

IISR

at a Glance



Indian Institute of Sugarcane Research
(Indian Council of Agricultural Research)
Lucknow 226 002

Introduction

Indian Institute of Sugarcane Research is located at 26° 56' N latitude, 80° 52' longitude and 111 metres above mean sea level on Lucknow-Raebareli Road in Lucknow (UP), the largest cane growing state of India. The average minimum and maximum temperatures during summer range between 18.4 and 39.1°C and in winter between 7.4 and 29.08°C. The rainfall which occurs mostly during July, August and September averages 658.3 mm and is 72.2 per cent of the annual rainfall (911.4 mm). The Indian Institute of Sugarcane Research (IISR), Lucknow was established by the erstwhile Indian Central Sugarcane Committee on February 16, 1952 for conducting researches on both fundamental and applied aspects of sugarcane culture as well as to co-ordinate the work done on this crop in different states of India. On April 1, 1969, it was transferred to the Indian Council of Agricultural Research (ICAR), New Delhi. Since its inception, the Institute has been working towards the upliftment of cane agriculture in India, in terms of quality, productivity, management practices and various policy issues.

Vision

To develop 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

- To conduct basic and applied research on all aspects of production and protection techniques of sugarcane and sugar crops.
- To work on breeding of varieties for sub-tropical region in close collaboration with Sugarcane Breeding Institute, Coimbatore.
- To develop linkages with State Agricultural Universities, Research Centres and other organizations for collaborative research, exchange of information and material.
- To provide training, consultancy and advisory services to farmers, industries and other users at regional, national and international levels.

Infrastructure

The Institute has five full-fledged Divisions, *viz.*, the Divisions of Crop Production, Crop Improvement, Crop Protection, Plant Physiology & Biochemistry, and Agricultural Engineering and three supporting sections and various laboratories. The Institute also houses the Coordination Cell of AICRP on Sugarcane and a *Krishi Vigyan Kendra* to coordinate dissemination of technologies to farmers. Other facilities include Glass houses, Net houses and Poly houses, Agrometeorology, ARIS cell, Dispensary, Guest house, Community hall, Auditorium and two Conference rooms. The library houses exhaustive literature on sugarcane besides CAB abstracting on CD ROM. The Institute has a well-developed farm (132 ha under cultivation). IISR has a regional centre with 20 ha of land at Motipur (Bihar), which is involved in breeder seed production and screening of sugarcane germplasm for red rot and waterlogging tolerance. In addition, the Institute has a divisional centre on Bio-Control at Pravaranagar (Maharashtra).



Technologies developed at IISR, Lucknow

CoLk 94184, an early maturing sugarcane variety

The Institute has developed a high sugar yielding cane variety, CoLk 94184 (Birendra) which has been released for commercial cultivation in the North Central Zone of the country (Eastern U.P. and Bihar). CoLk 94184 is a rare combination of two desirable attributes *i.e.*, early maturity and good ratooning ability. This variety will help in addressing the problem of low sugar and poor ratooning ability of the existing sugarcane varieties in the region. CoLk 94184 variety can withstand both moisture stress and waterlogging, hence it is capable of providing a boost to sugar recovery and cane production in U.P. and Bihar. On an average, farmers can harvest 76 tonnes of cane per hectare.

Spaced transplanting technique (STP)

A spaced transplanting (STP) technique has been developed for synchronisation of tillering and quick seed multiplication of sugarcane. It increases seed multiplication ratio from 1:10 to 1:40. It has become popular even in the neighbouring countries. It has contributed in fast spreading of newly evolved varieties at several places.

Technology for healthy seed cane production

Three-tier seed programme has been developed for the production of healthy seed cane for its regular supply to the farmers for commercial cultivation. This programme is mainly based on heat therapy because of its effectiveness in controlling seed-borne infections. It also encompasses various prophylactic measures to control insect pests and techniques for the production of healthy seed cane. Each tier of the programme (Breeder seed cane, Foundation seed cane, and the Commercial seed cane) is completed in one year and after third year, the Commercial seed cane is made available to the farmers. According to this seed programme, if starting is made with 1 hectare of Breeder seed cane, the Commercial seed cane produced at the end of multiplication stage (third year) would be sufficient to plant 1000 hectares by conventional method. Three-tier seed programme is being carried out at several sugar factories and research stations. A large number of workers have been trained for the purpose at various research stations and training centres. This programme provides disease-free healthy seed to growers. It has become popular all over the country. Moist-hot-air equipment, designed and developed at this Institute have been installed in a number of sugar factories. It has proved its usefulness in sustaining sugarcane production.

