All said and done, the sugar recovery in the country has been far below the levels achieved by the other major sugar producing countries viz., Brazil and Australia, where the agro-climatic conditions are somewhat comparable with that of India. The average recovery levels have been hovering around 10% at the national level, with a potential recovery level of >11% in sub-tropics and >13% in the tropics. Thus, we are yet to tap the huge potential in raising the sugar recovery levels.

Broadly speaking, in India, the low sugar recovery is governed by factors in the farmers' field-both crop specific as well as policy based- and also by those at the factory level. Without an appropriate varietal balance, harvesting schedule and varietal replacement strategy, combined with scientific management practices, the potential of the crop cannot be exploited to the full. So also, without an effective check on the post-harvest losses at the factory level with proportionate sugar recovery, all efforts for increasing sugar production at the field level becomes futile. In this regard, proper varietal planning to increase the area under early maturing varieties needs to be taken up. Ideally, the area under early maturing varieties needs to be 40-50% of the total area under cane. A shift from localized varieties to CVRC recommended varieties with better adaptability and resistance to abiotic and biotic stresses will help realize better sugar recovery. At the same time, area under autumn planted cane also needs to be increased.

A gradual replacement of denotified varieties with high yielding, early maturing, stress tolerant varieties like Co 0238, Co 0118, CoLk 94184, CoLk 9709, CoLk 07201 etc., should be an inherent component for realising the full potential for sugar recovery in sub-tropical India. There should be a wider difference in the State Advisory Price (SAP) for notified and rejected varieties as an incentive to sugarcane growers to discourage from growing the denotified varieties. Strengthening of seed production programme with emphasis on use of healthy seed material and proper varietal replacement is important. The yield enhancement with the availability of good quality seed material, with other inputs remaining static, can be to the tune of 15%. The use of MHAT/MHWT needs to be promoted for a healthy seed crop stand. The seed production programme taken up by IISR, in collaboration with the Government of Bihar, with buy-back arrangements with the sugar mills/sugarcane farmers can show the way in this regard. Tissue culture based seed production coupled with virus indexing is another important strategy.

A proper harvesting schedule which will help in maturity-based harvesting can go a long way in improving the sugar recovery. An ideal schedule would be to harvest ratoon (early crop), autumn planted cane, plant (early crop),

ratoon (mid-late), and then spring planted cane. A shift in this schedule leads to low productivity and more importantly, to low sugar recovery. In addition, scientific management practices in the field, along with adequate post harvest management strategies are indispensible for improving the final sugar recovery. It is imperative that the all critical points from harvest to sugar manufacture, such as use of clean and fresh cane and upstream milling process should be properly monitored .

The IISR has redefined its research priorities, with an aim to improve the sugarcane and sugar productivity of the country, especially in the sub-tropics, keeping in mind the inherent complexities of the crop as well as the intricacies in the sugarcane farming system. In the ***Year of Outreach****, the Institute envisages to march ahead with renewed vigour, to make sub-tropical India an indispensible player in the national sugar scenario, with respect to cane productivity and sugar recovery, through its farmer-centric innovations.*

This Annual Report is a comprehensive review of the Institute's research, outreach and related activities during the year 2013-14. We gratefully acknowledge the unstinted support and guidance from Dr. S. Ayyappan, Secretary (DARE) and Director General, ICAR, Dr. Swapan K Dutta, Deputy Director General (Crop Sciences), Dr. N. Gopalakrishnan, Assistant Director General (CC), other dignitaries, the Research Advisory Committee members and all others, at appropriate junctures. The efforts of the Editorial Committee and Head of Divisions/ Sections and other scientists in providing and compiling the information for the timely publication of the report is highly appreciated.

(S. Solomon)
Director

Contents

Preface

Executive Summary

About the Institute

1. Breeding sugarcane varieties for sub-tropics 1
2. High density cane farming 6
3. Natural resource management 9
4. Ratoon management 16
5. Mechanization of sugarcane farming 18
6. Management of pests and diseases 25
7. Physiology, biochemistry and biotechnology 29
8. Climate change and sugarcane 33
9. Post harvest technology 35
10. Sugarbeet research 37
11. ICT in sugarcane 38
12. Linkage and collaboration 40
13. IISR: Reaching out to stakeholders 45
14. Publications 49
15. Technical programme (2013-14) 64
16. Consultancy and contract research 68
17. Monitoring and Evaluation 69
18. Human resource development 71
19. Distinguished visitors 76
20. Farm and infrastructure 79
21. Personnel 83

Executive Summary

- CoLk 07201 (Ikshu-1), an early maturing sugarcane variety, has been identified by the Central Varietal Release Committee during October 2013 for commercial cultivation in North West zone.
- Three early sugarcane genotypes (CoLk 13201, CoLk 13202 and CoLk 13203) and two mid-late sugarcane genotypes (CoLk 13204 and CoLk 13205) were accepted for multi-location testing in North West Zone during AICRP (Sugarcane) Group Meeting held at Regional Agricultural Research Station (ANGRAU), Anakapalle (A.P.) on Oct. 25-26, 2013.
- Two early sugarcane genotypes (LG 08422 and LG 09062) and five mid-late sugarcane genotypes (LG 07444, LG 09067, LG 09072, LG 07652 and LG 08759) were found to be promising based on the cane and sugar yields as well as sucrose% and other characters in Station Trial. These genotypes will be proposed for multi-location testing under AICRP(S).
- Five breeding stocks, *viz.*, LG 07503, LG 08478, LG 07595, LG 07528 and LG 07443 containing high sugar, two genetic stocks of sugarcane LG 08865 and LG 08866 with high sugar and resistance to red rot pathotypes (Cf 08 and Cf 09) and five genetic stocks tolerant to top borer, *viz.*, LG 07650, LG 07675, LG 07680, LG 07690 and LG 07692 were sent to Sugarcane Breeding Institute for inclusion in the National Hybridization Garden at Coimbatore.
- Five thousand six hundred quintals seed cane of improved varieties of sugarcane was produced and distributed.
- One hundred twenty seven sub-tropical varieties of sugarcane were maintained in the Reference collection. DUS testing of three candidate varieties (New category), *viz.*, Co 0238, Co 0239 and Co 0118 was conducted for the second year.
- Six putative SSR markers associated with cane weight, five with cane length, seven with NMC, six with number of nodes, and three with cane girth were identified through association mapping studies.
- Muliplex PCR assay for detection of pathogens of red rot and smut diseases of sugarcane was standardized using primers designed from internal transcribed spacer region of ribosomal DNA.
- Use of three pre-sprouted cane nodes at every 25 cm in rows placed at 75 cm brought about significant yield enhancement (75.1 t/ha) over other planting materials and placement patterns wherein cane yield obtained was only up to 70.0 t/ha.
- Cane node technology of sugarcane planting was useful in reducing the seed cane quantity in sugarcane cultivation. In addition to rapid germination of cane buds, substantial saving of seed cane was recorded as we need only 17-18 q/ha seed cane in single node method as against 60-80 q/ha required under conventional method of planting.
- Assessing suitable cane node priming technique for accelerating germination indicated that the priming of cane nodes with hot water (50°C) + 3% urea solution for 02 hrs. or cattle dung, cattle urine and water in 1:2:5 ratio and planted directly in the field or after incubation (4 days) gave highest germination (75.10%) at 40 days after planting as compared to un-primed cane nodes or treating them with hot water (50° C for 2 h) only (49.4%). Conventionally planted crop with 3-bud setts produced the lowest germination (38.6%).
- Soil health parameters determined at the harvest of ratoon cane showed improvement in soil organic carbon, available N, P_2O_5 and K_2O status with application of trash and bio-agents. Trash application proved beneficial for improving sugarcane ratoon yield and sustaining soil

health for longer period.

- Soil samples collected from sugar mill command areas of Bihar, Haryana and eastern Uttar Pradesh revealed prevalence of saline-sodic soils in sugarcane growing soils of western Bihar and Haryana. Depleted organic carbon content is an area of concern since majority of samples analyzed had low organic content, except those from Palwal Sugar Mill, Haryana. Available nitrogen and phosphorus in top 15-cm soil layer were estimated to be low in majority of samples, whereas exchangeable K content varied from low to medium in eastern UP and Bihar and medium to high in Haryana. Among micro-nutrients, zinc was found to be universally deficient with sporadic deficiency of Fe and Mn particularly in Bihar soils.
- Optimization of irrigation application parameters *viz.*, furrow length, discharge rate and cut off length respectively (in furrow irrigation system) resulted in bringing out the best irrigation application parameters with significant reduction in total water use. A combination of 10 litres per second discharge + 85% cut off resulted in the highest WUE of 20.42 and 17.41 kg/m^3 in 50 m and 75 m furrow length. On an average, this combination also saved 44% of total irrigation water as compared to border irrigation method (general farmers practice). Along with this, soil moisture spread along the flow, *i.e.*, head, middle and tail region were also characterized.
- In order to evaluate and promote the adaption of 'Ratoon Promoter' developed by IISR, demonstrations on this machine were conducted in 11 villages covering 44 cane growers and 18.62 ha ratoon area in Biswan sugar mill zone (Sitapur). An average saving of 34 mandays/ha and net saving in cost to the tune of ₹ 4,000/ha was recorded in demonstration plots. Mean ratoon yield of 66 t/ha was recorded in demonstration plots which is 20% higher than the ratoon yield obtained by farmers in conventional method (55 t/ha).
- Incidence of early shoot borer, top borer, mealy bug and termite was recorded in few fields along with white grub damage in certain pockets. Increasing incidence of GSD and incidences of Pokkah boeng in many newly released genotypes were observed in factory command areas of various sugar mills of U.P., Uttarakhand, Bihar and Maharashtra. Incidence of yellow leaf disease (YLD) was also noticed in 8 genotypes at IISR farm. Incidence of shoot borer in the first fortnight of May along with the activity of its larval parasite *Sturmiopsis* sp., parasitisation of *Cotesia flavipes* during August-September and incidence of scale insect (*Melanaspis glomerata* Green) along with its predatory beetle were observed at Pravaranagar.
- Of the 61 elite genotypes screened, two were resistant, 38 were resistant to moderately resistant and 11 were moderately susceptible to highly susceptible against both the pathotypes (Cf 08 and Cf 09). Further, 30 of these genotypes were susceptible to smut and remaining 31 were tolerant. Natural incidence of wilt was observed in 12 genotypes. Incidence of leaf scald in two and of grassy shoot disease in three genotypes was also noticed.
- During 2013-14, 33 entries were evaluated under AICRP, out of which 24 were resistant to moderately resistant and 5 were moderately susceptible to highly susceptible to both the pathotypes (Cf 08 and Cf 09) and remaining 4 showed susceptible reaction to one pathotype and resistant to other. Sixteen genotypes were susceptible to smut, whereas rest 17 were tolerant. Natural incidence of wilt, grassy shoot disease (GSD) and yellow leaf disease (YLD) was also noticed in 12, 7 and 8 genotypes, respectively.
- In North Central Zone, 13 genotypes were screened against red rot. Five genotypes *viz.*, CoP 8437, CoP 9301, CoP

9437, CoSe 8451 and CoSe 8452 were moderately resistant. CoSe 10451 was highly susceptible to Cf 07 and moderately resistant to Cf 08, while CoSe 10452 and CoSe 10453 were moderately susceptible to highly susceptible to Cf 08 and moderately resistant to Cf 07.

- Highest inhibition in *C. falcatum* growth *in vitro* was recorded with culture filtrates of *Trichoderma* isolates STr-83 (70.6%) followed by STr-108 (67.3%). In field experiment, treatment with metabolites of isolates STr-12 and STr-108 exhibited a reduction of 42.6% and 40%, respectively, in the number of buds affected by *C. falcatum* relative to control.
- The enhanced expression of chitinase after induction of disease in red rot resistant genotypes as compared to red rot susceptible genotypes and the increased intensity of these proteins with time suggested a possible role of chitinase gene in conferring red rot resistance in sugarcane.
- After two rounds of reisolation of Cf 01 (isolated from Co 1148) inoculated on the differentials, disease reaction showed that host did influence the virulence behaviour of the reisolates. Host acted as a selective sieve to enrich any available specific virulence for the differential. Similarly, host selective pressure also forced in the drop of virulence level in reisolates.
- The incidence of top borer was reduced due to various trap crops as compared to control. A laboratory rearing technique using sugarcane stalk pieces and, field collected as well as laboratory reared top borer larvae was developed.
- Early and higher germination has been achieved by priming of seed with ethephon (100 ppm), effective in both spring and autumn planting.
- Tiller mortality was reduced by 7% in ratoon crop with application of cytokinin due to low oxidation of lipids in plasma membrane.
- Yield and juice quality of late planted cane after harvest of wheat is improved with three sprays of gibberellic acid (35 ppm). This has also increased the NMC/ha to 94,000/ha from 74,800/ha (control) and cane yield to 76.50 from 40.50 t/ha (control). Saving of seed (1.7 t/ha) was also achieved by planting these at 75 cm instead of 60 cm row to row spacing.
- A higher level of SAI gene expression in stale cane led to post harvest sucrose losses. Low expression was observed in cane treated with chemical formulations.
- A tractor operated ratoon management device with discs was developed for performing stubble shaving, off-barring and fertilizer application in sugarcane ratoon crop without disturbing the trash-mulch and is suitable for widely spaced single row or paired row crop.
- A tractor operated plant residue shredder was developed for reduction of size of the trash *in situ* in the field and shaving of stubbles.
- An attachment for tractor operated trench planter was designed, developed and attached with planter for facilitating laying of sub-surface drip laterals underneath the centre of planted paired furrows. Trench planter with drip laterals laying attachment was field tested at IISR farm.
- Impact of climate change on sugarcane insect-pests dynamics and behaviour indicated maximum incidence of top borer (*Scirpophaga excerptalis*. Wlk) was related to heat index (combining both temperature and humidity) of 18th met week. It was noticed that pest incidence declined with increasing warming in terms of HI.

About the Institute

The Indian Institute of Sugarcane Research (IISR), Lucknow was establishd in 1952 by the erstwhile Indian Central Sugarcane Committee for conducting research on fundamental and applied aspects of sugarcane culture as well as to co-ordinate research work done on this crop in different states of the country. The Government of India took over the Institute from the Indian Central Sugarcane Committee on January 1, 1954. It was transferred to the Indian Council of Agricultural Research (ICAR), New Delhi on April 1, 1969. The Institute is located in Lucknow, the capital city of Uttar Pradesh and conveniently situated at about 12 km from CCS Airport, Amausi and about 5 km each from Lucknow Railway Station and Alambagh Bus Station. The climate of the area is sub-tropical semi-arid type. Monthly average maximum temperature during April to June ranges from 36ºC to 40ºC and minimum temperature during November to February ranges from 7ºC to 11.5ºC. The annual average rainfall is around 880 mm.

Vision

An efficient, globally competitive and vibrant sugarcane agriculture

Mission

Enhancement of sugarcane production, productivity, profitability and sustainability to meet future sugar and energy requirement of India

Mandate

The mandate of the Institute approved by the ICAR in 2001 is:

i) To conduct basic and applied research on all aspects of production and protection techniques of sugarcane and other sugar crops particularly sugarbeet for different agro-climatic zones of the country

ii) To work on the breeding of varieties for sub-tropical region in close collaboration with Sugarcane Breeding Institute, Coimbatore

iii) To carry out research for diversification and value addition in sugarcane

iv) To develop linkages with State Agricultural Universities, Research Centres and other organizations for collaborative research, exchange of information and material, and

v) To provide training, and consultancy to end users at regional, national and international levels.

Issues and strategies

To achieve the desired growth in area, productivity and recovery of sugarcane in different agro-ecological zones of the country and to extend appropriate information and technologies to the end users, following issues and strategies have been identified which need to be pursued at.

Issues

- Low levels of cane yield and sugar recovery
- High cost of cane cultivation
- Decline in factor productivity

Strategies

Increasing the levels of cane yield and sugar recovery

a. Introgression of untapped genes in the parental gene pool

b. Enhancing selection efficiency through marker aided selection (MAS)

c. Improving sink strength and source efficiency

d. Enhancing productivity of ratoon cane

Reducing the cost of cane cultivation

a. Nutrient use efficiency through rhizospheric engineering and INM technology

b. Water use efficiency through micro-irrigation

c. Land use efficiency through companion cropping

d. Reducing cost of pesticide use in an eco-friendly manner through bio-intensive IPM and IDM

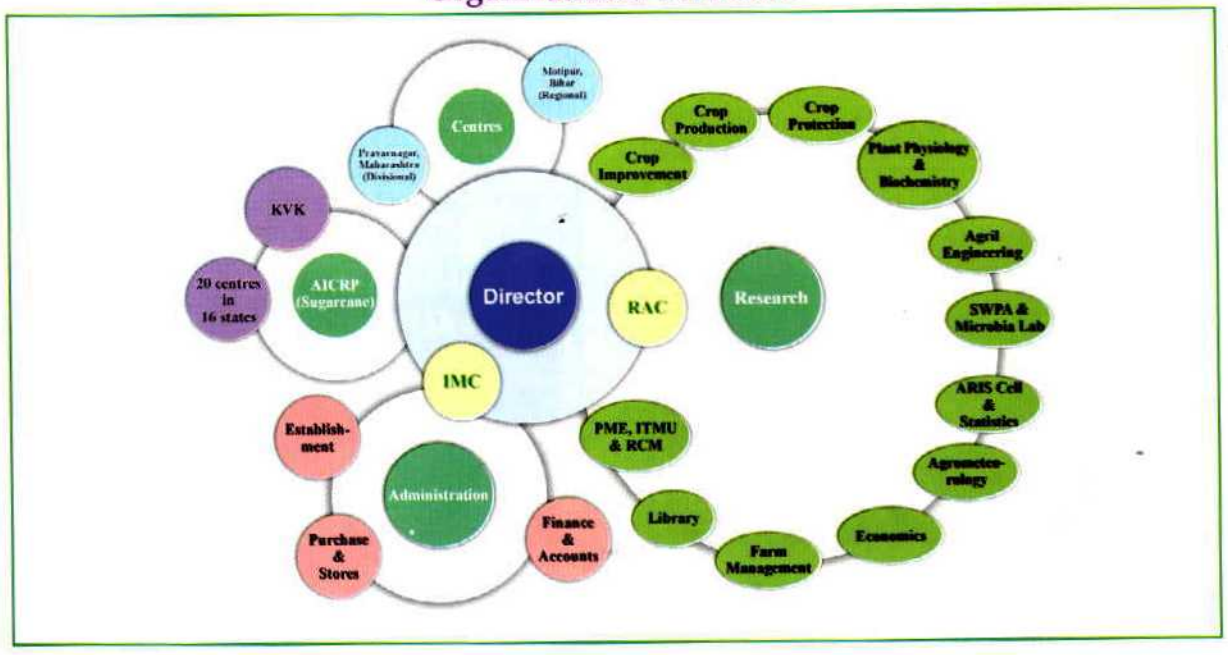
e. Mechanizing sugarcane farming

Arresting decline in factor productivity

a. Soil biological and nutritional dynamism

b. Carbon sequestering through cropping system

Organizational Structure



Particulars	Non-Plan (₹ in Lakh)		Plan (₹ in Lakh)	
	Revised Estimate	Expenditure	Revised Estimate	Expenditure
Indian Institute of Sugarcane	2756.00	2737.00	397.00	393.31
AICRP (S)			785.00	785.00

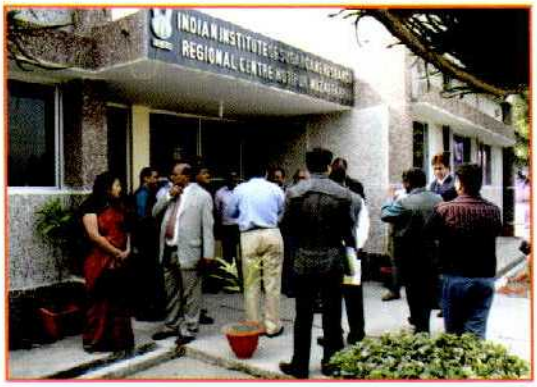
Staff Position as on March 31, 2014

Category	Sanctioned	Filled	Vacant
Scientific (including RMP)	74	58	16
Technical	130	115	15
Administrative	48	44	04
Supporting	74	46	28
Total	326	263	63

IISR Regional Centre, Motipur

The IISR Regional Centre, Motipur was established in 1988 as Research Centre of Coimbatore and was transferred to Indian Institute of Sugarcane Research, Lucknow. The Regional Centre has the mission of enhancing sugarcane productivity of North Central Zone. The main objectives of the Regional Centre are:

- Development of water logging tolerant and red rot resistant sugarcane varieties of North central zone.
- Quality seed production
- Dissemination of IISR technologies for sugarcane production and management.



Revenue Generation in IISR

Year	Revenue In ₹ (lakh)			
	From farm	Bio-fertilizer Unit	Others	Total from commercial initiatives
2010-11	44.43	-	6.18	50.61
2011-12	51.70	-	13.16	64.86
2012-13	65.14	10.67	22.13	87.27
2013-14	73.51	37.25	53.48	126.99

Total revenue generated from all sources
2010-11 109.47 lakh
2013-14 205.87 lakh

1

Breeding sugarcane varieties for sub-tropics

Sugarcane variety released for cultivation

CoLk 07201 (Ikshu-1), an early maturing sugarcane variety, has been released by the Central Varietal Release Committee during October 2013 for commercial cultivation in North Western Zone. The breeders and scientists who contributed for the development of this variety were Dr(s) A.D. Pathak, M.R. Singh, R.K. Rai, Rajesh Kumar, Sangeeta Srivastava, J. Singh, D.K. Pandey, P.K. Singh, Sanjeev Kumar, M. Swapna and Ramji Lal. Some characteristic features (Fig. 1.1) of CoLk 07201 (Ikshu-1) are given in Table 1.1.

Table 1.1. Characteristic feature of newly released variety CoLk 07201 (Ikshu-1)

Parentage	Yield (t/ha)	CCS (t/ha)	Sucrose (%) 10 months	Pol (%) cane at 10 months	Fibre (%)
CoLk 8102 x CoS 96260	78.76	8.72	16.34	12.32	13.49

Fig 1.1. Canes of variety CoLk 07201 (Ikshu-1)

Sugarcane clones accepted for evaluation under AICRP(S)

Three early (CoLk 13201, CoLk 13202 and CoLk 13203) and two mid-late sugarcane genotypes (CoLk 13204 and CoLk 13205) were accepted for multi-location testing in North West Zone during AICRP (Sugarcane) Group Meeting held at Regional Agricultural Research Station (ANGRAU), Anakapalle (A.P.) on October 25-26, 2013. The characteristics of accepted entries are given in Table 1.2.

Evaluation of sugarcane genotypes under Station Trial

A trial comprising of 20 genotypes including four controls (CoJ 64, CoPant 84211, CoPant 97222 and CoS 767) was conducted in CRBD with three replications to assess the performance of these genotypes which were drawn from various breeding projects. Three early (LG 07094, LG 05377 and LG 07771) and three mid-late sugarcane genotypes (LG 07785, LG 07584 and LG 07601) were found to be promising based on the cane and sugar yields as well as sucrose% and other characters. These genotypes will be proposed for multi-location testing under AICRP(S).

Collection, maintenance, evaluation and documentation of sugarcane germplasm under sub-tropical conditions

The collection of 314 genotypes consisting of *Saccharum officinarum*, *Saccharum barberi*, *Saccharaum sinense*, ISH clones, IkshuISH clones, LG selections, commercial hybrids *etc.*, was maintained and the required material was supplied to various on-going projects of the Institute. It includes 162 Commercial hybrids, 51 ISH & IkshuISH lines, 71 LG Clones and 30 species level genotypes. A 'Varietal Cafeteria' comprising of 10 Early and 13 Mid-late maturing varieties recommended for Uttar Pradesh was planted in October, 2013.

Developing breeding stocks for high sugar in sugarcane

This project has helped bring together sugar genes from diverse sources and has ended up in over fifty elite clones. These are being studied for their breeding behaviour in producing high sugar progeny. Five such breeding stocks, namely LG 07503, LG 08478, LG 07595, LG 07528 and LG 07443 were sent to Sugarcane Breeding Institute for inclusion in the National Hybridization Garden at Coimbatore.

Table 1.2. List of sugarcane clones accepted for evaluation (2012-13) in Zonal Varietal Trials under AICRP(S)

Genotype	Parentage	CCS (t/ha)	Cane yield (t/ha)	Group	Sucrose % (10M) Nov	Sucrose % (12M) Jan
CoLk 13201 (LG 04012)	CoLk 8002 GC	10.12	73.42	Early	19.06	
CoLk 13202 (LG 06605)	CoLk 8102 × CoS 96260	9.94	80.37	Early	17.33	
CoLk 13203 (LG 07771)	Co 86249 GC	9.72	77.88	Early	18.07	
CoLk 13204 (LG 07785)	CoH 56 GC	13.80	101.22	ML	16.45	19.27
CoLk 13205 (LG 07601)	Co 1158 x CoLk 8001	12.20	103.74	ML	16.29	16.92

Six entries were included in the Station Trial of the Division. These clones with varietal potential were LG 07584, LG 07554, LG 07461, LG 08420, LG 08425 and LG 07470 and were the progeny of LG breeding stocks developed under this project. One mid-maturing clone was proposed for AICRP(S).

Development of top borer tolerant genetic stocks of sugarcane

CoLk 07201 was identified for release for commercial cultivation in North Western Zone of India by AICRP(S). One early (CoLk 13202) and one mid late variety included in multilocation testing of North Western Zone under AICRP(S). Five genetic stocks tolerant to top borer *viz.*, LG 07650, LG 07675, LG 07680, LG 07690 and LG 07692 were sent to National Hybridization Garden at Sugarcane Breeding Institute, Coimbatore (Table 1.3 and Table 1.4). Over 2200 clones of different stages were evaluated. Thirty biparental crosses including nine intergeneric crosses were attempted.

Development of sugarcane varieties for subtropics

CoLk 13201 (Early) was accepted for AICRP(S) testing for North-West zone. CoLk 09202, CoLk 12201 and CoLk 13201 (Early) and CoLk 09204 (Mid-late) were accepted for UP State Varietal Trial. 108 clones selected from the seedling population (C_1) on the basis of quality and growth parameters were advanced to C_2. 40 clones were advanced to higher clonal generations on the basis of yield and quality characters. four clones, *viz.*, LG 09039, LG 09075, LG 09120, and LG 10035 were advanced to Station Trial of 2014-15 on the basis of their performance for yield and quality.

Development of breeding stocks of sugarcane for durable resistance to red rot

Two genetic stocks of sugarcane LG 08865 and LG 08866 having resistance to red rot to pathotypes Cf 08 and Cf 09 with high sugar were sent to National Hybridization Garden, SBI, Coimbatore.

Hybridization programme

Twelve new crosses attempted at National Hybridization Garden, SBI, Coimbatore. Clones were evaluated in different clonal generations.

Evaluation and selection of ratoon seedlings

A total of 182 clumps based on number of tillers and shoots/clump and visual performance from progenies of 18 different crosses promoted to first clonal generation for reaction to red rot pathotype Cf 09.

Evaluation of different clonal generation

A total of 21 clones from 97 clones of second clonal generation were advanced to next generation based on red rot reaction of two pathotypes Cf 08 and Cf 09 and high sucrose content. These clones showed > 17 % sucrose in

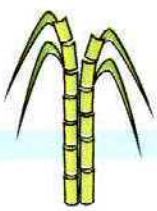


Table 1.3. Salient features of genetic stocks submitted to NHG

Genetic stock	Parentage	Top borer infestation			
		II brood	III brood	IV brood	Cumulative infestation
LG 07650	CoPant 90223 × CoH 72120	3.52	4.72	1.59	9.83
LG 07675	CoPant 90223 × CoH 72120	3.14	5.37	1.75	10.26
LG 07680	28NG 20 × IK 76-91	4.60	5.15	3.60	13.35
LG 07690	BO 109 × CoH 56	4.95	5.29	2.95	13.19
LG 07692	CoS 767 × BO 91	2.09	2.28	0.99	5.66
CoJ 64		7.60	30.05	14.13	51.78
CoS 767		9.95	10.78	6.23	26.96
CoLk 8102		11.91	19.46	8.71	40.08

Table 1.4. Salient features of therr advanced genotypes included in Station Trial

Genotype	Parentage	NMC (000/ha)	Yield (t/ha)	Sucrose % Nov	Sucrose % Feb	CCS (t/ha)
LG 07642	BO 109 × CoH 56	91.69	69.75	17.12	17.18	8.63
LG 07645	CoPant 90223 × CoLk 72120	96.89	71.79	16.93	18.12	8.39
LG 07680	28 NG 20 × IK 76-91	96.90	72.40	16.87	14.87	7.78
CoJ 64		58.29	51.45	15.64	19.02	6.76
CoS 767		59.39	52.40	15.16	18.10	6.49
CoLk 8102		69.39	54.35	15.20	15.71	5.84
CD		7.92	5.57	0.55	0.70	NS
CV		6.07	6.82	3.48	3.09	7.77

January. 41 clones from 100 clones of C1 were advanced to second clonal generation based on red rot reaction of pathotype Cf 09 and high sucrose.

Evaluation of advance clones in second plant crop and ratoon

A trial comprising of 12 advanced clones were evaluated in CRBD with three replications to validate for disease reaction to red rot and to assess their yield and quality performance along with two checks namely CoJ 64 and CoS 767. Clones namely LG 08826, LG 08869, LG 09810, LG 09814 and LG 09818 showed moderately resistant (MR) reaction to two virulent pathotypes, *viz*, Cf 08 and Cf 09. Clones *viz*., LG 08826, LG 08869, LG 09810 and LG 09814 gave > 85 t/ha of cane yield and > 9.9 t/ha of sugar yield. All the four clones gave > 17% sucrose. Similar trend was noticed in ratoon crop for cane yield as well as red rot reaction in LG 08826, LG 08869, LG 09810 and LG 09814. LG

08826 and LG 08869 were included in Station Trial (2014-15) based on cane and sugar yield per ha.

Development of sugarcane varieties for moisture deficit environment

CoLk 13203 (Early) and CoLk 13204 (Mid-late) were accepted for AICRP(S) testing for North-Western Zone. Four clones, *viz.*, LG 09709, LG 09743, LG 09746 and LG 09760 were advanced to Station Trial of 2014-15 on the basis of their performance under moisture deficit condition.

Evaluation of early maturing sugarcane clones of North West Zone

Initial Varietal Trial

A trial comprising of three test genotypes viz., Co 10035, CoH 10261 and CoS 10231 along with two standard varieties *viz.*, CoJ 64 and CoPant 84211 was conducted. Observations on yield and quality parameters were recorded as per the technical programme.

Advance Varietal Trial - I Plant

Five genotypes *viz.*, CoH 09262, CoH 09263, CoLk 09202, CoPb 09181 and CoS 09246 along with two standard varieties *viz.*, CoJ 64 and CoPant 84211 were evaluated for yield and quality parameters. Observations on yield and quality parameters were recorded as per the technical programme.

Advance Varietal Trial - II Plant

Three genotype CoPb 08211, CoPb 08212 and CoS 08233 along with two standards, CoJ 64 and CoPant 84211 were evaluated and observations on yield and quality parameters were recorded as per the technical programme.

Advanced Varietal Trial - Ratoon

Three genotype *viz.*, CoPb 08211, CoPb 08212 and CoS 08233 along with two standards, CoJ 64 and CoPant 84211 were evaluated for their ratooning ability. Observations on yield and quality parameters were recorded as per the technical programme.

Seed multiplication

The seed of seven genotypes *viz.*, CoH 11261, CoH 11262, CoLk 11201, CoLk 11202, CoLk 11203, CoPb 11211 and CoPb 11212 was multiplied for the next year's Initial Varietal Trial.

Evaluation of mid-late sugarcane clones for North West Zone

Initial Varietal Trial

A trial comprising of ten test genotypes *viz.*, Co 10036, Co 10037, Co 10039, CoH 10262, CoH 10263, CoPant 10221, CoPb 10181, CoPb 10182, CoPb 10183 and CoPb 10211 along with three standard varieties *viz.*, CoS 767, CoS 8436 and CoPant 97222 was conducted. Observations on yield and quality parameters were recorded as per the technical programme.

Advance Varietal Trial - I Plant

Five genotypes *viz.*, Co 09022, CoH 09264, CoLk 09204, CoPb 09214 and CoS 09232 along with three standards, CoS 767, CoS 8436, CoPant 97222 were evaluated for yield and quality parameters. Observations on yield and quality parameters were recorded as per the technical programme.

Advance Varietal Trial - II Plant

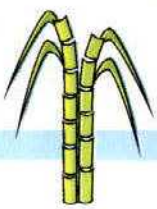
Six genotypes CoH 08262, CoH 08263, CoH 08264, CoPb 08217, CoS 08234 and CoS 08235 along with three standards, CoS 767, CoS 8436 and Co 1148 were evaluated. Observations on yield and quality parameters were recorded as per the technical programme.

Advanced Varietal Trial - Ratoon

Six genotypes *viz.*, CoH 08262, CoH 08263 CoH 08264, CoPb 08217, CoS 08234 and CoS 08235 along with three standards, CoS 767, CoS 8436 and Co 1148 were evaluated for their ratooning ability. Observations on yield and quality parameters were recorded as per the technical programme.

Seed multiplication

The seed of 13 genotypes *viz.*, Co 11026, Co 11027, CoH 11263, CoH 11264, CoLk 11204, CoLk 11205, CoLk 11206, CoPb 11181, CoPb 11182, CoPb 11213, CoPb 11214, CoS 11231 and CoS 11232 was multiplied for the next year's Initial Varietal Trial.



ICAR seed project: seed production in agricultural crops

Five thousand six hundred quintals seed cane of improved varieties of sugarcane was produced and distributed. More than 8.50 ha area was planted with newly released varieties for seed cane production during 2014-15.

