

# **FACTORS AFFECTING THE SUGARCANE YIELD AND SUGAR RECOVERY**

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# ABSTRACT

The sugarcane yield and sugar recovery both are most important issues in respect of cane growers as well as the sugar industry. As the cane price is paid on the basis of cane weight and not on the basis of sugar content present in cane juice. Therefore, both the aspects as what are the factors affecting the sugarcane yield and the sugar recovery have been described in the paper. The paper has been prepared on the basis of research conducted during last so many years which concludes that both are extremely important as the yield favours to the farmers and the sugar recovery to the sugar industry, but we have to balance the both. Therefore, our target should be to achieve 100 tonnes per hectare yield and 11.0 per cent sugar recovery.

**Keywords :** Sugarcane yield, sugar recovery, sugar content, cane growers, sugar industry.

# **1. Introduction**

**It is well known fact that sugarcane is a most important cash crop. It is a sure crop and farmers are assured upto some extent for returns even in adverse agro-climatic conditions. Therefore, it becomes important that the sugarcane varieties should be developed which are comparatively less affected by the factors reducing the cane yield and sugar recovery.**

**Sugarcane crop is grown in two different agro-climatic zones in the world, the Tropical and the sub-tropical, between 0-10 and 10-30° latitudes, respectively. The latitudes and ripening conditions in some countries are as given below :**

<b><i>Countries</i></b>	<b><i>Latitude</i></b>	<b><i>Growing conditions</i></b>
<b><i>India</i></b>	<b>8° N to 32° N</b>	<b>Tropical/Sub-tropical</b>
<b><i>Pakistan</i></b>	<b>24° N to 34° N</b>	<b>Sub-tropical</b>
<b><i>U.S.A.(Louisiana, Florida)</i></b>	<b>29° 35° N to 30° N</b>	<b>Tropical/Sub-tropical</b>
<b>South Africa</b>	<b>28° S to 31° S</b>	<b>Sub-tropical</b>

**The highest cane yield of about 200 metric tones per hectare is obtained in Hawaii having tropical conditions and 24 months age of crop at harvest. Because of favourable agro-climatic conditions for the crop growth, the yield in tropical areas is higher as compared to the sub-tropical regions. The age of the crop varies from 10 to 24 months depending upon the agro-climatic conditions.**

- **Amongst the sugarcane growing countries, the highest sugar recovery of 14% is obtained in Queensland in Australia. The sugar recovery in other important cane growing countries like Brazil, South Africa, U.S.A. (Hawaii, Louisiana and Florida), Mauritius, Cuba, Puerto-Rico and Pakistan varies from 9 to 11%.**

- **In India in tropical region Maharashtra, Tamil Nadu, Gujarat, Karnataka and Andhra Pradesh are the important cane growing states. Whereas, in sub-tropical region, Uttar Pradesh has the largest area under sugarcane in the country followed by Bihar, Haryana and Punjab. The sugar recovery is higher in the states of Maharashtra, Karnataka and Gujarat as compared to Andhra Pradesh and Tamil Nadu in the tropical region. In North Indian cane growing states of Uttar Pradesh, Bihar, Haryana and Punjab having sub-tropical conditions, the sugar recovery varies from 8.8 to 9.5% only, Punjab recording the lowest sugar recovery.**

**Thus, tropical region has an advantage of higher yield and higher sugar recovery as compared to the Sub-tropical region. The average cane yield in tropical region is about 85.08 tones while in the sub-tropical region, it is only about 60.70 tonnes per hectare. The area, average cane yield and sugar recovery figures for important cane growing states in India are as given below in Table 1.**



**Table 1 : Area, cane yield and sugar recovery in important cane growing states of the country (2011-12)**

	<b>Regions</b>	<b>Area ('000 ha)</b>	<b>Cane yield (tones/ha)</b>	<b>Sugar recovery (%)</b>
<b>(i)</b>	Tropical			
	Maharashtra	940	80.10	11.29
	Karnataka	410	90.30	10.91
	Gujarat	203	70.20	10.53
	Tamil Nadu	333	102.80	9.09
	Andhra Pradesh	200	82.00	9.75
<b>(ii)</b>	Sub-tropical			
	Uttar Pradesh	2277	59.60	9.14
	Bihar	235	51.50	9.30
	Punjab	84	58.40	8.80
	Haryana	107	73.30	9.01
<b>Source : Cooperative Sugar Journal, November, 2012</b>				