Technology package for intercropping in sugarcane

Sugarcane + Potato

- **Seed rate:** Sugarcane- 60 q/ha, Potato-25 q/ha
- 1:2 row ratio, sugarcane planted at 90 cm and two rows of potato are accommodated at 30 cm spacing
- Weed control through Simazine @ 1 kg a.i./ha as pre-emergence followed by hoeing and earthing up at 30 and 50 DAP, respectively
- Apply N:P:K fertilizers for Sugarcane @ 150:60:60, for Potato @ 120:80:100.
- **System yields:** Potato-272 q/ha and Sugarcane-90.6 t/ha with a profit margin of ₹ 1,06,736 /ha
- Benefit cost ratio : 1.63



Sugarcane + Rajmash

- **Seed rate:** Sugarcane- 60 q/ha, Rajmash- 80 kg/ha
- 1:2 row ratio, sugarcane planted at 90 cm accommodating two rows of rajmash at 30 cm spacing
- Apply N:P:K fertilizers for Sugarcane @ 150:60:60, for Rajmash @ 80:40:30.
- Control weeds through Pendimethalin as pre-emergence @ 2 kg a.i./ha followed by 2 to 3 hoeing after harvest of rajmash
- **System yields :** Sugarcane-86.8 t/ha, Rajmash grain-17.5 q/ha with a profit margin of ₹ 89,884/ha
- Benefit cost ratio : 1.69



Sugarcane + Mustard

- **Seed rate:** Sugarcane: 60 q/ha, Mustard: 5 kg/ha
- 1:2 row ratio, sugarcane planted at 90 cm and two rows of mustard accommodated at 30 cm spacing
- Apply N:P:K fertilizers for Sugarcane @ 150:60:60, for Mustard @ 30:20:0.
- Control weeds through Pendimethalin @ 2 kg a.i./ha as pre-emergence followed by two hoeing at 30 and 60 days after harvest of mustard
- **System yield:** Sugarcane-75.2 t/ha, Mustard-14.4 q/ha with a profit margin of ₹ 55,474/ha
- Benefit cost ratio : 1.40



Sugarcane + Wheat

- **Seed rate:** Sugarcane: 60 q/ha, Wheat: 75 kg/ha
- 1:3 row ratio, sugarcane planted at 90 cm and three rows of wheat accommodated at 20 cm spacing through IISR Planter cum Seeder under FIRB system
- Apply N:P:K fertilizers for Sugarcane @ 150:60:60, for Wheat @ 90:45:45.
- Control weeds through Pendimethalin @ 2 kg a.i./ha as pre-emergence followed by two hoeing at 30 and 60 days after harvest of wheat
- **System yield:** Sugarcane-74.5 t/ha, Wheat-39.4 q/ha with a profit margin of ₹ 56329/ha.
- Benefit cost ratio : 1.24



Technology package for modified planting methods in sugarcane

Ring-Pit method

- Mother shoot technology or no tiller technology
- Specifications:
 - ❖ Pit diameter : 75 cm
 - ❖ Depth : 30 cm
 - ❖ Centre to centre distance : 105 cm
 - ❖ No. of pits/ha : 9000
- Suitable for drought prone areas, undulating topography, light textured soils, saline - sodic soils, multiple ratooning and high yielding, tall and thick cane varieties
- Sugarcane yield : 125 t/ha
- Benefit cost ratio : 1.83



Trench method

- Trench specifications : 30 cm wide and deep
- Centre to centre distance : 120 cm (30:90 cm)
- Mechanized operation
- Less labour requirement
- Enhanced water use efficiency
- Sugarcane yield : 110 t/ha
- Benefit cost ratio : 2.15



FIRB method of planting

- Appropriate FIRB configuration (50-30-50 cm)
- Sowing of wheat on ridges (2-3 lines) in November
- Manual planting of sugarcane in irrigation ditches in Feb. - March
- Raising sugarcane through spaced transplanting technique and poly bag system.
- Enhances 30% yield of sugarcane as compared to sequential with full yield of wheat
- Benefit cost ratio : 1.24



Technology package for sugarcane ratoon management

- At initiation dismantling of ridges, stubble shaving and off-barring is recommended for good ratoon yield.
- Gap filling with slip setts/pre-germinated setts/polybag raised settlings is a must, if gaps exceed 15% of normal crop stand. More than 45 cm distance between subsequent clumps is taken as gap.
- Paired row system of planting (120:30) reduces gaps and optimizes plant population in subsequent ratoon. Thus, it produces higher yields compared to sole planting at 90 cm.
- Trash mulching (10 cm thick) in alternate rows for conserving soil moisture, minimizing weed infestation and maintaining soil organic carbon.
- Application of potassium (80 kg K_2O /ha) with irrigation water in standing plant cane one month prior to harvesting improves bud sprouting, number of millable canes and yield of succeeding ratoon crop.