Central sector scheme for PPV&FR authority

One hundred twenty seven sub-tropical varieties of sugarcane were maintained in the Reference collection. DUS Testing of three candidate varieties (New category) *viz.*, Co 0238, Co 0239 and Co 0118 was conducted for the second year.

Development of water logging tolerant and red rot resistant sugarcane clones for north Central Zones:

Station Trial was conducted to evaluate five promising test entries i.e. MG 10018, MG 10021, MG 10036, MG 10053 and MG 10143 along with two standards BO 130 and CoSe 95422 for cane yield and sucrose percentage. MG 10036 was recorded highest sucrose percentage followed by MG 10143. However, highest cane yield was recorded in MG 10018 (B 2.16 M). Based on the HR Brix and reaction to red rot, 37 clones were selected during the year. These clones were planted for further evaluation. Fluff of 10 biparental crosses were sown for raising the seedlings at IISR, Lucknow

2

High density cane farming

Optimization of plant population for improving physiological efficiency of sugarcane

Seed priming and three sequential applications of ethrel impacted early growth and cane yield. Spring planted cane (CoLk 94184) showed early and increased germination when setts were primed over night with 100 ppm ethrel. At 30 DAP, germination was 44% with primed setts whereas 21% with normal setts. T max, single cane weight and cane yield were 223905, 498 gm, 75.8 t/ha, respectively with control setts planting whereas these were 303905, 640 gm and 107 t/ha with 100 ppm ethrel primed setts. An increase of 29% per cane weight was observed.

In autumn planted crop, improvement in average cane weight was 727 g/cane in water primed and 752 g/cane in ethrel primed setts over controls (701 g/cane). Improvement in NMC was 11% (1,79,000) with mixture of co-enzyme primed setts, 13% (1,82,000) with mixtures of phosphates primed setts and 5.6% (1,70,000) with ethrel primed setts over controls (1,61,000). Improvement in cane yield was 10% (124.7 t/ha) with mixture of co-enzyme primed setts, 8.7% (123.3 t/ha) with mixtures of phosphates primed setts and 9.2% (123.8 t/ha) with ethrel primed setts over controls (113.4 t/ha).

Germination (%) of autumn planted cane at 21 DAP was 42% with 100 ppm, 38% with 50 ppm, 37% with water and 15% in control setts. Shoot population/ha was 11.6 lakh, 11 lakh, 9.0 lakh and 4.8 lakh in 100 ppm ethrel dipped, 50 ppm ethrel dipped, water dipped and control, respectively at 150 DAP.

Yield and juice quality of late cane planted after wheat harvest improved with three sprays of gibberellic acid (35 ppm). NMC/ha increased to 94,000/ha from 74,800/ha and cane yield to 76.50 from 48.02 t/ha. Saving of seed (~1.7 t/ha) by planting at 75 cm in place of 60 cm spacing was also recorded.

Serial application GA_3 on growth of spring planted cane was observed only when it was applied thrice at the intervals of 15 and 30 days (but not at 45-day intervals), and indicated additive growth response.

Phasic (thrice) hormonal foliar application (GA_3 @ 35 ppm) during growth cycle controlled the reducing sugars availability (by >15%, 11% and 3% during tillering, grand growth and maturity phases against control), governed the AI activities (by >13.5, 13.5% and 1.3% during tillering, grand growth and maturity phases than control) and sucrose (by < 5.5%, 3.5% and 1.3% during tillering, grand growth and maturity phases than control) which are correlated with LAI (R^2 =0.93, 0.91. 0.89, respectively), SLW ((R^2 =0.89, 0.90. 0.96, respectively) and CGR (R^2 =0.97, 0.95. 0.89, respectively).

Agronomic evaluation of promising genotypes of sugarcane

An experiment was conducted to evaluate three sugarcane genotypes (CoH 06265, CoS 06247 and CoH 06266) under three NPK levels (112.5, 45, 45; 150, 60, 60 and 187.5,75,75 kg/ha) with a view to identify suitable genotype under various fertilizer schedules in spring season. Initial soil chemical analysis indicated that soil was low in organic carbon (0.46%) and available nitrogen (262 kg/ha); medium in phosphorus (39.5 kg P_2O_5/ha) and potassium (284 kg K_2O/ha) contents. Sugarcane planting was done in the month of February 2013.

Sugarcane genotype, CoH 06265 produced the highest number of millable cane (1,02,350/ha) followed by CoS 06247 (90,840/ha) and CoH 06266 (7,6830/ha). The highest cane length (213.9 cm) was recorded with genotype CoS 06247 but thicker canes (2.477 cm diameter) were harvested with the genotype CoH 06265. Thus, both the genotypes could not yield significant difference in individual cane weight. Genotype, CoH 06266 recorded the lowest mean cane weight (924 g). There were no significant differences in sucrose content of different genotypes. The highest cane and sugar

yields (88.5 and 11.1 t/ha, respectively) was observed with genotype CoI1 06265. It was followed by CoS 06247 (79.4 and 9.96 tonnes cane and sugar yields/ha, respectively).

Mean number of millable canes, cane length, diameter, weight and cane and sugar yields significantly increased up to application of 150, 60, 60 kg NPK/ha. Recommended level of NPK *i.e.*, 150, 60 and 60 kg/ha fetched significantly higher cane (80.12 t/ha) and sugar yields (9.99 t/ha) which was at par with 125% NPK levels. Different fertility levels could not influence the juice quality parameters significantly. The interaction between genotypes and fertility levels were not significant.

Sugarcane yield maximization through optimizing shoot population density

Field experiment was conducted to conceptualize tillering dynamics for enhanced productivity of sugarcane in spring planting season. The experiment consisted 16 treatment combinations, *viz.*, four row spacing (120, 90, 75 and 60 cm) and four techniques of planting material (seed) placement (conventional three bud sett, parallel sett placement with 30 cm sett to sett spacing, pre-sprouted single cane node planting at 25 cm spacing and pre-sprouted three cane node planting at 25 cm spacing. The experiment was laid out in Randomized Block Design (Factorial) with three replications.

The data on sugarcane growth, yield attributes and yield indicate that significantly highest shoot population (167.9 thousand/ha at 150 DAP), number of millable canes (125.2 thousand/ha) and cane yield (75.2 t/ha) were recorded at closer row spacing of 60 cm. which was however, closely followed by 75 cm spacing (74.4 t/ha).The yield attributing characters, *viz.* cane length was significantly reduced at 60 cm spacing, however cane girth and average cane weight were not affected by row spacing treatments.

Placement of three pre-sprouted cane node at one place at 25 cm spacing recorded significantly higher shoot count (167.4 thousand/ha at 150 DAP), number of millable canes (124.3 thousand/ha) and cane yield (75.1 t/ha).The juice quality parameters *viz.*, brix, pol%, purity% and CCS% were not affected by row spacing however, significantly highest sugar yield (6.78 t/ha) was recorded at 60 cm spacing which was comparable to 75 cm spacing. The CCS% and CCS (t/ha) were observed to be higher when three pre-sprouted cane nodes bunch was placed at 25 cm distance. Observations on combined effect of row spacing and seed material placement treatments clearly indicated that placement of three pre-sprouted cane node bunch placed at 25 cm distance in 60 cm row spacing recorded the highest number of millable canes (140.3 thousand/ha) and cane yield (75.1 t/ha).

Modified plant geometry in sugarcane by introducing intra-row spacing to ensure higher population and productivity

The field experiment was conducted to ensure higher population of sugarcane by introducing intra row spacing in modified plant geometry for higher cane productivity. The experiment comprising 16 treatment combinations was laid out in RBD (factorial) with three replications. The treatment combinations were: 1. Planting material, *viz.*, three budded setts and two budded setts; 2. Planting geometry (intra- row spacing), *viz.*, placing setts in pair at intra- row spacing of 20 cm (end to end), placing setts in pair at intra-row spacing of 30 cm (end to end), placing three setts together at intra-row spacing of 30 cm (end to end) and conventional (end to end placement); 3. Sett treatment *viz.*; setts treatment (overnight soaking) with Resorcinol @ 0.1% and control (conventional). The soil of the experimental site was sandy loam in texture, low in organic carbon (0.33%), available nitrogen (219.8 kg/ha), medium in phosphorus (23.7 kg P_2O_5/ha) and potassium (202.8 kg/ha) and slightly alkaline in reaction (pH 7.9).

The experimental findings revealed that germination in sugarcane was not affected by planting materials used, *i.e.*, two-bud and/or three-bud setts. However, sugarcane planting with three-bud setts registered significantly higher tiller population resulting into more number of millable canes (103.1 thousand/ha) as compared to two budded setts (90.7 thousand/ha). Dry matter accumulation and leaf area index (LAI) were also significantly higher in sugarcane planted with three budded setts as compared to two-bud setts. Whereas, improvement in plant height in sugarcane planted with three-bud setts was not to the level of significance over two-bud setts.

Different planting geometry (intra-row spacing) could not influence germination per cent in sugarcane. However, tiller population recorded at different interval was significantly enhanced by introducing intra-row spacing in sugarcane planting. In general, tiller population increased up to the month of July and thereafter it starts declining due to tiller mortality. The highest tiller population (141 thousand/ha) was recorded in July in the treatment of placing three setts together at intra-row spacing of 30 cm (end to end) that was significantly higher than conventional method (125 thousand/ha). Plant height, dry matter accumulation and LAI improved significantly in sugarcane planted with three setts together at intra-row spacing of 30 cm (end to end) as compared to conventional method (end to end placement).

Sugarcane planting after setts treatment (overnight soaking) with Resorcinol @ 0.1% significantly augmented germination to the tune of 15.7% over conventional planting. Tiller population, dry matter accumulation and LAI improved significantly in setts treatment with Resorcinol @ 0.1% as compared to conventional planting.

Sugarcane planting with three-bud setts produced significantly higher cane yield (83.7 tonnes/ha) over sugarcane planting with two-bud setts (77.6 tonnes/ha) due to higher, heavier and lengthy millable canes. The highest cane yield (88.3 tonnes/ha) was recorded in the treatment of sugarcane planting with placing three setts (three budded) together at intra-row spacing of 30 cm (end to end) that was significantly higher than conventional (72.7 tonnes/ha) and other planting methods due to higher in number and heavier canes.. Sugarcane planting with two setts in pair keeping intra-row spacing 20 cm or 30 cm significantly enhanced cane yield over conventional method due to higher and heavier millable canes. Cane diameter and juice quality parameters were not affected by different treatments.

Optimization and standardization of cane node length for sprouted planting material

Experimental data indicated that the germination of cane buds counted at 10, 20, 30 and 40 days after planting (DAP) under cane node planting treatments was on an average 23.83, 70.77, 73.30 and 77.87%, respectively as against 8.31, 22.50, 28.13 and 40.52% recorded under conventional planting with 3-bud setts. Higher germination per cent in cane node planting treatments also produced significantly more number of tillers and millable canes than that of conventional planting methods. Cane yield also exhibited the same trend as the number of tillers and millable canes under different treatments, and it was significantly higher under cane node planted treatments producing 11.13% more cane yield than that obtained under conventional 3-bud planting method (73.33 t/ha). CCS% cane did not differ significantly due to different treatments.

Priming cane node for accelerating germination

Priming of cane nodes with hot water (50°C) + 3% urea solution for 2 h (T3) or cattle dung, cattle urine and water in 1:2:5 ratio and planted directly in the field (T4) or after incubation (4 days) (T6) gave maximum germination of cane buds (75.10%) at 40 days after planting (DAP) as compared to un-primed cane nodes (T1)(54.60%) or treating them with hot water at 50°C for 2 h (T2) only (44.33%). Conventionally planted crop with 3-bud setts produced the lowest germination (38.68%). Number of tillers and millable canes and yield of cane also exhibited the same trend as the germination of cane buds obtained in different treatments. Accordingly, cane yield obtained under T3, T4, T5 and T6 treatments was significantly higher to the tune of 12.87 and 11.52% than that of T1 and T2 treatments (un-primed cane nodes or treated with hot water only). Conventional planting with 3-bud setts although produced cane yield at par with primed cane node treatments but with the use of huge seed cane (72 q/ha) whereas only 17.52 q/ha seed cane was used in cane node planting method.

3

Natural Resource Management

Tillage techniques in plant-ratoon system for improving soil health and increasing sugarcane yield in subtropical India

A field experiment was initiated in March 2012. Before planting of sugarcane, primary tillage treatments were applied on experimental field. After that, subsoiling treatment up to depth of 45-50 cm was given. After planking, furrows were opened at 75 cm row spacing for sugarcane planting. Post plant tillage treatments/hoeing and integrated weed management practice were applied in plant cane to increase input use efficiency and sustain soil health in sugarcane (plant)-ratoon system as per treatments. In sugarcane ratoon, three treatments, *viz.*, 3 manual hoeings, one hoeing at ratoon initiation followed by atrazin @ 2 kg ai/ha and 2, 4-D @ 1 kg ai/ha application and trash mulching with bioagents (*Trichoderma*, *Gluconacetobacter* and *Pseudomonas*) were applied. Sugarcane variety CoPk 05191 was planted on March 4, 2012 in the experiment. Initial level of soil fertility indicated that soil had 0.42% OC, 258.5 kg available N/ha; 42.02 kg available P_2O_5/ha and 274 kg K_2O/ha.

Results on sugarcane ratoon crop revealed that trash management and weed control practices did not influence number of millable canes and sucrose content significantly. However, the highest individual cane weight (759.69 g) was obtained with application of trash with bioagents (Table 3.1). Thus, ratoon cane and sugar yields were significantly influenced by trash mulching along with application of bioagents. Three manual hoeings and integrated weed management practice involving atrazin, 2, 4-D and one hoeing at 90 days after initiation was found at par with respect to cane and sugar yields. Trash mulching along with bioagents improved sugarcane ratoon and sugar yields (12.88% and 10.73%, respectively) over three manual hoeings in ratoon (conventional practice).

Soil health parameters determined at the harvest of ratoon cane showed improvement in soil organic carbon, available N, P_2O_5 and K_2O status with application of trash and bioagents as compared to three manual hoeing or integrated weed management practice (atrazin, 2, 4-D and one hoeing) at 90 days after initiation. Thus, trash management with application of bioagents proved beneficial for improving sugarcane ratoon yield and sustaining soil health for longer period.

Carbon sequestration potential of sugarcane based cropping system for sustaining soil health and crop productivity

A study conducted to evaluate rice-wheat and sugarcane-ratoon- wheat cropping systems and to analyze the long term effect of sugarcane, rice and wheat cropping on carbon sequestration and crop yields revealed that after harvesting of rice crop, the highest SOC (0.57%) and available potassium (296 kg K_2O/ha) was determined in the treatment of complete residue recycling (CRR; Fig. 3.1). However, the highest available N was determined in the treatment where 25% additional fertilizer dose was applied with CRR. The highest available phosphorus (44 kg P_2O_5/ha) in soil was analyzed under CRR with *Trichoderma* application. Thus, these results indicated that complete residue recycling improved soil health parameters besides improving crop yields. Partial residue recycling (1/2 of produced residue addition) with and without *Trichoderma* application could not reach to level of CRR. The results from sugarcane based system after harvest of ratoon crop indicated overall superiority in improvement of SOC, available N, P and K as compared to rice-wheat system. The trend of effect of partial residue recycling and trash burning as well as incorporation was similar to rice-wheat system.

Table 3.1. Effect of various treatments on growth attributes, ratoon cane and sugar yields and soil health parameters at harvest of ratoon crop

Treatment	Growth attributes, ratoon cane and sugar yield					Soil health parameters at harvest of ratoon			
	Millable canes ('000/ha)	Cane weight (g)	Pol% juice	Ratoon yield (t/ha)	Sugar yield (t/ha)	Soil organic carbon (%)	Available N (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
Three manual hoeings	116.1	730.4	16.85	70.01	7.64	0.44	261.3	48.6	255.4
Atrazin @ 2 kg ai/ha followed by 2,4-D @1 kg ai/ha (post emergence) and one hoeing at 90 days after ratoon initiation	113.9	685.8	16.59	66.53	7.42	0.46	282.2	52.4	286.2
Trash mulching, *Trichoderma*, *Gluconacetobacter* and *Pseudomonas* application at the time of ratoon initiation	112.3	759.6	16.69	78.54	8.46	0.52	292.6	56.3	305.6
SE m±	4.31	24.92	0.19	1.56	0.23	0.010	6.10	0.84	5.50
CD (P=0.05)	NS	72.50	NS	4.62	0.68	0.030	18.20	2.63	16.50

Although, the higher amount of crop residues was added in the sugarcane based system as compared to rice-wheat system.

Carbon fixation through photosynthesis process in rice and sugarcane crops indicated that although rice leaves received higher PAR but higher rate of transpiration (4.843- 5.958 (mol m-2 s-1) as compared to sugarcane reduced net rate of photosynthesis (9.41- 12.79 mol m^{-2} s^{-1}). Thus, it could be proved that sugarcane is efficient C capturer and can reduce the adverse effect of CO_2 in the atmosphere also. Rice and sugarcane yields were significantly influenced by application of *Trichoderma* and residue recycling. There was an improvement of rice yield in the tune of 0.78 tonnes/ha (21.54%) over no residue and without *Trichoderma* application. Similar trend was also observed with sugarcane ratoon crop.

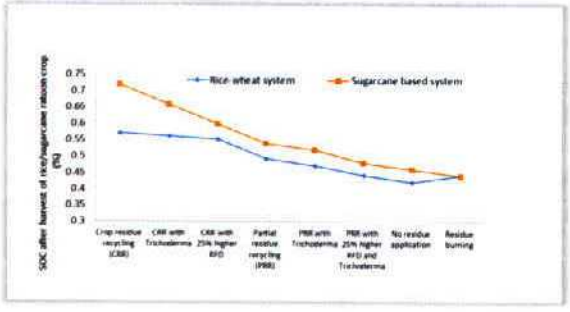


Fig. 3.1. Soil organic carbon (%) as enfluenced by various management practices in rice-wheat sugarcane-based cropping systems at Lucknow

Assessment of soil fertility status of sugar mill command areas of sub-tropical India

Soil samples from sugarcane fields were collected from depths 0-15 and 15-30 cm at the onset of sugarcane planting season 2014-15 from the Sugar Mill Command areas located in the states of Bihar, Haryna and eastern parts of Uttar Pradesh. Soil pH in command areas of Harinagar and Bharat Sugar Mills (Bihar) ranged from 7.11 to 9.12 in top soil layer with majority having pH 7.8. Samples from Riga and Hasanpur Sugar mill

areas were within neutral soil reaction. Electrical conductivity of Bihar soils was found to be non-saline for all the sugar mill areas. Organic carbon content in these soils varied from being low to medium and on an average the top soil contained less than 0.5% organic carbon. Available soil nitrogen content fared low for these soils, however, available P was rated to be low in 65 % of samples and medium to high for the others. Exchangeable K was determined to be in medium range (120-280 kg/ha) for 65% of the samples analyzed. Among micro-nutrients, Zn was universally deficient in Bihar soils; however, sporadic deficiency of Fe and Mn was also noticed particularly from Harinagar and Bharat Sugar mill (Gopalganj) command areas.

Soil samples collected from sugarcane fields of mill command areas in eastern Uttar Pradesh were found to be neutral in reaction and non-saline. The soil organic carbon content varied from low to medium with universally low available nitrogen content which ranged between 175.6 and 272.8 kg/ha. Available P was determined to be in low range for majority of the samples and only 30% samples contained P in medium availability range. Availability of K in these soils was low to medium with higher frequency for samples containing available K in medium range. Among micro-nutrients, zinc deficiency was found to be wide spread as all the samples contained less than the critical content of the element, whereas Cu, Fe and Mn were determined to be above the critical limit in these soils.

Assessing nutrient interactions for sustaining sugarcane productivity and soil health

Nutrient interaction experiments were initiated to study the interaction of nitrogen & potassium and phosphorus and zinc in sugarcane. Experiments initial soil data were pH 7.8, EC value 0.16 dSm-1, organic carbon 0.31%, available nitrogen 214.8 kg/ha, available phosphorus 13.4 kg/ha, available potash 204.6 kg/ha and available micronutrient, *i.e.*, zinc, copper, iron and manganese status were 0.71, 0.64, 14.25 and 5.58 ppm, respectively. There was no significant effect of nitrogen and potassium and phosphorus and zinc interaction found on cane yield and juice quality, *i.e.*, on brix, sucrose (%) and purity coefficient.

Enhancing sugarcane productivity and profitability under wheat-sugarcane cropping system

The field experiment was conducted during 2012-14 to enhance the productivity of sugarcane under wheat-sugarcane cropping system. The experiment comprising nine treatments *viz.*; T1: Autumn planted sugarcane, T2 : T1+ wheat (1:2), T3: T1+ wheat (1:3), T4: wheat sown on 15th November - late sugarcane, T5: wheat sown on 15th December - late sugarcane, T6: wheat sown (three rows) on 15th November under FIRB + sugarcane in furrows at 75 cm in 3rd week of February, T7: wheat sown (three rows) on 15th November under FIRB + sugarcane in furrows at 75 cm in 3rd week of March, T8: T6 with sowing of wheat on 15th December and T9: T7 with sowing of wheat on 15th December was laid out in Randomized Block Design with three replications. The findings revealed that wheat grain yield was the highest (46.6 q/ha) in November sown wheat in the treatment T4. Wheat yielded almost the same in flat as well as FIRB method. However, wheat sown in the month of November yielded higher than wheat sown in December due to higher number of ear heads per running meters, number of grains per ear head and test weight. Wheat (Nov.) + sugarcane (Feb/March) under FIRB method produced higher wheat yield (44.1 q/ha) over wheat (Nov) + sugarcane in 3:1 row ratio (40.2 q/ha) as well as 2:1 row ratio (33.5 q/ha).

Tiller population recorded at different stages indicated that tiller count in autumn planted sole sugarcane and sugarcane planted with wheat in 3rd week of February under FIRB system was higher compared with sugarcane planted with wheat in 3rd week of March under FIRB. The lowest tiller population was observed in sugarcane planted with wheat (1:3) under flat method followed by wheat-sugarcane system. The highest tiller count (231.8 thousand/ha) was recorded in the month of July in sugarcane planted in 3rd week of February with wheat under FIRB system and the lowest (86.4 thousand/ha) in sugarcane + wheat (1:3). The highest plant height (247 cm) was observed in autumn planted sole sugarcane followed by sugarcane + wheat (1:2) and wheat + sugarcane under FIRB system. The cane yield was the highest (89.0 tonnes/ha) in autumn planted sole sugarcane. Sugarcane planted in 3rd week of February in standing wheat under FIRB method (82.5 tonnes/ha) was significantly higher

than sugarcane planted in 3rd week of March in wheat under FIRB and sugarcane + wheat (1:2) due to higher NMC, cane length, cane weight and number of internodes. The lowest cane yield was recorded in wheat - sugarcane system (59.3 tonnes/ha) and sugarcane + wheat in 1:3 row ratio (60.3 tonnes/ha).

Developing efficient water application techniques in sugarcane

Field experiment was conducted to study the residual effect of different planting and irrigation methods on ratoon sugarcane. The experiment consisted of 10 treatments applied in plant cane, *viz.*, T1-Paired row planting (120-30 cm) and irrigation in furrows parallel to both the cane rows (15 cm apart from sugarcane row): PP-FID, T2-Paired row planting (120-30 cm) and irrigation in furrows parallel to single row (15 cm apart from sugarcane row) of paired rows: PP- FIS, T3-Furrow planting at 75 cm row spacing and irrigation in furrows of the cane rows : FP-FI, T4-Furrow planting at 75 cm row spacing and irrigation in furrows opened in the middle of two cane rows : FP-MFI, T5-Furrow planting at 75 cm row spacing and irrigation in skip furrows opened in the middle of two cane rows (skip furrow irrigation method) : FP- SFI, T6-Furrow planting at 75 cm row spacing and irrigation in alternate skip furrows opened in the middle of two cane rows (alternate skip furrow irrigation method): FP-ASFI, T7-Irrigation in deep trench-sugarcane planted at 120-30 cm : TP - TI, T8-Irrigation in furrows - sugarcane planted under FIRB system : FIRB -FI, T9-Flood irrigation (conventional)-Furrow planting (75 cm): FP-F, T10-Flood irrigation (conventional)-Paired row planting(120-30 cm): PP-F. The experiment was laid out in Randomised Block Design with three replications. Irrigation under each treatment was applied at 50% ASM in plant crop.

The data on ratoon sugarcane growth and yield (Table 3.2) indicated significant variations among the treatments. Significantly, the highest shoot count (227.7 thousand/ha at 180 DAP), number of millable canes (155.9 thousand/ha), ratoon cane yield (86.5 t/ha) and sugar yield (11.36 t/ha) were recorded under trench planting system in which irrigation was applied in deep trenches (TP-TI). Tallest ratoon cane (224.2 cm) was observed in trench planting system, however, thicker canes (2.30 cm) were produced under alternate skip furrow system. This system was closely followed by trench system of planting. Significantly the highest brix0 (21.1) of ratoon cane was recorded under trench planting system, which also fetched higher pol % (18.88) and commercial cane sugar content (13.13%; Table 3.3).

Deep tillage under different moisture regimes and N levels for modifying rhizospheric environment and improving sugarcane yield in plant-ratoon system

A field experiment was conducted at IISR farm with three tillage practices (T1: Control-recommended harrowing and cultivator for field preparation, T2: Deep tillage through disc plough (depth 25-30 cm) before planting and T3: Deep tillage through disc plough (depth 25-30 cm) before planting and subsoiling at 45-50 cm, two moisture regimes (M1: 0.5 IW/CPE ratio and M2: 0.75 IW/CPE ratio) at 7.5 cm depth of irrigation water and four N levels (N1- 0; N2-75; N3-150, N4-225 kg N/ha) to economise water use under modified rhizospheric environment in sugarcane (plant)-ratoon system. Thus, there were 24 treatment combinations replicated thrice in Split Plot Design. Combinations of tillage and moisture levels were kept in main plots and N levels in sub plots. Sugarcane variety CoPk 05191 was planted on February 14, 2012 in the experiment. Initial level of soil fertility indicated that soil had 0.42% OC, 284.5 kg available N/ha; 42.0 kg available P_2O_5/ha and 289 kg K_2O/ha.

Results on sugarcane ratoon crop revealed that deep tillage and subsoiling before sugarcane planting increased number of millable canes (106700/ha), individual cane length (195.6 cm), cane diameter (2.08 cm) and individual cane weight (751.3 g) over the control. There was 13.9% increase in mean cane yield (72.6 t/ha) with deep tillage and sub-soiling over the conventional tillage practices. Optimum moisture regime (0.75 IW/CPE) significantly increased ratoon cane growth and yield attributes over suboptimal regime (0.5 IW/CPE). Application of nitrogen up to 150 kg N/ha significantly increased growth, cane and sugar yields.

Tillage, moisture and nitrogen interaction on individual cane weight showed that sub-soiling and deep tillage under suboptimal

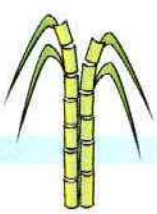


Table 3.2. Growth and yield of ratoon sugarcane under different planting methods

Treatment	Shoot/tiller number (000/ha)						
	120 DAP	150 DAP	180 DAP	210 DAP	NMC	Yield(t/ha)	CCS (t/ha)
PP-FID	156.46	170.83	178.67	156.32	125.77	68.15	8.08
PP-FIS	163.02	170.86	173.57	134.13	118.42	70.17	8.52
FP-FI	191.94	211.11	215.64	189.93	129.32	73.18	8.60
FP-MFI	166.48	184.42	188.83	151.04	123.04	71.06	8.84
FP-SFI	164.24	176.45	186.54	145.26	122.09	70.10	8.02
FP-ASFI	167.60	176.40	181.86	147.34	123.05	66.14	7.82
TP-TI	210.97	223.23	227.69	189.82	155.92	86.47	11.36
FIRB-FI	178.73	192.13	202.22	147.29	126.26	73.14	9.26
FP-FI	147.38	162.50	169.59	136.30	119.58	66.50	7.57
PP-FI	150.86	163.10	167.65	140.84	118.79	67.08	7.34
CD (5%)	12.68	14.51	16.97	15.67	11.62	8.63	1.68

Table 3.3. Effect of planting methods on juice quality and yield attributes of ratoon cane

Treatment	Brix°	Pol (%)	Purity (%)	CCS (%)	Length (cm)	Girth (cm)	Cane wt (kg)
PP-FID	19.90	17.28	86.85	11.85	200.45	2.02	0.87
PP-FIS	20.10	17.63	87.66	12.15	202.23	2.04	0.90
FP-FI	19.70	17.13	86.91	11.75	202.24	2.16	1.03
FP-MFI	20.42	18.00	88.20	12.43	201.36	2.30	0.84
FP-SFI	19.50	16.77	86.00	11.44	221.21	2.21	0.86
FP-ASFI	19.94	17.27	86.68	11.83	205.21	2.28	1.00
TP-TI	21.10	18.88	89.40	13.13	224.15	2.31	1.10
FIRB-FI	20.95	18.38	87.68	12.67	208.26	2.05	0.85
FP-FI	19.20	16.63	86.64	11.39	202.26	2.16	0.80
PP-FI	18.84	16.13	85.65	10.98	200.24	2.11	0.81
CD 5%	0.56	0.87	1.21	1.86	6.89	0.26	0.17

moisture level (M1) and application of N @ 150 kg/ha increased cane individual weight (734.7 g) significantly over T1M2 N3 (694 g- conventional tillage under optimal moisture level (M2) and application of 150 kg N/ha). Although the mean highest individual cane weight (879.7 g) in sugarcane ratoon was obtained with T3M2N4 (deep tillage and sub soiling, moisture regime at 0.75 IW/CPE and 225 kg N/ha).

Tillage and N interaction on water use efficiency (WUE- Table 3.4) showed that at suboptimal moisture regime irrigation water use efficiency improved significantly (180.9 kg cane/ha-mm water applied) up to 150 kg N/ha. However, at 0.75 IW/CPE, it increased significantly up to 225 kg N/ha. Suboptimal moisture regime showed higher WUE over optimal moisture regime (0.75 IW.CPE) at all the N levels. Increasing N levels, increased water use efficiency at both the moisture regimes

Tillage techniques in plant-ratoon system for improving soil health and increasing sugarcane yield in subtropical India

Results on sugarcane ratoon crop revealed that trash management and weed control practices did not influence number of millable canes and sucrose content significantly. However, the highest individual cane weight (758.6 g) was obtained with application of trash with bio-agents, *viz.*, *Trichoderma*, *Gluconacetobacter* and *Pseudomonas*. Thus, ratoon cane and sugar yields significantly influenced by trash mulching along with application of bio-agents. Trash mulching along with bioagents improved sugarcane ratoon and sugar yields (12.88% and 10.73%, respectively) over three manual hoeing in ratoon (conventional practice). Soil health parameters determined at the harvest of ratoon cane showed improvement in soil organic carbon, available N, P_2O_5 and K_2O status with application of trash and bio-agents as compared to three manual hoeing or integrated weed management practice (atrazin, 2, 4-D and one hoeing at 90 days after initiation. Thus trash management with application of bio-agents proved beneficial for improving sugarcane ratoon yield and sustaining soil health for longer period.

Rationalizing irrigation water use through optimizing field application parameters

Field experiment was initiated to optimize various irrigation application parameter, *viz.*, furrow length, discharge rate and cut off length for furrow irrigation system. First year results unveiled that a combination of 10 lps + 85% cut off had resulted in highest WUE of 20.42 and 17.41 kg/m^3 in 50 m and 75 m furrow length. On an average, this combination has also saved 44% of total irrigation water as compared to border irrigation method (general farmers practice). Even though a strong correlation was observed between the total water used and yield but it was not highly positive, exemplifying that "more the water used more the yield" is not a correct approach. However, yield *per se* was not significantly different between the check (border irrigation) and highly water efficient system (10lps+85% cut off). Juice quality parameters were also not found to be significant among any treatments.

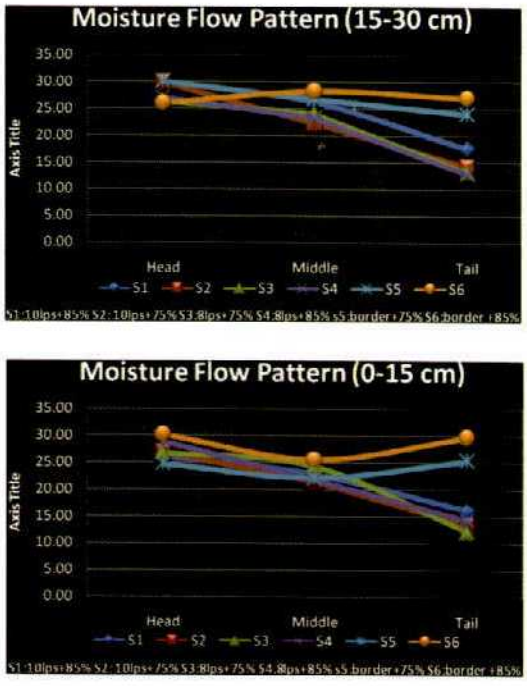


Fig. 3.2. Moisture flow pattern

Table 3.4. Effect of moisture and nitrogen on water use efficiency (WUE- kg cane /ha-mm water applied)

M/N	M_1 (0.5 IW/CPE ratio)	M_2 (0.75 IW/CPE ratio)	Mean
N_0	139.43	113.5	126.4
N_{75}	167.97	127	147.51
N_{150}	180.9	136.8	158.9
N_{225}	189.4	147.5	168.45
Mean	169.45	131.20	
SE m±	M x N :3.49		
CD (P=0.05)	10.20		

Moisture flow pattern were also estimated, which showed a clear downward flow of water in all the furrow irrigation combination methods with required water availability in tail end region. Efficiently, 10lps+85% and 10lps+75% treatment showed that the optimum discharge rate has an effect to move water towards tail end even though it is cut at 85% or 75% furrow length. Border irrigation method has shown a total irregular pattern of flow with ups and downs in head, middle and tail region along different depths resulting in inefficiency of water use (Fig.3.2). Another year of experiment (plant and ratoon) is needed to conclude the results.