## 2. Factors influencing the sugarcane yield

- i) **Variety** : Genetic potential of a variety plays an important role in determining the cane yield ; some varieties having a high yield potential while others have lower. In sugarcane, normally an inverse relationship exists between the cane yield and the sucrose content, high tonnage varieties having lower sugar potential and vice versa. However, some varieties possess a good combination of cane yield and sugar recovery; like CoJ 64, CoC 671, Co 86032 and Co 1148 etc. being the examples which meet the requirements of both the cane growers and the sugar industry.

The payment of higher cane price for high sugar content varieties by the industry has helped in inducing the farmers to grow high sugar content varieties as ultimately it is the sugar yield per hectare which is more important than cane yield and sucrose content alone.

**ii) Agro-climatic conditions :** In sub-tropical part of the country, both the low and the high temperature affect the sugarcane yield and the sugar recovery. In this part, the temperature goes down to 1°C and maximum upto 46°C which is responsible for low yield and low sugar recovery as the high and the low temperatures both check the growth of the sugarcane crop. In tropical part, i.e. mostly in Tamil

**Nadu and Andhra Pradesh the crop is affected due to the temperature and humidity during winter season which however increase the yield but sugar recovery is affected badly in both the states.**

**However, in tropical region there is potential of increasing the average cane yield upto 120 tonnes per hectare, whereas, in sub-tropical zone the potential is of 80 tonnes per hectare. Soil environment particularly water logged conditions also affect the cane yield adversely.**

- iii) Alkalinity/salinity :** In some parts of the country alkaline/saline soils and the sodic waters affect the sugarcane yield and the sugar recovery as these soils and the waters are not suitable to sugarcane crop. Therefore, the varieties should be developed which are resistant to salinity/alkalinity so that these may be grown under such conditions successfully.
- iv) Quality of sugarcane seed :** The quality of sugarcane seed has an important bearing on the cane yield. Short duration immature crop of 6 to 8 months age having received higher dose of nitrogen, germinates quickly and also gives significantly higher germination, plant population and yield.

**The use of moist hot air treated seed gives 15 to 20% higher yield, particularly in the ratoon crop as this treatment eliminates the ratoon stunting disease which has an adverse effect on the growth of sugar cane crop. Use of polythene bag transplanting technique, upper stalk portion buds and tissue culture technique help in quick propagation of seed and assured plant population of the crop to achieve higher yield. The tissue culture technique also helps in restoring the vigour and yield of varieties. Quality seed also helps in controlling various insect, pests and diseases.**

**v) Summer planting / late planting (after harvesting of wheat) :** The farmers in our country have small small-land-holdings. Therefore, they are bound to grow other crops such as wheat in winter season. After harvesting of wheat, they plant the sugarcane crop i.e. in the month of May or June. The crop which is planted in the month of May or June is badly affected by weeds as the monsoon comes in the month of July and hence the low yield is obtained.

**vi) Proper Varietal balance :** Most of the sugar factories in the country are not maintaining the proper varietal balance which is the basic requirement to achieve better yield and better sugar recovery. The proper varietal balance of early, mid and late maturing varieties should be maintained and the harvesting of these varieties should be done according to the varieties maturity group as early, mid and late maturing respectively. This ensures increase in yield and sugar recovery.



**3. Agronomic practices : The important agronomic practices which determine the cane yield are :**

- i) Time of planting :** The time of planting and duration of the crop particularly in the tropical cane growing states is an important factor in determining the cane yield. Adsali crop of 18 months age in Maharashtra gives 25 to 30% higher yield than Eksali 12 months crop. Similarly, in North India, autumn planted cane gives 25 to 30% more yield than the spring planted crop. Late planting of cane after harvesting of wheat crop in the month of April-May in North India adversely affects the cane yield.

