

SUGARCANE

Botanical Name : *Saccharum officinarum*

Family : Gramineae

Origin : New Guinea

Economic Importance:

1. Sugarcane (*Saccharum officinarum* L.) is the main sources of sugar in India and holds a prominent position as a cash crop.
2. Sugarcane juice is used for making white sugar, brown Sugar (Khandsari) and jaggary.
3. The main byproducts of the sugarcane industry are bagasse, molasses and press mud.
4. Bagasse is mainly use as a fuel for boiler, it also used for the production of compressed fiber boards, paper and boards.
5. Molasses is used in distilleries for the manufacturing of ethyl alcohol, butyl alcohol, citric acid; it also used as additive feed for animals.
6. Press-mud is used as manure in alkaline and saline soils to improve the soil status.
7. Green tops of cane are a good source of fodder for cattle.
8. Sugar industry in India is next in importance after the textile industry and providing employment to a larger number of people, in addition to earning considerable foreign exchange.

Geographical Distribution:

India, Brazil, Cuba, Mexico, Pakistan, China, Philippines and Thailand are the important sugarcane producing countries in the world. . India is the world's largest consumer and the second largest producer of sugar, topped only by Brazil. Nearly 2.8 lakh farmers have been cultivating sugarcane in the vast area of 4.4 lakh acres. Tropical countries like Colombia, Australia, and Egypt have higher productivity around 100 tonns per hectare.

Important sugarcane growing states are Uttar Pradesh, Maharashtra, Bihar, Punjab, Haryana, and Andhra Pradesh. Uttar Pradesh occupies the rank first in respect to area and production of sugarcane while Tamil Nadu occupied rank first in productivity and Maharashtra in in Sugar production. Sothern states produces higher yield per unit area as compared to northern because of favorable climatic condition.

Classification:

- *Saccharum officinarum*: (Nobale cane) Thick and juicy cane contains higher percentage of sugar, Low fiber and high tonnage.
- *Sacharum barberi*: (Indian cane) long and thin stalk and produce low yield.
- *Saccharum sinensis*: Short and thin stalk produce low yield.

Ecology:

Climatic requirements:

Sugarcane is a tropical crop but can be grown in subtropical region. Continuous growth occurs in warm humid condition. Optimum temperature requirement is 26 to 32°C, but does not germinate under low temperature below 7°C. Low temperature reduces tillering while high arrest the growth of crop and increases attack of borers. The crop does best in the tropical

regions receiving a rainfall of 750 to 1200mm. For ripening, it needs a cool, dry season; but where rainfall is too heavy and prolonged, the quality of the juice tends to be low, and where the weather remains comparatively.

Soil requirement:

Sugarcane can be grown on wide range of soils ranging from sandy loam to clay loam. But it thrives best on well drained loamy to medium heavy soils, but can also be raised on lighter soils and heavy clays, provided there is adequate irrigation available in the former type of soils and drainage is good in the latter type of soils. pH requirement should be 5.5 to 8.0, highly saline alkaline and acidic soils are not suitable for cultivation.

Field Preparation:

As sugarcane crop stands in field for more than a year, it is necessary to give deep ploughing by mould board plough drawn by tractor. The proper time for ploughing is immediately after the preceding crop is harvested or just after a good shower of rain received. The land is then exposed to atmosphere for a month. The harrowing is done 3 to 4 times to break clods and to make the land smooth and even to facilitate uniform irrigation. Four to Six ploughing to produce good tilth is recommended. Each ploughing should be followed by planking.

Cross Sub Soiling: Cross Sub Soiling is an advanced method of field preparation for sugarcane cultivation. The cross sub soiling at 1.0 m spacing should be done once in three to four years before preparing the field. This is done by tractor drawn sub-soiler to the depth of 45-50 cm. Do planking to break the clods and then prepare seed bed. This will help in breaking the hard pan, help in increasing water infiltration rate and better penetration of sugarcane roots. It is recommended for enhancing plant as well as ratoon cane yields.

Seed and Sowing:

1. Planting Time:

- **Suru or Seasonal (12 months):** 15 Dec to 15 Feb.
- **Pre-seasonal (15 Months):** 15 Oct to 15 Nov.
- **Adsali (18 Months):** 1 July to 15 Aug.