4

Ratoon management

Plant geometry in relation to mechanization in sugarcane

Field experiment was conducted to work out optimum plant geometry of different varieties for use of farm machinery. The experiment consisted of 12 treatment combinations with 3 planting geometries, *viz.*, 120, 150 and 30x120 cm row spacings and 4 varieties, *viz.*, CoS 96275, CoSe 92423, CoS 94257 and CoLk 94184. The experiment was laid out in split plot design allocating plant geometry in main plot and varieties in sub plots. The treatments were replicated thrice in the experiment.

The data on ratoon sugarcane growth, yield attributes and yield indicate that significant highest shoot population (166.71 thousand/ha), number of millable canes (141.44 thousand/ha) and cane yield (73.56 t/ha) was observed at 30x120 cm row spacing (Table 4.1). Variety CoSe 92423 recorded significantly highest yield (66.59 t/ha) to CoS 96275 and CoS 94257, however, it was found similar to CoLk 94184 (63.59 t/ha). The quality parameters were not affected by plant geometry but significantly highest sugar yield was obtained at 30x120 cm spacing. Different genotypes showed significant variation for different quality observations. Significantly highest brix (22.11), pol % (19.84) with purity of 89.71% and CCS % (13.82) was harnessed by CoLk 94184. This genotype also fetched significantly highest sugar yield (8.79 t/ha), which was closely followed by CoSe 92423 (Table 4.2).

Table 4.1. Ratoon cane growth, yield attributes and yield under different planting geometries and genotypic variations

Treatment	Shoot count 180 DAP	NMC (000/ha)	Cane length (cm)	Cane girth (cm)	Av. cane weight (g)	Cane yield (t/ha)
Row spacing						
120 cm	138.72	107.32	181.98	2.35	0.79	61.58
150 cm	116.33	90.14	179.36	2.48	0.93	52.68
30x120	166.71	141.44	182.28	2.39	0.82	73.56
CD (P = 0.05)	17.60	14.35	NS	NS	NS	8.65
Genotype						
CoS 96275	132.67	104.89	173.03	2.30	0.71	59.48
CoSe 92423	144.47	119.56	185.73	2.61	0.92	66.59
CoS 94257	144.76	104.16	178.23	2.54	0.92	60.77
CoLk 94184	140.43	123.25	187.81	2.58	0.83	63.59
CD (P = 0.05)	6.73	8.73	6.27	0.16	0.18	4.59

Assessment of sugarcane cultivation machines (RMD & RBS planter) on farmers' fields

To promote the adoption of Ratoon Promoter developed by IISR, method and result demonstrations on this machine was conducted in 11 villages covering 44 cane growers and 18.62 ha ratoon area in Biswan sugar mill (Sitapur) zone area. On-farm training in operational and maintenance aspect of the machine was organized for beneficiary farmers. Feedback proforma was developed and data on

Table 4.2. Effect of planting geometry and genotypes on quality attributes and sugar yield

Treatment	°Brix	Pol (%)	Purity (%)	CCS (%)	CCS (t/ha)
Planting geometry					
Row spacing					
120 cm	20.45	17.98	87.85	12.40	7.63
150 cm	20.55	18.10	87.92	12.49	6.59
30x120	20.59	18.00	87.33	12.38	9.09
CD (P = 0.05)	NS	NS	NS	NS	0.97
Genotype					
CoS 96275	21.15	18.69	88.33	12.93	7.64
CoSe 92423	19.17	16.51	86.12	11.28	7.55
CoS 94257	19.68	17.05	86.58	11.68	7.10
CoLk 94184	22.11	19.84	89.71	13.82	8.79
CD (P = 0.05)	1.23	1.33	1.10	1.16	0.79

performance of machine was collected by conducting personal interview of cane growers. A saving of average 34 mandays/ha and net saving in cost to the tune of Rs. 4,000/ha was recorded in demonstrated plots. An average ratoon yield of 66 t/ha in demonstration plots was recorded which is 20% higher than the ratoon yield obtained by farmers in conventional method (55 t/ha).

5

Mechanization of sugarcane farming

Development of tractor operated sugarcane harvester for small farms

Modified prototype of tractor operated front mounted sugarcane harvester was tested in the field for harvesting of paired row of sugarcane spaced at 30 cm. Dynamic instability was observed during field operation because of larger diameter (80 cm) of cutting blade discs for harvesting of paired row cane. The cutting blade discs were replaced with the smaller diameter (30 cm) cutting blades and harvester was field tested for harvesting of two rows of cane spaced at 75 cm (Fig. 5.1). The performance of harvester was satisfactory for partially lodged cane crop without any stability problem and breakdown. In moderately and heavily lodged cane crop, windrowing was a problem. The harvested cane were lifted manually and collected at a point where it was fed through the detrasher for its cleaning (Fig. 5.2). Lifting of cane was difficult as both harvested rows are windrowed linearly and piled in between the tyres of the tractor. The effective field capacity of the harvester was 0.15 ha/h. The limiting factor was lifting of harvested cane and its cleaning and bundle making. The

Fig. 5.1. Tractor operated front mounted sugarcane harvester under field operation

output of the detrasher was 1.0 tonne/h on clean cane basis.

Development of tractor operated sugarcane manager

Two models of tractor operated sugarcane manager have been developed and field tested.

Fig. 5.2. Tractor operated sugarcane detrasher for cleaning of harvested cane

The first model performs intercultural operation by using blade shovels to conserve soil moisture, band placement of fertilizer on both side of rows and earthing-up operation by using furrowers. It was field tested at farmer's fields in Shamli and Unn sugar mill area. The effective field capacity of this equipment varied from 0.3 to 0.4 ha/h. The depth of cut was 10 cm. There is provision for adjusting the inter-row spacing of blade shovels depending on the row spacing of the crop. Farmers are satisfied with the equipment and wanted to use it for another season. The equipment has been kept in Shamli and Unn sugar mill area for another season.

The second model of sugarcane manager is simple equipment for carrying out intercultural operation by using sweep shovels and earthing-up operation by using furrowers. It was field tested at IISR farm and farmers field in Barabanki district. It covers inter-spacing of three rows of cane. Two tynes with sweep shovel have been provided for interculturing of each inter-row spacings. The effective field capacity of the equipment was 0.40 ha/h.

Evaluation and refinement of sett cutting mechanism of sugarcane planter

The specifications *viz.* length, width, thickness and materials of construction of the different type of blades used in different sugarcane planters, proposed in the study, were checked and confirmed. It was found that overall

length, width and thickness of different blades ranged from 106 to 184 mm, 29.3 to 59.7 mm and 2.3 to 8 mm, respectively. The materials used for construction of the blades were high carbon steel/spring steel. The bevel angle in the curved blades ranged from 11.17 to 16.53 degree whereas, it ranged from 10.19 to 45 degree in straight blades. An experimental set up was fabricated for measurement of cutting energy in different blades during cutting of setts.

Design refinement of tractor operated sugarcane-cum-potato planter

New design has been conceptualized and fabrication work has been initiated. Main frame with three point linkage hitching system has been designed and fabricated. On this main frame, furrowers have been mounted for opening two furrows for planting sugarcane in the furrows. On outer sides and in the middle of these furrowers, three seed potato metering mechanisms have been mounted so as to plant one potato row on the raised bed in between two sugarcane rows. To avoid slippage, the seed potato picking cups have been mounted on chain and sprocket drive. Moulded plastic cups for seed potato picking have been provided in the improved potato seed metering mechanism. In the older version of sugarcane-cum-potato planter, these seed potato picking cups were mounted on flat belt-pulley system. Design and fabrication of seed potato hopper is under progress.

Exploratory prototypes developed

Development of tractor operated ratoon management device with discs

A tractor operated ratoon management device with discs (Fig 5.3) was developed for performing stubble shaving, off-barring and fertilizer application in sugarcane ratoon crop without disturbing the trash-mulch and is suitable for widely spaced single row or paired row crop. It is equipped with two discs for off-barring of both sides of row and opening of slit (without disturbing the trash mulch) for application of fertilizer near to root zone. Provision has been made for adjustment of height of the discs as per the height of the ridges in the field. An innovative approach has been developed and incorporated in the equipment for application and regulation of fertilizer. The rate of fertilizer is varied by varying the rotational speed of the metering augers (specially designed mild steel augers for free flow of fertilizer). The rotary speed of metering augers is varied by varying the peripheral length of the mild steel ground wheel (used for transmission of power to metering augers). The ground wheel has been provided with spikes. The peripheral length of ground wheel is varied by varying the length of spikes. The greater the peripheral length of ground wheel lesser will be the rotational speed of the metering augers for a particular forward speed of the equipment. The equipment is designed to vary the fertilizer from 75 to 150 kg/ha. A serrated disc has been provided for shaving of stubbles close to the ground surface. The height of disc could also be varied according to the height of ridges in the field. The power to serrated disc is transmitted from tractor P.T.O. through a power train consisted of pulley gear box, propeller shaft and universal joint crosses. The equipment was tested in the field at IISR farm. Equipment was supplied to National Institute of Abiotic Stress Management, Malegaon, Baramati, Maharashtra for large scale field testing.

Development of tractor operated plant residue shredder

After harvesting of sugarcane, large quantity of sugarcane trash and stubbles are left in the field. In order to remove the trash from the field, farmers either burn the trash *in situ* or employ labour for collection and removal from the field. Now-a-days due to environmental concerns of burning and labour scarcity in collection and removal of trash, cane growers are opting for keeping the trash in the field for decomposition for improving the soil health by way of addition of organic matter or using it as trash mulch for moisture conservation. In view of the above, a tractor operated plant residue shredder (Fig 5.4) was developed for reduction of size of the trash in situ in the field and shaving of stubbles. It consisted of a mild steel framework, pair of rotating blades in zig-zag profile, power transmission unit and chemical application unit.

Fig. 5.3. Tractor operated ratoon management device with discs

Fig. 5.4. Tractor operated plant residue shredder

Power to the blades was transmitted through tractor PTO. Power transmission unit consisted of telescopic propeller shaft, universal joint crosses, gear reduction box. The equipment was tested at IISR farm (Fig 5.5). The performance was satisfactory in dry trash. Field testing to be conducted under different field conditions during coming season.

Fig. 5.5. Tractor operated plant residue shredder under field operation

Development of attachment for laying of sub-surface drip laterals with IISR tractor operated trench planter

Tractor operated trench planter was developed during 2012-13 for paired row planting of sugarcane at a spacing of 30 cm. With the help of this equipment, all the unit operations involved in cane planting, *viz.*, sett cutting, furrow opening, placement of setts into opened furrows, application of fertilizer and insecticide solution and covering of soil over the seed-setts are performed simultaneously in a single pass of the tractor. An attachment was designed, developed and attached with this planter for facilitating laying of sub-surface drip laterals underneath the centre of planted paired furrows. Trench planter with drip laterals laying attachment was field tested at IISR farm (Fig 5.6). The performance of laying of sub-surface drip laterals was satisfactory. The equipment was able to lay the drip laterals at 7.5-10 cm underneath the centre of the planted furrows along with the paired row planting of sugarcane.

Fig. 5.6. Tractor operated trench planter with sub-surface drip laterals laying attachment

Development of tractor operated cane node planter

Design and development of tractor operated cane node planter has been initiated for mechanizing the newly developed cane node

planting technique. Two prototypes are targeted to be developed. First, for cutting of cane nodes from whole seed cane and its preparation before planting and the second prototype for planting of cut and prepared seed cane node in the field. Framework and furrow opening unit has been fabricated.

AICRP on FIM

Manufacturing of prototypes for conducting field adoptability trials under varying agro-climatic and soil conditions

Prototypes fabricated

Particular	Nos.
T.O. adjustable two row ground wheel driven sugarcane cutter planter	2
T.O. adjustable two row P.T.O. driven sugarcane cutter planter	3
T.O. ratoon management device	1
T.O. paired row (30 cm spacing) trencher	1
T.O. paired row (45 cm spacing) trencher	1
T.O. paired row (30 cm spacing) trench planter	1
T.O. three row furrower with frame	1
T.O. ratoon management device with discs	1
T.O. plant residue shredder	1
Modification of T.O. two row ground wheel driven sugarcane cutter planter	1
Modification of T.O. raised bed seeder (80 cm)	1
Power operated sugarcane cleaning/washing unit	1
Manual sett cutting machine	7
Total	**22**

Prototypes supplied

Name of equipment	Quantity
T.O. ratoon management device	1
T.O. raised bed seeder-cum-sugarcane planter	1
T.O. ratoon management device with discs	1
T.O. paired row (45 cm spacing) trencher	1
T.O. adjustable two row P.T.O. driven sugarcane cutter planter	1
T.O. adjustable two row ground wheel driven sugarcane cutter planter	1
Manual sett cutter	15
Manual sugarcane stripper-cum-detrasher	12
Total	**33**

Fig. 5.7. Tractor operated raised bed seeder under field operation at NSI, Kanpur

Frontline demonstration of IISR tractor operated ratoon management device (RMD)

IISR tractor operated ratoon management device (RMD) is used for stubble shaving, off-barring, interculturing (deep tilling), fertilizer as well as manure dispensing and earthing up in sugarcane ratoon crop. Frontline demonstration of this equipment was conducted at farmer's fields in Biswa Sugar Mill area of Sitapur district in 8.62 ha area. It covers two rows spaced at 75 cm in single pass. Effective field capacity of the equipment was 0.3 ha/h.

Frontline demonstration of IISR raised bed seeder/raised bed seeder-cum-sugarcane planter

Raised bed seeder (RBS) is used for opening of three furrows at a spacing of 80 cm and making of two raised beds in between three furrows and sowing of three rows of wheat at each raised bed. Planting of sugarcane is done manually in the opened furrows during February. Frontline demonstration of this equipment was conducted at National Sugar Institute, Kanpur in 2 ha area (Fig 5.7). Raised bed seeder-cum-sugarcane planter is used for planting sugarcane in furrows and drilling two rows of wheat on raised beds as companion crop. Frontline demonstrations of this equipment were conducted at farmer's fields in Bakshi-ka-Talab, District Lucknow in 0.4 ha area and at IISR farm in 0.1 ha area. It's field capacity was 0.2 ha/h and labour requirement was 20 man-h/ha.

Frontline demonstration of IISR modified three row cane planter

Frontline demonstrations of IISR tractor operated modified three row sugarcane planter was conducted at farmers fields in Shamli (Fig. 5.8) and Unn Sugar Mill area, Muzaffarnagar in 9.55 ha area and 11.75 ha in Faizabad, Sultanpur and Barabanki districts. Effective field capacity of the planter was 0.25 ha/h. Cost of planting was reduced by 60% as compared to conventional method of planting.

Fig. 5.8. Demonstration of IISR three row sugarcane cutter planter at Shamli

Frontline demonstration of IISR tractor operated paired row/trench planter

Frontline demonstrations of IISR tractor operated paired row/trench planter (Fig 5.8) was conducted at farmers fields of Lucknow and

Fig. 5.8. Tractor operated trench planter under field operation at farmer's field in Bakshi-ka-Talab, Lucknow

Barabanki districts in approx. 9.4 ha area. Equipment is used to plant one pair of sugarcane at 30 cm row spacing in deep and wide furrow (trench). The row spacing between the subsequent pairs could be varied by maintaining the spacing between the tractor tyre and previously planted rows. Cane was planted under 30:120 cm row geometry. Effective field capacity of the planter was 0.20 ha/h. Cost of planting was reduced by 60% as compared to conventional method of planting.

Table 5.1. Effect of irrigation treatments and nitrogen doses on sugarcane yield

Irrigation treatment	100% recommended dose of N	75% recommended dose of N	50% recommended dose of N	Mean
SSD at 75% PE	82.39	80.89	83.99	82.42
SSD at 100% PE	84.03	83.35	83.40	83.59
SSD at 125% PE	94.10	91.00	89.31	91.47
Average for drip	86.84	85.08	85.57	
Surface irrigation	79.54	76.42	73.32	76.43
SE (Irrigation)				1.41
CD (Irrigation)				4.50
SE (Nitrogen)				NS
CD (Nitrogen)				NS
SE (IxN)				NS
CD (IxN)				NS

Table 5.2. Effect of irrigation treatments and nitrogen doses on irrigation water use efficiency

Irrigation treatment	100% recommended dose of N	75% recommended dose of N	50% recommended dose of N	Mean
SSD at 75% PE	2890.84	2838.21	2946.88	2891.98
SSD at 100% PE	2211.26	2193.35	2194.81	2199.81
SSD at 125% PE	1980.99	1915.79	1880.12	1925.63
Average for drip	2361.03	2315.78	2340.60	
Surface irrigation	994.27	955.21	916.49	955.32
SE (Irrigation)				36.89
CD (Irrigation)				117.35
SE (Nitrogen)				NS
CD (Nitrogen)				NS
SE (IxN)				NS
CD(IxN)				NS

AICRP on Sugarcane

Optimization of fertigation schedule for sugarcane through sub-surface micro-irrigation technique under different agro-climatic conditions

Highest sugarcane yield of 94.10 t/ha was observed when sugarcane was drip fertigated with recommended dose of nitrogen and water equivalent to 125 % pan evaporation. However, irrigation water use efficiency (IWUE) was the highest at 2946.88 kg/ha-cm when fertigation was done and the amount of irrigation water was kept as 75 per cent of pan evaporation. The sugarcane yield and IWUE was not influenced significantly by doses of nitrogen in fertigation treatments. With surface irrigation, the mean sugarcane yield and IWUE were 76.43 t/ha and 955.32 kg/ha-cm respectively. The results are presented in Tables 5.1 and 5.2.

Externally Funded Project

Enhancing water and nutrients use efficiency through drip irrigation & fertigation in spring planted sugarcane under sub tropical conditions

Sugarcane crop was planted and irrigated as per the treatments mentioned in Fig. 5.9 Highest sugarcane yield of 114.03 t/ha was observed in ring-pit planting with drip fertigation. The irrigation water use efficiency was also highest (2603.52 kg/ha-cm) for this treatment. Sugarcane yield and irrigation water use efficiency was also higher and comparable with ring-pit planting in those treatments in which planting was done at 75 cm row to row spacing with drip fertigation. The results are presented in Fig. 5.9.

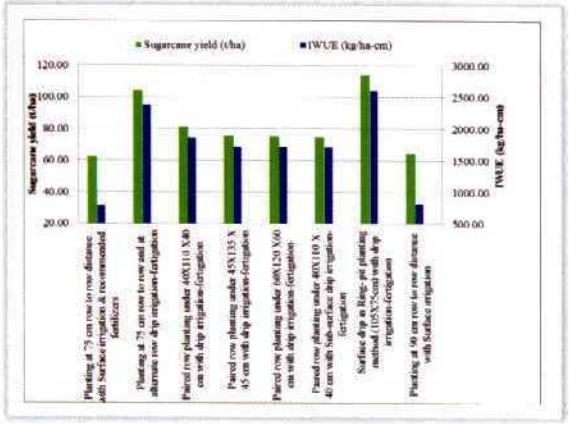


Fig. 5.9. Effect of irrigation treatments on sugarcane yield and water use efficiency

6

Management of pests and diseases

Identification of pathotypes in red rot pathogen

This year, 12 new isolates, *i.e.*, one each from BO 91 (IR 48) and CoS 91269 (IR 57) and ten isolates from CoLk 8102 (IR 50, IR 51, IR 52, IR 53, IR 54, IR 55, IR 56, IR 58 and IR-59) were collected and evaluated for their virulence pattern on the designated differentials using plug method of inoculation. The result indicated that the virulence pattern of the isolates more or less matched with the designated pathotype Cf 02. This year, emergence of any new virulent pathotype was not observed in this zone.

Pathotype formation in *Colletotrichum falcatum* in relation to breakdown of resistance in cane genotype

During August, Cf 01 (*Colletotrichum falcatum* isolated from Co 1148) was inoculated on the differentials and after three weeks reisolation was done from the furthest point of infection. Reisolates were reinoculated in the respective differentials in September. Six sporulating variant cultures of Cf 01 were established after second round of reisolation. These cultures were multiplied on liquid medium for molecular studies. From the disease reaction after two rounds of reisolation, it was clear that host did influence the virulence behaviour of the reisolates. Host acted as a selective sieve to enrich any available specific virulence for the differential. Similarly, host selective pressure also forced in the drop of virulence level in reisolates.

Genome sequencing of red rot pathogen

Fresh red rot culture of Cf 01 (*C. falcatum*) isolated from the inoculated canes of variety Co 1148 was purified and maintained on oat meal agar. The culture was harvested and the total DNA was extracted using CTAB method and fungal gDNA extraction MiniKit (XcelGen). The purity of isolated DNA checked by UV spectrophotometer ranged between 1.7-1.9 (A260/A280).

Enhancing efficacy of *Trichoderma* based red rot management system

Studies were carried out to isolate, enumerate and characterize *Trichoderma* isolates from sugarcane agro-ecosystems of sub-tropical India. A total of 34 isolates were established from an organic sugarcane agro-ecological niche and characterized for colony characters including growth rates at different temperatures. Based on these characters, 19 isolates were tentatively identified as *T. harzianum*, two as *T. atroviride* and one as *T. virens*. Diffusible antifungal metabolites produced by *Trichoderma* isolates were screened against *C. falcatum in vitro* and *in vivo*. The highest inhibition in *C. falcatum* growth *in vitro* was recorded with culture filtrates of isolates STr-83 (70.6%) followed by STr-108 (67.3%). In field experiment, treatment with metabolites of isolates STr-12 and STr-108 exhibited a reduction of 42.6% and 40%, respectively, in the number of buds affected by *C. falcatum* relative to control. In screening for enzyme production by *Trichoderma* isolates, chitinase production was observed in four isolates (STr-83, 92, 96 & 108) and cellulase production in five isolates (STr-81, 83, 85, 96 & 108).

Mass multiplication of *Trichoderma* on cheaper substrates and development of suitable delivery system for disease management in sugarcane

In field trial, no significant effect of *Trichoderma* multiplied culture was found on the germination, disease incidence, juice quality and cane yield of four red rot susceptible varieties. *In vitro* screening of various materials, sorghum grains and bagasse were found promising as substrates for multiplication of *T. harzianum*. Shelf life studies of *T. harzianum* multiplied on sorghum grains and bagasse revealed that population of *T. harzianum* remained almost constant on both the substrates for a period of 60 days after which a decline in population of *T. harzianum* was observed. It was recorded as 6.3 x

10^6 cfu/g on sorghum and 4×10^6 cfu/g on bagasse at 150 days after inoculation.

Management of red rot through modulating host resistance

Biochemical attributes and SOD (Superoxide dismutase) gene expression was studied in control and red rot inoculated stalk tissues of nine sugarcane genotypes (resistant and susceptible). The content of reducing sugars was very high in red rot deteriorated tissues compared to control; level of increase was more in susceptible genotypes indicating higher sucrose degradation in them. Quantitative analysis of peroxidase (POX) and polypenol oxidase (PPO) enzymes indicated higher enzyme activity in resistant genotypes. Higher expression of SOD gene was detected in resistant genotypes (BO 91, CoLk 94184) as compared to susceptible (Co 1148, CoLk 7701).

Transcriptional activity of chitinase gene was studied in cane stalks (both in inoculated and uninoculated) of resistant and susceptible sugarcane varieties, clones of *S. spontaneum* and *S. barberi*. The resistant genotypes showed early induction of chitinase activity which increased with time from 1 day to 3 days after inoculation. The enhanced expression of chitinase after induction of disease in red rot resistant genotypes as compared to red rot susceptible genotypes and the increased intensity of these proteins with time suggested a possible role of chitinase gene in conferring red rot resistance in sugarcane.

Management of red rot through fungal endophytes in sugarcane

The identified fungal endophytes isolated from different leaves and roots of healthy sugarcane plants showed their antagonistic activity against *C. falcatum in vitro*. These were further tested for its effect on sett germination and settling vigour. Data revealed that the setts treated with two endophytes, *i.e., Trichoderma* and *Aspergillus* strains showed more settling vigour as compared to untreated sugarcane setts, *i.e.*, setts treated with water. The root and shoot length, and total biomass of the plant were higher in sett treated with *Trichoderma* and *Aspergillus* as compared to the sett treated with water as check.

Tissue culture-raised sugarcane plantlets of different genotypes, *i.e.*, CoS 767, Co 1148, and CoLk 94184 were used to detect the presence of fungal endophytes in leaves and roots. Overall colonization rate of fungal endophytes was less in these plantlets as compared to sett-raised sugarcane plants.

Survey of diseases naturally occurring in the area on important varieties

Under this programme, command area of sugar mills located in the districts adjoining Lucknow, *viz.*, Barabanki, Faizabad, Gonda, Hardoi, Rae Bareli and Shahjahanpur were surveyed. Red rot incidence was observed in old and rejected varieties like CoLk 8102, CoS 91269 and BO 91 but not in any of the new genotypes. Red rot affected samples of these varieties were collected and used to test the virulence.

Incidence of smut was observed in CoSe 92423, CoSe 01434, CoSe 03234 Co 0236 and CoS 8432. Incidence of GSD was also observed in Co 0238 and CoPk 09151 CoSe 98231 and CoLk 94184. Incidence of Pokkah boeng was observed in Co 0238, Co 0239, CoS 8436 and CoS 8432.

Survey and surveillance of insect pests and diseases of sugarcane in subtropical area

Factory command areas of various sugar mills of U.P., Uttarakhand, Bihar and Maharashtra were surveyed. Due to delayed monsoon rains and prevailing high temperatures this year, incidences of early shoot borer and mealy bug were noticed that affected several sugarcane areas of western districts of U.P. In general, insect pest incidence was low. However, incidence of early shoot borer (5-10%), top borer (1-15%), mealy bug (5-20%) and termite (up to 20%) was recorded in few fields. White grub damage (10-20%) was observed in certain pockets.

Increasing incidence of GSD in most of the cane growing areas and more than 20% incidence of GSD in some plots caused concern. Incidence of Pokkah boeng was observed in many newly released genotypes. Incidence of red rot was observed mostly in the older genotypes, *viz.*, CoSe 92423, CoSe 95422, CoS 91269, CoLk 8102 (1-2%)

etc. however it was also observed in UP 7250, a newly released genotype. In some fields, incidence of red rot was quite high (>20% crop was affected). Smut was observed in genotypes, *viz.*, CoSe 92423, CoSe 96275, CoSe 01235, Co 0238, Co 0239 and CoS 767. Leaf scald was also noticed in Co 0238 and CoLk 8102.

Evaluation/screening of sugarcane germplasm/genotypes against red rot and smut

Of the 61 genotypes screened, two genotypes were resistant (R), 38 genotypes were resistant (R) to moderately resistant (MR) and 11 genotypes were moderately susceptible (MS) to highly susceptible (HS) against both the pathotypes (Cf 08 and Cf 09). Two genotypes were moderately susceptible (MS) to susceptible (S) against Cf 08 and moderately resistant (MR) to Cf 09 while eight genotypes were moderately susceptible (MS) to highly susceptible (HS) to Cf 09 and resistant (R) to moderately resistant (MR) to Cf 08. Of the 61 genotypes tested, 30 genotypes were susceptible and remaining 31 were tolerant to smut. Natural incidence of wilt was observed in 12 genotypes. Incidence of leaf scald in two genotypes and of grassy shoot disease in three genotypes was also noticed.

Evaluation of zonal varieties for red rot, smut and wilt

During 2013-14, 33 entries were evaluated. Twenty four genotypes were resistant to moderately resistant and to highly susceptible and five genotypes, *viz.*, Co 100039, CoH 09262, CoH 10263, CoPb 08217, CoPb 10182 and CoPb 10183 were moderately susceptible to highly susceptible to both the pathotypes (Cf 08 and Cf 09) and remaining four genotypes showed susceptible reaction to one pathotype and resistant to other.

Sixteen genotypes, *viz.*, Co 09022, Co 10035, Co 10037, CoH 09262, CoH 09263, CoH 10262, CoPant 10221, CoPb 08217, CoPb 09181, CoPb 09214, CoPb 10181, CoPb 10182, CoPb 10211, CoS 08234, CoS 09246 and CoS 10231 were susceptible and rest 17 were tolerant to smut.

Natural incidence of wilt was noticed in 12 genotypes, *viz.*, Co 10036, Co 10037, Co 10039, CoH 08263, CoH 09263, CoH 10261, CoH 10263, CoPb 08211, CoPb 09181, CoPb 10181 and Co S 10231.

Natural incidence of grassy shoot disease (GSD) was observed in genotypes Co 10035, CoH 08262, Co H 09264, CoLk 9202, CoPb 08212, CoPb 10182 and LG 05002 and of yellow leaf disease (YLD) in genotypes Co 010035, Co 010036, CoH 08263, CoLk 9202, CoPant 10221, CoS 08234, CoS 09232 and CoS 10231.

In North Central Zone, 13 genotypes were screened against red rot. Five genotypes *viz.*, CoP 8437, CoP 9301, CoP 9437, CoSe 8451 and CoSe 8452 were moderately resistant. CoSe 10451 was highly susceptible to Cf 07 and moderately resistant to Cf 08, while CoSe 10452 and CoSe 10453 were moderately susceptible to highly susceptible to Cf 08 and moderately resistant to Cf 07.

Containment of major insect-pests of sugarcane through habitat modifications

The incidence of top borer (I brood) ranged from 10.63-16.48% along with various trap crops in comparison to control (18.78%). The minimum incidence of I brood was observed in plots along with coriander (10.63%), marigold (12.71%), tomato (13.38%) and mustard (14.74). The incidence of II brood was low (0.20 to 2.45%). The minimum incidence of III brood (5.66%) was observed in plot along with marigold in comparison to control (14.57%). The incidence of top borer (IV brood) ranged from 12.11 to 20.75% in plots along with maize, tomato and jowar as compared to 23.08% in control. The minimum incidence of V brood (9.34%) was observed in plots with jowar in comparison to 19.38% in control.

Semio-chemicals for the management of sugarcane top borer

Experiment was planted with three top borer susceptible sugarcane varieties (CoLk 8102, Co 0238, and CoJ 64) in February, 2013. Field collected top borer larvae were crushed in water for preparing spray solution. Spray was maintained @ 1000 larvae and 1000 liters of water/ha. Foliar spray was done in standing crop in June. Effect of spraying of crushed top borer

larvae on parasitisation by larval/pre pupal parasites and on incidence of top borer (IV Brood) was studied. The parasitisation in CoLk 8102 by *Rhaconotus* sp. was high (24%) followed by *Stenobracon* sp. (8.0%) and *Isotima javensis* (4.0%) and the empty cocoons of parasites (unidentified) were 32%. In Co 0238, the parasitisation by *Rhaconotus* sp. was 12% followed by *Stenobracon* sp. (8.0%) and *Isotima javensis* (8.0%) and the empty cocoons of parasites (unidentified) were 48%. In CoJ 64, the parasitisation by *Rhaconotus* sp. was 36% followed by *Stenobracon* sp. (28%) and *Isotima javensis* (12.0%) and the empty cocoons of parasites (unidentified) were 12%. Parasitisation in treated plots was higher over untreated control. Incidence of top borer (IV brood) was low in treated plots.

Development of technique of mass multiplication of larval parasitoid for management of sugarcane top borer

A laboratory rearing technique using sugarcane stalk pieces, field collected top borer larvae and laboratory reared larvae was developed. The parasitisation of *Corcyra* borer larvae by *Stenobracon nicevillei* was 2-3%. It was observed that *Stenobracon* required two larvae of *Corcyra* for complete development. The parasitisation of top borer larvae by *Rhaconotus scirpophagae* was 20-26% and emergence of adults ranged from 36-45%.

7

Physiology, Biochemistry and Biotechnology

Modulating the expression of sucrose metabolizing enzymes for high sucrose accumulation in sugarcane

Foliar application of chemical mixture containing enzyme effectors and growth hormone (Mg+Mn+ ethrel) was performed in the month of October and sucrose content was determined in high (CoJ 64) and low sugar (BO 91) varieties in the months of December and January. Both varieties exhibited higher sucrose content due to chemical treatment. Large scale trial on foliar application was performed on variety CoLk 94184. Sucrose content increased from 19.7% (control) to 21.24% in treated plants.

Molecular study to reveal transcriptomes and genes associated with sucrose transport and accumulation in sugarcane

Semi qRT-PCR expression of SAI in various internodal tissues of early (CoJ 64) and late-maturing variety (BO 91) indicated uniform, low level of expression in CoJ 64 while BO 91 exhibited increased expression at early crop stage, which declined later. Real-time qPCR carried out at four crop stages revealed high CWI expression in upper internodes of CoJ 64. In BO 91, CWI expression was high in both top and bottom internodes which declined significantly only in top internodes as crop matures. Overall, CWI expression was higher in CoJ 64 than that in BO 91. With crop growth, no major change in SPS expression was observed in CoJ 64, whereas in BO 91, it decreased. Similarly, no major change was observed in SS expression too; however, its expression especially in lower internodes was higher in CoJ 64 than that in Bo91 (Fig 7.1). Findings enhance our understanding about expression of these genes in sugarcane varieties differing in content and time of peak sucrose storage. Thus, employing these genes synergistically, improvement of sugarcane for sucrose is possible.

Minimizing post-harvest sucrose deterioration and its molecular assessment in sugarcane

Mannitol concentration at the time of harvest,

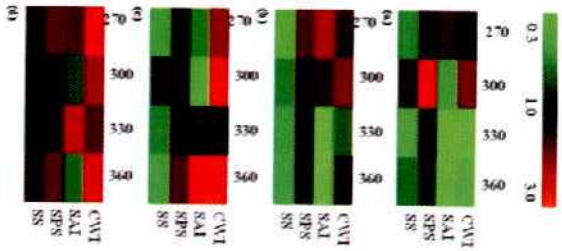


Fig. 7.1. Expression patterns of different genes associated with sucrose transport

during low temperatures (7-8°C) in December was 1896 ppm/100 brix which increased four times after 240 hours of harvest. In April, when the ambient temperature was high (42-45°C), mannitol content at the time of harvest was 10521 ppm/100 brix which increased by 5.6 times and was 59215 ppm/100 brix after 240 hours of harvest. Dextran concentration at the time of harvest during low temperature was 6553/100 brix which increased 2.6 times after 240 hours of harvest. During the high temperature period in April, the dextran content was 7959/100 brix and it increased by 4.84 times after 240 hours of harvest. The decline in CCS in December after 240 h of harvest was 3.07 units. In April when temperature was higher, the decline in CCS after 240 hours of harvest was 5.23 unit.