- ii) **Seed rate** : Use of recommended seed rate is necessary to obtain good germination and optimum plant population, particularly in North Indian cane growing states where the germination is low due to sub-tropical conditions. Lower seed rate in Uttar Pradesh and Bihar is one of the reasons for the low yield.
  
- iii) **Soil treatment** : Dipping of seed cane cuttings in 0.25% solution of organomercurial fungicides like Emisan before planting helps in hastening and improving the germination and ultimately the stalk

population and yield. About 10.0 % increase in yield has been recorded with this treatment. This treatment also controls seed sett borne smut disease. Soil application of Chlorpyrifos or Rynaxypyr (Chlorantranilipron 18.50%) at the time of planting is an important recommendation for the control of termites and shoot borer and improving the efficiency of soil applied nitrogenous fertilizers. There is 10 to 15% increase in the yield of sugarcane by this treatment.

**iv) Integrated weed management :** Weeds in sugarcane crop are responsible for reducing the yield by 15 to 20%, sometime upto 40 percent if not controlled. There is, therefore, need for integrated weed management consisting of cultural practices and the application of suitable weed control chemicals.

**v) Integrated insects, pests and disease management :** Among the insects, pests, shoot borer, top borer, black bug and stalk borer cause considerable reduction in yield, particularly the top borer brings about even 50% reduction in yield if the incidence is high (table 2). Out of the diseases, ratoon stunting disease affects the cane yield adversely, particularly the yield of ratoon crop. There is, therefore, need for controlling these insect, pests and diseases effectively.

<b><i>Pest/species</i></b>		<b><i>Extent of losses in terms of</i></b>	
		<b>Per cent reduction in cane yield</b>	<b>Per cent reduction in juice quality</b>
<b>A.</b>	<b>Borers</b>		
	Shoot borer	33	12.0 in sugar recovery
	Top borer	70 during the 3 <sup>rd</sup> brood	46.6 in CCS%
	Stalk borer	31.8	20.4 in sucrose
	Internode borer	56.6	39.02 in CCS%
	<b>Gurdaspur borer</b>	15	74.0 in sugar and gur recovery
<b>B.</b>	<b>Sucking pests</b>		
	Scale insect	63.4 (sometimes complete failure of the crop)	15.0 in CCS%
	Mealybug	20.5	27.7 in CCS%
	Pyrilla	28.1	50.0 in sugar recovery
	White fly	65.3	7.7 in CCS

<b>C. Subterranean pests</b>			
	<b>White grub</b>	<b>90-100% mortality of infested plants</b>	
	<b>Termites</b>	<b>33</b>	
<b>D.</b>	<b>Other</b>		
	<b>Rats</b>	<b>75 in damaged, unlodged canes</b>	<b>27.8</b>

Source : SBI, Coimbatore, Tamil Nadu

**vi) Fertilizer and water management :** **Balanced use of nutrients, N, P and K on the basis of soil test and placement of fertilizers below the seed pieces at the time of planting and drilling in May/ June along with the cane rows helps in more efficient utilization of fertilizers and increasing the cane yield. In micro-nutrient deficient areas, the use of iron and zinc is also essential to achieve optimum yield level, particularly in the ratoon crop. Green manuring, use of farm yard manure, press mud, press mud bio-compost, vermicompost and bio-fertilizers help in improving the soil fertility and obtaining higher cane yield. These also help**

**in reducing the dose of inorganic fertilizers. In order to economise and improve the water use efficiency, drip, sprinkler and skip furrow irrigation systems are recommended, particularly in the tropical cane growing states where water availability is limited and irrigation requirements of sugarcane are very high. Light and frequent irrigations are more useful from yield point of view.**



**vii) Ratoon management :** The ratoon crop occupies about 50% of the total cane area in the country. However, the yield of ratoon crop is lower than the plant crop. This is due to the fact that the recommended package of practices in ratoon crop are not followed by the farmers. The ratoon crop can give as high yield as the plant crop or even higher than the plant crop if the recommended package of practices like trash mulching, integrated weed control, balanced use of fertilizers, gap filling with polythene bag raised plantlets are followed and insect, pests like shoot borer and black bug effectively controlled.

