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Improved technological interventions

for autumn sugarcane planting

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Sugarcane (Saccharum *spp. hybrid) is one of the most important industrial crops for sugar production grown under both tropical and subtropical conditions. It is cultivated in an area of 5.3 m ha with an average productivity of 70.8 tonne/ha in country while the corresponding figures for Punjab is 96.0 thousand and 70.0 tonne/ha, respectively planted in both as autumn and spring season crop. However, the spring crop occupies major area, which is generally planted after harvesting of potato, green pea,* rabi *fodder and oilseed crops (from mid-February to end of March). This crop remains in the field for 2 to 3 years, as a plant and ratoon, therefore, the selection of ideal variety with suitable maturity group and improved agronomic practices need to be ensured for realization of potential yield of this crop especially for autumn planting. It is essential for raising healthy cane seed production as well as initiation of early crushing season for sugar industry with good recovery.*

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TO harness better returns from autumn sugarcane crop, it is essential to grow intercrops that may increase the per unit area income of the sugarcane farmers.

Improved varieties of sugarcane

In sugarcane crop, varieties play a major role in the cane yield and sugar recovery. Selection of an ideal variety of sugarcane to be planted in a particular agro-ecological zone is primary requisite to explore its sugar yield potential and augmenting sugarcane productivity. Sugarcane varieties divided in two different maturity groups early-and mid-late maturing, to meet the requirement of both the farmers and industries, it is always better to have more number of varieties with different maturity period so that proper and effective varietal scheduling can be practised to provide quality cane to the factories throughout the crushing period. Especially for autumn sugarcane planting early maturing varieties are recommended for good returns and recovery. Early maturing varieties of sugarcane are those which mature in 8 to 10 months and give 16 to 17 % sucrose in juice with 85 % purity. Some early maturing varieties of sugarcane and their salient features recommended for Punjab are given in Table 1 that are preferred by farmers in state as they mature between 8 and 10 months, vacate fields early give option for growing other winter crops and also get edge of higher rates.

Ideal seed rate for enhanced germination

Utmost care should be taken for the selection of cane seed material. It should be free from important diseases like red rot, wilt, smut,

Table 1. Improved maturing varieties of sugarcane and their salient features recommended in Punjab

Varieties of sugarcane	Average cane yield (tonne/ha)	Sucrose content (%)	Salient features
'CoPb 92'	83.75	16.2 to 17.4 (Nov.-Dec.)	Medium thick long canes, Moderately resistant to Red rot and less susceptible to borer complex, good ratooner
'Co 118'	80.50	16.2 to 17.2 (Nov.-Dec.)	Thick purple cane, tolerant to lodging, shy tillering, Moderately resistant to Red rot and less susceptible to borer complex, average ratooner
'CoJ 85'	76.25	16.0 to 17.5 (Nov.-Dec.)	Shy tillering, thick green canes, tolerant to prevalent pathotypes of red rot disease and low temperature stress, average ratooner prone to lodging.
'CoJ 64'	75.00	16.1 to 17.5 (Nov.-Dec.)	Good germinator, with profuse tillering, medium thick, greenish yellow canes susceptible to red-rot, quality of gur is excellent.

ratoon- stunting disease, grassy shoot disease and pest like root borer, shoot borer and stalk borer etc. Generally immature canes are conceded as good seed material which primate better germination. However, one-third portion cane from top should be used as seed cane. The recommended seed rates are: twenty thousand three budded or 15 thousand four budded setts or 12 thousand 5 budded or 30 to 35 q good quality canes are sufficient for planting 1 acre (0.404 ha). All the buds of seed cane should be undamaged and healthy which helps to improve germination of this crop. Generally 12 healthy and undamaged buds are recommended for running 1 m. Two or three budded setts of sugarcane, under conventional method of planting, were found to give higher germination.