For minimizing post-harvest sucrose losses, electrolyzed water (EW) and benzalkonium chloride + sodium metasilicate (BKC+SMS) (0.1% each) mixture was sprayed on canes and kept for different days for staling. SAI gene expression was studied using total RNA isolated from fresh and staled canes (both from untreated and treated stalks) by performing qRT-PCR. Results obtained indicated significant increase in SAI gene

expression in staled cane as compared to fresh cane and it was significantly decreased by both EW and BKC+SMS mixture treatments on staled canes.

Elucidation of the role of species chromosomal complement in sugarcane genotypes adapted to subtropical conditions

This project aims to understand chromosome variability in adapted parents, crosses and clonal generations, and the contribution of species-specific chromosomes in elite genotypes of sugarcane to determine their role in the adaptability to target environment. In this context, chromosome variability studies in clonal population of the cross CoLk 1158 × BO 91 were continued. Further, macerozyme digested root tips of plants from cross population CoLk 1158 × BO 91 were squashed in 45% glacial acetic acid and slides were air-dried through ethanol series after removing cover glass. Genomic DNA of parent varieties was used to optimize probe preparation for in *situ* hybridization studies.

Identification and expression analysis of resistance gene analogues against red rot disease in sugarcane

To find the possible resistance gene analogues against red rot disease of sugarcane, amplification of NBS-LRR Resistance Gene Analogues (RGAs) was achieved using eighteen RGA specific primer pairs. Ten putative RGAs were identified, four from BO 91 and six from CoS 767. The length of RGA sequences showed variability ranging from 356 bp to 742 bp having the GC content from 37.6 to 43.5%. A search of GenBank using the BLAST algorithm revealed that these RGA sequences were most similar to the NBS/LRR resistance protein-like gene sequences of *Saccharum* hybrid cultivars elsewhere (Table 7.1). A similarity limited to the conserved motifs was found to resistance gene-like mRNA sequences related to disease resistance mechanism also.

Table 7.1. Sequences producing significant alignments with putative RGA sequence

Description	Query cover	E value	Identity	Accession
Saccharum hybrid cultivar DNA, resistance gene analogue RGA-3, cultivar: NSG-311	100%	4e-22	100%	AB836667.1
Saccharum hybrid cultivar Q117 clone RGA-Q16 resistance gene-like mRNA, complete sequence	100%	4e-22	100%	AY849885.1
Saccharum hybrid cultivar Q117 clone RGA-Q15 resistance gene-like mRNA, complete sequence	100%	4e-22	100%	AY849884.1
Sorghum bicolor hypothetical protein, mRNA	100%	8e-19	97%	XM_002459996.1
Saccharum hybrid cultivar clone 1365 NBS/LRR resistance protein-like gene, partial sequence	100%	8e-19	97%	EF656338.1
Saccharum hybrid cultivar clone 1253 NBS/LRR resistance protein-like gene, partial sequence	100%	8e-19	97%	EF656335.1

Mapping of loci linked to sugar content in sugarcane

A segregating self population of CoLk 7901 in the C_1 generation was phenotyped for juice quality traits. Hand Refractometer Brix was recorded from October onwards with a mean value of 20.8 for the population. Juice quality analyses were carried out during January and February 2014. The sucrose % juice values ranged from 8.2-19.8 (Fig. 7.2). 7% of the clones had a mean sucrose % juice value less than 13 while 19% exhibited a mean sucrose % juice value more than 18. Another self population of CoLk 7901 in the C_2 stage was phenotyped during November and January with the mean sucrose % in juice values 10.4-20.2. This will be utilized for further genotyping studies. Genotyping studies were continued in the bi-parental population of CoLk 7901 x HR-83-65 using 35 primers with only two primers exhibiting variation among the contrasting clones. Five primers exhibited polymorphism among the sugarcane clones with high sugar content (sucrose % juice > 18). More number of primers will be utilized for mapping studies in the population next year. The

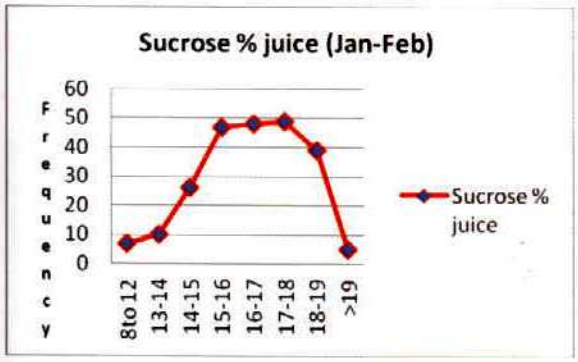


Fig. 7.2. Distribution of mean sucrose % juice values in a self population of CoLk 7901 (C_1 generation)

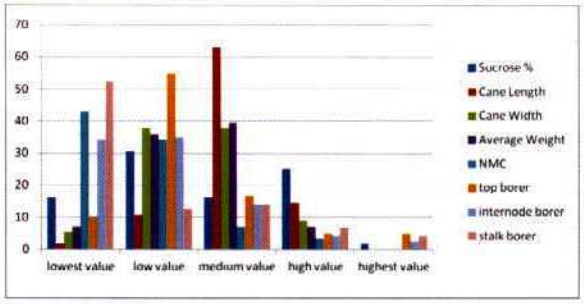
polymorphic bands from these clones will be further analyzed for exploring the possibility of using these as markers for sugar content.

Association mapping in sugarcane

One hundred SSR markers (genomic SSRs and EST-SSRs) were used for deciphering their linkage disequilibrium based association with number of millable canes (NMC), cane length, number of nodes, cane girth and cane weight, in a set of 108 sugarcane genotypes/cultivars of sub- tropical India. Population structure was analyzed using model-based approach. Marker-trait association was analyzed by mixed linear model (MLM) using TASSEL Population structure using model-based approach revealed seven genetically distinct groups/admixtures. Marker-trait association by mixed linear model (MLM) using TASSEL identified six putative SSR associated with cane weight, five with cane length, seven with NMC, six with number of nodes, and three with cane girth. These associated markers after validation could be used in MAS for developing of suitable sugarcane varieties.

Development of SSR markers for red rot resistance from EST database of sugarcane

Linkage analysis was carried out based on the genotypic (250 EST-SSR and gSSR primers) and phenotypic data (average of two years screening data against race Cf 01 of red rot) of the mapping



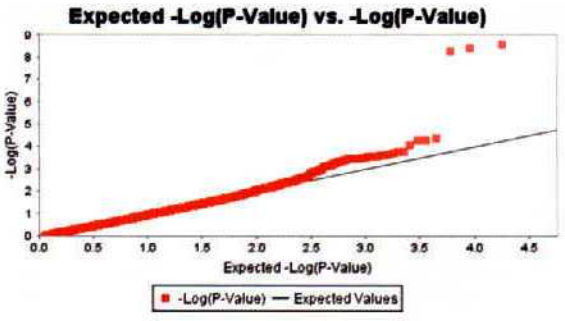


Fig. 7.3. Graphical frequency distribution of 108 *Saccharum* accessions for desirable agronomic traits (a), and QQ Plot for identification of markers associated with the agronomic traits based on p value (b)

population comprising of 134 clones of CoS 96268 self. Linkage map was developed and identified five putative QTLs linked with red rot resistance in sugarcane. The association panel of 124 sugarcane varieties/promising genotypes of sub-tropical India were analyzed for population structure using model-based approach and identified seven genetically distinct groups or admixtures thereof within sugarcane (Fig 7.3a). General Linear Model using TASSEL was carried out and identified four EST-SSR markers significantly associated with red rot resistance (race Cf 01; Fig 7.3b).

Optimization of multiplex PCR tools for detection of major sugarcane diseases

This work was taken up for development of multiplex molecular tools to diagnose the pathogens of major seed transmitted diseases. Accordingly, multiplex PCR assay was standardized for detection of red rot and smut diseases of sugarcane using primers designed from internal transcribed spacer region of ribosomal DNA of *C. falcatum* and *S. scitamineum* (Fig.7.4). Further optimization studies are in progress.

Disease-free quality seed cane production through tissue culture technique

Cultures of sugarcane genotypes, CoLk 94184, CoLk 9709, Co 0238, and Co 05011 were established under *in vitro* conditions. Shoot initiation was achieved on Murashige and Skoog's medium supplemented with 4.44 µM benzyladenine (BA) and 4.6 µM kinetin (Kin) + 3% sucrose. Multiple shoot production (100% shoot regeneration frequency) was achieved through enhanced axillary shoot proliferation using apical shoot explants on MS medium supplemented with 2.22 µM BA + 2.3 µM Kin + 26.8 µM naphthalene acetic acid (NAA) + 3% sucrose. Vigorous rooting was obtained on MS medium containing 26.8 µM NAA and 5% sucrose. Plantlets were acclimatized in soil, sand and compost (1:1:1) for about 3 weeks and thereafter, transferred to open field with >95% survival. Over all, more than 5000 plantlets of sugarcane varieties, *viz.*, CoLk 94184, Co 05011, CoLk 9709 and Co 0238, CoS 767 were transferred to the field.

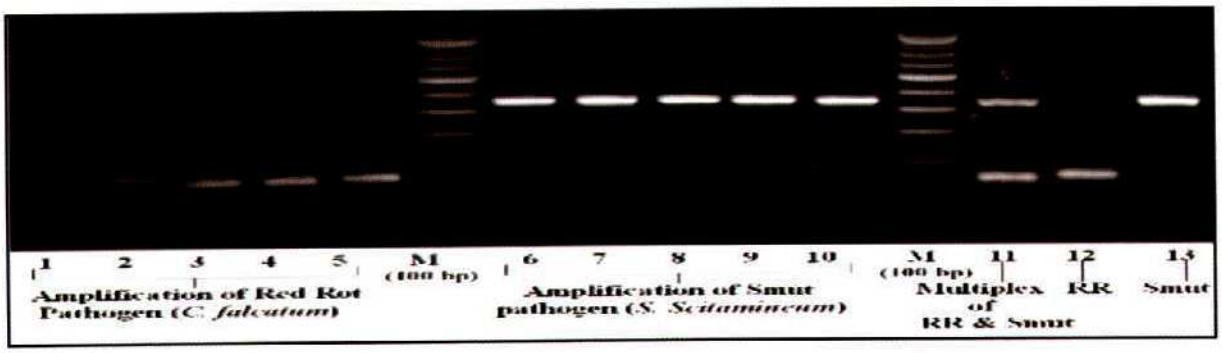


Fig. 7.4. Multiplex PCR amplification of genomic DNA of *C. falcatum* and *S. scitamineum*

8

Climate change and sugarcane

Compilation, analysis and documentation of long-term weather database in relation to sugarcane crop culture

During the period of the report, the daily weather data on maximum and minimum temperature, morning and afternoon relative humidity, duration of bright sunshine, rainfall, wind velocity, pan evaporation were collected from met yard, collated, and long-term database updated. The data was supplied as per demand of the scientists of the Institute, ICAR Institutes, and central organization such as IMD, Govt. of India, SAU's and state agencies such as UPCAR.

Long-term (1990- 2009) average cane productivity data from Muzaffarnagar district of western Uttar Pradesh was collected alongwith monthly average weather data. The productivity data was analyzed with respect to average % RTD (relative temperature disparity) during crop elongation phase (July- September). A highly significant negative correlation (r = - 0.731) was observed between average % RTD and average cane productivity. A linear regression was worked out for estimating average cane productivity based on average % RTD (July- September).

The long-term monthly Pol % cane and annual weather data collected from Shakumbhari Sugar Mills, Saharanpur (2002-03 to 2011-12) of western Uttar Pradesh was analyzed with respect to % RTD (3 months before the crushing) and workable statistical model was developed on to estimate the Pol % Cane three months before harvest.

Impact of climate change on sugarcane insect-pests dynamics and behaviour

During the period of report, long-term maximum incidence of top borer *Scirpophaga excerptalis* Wlk.) was related to heat index (combining both temperature and humidity) of 18th met week. It was noticed that pest incidence declined with increasing warming in terms of HI.

The long-term (2000-01 to 2011-12) data on maximum incidence of top borer *Scirpophaga excerptalis* Wlk.) was related to heat index (HI) of the 18th met week. The HI was computed with the following Steadman, R.G. (1979) formula as under

HI = -42.379 + 2.04901523*T + 10.14333127*RH - 0.22475541T*RH - 6.83783*10-3T2

- 5.481717x10-2*RH2 + 1.22874x10-3 *T2*RH + 8.5282x10-4*T*RH2 - 1.99x10-6*T2*RH2

where T is temperature (ºF) and RH is relative humidity (%)

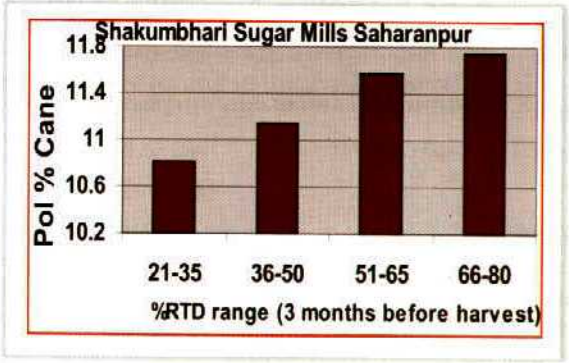


Fig. 8.1 Average Pol % Cane

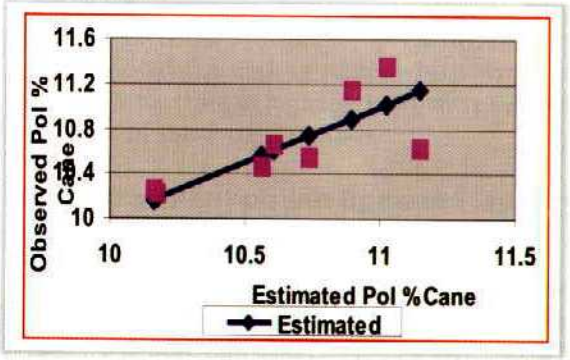


Fig. 8.2. Model validation

The HI was computed for morning and afternoon. The pest incidence was related to morning HI, afternoon HI and sum of both. The correlation of pest incidence were -0.844, -0.629 and -0.795, respectively for morning, afternoon and sum of HI. The linear regressions were also developed for the three indices, which are shown in Fig. 8.3, 8.4 and 8.5. It is clearly brought out that with increase of warming in 18th met week the pest incidence is declining.

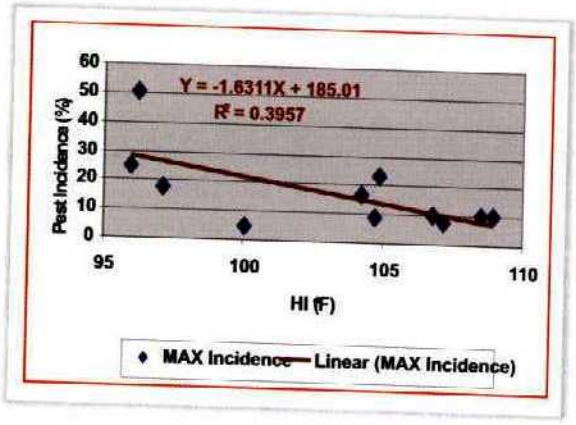


Fig. 8.4. Afternoon HI and maximum pest incidence

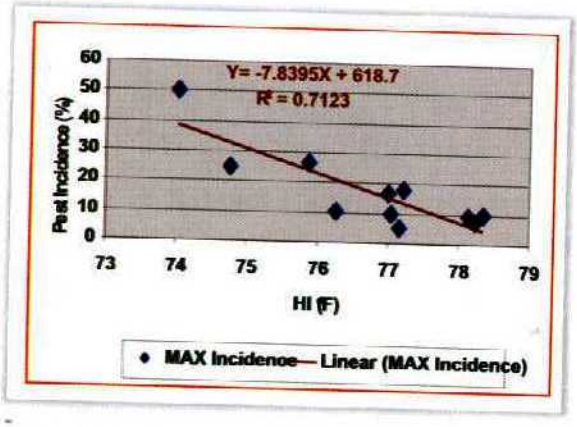


Fig. 8.3. Morning HI and maximum pest incidence

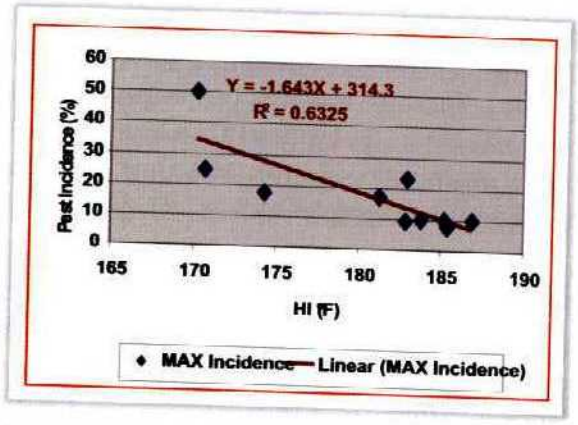


Fig. 8.5. Sum of HI and maximum pest incidence

9

Post-harvest technology

Development of a jaggery furnace with efficiency boosting device

A miniature model of efficiency boosting device was fabricated and tested. The per cent increase in thermal efficiency was found to be 35 with per cent saving of fuel and time of 26 and 30, respectively.

Shelf life enhancement of jaggery

Optimization of parameters for shelf life enhancement of jaggery under modified atmosphere packaging : Cubical jaggery of CoS 96268 (sample size 250 g) was evaluated for shelf life in PET film pouches of thickness 95 µ, 65 µ and 50 µ at moisture content 8, 9 and 10% (w.b.) and temperatures at 10ºC, 20ºC and 30ºC for 135 days under nitrogen environment. The observations recorded at an interval of 45 days indicated an increase in colour, moisture content and reducing sugars with increase in temperature. Hardness increased with decrease in temperature and increase in thickness of film.

Evaluation of shrink wrap, stretch wrap and modified atmospheric packaging for storage of jaggery cubes and blocks: The jaggery sample packed in the stretch wrap, shrink wrap and nitrogen environment were analysed after six months indicating that nitrogen environment provided most suitable environment for jaggery quality.

Development of a small capacity cane crushing unit for household purpose

The set of three gears for power transmission to the crushing unit was replaced by a speed reduction gear box procured from local market. It was assembled maintaining proper alignment and the compact unit performed smoothly without making any noise. The single pass crushing capacity of this unit was 60 kg/h with 30% juice recovery and double pass capacity was 30 kg/h with 55-60% juice recovery (cane weight basis).

Evaluation of jaggery furnaces for green house gases emission and bagasse combustion level

In case of 3-pan furnace, fluctuation in data for carbon monoxide (CO), carbon dioxide (CO_2), oxygen (O_2) and combustion efficiency was observed. However, maximum values for these reached to 2000 ppm, 15%, 20% and 73%, respectively. Flue gas temperature reached to 294ºC, which indicated loss of heat energy.

Refinement of juice extraction process with special reference to sugarcane cleaning and juice filtration

A power operated cleaning-cum-washing machine was developed, which consisted of mechanisms for sugarcane feeding through a chute, scraping, scrubbing, washing with re-circulatory forced water spray system, GI water tank and a compact power transmission system consisting of 1.0 hp motor, speed reduction unit and chain-sprocket arrangement. The preliminary testing of the machine has been done.

Development of evaporator for sugarcane juice

The batch type mechanical screw press rectangular system for jaggery moulding was redesigned. It has been provided with two vertical shafts for smooth vertical movement of the rotor pistons into the static moulding frame. Third vertical shaft (rectangular) was also provided with spring loaded lever system from backside of rotor system for pressing out the jaggery moulds. A sliding plate, which works as platform for setting of jaggery, has been provided at bottom of these base moulds.

Development of power operated jaggery moulding machine

The batch type mechanical screw press (rectangular system) for jaggery moulding was redesigned and fabricated. It has two vertical shafts for vertical movement of rotor pistons into

static moulding frame. Third vertical shaft (rectangular) was also provided with spring loaded lever system from back side of rotor system for pressing out the jaggery moulds after setting. A sliding plate, which works as a platform for setting of jaggery, was provided at bottom of these base moulds.

Assessment of post-harvest losses in crops/commodities

The survey was conducted for assessment of post-harvest losses in ten crops/commodities, *viz.*, wheat, paddy, pigeonpea, mustard, bajara, mango, guava, potato, green pea, sugarcane, jaggery and *khandsari* in five districts of Uttar Pradesh, *viz.*, Chandauli, Deoria, Kanpur Dehat, Etawah, and Unnao. Data collected by enquiry as well as by actual observation for assessment of losses at farmer/market/processor/godown level is under analysis by the software designed, developed and supplied by IASRI, Pusa, New Delhi.

Development/adoption of suitable mixer for production of value-added jaggery using *aonla* as natural source of vitamin C

A manual mixer with auger kind of arrangement on the main vertical shaft with side blades and scrappers for 13 kg jaggery capacity has been designed.

Study on determining storage losses in food grains in FCI and CWC warehouses and to recommend norms for storage losses in efficient warehouse

FCI as well as CWC godowns at Raebareli and Basti were visited to familiarize and finalize the selection of stacks and chambers.

10

Sugarbeet research

The advent of tropicalized sugarbeet genotypes from IISR, Lucknow and its coordinating centres made significant progress in the cultivation in subtropical India. To harvest more sugar per unit area and time intercropping of sugarbeet with sugarcane can be done for achieving higher profit. The changing biofuel scenario in the country has started looking at sugarbeet with ethanol as the end product. The availability of efficient sugar processing technology particularly suited to our indigenous factories is essential for the successful commercial exploitation of sugarbeet.

Twelve sugarbeet varieties were evaluated for root yield, quality and tolerance to diseases and pests (Fig. 10.1). Amongst varieties evaluated, PAC-60008, SZ-35, Magnolia and Calixta were found superior in root yield, while Shubhra, SZ-35 and PAC-60008 were superior in sucrose content. However, PAC-60008 possessed the highest gross sugar yield followed by SZ-35 (Table 10.1). Fifty two germplasm/breeding lines were maintained at Sugarbeet Breeding Outpost, Mukteswar. A total of 60 kg seed was produced and 40 kg seed was sold to Animal Breeding Centre, Salon and KVKs.

Table 10.1. Performance of sugarbeet varieties at IISR, Lucknow

Variety	Root yield (t/ha)	Sucrose content (%)	Gross sugar (t/ha)
Calixta	73.48	13.81	10.144
R-06	59.29	13.12	9.064
Shubhra	58.87	14.73	8.673
LKC-2007	60.48	13.46	8.689
SZ - 35	83.31	14.52	12.119
LS - 6	61.74	14.09	9.698
PAC - 60008	85.63	14.43	12.382
Magnolia	81.67	13.61	11.257
Cauvery	68.84	13.54	10.554
LKC - 95	70.70	13.66	10.857
IISR Comp-1	52.79	13.88	7.353
LKC-2006	57.89	13.51	7.662
Mean	67.89	13.86	9.462
CD 5%	15.47	1.21	2.088
CV%	13.5	5.1	12.5

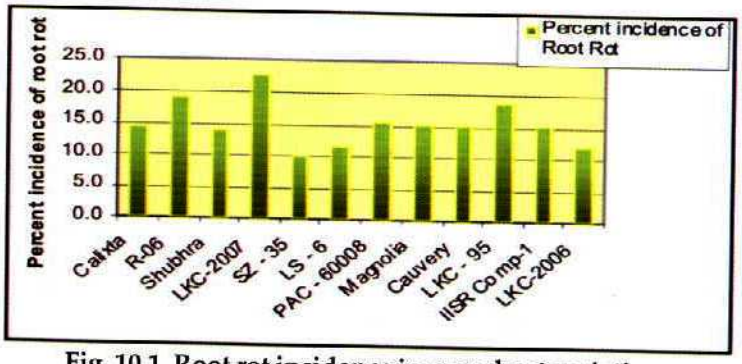


Fig. 10.1. Root rot incidence in sugarbeet varieties

ICT in sugarcane

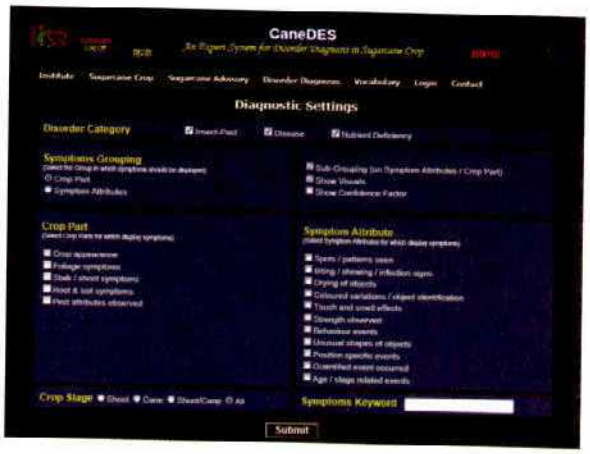
Estimation of optimum sample size for evaluation and prediction of cross performance

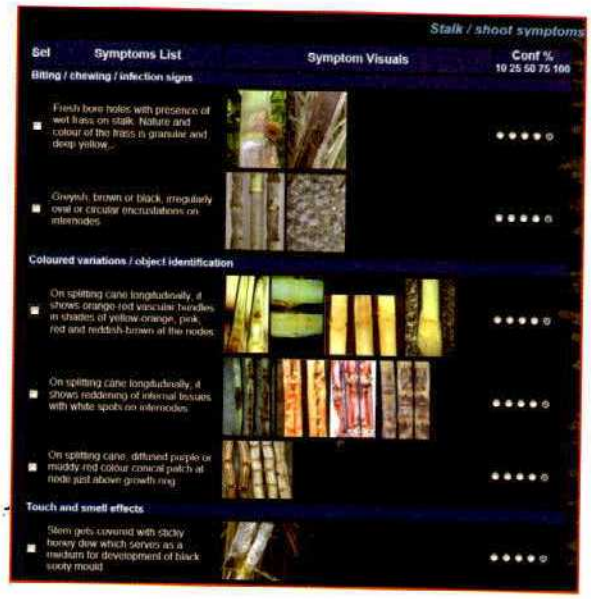
A software for generating random samples of various sizes: 30, 60..... 300 and computing margin of error associated with each sample was developed and utilized for for estimation of optimum sample size for evaluation and prediction of cross performance. Different statistical functions were found suitable for different characters.

Sugarcane seedlings were grown from open pollinated fluff of important varieties. Data on cane length, number of millable canes, cane weight, cane diameter, internodes length and HR Brix on all seedlings were recorded. The maximum variability was observed in SCW followed by NMC, HR brix, cane height, internode length and diameter. Cane weight (with maximum variability) was considered for finding the optimum number of seedlings. A computer programme has been prepared for obtaining margin of error associated with large number of samples of various sizes. It generates desired number of samples of different sizes. Different statistical functions were found suitable for different characters for margin of error detected with various samples observed. Margin of error dropped from sample size of 60 to 150 sharply, after that, it dropped slowly. It was concluded that the optimum size of seedlings to be grown for evaluating progeny mean and variance was 150-160 with maximum 5% margin of error in mean.

Development of decision support tools in sugarcane cultivation

CaneDES, an expert system to diagnose disorders in sugarcane caused by various biotic and abiotic stresses has been developed. It is a web based system available in both Hindi and English languages with remote accessibility to





sugarcane farmers. A new classified knowledge representation technique has been adopted for the development of expert system, to manage the diagnostic knowledge efficiently. System was evaluated with the help of domain experts and extension personnels engaged in the services to sugarcane farmers. Evaluation was made in terms of time taken by extension personnel in diagnosis of disorder and confidence factor received from the system and results indicate high usability and efficiency of the system. System is of generic nature and can be used in other crop environment with changes in the knowledge base.

Geographical Information System of sugarcane and sugar in India

Based on the performance of 549 sugar factories in India during 2011-12, district-wise data of crushing capacity (M.T.), cane crushed (Lakh M.T.), sugar produced (Lakh Qtl.), molasses produced (M.T.) and sugar recovery (%) were estimated. Out of 451 sugarcane producing districts in the country, all the 549 sugar factories are located in 175 districts of the country. For mapping on the district-wise map of India, these districts were further grouped into three categories, High (>0.57%), Medium (0.17-0.57%), Low (<0.17%), as per the contribution of sugar production in a district. These districts were further analyzed to study the contribution of each class interval. In high group, 43 districts contribute nearly 76% of sugar and 73% of molasses production from 74% of total cane crushed. These 43 districts can be considered as the most important districts of sugar production so we can think to develop plans for their improvement and whenever the policies are farmed for sugar industry, 43 high sugar producing districts should be given greater thrust on technology development and extension activities. Three hundred and thirty one sugar factories are located in these districts of the country.

In medium category, 59 districts contribute 20% sugar and 22% molasses production of the country from 21% of total cane crushed in the country. In low category, 73 districts are contributing only 5% sugar and 6% of molasses production of the country with lowest recover of 8.92 %. To conclude, in high group of forty three districts, we can think only for sugar production zone in the country whereas low category 73 of districts, country can frame a policy to use sugarcane for ethanol production and co-generation of electricity to meet the 20% blend mandate in 2017.

Agricultural Economics

The trends in world sugar market and prices were analysed for the last 15 years. The shift in EU sugar trade position from a net exporter of predominantly white sugar to a net importer of mainly raw sugar is the major development during the period. The downward trend that characterised sugar prices from mid nineties seemed to have dissipated by the turn of this decade. Also, the influence of the energy market on the world sugar market has strengthened over the period, because sugarcane (accounting for over 80 per cent of world sugar output) is a major input for the production of ethanol in largest sugar exporting country of Brazil, a substitute for fossil fuels. The sugar price upswing in recent past years may be attributed to some extent to better returns from biofuels. The countries having greater market access to the EU due to preferential policies will benefit in the trade. In countries like India, the level of R&D funding in sugarcane and the speed of adoption of technologies need to be enhanced to result in higher productivity growth sufficient enough to force real prices to decline.

The impact of ICT based innovation in sugarcane marketing was assessed in UP. Sugarcane is a perishable raw material for sugar industry and it must be processed at the earliest after harvesting in order to minimize losses in cane tonnage and sugar recovery. The quality of cane produced and supplied to sugar mills is of paramount importance and its logistics need to be organized on scientific lines. This involves multiple services and consequently, the interactions for activities between the farmers and the sugar mills are numerous. Field studies in Central UP revealed that more than 50 different types of interactions took place between an average farmer and the sugar mill to organize his cane supply and receive price payments. One such ICT based intervention in operation in UP was evaluated. The direct financial benefits to farmers were to the tune of Rs 67.62 million in sugar mill command area and, to an average sugar mill, to the tune of Rs. 63.77 million. There were indirect benefits in terms of saving in travel cost and time too.

12

Linkage and Collaboration

Three scientists from Bangladesh Sugarcane Research Institute (BSRI), Bangladesh were imparted training on "Sugarbeet Production and Management" during May 21-June 4, 2013 at IISR Lucknow. The training programme included a series of lectures on different aspects of sugarbeet cultivation and improvement and a visit to the Sugarbeet Breeding Outpost, Mukteswar. The trainees also participated in an IISR-Industry Interface on "Research and Development Initiatives for Sugarbeet in India" held at the Breeding Outpost, Mukteswar during May 29-30, 2013.

Three scientists from Bangladesh Sugarcane Research Institute (BSRI), Bangladesh were imparted training on "Sugar Mill Waste Water Treatment and Mechanization" during May 16-25, 2013 at IISR, Lucknow. Apart from attending lectures on various mechanization aspects, the trainees also visited various sugar mills to learn about the waste water treatment and other related aspects.

A high level delegation led by the Hon'ble Minister for Sugar Industries, Government of Sri Lanka, Shri. Lakshman Senewiratne visited IISR during June 15-20, 2013. The team also included Dr. A.P. Keerthipala, CEO & Director, Sugarcane Research Institute (SRI), Sri Lanka and Dr. A. Wijesuriya, Head, Division of Crop Improvement. The delegation discussed about the R & D activities of the Indian Sugar Industry

explored opportunities to develop Sri Lankan sugar Industry in collaboration with Indian counterparts.

A high level delegation led by the Director General, BSRI, Bangladesh visited IISR during June 27-July 4, 2013 to discuss about collaborative programmes on sugarcane and Sugarbeet cultivation between India and Bangladesh. The delegation also included from scientists from BSRI, Bangladesh and officials from Ministry of Sugar Industry, Bangladesh.

A delegation from Indonesia visited IISR on September 2, 2013 and interacted with the scientists at IISR on sugarcane production and management.

Dr. Islam A. Siddiqui, Chief Negotiator, Office of the President of USA visited IISR on September 23, 2013 and interacted with the scientists.

International Conclave on Sugar Crops: "Sweeteners and Green Energy from Sugarcane : Emerging Technologies"

An International Conclave on Sugar Crops on "Sweeteners and Green Energy from Sugarcane: Emerging Technologies" was organized at IISR, Lucknow on February 15-17, 2014. About 150 delegates including 25 international delegates representing ten various sugarcane growing countries participated in the deliberations during the Conclave. Different aspects of sugar crops cultivation including improvement, management, production, marketing and diversification were discussed.

Visit of Director and other scientists

Dr. S. Solomon, Director IISR and Dr. S.N. Sushil, Principal Scientist, attended the "1st Workshop on Improving the Productivity and Quality of Sugarcane in Vietnam" at Ho Chi Minh City, Vietnam on July 19-20, 2013.