2. Selection of seed:

- The seed material of 10 to 11 months age from well-manured nursed seed nursery should be selected.
- The seed material should be thick, succulent, juicy and healthy. The eye buds should be green, well developed, thick prominent but not over mature.
- Seed material should be free from pest and diseases.
- Top 1/3 to 2/3 portion of cane should be used a seed material and it should be planted within 24 hours after harvesting for better germination.
- Seed material should be changed after every 4 to 5 years, for higher production.

3. **Quantity of seed material require:** Generally for planting one ha area 25000-30000 two or three budded setts are require (7-10 tonnes/ha)

One budded setts are depends upon spacing maintained between plant to plant and row to row.

| Sr. No. | Spacing (cm) | No. of One budded setts/ha |
|---------|--------------|----------------------------|
| 1 | 120 x 45-60 | 13,888 |
| 2 | 150 x 45-60 | 11,111 |
| 3 | 180 x 45-60 | 9,259 |
| 4 | 240 x 45-60 | 6,944 |

4. **Seed preparation and treatment:** Before sett treatment remove all dry leaves of cane stalk with hand to avoid injury to buds with tools. Then cut the stalk with sharp sickle and prepare setts according to requirement.

Seed treatment in sugarcane is required to be done to enhance germination, growth, vigor, protection from pests and diseases and increase nitrogen fixation.

- a. **Soaking In Water:** By soaking the sets in water the fresh weight of seed material is increased by 2 to 4% which results in better germination. Soak the sets in water for 12 to 24 hours. Soaking in water is useful when the seed material is old and easy conversion of sucrose to glucose.
- b. **Lime Water Treatment:** This treatment is given if the seed material is of more age and dry eye buds. Sets are soaked in lime water for 24 hours. Lime water is prepared by dissolving 500 g of lime in 180 lit of water. This treatment also improves germination of dry buds
- c. **Mercurial Compounds Seed Treatment:** To protect the sets and crop from fungal diseases and to improve germination the sets are dipped in 0.1% Bavistin along with one insecticide for 2 to 3 minutes.
- d. **Hot Water/Air Seeds Treatment:** This seed treatment is specially given to sets to be planted in seed nursery. The sets are treated with hot water 500C for two hours or 520c for ½ hours or hot air 520 for 6 hours or moist air 540C for 4 hours or aerated steam 520 C for 2 hours. This seed treatment helps to control grassy shoot, red rot and ratoon stunting diseases of sugarcane and to some extent controlling smut and other viral diseases.
- e. **Bio-fertilizer seed treatment:** The sets are treated with Acetobactor or Azotobactor culture @ 10 kg 200 lit water to improve nitrogen fixation by non-symbiotic bacteria. Sets are dipped (in the culture) for 30 minutes.

5. Planting methods:

On the basis of layout or system of planting:

1. **Flat planting (planting in flatbed):** Commonly followed in low rainfall areas of North India. It is simplest & cheapest method of planting. In this method shallow furrows (8-10cm) are opened at 75 or 90cm, distance 2 or 3 eye budded sets are placed end to end in the furrows. After this, furrows are covered with soil & heavy planking levels the field. There should be adequate moisture in field at the time of planking. Generally earthing up is not done. But to avoid of lodging light earthing up may be given.
2. **Ridges & furrows method:** - This is the most common method of sugarcane planting followed in Maharashtra. In this method the ridges and furrows are opened with the help of ridger by keeping 120 cm distance between furrows in heavy soil and 105 cm distance in light to medium soil. Main and sub-irrigation channels are opened at appropriate distance. First sets are laid on the top ridges end to end and later planted in furrows by two ways known as wet method and dry method of planting.
 - A. **Wet method:** For light to medium soils, wet method of planting followed. It consist of irrigating furrow first allowing them to soak for some time & pressing the sets 5-7 cm deep in furrows under the feet of manual labours, care is being taken to see that the eye buds are on sides of the shoots. This method of planting also called 'Blind planting', as there is no control over depth of planting & the position of eye buds.
 - B. **Dry Method:** On heavy soils, the sets may be placed at more depth causing poor germination on such soils dry method is followed. This method is also adopted for Adsali planting & for salt affected soils. In this method small shallow trenches are prepared with the help of kudali & sets are placed end to end, and then cover the sets with soil & light irrigation is applied.
3. **IISR 8626 Method:** In North Indian loams soils, cane yields could be increased by a technique known as IISR 8626. This technique developed at Indian institute of Sugarcane research Lucknow. The technique referred to planting of long rayungans vertically in deep fully fertilized of irrigated trenches. Rayungans are sets with shoots produced by cutting of the tops of standing canes.
4. **Trench or Java Method:** It is practiced in Jawa & Mauritius & in coastal areas of Orissa, A.P. & T.N. Where, the crop grows very tall & the strong winds and torrential rains are liable to lodge the crop. The rectangular trenches 20-30 cm deep are prepared at 90-120cm apart. Basal dose of fertilizer are applied in trenches. Shallow furrows (5-

7cm) are opened at the bottom of trenches and sets are placed end-to-end & covered with soil. After planting of setts irrigation is given. In this method cane gets good anchorage (support) which prevents lodging in early stages.