Pre-planting techniques

Sub-soiling: Intense mechanization involving use of heavy machinery in present day agriculture and soil preparation activities cause deterioration of soil physical conditions and make hard crust in sub-soils up to the depth of 75 to 100 cm that cause poor water and nutrition uptake by plant ultimately affect the plant growth and yield. Sub-soiling in sugarcane is required and is necessary. It is a process of deep tilling of the ground mainly practised to uncompact the soil. It also improves aeration of the soil and dispersion of nutrients. Tilling deeper would incorporate the sub-soil with the top soil. In sugarcane crop, cross sub-soiling at 1.0 m spacing should be done once in 3 to 4 years before preparing the field. Deep tillage provides enough space for root development which ultimately led better plant nutrient uptake and crop stand. This will help in breaking the hard pan, increasing water infiltration rate and better penetration of sugarcane roots which results in higher cane yield.

Seed treatment: Smut and red rot diseases are soil and seed borne. Therefore, the seed should be treated before planting. Dipping the cane setts in 0.25% Emison 6 or Bagalol 6 or 25% solution of Tilt 25 EC reduces incidence of diseases and improves germination. Seed priming improves the seed germination by alleviating the detrimental effects of various stresses. Water soaking for 24 hr prior to planting improves germination.

Planting time and techniques: In northern India, sugarcane is planted twice a year in October (autumn) and February-March (spring). Sugarcane requires about 25° to 32°C for good germination. This temperature requirement is met twice in north Indian conditions i.e. in October and also in February-March. Autumn planting of sugarcane is done in October. For good yield, planting should be completed up to 20 October. Delay in planting may cause reduction in yield as germination of sugarcane is reduced due to low temperature.

Different planting techniques/ methods: In sugarcane crop following methods are used:

Flat sowing: Plant the crop in rows 75 cm apart followed by planking. Besides saving irrigation water following the new planting techniques as detailed below gives higher yield.

Paired row trench planting: It is an improved method of planting where the seed is planted in paired rows in trenches 30 cm broad and 20 to 25 deep. The cane setts are placed at the bottom of trenches covered with soil left between the two rows and distance between two trenches should be 90 cm. Planting with this technique saves irrigation water, eases propping up operation, prevents lodging and gives comparatively higher cane yield.

Furrow irrigated raised bed: This is the latest improvement in planting of sugarcane crop especially for farmers who plant sugarcane after wheat harvest. In this method, sugarcane is planted in standing wheat crop sown with furrow irrigated raised bed planter. Apply irrigation to wheat crop after reshaping of beds, one day prior to sowing of sugarcane crop in February. Three budded cane setts are then planted manually by pressing into the wet soil by foot from second fortnight of February to March.

Intercropping in autumn sugarcane

Sugarcane is a long duration crop and remains in field for 12-16 months. For higher return from per unit area, adopt intercropping in autumn sugarcane with other short duration crops like potato, tomato, chillies, onion, garlic, carrot, turnip, cabbage, knol-kohl, lettuce, coriander, peas, lady's finger, linseed, fennel, *sarson*, *raya*, sunflower, lentil and wheat.

The intercrop should not be taken as a major crop. It is grown just to have some additional income. Planting of intercropping should be done in inter-row spaces and plant to row spaces should be critically maintained to avoid undue competition. The inter-row space (90 cm to 120 cm) should be adopted for intercropping (Table 2).

Fertilizer

Nitrogen (N) similar to spring crop should be applied in the form of

Table 2. Intercrops recommended for autumn sugarcane planting.

Intercrop	Variety	Sowing/ Planting time	Seed rate (kg/acre)	No. of rows between two cane rows	Spacing between rows of intercrop	Harvesting time	Remarks
Potato	'Chandermukhi' or any other short duration variety	20 Sep.-15 Oct.	800	1	–	End of Dec.	Wheat and onion intercrops can also be taken after harvesting potato crop in end Dec.
Wheat	Recommended varieties	Last week of Oct.-15 Nov.	16	2	20 cm	Mid-Apr.	—
Raya (*Brassica juncea*)	Recommended varieties	Whole of Oct.	1	2	30 cm	Mid-Mar.	Sow *raya* either with planting of sugarcane in Oct or after giving first irrigation.
Gobhi sarson (*B. napus*)	'GSL-1' or 'GSL-2'	10 Oct.-31 Oct.	1	1	–	First fortnight of Apr.	—
Toria (*B. campestris var. toria*)	Recommended varieties	20 to 30 Sep.	1	2	30 cm	End Dec.	Wheat can also be sown after *Toria* is harvested.
Winter Maize	'Partap 1'	25 Oct. - 10 Nov.	7	1	–	May	Sow maize after irrigation or in third week of Oct.
Cabbage	Recommended varieties	Last week of Oct. to Nov.	—	1	—	Jan. and Feb.	Transplant 4 to 5 weeks old seedlings from end Oct. to November
Radish	Recommended varieties	Oct.	04-May	2	30cm	Jan.	—
Peas	Recommended varieties	Oct.	22	2	30 cm	—	—
Gram	Recommended varieties	25 Oct.-10 Nov.	12	2	30 cm	Apr.	—
Garlic	Recommended varieties	4th week of Sep to first week of Oct.	112 .	3	15cm	Apr.	For paired row trench planted sugarcane, use 85 to 95 kg garlic seed