Skip furrow method of irrigation-a water saving sugarcane production technology

After germination of sugarcane (35-40 days after planting), 45 cm wide and 15 cm deep furrows are made in alternate rows. It saves irrigation water by 36.5% and improves water use efficiency by 64%.



Weed management

An effective integrated method of weed management involving cultural and chemical methods has been evolved. It comprises of one hoeing after first irrigation and application of Atrazine @ 2.0 kg ai/ha after second irrigation. It is effective in checking weed growth (WCE 97-100%) and increases cane yield and saves 50% cost as compared to manual hoeing. Metribuzin 1.0 kg ai/ha, or Ametryn 2.0 kg ai/ha or Atrazine 2.0 kg ai/ha as pre-emergence application followed by 2,4-D @ 1.0 kg ai/ha at 60 days after planting (DAP) and one hoeing at 90 DAP has been recommended for effective and economic weed management in sugarcane.

Management of diseases

- Treatment of cane in Moist Hot Air (MHAT) at 54°C and 95-99% RH for 2½ hours eradicates sett-borne infections of ratoon stunting disease (RSD), grassy shoot disease (GSD) and smut (99-100%). It also reduces the sett-borne infections of leaf scald and red rot up to 80%.
- Removal and destruction of infected plants on the first appearance of the disease in case of red rot, smut, GSD and leaf scald.
- Treatment of setts with fungicides like Bavistin, Vitavax, Dithane M-45 etc., at the time of planting protects the setts from surface-borne propagules and superficial infections and rotting.
- Management of seedling diseases (fluff raised) in the nursery bed was achieved through pre-sowing application of formaldehyde and seed treatment with Thiram and post sowing application of Ridomil, Bavistin, and the pre-sowing application of *Trichoderma*.

Red rot

- A methodology for identification of *Colletotrichum falcatum* pathotypes, based on infection potential in 13 sugarcane differentials, was developed and so far, 11 pathotypes have been identified.
- Developed techniques of inoculation, like IISR nodal, Parafilm method, etc., for evaluation of sugarcane germplasm and progenies.
- Potent antagonistic strains of *Trichoderma harzianum*, *T. viride* and *Gluconacetobacter diazotrophicus* were identified against *C. falcatum*. Field application of *T. harzianum* protects red rot infection to the tune of 50%.



- Developed an integrated red rot management schedule using healthy seed cane and application of *Trichoderma* enriched pressmud.
- Frequent breakdown of varietal resistance against red rot is due to the appearance of new pathotypes matching the resistance of cane genotypes.
- Disease appearance in May-June (pre-monsoon), as spindle infection acts as the major source of secondary inoculum and in favourable weather helps in rapid spread of the disease.

Smut

- Developed a staining technique to detect latent infection of smut in nodal and apical buds.
- Developed an integrated management module using MHAT, trash burning, stubble shaving and roughing of affected clumps.

Wilt

- *Acremonium implicatum* and *A. furcatum* were identified as causal agents of wilt disease of sugarcane.

RSD

- Ratoon stunting disease was identified as the key disease in variatal deterioration/decline.
- Management schedule using heat therapy was developed and perfected.

Mosaic

- Three strains viz., A, B and F of SCMV (Sugarcane mosaic virus) are present in subtropical India and strain B is the most prevalent.

GSD

- *Deltocephalus vulgaris* was identified as the leaf hopper vector of GSD (Grassy shoot disease) phytoplasma.

Management of insect-pests

- Developed an integrated IPM schedule for borer complexes in sugarcane.
- Promoted bio-control of *Pyrilla*, woolly aphid, scale insect and borer complexes in large scale in different states through introduction, inundative release and conservation of parasitoids and predators.

Pyrilla

- The field technology for bio-control of *Pyrilla* through conservation and redistribution of *Epiricania melanoleuca* @ 4000-5000 cocoons/ha was developed.

Woolly aphid

- Release of *Dipha aphidivora* @ 1000 larvae/ha or *Micromus igorotus* @ 2000 larvae / ha at 15 days interval from August to October.

Stalk and Internode borer

- Release of *Trichogramma chilonis* @ 50,000 adults/ha at 10 days interval from July to October and *Cotesia flavipes*, @ 500 gravid females /ha/week from July to November.