5. Pit method or ring planting Technique:

- Pit to pit spacing- 1.5x1.5 m
- Number of pits/ha- 4,444 pits
- Pit diameter – 0.9 to 1.2 m
- Pit depth – 0.38 to 0.45m
- Number of budded setts / pit – 32 (Single budded setts) or 16 number of two budded setts.

Fill the pits to a depth of 15 cm with compost and native soil and mix it well. Place the healthy setts in circular fashion leaving 10 cm from the outer boundary of the pits with equal spacing between each setts and cover the setts with the soil. On 50 to 60 days after planting give partial earthing up by sliding the soil from the outer boundary of the pit and full earthing up should be given leaving a depression of 2.5 cm from the ground level at 90 to 100 days after planting.

- 6. Paired row system:** Considering the importance of the intercrops & use of modern irrigation systems like drip in Sugarcane cultivation for increasing the net income from unit area of land, the paired row system of planting is promising & important to sugarcane growers. In this system the first two furrows are opened at distance of 75cm after this pair of furrows, an open space of Patta is left of about 120 to 135cm and again a pair of furrows at a distance of 75cm followed throughout the field.

In this system, number of rows or plant population is maintained as that of conventional system, also seed requirement same. Intercrops are grown in patta immediately after planting of cane. This system is most suitable for drip irrigation to cane as there is 30-40 % saving in initial investment on drip system. One lateral of drip can irrigate efficiently two line of sugar cane & hence 50% saving of laterals. Laterals are spread at the center of paired row.

On the basis of seed material used:

1. Normal or conventional method
2. Rayungan method or rajooning method
3. Spaced planting
4. Spaced transplanting technique (STP)
5. Partha method

6. Stubble or clonal method of planting
1. **Normal or conventional method:** Under the conventional system, the Setts (Stem cuttings or sections of sugarcane stalks usually having three buds used for planting sugarcane) are grown in rows of 90 cm spacing and are arranged in a series without adequate spacing.
2. **Rayungan Method:** Rayungan method is followed for adsali sugarcane planting at river side's fields in heavy rainfall areas of Kolhapur district. In these areas usually cane fields get flooded during rainy season which effects on germination. In such cases set cannot be planted directly in main field. Single bud sets are planted vertically in nurseries which are prepared high lying area of the farm in the month of June – July. After six weeks the sprouted sets are transplanted in the main field when the danger of flooding is over.
3. **Spaced Planting:** In this method, single eye bud sets are prepared by cutting the sets 2.5 - 3cm on upper side of the bud & 5-6cm at lower side of the bud. These sets planted horizontally in furrows at a spacing of 30-35cm apart keeping the eye bud upward & covered with soil 3-4cm. Advantages – 1) saving of the seed material 2) Germination % above 80.
4. **Spaced transplanting (STP) method with single eye set:** Recently in STP (Spaced transplanting) method single seedlings are used for planting. Either direct sets or seedlings raised in polybag nurseries are transplanted into the field after 50-55 days. For this STP or single eyed set method 0.75-1MT seed per acre is required. For both furrow and flat method rows are made 90cm apart and settlings are spaced at 45 – 90cm. If any settlings fails to establish it is required to replace by the extra stock maintain in the nursery. This method saves seed cost by 60-70%. In this method distance between two sets kept at 30cm.
5. **Partha" method:** A technique developed by Mr. S.V. Partha saradhy an eminent sugarcane scientist. Suggested for water logged or excess soil moisture conditions (coastal Andhra Pradesh and Tamil Nadu during N-E monsoon period) In this method three eye budded sets are planted in a slanting position, 60° to the vertical, in the wet furrow or half-way on the ridges. Usually one eye bud is thrust into the soil and the remaining two will be above, which will sprout. Once the monsoon recedes, the in situ sprouted sets are pressed down into the soil and made to lie horizontally. Soil is put to the base. At this stage, the crop is manured.
6. **Tissue culture or Clonal method of planting:** In this method, line stubble or whole clone (stool) from previous crop of sugarcane is used for planting. This method saves

the seed material and also useful for rapid multiplication of newly developed improved variety at faster rate.