urea (195 kg) in three equal splits. one-third dose of N should be applied at planting time, one-third at the end of March and remaining by the end of April. Phosphatic fertilizers are to be applied on soil-test basis. The fertilizers recommended for intercropping vary according to intercrop rotations.

Weed management

Weed management is extremely beneficial as uncontrolled growth of weeds can cause 15 to 75 % cane yield loss depending upon the weed species. Weeds can effectively be controlled with two or three hoeing with triphali or tractor drawn tillers. Alternatively, weeds can also be controlled economically and effectively with recommended herbicide formulations applied as pre-emergence and post-emergence in sole and intercrops (Table 3).

Sencor 70 WP and Karmax/Klass 80 WP formulations can effectively control the hardy weed, if *Bans patta (Bracharia reptans)* infests the field. However, when the crop in infested with *Dila* (*Cyprus rotundus*) or *Ipomoea* spp. application of 2, 4-D (Sodium salt 80%) @ 800 g or 2, 4-D (Amine salt 58%) in 200 liters of water are effective when the weeds are at 3 to 5 leaf stage .

Irrigation and fertigation

The crop should be irrigated at 10 to 12 days interval between December and January to safe the crop from cold injury due to low temperature and between April and June to avoid prevailing hot and dry conditions. Subsequently, the intervals and frequency can be adjusted according to rainfall during *kharif*. However, in severe and extended frosty nights light irrigations should be given to save the crop.

Drip irrigation along with fertigation in sugarcane is a relatively emerging technology that can conserve water, energy and increase profits. It may help in solving three most important problems of irrigated sugarcane-water scarcity, rising pumping (energy) costs and depressed farm profits. Sugarcane being a giant crop producing huge quantity of biomass generally demands higher amounts of water and nutrients. For producing higher cane and sugar yields on a sustainable basis, application of adequate amounts of fertilizer nutrients viz., N, P and K is essential. Further, there is a need to improve fertilizer use efficiency which can be dealt with 'Fertigation', where both water and fertilizers are delivered to crop simultaneously through a drip irrigation system. Fertigation ensures that essential nutrients are supplied precisely at the area of most intensive root activity according to the specific requirements of sugarcane crop and type of soil resulting in higher cane yields and sugar recovery. The drip irrigation adoption in sugarcane increases water use efficiency (60 to 200%), saves water (20 to 60%) , reduces fertilization requirement (20 to 33%) through fertigation, produces better quality crop and increases yield (7 to 25%) as compared with conventional irrigation.

Insect-pest management

Pests and diseases affect cane yield by reducing tiller count and inhibit cane growth. Because of the long

Table 3. Pre-and post-emergence herbicides recommended for sole and inter-cropped sugarcane.