**viii) Mechanisation :** The planting of sugarcane in the country is done manually while in other cane growing countries planting and harvesting have been totally mechanized. In order to improve the cane yield further in India, there is an urgent need of mechanized planting of sugarcane. Some of the companies in the country have now developed very efficient tractor drawn cane planters which need to be popularized among the cane growers on priority basis. These planters cut the seed cane, place the cuttings in furrow, do the seed and soil treatment and have arrangement for fertilizer application. Mechanised cane planting may help in increasing the cane yield as compared to the manual planting done at present.

**ix) Cropping patterns :** It is observed that the farmers grow sugarcane after harvesting of cane in the month of November-December, they sow the crop of wheat and after harvesting of wheat they again plant sugarcane crop. Therefore, to take better yield and better sugar recovery, it is essential to have a cropping patterns of different crops such as fallow – sugarcane, pulses – sugarcane, vegetables – sugarcane and legumes – sugarcane etc. This will ensure to increase yield and sugar recovery.

## 4.0 Factors influencing sugar recovery

Sucrose accumulation in sugarcane is primarily determined by the genetic potential of a variety and the environment under which it grows. Variety-environment interaction, therefore, plays the key role in determining the sugar recovery. The various factors influencing the sugar recovery are as described below :

- i) **Genetic sugar potential** : Genetic potential of a variety plays key role in determining the sugar recovery. While some varieties have high sugar potential, others have lower. In North India, CoJ 64 an early maturing variety and Co 1148 a late maturing variety had higher sugar potential than CoS 767 and other varieties which occupy major area in the belt.

Similarly CoC 671 among early maturing varieties and Co 86032 a mid maturing variety in tropical zone have higher sugar potential and yield than other varieties. Another variety with higher sugar genetic potential which showed its impact in improving the sugar recovery from 9 to 10% in Andhra Pradesh was Co 997. The other high sugar content varieties developed in the country are : Co J64, Co 89003, CoPant 84211, Co H 56, Co J 83, Co J 85, Co S 88230, CoS8436 and now Co 0118, Co 0238 and Co 0239 in the sub-tropical region (Table No.3). The adopting of a sugarcane variety in a particular area depends upon a number of factors. Viz., yield potential, soil conditions, agro-climatic conditions and resistance to insects, pests and diseases which vary in tropical and sub-tropical regions.

<b>S.No</b>	<b>State</b>	<b>Early Ripening</b>	<b>Mid season &amp; late Ripening</b>
<b>1</b>	<b>Uttar Pradesh Normal Conditions</b>	<b>CoS 8436, CoJ 64, CoS 88230, CoS 96268, CoJ 85, CoJ 83 and Co 0238 Co 89003</b>	<b>CoS 767, CoS 8432, Co 0118, Co 0239, Co Se 95422, CoS 97261, CoPant 84212, Co Pant 97222</b>
	<b>Water logging</b>		<b>BO 91, CoS 767, CoS 8118, CoS 837, CoS7918, CoS 8119, CoS 8009</b>
<b>2</b>	<b>Bihar Normal Conditions/ Water logging</b>	<b>CoS 8436, CoS 88230, CoS 96268, CoSe 98231, Co P 9301, BO 138 and BO 145</b>	<b>Bo 139, CoSe 03234, Co 0238, Co 0239, Co 0118, Co 98014, CoLk 94184</b>

<b>3</b>	<b>Orissa Water logging</b>	<b>Co 6907, Co 7508, Co 7704, Co 8401, Co 62175</b>	<b>Co 7219, Co 8201, Co 975, Co 7706, Co 8402, Co 62175, Co 62175, Co 419, Co 6304</b>
<b>4</b>	<b>Assam</b>	<b>Co 1008</b>	<b>Co 8315, Co Jor 1, Co Jor 2, Co 1132</b>
<b>5</b>	<b>Punjab</b>	<b>CoJ 64, CoJ 83, CoJ 85, Co 89003 Co 0238,</b>	<b>CoJ 88, CoS 8436, CoS 88230, Co 0118, Co 0239</b>
<b>6</b>	<b>Haryana</b>	<b>Co 89003, CoJ 64, CoJ 83, CoJ 85, Co 0238</b>	<b>CoPant 84212, CoS 8436, CoS 88230,, Co 0239 and Co 0118</b>
<b>7</b>	<b>Rajasthan</b>	<b>Co 29, Co 997, Co 527, Co 6617, Co PK 05191</b>	<b>Co 1253, Co 419, Co 1007, CoL 111, Co 449, Co 527</b>
<b>8</b>	<b>Madhya Pradesh</b>	<b>CoC 671, CoJn 86141, Co 7314, CoJ 64</b>	<b>Co 86032, CoLk 8001, CoS 767, CoS 88230, CoS 8436 and Co 1148.</b>