Manures and fertilizers:

Sugarcane is a heavy feeder and long duration crop so adequate manuring is most essential. Apply well decomposed **farm yard manure or Compost @ 15-20 t ha⁻¹** at the time of land preparation generally 15 days before planting.

The quantity of fertilizers to be applied varies according to the fertility status of the soil. However, when soil test values are not available, then apply recommended dose of fertilizer according to planting season.

RDF:-

| Sr. No. | Planting season | RDF/ha |
|----------------|------------------------|-----------------------|
| 1. | Adsali | 400:170:170 Kg NPK/ha |
| 2. | Pre-seasonal | 350:170:170 Kg NPK/ha |
| 3. | Suru/seasonal | 250:115:115 Kg NPK/ha |
| 4. | Ratoon | 250:115:115 Kg NPK/ha |

Time of application of fertilizer's: Sugarcane is long duration crop so fertilizer dose should be applied in four split doses.

| Sr. No. | Time of application | % of RDF |
|----------------|---|-----------------|
| 1 | At planting | 10% N+50%P+50%K |
| 2 | 6 week after planting | 40% N |
| 3 | 12 weeks after planting (1 st earthing up) | 10% N |
| 4 | 20-24 weeks after planting (At final earthing up) | 40% N+50%P+50%K |

Micronutrients should be applied according to need and deficiency of nutrients. Generally, apply 25 Kg Ferrous Sulphate, 25 Kg zinc Sulphate, 10 Kg Magnesium sulphate and 5 kg Borax.

Irrigation and Water Management:

Sugarcane is a long duration and irrigated crop. The plant crop season is being 12-18 months in India depending on planting season and climatic condition. Water requirements of sugarcane are 220 ha cm to 350 ha cm. evenly distributed over the growing season.

Considering the soil type, crop stage and evaporation rate, when 50% soil moisture exhausted crop should be irrigate. Grand growth stage requires higher amount of water and it is highly sensitive for water requirement.

Accordingly planting season, Seasonal (Suru) crop requires 250-275 ha cm, Pre-seasonal 280-300 ha cm, Adsali 300-320 ha cm while Ratoon requires 225-250 ha cm of water. Water requirement of sugarcane will increases from vegetative stage to flowering stage and later on start declines. Apply irrigation water 7 to 10 day's interval in summer, 14 to 15 days in monsoon and 18 to 20 days in rabi according to soil type and climatic condition.

Intercultural operations:

Weed Management

Weed management in plant crop:

Presence of weeds interferes with the growth and development of the crop and ultimately reduces the cane yield. Among various reasons for the loss in cane yield, intense competition by weeds to the crop for nutrients, moisture and space is the most important one.

To manage the weeds in sugarcane, Metribuzin 1.0 kg ai/ha or ametryn @ 2.0 kg ai/ha as pre-emergence is as effective as earlier recommended pre-emergence herbicide atrazine @ 2.0 kg ai/ha. Either of these herbicides should be coupled with application of 2,4-D @ 1.0 kg ai/ha at 60 days after planting (DAP) and one hoeing at 90 DAP to sustain cane yield equivalent to three manual hoeing's at 30, 60 & 90 DAP.

Weed management in ratoon crop:

Three hoeing's, at 1, 4, and 7 weeks after ratoon initiation should be adopted for effective control of weeds in sugarcane ratoon crop. However, under limitations of manpower-availability, cost etc., pre emergence application of either of atrazine @ 2.0 kg a.i./ha or metribuzin @ 1.0 kg a.i./ha (800- 1000 litres water/ha) followed by either of 2,4-D Na salt @ 1.0 kg/ ha ai (in 600-800 litters water/ha) or hoeing at 45 days after ratooning can be successfully practiced. Further, trash mulching in alternate rows and hoeing in un-mulched furrow at 1 & 6 weeks after ratoon initiation is also a good option.

Earthing-up:

Earthing-up is also required in sugarcane cultivation. It is done to suppress the growth of excess tillers facilitate irrigation and economies water, to drain out the excess water from the field, to control weed infestation and to protect the crop from lodging.