Dr. S. Solomon, Director, IISR visited Sugarcane Research Institute (SRI) Sri Lanka to attend the Research Review of Meeting of SRI, Sri Lanka during July 9-11, 2013.

IISR-Industry Interface Meeting on Sugarbeet

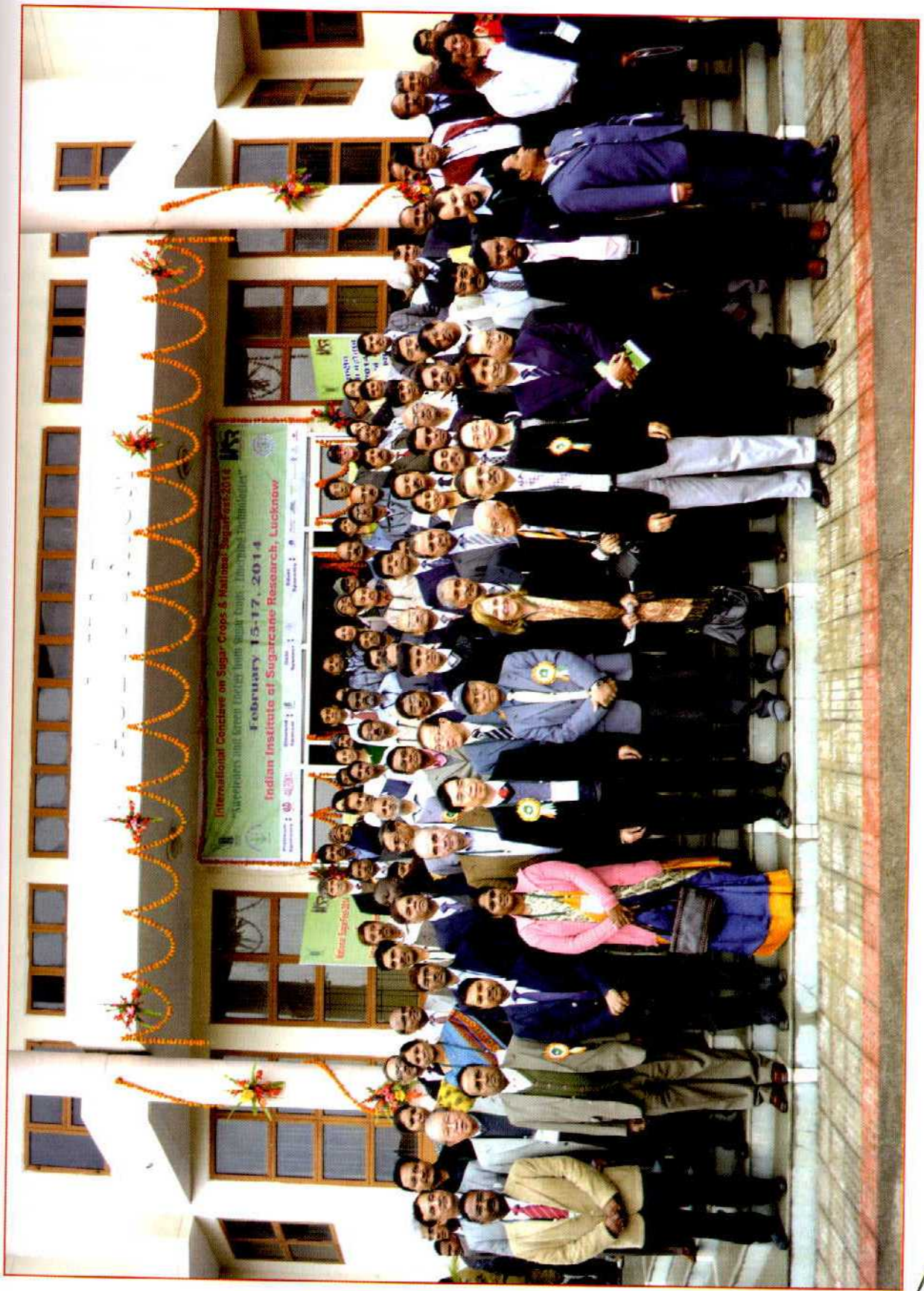
IISR-Industry Interface on "Research and Development Initiatives for Sugarbeet in India" was organized at the Sugarbeet Breeding Outpost of IISR at IVRI, Mukteswar Campus, Distt. Nainital on May 28-29, 2013. More than 50 participants representing Research Institutions, Agricultural Universities, sugar and seed industries of six countries took part in this event.

National Conference on "Women in Sugarcane Agriculture and Industry"

A three day National Conference on "Women in Sugarcane Agriculture and Industry" was held at Indian Institute of Sugarcane Research, Lucknow during August 29-31, 2013. Dr. Roop Rekha Verma, Former Vice Chancellor, University of Lucknow, Lucknow was the Chief Guest. More than 300 persons including researchers, industrialists, administrators, academicians, sugarcane farmers and labourers attended the Conference and deliberated on the role of women in sugarcane agriculture, research and industry under various capacities, issues and concerns of women workers in these areas and also the possible solutions.

Researchers-Sugar Industry-Manufactures Meet

To commemorate ICAR Industry day, a one-day researchers-sugar industry-Manufactures meet was organized at IISR, Lucknow on October 30, 2013 to address the issues related to mechanization of sugarcane harvesting. Simbhaoli Sugar and Mawana Sugars from Sugar Industry, John Deere, TAFE, Chennai, Mahindra Group, Shrijee Group of Companies from manufacturers and research organizations *viz.*, IISR, Lucknow; VSI, Pune; NSI, Kanpur; UPCSR, Shahjahanpur participated in the meet. The sugar mill associations were represented by Dr. G.S.C. Rao, President STAI, Mr. Vinay Kumar, Ex. MD, NFCSF and Dr B.K. Yadav, MD, UPCSF. The meet emphasized the need for joint collaborative efforts of researchers. Industry and manufactures for providing a solution to the problem of mechanization in sugarcane harvesting. Agencies


International Conclave on Sugar Crops & National Sugarcane 2014
February 15-17, 2014
Indian Institute of Sugarcane Research, Lucknow

like SDF need to invite and fund such types of research project proposals.

Institute Foundation Day

The 62nd Foundation Day of the Institute was celebrated at the Institute on February 16, 2014. Shri ShivajiRao C Deshmukh, IAS (Retd.) and DG, VSI, Pune who was the Chief Guest, delivered the Foundation Day Lecture on "Indian Sugar Industry: R & D Priorities for 21st Century"

National SugarFest-2014

National SugarFest-2014 was celebrated at the Institute on February 15-17, 2014. On this occasion, a large number of competitions were organized for students working bodies and housewives.

UP-*Kisan Vigyan Sangam*

UP *Kisan-Vigyan Sangam* Meet was organized at IISR, Lucknow on February 16-17, 2014.

Silver Jublee of Motipur

The Silver Jubilee of Indian Institute of Sugarcane Research Regional Centre, Motipur was celebrated on 29th - 30th November, 2013, which included a National Seminar on "IISR Initiatives for Improving Sugarcane and Sugar Industry in India sub-tropics" and farmer's training on Quality Sugarcane Seed Production. The National Seminar and farmer's training on Quality Sugarcane Seed Production was inaugurated by Dr. S. Solomon, Director, IISR, Lucknow.

MoUs with Universities

The Institute has signed MOU with eight universities for encouraging research in sugarcane while pursuing Ph.D. degree under co-guidance/ guidance of scientists of this Institute

Training to sugar mill development officials.

A three week training programme for sugarcane production and management was organized at the Institute for 17 sugar mills sponsored officials during July 1-21, 2013.

Other Trainings

Training programmes to ATMA Bihar and Madhya Pradesh were organized for farmers from Bihar, Madhya Pradesh and Rajasthan.

Exhibition/*Kisan Mela*

The Institute participated in exhibitions and *Kisan Mela* at Science Expo at Regional Science Centre, Lucknow, *Kisan Mela* at CSAUA&T, Kanpur, in AgriTech 2014 at Punjab *etc.* Stalls were put up during the National SugarFest-2014 and UP *Kisan Vigyan Sangam* 2014 along with organization of *Kisan Goshti.*

Training on Quality Jaggery Production

A three day training programme on "*Uttam Gur Utpadan*" for sugarcane farmers from Punjab was organized at the Institute on November 19-21, 2013.

Field training on "Quality Jaggery Making" at Datia (M.P.)

A two-day training on "Quality Jaggery Making" was organized in collaboration with Krishi Vigyan Kendra, Datia (M.P.) for the sugarcane farmers in Datia on March 6-7, 2014. The training was attended by about 75 sugarcane farmers and jaggery manufacturers of Datia.

13

IISR: Reaching-out to Stakeholders

Assessment of sugarcane cultivation machines (RMD & RBS planter) on farmers' fields

To promote the adoption of Ratoon Promoter developed by IISR, method and result demonstrations on this machine was conducted in 11 villages covering 44 cane growers and 18.62 ha ratoon area in Biswan Sugar Mill (Sitapur) zone area. On-farm training in operational and maintenance aspect of the machine was organized for beneficiary farmers. Feedback proforma was developed and data on performance of machine was collected by conducting personal interview of cane growers. A saving of average 34 labours/ha and net saving in cost to the tune of ₹ 4000/ha was recorded in demonstrated plots. An average ratoon yield of 66 t/ha in demonstration plots was recorded which is 20% higher than the ratoon yield obtained by farmers in conventional method (55 t/ha).

Entrepreneurship development for sugarcane seed production and multiplication

To motivate the farmers for enterprising in cane seed production and multiplication of selected improved sugarcane varieties, participatory training was organised in mill zone area of Biswan Sugar Mill, Biswan. Farmers were trained in techniques of seed cane production and they were educated about benefit of cane seed cultivation and multiplication in their own cane fields. For production of foundation cane seed of six selected varieties, *viz.*, CoLk 94184, CoPk 05191, Co 0238, Co 0118, Co 05011, Co H128 on factory farm/farmers' fields, breeder seed of these varieties was planted as autumn cane in 1.50 ha area. To assess the entrepreneurial ability of farmers, 10 parameters/traits of Entrepreneur behaviour, *viz.*, risk taking, innovativeness, hope of success, persuasability, manageability, self confidence, knowledgeability, persistence, use of feedback, achievement motivation were identified and statements were formed to collect responses on these identified traits.

Krishi Vigyan Kendra, IISR Lucknow

On Farm Testing/Trials (OFTs)

During 2013-14, four OFTs were conducted pertaining to various disciplines as per identified major thrust areas. OFTs are most important mandatory component of KVK under which evaluation of recent developed technologies or varieties in specific agro climatic condition for future recommendations or popularization. which are given below:

1.Performance of intercropping of turmeric and elephant foot yam in mango orchards: Mango crop grown in large areas of Lucknow district.

Farmers mainly having orchard of sole crop. They do not intercrop in between crop spacing, because of shed effect. So, for the best utilization of plant space introduction of shed loving plants like turmeric or foot yam was carried out at farmers field. Keeping these facts in view, an experiment was laid out to find out the performance of intercropping of turmeric and elephant foot yam. Result revealed that T2: Mango + Elephant Foot Yam gave higher net income ₹ 3,29,675/ha. followed by T3: Mango + Turmeric (₹ 2,51,850/ha.) over control T1:Mango sole crop (₹ 1,36,000/ha.).

2. Management of fruit-fly in mango orchards: Lucknow district covered large area under mango cultivation. Several consignments were rejected in past due to incidence of fruit fly and presence of residual effect of pesticides. So, KVK, Lucknow conducted a trial to test the effectiveness of fruit fly traps and insecticide (Malathion 50 EC). Result revealed that incidence of fruit-flies were higher in farmers practices, *i.e.*,T1- 20% followed by T2 (Use of fruit fly trap): 4%,T3(Spray of insecticide (Malathion 50 EC): 3%,. Quality yield of mango was recorded 9.6 t./ha., 14.9 t/ha. and 14.1 t./ha, respectively. The economics shows that net income was the maximum in T2 (₹ 1.56 lakh/ha.) and T3 (₹ 1.44 lakh/ha.) over control (T1) ₹ 0.94 lakh/ka.

3. Performance of IPM in tomato crop: Lucknow district farmers mainly grow vegetables as a cash crop, in which tomato having important place. This crop having incidence of many number of insects and diseases, so, crop needs to assess the effect of IPM in this crop. The result revealed that T2 IPM showed minimum incidence of insect and diseases over T1 farmer practice where damping off (10%), early blight (5%) late blight (30%), buckey ror (2%), wilt (3%), TLCV (5%) and whitefly (20%). Yield revealed that T2 showed 34.7% increase in yield over control and economics reflected that net return of IPM demonstration was ₹ 6.7lakh/ha. and check was ₹ 3.9 lakh/ha.

A. Frontline Demonstration: FLDs on oil seed, pulses and other crops or enterprises were conducted. 233 demonstrations at farmers' field in an area of 63.25 ha, in which vegetables covered 16.0 ha. followed by cereals 15.0 ha, fodder crops 12.25 ha and oilseeds and pulse crops covered 10 ha each. area and vaccination and deworming of 2000 animals (Buffaloes and Cows) were carried-out.

B. Imparted training: Krishi Vigyan Kendra has offered 56 training courses for participating farmers, farm women, rural youths, sponsored and extension personals on various topics with an objective to improve skill and upgrade their knowledge about developed and potent product. Total 1120 participants (800 male and 320 female) attended the programme.

C. Sponsored training: Two days programme for 20 trainings each for one hundred farmers of Lucknow district under State Horticulture Mission Programme was carried out at KVK, IISR, Lucknow, in which selected progressive farmers of eight different blocks of Lucknow district were trained. Training was mainly focused on improved technologies pertaining to Mango, potato, banana, gladiolus, rose, spices crop, nursery raising and protected cultivation of vegetables.

D. Other extension activities:

Field visits: One hundred farmers from different villages of Lucknow district visited at KVK, IISR, Lucknow. During the visit, they have seen different technologies of sugarcane crop, jaggery and *khandsari* processing unit, Krishi Vigyan Kendra, vermicompost unit and developed implements related to sugarcane cultivation.

Agro Advisory Services: Five hundred seventy agro-advisory services provided to solve the farmers quarries KVK visited farmers or on telephonic conversations.

***Kisan Mela*:** A Kisan Mela was organized at Indian Institute of Sugarcane Research, Lucknow on Feb. 15-17, 2014. About 825 farmers attended the *Kisan Mela*. Technology exhibition stalls of different research organizations, manufacturers, KVKs and line departments were also demonstrated in *Kisan Mela*.

***Kisan Gosthi*:** Four *Kisan Gosthi* were organized on Protected Cultivation, IPM in horticultural crops, Dairy management and value addition of different horticultural crops were covered. About 350 farmers participated in these programmes.

IISR Bio-control centre, Pravaranagar, Maharashtra

There were incidence of shoot borer (*Chilo infuscatellus* and *Sesamia inferens*) from 4 to 30%; internode borer (*C. sacchariphagus*) from 3 to 7%; top borer from 2-10%; mealy bug from 2-5%; termites) from 2-5%; white fly, 8-20%; woolly aphid 2-10%; *Pyrilla*, 0.10 to 0.028 N/A per leaf; white grub, 5-60% on CoM 265 and scale insect incidence was 3-5% on Co 86032. The following parasitoids and predators- *S. inferens* and *C. flavipes* on early

Activity	No. of programmes	No. of farmers	No. o extensi person
Advisory services	570	-	-
Diagnostic visits	10	240	5
Group discussions	8	155	10
Kisan Ghoshthi	4	350	20
Film show	14	300	
Kisan Mela	01	825	20
Animal health camp	01	935	
Exhibition	04	110	35
Participation in farmers' fairs of various institutions	03	850	25
Celerabition of important days	1	150	
Delivered lectures	15		
Method Demonstrations	10	125	-
Scientists' visit to farmers fields	109	829	-
Farmers visit to KVK	5	100	
TV/Radio talks	8		-
Total	**763**	**4969**	**115**

shoot borer, *D. aphidivora* and *M. igorotus* on woolly aphid on *Pyrilla*, *A. mayurai* and *B. bharatiya* on scale insect and *Z. bicolorata* on *Parthenium* weed were found active. A total of 1,53,60,000 adults of *Trichogramma* sp. were mass multiplied and released in 1105 acre area. Release of *Trichogramma* sp. was found effective against shoot borer.

Bihar Sugarcane Seed Production Scheme Phase II

Another phase of breeder seed production has been initiated at Hasanpur sugar mill as a part of II Phase of seed production programme. The MOU was signed on March 12, 2014.

AICRP(S) on Sugarcane

The Group Meeting of AICRP on Sugarcane was organized at the RARS, Anakapalle from 25th to 26th October, 2013. On this occasion, Dr. A. Padma Raju, Vice Chancellor, ANGRAU, Hyderabad was the Chief Guest. Dr. O.K. Sinha, Project Coordinator (Sugarcane) presented the Annual Progress Report of AICRP on Sugarcane for the year 2012-13. Dr. S. Solomon, Director, IISR, Lucknow emphasized the role of AICRP in developing varieties for different zones of the country, agro technology, crop protection techniques. Dr. N. Vijayan Nair, Director, SBI, Coimbatore gave an account on the role of AICRP in varietal development. Dr. A. Padma Raju, Vice Chancellor, ANGRAU, Hyderabad, urged for extensive use of sugarcane germplasm for development of varieties tolerant under drought and waterlogged situations.

Dr. N. Gopalakrishnan, ADG (CC), ICAR laid emphasis on increasing the sugarcane productivity and sugar production, improvement in soil health, development of sugarcane harvester suited to our conditions and developing technologies to enhance ratoon crop yield. Five varieties of sugarcane were identified during the Group Meeting - 2013: CoLk 07201 (Ikshu 1) - early maturing and Co 06034 (*Karan* 11) - midlate maturing for North West Zone; CoP 06436 - mid-late maturing for North Central & North Eastern Zones; and CoA 08323 (*Buddhi*) and CoC 08336 - early maturing for East Coast Zone.

Bihar Sugarcane Seed Production Scheme

12500 qt breeder of varieties, viz., CoLk 94184, Co 0232, Co 0233 and BO 133 at Motipur, and varieties viz., CoP 9301, CoLk 94184, BO 139, Co 0238, Co 0239, Co 0118, CoS 767, CoS 8432 and Co 0232 grown at Harinagar were produced and distributed to sugar factories of Bihar.

Another phase of breeder seed production has been initiated at Hasanpur sugar mill as a part of this Seed production Scheme. The MOU was signed on March 12, 2014.

14

Publications

Research papers

International

Ansari, M.I., Yadav, A. and Lal, R.J. (2013). An overview on invertase in sugarcane. *Bioinformation* 9: 464-465.

Anwar, S.I. and Singh, R.D. (2012). Convective heat transfer coefficient of Indian gooseberry (*Emblica officinalis*) dried in three different forms under forced convection mode. *Journal of Engineering Science and Technology* 7: 635-645.

Jha, S.K., Singh, R.K., Damodaran, T., Mishra, V.K. and Rai, D. (2013). Fluoride in ground water: Toxicological exposure and remedies. *Journal of Toxicology and Environment Health.* Part-B 16: 1-15.

Kumar, D., Singh, J., Rai, D.R., Bhatia, S., Singh, A.K. and Kumar, M. (2013). Colour changes in jaggery cubes under modified atmosphere packaging in plastic film packages. *Agrotechnology* S11:005. doi: 10.4172/2168-9881.S11-005.

Kumar, D., Singh, J., Rai, D.R., Kumar, M. and Bhatia, S. (2013) Effect of modified atmosphere packaging on keeping quality of jaggery. *Sugar Tech* 15: 203-208.

Mishra, A.K. Shukla, S.K., Yadav, D.V., and Awasthi, S.K. (2013). Iron, manganese and sulphur uptake and nutrients availability in sugarcane based system in subtropical India. *Sugar Tech.* Springer link DOI 10.1007/s12355-013-0269-y.

Pathak A.D., Kapur R., Solomon S., Kumar R., Srivastava S. and Singh P.R. (2014). Sugar beet: A historical perspective in Indian context. *Sugar Tech* 16: 125-132.

Shukla S.K, Singh P.N., Chauhan R.S. and Solomon, S. (2013). Soil physical, chemical and biological changes and long term sustainability in subtropical India through integration of organic and inorganic nutrient sources in sugarcane (*Saccharum* spp. hybrid complex). *Sugar Tech*, Springer link DOI 10.1007/s12355-013-0300-3.

Singh, J., Solomon, S. and Kumar, D. (2013). Manufacturing jaggery, a product of sugarcane as health food. *International Journal of Agrotechnology* S-11: 007-2013, pp 1-3.

Singh, P., Rai, R.K., Suman, A., Srivastava, T.K, Singh, K.P. and Yadav, R.L. (2013). Ratooning induced rhizospheric changes impede nutrient acquisition and growth in sugarcane ratoon crop during grand growth stage in sub-tropics. *Sugar Tech* 15: 52-64.

Singh, P., Suman, A., Rai, R.K., Singh, K.P., Srivastava, T.K., Arya, N., Gaur, A. and Yadav, R.L. (2013). Bio-organic amendment of Udic Ustochrept soil for minimizing yield decline in sugarcane ratoon crops under sub-tropical conditions. *Communications in Soil Science and Plant Analysis* 44: 1849-1861.

Singh, R.K, Jena, S.N, Khan, S.M., Yadav, S. Banerjee, N., Raghuvanshi, S. Bhardwaj, V., Duttamajumder, S.K., Kapur, R., Solomon, S., Swapna, M., Srivastava, S. and Tyagi, A.K. (2013). Development, cross-species/ genera transferability of novel EST-SSR markers and their utility in revealing population structure and genetic diversity in sugarcane. *Gene* 524(2): 309-329.

Singh, S.N., Singh, A.K., Singh, S.C., Kumar, R., Mohanty, M. and Sharma, M.L. (2013). Relay intercropping of autumn sugarcane with rice following potato for enhanced cane and sugar productivity in sub-tropical India. *International Journal of Agricultural and Statistical Sciences* 9(1): 229-234.

Srivastava S. and Sunkar R. (2013). Emerging role of microRNA in drought stress tolerance in the biofuel, bioenergy crop sugarcane. *Journal of Biotechnology Biomaterials* 3(3): 56.

Vishakumari, V., Mishra, A.K., Parihar, S.S., Srivastava, T.K. and Khan, C. (2013). Soil

moisture dynamics and yield of wheat (*Triticum aestivum* L.) crop at New Delhi India conditions. *American Eurasian Journal of Agriculture and Environmental Sciences* 13: 713-722.

National

Baitha, A. (2013). Biological observations on field collected strain of *Trichogramma chilonis* Ishii at fluctuating and constant temperatures. *Insect Environment* 18: 51-53.

Gangwar, L.S., Soloman, S., Verma, M.R., Hasan, S.S. and Bajpai, P.K. (2013). Growth pattern and instability in sugarcane production during pre- and post-liberalization regimes. *Agricultural Economics Research Review* 26: 194.

Kapur, R., Duttamajumder, S.K., Srivastava, B.L., Madhok, H.L. and Kumar, R. (2013). Harvest index and the components of biological yield in sugarcane. *Indian Journal of Genetics* 73: 386-391.

Mishra, A.K., Shukla, S.K., Yadav, D.V. and Awasthi, S.K. (2013). Improving sugarcane growth and yield through Fe, Mn and S nutrition in subtropical India. *Current Advances in Agricultural Sciences* 5(1): 45-49.

Prakash, B. and Sharma, A.K. (2013). Technological, institutional, infrastructural and policy imperatives for chickpea production under dryland agriculture. *Indian Journal of Agricultural Economics* 68 (3): 364-365.

Sharma, A.K. and Prakash, B. (2013). Challenges and opportunities of sugar business in India. *Indian Journal of Agricultural Economics* 68 (3): 484-485.

Sharma, A.K. and Prakash, B. (2013). Problems and prospects of sugar industry in Karnataka. *Indian Journal of Agricultural Marketing* 27(3): 103-104.

Shukla, S.K., Awasthi, S.K., Singh, R., Nigam, M., Gaur, A. and Singh, A.K. (2013). Integrated nutrient management in sugarcane-based production systems: A review. *Current Advances in Agricultural Sciences* 5(1): 1-7.

Singh, J. and Gupta, R. (2013). Increasing water productivity in rainfed areas - Options and prospects. *Agricultural Engineering Today* 37(2): 23-30.

Singh, A.K. (2013) Management of post harvest anthracnose disease of mango by pre- and post-harvest treatments. *Annals of Plant Protection Sciences* 21(2): 446-447.

Singh, P.R., Gupta, R. and Singh, A.K. (2013). Mechanization of sugarcane planting to enhance profitability of sugarcane farmers. *Sugar Journal* SI: 199-202.

Srivastava, T.K., Vishakumari, V. and Singh, A.K. (2013). Fertilizer best management practices in sugarcane. *Indian Journal of Fertilizers* 9(4): 96-107.

Books/Proceedings

Jain, R., Rao, G.P., Singh, S.N., Shukla, S.K., Swapna, M., Nithya, K., Visha, Kumari V., Holkar, S.K., Singh, P., Ashfaque, M., and Prakash, B. (2014). The power of sugar crops: Proceedings of international conclave on sugar crops: Sweeteners and green energy from sugar crops: Emerging technologies (Feb. 15-17) IISR, Lucknow, p. 205.

Jain, R., Swapna, M., Joshi, D., Nitya, K., Vishakumari, V., Singh, R.K., Singh, S.N., Verma, R.R., Prakash, B. and Singh, A. (2013). Ikshu Women Marching Ahead, p. 129.

Jain, R., Swapna, M., Joshi, D., Nitya, K., Vishakumari, V., Singh, R.K., Singh, S.N., Verma, R.R., Prakash, B. and Singh, A. (2013). Proceeding on National Conference on Women in Sugarcane Agriculture and Industry, p. 239.

Kumar, S., Singh P.K., Swapna, M. and Pathak A.D. (2013). Proceedings of "IISR-Industry Interface on Research and Development Initiatives for Sugarbeet in India" (May 28-29) Sugarbeet Breeding Outpost, IISR, Mukteswar, Nainital.

Shrivastava, A.K., Solomon S., Pathak, A.D., Singh P., Srivastava S., Lal, S., Singh, S.N., Swapna M. and Kumar, D. (2013). A Journey of Pride (1988-2013) IISR Regional Centre, Motipur (Bihar), p.64.

Shrivastava A.K., Solomon S., Pathak A.D., Srivastava S., Kumar, S. and Singh P. (2013). *Smarika: Sangosthi, Bharat Ke Uposhna Jalwayu*

wale Khetro main Ganna evam Chini Udyog Vikas Ke Liye Bhartiya Ganna Anusandhan Sansthan ki Pahal. IISR- Regional Centre, Motipur, Mujaffarpur, Biihar, p. 194.

Reports/Technical Bulletins

Anwar, S.I., Kumar, D. and Singh, J. (2013). *Uttam Gur Utpadan - Prashikshan Pustika*, IISR, Lucknow, p. 56.

Rai, D. and Singh R.K. (2013). *Pramukh Audyanik Fasaloon me samekit nasijeev prabandhan*, p. 70.

Rai, D., Singh R.K., Singh V. and Singh R.K. (2013). *Madhumakhhi Palan*, p. 30.

Shrivastava, A.K., Duttamajumder, S.K. and Solomon, S. (2013). *Uttar Pradesh mein Ganna kheti ki Kishanopayogi Aavashyak Jankari*. IISR, Lucknow, p. 73.

Singh, J., Anwar, S.I., Singh, R.D. and Kumar, D. (2013). Catalogue of technologies developed for processing, handling and storage of jaggery. IISR, Lucknow, p. 25.

Singh, J., Singh, P.K., Srivastava, T.K., Sharma, A.K., Singh, P., Joshi, D. and Kumar, S. (2013). Annual Report 2012-13, Indian Institute of Sugarcane Research, Lucknow. p. 90.

Periodicals

Singh, P.K., Srivastava, T.K., Shukla, S.K., Singh R.K., Pandey, D.K., Kumar, Joshi, D., Singh, G.K. and Singh, A.K. (2013). Ikshu: 2(1): Jan.-June, Rajbhasha Magazine, IISR, Lucknow.

Book Chapters

Dey, P., Hasan, S.S. and Kumar, S. (2013). Strategies for knowledge management in agriculture domain. *In*: Information and Knowledge Management: Tools, Techniques and Practices (Roy, A.K., Ed.), New India Publishing Agency, New Delhi, pp. 455-461.

Gupta, R. and Singh, P.R. (2012). Water management for sugarcane: The greatest challenge for economic growth and environmental sustainability. *In*: Nair N.V., Puthira Prathap D., Viswanathan R. Srikanth J., Bhaskaran A. and Ram B. (Eds.). SSRD, Coimbatore, pp.161-170.

Kapur, R. and Swapna, M. (2014). Sugarcane. *In*. Breeding Field Crops 2: Advances (Chopra V.L., Ed.), Studium Press, Houston, USA, pp. 111-129.

Kumar, S., Singh, J., Singh, P.K., Pandey, D.K. and Siraree, A. (2013). *Uttar Madhya Kshetra hetu Unnat Ganna Kismen evam Beej Utpadan Taknik*. In: Smarika of Rashtriya Sangoshthi: *Bharat Ke Uposhna Jalvayu Wale Shetron Mein Ganna Evam Chini Udyog Vikas ke Liye Bhartiye Ganna Anusandhan Sansthan Ki Pahal* (Nov. 29-30), IISR Regional Centre, Motipur, Muzaffarpur, Bihar, pp. 93-104.

Pathak, A.D. and Kapur, R. (2013). Current status of sugarbeet. Souvenir, IISR-Industry Interface on Research and Development Initiatives for Sugarbeet in India (May 28-29), Sugarbeet Breeding Outpost, Mukteswar, pp. 8-14.

Pathak, A.D., Kapur, R., Solomon, S., Kumar, R. and Srivastava, S. (2014). Prospects of sugarbeet cultivation in India. Proc. of International Conclave on Sugar Crops: Power of Sugar Crops (Feb 15-17), IISR, Lucknow, pp. 73-78.

Singh, A., Singh, A.K., Singh, R.K. and Singh, V. (2013). Empowering rural women with approaches and opportunities with different training modules. *In*.: National Conference on Women in Agriculture and Industry (Aug. 29-31), IISR, Lucknow, pp. 106-110.

Singh, A.K. and Pathak, A.D. (2013). Production economics of tropicalized sugarbeet. *In:* Souvenir, IISR-Industry interface on Research and Development Initiatives for Sugarbeet in India (May 28-29), Sugarbeet Breeding Outpost, Mukteswar, pp.15-23.

Singh, R., Singh, R.K., Singh, S., Singh, V. and Singh, A.K. (2013). Participation and performance of women in sugarcane agriculture. *In*: National Conference of Women in Agriculture and Industry (Aug. 29-31), IISR, Lucknow, pp. 95-98.

Singh, S.S. and Srivastava, T.K. (2013). Agriculture management strategies for flood affected regions. In. Water Management in Agriculture (Meena, M.S., Singh, K.M. and Bhatt B.P, Eds.), Jaya Publishing House, pp. 241-258.

Singh, V.P., Singh, S., Singh, R.K. and Singh, A.K. (2013). Political and legal barrier hindering participation of women in sugarcane agriculture. *In:* National Conference on Women in Agriculture and Industry (Aug. 29-

31), IISR, Lucknow, pp. 99-105.

Sithanantham, S., Geetha, N., Baitha, A. and Jalali, S.K. (2013). Utility of *Trichogramma* for biocontrol of sugarcane borers. *In*: Biological Control of Insect Pests Using Egg Parasitoids [S. Sithanantham, *et al.* (eds.)], Springer India, pp. 271-300.

Srivastava, S. and Gupta, P.S. (2013). Sugarcane biodiversity: Conservation, evaluation and utilization. In: Plant Diversity of Uttar Pradesh (Mishra, G. K. and Saini, D.C., Eds.), Bishen Singh and Mahender Pal Singh Publishers, Dehradun, India, pp. 182-205.

Srivastava, T.K., Singh, A.K. and Singh, I. (2013). Sugarcane. *In*: Textbook of Field Crops Production: Commercial Crops (Vol. II). Indian Council of Agricultural Research, New Delhi.

Folders

Anwar, S.I., Singh, R.D. and Singh, J. (2013). Value-added jaggery with natural vitamin C (Bilingual), IISR, Lucknow, p. 8.

Duttamajumder, S.K., Lal, R.J. and Misra, S.C. (2013). Management of red rot of sugarcane (Bilingual), IISR, Lucknow, p 8.

Singh, M.R. and Duttamajumder, S.K. 2013. Top borer of sugarcane and its management (Bilingual), IISR, Lucknow, p 8.

Sushil, S.N. and Duttamajumder S.K. (2013). White grubs of sugarcane and their management (Bilingual), IISR, Lucknow, p. 8.

Popular Articles

Anwar, S.I. (2013). *Gur Banane Hetu Ganne Kee Upyukt Kataai, Chhantaai Evam Ras Nishkasan. In: Uttam Gur Utpadan- Prashikshan Pustika*, IISR, Lucknow, pp. 18-24.

Anwar, S.I. (2013). *Gur Ikaaee Kee Sthapna Hetu Aavhsyaktaaein. In: Uttam Gur Utpadan-Prashikshan Pustika*, IISR, Lucknow, pp. 50-54.

Anwar, S.I. (2013). *Gur Ka Moolyavardhan Evam Dhalaai. In: Uttam Gur Utpadan- Prashikshan Pustika*, IISR, Lucknow, pp. 36-42.

Anwar, S.I. (2014). Jaggery (*Gur*) moulding helped packaging, handling and retail marketing. Agri-Innovation Foundation Newsletter, 2(1).

Anwar, S.I. (2014). *Masale Ke Gunon Se Gur Ko Sajaiye*. Ikhsu, 2(2): 62-65.

Anwar, S.I. (2014). Shatranjee ganaa. Ikshu, 2(2): 85.