Top borer and white grub

- Soil application of Furdan 3G @ 33 kg/ha (carbofuran 1 kg a.i./ha) or Thimet 10 G @ 30 kg/ha (thimet 1 kg a.i./ha) around the clump base during 2nd-3rd week of June along with trapping of top borer moths using pheromone trap. Availability of sufficient moisture has to be ensured before the insecticide application for uptake of insecticide from soil.
- Developed a light + pheromone trap to catch adult white grub beetles.

Termite, early shoot borer and root borer

- Application of chlorpyrifos 20 EC @ 5 litres/ha in 1600-1800 litres water (3 ml/litre) over cane setts in furrows at planting for checking the infestation of termite, white grub, shoot borer and root borer.
- Collection and destruction of infested shoots at periodic intervals from March to May on campaign basis.

Rodents

- Integrated rodent management programme for sugarcane based cropping system was evolved.
- Seasonal activity of rodent was worked out and rodent control with zinc phosphide (2%) baiting followed by bromadiolone baiting was validated on large area.



Mechanization of cane agriculture

The Institute has strong presence in the mechanization of the cane planting operations. Several labour saving devices have been designed and developed for planting, interculture/earthing-up, and ratoon management.

Ridger-type sugarcane cutter-planter

Ridger type sugarcane cutter-planter, PTO driven, performs major operations involved in cane planting at a spacing of 75/90 cm. It has effective capacity of planting one ha in 4-5 hours and saves approximately 60% cost of planting operation.

Three-row multipurpose sugarcane cutter-planter

Three-row multipurpose sugarcane cutter-planter, ground wheel driven, performs all operations involved in cane planting at a spacing of 75 cm. It has effective capacity of planting of one ha in 3.5 to 4 hours, and saves approximately 70% cost of planting operation.

Paired row sugarcane cutter-planter

Paired row sugarcane cutter-planter, PTO driven, was developed for planting of sugarcane under paired row geometry (30 cm spacing). The subsequent spacing between the paired rows could be varied. It has effective capacity of planting of one ha in 4-5 hours, and saves approx. 60% cost of planting operation.

Raised bed seeder

Raised bed seeder was developed for making three raised beds (2 full beds + 2 half beds) for sowing of wheat simultaneously at a spacing of 17 cm, and three furrows at a spacing of 75 cm- for planting of sugarcane as and when required. It has an effective capacity of 0.35-0.40 ha/h.

Raised bed seeder-cum-sugarcane cutter-planter

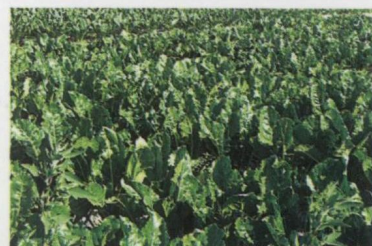
Raised bed seeder-cum-sugarcane cutter-planter was developed to plant two rows of sugarcane in furrows and drill two rows of wheat as companion crop on the main raised beds and one each on the either side of half raised beds. It has effective capacity of 0.20-0.25 ha/h and saves approximately 60% of the cost of operation.