<b>9</b>	<b>Gujarat</b>	<b>CoC 671, Co 86032, Co 87263, Co 94008, Co 94012, CoN 95132, Co 95006, CoSi 97071</b>	<b>Co 87025, Co 87044, CoN 91132, Co 91010, CoN 93009, CoN 05171, CoN 05072</b>
<b>10</b>	<b>Maharashtra</b>	<b>CoC 671, Co 94008, Co 94012, Co 92005, Co 99004, Co VSI 434</b>	<b>Co 86032, Co 87025, Co 91010, Co 7219, CoMo 265, Co 2001-13, Co 2001-15, Co VSI 9805</b>
<b>12</b>	<b>Karnataka</b>	<b>CoC 671, Co 94008, Co 94012, Co 85002, Co 99004,</b>	<b>Co 86032, Co 87025, Co 91010, Co 92020, Co 2001-13, Co 2001-15</b>
<b>13</b>	<b>Andhra Pradesh</b>	<b>83A30, 87A298, 84A125, CoV 94101, 91V83, 93V297</b>	<b>Co 86032. Co 7895, CoV 92102, 97R129, Co 7218, 87A380, 99V30</b>



14	Tamil Nadu	CoC 671, Co 86249, Co 90063, CoC 8001, CoS 85061, CoC 98061, CoG 94077, CoSi 95071, Co 94008, Co 94012, Co 99004	Co 86032, Co 91010, CoSi 98071, Co 95020
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**Source :SBI, Coimbatore**

**Note : Co = Coimbatore, BO= Bihar, Orissa, A = Anakapalle, C=Cuddalore, J = Jalandhar, KHS = Karnataka Hybrid Sugarcane, S =Sahajahanpur, Si- Sirugamani (TN), P = Pusa (Bihar), M=Maharashtra, R=Rudrur**

**ii) Environment :** Out of the environmental factors, climate plays the major role in determining the sucrose accumulation in sugarcane plant. Optimum cool and dry climate during the ripening period is conducive to higher accumulation of sucrose and wherever such conditions exist the sugar recovery is higher. The optimum temperature range for cane ripening is from 10°C to 20°C and relative humidity less than 60%. Whereas, for growth, the favourable temperature range is from 25°C to 35°C and humidity more than 70 per cent. The other parameters of climate influencing ripening of cane are rainfall, its distribution pattern, humidity, sunshine and length of photoperiod etc. These optimum ripening

period conditions are available in Maharashtra, Gujarat and Karnataka during the ripening period while in Tamil Nadu, Andhra Pradesh and Kerala these conditions are not that suitable as a result of which the sugar recovery is low in these three states although all the above six states are in the tropical zone.

- In the sub-tropical cane growing states of Uttar Pradesh, Punjab, Bihar and Haryana, optimum ripening conditions of temperature, humidity, sunshine and photoperiod exist during October-November and then from end January to March,

during this period cool dry weather conditions prevail favouring ripening and sucrose accumulation. However, during the months of December and January, the ripening process slows down due to low temperature conditions, the temperature dipping to as low as 2.0°C and some higher humidity because of winter rains and subsequently less sunshine period. Due to these conditions, the overall sugar recovery for the season is affected.