S. No.	Herbicides	Dose/acre (0.404 ha)	Amount of water (liters.)	Time of application
Pre-emergence				
a. Sugarcane as a solo crop				
1	Stomp 30 EC	400 ml	200	Within two-three days after sowing.
2	Sencor 70 WP (metribuzin)	800 g	200	(do)
3	Atrataf 50 WP (atrazine)	600 g	200	(do)
b. intercropping in sugarcane				
1	Atrataf 50 WP (atrazine)	600 g	200	Within 2-3 days after sowing of winter maize as intercrop.
2	Axial 5 EC (pinoxaden)	400 ml	150	At 30-40 days after sowing of wheat as intercrop.
3	Leader/SF-10/Safal/Marksulfo WG	13 g	150	(do)
4	Stomp 30 EC	400 ml	200	Within two-three days after sowing
Post-emergence				
a. Sugarcane as a solo crop				
1	2, 4-D Sodium salt 80 WP	800 g	200	At 3 to 5 leaf stage
2	2, 4-D amine salt 58 WP	800 g	200	(do)
b. intercropping in sugarcane				
1	Isoproturon 75 WP	500 g	150	At 30-40 days sowing of wheat as intercrop.
2	Algrip/Algrip Royal/Markgrip 20 WP	10 g	150	At 30-40 days sowing of wheat as intercrop for broadleaf weeds.

growth duration that sugarcane crop needs, it is extremely vulnerable to insect and pests, some estimates suggest that 20.0 % is the actual decline in production is due to insect and pests. Borers and sucking pests are the major aerial pests whereas termites and white grubs constitute the sub-terranean pests. Among the aerial pests, shoot borer is a key pest throughout the country; internode borer generally prevalent in southern states; stalk borer and top borer in Punjab, Haryana, Uttar Pradesh and Bihar; root borer, though a pest of the subtropics, invaded some areas of tropical India a decade ago but subsequently became negligible; scale insect in Andhra Pradesh, Gujarat and Maharashtra; pyrilla in sub-tropical sugarcane belt; the introduced woolly aphid briefly attained major pest status in tropical India in recent times. Insecticides prevent the rapid buildup of pest populations and reduce economic injury levels. Despite the minimal usage, there is a need to select appropriate insecticide and formulation, and adopt correct method and time of application for different seasons and situations. Different chemical recommendations are advised for the integrated management of prevalent insects:

- The 350 ml Chlorpyriphos in 400 litres of water per acre (0.404 ha) for the control of black bug.
- Ten kg Regent 0.3 G (fipronil) per acre (0.404 ha) mixing in 20 kg moist sand/soil before the setts are covered with soil by planking for the control of termite and early shoot borer.
- The 150 ml Coragen 18.5 SC or 45 ml Imidagold 17.8 SL or 2 litre of chloropyriphos in 400 litres water/ acre (0.404) about 40 days of planting for the control of early shoot borer.
- Ten kg ferterra 0.4 GR or 12 kg Furadan 3G at the base shoots in the last week of june or in the first week of July for the top borer control.

Management of rodents: Sugarcane being a long duration crop (2-3 years as plant and ratoon) provides shelter to rats that cause severe damage to crop. To prevent this damage, poison baiting should be done twice, first in July (after transplanting of paddy) and second in October-November (after harvesting of paddy) with zinc phosphide (2%) or Bromodialone (0.005%) followed by another baiting after 15 days with Bromadiolone.

Preparation of poison (Zinc phosphide 2%) bait: Pearl millet/Sorghum or cracked wheat grains (1 kg) smear it with 20 g of groundnut or sunflower oil, and then add 20 g of powered sugar and mix thoroughly with 25 g zinc phosphide powder.

Bromadiolone (0.005%): One kilogram of any cereal flour is mixed with 20 g of sunflower or groundnut oil. Then add 20 g of powered sugar and then mix 20 g of 0.25% Bromadiolone powder.

SUMMARY

To harness higher productivity and better sugar recovery the technological interventions elucidated above and some general considerations given below be advocated to growers and millers. Avoid excessive irrigation and late application of nitrogen (N) fertilizers, when the crop is near maturity. Last application of fertilizer should be completed by June/July. Prevent the lodging of crop by timely propping and earthing up. Protect the crop from frost by light irrigation application during frost period. Harvest the crop at proper maturity stage. Ratoon crop should be harvested first as it matures earlier than plant crop. Cane should be supplied to mills immediately after harvesting by using stipulated quantity of binding material, preferably paddy straw. The afore mentioned agro-techniques led to precision sugarcane farming and help the growers to get higher productivity and returns per unit area under autumn planting of sugarcane crop.

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