Ratoon Management Device

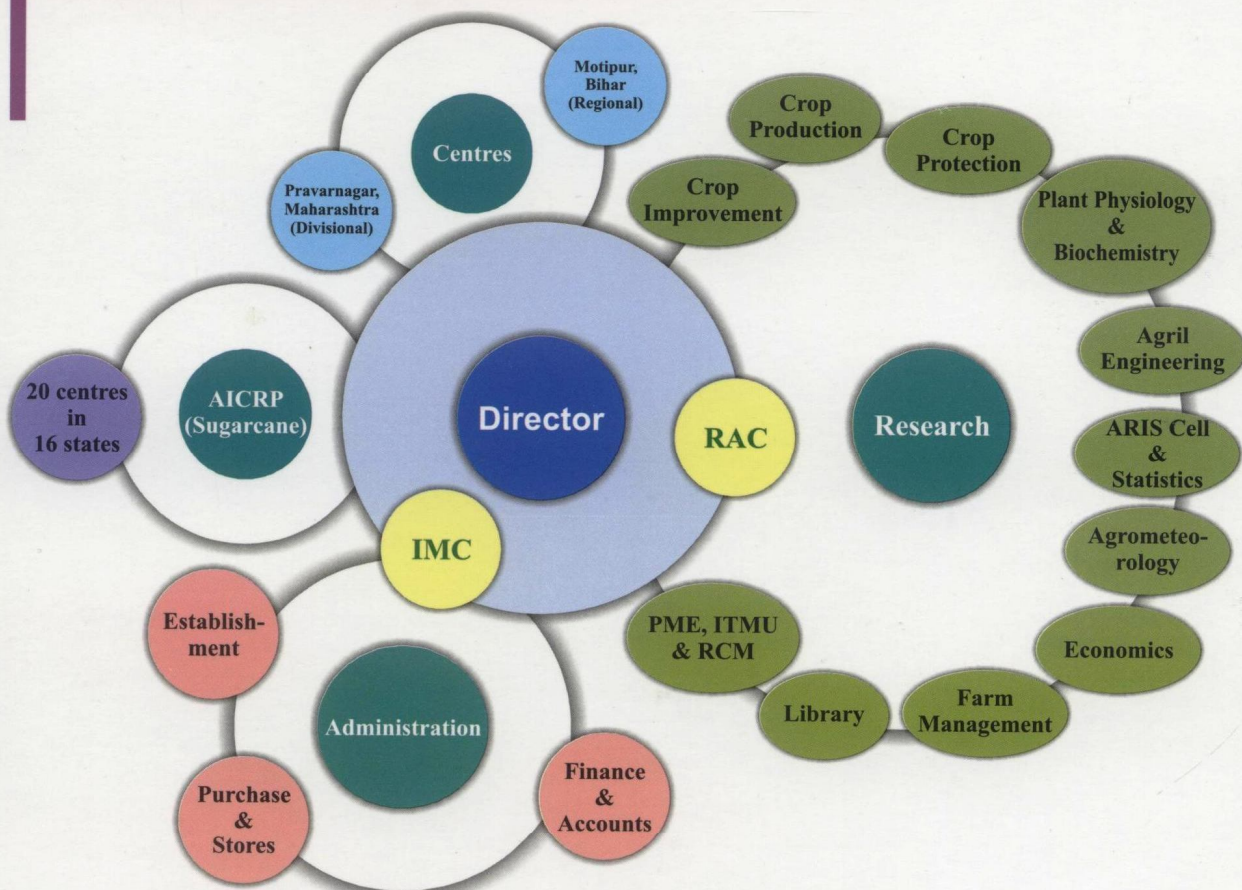
Ratoon management device (RMD) executes all the operations involved in management of ratoon crop such as stubble shaving, deep tilling, off-barring, placing manure, fertilizer/bio-agents, chemicals in liquid form and earthing up operations in a single pass of operation. It has capacity of 0.35-0.40 ha/h and saves 60% of the cost of operation.

Agro-techniques for sugarbeet cultivation

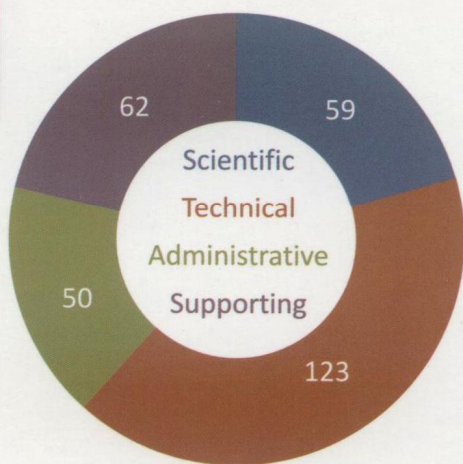
- Agro-techniques for sugarbeet under tropical and subtropical growing conditions were developed. A complete cultivation package encompassing agronomic, entomological and pathological practices was developed.
- Developed popular sugarbeet varieties, viz., IISR Comp.-1 and LS-6.
- Sugarbeet seed production technique has been developed and standardized.
- Pelleting of seeds of sugarbeet with fungicide + bentonite clay was standardized for management of seedling diseases.
- *T. harzianum* in early stages and fungicides in later stage (high temperature) controlled *Sclerotium* root rot of sugarbeet.
- Implements for sugarbeet sowing were designed.



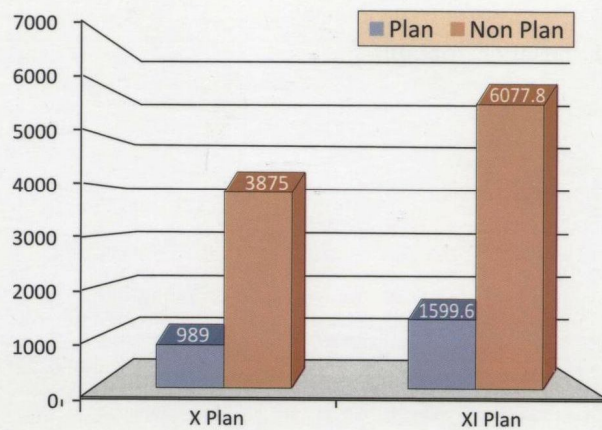
Organizational Structure



Manpower and Budget



Personnel



Financial outlay (Rs. in lacs)

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