**iii) Flowering :** In the tropical cane growing states weather conditions are favourable for flowering of sugarcane and as such crop flowers profusely in the states like Tamil Nadu. In the sub-tropical areas of

**Bihar and eastern part of Uttar Pradesh such conditions also exist particularly where water logging exists. From commercial crop and sugar recovery point of view, flowering is not a desirable character as it has an adverse effect on the sugar recovery. However, flowering varies with the varieties: some varieties being non-flowering and some shy flowering, even under favourable weather conditions. Non-flowering varieties are more suitable for obtaining better sugar recovery in the tropical areas.**

**iv) Soils :** The soil environment, particularly water logged conditions in large areas in Bihar and eastern part of Uttar Pradesh have an adverse effect both on growth and maturity of cane. Under such anaerobic conditions during the monsoon period of July, August and September, the plant roots stop functioning resulting in less water and nutrient intake and also the photosynthetic activity and transpiration rate are retarded. It has been estimated that there is 0.5 unit less sugar recovery in such areas. The soils in the tropical regions are laterite, black heavy textured and alluvial soils along with coastal areas and mostly alluvial soils in the Indo-gangetic plains of North India.

**The Indian soils are mostly deficient in nitrogen, medium in phosphorus and high in potassium contents. In tropical areas, sugarcane crop responds to nitrogen, phosphorus and potash and the nutrient requirements are also much higher as compared to sub-tropical region. Light textured soils are more suitable for cane ripening.**

## **5. Agronomic practices : The important agronomic factors which influence the sugar recovery are :**

- i) Age of the crop :** The age of the crop at harvest has considerable influence on the recovery of crop. The age in tropical cane growing areas varies from 12 to 18 months while in sub-tropical region, it is only 10 to 12 months depending upon maturity of early, mid and late maturing varieties. The age plays greater role in influencing sugar recovery in tropical zone as favourable conditions exist round the year for growth and as such maturity gets delayed. The crushing of cane on age basis in these areas is, therefore, important in obtaining better sugar recovery. In sub-tropical region of north India also, autumn planted crop (September-October) having 12 to 14 months age gives higher sugar recovery of 0.5 unit compared to spring planted crop in February-March.



**ii) Harvesting on maturity basis :** The aim of harvesting at a particular age of the crop or on the basis of maturity survey or adoption of varietal crushing schedule based on maturity period of different varieties, is to harvest when the varieties have attained their peak maturity for obtaining better sugar recovery. However, varietal crushing schedule based on maturity of different varieties has been proved more useful from practical point of view. This crushing schedule requires crushing of early ripening varieties in November-December, mid season varieties in January-February and late maturing varieties in March/April.

**iii) Fertiliser and water use :** Out of the three major plant nutrients, viz. nitrogen, phosphorus and potash, nitrogen plays an important role in influencing the sugar recovery. Application of higher dose of nitrogen than the recommended ones through inorganic fertilizers like urea and calcium ammonium nitrate and their late application delays the ripening of the crop resulting in lower sugar recovery. However, balanced use of nitrogenous, phosphatic and potassic fertilizers helps to get better sugar recovery. Use of organic manures like farm yard manure, press mud, press-mud bio-compost, green manuring and bio-fertilizers help in obtaining better sugar recovery than the inorganic fertilizers.

Experiments conducted on water management have shown that frequent and light irrigations are helpful in obtaining better sugar recovery than heavy and few irrigations. An optimum and judicious use of nitrogen and irrigation water are necessary in getting optimum sugar recovery.

**iv) Ratoons :** Ratoon crop helps in obtaining higher sugar recovery due to its early maturity than the plant crop in the early part of the crushing season. The practice of supplying ratoon cane first to the mills in earlier part of the crushing season is prevalent in all the cane growing areas. Efficient ratoon management practices also enhance the sugar recovery.

**v) Lodging :** Lodging of the crop very adversely affects the sugar recovery. In the coastal belt of Andhra Pradesh, crop lodges badly due to severe cyclones resulting in to poor quality of cane. Similarly in North India, well grown crop lodges during August-September due to rains and high velocity winds thus affecting the sugar recovery. The incidence of stalk borer and rats also increases significantly in lodges crop which further brings down the recovery. The sugar recovery losses due to lodging varies from 0.5 to 1.0 unit depending upon the intensity of lodging.