Anwar, S.I. (2014). Uttam Gur Utpadan- IISR takneek. IISR, Lucknow.

Awasthi, S.K. and Shukla, S.K. (2013). *Trichoderma Evam Gluconacetobacter Ka Ganne Ki Vriddhi Tatha Mrida Swasthya Par Prabhaw*. Ikshu 2(1): 19-22.

Baitha, A., Rajak, D.C., Gangwar, S.K. and Lal, B. (2013). *Keetnasakon Ka Prayog Karate Samay Sawadhaniyan*. Ikshu 2(1): 59-62.

Kumar, D. (2013). *Gur Kee Upyukt Packaging Evam Marketing*. In: Uttam Gur Utpadan - Prashikshan Pustika, IISR, Lucknow, pp 43-46.

Lal, R.J., Rajak, D.C. and Sushil, S.N. (2013). *Ganne Ke Pramukh Rog Evan Keet Tatha Unka Samekit Prabandhan*. Ikshu 2(1): 22-27.

Prakash, B. and Sharma, A.K. (2013). *Basantkaleen Ganne Ke Sath Mung Evam Urd Ki Antahafasli Kheti*. Ikshu 2(2): 27-28.

Rajak, D.C., Sushil, S.N., Baitha, A and Rai, D. (2013). *Ganne Ke Pramukh Keet Evam Unka Samyik Prabandhan*. Kisan Jyoti 3(1): 12-16.

Sah, A.K. and Singh, S.N. (2013). *Aise Karen Ganna Kheti Men Pani Kee Bachat*. Ikshu 2(2): 12-15.

Sah, A.K. and Singh, S.N. (2013). *Ganna Utpadan Mein Mityvayi Jal Prabandhan*. Krishak Srinkhala, April: 42-43.

Sharma, A.K. and Prakash, B. (2013). *Cheeni Ka Antarrashtriya Vyapaar-Ek Paridrashya*. Ikshu 2(2): 29-31.

Shukla, S.K., Kumar, S. and Awasthi, S.K. (2013). *Jal Mein Dhatuon Se Badhati Samasyayein Evam Unka Nidan*. MatsyaLok (Rajbhasha Magazine), NBFGR, Lucknow, pp. 76-78.

Singh, J. (2013). *Gur Ka Pilot Plant Lagane Sambandhee Jaankari*. In. Uttam Gur Utpadan- Prashikshan Pustika, IISR, Lucknow, pp. 47-49.

Singh, J. and Tiwari, M. (2014). *Gur Kee Grading, Packaging Aur Bhandaran*. Ikhsu, 2(2): 32-34.

Singh, P., Joshi D. and Rai, R.K. (2014). *Ganna Krishi Evam Udyog Mein Mahilaaon Ki Saajhedaari*. Kheti 66(11): 100-103.

Singh, R.K., Prakash, B., Singh, R.K. and Rai, D. (2014). *Basantkaleen Ganne Ki Labhdayak Kheti*. Khad Patrika 55(3): 31-38.

Singh, S.N., Vishakumari, V. and Sah, A.K. (2013). *Unnat Sashay Taknik Dwara Basantkalin Ganne Kee Kheti Se Adhik Utpadan Avam Labharjan. Ganna Utpadan Takniki* (Ganna Kheti Traimasik), Uttar Pradesh Ganna Shodh Parishad, Shahjahanpur. 11 (1): 12-19.

Siraree A., Singh A.K., Singh J. and Singh, P.K. (2013). *Paudha Kism Aur Krishak Adhikar Sanrakshan Adhiniyam*, 2001 mein Krishakon ke Adikar. Ikshu 2(1): 40-41.

Siraree A., Singh, A.K., Singh, J. and Singh P.K. (2013). *Chukandar Ki Vagyanik Kheti*. Ikshu 2(1): 32-35.

Srivastava, T.K., Singh, K.P., Singh P. and Rai, R.K. (2013). *Karbnik Khadon Ke Prayog Se Ganne Ki Bahu-Pedi Kheti*. Kheti 66(9): 13-16.

Tiwari, M. and Singh, J. (2013). *Gunkaari Pudina*. Ikshu 2(1): 76.

Tiwari, M. and Singh, J. (2013). *Sehat Ki Sanjeevani*. Ikshu 2(1): 80.

Tiwari, M., Singh, J., Kumar, D. and Mishra, S.K. (2013). *Gur Ke Vibhinn Utpaad Kaise Banayen*. Krishak Shrinkhala, 39: 40-44.

Verma, R.R. and Singh, I. (2013). *Ganne Me Poshak Taton Ka Prabandhan*. Ikshu (1). IISR, Lucknow.

Papers in Seminars/Symposium/ Workshop

Ansari, M.I., Charles, M.R., Iqbal, A., Qamar, A. and Lal, R.J. (2014). Molecular variation in *Colletotrichum falcatum* isolates prevalent in red rot infected sugarcane. Proc. International Conclave on Sugar Crops, (Feb. 15-17) IISR, Lucknow, p. 122.

Anwar, S.I. (2013). Experimental identification of best fin configuration for modified pans developed for jaggery making furnace. *In*: 47th Annual Convention and Symposium of ISAE, DRR, Hyderabad.

Anwar, S.I., Kumar, D. and Tiwari, M. (2014). An attempt towards enhancing medicinal value of jaggery. *In*: International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow.

Anwar, S.I., Singh, J. and Kumar, D. (2013). Nutritional security through value-added jaggery using Indian spices and herbs. *In*: National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow.

Anwar, S.I., Singh, P.R and Singh, J. (2014). A novel concept for improving thermal efficiency of open pan jaggery furnaces. *In*: 48th ISAE Convention and Symposium, (Feb 21-23), MPAU, Udaipur.

Anwar, S.I., Singh, R.D. and Pandey, P.R. (2013). Assessment of storability of value-added jaggery prepared using *aonla* as a natural source of vitamin C. *In*: 47th Annual Convention and Symposium of ISAE, DRR, Hyderabad.

Ashfaque, M., Prakash, B. and Sharma, A.K. (2013). Problems and prospects of women labourers involved in sugarcane cultivation in Uttar Pradesh. *In*: National Conference on Women in Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 178-179.

Baitha, A. (2014). Management of internode and stalk borer of sugarcane through bio-agents. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, 142 p.

Bajpai, P.K, Singh, J., Hasan, S.S. and Kumar, R. (2014). Optimum number of seedlings for evaluation of progeny mean and variance in sugarcane. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp 202.

Banerjee N and Singh RK. (2013). Association mapping approaches for MAS- An innovative technique for young woman researchers. *In*: National Conference on Women in sugarcane Agriculture and Industry (Aug. 29-31), IISR, Lucknow.

Banerjee, N., Serari, A, Kumar, S., Singh J., Madhok HL and Singh, R.K. 2014. Association mapping for yield contributing traits in sugarcane. *In*: International Conclave on Sugar Crops and National SugarFest-2014 (Feb. 15-17), IISR, Lucknow.

Banerjee N., Madhok H.L., Siraree A., Kumar, S. and Singh, R.K. (2013). Transgenics in sugarcane-A promising opportunity for woman researchers. *In*: National Conference on Woman in Sugarcane Agriculture and

Industry (Aug 29-31), IISR, Lucknow, p. 209.

Banerji, R., Singh, P., Anwar, S.I., Shrivastava, A.K. and Solomon, S. (2013). Micronutrients in jaggery and women's health. *In*: National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow.

Dohare, R.S., Kumar, R. and Singh, G.K. (2013): A perspective of women empowerment through frontline extension delivery system of *Krishi Vigyan Kendras* (KVKs) in arid and semi-arid agricultural environment. *In*: Souvenir, National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow.

Dohare, R.S., Thakor, R.F. and Kumar, R. (2014). Perspective of frontline extension delivery system for economical, emancipation of sugarcane farming in tribal areas of Valasad district in South Gujarat. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow.

Duttamajumder, S.K. and Misra, S.C. (2014) Dynamics of red rot (*Colletotrichum falcatum*) development and spread in relation to sett-borne inoculum. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 128.

Gangwar, L.S., Hasan, S.S. and Verma, M.R. (2013). Economic status of rural women in sugarcane based farming systems. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 89-94.

Gangwar, L.S., Sah, A.K. and Hasan, S.S. (2013). Current status of sugarbeet production in India: Problems and future scenario. *In*: IISR-Industry Interface on Research and Development Initiatives for Sugarbeet in India. Sugarbeet Breeding Outpost IISR, Mukteswar, Nainital. p. 50.

Gangwar, L.S., Solomon, S., Hasan, S.S. and Verma, M.R. (2014). Analysis of growth and instability pattern of sugarcane production and productivity in major sugarcane producing countries. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp. 199.

Gupta, C., Singh, S.N., Shukla, S.K., Singh, A.K. and Srivastava, T.K. (2014). Effect of macro- and micro-nutrients combination on yield and quality of sugarcane in sub-tropical India. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p 162.

Gupta, R. (2014). Drip irrigation: The only option to enhance sugarcane and sugar productivity under limited water supply conditions. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 184.

Gupta, R. and Singh, P.R. (2013). Drip irrigation: A promising method of irrigation to sustain sugarcane productivity in reduced water supply situation attributable to climate change. *In*: Proc. 72nd Annual Convention of the Sugar Technologists' Association of India, (Sept. 26-28), Lucknow, pp. 59-69.

Gupta, R., Singh P.R. and Singh, A.K. (2013). Optimizing irrigation water and land need for sugar production through intercropping sugarbeet in autumn planted sugarcane. *In*: Souvenir, IISR- Industry Interface on Research and Development Initiatives for Sugarbeet in India, (May 28-29), IISR, Lucknow, pp. 51-52.

Gupta, R., Singh, P.R. and Singh, A.K. (2013). Role of women in managing irrigation and domestic water for improved rural livelihoods. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, p. 226.

Gupta, R., Singh, P.R., and Singh, S. (2014). Adoption of drip irrigation with fertigation to enhance irrigation water and nutrient use efficiency in sugarcane farming. *In*: Souvenir, 48th Annual Convention of ISAE and Symposium on Engineering Intervention in Conservation Agriculture, (Feb. 21-23), CTAE, Udaipur, p. 180.

Hasan, S.S. and Bajpai, P.K. (2013). Advancements in ICT activities in sugarcane. Diamond Jubilee Celebrations & National SugarFest, pp. 91-93.

Hasan, S.S., Bajpai, P.K., Kumar, R., Gangwar, L.S. and Sah, A.K. (2014). ICT tools for decision support in sugarcane cultivation. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp. 201.

Hasan, S.S., Gagwar, L.S., Singh, S.N., Singh, M.R.

and Sah, A.K. (2013). Women participation in sugarcane and sugar industry. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 135-138.

Hasan, S.S., Gagwar, L.S., Singh, S.N., Singh, M.R. and Sah, A.K. (2013). Women participation in sugarcane and sugar industry. *In:* Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 135-138.

Holkar, S.K., Gaikwad, K.S., Meena, M.R., Parameswari, B., Rao, G.P. and Jain, R.K. (2014). Detection and partial molecular characterization of sugarcane mosaic virus in sugarcane genotypes. *In*: Proc. International-Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 122.

Holkar, S.K., Kumar, R., Maheshwari, Y., Katiyar, A., Jain, R.K. and Mandal, B. (2013). Duplex RT-PCR for specific detection of Watermelon bud necrosis virus and Groundnut bud necrosis virus, the two closely related tospoviruses in India. *In*: Proc. International Conference of Indian Virological society (IVS) on Asia-Pacific Congress of Virology (VIROCON), (Dec. 17-20), Amity University, p. 74.

Jain, R., Lal, R.J., Chandra, A. and Solomon, S. (2013). Biochemical attributes and SOD gene expression associated with red rot resistance in sugarcane. *In*: National Conference on Microbes Promoting Crop Health, Productivity and Sustainability and Zonal Meeting of Indian Phytopathological Society (MEZ), (Oct. 26-27), CIMAP, Lucknow, p. 41.

Jain, R., Vishakumari, V., Nithya, K., Shrivastava, A.K. and Solomon, S. (2013). *Bihar Mein Chini Sah-Utpadan Evam Alocohol Udyog. In Rastriya Sangosti, Bharat Ke Uposhan Jalvayu Vale Shetron Mein Ganna Evam Chini Udyog Vikas,* IISR Regional Centre, Motipur, Bihar, pp. 144-150.

Joshi, D. and Nithya, K. (2013). Crop protection: Gender issues and potential for women empowerment in sugarcane farming. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 111-113.

Joshi, D., Singh, P. and Singh, A.K. (2014). Population dynamics and diversity of *Trichoderma* under an organic multiratooning sugarcane cropping system. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp. 131-32.

Kapur, R., Duttamajumder, S.K. and Kumar, R. (2014). A comparative study of breeding behaviour in sugarcane with extremes of mating. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 103.

Kumar, D. and Anwar, S.I. (2014). *Gur udyog-Ek Aarthik Vishleshan*. In. National Seminar on Food Processing and Management-Self Employment Avenues for Entrepreneurs, (Jan. 28-29), CIPHET, Ludhiana.

Kumar, D., Anwar, S.I. and Singh, R.D. (2014). Byproduct utilization in sugar industry. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 188.

Kumar, D., Singh, J. and Anwar, S.I. (2013). Sugarcane juice-An ideal health drink for women. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow.

Kumar, R., Hasan, S.S. and Bajpai, P.K. (2014). GIS-based mapping approach for sugarcane planning at district level in India. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow.

Kumar, R., Sinha, O.K., Dohare, R.S., Gupta, C. and Singh, P. (2013). Role and participation of rural women in agricultural activities: An overview. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow.

Kumar, R. (2014). Growth of sugar production in different states of sub-tropical and tropical India. *In*: Proc. National Seminar on Recent Advances and Challenges in Sugarcane Research, (Jan. 23-24), ZARS, UAS, Dharwad, Mandya.

Kumar S, Singh, J, Madhok, H.L., and Singh, R.K. 2014. Production of disease-free and genetically uniform seed cane exploiting in *vitro* propagation and their genetic fidelity testing. *In*: International Conclave on Sugar Crops. (Feb. 15-17), IISR Lucknow, p. 116.

Kumar, S., Singh, J., Singh, P.K., Pandey, D.K. and Siraree, A. (2014). Implementing effective seed cane production chain and its distribution network for replacing old sugarcane varieties. *In*: Proc. National Seminar on Recent Advances and Challenges in Sugarcane Research, (Jan. 23-24), ZARS, UAS, Dharwad, Mandya, pp. 30.

Kumar, S., Singh P.K., Singh, J., Pandey, D.K., Siraree, A. and Singh, R.K. (2014). Strategies for early generation selection in ratoon crops to obtain higher plant-ratoon productivity in sugarcane. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 112.

Kumar, S., Singh, J., Singh, P.K., Pandey, D.K., Lal, S. and Sirare, A. (2014). Implementing effective seed cane production chain and its distribution net work for replacing old sugarcane varieties. *In*: Proc. National Symposium on Recent Advances and Challenges in Sugarcane Research (Jan 23-24), S.R.I., Mandya, pp. 30.

Lal, R.J. (2013). *Ganne Mai Rog Prabhandhan- Takneek Avam Mahatwa. In. Proc. National Seminar on Bharat Kay Uposad Jalvayu Wale Chaitro Mai Ganna Avam Chini Udyog Vikas Kay Liye Bhartiya Ganna Anusandhan Sansthan Ke Pahal* (Nov. 29-30), IISR Regional Center, Motipur, pp. 41-52.

Lal, R.J. (2013). Sugarbeet diseases and their management. *In*: IISR-Industry Interface on Research and Development Initiatives For Sugarbeet in India, (May 28-29), Sugarbeet Breeding Outpost IISR, Mukteswar, Nainital.

Lal, R.J. (2013). *Trichoderma* sp. - A boon for fighting an unceasing battle against plant pathogens. *In*: Proc. of Lucknow Science Congress, BBAU, Lucknow, (March 20-21), pp. 35-36.

Lal, R.J. (2014). Impact of major diseases on cane productivity and sugar recovery. *In*: Proc. National Symposium on Recent Advances and Challenges in Sugarcane Research (Jan 23-24), S.R.I., Mandya, p. 115.

Lal, R.J. and Duttamajumder, S.K. (2014). Effect of flooding/water logging on cane yield, sugar recovery and red rot incidence in command area of Bajaj Hindustan Ltd. Sugar Mill Unit, Pallia Kalan. In. Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp. 167-168.

Lal, R.J. and Misra, S.C. (2013). Women-the key driving force of agriculture in India. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 170.

Lal, S. and Panwar, L. (2013). Eco-friendly disease management technologies in sugarcane agriculture for women. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 224-225.

Lal, S., Pandey, D.K., Singh, P.K. Singh, J., Kumar, S., and Panwar, L. (2013). Screening of sugarcane progenies for durable resistance to redrot. *In*: National Conference on Microbes Promoting Crop Health, Productivity and Sustainability, Zonal Meeting, Indian Phytopathological Society (Mid-Eastern Zone) (Oct. 26-27), CIMAP, Lucknow, p. 84.

Lal, S., Pandey, D.K., Singh, P.K., Kumar, S., Singh J. and Panwar, L. (2014). Evaluation of sugarcane progenies of different crosses against Red Rot. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 140.

Lal, S., Singh, R.K. and Panwar, L. (2014). Endophytes: A new window for better sugarcane growth and productivity. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 139.

Lal, S., Singh, R.K., Irshad, S., Singh, K. and Panwar, L. (2013). Genetic diversity assessment of *Colletotrichum falcatum* isolates causing red rot of sugarcane. *In*: National Conference on Microbes Promoting Crop Health, Productivity and Sustainability, Zonal Meeting, Indian Phytopathological Society (Mid-Eastern Zone), (Oct. 26-27), CIMAP, Lucknow, p. 54.

Lal, S., Srivastava, S.N. and Bhatnagar, S. (2013). Relative efficacy of fungicides against *Cercospora* leaf spot of sugar beet. *In*: National Conference on Microbes Promoting Crop Health, Productivity and Sustainability, Zonal Meeting, Indian Phytopathological Society (Mid-Eastern Zone), (Oct. 26-27), CIMAP, Lucknow, pp. 83-84.

Nithya, K. and Joshi, D. (2013). Women empowerment through mass production of bio-control agents. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, p. 181.

Nithya, K., Velazhahan. R., and Valluvaparidasan. V. (2014). Molecular characterization of *Colletotrichum falcatum* causing sugarcane red rot. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 122.

Pandey, D.K, Lal, S., Kumar, S., Singh, J., Singh P.K. and Saxena, V.K. (2014). Variability for brix and red rot reaction in progenies of crosses in sugarcane (*Saccharum* species hybrid complex). *In*: Proc. National Symposium on Recent Advances and Challenges in Sugarcane Research, (Jan. 23-24), S.R.I., Mandya, p. 10.

Pandey, D.K., Kumar, S., Lal, S., Singh, P.K. and Singh, J. (2014). Studies on durable resistance to red rot of sugarcane caused by *Colletotrichum falcatum* Went. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 115.

Pandey, K., Gupta, A., Qamar, A., Lal, R.J. and Ansari, M.I. (2013). Molecular and pathogenic characterization of red rot pathogen of sugarcane. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 207-208.

Pathak, A.D., Kapur, R., Duttamajumder, S.K. and Joshi, B.B. (2014). Performance of sugarbeet varieties in Indian subtropics. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 119.

Pathak, A.D., Kapur, R., Solomon, S., Kumar, Rajesh and Srivastava, S. (2014). Prospects of sugarbeet cultivation in India. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp. 73-78.

Pathak, A.D., Singh, M.R., Kumar, R., Rai, R.K., Srivastava, S. and Singh, P. (2014). Development of top shoot borer (*Scirpophaga excerptalis* Walker) tolerant sugarcane genetic stocks. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp. 113-114.

Prakash, B., Sharma, A.K. and Ashfaque, M. (2013). Rural non-farm sector: An additional source of income for female sugarcane workers. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 180.

Rai, D. (2013). Effect of Insect pest and diseases on production and productivity of sugarcane crops in different agro-climatic condition of India. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, p. 221.

Rai, D., Singh, R.K., Singh, V. and Singh R. K. (2014). Sugarcane cultivation: Challenges for farmers. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp. 99-204.

Rai, D., Singh, R.K., Singh, V., Singh, R.K. and Balaji R.M. (2014). Need to popularize sustainable management practices of fruit fly in mango orchard. *In*: 16th Indian Agricultural Scientists and Farmers Congress, (Feb. 22-23), Integral University, Lucknow, p. 11.

Rajak, D.C. (2014). Evaluation of chemicals, botanicals and bioagents for the management of *Pyrilla perpusilla* Walker and their impact on yield and quality parameters of sugarcane. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp. 141.

Rajak, D.C., Pratap, M., Pal, I. and Lal, R.J. (2013). *Ganne Nasikeelo Ka Javik Niyantran. In: Proc. National Seminar on Bharat kay Uposad Jalvayu Wale Chaitro Mai Ganna Avam Chini Udyog Vikas Kay Liye Bhartiya Ganna Anusandhan Sansthan Ke Pahal* (Nov. 29-31), IISR Regional Center, Motipur, pp. 156-160.

Sah, A.K. (2013). Communication skill of women: A powerful tool for technology dissemination. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 84-88.

Sah, A.K. (2013). *Upposhna Jalvayu Wale Rajyon Men Uttarotar Ganna Vikas Ke Liye Samekit Prasar Karyakram. Rashtriya Sangoshthi On Bharat Ke Upposhna Jalvayu Wale Kshetron Men Ganna*

Avam Chini Udyogvi Kaskeliye Bhartiya Ganna Anusandhan Sansthan Kee Pahal, (Nov. 29-30), IISR Regional Centre, Motipur, Muzaffarpur (Bihar), pp. 82-92.

Sah, A.K. and Hasan, S.S. (2014). Conversing information into knowledge system: emerging extension approach for inclusive growth of sugar industry. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp. 198.

Sharma, A.K. and Prakash, B. (2013). Role of sugarcane-based products in tackling women and childhood undernutrition. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 223-224.

Sharma, A.K., Solomon, S. and Prakash, B. (2014). ICT-based innovations in sugarcane marketing and its implications for enhanced sugar recovery in Uttar Pradesh. *In*: National Seminar on Recent Advances and Challenges in Sugarcane Research, (Jan 23-24), S.R.I., Mandya, pp. 133-134.

Sharma, A.K., Solomon, S., Prakash, B., Ashfaque, M. and Singh, N. (2014). Sugar production and consumption scenario in 21st Century. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow.

Shrivastava, A.K. and Mishra, S.K. (2013). *Uttari Bihar Mein Ganne Ki Gunwatta Par Tapkram Ka Prabhav. Smarika. In. National Conference. Bharat Ke Uposhna Jalvayu Wale Chhetron Mein Ganna Evam Cheeni Udhyog Vikas Ke Liye Bhartiya Ganna Anusandhan Sansthan Ki Pahal*, IISR Regional Centre, Motipur, pp. 163-165.

Shukla, S.K. and Awasthi, S.K. (2013) Sugarbeet: A supplement to sugarcane in non-traditional areas to meet future sugar demand. Souvenir. *In*: IISR Industry Interface on Research and Development Initiatives for Sugar Beet in India, (May 28-29), Sugarbeet Breeding Outpost, Mukteswar, pp. 55-57.

Shukla, S.K., Solomon, S., Srivastava, T.K., Kumar, S., Awasthi, S.K., Gaur, A. and Swaha S. (2014). Crop residue management and inoculation of *Trichoderma viride* in rice-wheat and sugarcane-based cropping systems for sustaining soil health and improving crop yields. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp. 154.

Shukla, S.K., Swaha S. and Gaur, A. (2013). Sustainable livelihood module through bio-fertilizers for cane women. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), Lucknow, pp. 70-74.

Singh I., Srivastava, T.K. and Singh, A.K. (2014). Modified plant geometry in sugarcane by producing inta-row spacing to ensure higher population and productivity. *In*: Proc. National Seminar on Recent Advances and Challenges in Sugarcane Research, (Jan. 23-24), ZARC, Mandya (UAS, Bangalore), p. 50.

Singh R.K. and Singh, R.K. (2014). Effect of feeding sweet sorghum on performance of Murrah Buffaloes. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp. 99-205.

Singh, A.K. (2013). Technological options for profitable sugarcane cultivation. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 66-69.

Singh, A.K. and Joshi, D. (2013). Evaluation of substrates for mass production of *Trichoderma harzianum* for management of red rot of sugarcane. *In*: National Conference on Microbes Promoting Crop Health, Productivity & Sustainability & Zonal Meeting of Indian Phytopathological Society (MEZ) (Oct. 26-27), CIMAP, Lucknow, pp. 83.

Singh, A.K. and Singh, P.R. (2013). Mechanization of sugarcane harvesting in India. *In*: Proc. 72nd Annual Convention of STAI, (Sept. 26-28), Lucknow, pp. 151-159.

Singh, A.K. and Singh, P.R. (2014). Development of a tractor operated ratoon management device with disce. *In*: Souvenir 48th Annual Convention of ISAE and Symposium on Engineering Intervention in Conservation Agriculture, (Feb. 21-23), CTAE, Udaipur, p. 105.

Singh, A.K., Sharma, M.P., Srivastava, A.C., Singh, J. and Singh, P.R. (2014). Mechanization of a tractor operated paired row sugarcane cutter planter. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp. 181.

Singh, A.K., Singh, P.R. and Gupta, R. (2013). Mechanization of sugarcane harvesting. *In*: Souvenir, All India Seminar on Mechanization of Sugarcane Cultivation, (July 30), STAI, NSI, Kanpur.

Singh, A.K., Singh, P.R. and Singh, S. (2013). *Ganne Ki Kheti Ke Liye Unnat Yantr Aavashaykta Evan Pragrahan. Rastriya Sangoshthi on " Bharat Ke Uposhna Jalvayu Wale Kshetron Me Ganna Evam Chini Udyog Vikas Ke Liye Bhartiy Ganna Anusandhan Sansthan ki Pahal*, (Nov. 29-30), IISR Regional Centre, Motipur (Bihar), pp. 29-40.

Singh, A.K., Srivastava, T.K. Singh, K.P. and Singh, A.K. (2014). Altering plant geometry in relation to mechanization in sugarcane. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 183.

Singh, A.K., Vishakumari, V. and Singh, K.P. (2013). Role of Indian women in sugarcane planting. *In*: National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, p. 167.

Singh, A.K., Vishakumari, V. and Singh, K.P. (2013). Role of women in sugarcane Production. *In*: National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow.

Singh, I. and Verma, R.R. (2013). Contributing role of farm women in sugarcane planting under different geometries. *In*: National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow.

Singh, I., Solomon, S., Srivastava, T.K., Shukla, S.K. and Rai, R.K. (2014). Growth and yield parameters in sugarcane as affected by seaweed (*Kappaphycus* and *Gracilaria*) sap spray. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 149.

Singh, J. and Solomon, S. (2013). Opportunities and prospects for women in sugarcane based cottage industries. *In*: National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow.

Singh, J., Anwar, S.I., Singh, R.D., Kumar, D. and Mishra, S.K. (2014). Development of a cleaning-cum-washing machine for sugarcane. *In*: 48th ISAE Convention and Symposium, (Feb. 21-23), MPAU, Udaipur.

Singh, J., Kumar, D., Anwar, S.I. and Verma, P. (2013). Interventions in jaggery production: A frugal approach. *In*: Engineers Day Celebration, (Sept. 15), Engineers Bhavan, Lucknow.

Singh, J., Kumar, D., Anwar, S.I., Singh, P. and Solomon, S. (2013). Nutritional food security through sugarcane based product - Jaggery. *In*: National Seminar on Women in Sugarcane Agriculture, (Aug. 29-31), IISR, Lucknow.

Singh, J., Singh, P.K., Kumar, S. and Pandey, D.K. (2014). Flowering in sugarcane and its effect on cane yield juice quality. *In*: Proc. National Seminar on Recent Advances and Challenges in Sugarcane Research, (Jan. 23-24), Directorate of Research and ZARS, UAS, Dharwad, Mandya, p. 9.

Singh, J., Singh, P.K., Siraree, A., Kumar, S. and Pandey, D.K. (2014). Special cane characters and DUS testing of sugarcane varieties-A future need. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp. 113.

Singh, J., Solomon, S. and Kumar, D. (2013). Status and prospects of jaggery and khandsari industry in India. *In*: National Seminar on Food Processing with Quality Assurance for Augmenting Rural Prosperity, (June 21-22), MPUA&T, Udaipur.

Singh, K.P., Srivastava, T.K. and Singh, P. (2014). Changes in soil health under varying nutrient management practices in multi-ratooning of sugarcane. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), p. 178.

Singh, M. (2013). *Ganna Ke Naashi Keeton Ka Samekit Prabandhan. Smarika Rashtriya Sngoshthi " Bharat Ke Uposhn Jalvayu Wale Kshetron Mein Ganna Evam Chini Udyog Vikas Ke Liye Baytiya Ganna Anusandhan Sansthan Ki Pahal*, prashth, pp. 53-66.

Singh, M., Siraree, A. and Singh P.K. (2014). Jaggery or white sugar: The Prebiotics view. *In*: Souvenir International Conference on Scientific and Technological Advancements: Social issues and Health Concerns, (Feb. 18-19), BBA University, Lucknow, pp. 74-75.

Singh, M., Siraree, A. and Singh, P.K. (2013).

Gender issues in conservation and sustainable use of water. *In*: Souvenir National Conference on Water and Biodiversity, (May 22), UPSBB, Lucknow, pp. 125-128.

Singh, M.R. (2014). Screening of sugarcane genotypes for their reaction against borer pests in sub-tropical India. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), pp. 140-141.

Singh, N., Prakash, B., Ashfaque, M. and Sharma, A.K. (2013). Jaggery: A cheap and reliable source of home remedy practiced in ailments by elderly rural women since time immemorial. *In*: National Conference on Women in Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 220-221.

Singh, P.K., Singh J., and Siraree, A. (2013). Registration of sugarbeet varieties in India: A pressing need. *In*: Souvenir IISR-Industry Interface on Research and Development Initiatives for Sugarbeet in India, (May 28-29), Sugarbeet Breeding Outpost, IISR, Mukteswar, Nainital, pp. 63.

Singh, P.K., Singh, J., Kumar, S, Siraree, A. and Pandey, D.K. (2014). Reaping commercial advantage through IPRs on newly released sugarcane varieties. *In*: Proc. National Seminar on Recent Advances and Challenges in Sugarcane Research, (Jan. 23-24), Directorate of Research and ZARS, UAS, Dharwad, Mandya, pp. 155.

Singh, P.K., Singh, J., Kumar, S., Pandey, D.K. and Siraree, A. (2014). Deciphering the provisions of IP Laws for facilitating germplasm and varietal exchanges at international level. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, pp. 111-112.

Singh, P.K., Singh, J., Kumar, S., Pandey, D.K., Siraree, A. and Singh, M. (2013). Moving ahead from gender blind to gender sensitive programmes in agriculture. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 79-83.

Singh, P.R, Singh, S. and Gupta, R. (2013). Mechanization of sugarcane cultivation-problems and prospects. *In*: Proc. 72nd Annual Convention STAI, (Sept. 28-27), Lucknow, pp. 141-150.

Singh, P.R. and Gupta, R. (2013). Women friendly mechanization of sugarcane agriculture. In. Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 35-40.

Singh, P.R. and Gupta, R. (2014). Design and development of deep trench sugarcane paired row planter with sub-surface drip laterals laying attachment. *In*: Souvenir 48th Annual Convention of ISAE and Symposium on Engineering Intervention in Conservation Agriculture, (Feb. 21-23), CTAE Udaipur, p. 109.

Singh, P.R., Singh, A.K. and Gupta, R. (2013). Development of farm machinery at IISR for sugarcane culture. *In*: Souvenir All India Seminar on Mechanization of Sugarcane Cultivation, (July 30), STAI-NSI, Kanpur.

Singh, P.R., Singh, A.K., Singh, S. and Gupta, R. (2013). *Ganne Ki Phasal Hetu Yantrikaran. In*: Smarika, *Rastriya Sangoshthi on Bharat Ke Uposhna Jalvayu Wale Kshetron Me Ganna Evam Chini Udyog Vikas Ke Liye Bhartiy Ganna Anusandhan Sansthan Ki Pahal*, (Nov. 29-30), IISR Regional Centre, Motipur (Bihar), pp. 20-28.

Singh, R., Singh, R.K., Singh, S., Singh, V. and Singh, A.K. (2013). Participation and performance of women in sugarcane agriculture. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 95-98.

Singh, R.D. and Kumar, D. (2014). Filtration efficiency of mechanical filtration unit for sugarcane juice. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 185.

Singh, R.D., Singh, J., Anwar, S.I. and Kumar, D. (2014). Effect of shrink wrap packaging on quality and shelf life of jaggery. *In*: 48th ISAE Convention and Symposium, (Feb. 21-23), MPAU, Udaipur. p. 40.

Singh, R.D., Srivastava, A.C., Shahi, H.N., Singh, P.R. (2014). Performance and benefit cost ratio of seeder cum sugarcane cutter planter at farmers fields. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 185.

Singh, R.K. (2013). Development of capacity

building of cane farm women through intervention of Krishi Vigyan Kendra. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, p. 191.

Singh, R.K., Lal, M., Banerjee, N., Singh, I., Siraree, A. and Singh P.K. (2013). New vistas for gender empowerment through biotechnology. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 52-58.

Singh, R.K., Sharma, A.K. and Singh, R.K.(2013). Improving economic status of women through production of sugar rich green fodder. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, p. 182.

Singh, R.K., Sharma, A.K., Singh, R.K. and Prakash, B. (2013). Problems and prospects of sugarbeet cultivation as fodder crop in subtropical India. *In*: IISR-Industry Interface on Research and Development Initiatives for Sugarbeet in India, (May 28-29), Sugarbeet Breeding Outpost, IISR, Mukteswar, Nainital, pp. 53-54.