Light Earthing up (Bal-bandhani/Tagarani): When crop attains 3 to 3.5 months age a light earthing up is done by running a light plough or hoe in the furrow side. This operation loosens the soil in furrow, prune the non-functional roots and suppress the growth of late tillers. During light earthing apply third dose of fertilizer i.e. 10% of nitrogen.

Main/Final Earthing up: The crop is ready for final earthing up when crop attains 5 month age with two to three internodes are visible. It consists of breaking the ridges and converting in to furrows. This operation is done by running a wooden plough or ridger.

Tying and Wrapping:

These operations are most essential in sugarcane cultivation just to provide mechanical support to the grown up plants to prevent lodging. The leaves are removed from the plants and wrapped together by taking all canes in one bundle. By wrapping the distribution of CO becomes easy and proper throughout the field. After wrapping, the clumps in, adjacent rows are tied together (cross-wise). Tying should be done in the month of August when cane reaches about 2 m height. Green leaves should not be tied up together while tying up the crop.

Cropping systems:

Since sugarcane is a crop which gives income after about a year of planting, there is a need to diversify the cropping system by introducing other crops, either in a sequence or as intercropping. This not only generates mid-season income for the marginal farmers to meet the expenses for sugarcane cultivation, but also fulfills the household requirement of food, fiber

and oilseeds mitigating the ill-effects of sugarcane monoculture. The inclusion of short duration, high value crops in sugarcane based production system as inter-and/or sequential crops holds great promise in increasing the land utilization efficiency, reducing the production cost, economizing the use of market purchased costly inputs and making the system sustainable.

Intercropping in Sugarcane

Intercropping in sugarcane offers great opportunity for increasing farm income per unit area and time. The success of intercropping depends on the selection of crop, variety, sowing time, planting geometry, fertilizer management and other crop management practices. In southern India, sugarcane is usually rotated with rice. In north India, sugarcane is generally grown after harvest of cotton, maize, sorghum, paddy, toria, potato, pea, wheat etc.

| Planting season | Intercrops |
|-----------------|--|
| Seasonal (Suru) | Summer groundnut, Soybean, Water melon, cucumber |
| Preseasonal | Potato, Gram, cabbage, cauliflower, onion |
| Adsali | Groundnut, soybean, cowpea, radish, Coriander, fenugreek |

Harvesting and Threshing:

Sugarcane crop matures within 10-12 months in north India and 12-16 months in south India depending upon the season of the crop. The crop should be harvested when sucrose contents value reaches to minimum 16.5% with 85% juice purity.

The maturity of sugarcane is influenced by temperature, planting time, variety, manuring fertilization and irrigation. In general the signs of maturity are as below.

1. General yellowish appearance of the crop and reduction in green leaf number.
2. Cessation of growth and emergence of inflorescence in case of flowering varieties.
3. Swelling of the eye buds.
4. Gives metallic sound, breaking of the cane at the node and sweetness of juice is increased
5. Sparking of sugar crystals when the cane stalk is cut longitudinally and seen in the light.
6. Brix saccharometer reading 21 to 24 Brix.

Stalks are cut down from ground level and dried leaves are stripped out from cane and green part is cut from top most part of cane. Clean canes are tied in bundles and send to factory.

Yield: A good crop yields about 150 to 180 tonnes/ha from Adsali, 130 to 150 tonnes from Pre-seasonal and 100 to 120 tonnes from Seasonal (Suru)

Average cane yield of India is 70 tonnes /ha.

Varieties:

Early varieties: CO- 419, CO-7219, CO-8014, COC-671, CO- 94012

Mid late varieties – CO-86032, CO-M- 0265, CO-92005, COVSI 9805

Ratoon management in Sugarcane:

After harvesting of main crop stubbles are allowed to sprout and grow called ratoon. Ratoon save the cost on land preparation, seed material and takes benefit from residual manure. Only one ratoon should be taken for economical and better yield.

Following points should be followed for obtain good yield from ratoon.

- Harvest the main crop at proper maturity stage.
- Cut the stems close to ground level.
- All trash and dried canes should be removed immediately, and no irrigation should be providing for four to six weeks.
- Loosen the soil by cultivator or any other implement and follow hoeing operation twice.
- Apply recommended dose of fertilizer i.e. 75 kg N+115 Kg P+115 Kg K. and irrigate the crop
- Apply 2nd dose of nitrogen (75 Kg) at 6 weeks after first dose.
- Control the weeds by regular weeding and hoeing operations
- Apply third dose of Nitrogen i.e. 100 Kg at 4.5 to 5 months age and follow final earthing up.