**vi) Insect, pests and diseases :** Insect pests and diseases also affect the sugar recovery (Table No.2). While there are a large number of insect, pests and diseases, the pests affecting the sugar recovery are pyrilla, black bug, stalk borer and internode borer and diseases red rot, wilt and smut. Effective biological and chemical control measures are available for the control of pyrilla and black bug, but stalk borer continues to be a serious problem in North India which lowers down the sugar recovery. There is a loss upto 0.5 unit of sugar recovery in severely infested stalk borer crop. Red rot and wilt diseases significantly bring down the recovery, the loss being as high as 1.0 to 2.0 units depending on the incidence of these diseases. Smut disease is

problem in the tropical cane growing areas particularly in the ratoon crop. In severely infested crop, there is a decline in sugar recovery upto 0.5 unit. However, this disease can be kept under control and as such the recovery losses due to this disease can be minimized.

**6. Hot weather crushing :** Late crushing of cane in May and June affects the sugar recovery adversely. The rate of inversion is much faster under high temperature conditions in certain varieties during the later part of crushing season in May and June and sugar recovery losses being as high as 2.0 to 3.0 units. This loss is more prominent in North India

i.e., in U.P. Bihar, Haryana and Punjab etc. where the temperatures are much higher as compared to tropical areas, namely Maharashtra, Gujarat and Karnataka.

**7. Processing efficiency :** Besides the quality of cane and other factors as discussed above, processing efficiency of the mills also plays an important role in achieving higher sugar recovery. The average losses in bagasse, molasses and press-mud range between 2.0 to 2.5 % depending upon the processing efficiency of individual factories. Whereas, there is scope of reducing these losses by improving milling and boiling house efficiencies, the attainment of recoveries higher than 10% is largely the function of other factors as numberated above.

**8. Role of sugar factories : Some sugar factories in the country have been making positive contribution by way of cane development and control of insect pests and diseases. A number of factories have installed Moist Hot Air (MHAT) units for treatment of cane seed. Factories also propagate high yielding and high sugar content varieties in their operational areas and achieve higher sugar recovery. Despite these activities, the recoveries in the sub-tropical areas have been hovering around 9.0 to 10.0%. The advantage of higher recovery in tropical areas of Maharashtra, Gujarat and Karnataka at about 11.0% will, therefore, continue to stay because of favourable agro-climatic conditions.**



**9. Role of Sugarcane Research Institutes/Stations :**  
The two central (ICAR) Sugarcane Research Institutes, one at Coimbatore (SBI), the second at Lucknow (IISR) and State Research Stations are engaged in developing new cane varieties and production technology. The research output of these institutes has played an important role in improving the sugar recovery in the country as these Institutes / Stations have the responsibility of developing high sugar content varieties, the cultivation of which helps in improving the sugar recovery. The cultivation of Co 1148 in north India and Co 740 in Maharashtra developed by Sugarcane Breeding Institute, Coimbatore has played a key role in serving the sugar industry.

Similarly, CoJ 64, an early maturing high sugar content variety developed by the PAU, Sugarcane Research Station, Jalandhar and CoC 671 variety developed by Cuddalore Sugarcane Research Station in Tamil Nadu have significantly improved the sugar recovery in North India and tropical part of the country respectively. The Sugarcane Research Station, Shahjahanpur in Uttar Pradesh has developed some cane varieties like CoS 88230, CoS 8436, CoS 96268 and CoS 767 which have also helped in improving sugar recovery. The other high sugar content varieties developed are : Co 0238, Co 0118 and Co 0239 by Sugarcane Research Station of SBI, Coimbatore, at Karnal and CoJ 85 by the PAU Sugarcane Research Station, Ladowal. The

**technology of heat therapy of Sugarcane for producing disease free seed was developed by the Indian Institute of Sugarcane Research, Lucknow which has played an important role in improving the cane yield and sugar recovery.**

**Without new varieties and technologies, it is not possible to increase the sugar recovery. The Research Institutes have, therefore, to play a greater role in future in this respect not only to increase sugar recovery but also the varieties for co-generation, high yielding and for ethanol production also.**

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