Singh, R.K., Singh, P.K. and Kumar S. (2014). Technological intervention for Enhancing sugarcane productivity in Uttar Pradesh and Uttarakhand through KVKs: An urgent need. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 197.

Singh, S. and Singh, P.R. (2014). Sugarcane as a viable energy source. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 191.

Singh, S., Singh, P.R. and Singh, A.K. (2013). Need of ergonomical interventions to reduce drudgery of women in sugarcane cultivation. In. Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, p. 227.

Singh, S., Singh, P.R., Singh, A.K. and Gupta, R. (2014). Present status and future need of mechanizing sugarcane cultivation in India. *In*: Souvenir, 48th Annual Convention of ISAE and Symposium on Engineering Intervention in Conservation Agriculture, (Feb. 21-23), CTAE Udaipur, p. 121.

Singh, S.N., Srivastava, T.K., Singh, M.R., Venugopal ,V. and Solomon, S. (2014). Economizing nutritional need and reducing incidence of pests and diseases through Fungabact Kit in sugarcane cultivation. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 130.

Singh, S.R., Shukla, S.K. and Srivastava, T.K. (2014). Nutrient management for maximizing yield potential of sugarcane through leaf analysis and soil test crop response. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 173.

Singh, V. and Rai, D. (2013). Nutritional Security through Sugarcane Juice. *In*: National Conference of Women in Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 221.

Sinha, O.K. and Kumar, R. (2013). Spread index-based analysis of sugarcane production and productivity for the crop improvement in Andhra Pradesh. *In*: Souvenir Group Meeting of All India Coordinated Research Project on Sugarcane, (Oct. 25-26), RARS, Anakapalle, pp. 13-15.

Siraree, A., Banerjee, N., Singh, R.K., Singh, J., Singh, P.K. and Kumar, S. (2014). Distinctiveness, Uniformity and Stability (DUS) testing of sugarcane varieties (*Saccharum* spp. hybrid) based on morphological descriptors and SSR markers. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 124.

Siraree, A., Singh, P.K. and Singh, J. (2013). Capacity building needs for enhancing women's role in agro-biodiversity conservation. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, p. 189.

Solomon, S. and Shukla, S.K. (2013). Carbon sequestration in sugarcane based system for improving sugar production *vis-a-vis* sustaining soil health. *In*: 43rd Annual Convention of SISSTA, (July 26-27), Chennai, pp. 43-54.

Solomon, S., Singh, P., Nithya, K., Joshi, D. and Vishakumari, V. (2013). Women in Sugarcane Agriculture and Industry: Retrospect's and

Prospects. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 8-12.

Srivastava S. (2013). An exploration across microscope-microsatellites-microRNA for improving sugarcane. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow.

Srivastava S., Pathak A.D. and Saxena V.K. (2013). Genetic diversity of sugar beet evaluated by microsatellites DNA markers. *In*: Proc. IISR-Industry Interface on Research and Development Initiatives for Sugarbeet in India, (May 28-29), Sugarbeet Breeding Outpost, IISR, Mukteswar, Nainital, p. 48.

Srivastava, A.K. and Solomon, S. (2013). Organic carbon- yield relationship in sugarcane in UP. In. Proc. 72nd Annual Convention STAI, (Sept. 26-28), Lucknow, pp. 167-170.

Srivastava, A.K., Bajpai, P.K., Solomon, S., Hasan, S.S. and Kumar, R. (2013). Relative temperature disparity- yield relationship in sugarcane in eastern Uttar Pradesh. *In*: Proc. 72nd Annual Convention STAI, (Sept. 26-28), Lucknow, pp. 183-187.

Srivastava, A.K., Bajpai, P.K., Solomon, S., Kumar, R. and Hasan, S.S. (2014). Impact of temperature variability on sugarcane quality in western Uttar Pradesh. In: Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 177.

Srivastava, A.K., Mishra, S.K. and Kumar, V. (2014). Calibration, validation and sensitivity of CANEGRO model for sugarcane for Lucknow conditions. In. Proc. International Conclave on Sugar Crops, (Feb. 15-17), IISR, Lucknow, p. 176.

Srivastava, S. and Lal, R. (2014). Transcriptional activity of chitinase gene in sugarcane genotypes challenged with red rot disease. In. Proc. 16th Indian Agricultural Scientist & Farmers' Congress, (Feb 22-23), Integral University, Lucknow, pp. 73-74.

Srivastava, S. and Sunkar, R. (2014). Role of micro-RNA in drought stress tolerance in sugarcane: Current status and future research. *In*: Proc. International Conclave on Sugar Crops, (Feb 15-17), IISR, Lucknow, p. 120.

Srivastava, S., Lal, R., Swapna, M., Pathak, A.D., Singh, R.K. and Saxena, V.K. (2014). Analysis of expression of NBS-LRR resistance gene analogues against red rot disease in sugarcane. *In*: 16th Indian Agricultural Scientist & Farmers' Congress, (Feb 22-23), Integral University, Lucknow.

Srivastava, S., Shukla, S.K., Singh, S.R., Awasthi, S.K. and Kumar, S. (2013). Sugarcane potential, achievements and scope in future. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, p. 205.

Srivastava, T.K. and Vishakumari, V. (2013). Technological empowerment of women for sustaining sugarcane production. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow.

Srivastava, T.K., Bajpai, P.K. and Verma, R.S. (2014). An efficient statistical design for weed control experiments in sugarcane. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), Lucknow, p. 179.

Swaha, S., Gupta, S., Singh, K., Shukla D., Awasthi, S. K. and Shukla, S.K. (2013). Bio-intensive management for enhanced biomass, sugarcane productivity and sustaining carbon-climate-human balance in India. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, p. 225.

Swapna, M, Pandey D.K. and Srivastava, S. (2014). Towards molecular breeding in sugarcane: Development of mapping population for quality traits. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), Lucknow, p. 125.

Swapna, M. and Pandey, D.K. (2013). Adding sweetness to sugarcane: The changing scenario. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 143-149.

Tiwari, M., Singh, J., Anwar, S.I., Kumar, D. and Mishra, S.K. (2013). Women's role in value-added product of jaggery for cottage industry. *In* Proc. National Conference on

Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow.

Tripathi, N., Singh, P., Joshi, D., Rai R.K. and Arya, N. (2013). Colloidal chitin preparation for assaying chitinase activity of *Trichoderrma* spp. against *Colletotrichum falcatum*: A modified process. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow, pp. 213.

Verma, R.R., Singh, I. and Singh, R.K. (2013). Nutritional security through sugarcane jiggery. *In*: Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow.

Verma, R.R., Singh. K.P., Singh, R.K. and Srivastava, T.K. (2014). Soil fertility status of sugarcane growing soils of Punjab: An approach for nutrient management for enhancing sugarcane productivity. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), Lucknow, p. 156.

Vishakumari, V., Singh, K.P. and Srivastava, T.K. (2013). Gender-based adaptation propositions for sustenance of climate influenced sugarcane agriculture. *In:* Proc. National Conference on Women in Sugarcane Agriculture and Industry, (Aug. 29-31), IISR, Lucknow.

VishaKumari, V., Singh, S.N., Srivastava, T.K. and Solomon, S. (2014). Effect of soil applied sugar mix (sulphur-based micro-nutrient mix) on yield and quality of sugarcane. *In*: Proc. International Conclave on Sugar Crops, (Feb. 15-17), Lucknow, p. 155.

Technical Programme (2013-14)

Division of Crop Improvement

B 1.1 Evaluation of early maturing sugarcane clones of North West Zone (J. Singh and D.K. Pandey; 02/2009-LT)

B 1.2 Evaluation of mid-late sugarcane clones for North West Zone (J. Singh and D.K. Pandey; 02/2009-LT)

B 1.7 Collection, maintenance, evaluation and documentation of sugarcane germplasm under sub-tropical conditions (P.K. Singh, Sanjeev Kumar and J. Singh; 01/95 - LT)

B 2.3 Development of sugarcane breeding stocks for high sugar (Raman Kapur and S.K. Duttamajumder; 11/93-3/14)

B 2.9 Development of top borer tolerant genetic stocks of sugarcane (A.D. Pathak, R.K. Rai, Sangeeta Srivastava, M.R. Singh and Rajesh Kumar; 3/2000-2/15)

B 2.10 Development of sugarcane varieties for moisture deficit environment (Sanjeev Kumar J. Singh and P.K. Singh 02/02 - 2013)

B.2.13 Development of sugarcane varieties for sub-tropics (J. Singh, D.K. Pandey, P.K. Singh and Sanjeev Kumar; 10/2003-LT)

B 2.14 Development of breeding stocks of sugarcane for durable resistance to red rot (D.K. Pandey, P. K. Singh, Sunita Lal, J. Singh and Sanjeev Kumar; 10/04-10/2014)

B2.15 Developing sugarbeet varieties for Indian agro-climates (A.D. Pathak, Raman Kapur, S.K. Duttamajumder, and Arun Baitha; 09/2008- 09/2013)

B3.17 Elucidation of species chromosomal complement in sugarcane genotypes under sub-tropical conditions (Sangeeta Srivastava and Raman Kapur; 2010- 2015)

B3.18 Identification and expression analysis of resistance gene analogues against red rot disease in sugarcane (Sangeeta Srivastava, Ramji Lal, R.K. Singh and M. Swapna; 01/10-12/14)

B3.19 Mapping of loci linked to sugar content in sugarcane (M. Swapna, Sangeeta Srivastava and D.K. Pandey; 12/09-03/15)

Externally Funded Projects

1. Central Sector Scheme for PPV&FRA (J. Singh and P.K. Singh; 2006- LT)

2. ICAR Seed Project "Seed Production in Agricultural Crops" (Sanjeev Kumar and P.K. Singh; 2012-2017)

Division of Crop Production

A 1.1.31 Standardization and optimization of cane node technology for sugarcane planting (S.N. Singh and T.K. Srivastava; 2/12-3/14)

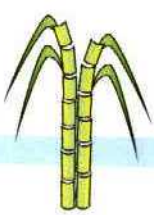
A1.2.27 Developing efficient water application techniques in sugarcane (A.K. Singh, T.K. Srivastava, Akhilesh Kr Singh and S.N. Singh; 02/10-01/14)

A1.2.28 Deep tillage under different moisture regimes and N levels for modifying rhizospheric environment and improving sugarcane yield in plant-ratoon system (S.K. Shukla, Akhilesh K. Singh and Rajendra Gupta; 2010-13)

A1.2.29 Tillage techniques in plant-ratoon system for improving soil health and increasing sugarcane yield in subtropical India (S.K. Shukla, Akhilesh K. Singh and Rajendra Gupta; 3/12-3/16)

A 1.1.30 Yield maximization through optimizing shoot population density (T.K. Srivastava, A.K. Singh and Ishwar Singh; 2/12-3/15)

A 2.31 Effect of bio-manuring on sugarcane productivity and soil properties under plant and subsequent ratoon (K.P. Singh, T.K. Srivastava and Pushpa Singh; 03/2003 - LT)



A 2.35 Assessment of soil fertility status of sugar mill command areas of sub-tropical India (T.K. Srivastava, K.P. Singh R.R. Verma, Om Prakash and R. K. Singh; 03/12-04/14)

ET 1.12 Documentation and confirmation of indigenous technical knowledge under sugarcane based cropping system (Kamta Prasad, T.K.Srivastava, K.P. Singh, R. Gupta and A.K. Sah; 2012-15)

ET 1.13 Assessment of sugarcane cultivation machines (RMD & RBS cum Planter) on Farmers' fields (A.K. Sah, A.K. Singh, Kamta Prasad and R.K. Singh; 9/12-9/15)

ET 1.14 Entrepreneurship development for sugarcane seed production and multiplication (A.K. Sah, S.N. Singh, Sanjeev Kumar, Ramji Lal, S.N. Sushil and Kamta Prasad; 2012-16)

A1.2.30 Rationalizing irrigation water use in sugarcane through optimizing field application parameters (V. Visha Kumari, Rajendra Gupta, Ishwar Singh and A.K. Singh (11/13 - 10/15)

A 2.36 Assessing nutrient interactions for sustaining sugarcane productivity and soil health (Ram Ratan Verma and Ishwar Singh (2/13 - 3/16)

AS 42 Agronomic evaluation of promising genotypes of sugarcane (S.K. Shukla, Ishwar Singh; Long term)

AS 63 Plant geometry in relation to mechanization in sugarcane (A.K. Singh, T.K. Srivastava, K.P. Singh; 2011-2014)

AS 64 Response of sugarcane crop to different plant nutrients in varied agro-ecological situations (C. Gupta, S.N. Singh, S.K. Shukla, A.K. Singh; 2011 - 2014)

AS 65 Enhancing sugarcane productivity and profitability under wheat-sugarcane cropping system (Ishwar Singh, S.N. Singh; 10/12 - 6/15)

AS 66 Priming of cane node for accelerating germination (S.N. Singh, T.K. Srivastava; 2012-13)

AS 67 Optimization fertigation schedule for sugarcane through micro-irrigation technique under different agro-climatic conditions (R. Gupta, S.K. Shukla and C. Gupta; 2012-14)

Externally Funded Projects

1. Carbon sequestration potential of sugarcane based cropping system for sustaining crop health and crop productivity in Uttar Pradesh (DST, GOI) 2012-15 (67.204 lakhs)

Division of Crop Protection

M 2.14 Pathotype formation in *Colletotrichium falcatum* in relation to breakdown of resistance in cane genotype (S.K. Dattamajumder, S.C. Misra and Sangeeta Srivastava; 2/09 - 3/14)

M 15.4 Management of red rot through modulating host resistance (Ramji Lal, Sangeeta Srivastava, S.K. Shukla, Radha Jain and Sanjeev Kumar; 8/09 - 7/13)

M 15.5 Management of red rot through fungal endophytes in sugarcane (Sunita Lal and R.K. Singh; 2/09 - 1/14)

M 15.6 Enhancing efficacy of *Trichoderma* based red rot management system (Deeksha Joshi, A.K. Singh and Pushpa Singh; 2012-17)

M 15.7 Mass multiplication of *Trichoderma* on cheaper substrates and development of suitable delivery system for disease management in sugarcane (A. K. Singh and Deeksha Joshi; 2012-17)

M 17 Evaluation/screening of sugarcane germplam/genotypes against red rot and smut (S.K. Duttamajumder and Ram Ji Lal; 1992-93 to LT)

M 20.1 Genome sequencing of red rot pathogen (S.K. Duttamajumder, Amaresh Chandra, R.K. Singh, Deeksha Joshi and Nithya, K.; 09/12-02/17).

EM 01 Survey and surveillance of insect-pests and diseases of sugarcane in sub-tropical India (S.K. Duttamajumdar, S.N. Sushil, M.R. Singh and Ramji Lal; 4/06-LT)

Ento 2.1 Mechanism of resistance against top borer in sugarcane (S.N. Sushil, A. Chandra. A.D. Pathak and M.R. Singh; 4/12-3/17)

E 4.2(iv) Bio-intensive management of white grubs

in sugarcane (S.N. Sushil and Deeksha Joshi; 8/09 - 3/13)

Ento11.1 Development of techniques for laboratory mass multiplication of the borers and its parasitoides (M.R. Singh; 2/06 to 3/12)

Ento 11.2 Development of techniques of mass multiplication of larval parasitoids for management of sugarcane top borer (Arun Baitha and M.R. Singh; 04/12-03/17)

Ento 15.1 Containment of major insect-pests of sugarcane through habitat modifications (Arun Baitha and M.R. Singh; 4/12 -3/17)

Ento 15.2 Semiochemicals for the management of sugarcane top borer (M.R. Singh and Arun Baitha; 3/12-2/17)

Division of Plant Physiology and Biochemistry

PB-23 Optimization of plant population for improving physiological efficiency of sugarcane (R.K. Rai, A.K. Shrivastava, R. Banerji, A. Chandra, Pushpa Singh, S. Solomon and Radha Jain; 2/10-3/13)

PB-24 Modulating the expression of sucrose metabolizing enzymes for high sucrose accumulation in sugarcane (Radha Jain, A. Chandra and S. Solomon; 10/09 - 3/12)

PB-26 Developing a technology for preservation & packaging of sugarcane juice (R. Banerji, A. Chandra, S. Anwar and S. Solomon; 2012-14)

PB-27 Molecular study to reveal transcriptomes and genes associated with sucrose (GAS) transport and accumulation in sugar (A. Chandra, Radha Jain and S. Solomon; 2012-17)

PB-28 Minimizing post harvest sucrose deterioration and its molecular assessment (S. Solomon, A. Chandra and Radha Jain; 04/12-03/15).

Division of Agricultural Engineering

AE 4.5 Evaluation and refinement of sett cutting mechanism of sugarcane planters (R.D. Singh and P.R. Singh; 3/08-02/14)

AE 9.1 Design refinement of sugarcane-cum-potato planter (P.R. Singh, Rajendra Gupta and A.K. Singh; 7/12 - 6/15)

AE 1.51 Development of tractor operated sugarcane manager (P.R. Singh, A.K. Singh, Rajendra Gupta and T.K Srivastava; 4/12 - 12/14)

AE1.9F Development of sugarcane harvester for small farms (A.K. Singh and P.R. Singh; 3/12- 2/16)

AE 7.6.2 Development of a jaggery furnace with efficiency boosting device (S.I. Anwar and P.R. Singh; 4/12- 3/15)

Jaggery Unit

LKO/PHTS/07/2 Development of a small capacity cane crushing unit for house hold purpose (Jaswant Singh and Dilip Kumar; 12/06 - 03/13)

LKO/PHTS/08/01 Evaluation of shrink-wrap, stretch wrap and modified atmosphere packaging for storage of jaggery cubes and blocks (R.D. Singh, Jaswant Singh and S.I. Anwar; 12/06 - 03/13)

LKO/PHTS/11/01 Evaluation of jaggery furnaces (single, double and triple pan) for emission of green house gases and level of bagasse combustion (S.I. Anwar, R.D. Singh and Jaswant Singh; 04/11 - 03/14)

LKO/PHTS/11/02 Refinement of juice extraction process with special reference to sugarcane cleaning and juice filtration for 100 kg jaggery/8 hrs (Jaswant Singh, S.I. Anwar and R.D. Singh; 04/11 - 03/14)

LKO/PHTS/11/03 Development/ adoption of evaporator for sugarcane juice (R.D. Singh, Jaswant Singh and S.I. Anwar; 04/11 - 03/14)

I.KO/PHTS/11/04 Development of power operated jaggery moulding machine (Jaswant Singh, R.D. Singh and S.I. Anwar; 04/11 - 03/14)

LKO/PHTS/11/05 Development/Adoption of suitable mixer for production of value-added jaggery using *aonla* as a natural source of vitamin C (S.I. Anwar, R.D. Singh and Jaswant Singh; 04/11 - 03/14)

AE/PHT-1/2011 Optimization of parameters for shelf life enhancement of jaggery under modified atmosphere packaging (Dilip

Kumar and Jaswant Singh; 04/11 - 03/14)

Externally Funded Project

LKO/PHTS/12/1 Assessment of harvest and post-harvest losses of major crops/commodities of India [Funded by MoFPI, GOI] (Jaswant Singh, R.D. Singh, S.I. Anwar and Dilip Kumar; 04/12 - 03/15)

Agro-meteorology Unit

AM3 Compilation, analysis and documentation of long-term weather data base in relation to sugarcane crop culture (Arun Kumar Srivastava, P.K. Bajpai and S.S. Hasan; 3/00 - LT)

AM5 Impact of climate change on sugarcane Insect-pests dynamics & behaviour (Arun Kumar Srivastava, Rajesh Kumar, M.R. Singh and S.N. Sushil; 04/12- 03/16)

Agricultural Economics, Statistics and Computer Applications section

AES 4.10 Development of decision support tools in sugarcane cultivation (S.S. Hasan, Rajesh Kumar, S.K. Shukla, A.K. Sah and Arun Baitha; 01/08-12/13)

AES 4.12Developing efficient sugarcane marketing strategies in India (A.K. Sharma and M.R. Verma; 4/10- 3/13)

AES 4.16 Estimation of optimum sample size for evaluation and prediction of cross-performance (P.K. Bajpai, J. Singh, S.S. Hasan and Rajesh Kumar; 3/12-2/15)

AES 4.14 Geographic information system of sugarcane and sugar in India (Rajesh Kumar, S.S. Hasan and P.K. Bajpai; 2012 - 15)

AES 4.15 Development of data mining and presentation tools in sugarcane (S.S. Hasan, P.K. Bajpai and Rajesh Kumar; 4/12-3/15)

IISR Regional Centre, Motipur, Muzaffarpur, Bihar

B 2.16 (M) Development of waterlogging tolerant and red-rot resistant sugarcane clones for North Central Zone (Devendra Kumar, Sanjeev Kumar and Ramji Lal; 2012-15)

B 1 (M) Evaluation of Sugarcane clones under Zonal Varietal Trials for North Central and Eastern Zone (Devendra Kumar; Long Term)

Externally Funded Project

Bihar Sugarcane Seed Project (Devender Kumar and A.D. Pathak; 03/13 - 03/18)

16

Consultancy and Contract Research

List of ongoing Consultancy and Contract Research projects

Sponsoring agency	Title of the Team	Period 2012-2014	Budget (₹in lakh)
FMC	Evaluation of sulfentrozone 48% F for weed control in sugarcane (A.K. Singh, T.K. Srivastava, S. Solomon)		7.5
Sri Ram (DSCL)	The effect of sugaring on yield and quality of sugarcane crop in composition with bentonife S. sulfozinc and calcium nitrate (S.N. Singh, T.K. Srivastava, V. Visha Kumari, S. Solomon)	2012 – 2014	5.0
Deepak Fertilizers & Petro chemicals Co. Ltd.	Studies on the effect of Zinc bensulf on yield and quality of sugarcane (R.R. Verma, S. Solomon, S.N. Singh, V. Visha Kumari)	2013 – 2015	6.0
Nagarjuna Fertilizers	Effect of NP production growth yield and quality of sugarcane in sub-tropical India (S.K. Shukla, T.K. Srivastava, S. Solomon)	Oct. 2012 – March 2014	10.0
Jain Irrigation	Enhancing water & nutrient use efficiency through drip irrigation & fertigation in spring planted sugarcane under sub-tropical condition (Rajendra Gupta, S.N. Singh)	2012 – 2014	6.0
NRDC	Performance evaluation of Pusa Hydrogel in sugarcane (Ishwar Singh, T.K. Srivastava, R.R. Verma)	2013 – 2014	1.0
CSMCRI, Bhavnagar	Evaluation of crop nutrition potential of sea weed ..... on sugarcane(Plant & ratoon) (Ishwar Singh, S. Solomon, T.K. Srivastava, S.K. Shukla, R.K. Rai)	2012 – 2013	14.2
FMC India Ltd	Bio-efficacy of carbosulfan 6G against top shoot borer	March 2012-2014	5.00
Nagarjuna Fertilizer	Effect of NP-1 product on growth, yield and quality of sugarcane in sub-tropical India	October 2012-March 2014	10.00
Bayer Crop Science	Evaluation of Fipronil 0.6 GR against ESB and termites	March 2013 - 2015	5.00
DuPont India Pvt. Ltd.	Bioefficacy testing of chlorantraniliprole 35 WG against top, stalk and internode borer in sugarcane	March 2013 - 2015	10.00
Rana Sugars	Evaluation of herbicide in sugarbeet	March 2013 - 2014	1.25 lakh
NRDC	Testing of hydrogel in sugarcane	March 2013 - 2014	1.00 lakh
IPM Biocontrol Labs Pvt Ltd.	Testing of biofertilizer 'Hi-brix' in sugarcane	March 2013 - 2015	5.00 lakh
Deepak Fertilizers & Petrochemicals Corporation Ltd.	Studies on the effect of Zinco-Bensulf on yield and quality of sugarcane	March 2013 - 2015	6.00 lakh

17

Monitoring and Evaluation

Research Advisory Committee Meeting

The XIX meeting of Research Advisory Committee (RAC) of the Indian Institute of Sugarcane Research, Lucknow for the Year 2013 was held on April 25, 2013. Dr. S. Nagarajan, Former Chairperson, PPV & FRA, Govt of India, Former Director, IARI, New Delhi and Chairman, RAC presided over meeting. Dr. B.L.Jalali, Prof. R.P. Sharma, Prof. Bachchan Singh, Dr. V.P. Singh, Sh Kunwar Ajay Singh and Dr. S. Solomon were other members who attended the meeting. Shri. J.L.Jain, GM (Cane), Harinagar Sugar Mills Ltd, West Champaran, Bihar and Shri. R.C. Singhal, Chief Executive, the Saksaria Sugar Mill Ltd, Sitapur, UP participated in the meeting as special invitees representing sugar mills of sub-tropical region, Bihar and UP, respectively. All the Heads of Division/Incharges of sections and scientists representing different disciplines also participated in the meeting as special invitees.

The agenda of the meeting included Presentation of the highlights of RAC meeting held on April 25, 2013, Presentation of ATR on the recommendations of the IRC meeting held on September 5-7, 2012, Presentation of Pravaranagar, Motipur and Mukteshwar Centre research highlights and priorities by concerned HODs/Incharges/Nodal Officers, Presentation of Division-wise yearly research output and technologies developed for its popularization, Discussion on the abridging/clubbing together of research projects as per ICAR guidelines and proceedings of the HODs meeting with DG, ICAR, Discussion on project-wise achievements during 2012-13 and scientist-wise work-load/targets for the year 2013-14, Discussion on extension in time period and modification of existing projects, Publications to be made during the next year and any other item with the permission of the chairman. All the 54 on-going projects were reviewed in the meeting.

Institute Research Council Meeting

The Institute Research Council (IRC) meeting of the Indian Institute of Sugarcane Research, Lucknow was held under the Chairmanship of Dr. S. Solomon, Director of the Institute during April 29-May 1, 2013 to review the progress made under different research projects during 2012-13 and to discuss the technical programmes for the (next) year 2013-14.

Institute Technology Management Committee Meeting

Two meetings of ITMC were held during the year. First meeting of Institute Technology Management Committee of the year was held under the chairmanship of Dr. S. Solomon, Director, IISR, Lucknow on October 28, 2013 in the Director's Conference Room. The other officials present in the meeting were Dr. S.K.

Duttamajumdar, HOD (Crop Protection), Dr. T.K. Srivastava, HOD (Crop Production), Dr. P.R. Singh, HOD (Ag. Eng.), Dr. A.K. Srivastava, HOD (PPB), Dr. J. Singh, Principal Scientist (Crop Improvement), Dr. S.K. Shukla, Pr. Scientist & I/c BPD Unit, Dr. M. Swapna, Sr. Scientist, PME cell, Dr. R.K. Singh, PC, KVK, Dr. Dileep Kumar, Scientist, Mr. Ratnesh Kumar, SAO, Sh. K.P. Yadav, AAO & F&AO and Dr. A.K. Sharma, Pr. Scientist and Nodal Officer, ITMU. The second meeting was held on March 25, 2014.

RFD Meeting

Number of RFD meetings were held during the year under the chairmanship of Dr. S. Solomon, Director, IISR. The first meeting was held in the month of April 2013 to finalize the RFD 2013-14. The second meeting of RFD was held on June 3, 2013 to revise the RFD 2013-14. The third RFD meeting was held on August 19, 2013, the section VI of RFD 2013-14 was revised. The fourth meeting of RFD was held on September 21, 2013 to further revise the RFD 2013-14 as per the directives of the Council. In the fifth meeting held on November 4, 2013, the Innovation Action Plan (IAP) 2013-14 prepared by the RFD Nodal Officer was discussed and finalized.

Institute Biosafety Committee Meeting

IBSC meeting held on December 21, 2013 under the chairmanship of the Director. Various steps regarding biosafety involved in the experimentation was discussed.

Institute Management Committee Meeting

The 35th and 36th Meeting of Institute Management Committee meeting held on November 8, 2013 and March 14, 2014, respectively under the chairmanship of the Director. The progress of the various Divisions/ Sections of the Institute was reviewed in the meeting and various agenda items related to Administration and Finance were discussed.

18

Human Resource Development

Award and Recognition

- *'Ikshu*: Rajbhasha Patrika' of Indian Institute of Sugarcane Research. The Patrika received coveted *Indira Gandhi Rajbhasha Puraskar* 2013-14 (2nd Prize) of Department of Official Languages, Ministry of Home Affairs, GOI. The Shield was given by Hon'ble President of India on 14th September, 2013 at Vigyan Bhawan, New Delhi.
- Dr. P.K. Singh is elected as Fellow, Association for Advancement of Biodiversity Sciences, Karnataka University, Dharwad in 2014.
- Dr. P.K. Singh is Member of Project Appraisal Committee of UP State Biodiversity Board, Govt. of Uttar Pradesh, Lucknow.
- Dr. Sangeeta Srivastava was awarded "Certificate of Recognition" at the 4th World Congress of Biotechnology-"Unveiling the Current Frontiers in the Field of Biotechnology", an International Conference held at Raleigh, NC, USA from September 23-25, 2013.
- Dr. Sangeeta Srivastava has been nominated as Fellow of "Society of Sugar Research and Promotion" during the "International Conclave on Sugar Crops" held at IISR, Lucknow, from Feb 15-17, 2014.
- Dr. Nandita Banerjee, A. Siraree, S. Kumar, J. Singh, H.L. Madhok and R.K. Singh received Best Paper Award for the paper "Association mapping for yield contributing traits in sugarcane" during interactive session in International Conclave on Sugar Crops "Sweeteners and Green Energy from Sugar Crops: Emerging Technologies" organized at IISR, Lucknow on February 15-17, 2014.
- Dr. T.K. Srivastava was nominated as Member, Expert Panel for reviewing the research proposals intended to be funded by the Uttar Pradesh Council of Agricultural Research, Lucknow.
- Dr. T.K. Srivastava has been selected as Editor, Indian Journal of Agronomy for the biennium 2013-14.
- Dr. T.K. Srivastava was Convener, Technical Session I of the International Conclave on Sugar Crops "Sweeteners and Green Energy form Sugar Crops: Emerging Technologies" Feb. 15-17, 2014 IISR, Lucknow.
- Dr. S.K. Shukla received Best Oral Paper award in session III entitled "Sustainable livelihood module through bio-fertiliser for cane women" in National Conference on Women in Sugarcane Agriculture and Industry on Aug. 29-31, 2013 organized at IISR, Lucknow.
- Dr. A. K. Singh received Best Poster Award: Role of Indian women in sugarcane planting. National Conference on Women in Sugarcane Agriculture and Industry, Aug. 29-30, 2013.
- Dr. Ishwar Singh and Dr. Ram Ratan Verma were awarded with Second Prize for poster presentation on "Contributing role of farm women in sugarcane planting under different geometries" in National Conference on Women in Sugarcane Agriculture and Industry, Aug. 29-31, 2013 at IISR, Lucknow.
- Dr. A.K. Sharma, received Best Paper Award for the paper entitled " ICT based Innovations in sugarcane marketing and its implications for enhanced sugar recovery in Uttar Pradesh" in the National Seminar on Recent Advances and Challenges in Sugarcane Research, Mysore organized at Jan. 23-24, 2014.
- Sh. Brahm Prakash was elected as Member of the Executive Committee of Indian Society of Agricultural Marketing during 2013.

- Dr. Rajesh Kumar received Best Oral Presentation award for "Growth of sugar production in different states of sub-tropical and tropical India" in the National Seminar on Recent Advances and Challenges in Sugarcane Research, organized at ZARS, Mandya.

Trainings/workshop Attended

- Dr. Sangeeta Srivastava worked on miRNA at the Department of Biochemistry and Molecular Biology, Oklahoma State University, USA for six months from May to October, 2013 under DBT CREST award.
- All the Scientists of the Institute attended Annual Zonal Workshop of KVKs-Zone IV held at IISR, Lucknow during May 26-28, 2013.
- All the Scientists attended National Conference on Women in Sugarcane Agriculture and Industry organized at IISR, Lucknow during Aug. 29-31, 2013.
- All the scientists attended one day Awareness-cum Sensitization Programme on 'Intellectual Property Management with Specific Emphasis on Copyright' on March 25, 2014 at IISR, Lucknow.
- All the scientists participated in one day Training-cum Awareness Programme on ' Plant Variety and Farmers Right Conservation Act' organized jointly by PPV&FRA, New Delhi and KVK, IISR, Lucknow on 28th March, 2014 at IISR, Lucknow.
- All the Scientists of the Institute attended International Conclave on Sugar Crops, organized at IISR, Lucknow during Feb. 15-17, 2014.
- All the scientists attended the National Meet on Tractor and Agricultural Machinery Manufacturers (TAMM-2014) held at IISR, Lucknow on February 08-09, 2014.
- Dr. P.K. Bajpai attended training on "Developing, Commissioning, Operating and Managing an Online System for NET/ ARS-PRELIM Examination in ASRB/ ICAR during Nov. 21-22, 2013 at ASRB/ IARI, New Delhi.
- Dr. P.K. Singh attended "5 Day NAIP sponsored Management Development Workshop" on Technology Management for Researchers' from January 27-31, 2014 at NAARM, Hyderabad.
- Dr. A.K. Sah attended Seminar on "Falling Recovery in North India- opportunities and Challenges" organized by Sugar Technologists Association of India, New Delhi held at Gandhi Bhawan, Shahjahanpur, UP on April 23, 2013.
- Dr. A. K. Sah attended a training workshop on "Scientific Report Writing and Presentation" held at NAARM, Hyderabad during November 26-30, 2013.
- Dr S.N. Singh participated in Bonsucros's Stakeholders meeting on finalization of sugarcane production standards for enhanced cane and sugar productivity at Chennai on February 28, 2014.
- Mr. Brahm Prakash attened National Training Workshop on Scientific Report Writing and Presentation at NAARM, Hyderabad during July 30 - Aug. 3, 2013.
- Dr. A.K. Sharma, Mr. Brahm Prakash and Mr. Mohd. Ashfaque attended Training and Awareness Programme on Intellectual Property Rights at NBFGR, Lucknow on March 20, 2014
- Dr. S. N. Singh attended NABARD seminar on "*Gramin Uttar Pradesh Mein Satat Pragati Hetu Behtar Krishi Utpadakta*" at Lucknow during Feb. 05-06, 2014.
- Dr. P.R. Singh attended 43rd Annual convention of South Indian Sugarcane and Sugar Technologists Association held at Chennai during July 26-27, 2013.
- Dr. P.R. Singh attended the Coordination Committee Meeting of AICRP on FIM held at CCSHAU, Hisar during Nov. 12-14, 2013.
- Dr. P.R. Singh attended the National Seminar on Sugarcane held at PAU, Ludhiana during October 15-16, 2013 & acted as Chairman of Technical Session on Mechanization.

- Dr(s). P.R. Singh, Rajendra Gupta, S.I. Anwar, R.D. Singh and Er. Sukhbir Singh attended the 48th ISAE Annual convention & symposium at CTAE, MPUAT, Udaipur during 21-23 Feb., 2014.
- Dr. R.D. Singh participated and exhibited IISR technologies in Progressive Punjab Agriculture-2014 at Mohali during Feb. 16-19 , 2014.
- Dr. Rajendra Gupta attended the Group Meeting of AICRP on Sugarcane held at Regional Agricultural Research Station, ANGRAU, Anakapalle from Oct.25-26, 2013.
- Dr(s). P.R. Singh, A.K. Singh and Rajendra Gupta attended 72nd Annual Convention of STAI held at Lucknow on Sept. 26-28, 2013.
- Dr(s). P.R. Singh, A.K. Singh and Rajendra Gupta attended All India Seminar on Mechanization of Sugarcane Cultivation organized by STAI held at NSI, Kanpur on July 30, 2013.
- Er. Sukhbir Singh, Sh. S.K. Kushwaha and Sh. Chaman Singh attended 80 hours training on Solid Works from CADD Centre, Lucknow.
- Dr. S.K. Shukla took part in Management Development Programme Workshop on PME of Agricultural Research Projects on November 19-23, 2013 at NAARM, Hyderabad.
- Dr(s). S. Solomon, A.K. Shrivastava, A.D. Pathak, T.K. Shrivastava, P.R. Singh, J. Singh, P.K. Singh, A.K. Singh, S.N. Singh, Radha Jain, Deeksha Joshi, V. Visha Kumari, Arun Baitha and Deeksha Joshi attended National Seminar on IISR Initiatives for Development of Sugarcane and Sugar Industry in Indian Subtropics at IISR Regional Centre, Motipur (Muzaffarpur) held on November 29-30, 2013.
- Mr. S.K. Holkar attended FOCARS Training (January 1-August 9, 2013) at NAARM, Hyderabad, Seven months (Including three months Foundation course at NAARM, one month Orientation Programme at IISR, Lucknow and three months Professional Attachment Training at NRCPB, New Delhi) and two days training on Agricultural Research and Technical Writing at BBAU, Lucknow.
- Dr. M.R. Singh attended Training on "Pest Surveillance" at National Institute of Plant Health Management, Hyderabad, during October 3-10, 2013.
- Dr(s). S. Solomon, A.D. Pathak, Ramji Lal, S.N. Singh, Nithya, K. and Visha Kumari, V. attended the IISR-Industry Interface on Research and Development Initiatives on Sugarbeet in India at Sugarbeet Breeding Outpost, Mukteshwar, Uttarakand during May 28-29, 2013.
- Dr(s). Jaswant Singh and Dilip Kumar attended the 29th Biennial Workshop of AICRP on PHT held at MPUA&T, Udaipur during Sept.23-26, 2013.
- Dr. Dilip Kumar attended the training on Storage Loss Parameters and Methods of Their Computation organized by FCI under ICAR-FCI project during July 16-17, 2013 at UAS, Bangalore.
- Dr. A.K. Sharma attended the National Seminar on Recent Advances and Challenges in Sugarcane Research held at Mysore during Jan. 23-24, 2014.
- Mr. Brahm Prakash attended 73rd Annual Conference of the Indian Society of Agricultural Economics held at NAARM, Hyderabad on December 18, 2013.
- Mr. Brahm Prakash attended 27th National Conference on Agricultural Marketing held at UAS, Dharwad on December 19-20, 2013.
- Dr. Sanjeev Kumar attended a short-term training on Bioinformatics Approaches in Genomics, Transcriptomics and Proteomics (Nov. 12-22) at NBFGR, Lucknow.
- Dr. Sanjeev Kumar attended AKWL Convention on Transformation through IT and Biotechnology Infusion (Oct. 19, 2013) at Lucknow.

International

- Dr. Amaresh Chandra attended ASSCT (Florida and Louisiana) Joint Meeting at Panama City, Florida, USA from June 12-14,

2013. Dr. Amaresh Chandra attended APS-MSA Joint Meeting at Austin, Texas, USA from August 10-14, 2013.

- Dr. Amaresh Chandra attended Plant and Animal Genome XXII (The International Conference on the Status of Plant and Animal Genome Research) at San Diego, CA, USA, January 11-15, 2014.
- Dr. Amaresh Chandra ASSCT, Louisiana Meeting at Lafayette, Louisiana, USA from Feb 11-12, 2014.
- Dr. Sangeeta Srivastava was deputed to work on miRNA at the Department of Biochemistry and Molecular Biology, Oklahoma State University, USA for six months from May to October, 2013 under DBT CREST award.
- Dr. Sangeeta Srivastava attended 10th BMBGSA (Biochemistry and Molecular biology Graduate Student Association) Symposium held at Oklahoma State University, Stillwater, USA from Sept. 19-20, 2013.
- Dr. Sangeeta Srivastava participated in the 4th World Congress of Biotechnology - "Unveiling the Current Frontiers in the Field of Biotechnology", an International Conference held at Raleigh, NC, USA from September 23-25, 2013.
- Dr. Sangeeta Srivastava attended "Hazardous Communication- Awareness Training" at the Department of Biochemistry and Molecular Biology, Oklahoma State University, Stillwater, USA, on 20th August, 2013.

Capacity building of sugar mill personnel/Entrepreneurs

Name of Training	Topic	Duration	Sponsoring agency	Clientele groups	No. of participants
21 Days National Training	Sugarcane management and development	July 1-21, 2013	Sugar mills	Cane development personnel of sugar mills	16
Three Days training for DCOs of UP Govt.	Sugarcane production technology	September 3-5, 2013	LalBahdurShastri Ganna KisanSansthan, Lucknow	District Cane Officers of Uttar Pradesh	23
Three Days training for NGO workers	Sugarcane production technology	November 5-8, 2013	PANI-NGO, Ambedkarnagar, UP	Community Resource personnel	30
Three Days farmers' training-cum-workshop	Jaggery production Technology	November 19-21, 2013	ATMA, Hoshiyarpur, Punjab	Farmers of Hoshiyarpur district	17
One Day Training-cum-visit	*Ganna utpadan taknik*	December 19, 2013	ATMA, Bhind, M.P.	Farmers	42
One Day Training	*Entrepreneurship in Sugarcane Production*	December 28, 2013	Agri-clinic and Agri-business Training Institute, Lucknow	Ari-entrepreneurs	43
One Day Training-cum-visit	*Ganna utpadan taknik*	February 14, 2014	Director, Agriculture, SawaiMadhopur, Rajasthan	Farmers	50
One Day Training-cum-visit	*Ganna utpadan taknik*	February 28, 2014	ATMA,Anooppur, M. P.	Farmers	17
Three Days Farmers' Training	*Ganna utpadan taknik*	March 1-3, 2014	ATMA,Seoni, M. P.	Framers	26
One Day Training-cum-visit	*Ganna utpadan taknik*	March 01, 2014	KisanKalyan and krishiVikas, Anooppur, M.P.	Farmers	54
One Day Training-cum-visit	*Ganna utpadan taknik*	March 03, 2014	ATMA, Umaria, M.P.	Farmers	26

- Dr. Sangeeta Srivastava successfully completed "RAM-1: Radioactive Material (RAM) - Unsealed sources" programme on Web at Oklahoma State University, Stillwater, USA, on 28th June, 2013 with 97% score.

Trainings Organized:

- Dr(s). J. Singh and P.K. Singh, Nodal Officers for DUS Testing Centre for Sugarcane at IISR organized one day "Awareness-cum-Training Programme on Implementation of PPV&FRA Act, 2001 in India" on March 28, 2014.

Capacity building through Exhibitions

Sugarcane technologies developed by the Institute were displayed with the help of posters to farmers, entrepreneurs, delegates, students at *'Progressive Punjab Agriculture Submit-2014'* and *Kisan Mela* organized by Punjab Government at Chappar Chiri, Mohali (Punjab) on February 16-19, 2014. Broachers/folders published by the Institute on latest sugarcane technologies were also distributed to the farmers.

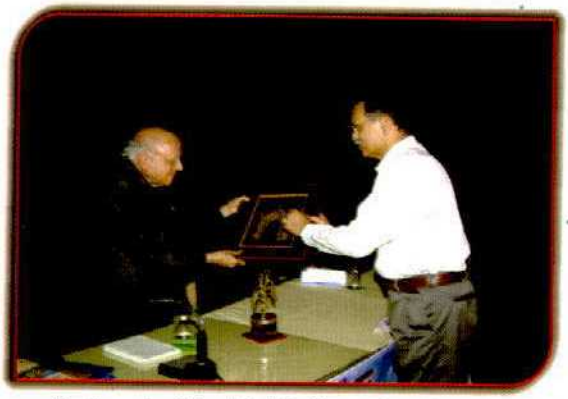
Capacity building of Farmers/Visiting Farmers

During the year 2013-14, about 1500 farmers from different states of the country visited the Institute and during their visit, they got acquainted with practical aspects of sugarcane technologies developed by the institute. Visit of Cane Development inspectors of different districts of Uttar Pradesh was organized and imparted training in latest cultivation techniques.

S. No.	Organizer	Place	Duration	Event
1	Key2 Green Pvt. Ltd. New Delhi	IISR, Lucknow	October 25-27, 2013	AgriFest-2013
2	IISR, Lucknow	IISR, Lucknow	October 26-27, 2013	*Kisan-Vigyan Sangam*-2013
3	Regional Science City, Lucknow	Lucknow	Jan. 30 - Feb.03 2014	Science Expo-2014
4	IISR, Lucknow	IISR, Lucknow	February 15-17, 2014	National SugarFest 2014
5	IISR, Lucknow	IISR, Lucknow	February 16-17, 2014	*UP Kisan-VigyanSangam, 2014*
6	Govt. of Punjab	Mohali, Punjab	February 16-19, 2014	Progressive Punjab Agro-Tech-2014
7	CSA, Kanpur	Kanpur	February 25, 2014	All India Famers' Fair-2014

19

Distinguished Visitors



Padmashri Prof. M.S. Swaminathan, Honble member of Rajya Sabha and Ex- Director General, ICAR on April 16, 2013.

Dr. M.S. Aulakh, Vice Chancellor, MSKJUAT, Banda on April 16, 2013.

Dr. K.D. Kokate, DDG (Education), ICAR on May 26-28, 2013

Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR on May 28, 2013.

Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR on May 28, 2013.

Sh. Tariq Anwar, Hon'ble Minister of State for Agriculture and Food Processing, Govt. of India on October 06, 2013.

H.E. Mr. Lakshman Senewiratne, Hon'ble Minister of Sugar Industries Development, Govt. of Sri Lanka on June 15-20, 2013.

Dr. Shivaji Rao Deshmikh, IAS (Retd.), DG, VSI, Pune on August 29 - 31, 2013 and February 16-17, 2014.

Dr. Swapan K. Datta, DDG (Crop Science) on August 23, 2013, December 28, 2013 and February 15, 2014.

Dr. Islam A. Siddiqui, Chief Agriculture Negotiator, USA on September 23, 2013.

Dr. Gurbachan Singh, Chairman, ASRB on February 22, 2014.

Dr. N. Gopalakrishnan ADG (CC) inaugurating the Interactive Poster Seassion in International Conclave on Sugar Crops.

Visit of STAI Delegates at IISR Farm

Sh. Tushar Giri Nath, IAS, Secretary, Govt. of Karnataka on December 30, 2013

Other Distinguished Visitors

Dr.Arvind Kumar, DDG (Education), ICAR on August 23, 2013.

Dr. Kamal Humayun Kabir, Director General, BSRI, Bangladesh on June 27 - July 03, 2013.

Shri Narendra Mohan, Director, NSI, Kanpur on October 30, 2013.

Sh. Sudhir Kumar, Secretary, Dept. of Food and Consumer Affairs, GOI on October 30, 2013.

Visit of Dr. N. Vijyan Nair, Director, SBI, Coimbatore

International Delegates at IISR Farm

20

Farm and Infrastracture

The farm section is an important unit of the Indian Institute of Sugarcane Research which facilitates research activities by providing logistic support including inputs, tractors, farm implements, labourers and other resources for field experimentation. The farm section arranges all these resources, maintains and provides to different scientific divisions as per their requirement. Apart from this, the farm section maintains the entire farm and keeps it presentable by cleaning road sides, bunds and channels properly. This unit is also engaged to generate revenue by producing quality seed of sugarcane and other produce like wheat, paddy, mustard and gram *etc.*

Major activities of the farm section

The activities which are being conducted by the farm section are enormous and having versatile nature. The main activities of the farm section are summarized and given below:

1. To provide logistic support for conducting field experiments
2. Seed production of sugarcane, wheat and paddy *etc.*
3. Disposal of farm produce and revenue generation
4. Procurement and distribution of farm inputs
5. Maintenance and repairing of irrigation sources and system
6. Maintenance and minor repairing of farm machinery and implements
7. Development and maintenance of the farm
8. Improvement of soil fertility
9. Labour management
10. Management of livestock

Significant achievement during 2013-14

Procurement of farm implements and machine

Farm section has been equipped with a new fleet of farm implements and machine under which the following items were procured.

Sl. No.	Implements/machine	Capacity	Cost (₹)
1.	Disc plough	3 discs	26250
2.	Disc harrow (Trailing type)	14 discs	33075
3.	Disc harrow (Mounted type)	12 discs	23500
4.	Cultivator	13 tines	22500
5.	Cultivator	11 tines	18375
6.	Electronic weighing machine	200 kg	11970
7.	Electronic weighing machine	200 kg	11970

- **Seed production of sugarcane**

  During the period under report, 5190.82 qt. seed of sugarcane was produced and supplied to 126 stakeholders in comparison to 4749.11 qt. in 2012-13 and 4040.73 qt. in 2011-12.

- **Revenue generation**

  A total revenue of ₹ 73,14918/- (Rupees seventy-three lakh fourteen thousand nine hundred eighteen only) was generated by the farm section during the reported period 2013-14 as compared to ₹ 65,14,196/- in 2012-13 and ₹ 51,90,528/- in 2011-12.

Revenue generated during the year 2013-2014

Crop/source	Area (ha)	Yield (q/l/kg)	Amount received(₹)	Amount outstanding(₹)	Revenue (₹)
1. Sugarcane	46.7	14441.9	35,31,628	15,75,395	39,38,149
A. Seed	9.66	5190.82	18,36,544		18,36,544
B. Supply to Sugar mill	37.04	5808.99	12,25,695	15,75,395	16,32,216
C. Sold for other purpose		345.54	82,035		82,035
D. Supplied to jaggary unit		656.25	0		0
E. Used as seed		2400	0		0
F. Sold in festival		15.55	15,550		15,550
G. Cane juice		24.75	0		0
Sold as bulk & in bottle	lit.	9047	1,28,177		1,28,177
H. *Gur*	kg	4458.14	2,31,587		2,31,587
I. Vinegar	lit.	180.6	12,040		1,2,040
2. Wheat	16.18	633.9	7,15,850		7,15,850
3. Paddy	14.63	601.3	5,31,300	2,28,902	7,60,202
4. Mustard & *Toria*	29.16	315.47	9,46,916		9,46,916
5. Gram	6.85	72.6	2,10,720		2,10,720
6. *Arhar*	4.99	47.76	1,84,640		1,84,640
7. Potato		12.8	12,320		12,320
8. *Urd*	5.8	4.54	15,890		15,890
9. *Til*	5.94	3.34	13,360		13,360
10. *Amala*		Auction	11,500		11,500
11. *Bel*/mango		Auction	65,100		65,100
12. Grass cutting			33,750		33,750
Grand total= A to I+ 2 to 12			**62,72,974**	**15,75,395**	**69,08,397**
Payment received from Haidergarh Sugar mill during 2013-14					
Outstanding amount of 2012-13					11,68,874
Payment for April 2013-14					56,821
Total payment received in 2013-14					12,25,695
Revenue of 2013-14 for supply of s.cane to Haidergarh Sugar Mill					
Payment received for April 2013-14					56,821
Outstanding payment up to March 2013-14					15,75,395
Total revenue of 2013-14					16,32,216
Total revenue for the year 2013-14 (A)					69,08,397
Outstanding amount paid by Haidergarh Sugar Mill for 2012-13(B)					11,68,874
Actual amount received during the year 2013-14 (A-B)					57,39,523
Actual amount received during the year 2013-14					57,39,523
Outstanding amount to be paid by Haidergarh Sugar Mill, Barabanki					15,75,395
Total revenue for the year 2013-14					**73,14,918**

Crop-wise revenue generated during the period from 2011-12 to 2013-14

Period	Revenue of different Agricultural Produce							Outstanding amount	Total Revenue (₹)
	Wheat	Paddy	Gram	Toria	Arhar	Sugarcane	Others		
2011-12	13,35,185	10,06,124	3,60,010	70,620	0	22,97,011	1,01,578	0	51,70,528
2012-13	17,28,579	8,10,113	3,40,380	4,36,063	0	29,29,712	2,69,349	0	65,14,196
2013-14	7,15,850	7,60,202	2,10,720	9,46,916	1,84,640	39,38,149	1,51,920	406521	73,14,918

- **Database for crop history of IISR farm for the period of 2008-09 to 2012-13**

  A database was prepared by compiling the facts related with the crops grown in each and every field of the farm. These data were compiled for every crop season of each year from 2008-09 to 2012-13. Crop history was prepared for 136 fields that occupied 125 ha area of cultivable land. The area, production and productivity of different crops grown during the five years were compiled. The average productivity of the different crops of all five blocks was also calculated over the period under report.

- **Development of the farm**

  The bushes behind newly constructed bio-control laboratory was cleared by JCB and about five ha area was cleared by using different resources of the farm section and all the area was developed and levelled by using plough, cultivator, leveller and planking. Besides this, a main drainage between D-series and orchard was deepened, levelled and freed from bushes.

- **IRC farm**

  The Institute Research Council had started a new concept as "IRC farm" under which all members of the IRC visited each field experiment and discussed about that experiment and suggest new ideas to make it more scientific and innovative. Finally, all members of the IRC assembled at farm premises and discussed improvement of farm and offered suggestions for the same. All arrangement for this programme had been made by the farm section and a new chapter opened at field level.

- **Agro-tourism**

  The bullock cart was decorated for National sugar fest as a programme of farm tourism. The people who have not seen bullock cart earlier, particularly children and ladies enjoyed by riding over bullock cart.

- **Harvesting of gram by combine harvester-thresher**

  The Combine harvester-thresher purchased by Engineering Division was utilized for the harvesting of gram (8 ha) besides its use for paddy and wheat. This innovative idea saved public money (approximately ₹ 80,000) that would have been spent for harvesting, threshing and winnowing of the gram.

- **Yield maximization of sugarcane**

  The maximum yield of sugarcane was obtained by multiplying two varieties namely CoLk 94184 and CoPk 05191 and these varieties preformed 1002.5 and 1010 qt. per hectare, respectively.

Infrastructure development

During the year 2013-14, institute took-up massive face-lifting programme mostly with internal resources. These included face-lifting of Guest House, Farm area, Ikshupuri residential area, *Kharika* block, KVK campus, *etc*. An extremely useful ground facility for organization of Sports' Events

was developed at the Ikshupuri residential area. The list of new infrastructure developed is as below:

21

Personnel

(As on March 31, 2014)

Director	:	Dr. S. Solomon
Crop Improvement		
Principal Scientist & Head	:	Dr. A.D. Pathak
Principal Scientist (Plant Breeding)	:	Dr. Raman Kapoor
	:	Dr. Jyotsnendra Singh
	:	Dr. D.K. Panday
	:	Dr. P.K. Singh
	:	Dr. Sanjeev Kumar
Principal Scientist (Genetics & Cytogentics)	:	Dr. (Smt.) Sangeeta Srivastava
Principal Scientist (Genetics)	:	Dr. R.K. Singh
Senior Scientist (Genetics)	:	Dr. (Ms.) M. Swapna
Senior Scientist (Plant Biotecnology)	:	Dr. Sanjeev Kumar
Technical Officer(s)	:	Mr. B.B. Joshi, Smt. Hem Lata Madhok, Mr. Raghvendra Kumar, Mr. Ram Kumar Gautam, Mr. Vimal Kumar Saxena, Mr. Ram Mutry, Mr. Ram Sewak
Crop Production		
Principal Scientist & Head	:	Dr. T.K. Srivastava
Principal Scientist (Agronomy)	:	Dr. K.P. Singh
	:	Dr. S.N. Singh
	:	Dr. A.K. Singh
Senior Scientist (Agronomy)	:	Dr. Ishwar Singh
Principal Scientist (Agril. Extention)	:	Dr. (Smt.) Hema Pandey
	:	Dr. A.K. Sah
Senior Scientist (Agril. Extention)	:	Mr. Kamta Prasad
Senior Scientist (Soil Science)	:	Dr. Shiv Ram Singh
Scientist SS (Soil Science)	:	Dr. Ram Ratan Verma
Scientist (Agronomy)	:	Ms. V. Visha Kumari
Technical Officer(s)	:	Dr. J.K.S. Gautam, Dr. Om Prakash, Mr. Anil Kumar Singh, Dr. R.K. Singh, Mr. Ram Darash and Mr. S.N. Srivastava
Crop Protection		
Principal Scientist & Head	:	Dr. S.K. Duttamajumder
Principal Scientist (Pathology)	:	Dr. Ram Ji Lal

Principal Scientist (Pathology)	:	Mrs. Sunita Lal
Principal Scientist (Pathology)	:	Dr. Anil Kumar Singh
Principal Scientist (Agril. Entomology)	:	Dr. Maharam Singh
Principal Scientist (Agril. Entomology)	:	Dr. Arun Baitha
Scientist SG (Plant Pathlogy)	:	Mr. S.C. Mishra
Senior Scientist (Plant Pathology)	:	Dr. Dinesh Singh
Scientist SS (Pl. Pathology)	:	Dr. Deeksha Joshi
Scientist (Plant Pathology)	:	Dr. (Ms.) Nithya K.
Scientist (Plant Pathology)	:	Mr. S.K. Holkar
Technical Officer	:	Dr. D.C. Rajak, Smt. Pramila Lal, Mr. Amar Nath, , Mr. B.L. Maurya, Mr. I.P. Maurya, Mr. Nar Singh, Mr. M.P. Sharma and Mr. Shri Krishna Mishra

Agricultural Engineering

Principal Scientist & Head	:	Dr. P.R. Singh
Principal Scientist (Farm Mach. & Power)	:	Dr. A.K. Singh
Senior Scientist (Soil Water Cons. Engg.)	:	Dr. Rajendra Gupta
Senior Scientist (FMP)	:	Er. Sukhbir Singh
Scientist (SG) Agril. Process Engg.)	:	Er. Prasoon Verma
Technical Officers(s)	:	Mr. Jasbir Singh, Mr. Suresh Kumar Kushwaha, Mr. Chaman Singh, Mr. Julianus Minz, Mr. Rajendra Singh, Mr. Ram Narayan Kureel, Mr. Someshwar Mishra, Mr. Surya Dev Singh and Mr. Ram Sahay Vishwakarma, Dr. Anoop Singh Sachan

Plant Physiology & Biochemistry

Principal Scientist & Head	:	Dr. Amresh Chandra
Principal Scientist (Plant Physiology)	:	Dr. A.K. Shrivastava
	:	Dr. R.K. Rai
	:	Dr. Radha Jain
Principal Scientist (Organic Chemistry)	:	Dr. Pushpa Singh
Senior Scientist (Biochemistry)	:	Mr. Raman Banerji
Technical Officers(s)	:	Dr. Namita Arya, Mrs. Anita Sawnani, Mrs. Meena Nigam, Mr. Somendra Prasad Shukla, Dr. Ram Kishor and Mr. C.P. Prajapati

AICRP on Sugarcane

Project Coordinator	:	Dr. O.K. Sinha

Principal Scientist (Agril. Statistics)	:	Dr. Rajesh Kumar
Principal Scientist (Agril. Extension)	:	Dr. R.S. Dohare
Principal Scientist (Agronomy)	:	Dr. Chandra Gupta
Technical Officer(s)	:	Mr. Mahendra Singh, Dr. G.K. Singh and Mr. Adil Zubair

Krishi Vigyan Kendra

Principal Scientist (Hort.) & In-Charge	:	Dr. R.K. Singh
SMS (Home Science)	:	Dr (Smt.) Veenika Singh
SMS (Plant Protection)	:	Dr. Deepak Rai
Senior Technical Officer	:	Dr. Rakesh Kumar Singh

Jaggery Unit

Principal Scientist (AS & PE) & Incharge	:	Dr. S.I. Anwar
Senior Scientist (Farm Mech. & Power)	:	Dr. R.D. Singh
Scientist (AS & PE)	:	Dr. Dilip Kumar
Technical Officer	:	Mr. Sunil Kumar Mishra

PME Cell

Principal Scientist & Incharge	:	Dr. A.K. Sharma
Principal Scientist	:	Dr. S.K. Shukla
Senior Scientist	:	Dr. M. Swapna
Technical Officer	:	Mr. Brahm Prakash and Mrs. Neelam Singh

Economics & Statistics/AKMU

Pr. Scientist & Incharge	:	Dr. P.K. Bajpai
Pr. Scientist (Agril. Economics)	:	Dr. A.K. Sharma
	:	Dr. L.S. Gangwar
Senior Scientist (Computer Application)	:	Dr. S.S. Hasan
Technical Officer	:	Dr. Mani Ram Verma

Agrometeorology

Principal Scientist & I/C	:	Mr. Arun Kumar Srivastava
Technical Officer	:	Mr. Surendra Singh

Soil, Water, Plant Analysis and Microbiology Laboratory

Principal Scientist & In-Charge	:	Dr. S.K. Shukla
Technical Officer(s)	:	Dr. S. K. Awasthi, Mrs. Asha Gaur and Mr. Ram Singh

Training Unit

Principal Scientist & In-Charge	:	Dr. T.K. Srivastava
Principal Scientist	:	Dr. A.K. Sah
Technical Officer	:	Mr. A.K. Singh

Library

Principal Scientist & In-Charge	:	Dr. Ashok Kumar Shrivastava
Technical Officer(s)	:	Mr. G.K. Gupta, Mr. Ghanshyam Ram, Mr. R.N.P. Bharti

In-Charge, Seed Production Unit : Dr. Sanjeev Kumar

Farm Section

Principal Scientist & In-Charge	:	Dr. T.K. Srivastava
Farm Managar	:	Mr. C.P. Singh
Technical Officer(s)	:	Mr. B.B. Singh, Mr. Faujdar Singh, Mr. Shyam Lal and Mr. Satya Narain

Institute Technology Management Unit

Nodal Officer	:	Dr. A.K. Sharma
Technical Officer	:	Mr. Brahm Prakash

Hindi Unit

Principal Scientist & In-Charge	:	Dr. P.K. Singh
Technical Officer	:	Mr. Abhishek Kumar Singh

Art & Photography

Principal Scientist & In-Charge	:	Dr. A.K. Sharma
Technical Officer(s)	:	Mr. Vipin Dhawan, Mr. Y.M. Singh and Mr. Avadhesh Kumar Yadav

Administration

Senior Administrative Officer	:	Mr. Ratnesh Kumar
Finance & Accounts Officer	:	Mr. Arun Kumar Srivastava
Assistant Administrative Officer	:	Mr. Kamla Prasad Yadav
Assistant Administrative Officer	:	Mr. R.K. Yadav
Assistant Administrative Officer	:	Mr. Ram Das
Assistant Administrative Officer	:	Mr. V.P. Tiwari

I/c, Security Officer : Mr. Sanjay Bhatnagar

Dispensary

In-charge	:	Mr. Ratnesh Kumar
Senior Medical Officer	:	Dr. S.K. Sethi
Technical Officer	:	Mr. D.N. Sinha

In-Charge, Vehicle : Mr. R. K. Yadav

In-Charge, Landscaping : Mr. S.D. Tiwari

In-Charge, Guest House : Mr. Ratnesh Kumar

Manager, Guest House : Mr. Nag Chand

Estate Section

In-Charge	:	Mr. M.H. Ansari
Technical Officers	:	Mr. Vinayak Savant, Mr. Krishna Nand Singh, Mr. Lakhan Lal Verma, Mr. Rajendra Singh, Mr. Umesh Kumar, Mr. Vishva Nath Mehrotra and Mr. G. Prasad

IISR Regional Centre, Motipur (Bihar)

Incharge	:	Dr. A.D. Pathak
Senior Scientist (Agronomy)	:	Dr. V.P. Jaiswal (on leave)
Technical Officer	:	Mr. B.D. Singh

Joining (2013-2014)

Name	Designation	w.e.f.
Sh. Holkar Somnath Kadappa	Scientist (Plant Pathology)	11.04.2013
Dr. Shiv Ram Singh	Senior Scientist (Soil Science)	05.07.2013
Er. Sukhbir Singh	Senior Scientist (FMP)	12.07.2013
Dr. Dinesh Singh (Transferred from DSR, Mau)	Senior Scientist (Plant Pathology)	06.08.2013
Er. Prasoon Verma 12.08.2013	Scientist (SG) (Agril Structural & Process Engg.)	
Dr. Sanjeev Kumar (Transferred from IIVR, Varanasi)	Senior Scientist (Agril Biotech)	13.08.2013
Dr. Anoop Singh Sachan (Transferred From IISR Reg. Centre, Motipur)	T-6	11.12.2013
Sh. Ashish Singh Yadav (Transferred From CARI, Port Blair)	T-3	06.02.2014
Sh. Raj Narain Prasad Bharti (Transferred From Directorate of Weed Science Research, Jabalpur)	T-5	11.10.2013

Promotions (2013-2014)

Technical Staff Name	Promoted to the Grade	w.e.f
Sh. Kalpnath	T-3	26.06.2012
Sh. Keshav Prasad	T-1-3	29.06.2006
Sh. G.K. Gupta	T-9	03.02.2012
Sh. Sant Ram	T-3	08.12.2012
Sh. Dulloo	T-5	01.01.2013
Sh. Ram Murti	T-6	17.11.2012
Dr. Rakesh Kumar Singh	T-6	13.03.2012
Sh. Jasbeer Singh	T-7-8	01.07.2012
Dr. (Mrs.) Veenika Singh (KVK)	T-7-8	29.08.2010
Dr. Deepak Rai (KVK)	T-7-8	0309.2010
Dr. Mani Ram Verma	T-9	01.01.2003
Dr. Om Prakash	T-7-8	16.12.2012
Sh. V.K. Saxena	T-7-8	01.07.2013
Sh. Bijai Bahadur Singh	T-7-8	01.01.2013
Sh. Surendra Singh	T-7-8	10.10.2013

Administrative Staff Name	Promoted to the post	w.e.f
Sh. Raj Kumar Yadav	Assistant admn. Officer	01.05.2013
Sh. Ganesh Singh Negi	Assistant	31.05.2013
Sh. R.V. Dwividi	Assistant	31.05.2013
Sh. V.P. Tiwari	Assistant Admn. Officer	01.11.2013
Grant of MACP to Administrative & Supporting Staff Name	Designation	Granted MACP
Sh. S.K. Bagchi	Assistant	17.09.2012
Ms. Maya Agarwal	Assistant	02.04.2013
Sh. Anand Mohan Srivastava	Assistant	22.09.2012
Smt. Raj Shankar	Assistant	15.11.2013
Sh. Sant Ram	SSS	25.01.2014
Sh. Mahavir	SSS	11.02.2014
Sh. Srikishan	SSS	11.02.2014

Drought contingency plan for sugarcane crop

Water management:

- In case of delayed onset of monsoon or prolonged dry spell during rainy season, it is advised to go for frequent light irrigations in place of heavy irrigation.
- Furrow irrigation with cut off at 85% furrow length should be adopted and flood irrigation need to be discarded to save the water and cover more crop area. Irrigating only alternate furrows would further enhance the irrigation efficiency and water saving.
- Dust mulching by shallow hoeing of inter –row spaces to break the capillaries would effectively prevent the moisture loss from deeper layers of the sugarcane fields.
- Sugarcane planting after wheat harvest, if delayed, till June should be entirely avoided.

Other measures:

- Lower dried leaves of standing sugarcane crop may be stripped and laid in the inter-row spaces as a mulch to conserve moisture and prevent weed growth.
- Earthing up on sugarcane rows should be done especially in autumn planted and autumn initiated ratoon crops to prevent wasteful tillering and also to effectively harvest water from likely rains.
- Spray of ethrel (12 ml in 100 litres of water) should be done on sugarcane leaves during the dry spell to mitigate the adverse effects of moisture stress.
- In order to maintain the crop growth and the resilience against dry weather, foliar spray of urea (2.5%) alone or in combination with MoP (2.5%) should be done.
- Control measures against sugarcane pests like top borer, black bug (ratoon), inter-node borer *etc*. need to be timely adopted.

CoLk 07201

An early maturing, high yielding and good ratooning variety

भारतीय गन्ना अनुसंधान संस्थान

लखनऊ-226 002, उत्तर प्रदेश, भारत

Indian Institute of Sugarcane Research

Lucknow - 226 002, Uttar Pradesh, India

Tel: +91-522-2480735-737; Fax: +91-522-2480738

E-mail: iisrlko@sancharnet.in

www.iisr.nic.in

...ari & Sons
...@gmail.com
...522) 4071816